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**Geographical perspectives on the social determinants
of inequalities in under-five mortality in Nigeria:
towards an integrated approach**

Mildred Oiza Ajebon

Submissions for Doctor of Philosophy



Department of Geography

Faculty of Social Sciences and Health

Durham University, UK

April 2019

Geographical perspectives on the social determinants of inequalities in under-five mortality in Nigeria: towards an integrated approach

Mildred Oiza Ajebon

Abstract

Nigeria is the highest contributor to under-five mortality in the Sub-Saharan African region and the second highest in the world. Annual rates of reduction have remained consistently lower than the Sub-Saharan regional average and wide inequalities have been reported. In addition, Nigeria continues to rank last in the Commitment to Reducing Inequality (CRI) index indicating that Nigeria's effort at reducing inequalities is the worst in the world. Addressing inequalities in the under-five mortality rate problem requires a contextualised understanding of the social determinants of under-five mortality and the complex processes shaping unequal distribution of risk factors in most vulnerable populations. This study aims to explore the social determinants and the processes shaping inequalities in under-five mortality rates at multiple geographical scales using mixed-methods: a combination of global statistical methods and ArcGIS-based spatial statistics and semi-structured interviews. To date, international research from the perspectives of the geographies of health on the relationship between place, agency and the social determinants of health remain very limited. This study is the first within the Nigerian context to incorporate the lay narratives of mothers into statistical modelling of area-level data in an attempt to demonstrate how and why the social determinants of under-five mortality interlock simultaneously, to create inequalities in the health experiences of groups and individuals. In addition, this study goes beyond risk discourses to explore individual agency and the collective responses of mothers to perceived child health-risk factors in their local context. This study moves beyond risk narratives to examine the power dynamics mediating people's capabilities to choose informed responses to health-risks. The findings highlight complex underlying interrelationships in the social determinants of under-five mortality, alongside marked geographical and social inequalities. The findings suggest the need to steer away from the dominant one-size-fits-all biomedical policy approach to addressing health inequalities and calls for research and policy practice to be sensitive to the social context of women's lives in which inequalities in child health are embedded.

Key words: Under-five mortality, health-risk, inequalities, lay knowledge, mixed-methods, Nigeria, intersectionality theory.

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List of Abbreviations

ACT	Artemisinin based Combination Therapy
A & E	Accident and Emergency
AIDS	Acquired Immunodeficiency Syndrome
ANOVA	Analysis of Variance
CRI	Commitment to Reducing Inequality
CSDH	Commission for Social Determinants of Health
DFID	Department of International Development
DHS	Demographic and Health Surveys
EA	Enumeration Areas
EFA	Exploratory Factor Analysis
EU	European Union
FCT	Federal Capital Territory
GIS	Geographical Information Systems
GNP	Gross National Product
GWLR	Geographically Weighted Logistic Regression
GWR	Geographically Weighted Regression
HIV	Human Immunodeficiency Virus
IHRR	Institute for Hazard, Risk and Resilience
IPT	Intermittent Preventive Treatment
IRS	Indoor Residual Spraying
LGA	Local Government Area

LLIN	Long-Lasting Insecticidal Nets
MDG	Millennium Development Goals
NDHS	Nigerian Demographic and Health Surveys
NGO	None Governmental Organisations
NPC	National Population Commission
OLS	Ordinary Least Squares
OLSR	Ordinary Least Squares Regression
PhD	Doctor of Philosophy
RA	Research Assistants
RGS-IBG	Royal Geographical Society with Institute British Geographers
SDG	Sustainable Development Goals
SDH	Social Determinants of Health
SMC	Seasonal Malaria Chemoprevention
SP	Sulfadoxine/Pyrimethamine
SPSS	Statistical Package for the Social Sciences
UK	United Kingdom
UN	United Nations
USAID	United State Agency for International Development
VIF	Variance Inflation Factor
WHO	World Health Organisation
WPV	Wild Polio Virus

Declarations

The material contained in this thesis has not been previously submitted for a degree in this or any other institution. It is the sole work of this author.

Copyright Statement

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Dedication

For my very dear husband and beloved son, Harrison Chukwuma & Jayden Onyekachukwu,

You are my heroes!

Learn to do right. See that justice is done - help those who are [vulnerable] oppressed, give orphans their rights, and defend widows. (Isaiah 1:17 - GNTA)

CHAPTER 1

Background to the Study

1.0 Introduction

‘Leaving no one behind’ – the cornerstone of the Sustainable Development Goals (SDGs) agenda – signifies a key shift in global health research enquiry and policy agenda (Kapilashrami *et al.*, 2018:216). With this shift comes the increasing recognition for the need to precisely identify the factors and understand the complex processes which increase the health disadvantage of vulnerable groups in order to effectively match health interventions to local needs (United Nations, 2016).

This research argues that in order to truly ‘leave no one behind’, new insights are needed into identifying the determinants of health-risk and the multiple ways in which they are co-constituted across multiple scales in shaping unequal health experiences between and within population groups. Using the example of under-five mortality risk, it explores innovative ways of identifying, understanding and tackling the complex root causes of health inequalities for those at the crossings of multiple axes of vulnerabilities, especially in very diverse and low resource settings like Nigeria. In addition to demonstrating the multiple geographical and socioeconomic layers of inequalities, this study advances the argument for the need to shift health improvement strategies, from the dominant biomedical-oriented design towards understanding the contextualised accounts and multiple ways in which the social determinants of health are co-constituted in moving forward with the SDGs.

Previous bodies of work have examined the risk factors of under-five mortality mainly from a public health perspective, and methodological practices have largely involved identifying single or multiple sets of risk factors, which contribute to health inequalities. (Adebowale *et al.*, 2017, Adedini *et al.*, 2015a, Adeyemi *et al.*, 2008, Ettarh *et al.*, 2012, Houweling, 2005, Kanmiki *et al.*, 2014, Mohammad *et al.*, 2017). Very little attention has been paid to the geographical variation at multiple scales in a single study. Studies, which have attempted to incorporate geographical variation in under-five mortality within the Nigerian context, have mainly incorporated large scale indicators such as geopolitical regions of Nigeria with multilevel statistical analysis of multiple sets of demographic indicators of mothers in an additive manner (Adedini *et al.*, 2015a, Antai *et al.*, 2009, Ettarh *et al.*, 2012). Accumulating

bodies of evidence on the social determinants of health suggest that identifying separate single or multiple sets of determinants of health is important in health inequalities research, especially as a starting point for action on the social determinants of health. However, it is more important for health-risk categories not to be conceptualised as fixed but treated as context-specific, open, dynamic, and relational within an intersectionality framework (Bauer, 2014, Hancock, 2007, López *et al.*, 2016, Nygren *et al.*, 2014). These debates on the need to incorporate contextualised accounts of inequalities have been more in developed welfare states (Bartley, 2017) and less so in the global south. Within existing health inequalities debate, there is an increasing recognition of the multiplicities and relativity, and the multiple levels of organisation of the social determinants of health (Diez Roux, 2001). Thus, intersectionality thinking is increasingly seen in global health as a promising approach capable of broadening research and policy understanding of the multidimensional power structures and processes through which inequalities in health is both created and sustained.

In designing and operationalising this research project, intersectional thinking provided a theoretical and analytical space through which to understand how health-risk factors may interlock differently for individuals, households and communities in creating unequal neighbourhood vulnerabilities and lived experiences of health in the everyday life. The study adopts the lenses of intersectionality to explore the potential power of intersectionality thinking to the understanding of the social determinants and inequalities in under-five mortality in Nigeria. It argues for the need to explore the multiple ways in which the social determinants of health might interlock to shape individual health-risk experiences of vulnerable populations.

This study demonstrates that health inequalities reflect more fundamental problems of structural violence in the wider society and speaks directly to the nature of individual and collective vulnerabilities described by Sen (1999) as ‘unfreedoms’. In so doing, it moves beyond the simplicity of examining health inequalities with a single set of categories and pushes against the idea of ‘blaming the victim’ (López *et al.*, 2016) to incorporate human agency in understanding the social context of inequalities. The study argues for the need to understand ‘*how and why [individual and collective] choices are often preconfigured by the distal pathogenic effects of inequality*’ (Herrick, 2017:218). Health inequalities are both a cause and consequence of the power structures in society which stymies the exercise of individual and collective agency (Farmer *et al.*, 2004). Farmer argues that health inequalities both contribute to and reinforce broader conditions of structural violence in the wider

society in a social spiral. Such perspectives, Herrick 2017 has noted, are less emphasised in the ‘programmatic mind-set’ of global health policies.

By incorporating lay narratives into multilevel statistical analysis of population-level inequalities in a complementary way, this thesis therefore, makes an important empirical and methodological contribution to a new strand of research in health geography. It moves beyond traditional approaches of examining single or multiple categories of the social determinants of health to synthesise the unique strengths of quantitative and qualitative methods in order to develop a more in-depth understanding at scale in addition to critically evaluating the differential impacts of health inequalities on population groups and individuals based on the ability of those individuals to articulate their own lived experiences of health risks.

This background chapter is laid out in four sections. Section 1 presents the research aim and objectives. Section 2 presents the background context and the overarching argument to the research project. Section 3 introduces the main organising framework and the key concepts utilised, and section 4 outlines the structure of this thesis.

1.1 Aim and Objectives

The central aim of this thesis is to examine the social determinants of health and inequalities in under-five mortality across multiple scales in Nigeria using mixed-methods. The aim of this research is twofold. First, it attempts to examine the main geographical and social determinants of under-five mortality. Secondly, it critically examines how the identified health determinants are co-constituted to simultaneously create unequal health experiences between individuals and within population groups. Four specific research questions are examined in order to address the research gaps in the social determinants of health literature both internationally and within the Nigerian context. These include:

1. What are the social determinants of under-five mortality in Nigeria?
2. How do the patterns of variation in under-five mortality relate to indicators of social and geographical attributes of the population?
3. How are under-five health-risk factors perceived and understood by mothers?
4. How do mothers respond both individually, and collectively, to perceived health-risks?

1.2 Background Context

This section provides a brief context to this research project. It discusses the importance of focusing on under-five mortality as the main health-risk of investigation. It presents the rationale for adopting methodological and multilevel perspectives and outlines the overarching argument that runs through this thesis.

1.2.1 A focus on under-five mortality

Under-five mortality rate is a widely used indicator for assessing the economic development of countries. It is an extensively used measure of global economic well-being and health inequalities. A focus on under-five mortality as the topic of interest rightly claims attention in this study given the high burden of under-five deaths in many developing countries including Nigeria. Reducing the mortality rate of children under the age of five years remains a matter of urgency in global health (Bamford *et al.*, 2018) as intolerable numbers of children (15,000) continue to die per day across the world. The Sustainable Development Goal (SDG) 3.2 is dedicated to 'ending preventable deaths of new-borns and children under the age of 5 years by the year 2030 (WHO). Although, substantial progress has been made in cutting the global under-five mortality rate from 91 deaths per 1000 live births in 1990 to 41 in 2016, current rates are considered too high. Despite this achievement, an estimated 4.6 (5.3, 6.0) million children died from preventable causes before the age of five years in 2016.

The global burden of under-five mortality remains unevenly distributed with most of the deaths concentrated in just two regions of the world in South-East Asia (28%) and Sub-Saharan Africa (46%). Six countries account for 50% of global under-five mortality namely, India, Nigeria, Pakistan, the Democratic Republic of Congo, Ethiopia and China. India and Nigeria alone account for 32% of global under-five mortality (Hug *et al.*, 2017). Nigeria has consistently recorded higher than the Sub-Sahara African regional average in under-five mortality since 1990 with an estimated 104 per 1000 live births compared with 79 deaths per 1000 live births in Sub-Saharan Africa in 2016. Nigeria, as the second highest contributor to global under-five deaths in the world and the highest in Africa, loses about 2,300 under-five children and 145 women of reproductive age daily mostly from preventable and treatable causes. These statistics represent the pain of human tragedy for thousands of families who have lost children in recent years. Even more devastating is the knowledge that most of these deaths could be prevented if essential interventions reached vulnerable children on time.

Although analyses of recent trends show some progress in cutting down under-five mortality in Nigeria during the MDG era, the average annual rate of decline of 3.2% to 3.9%

since 2005 in Nigeria remains lower than the estimated 4.3% in Sub-Saharan Africa. Figure A shows 2 trend charts developed from the 2018 UNICEF child mortality estimates (UNICEF, 2018). Figure A(i) shows that whilst the average under-five mortality rate has been declining steadily for both Nigeria and the Sub Saharan Africa region since 2003, the average under-five mortality rate for Nigeria remains lower than the regional average. Figure A(ii) shows that the health gap in under-five mortality rate between the poor and the rich has been rising since 2008. This supports the concern raised by Graham (2004) that acting on the structural determinants of health alone without simultaneously addressing the factors that create unequal distribution in health outcomes will in no doubt improve the overall health of the population but may widen the health inequality between rich and poor groups. Nigeria may need to pay more attention to addressing health inequalities and other forms of inequalities. According to Max *et al.* (2018), the 2018 CRI shows that government efforts at addressing inequalities in Nigeria's appears to be the worst in the world. There is a lack of commitment to reducing inequalities between the rich and the poor in Nigeria.

Overall, the pace of reduction in under-five mortality is too slow to meet Sustainable Development Goals (SDGs) of ending preventable deaths and reducing under-five mortality to 25 deaths per 1000 live births by 2030. The 28 out of the 67 countries like Rwanda that achieved a more than two third reduction in under-five mortality since 1990, are low or lower-middle-income countries, indicating that reducing under-five mortality is possible in low resource settings. More research efforts are needed to understand how inequalities in under-five health risk can be more efficiently addressed.

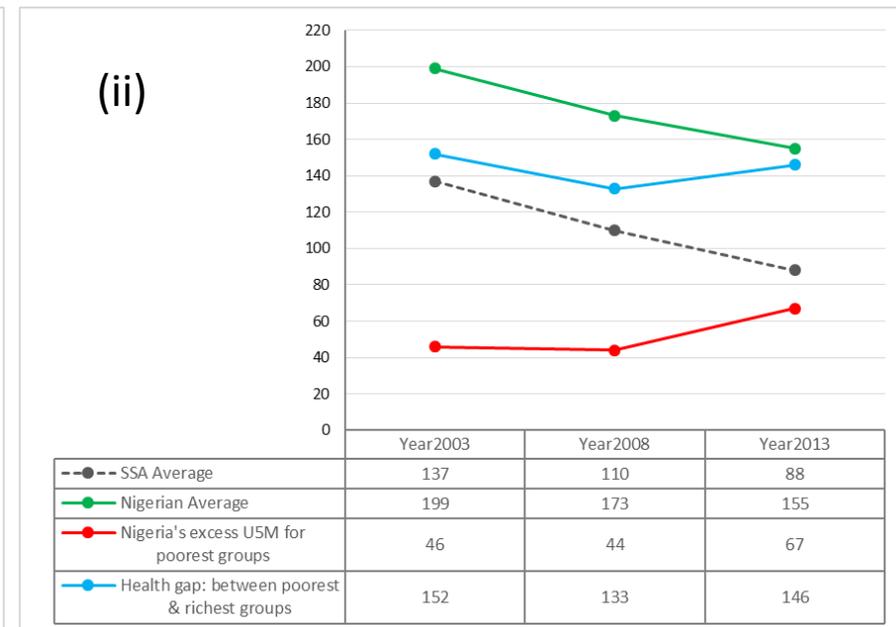
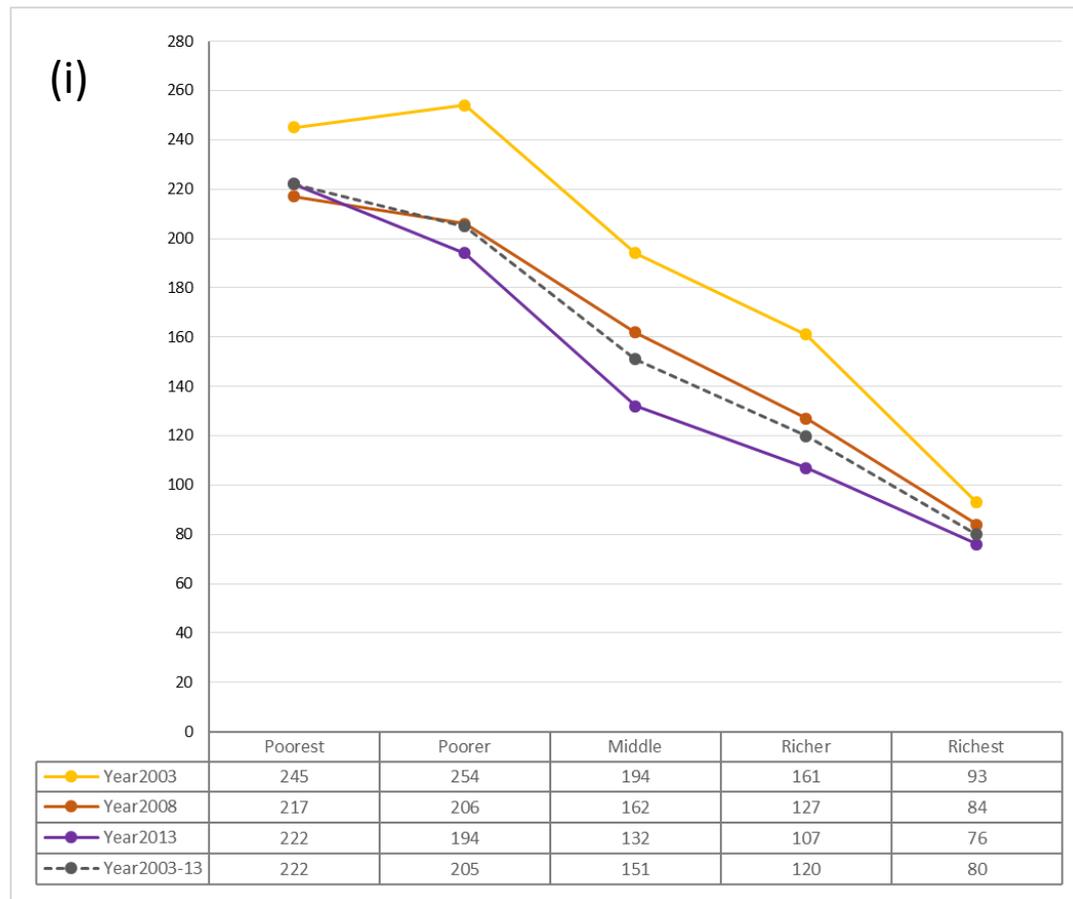


Figure A: Trends in under-five mortality rate in Nigeria and Sub-Saharan Africa (Source: author's work).

Trends in under-five mortality rate in Nigeria and SSA by wealth groups in Nigeria, 2003-2013. (ii) Health gap between the rich and the poor

1.2.2 Contours and landscape of the problem of under-five mortality in Nigeria.

From a global perspective, under-five mortality remains a public health emergency. According to Liu *et al.* (2012), 7.6 million children younger than the age of 5 years died in 2010. Although the total number of under-five deaths decreased from 9.6 million deaths in 2000 and the mortality rate decreased from 73 to 57 per 1000 live births, indicating improvement in child health indicators, they point out that only a few countries are on track to meeting global child health targets. They, therefore, suggested that the distribution, causes of and trends in under-five mortality should be updated periodically to provide the needed information to guide interventions.

Over 60% of deaths in children aged under 5 years in 2010 resulted from causes that are related to infectious diseases for example, malaria, diarrhoea, lower respiratory infections, and measles (Liu *et al.*, 2012, Prüss-Üstün *et al.*, 2016). Underlying many causes of infectious diseases is undernutrition. Undernutrition is both a cause and a consequence of infectious diseases. Kramer *et al.* (2015) noted that nearly half (45%) of all deaths in children globally is related to the problem of undernutrition. Nigeria accounts for 7% share of 161 million of global stunting due to under-nutrition. Overall, a third of global burden of the leading causes of under-five deaths and diseases in developing regions has been attributed to modifiable environmental and social determinants of health. There is now ample evidence that this burden is much higher in developing countries than in developed worlds (Prüss-Üstün *et al.*, 2016).

From a conceptual perspective, the causes of under-five deaths more specifically, and other health outcomes in different population segments of society have been theorised to depend significantly on the social determinants of health. These include the physical and social environment in which people are born, grow, live and age (WHO Commission of the Social Determinants of Health 2008). In the context of under-five mortality, the social determinants of health relate to the roles of material and socioeconomic conditions of residential places in which children live and the ways in which those conditions shape the health outcomes of children younger than 5 years. One of the improvement of the SDGs over the preceding MDGs is that health is strongly recognised as a multidimensional social phenomenon. Thus, the commission for social determinants of health has conceptualised health as both a medically and socially constructed phenomenon. This perspective has critical implications for public health strategies such as surveillance, prevention and promotion.

1.2.2.1 Main causes of under-five mortality in Nigeria

Nigeria is the highest contributor to deaths of children younger than 5 years globally. Many of these deaths are caused by infectious diseases and underlying influences such as undernutrition. In 2010, about 700,000 children died before their 5th birthday (GHO, 2012). Figure B, shows that about 60% of under-five deaths are attributable to leading causes such as malaria (20%), pneumonia (17%), preterm births (12%) and diarrhoea (11%) (GHO, 2012, WHO/CHERG, 2012).

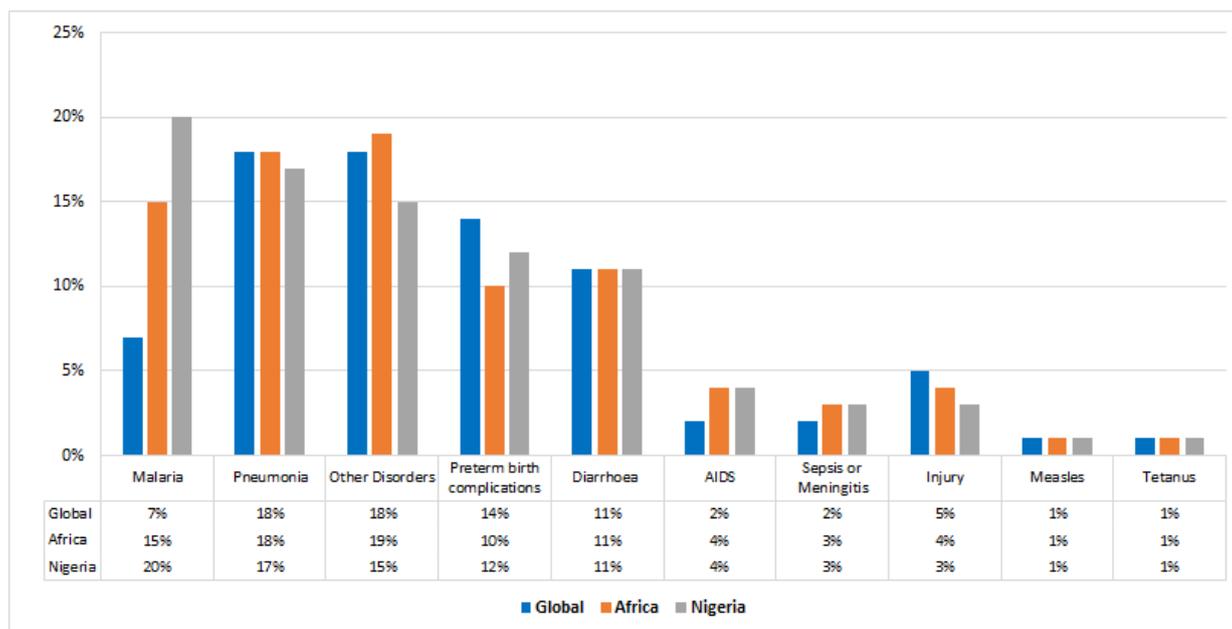


Figure B: Leading causes of under-five deaths in Nigeria, Africa and globally, 2010
(Source: The data for the bar chart were extracted from WHO/CHERG (2012) and Liu *et al.* (2012).

Figure B shows the leading causes of under-five mortality in Nigeria in relation to the African region and global statistics. In terms of percentage contribution to under-five deaths, the Nigeria's statistics in 2010 was broadly similar to those of the African Region and global rates with the exception of malaria. Malaria was estimated to have contributed the highest proportion (20%) to under-five deaths in Nigeria compared with the African Region (15%) and globally (7%), suggesting inequalities in the regional and global distribution of malaria.

Since it is impossible to examine Nigeria's effort in reducing all the leading causes of under-five mortality as shown in Figure B, the rest of this sub-section briefly examines Nigeria's efforts towards addressing the malaria crisis as an indirect way of reducing the high burden of under-five mortality in the country. I then examine the ways in which the major causes of under-five mortality is conceptualised and how these conceptualisations influence and

shape the intervention strategies, including national and international policy efforts towards addressing the major risk factors of under-five mortality in Nigeria.

Like many developing countries facing disproportionately higher burden of infectious diseases, Nigeria tends to focus attention on child health interventions aimed at controlling, treating and eradicating childhood infectious diseases. A review of recent national health care policy documents that were developed as part of the renewed commitment to the MDG and SDG frameworks show that over the last three decades, Nigeria has recorded some progress in the performance of its health system and other key indices of health for major communicable diseases that are contributing to the high under-five mortality rates.

The fight against Malaria: a tale of successes and failures

Malaria is a major killer in Sub-Saharan Africa. It is a preventable and curable but life threatening disease caused by parasites that are transmitted to people through bites of *Anopheles* mosquitoes. The main symptoms (fever, headaches and chills) usually appear 10-15 days after the infective bite. According to the estimates in the WHO (2018) report, there were about 219 million cases of malaria in 87 countries resulting in about 435,000 deaths in 2017. The report shows that WHO African region continues to bear a disproportionately high share of the global malaria burden. In 2017 for example, the African region recorded 92% of global malaria cases and 93% malaria-related deaths with nearly 60% of global under-five deaths resulting from Malaria occurring in 5 countries: Nigeria (25%), Democratic republic of Congo (11%), Mozambique (5%), and Uganda (4%) and India (4%) (GHO, 2012).

The above statistics shows that malaria is endemic in all parts of Nigeria. *Plasmodium falciparum* is the dominant parasite species that is mainly transmitted by *Anopheles* mosquitos across Nigeria and the African region. The parasite is transmitted all year round but malaria transmission peak period in Nigeria runs from July through to November and 97% of the country's population is at risk.

'Malaria remains an important cause of morbidity and mortality in Nigeria and it accounted for 32 percent of the global estimate of 655,000 malaria deaths in 2010 (World Health Organisation, 2012). An estimated 97 percent of the country's approximate population of 160 million residents are at risk of malaria. Children under the age of 5 and pregnant women are the groups most vulnerable to illnesses and death from malaria infection in Nigeria in Nigeria' (Federal Ministry of Health, 2016:9).

Globally and in Nigeria, malaria control interventions have evolved significantly over the years. In 2017, the total funding for malaria control and elimination reached an estimated US\$ 3.1 billion whilst contributions from governments and endemic countries reached US\$ 900 million (29% of total funding). These efforts have led to remarkable gains in reducing malaria (WHO, 2018). For many years, the success of the global response to malaria was considered one of the most significant public health achievements made possible through the implementation of effective individual disease control measures, and significant reduction in malaria cases and deaths. Sadly, from 2010, the rate of decline has stalled and the 2017 world malaria report shows troubling shifts in the trajectory of Malaria disease in many developing countries including Nigeria. More than half of the endemic countries are way off track to meeting critical targets in addition to an increasing resistance to existing treatments. Some endemic countries like Nigeria are beginning to see a reversal of the health gains achieved (Alonso *et al.*, 2017, Barber *et al.*, 2017). Given the recent reversal in malaria reduction trends, it is unlikely that the disease will be eliminated in the near future without a vaccine in addition to addressing the social and environmental context of people's lives creating differing exposures to and consequences of Malaria risk. New strategies are urgently needed to stem the Malaria disease that continues to cause millions of clinical cases and hundreds of thousands of deaths annually. Although malaria vaccines have long been a research priority, only in 2017 did WHO announce the advancement of the vaccine to implementation stages (Coelho *et al.*, 2017).

In Nigeria, focused intervention efforts have utilised approaches that channel intervention through the health system down to the community level by prioritising increase in accessibility to malaria commodities and services. Such intervention strategies have historically centred on 3 key strategies: distribution of Long-Lasting Insecticidal Nets (LLIN) to protect 29 million households, campaign to increase access to subsidised Artemisinin based Combination Therapy (ACT) in both public and private health practice and improved health service delivery. Over 58 million LLINs were distributed in the 5 years preceding the year 2014 (Federal Ministry of Health, 2014). The current National Malaria Strategic Plan (2014-2020) aims to transition focus from malaria control to malaria elimination by the year 2020. The country is way off track to reaching this target of complete elimination of malaria by the year 2020.

The 2014-2020 national malaria strategic plan adopts the strategy of: scaling up Indoor Residual Spraying (IRS); universal coverage of LLIN; larval source management; deploying Seasonal Malaria Chemoprevention (SMC); prompt access to testing facilities and effective case management; and use of Intermittent Preventive Treatment (IPT) with

Sulfadoxine/Pyrimethamine (SP) for pregnant women. Despite these efforts, the evidence that this thesis presents in chapters 6 and 7 shows that vulnerability of children aged under 5 years to Malaria remains a major public health challenge to date. Many participants in the case study areas have reported low utilization of the distributed nets, heavy treatment burden on poor families; areas and the lack of access to affordable services especially in rural and poor urban populations and the social context of malaria risk remain unaddressed.

1.2.2.2 Reducing under-five mortality: global strategies and funding

Over the years, the WHO and the UN in partnership with member countries and NGOs have provided the platform for developing targets and providing evidence for addressing global health challenges including under-five mortality. Through global development goals such as the MDGs and SDGs, specific targets have been set to enable countries monitor individual and collective progress towards a more healthy society. It is important to mention here that Nigeria has always been a signatory to global development goals. Nigeria's partnership with the UN and donor agencies has contributed to shaping national health policies and strategic plans. In the context of childhood diseases and under-five mortality more generally, recent successes in Nigeria for example, the eradication of wild polio and other improvements in childhood health indicators would not have been possible without the strategic platform, which international agencies provide for addressing health risk factors. Many international development agencies mostly those in Western developed economies, through the provision of aid to the federal government of Nigeria, have partnered with the government of Nigeria in her efforts towards addressing the disproportionately high burden of childhood diseases in the country. Nigeria's efforts have been supported mainly by notable western organisations such as the Bill and Melinda Gates Foundation, European Union (EU), Government of Germany, Global Affairs Canada, United States Agency for International Development (USAID), Rotary International, World Bank and the Department of International Development (DFID UK). These international partnerships continue to be important if developing countries like Nigeria must meet global development goals.

1.2.2.3 Inequalities in under-five mortality in Nigeria

Although overall improvements in population health have been achieved over the years, there are concerns that inequalities between rich and poor groups persist and may be widening. This is true on a global scale, between, and within countries (Brinda *et al.*, 2015, Max *et al.*, 2018). There is now an accumulating global evidence of geographical inequality

in health between urban and rural areas (Burgert-Brucker *et al.*, 2015, Garenne *et al.*, 2006, Moyer *et al.*, 2013). In Nigeria, a relative health disadvantage has been observed for rural populations (Okafor *et al.*, 2014a) for most health outcomes ranging from child survival rates (Adedini *et al.*, 2015c) to child care seeking behaviour (Okafor *et al.*, 2014a, Titus *et al.*, 2015). Understanding geographical variations in the health outcomes of children is inevitable in a diverse country like Nigeria where the sociodemographic and environmental factors influencing health are likely to vary in distribution. Rural-urban, regional divides and inequalities in maternal education in health are recognised in policy documents, especially in terms of access to health services. For example, on page 9, the 2016 national health policy document mentions regional and educational divides: *'There is inequality in access to services due to socio-economic status and geographic locations'* (Federal Ministry of Health, 2016).

However, policy initiatives and documents in Nigeria are characteristically silent on religious, ethnic and socioeconomic inequalities. This could be because Nigeria does not officially collect data on ethnicity and religion as a way of encouraging national unity. There is no evidence that omitting ethnic and religious indicators from national censuses has fostered national unity between diverse groups in the country. Thus, one of the benefits of using the NDHS data in this study is that it provides empirical evidence in the ways in which child health experiences may differ across ethnic and religious groups in Nigeria. The works of Antai (2011b) and Antai (2011a) are examples of academic research works using NDHS data to highlight ethnic and religious inequalities in under-five health. Ethnicity and religion are very important indicators of health inequalities that can extend research understanding of why health differences occur across social groups.

Nigeria's very poor ranking as the last country in the Commitment to Reducing Inequality Index reflects the poor attention being paid to issues of inequality by existing policy and investment efforts. This thesis has argued that this needs to change. There is a research need to flag up the health damaging effects of socioeconomic inequalities of all kinds to population health. In addition, no mention is made of the need to address the social context of women's lives as a deliberate strategy for improving child health. The under-five mortality problem and attempts at addressing it are predominantly conceptualised through biomedical perspectives rather than social constructivism. Biomedical perspectives have prioritised medical solutions such as health infrastructure and health service delivery, immunization, prevention and treatment of infectious diseases over other social and cultural determinants of child health.

Whilst there is a vast body of literature on the geographies of health inequalities in western academic literature for example (Bambra, 2016, Curtis, 2004, Gatrell *et al.*, 2014, Meade *et al.*, 2010) and the global south (Adedini *et al.*, 2015c, Antai, 2011b, Collado, 2010, Diamond-Smith *et al.*, 2015, Wang *et al.*, 2014), studies employing integrated approaches to understanding how the social and spatial patterns of health are related to wider societal structures and human agency remain sparse. This thesis has argued for multidisciplinary research efforts in understanding the social context in which inequalities in under-five mortality risks occur in developing countries that bear disproportionately high burden of under-five mortality such as Nigeria. This study contributes to this research necessity by employing integrated methods to examine why and how inequalities occur in under-five mortality in Nigeria.

1.2.2.4 How is the problem of under-five mortality understood and conceptualised?

As discussed in section 1.2.2.1, the main causes of under-five mortality are understood globally to result from several environmental, social risk factors and preventable diseases, mainly infectious diseases and chronic malnutrition. There is now global evidence that the deaths occurring in the first 28 days of child's birth have been attributable to endogenous factors such as genetically-induced defects, premature birth complications, and quality of antenatal, delivery and postnatal care. The deaths which occur after the first month of birth are largely due to socioeconomic, environmental, nutritional factors and health behaviours of households (Morakinyo *et al.*, 2017).

Reducing child mortality has been central to health discourses for several decades. Governments, health institutions, policy makers and professionals all over the world have demonstrated concerted efforts towards understanding and eliminating all preventable causes of childhood deaths. On a global scale, Morakinyo *et al.* (2017) have noted that these efforts have resulted in the development of remarkable and measurable intervention strategies for reducing mortality in children aged under 5 years between 1990 – 2015 , and 2015 – 2030 as specified in the MDGs and SDGs respectively. They suggested that because of these international efforts, many countries now use the rate of reduction in under-five and maternal mortality as the bases for key development strategies. These international collaborations have led to considerable gains in reducing childhood deaths globally. However, they were insufficient for meeting the MDGs, many countries including Nigeria are off track from the SDGs goal of eliminating all preventable causes and widening health inequalities have been reported (Chin *et al.*, 2011, Yuan *et al.*, 2014).

Morakinyo *et al.* (2017:17), in outlining the recent strategies targeted at reducing many childhood diseases, suggested that the recent improvements in some child health indicators may have been due to Nigeria's government initiatives in increasing access to and coverage of immunization programmes:

In Nigeria, the successes recorded may be because of the various interventions of government in ensuring wider immunization coverage for all vaccine preventable diseases. In the year 2002, Nigeria endorsed the United Nations Special Session (UNGASS) goals on children of achieving by the year 2010 full immunization of children under one year of age at 90% coverage nationally with at least 80% coverage in every district or equivalent administrative unit. A national policy on sustainable development with the sole aim of reducing infant and under-five mortality rates was formulated between 2003 and 2006. The WHO in the year 2006 and 2007 also endorsed the introduction of Haemophilus Influenza b (Hib) and Pneumococcal conjugate vaccines respectively into all national immunisation programs. Moreover, the pentavalent vaccines that protect against Hib, hepatitis b, diphtheria, tetanus, and whooping cough were introduced by the Nigerian government to the immunization schedule in 2011 [21]. It was postulated that with the introduction of the pentavalent vaccine, about 400,000 cases of Hib would be prevented and about 27,000 lives saved annually. Studies have shown that the use of vaccines to prevent the occurrence of diseases such measles, diphtheria, pertussis, Hib, and pneumococcus, has the potential to largely reduce disease incidence in children.

I argue that the vaccination programmes may have been successful because vaccination uptake is a lower agency intervention compared with available malaria prevention and treatment options. Existing malaria interventions usually require high agency where the responsibility of preventing and treating the disease lies more with the individual. There is evidence that low agency interventions are most likely to achieve the dual public health goal of preventing diseases and reducing health inequalities (Adams *et al.*, 2016). Individuals with better capacities to access the interventions are likely to have better health experiences compared with disadvantage members of society. This is not to say that high agency interventions are not valuable. New ways of developing low agency interventions for the malaria epidemic in Nigeria and many endemic developing countries is definitely worth thinking about.

Overall, Nigeria recognises the need to address the disproportionately high mortality rates amongst children aged under five years. However, the problem has been addressed indirectly and mainly through a biomedical focus. Interventions such as immunization of children against communicable and diseases are emphasised. Very little attention is paid to the physical, geographical context and ways in which infrastructural deficits, especially in poor neighbourhoods, exacerbates the risk of infectious diseases. Efforts at addressing the derelict nature of existing physical and health infrastructure are very poor.

In the context of under-five mortality, the mention of the term ‘environment’ and ‘environmental issues’ are often utilised in the context of physical elements of the environment: rainfall, vegetation, drought, flooding, climate change etc. The inclusion of social science and geographical perspective in the health policy landscape in Nigeria is almost non-existent. This could be because of the dominance of the health policy landscape of Nigeria by medical fields and public health practitioners. There is therefore an urgent need to draw the attention of health policy makers and the Federal Ministry of Health to the relevance of deploying multidisciplinary strategies in order to address child health problems more effectively.

This thesis has therefore argued that in order to eliminate all preventable causes of under-five mortality, Nigeria will need to adopt more holistic approaches that combine biomedical solutions with the social context of population health. There is also an urgent need to both address infrastructural deficits in addition to addressing the inequalities and the broader physical and social contexts in which children are born, grow and live. The missing point in the policy landscape that has to be made is that the role of women agency is critical to child health and future solutions targeted at improving child health indices must prioritise the social aspects women’s lives and women’s access to societal resources. The current high rate of mortality among children aged under five years from preventable causes is concerning and totally unacceptable. Efforts at eliminating all preventable causes of under-five mortality require working across multiple sectors. Multidisciplinary research efforts are needed for providing the needed evidence base for optimal results and sustaining good health.

1.2.3 Why integrated approaches are important

This study utilises a mix of quantitative methods and qualitative interviewing in a complementary manner in order to shed light on the social determinants of inequalities in Nigeria. The empirical investigation is classified into three phases. First, a wide range of global statistical methods (bivariate correlations, Exploratory Factor Analysis (EFA), One-Way ANOVA, linear, and logistic regression methods) are applied to the pooled Nigeria Demographic and Health Survey cluster-level datasets for the period 2003-2013 in order to identify the main health-risk domains and to predict under-five mortality rate. Logistic regression and GIS-based spatial methods (Geographically Weighted Regression (GWR) and Getis-Ord-Gi* statistics - pronounced G-i-star) are used to examine and map spatially varying relationships and hot spots of under-five mortality across multiple scales. The last analytical phase employs an intersectionality lens to explore the perception of health-risk factors and adaptation strategies from the lay narratives of interviewed mothers in order to

provide critical insights into the social context in which perceptions of health-risks are constructed.

By carefully combining quantitative methods that allow for interrelationships between multiple sets of determinants to be identified with contextualised accounts of health-risks, this research stands aside from typical health inequalities research that tend to focus on single sets of categories and methods. For example, several studies have examined individual-level drivers of under-five mortality from a public health perspective more broadly but less is known about the geographical inequalities in the distribution of under-five mortality and underlying risk structures between and within regions (Monden *et al.*, 2012, Nattey *et al.*, 2013, Singh *et al.*, 2013). Previous bodies of work have paid less attention to understanding why geographical variations in under-five mortality exists despite research evidence suggesting that contextual factors could be more important in accounting for under-five mortality rates compared with individual level characteristics (Adedini *et al.*, 2015c, Antai, 2011b).

This research acknowledges existing debates on the strengths and weaknesses of both qualitative and quantitative research paradigms. For example, it has been argued that individual level analyses demonstrate the importance of distinctive dimensions of health perception, and that individual experiences are valuable for demonstrating how health-risks dimensions may manifest uniquely in different context. Other critics of ecological analysis have pointed out that, although there are some generalizable elements of individual experiences, there is also considerable diversity and caution must be applied in making assumptions about individual health on the basis of aggregated characteristics: aggregated analysis risk arguments underpinned by ecological fallacy, a risk which becomes greater as the scale of analysis becomes larger, (Curtis *et al.*, 1996). For example, national level statistics may conceal important local patterns in health observable at neighbourhood and individual levels.

Scholars in favour of ecological analysis have argued that this potential for generalisation, is perhaps, one of the reason that, *'in terms of the politics of public health debates, statistical information which is applicable to large groups of people sometimes carries more weight in arguments over allocation of society's resources than do detailed accounts of the experience of individuals'* (Curtis *et al.*, 1996:75). The point of the presentation of quantitative results being more forceful in political discourse than the use of qualitative data is also made by (Kwan, 2002:166) in defence of the relevance of quantitative methods in feminist geography research. *'Hard data obtained using quantitative techniques often appear to be more*

convincing to public policy makers. Surveys may have the power to change public opinion in ways that a limited number of in-depth interviews may not'.

The emphasis on quantitative over qualitative evidence by public health policy makers reflects the biomedical emphasis on 'objectivity' claim for generalising statistical evidence. It is not always the case in the age of social media that numbers speak more loudly than individual experiences in political debates. Concerns raised by an individual's experience have sometimes initiated political action on health and other problems. For example, the 'Max and Keira's Law', the opt-out law due to come into force in England in 2020, which is named after Max Johnson the boy who benefited and Keira Ball, the girl who gave her permission for Max to receive her heart, is a case in point (English *et al.*, 2019). In a second example, the single image of three-year old Aylan Kurdi who was washed up drowned on Bodrum beach in Turkey on 2 September 2015, unravelled the deep health tragedy arising from civil conflict in Syria (De Andrés *et al.*, 2016, El-Enany, 2016, Vollmer *et al.*, 2018). The iconic image spread to 20 million screens in 12 hours and dramatically transformed the language used on social media around immigration with more people using the word 'refugee' rather than 'migrant' (Vis *et al.*, 2015). It provoked hundreds of opinion and editorial articles and forced politicians to speak out (Prøitz, 2018) and inactive masses to respond in favour of accepting significant higher number of refugees into western countries (Blommaert, 2015).

Despite the limitations of quantitative analyses, they are very revealing of the regional differences in health among population groups and of the range of social determinants of health. To some extent, area variation in health could be explained in terms of contextual factors of the living environment that are measurable. However, area measures of environmental conditions are limited in their ability to capture complex variations in socioeconomic and physical risk factors like housing, occupation, income, access to health services, health behaviours etc. with crude indicators. No set of indicators has been found to account for all determinants of health inequalities in literature. Thus, the geography of health differences reminds the researcher about the complexity of health differences and the limitations of available tools to measure them.

This study argues, in line with Mason (2006:12) that the 'theoretical wrangles' about these dualisms, see for example, Morgan (2007), are unnecessary because lived experiences of health transcend them and so should research approaches. This study demonstrates the ability of health geography research to complement population-level quantitative research analysis with the more in-depth analysis favoured by individualistic approaches and individual qualitative methods in addressing multilevel research questions. Ecological

analysis of survey data is utilised in this thesis to show how health differences seems to be generalised for population groups as a whole providing a clear picture of the scale of health problems. Qualitative methods on the other hand allows this thesis to enhances the capacity to understand how the explanations of the causes of illness and the capabilities of mothers to respond to health-risk conditions are rooted in the structures of power in the wider society.

1.2.4 Multilevel perspectives are needed

One of the tensions in global health development programmes is to determine the appropriate scale at which we stop thinking about spatial heterogeneities in order to target vulnerable populations more effectively. In many developing countries including Nigeria, health programmes tend to assume '*a certain rhetorical universality*' in health experiences, especially because global health programmes are largely dominated but biomedicine and epidemiology disciplines (Herrick, 2016:675). In line with Herrick's argument for more recognition of the potential of geographical perspectives in global health research and policy practice, this thesis aims to demonstrate the conceptual and analytical tools of health geography for integrating global health with the 'socialising disciplines' (p.683) for understanding inequalities in health. It makes the important point that in order to sustainably reduce under-five mortality rate and eliminate inequalities in this SDG era, it is important to identify '*the complex set of interwoven engagements and interrelationships*' in the social determinants of inequalities in addition to the investigating the social processes shaping inequalities at different spatial levels: national, sub-national and localised geographies down to individual and contextualised levels of analyses.

In terms of the scale of investigation, previous studies based on the Demographic and Health Surveys (DHS) data, have mainly utilised larger geographies namely, individual state-level and geopolitical administrative units for analysing and mapping a variety of child health indicators in Nigeria. Studies based on smaller geographical units such as the DHS cluster data and other survey sources are rare. A few studies have suggested that the inherent bias in DHS cluster level data for lack of use, noting that DHS cluster sample is not designed to be representative of small areas and communities in most developing countries. However, this study argues that this bias has been demonstrated to be negligible in previous research (Kravdal, 2006, Storey *et al.*, 2009) so that the DHS remains one of the most reliable and comprehensive survey data source for assessing geographical and social determinants of inequalities in health for small areas in developing countries including Nigeria (NDHS). Details of this bias but continuing relevance of DHS clusters for mapping health distributions are highlighted in more detail in chapter 3, section 3.2.1.

There is no known study that has examined spatial clustering in under-five mortality rate at the DHS cluster level across Nigeria with the aim of identifying significantly low (cold spots) and high (hot spots) mortality areas. With a focus on the analysis of conventional individual and behavioural risk factors of under-five mortality drivers, previous research has paid less attention to the underlying interactions and latent linkages between wider socioeconomic, environmental, health care and behavioural context in which under-five deaths may occur. It is important to move away from biomedical model-informed health research which prioritises conventional individual lifestyle and behavioural risk factors of mothers such as use of smoking, use of insecticidal treated mosquito bed nets and childhood vaccinations, medical care for mothers and children, to also account for place effect (Riva *et al.*, 2012) in maternal and child health in the global south.

This study also demonstrates the importance of incorporating place into the intersectionality research process. Geographical studies employing intersectionality frameworks for understanding the social determinants of health recognise the need to understand how sociodemographic identities of people may interlock to influence health-risk for those at the crossings of the multiple axes of inequalities. However, the role of unique geographical contexts in the intersection of power, oppression and privilege is less emphasised in the emerging and diverse field of intersectionality, suggesting a conceptual niche for health geographers to fill.

Overall, this study demonstrates the need to complement population level quantitative investigations with qualitative techniques that recognise and make visible the human agency in terms of the ability of people to contribute and modify the health-risk conditions in the environment in which they live. Incorporating lay knowledge and experiences of health-risks with positivist methods, I have argued, holds potential for extending research understanding on the underlying mechanisms creating health differences. It is on this premise that this study attempts to incorporate contextualised accounts with quantitative explanatory frameworks to examine the main domains of the social determinants of health and the multiple ways in which they might interlock to create inequalities in under-five mortality in Nigeria.

1.2.5 Overarching argument of this thesis

Quantitative methods are powerful for predicting health outcomes and estimating potential risk factors to population health. Quantitative and epidemiological approaches hold major influence of public health policy (Wemrell *et al.*, 2016) These methods have informed many health policies including under-five mortality targets in many countries and globally. The

development in computer hardware and statistical techniques including Geographical Information Systems (GIS) have allowed easier handling of complex datasets by health geographers for predicting health outcomes and combining risk factors which may co-occur or sequentially over time and across multiple levels. A combination of GIS-based methods and conventional statistical techniques have been utilised in this study to identify the ways in which, under-five mortality risk factors might co-exist and the spatiality of unequal distributions of health outcomes.

Whilst quantitative approaches to understanding health inequalities have undoubted advantages, they are limited for in-depth understanding of individual experiences and social processes underlying health inequalities (Popay *et al.*, 1998). This study has therefore incorporated the explanatory strength of qualitative granularity to shed more light into the social processes creating unequal distribution in under-five mortality. I draw on the work of (Popay *et al.*, 1998) to discuss key limitations of quantitative methods. These are presented next.

Research and policy practice mostly approach the social determinants of health by breaking them down into constitutive categories in what has been described as ‘a components approach’ (Atkinson *et al.*, 2011). This thesis argues that identifying single sets of health-risk factors are important as first steps in researching social determinants of health. However, these should ideally be complemented with more in-depth understanding of lived experiences of health-risks in vulnerable populations. Existing critique of the dominant components approach emphasised by population-health research relates with the stripping away of the context of people’s lives through identifying single sets of biological and social determinants of health for entire populations (Bauer, 2014) and for the failure to recognise the role of human agency as active participants in shaping the condition that influence health outcomes (Labonté *et al.*, 2005). The dominant epidemiological framing of health tends to assume a freedom to make informed choices, which do not sufficiently reflect what many lay people experience as real possibilities for action in different contexts. There are methodological constraints that limit the capacity of quantitative methods in population health to satisfactorily account for interrelationships of contexts and agency in their impact on health (Williams, 2003). The critiques of a quantitative research tradition centre on four weaknesses: the over reduction of health determinants into unidimensional categories in the explanation of health inequalities and the inevitable failure to adequately represent the complexity of social processes in creating differing health experiences; the need to incorporate the significance of place and time in theorising health inequalities; the lack of capacity to account for human agency as active participants in the processes that influence

health; and emphasis on deficit perspectives which privilege risk factors and vulnerability rather strengths or assets (Morgan *et al.*, 2010, Panter-Brick, 2014).

First, quantitative methods tend to give prominence to the quantification of socioeconomic attributes. This is important for identifying risk-factors that are more widespread in the population as first steps to identifying the determinants of health. However, this research tradition lacks the capacity to reflect effectively, the geospatial intersections in which health determinants may occur resulting in largely disembodied accounts of health and undue reliance on abstracted and decontextualized data. Individual experiences are reduced into predefined hard and fast categories in the data collection and analysis process in an attempt to produce generalizable explanations of health inequalities (Kwan, 2002). Employing such approaches as the only route of enquiry could mask the processes creating health inequalities within populations especially for women (Rose, 1992, Rose, 1993) in developing countries.

Shim (2002) has argued that employing multifactorial models where population and geographical attributes such as gender, social class, race/ethnicity, wealth, space and neighbourhood boundaries are treated as stark individual categories amounts to a black box within which the self-contained individual variables are routinized. This implies that the internal processes within the 'black box', for example, how wealth levels and female disempowerment create inequalities in under-five mortality experiences for women, remain unclear. Quantitative approaches to explaining health inequalities risk rendering invisible the social relations of power which may structure the material and social conditions that influence the stratification of health and illness (Shim, 2002, Williams, 2003). Although the statistical inputs and outputs to the black box seems to produce policy-relevant results for targeting vulnerable populations, predicting health outcomes within given populations, such works fail to explain 'how' and 'why' health inequalities occur. For example, how does ethnicity or religious affiliation or being resident in the North or South in Nigeria contribute to the risk of under-five mortality? How do these population attributes work together to shape varying experiences of health in varying contexts? By complementing the strengths of quantitative methods to identify the most wide spread macro-level factors associated with inequalities with the power analysis of lay narratives of the interviewed mothers, this study sheds more light on the experiential aspects of health inequalities.

Secondly, little of the epidemiology and social science literature on health inequalities has moved beyond considering of social factors such as gender, ethnicity, and socioeconomic status, as discrete influences. This mimics traditional epidemiology in limiting the capacity

for broader reflections on perceived and experiential dimensions of health. Thus previous research has noted the need to go beyond the well-established variable-oriented quantitative approaches within health geography and the social sciences, of attending to separate categories of health determinants, to integrate more fluid social science methods such as qualitative interviewing and more micro-level qualitative research analysis, which could account for the relational and complex intersections in which health inequalities are situated and contextualised (Atkinson, 2013).

Thirdly, within the health inequalities field, the need to complement situated accounts of health beyond the 'worse and better' ecological accounts of health has become more apparent with the development of multilevel approaches in the explanation of the relationships between geographical and socioeconomic dimensions and health (Bartley *et al.*, 1998, Marmot *et al.*, 2006). Knowledgeable narratives have therefore illustrated the need to contextualise health by reference to the wider material and environmental conditions in which health determinants are embedded (Williams, 2003). Besides genetic susceptibilities and socioeconomic associations, there are also cultural differences in such things as perception of symptoms, compliance with child health regimes (e.g.) like vaccinations, and family networking (Meade *et al.*, 2000). Many studies have pointed out the need to account for micro-levels of explanation in health inequalities studies. For example, Macintyre (1997) pointed out that the micro social context need to be taken into account as there is no reason to suppose that the social and environmental influences on health generating health inequalities in under-five mortality at national levels of explanation are the same at more local scales.

Fourthly, population health research has a strong potential to highlight the widespread health deficits in the general population in its efforts to address the determinants of health. Hence, public health policy practice and intervention programmes have tended to focus on reducing health risk factors rather than empowering communities and individual to sustain health development (Morgan *et al.*, 2010). This study argues that whilst such perspectives are crucial for the reduction and possibly, the elimination of health-risk factors, the weaknesses of deficit models need to be complemented by understanding how people respond to health-risks. Understanding how individuals and groups draw on neighbourhood resources for health through the inclusion of lay knowledge is important for understanding how the capabilities of people to choose adaption strategies is mediated by structures of power in a social spiral.

Redressing the balance does not suggests that one approach is better than the other is but rather necessary for understanding the persistence of health inequalities across societies. As

Hankivsky (2014) notes, the inclusion of the voices and perceptions of women in this thesis is essential for a richer academic discourse on the social determinants of health. It is beyond the scope of this work to provide a comprehensive account of the need for an integrated approach to theorising the social determinants of health and inequalities. These are available elsewhere. The works of Macintyre (1994), Popay *et al.* (1998) and Williams (2003) provide thought provoking ideas on the failure of quantification attempts to capture the contexts in which health determinants are embedded. These articles also make a case for the complementary value of individual level qualitative approaches in rendering visible the hidden processes shaping individual health experiences. The brief criticisms of quantitative methods and deficit perspectives, which have been outlined here, is not an attempt to perpetuate a needless oppositional stance between both approaches. According to Massey (1999:261):

One of the most well-established and best-fortified of these divides within geographical knowledge (creation) has been that between the 'physical' and 'human' science [methods]. Yet even that ingrained counter position between so-called 'natural and 'social' (which has led us astray in holistically conceptualising space and time) is increasingly being questioned, and my conviction is that they are now up for re-inspection and problematisation, then geographers should be in good position to make a leading contribution.

There should not be a preferred alternative between quantitative and qualitative approaches. Kwan (2002) has warned that doing so will amount to reinforcing the dualistic thinking that ignores the complementary potential of both approaches. This thesis is theoretically positioned to demonstrate the need for understanding health inequalities from different perspectives and adopting more holistic approaches towards understanding the health experiences of vulnerable populations.

In this study, the quantitative analysis of NDHS data has been complemented with qualitative interviewing in an attempt to offer richer explanations of what constitute the social determinants of health and how inequalities in under-five mortality are created across the geographical and socioeconomic scales of analysis considered. Employing a mixed-method approach in this study presents a good triangulation strategy which has been credited for addressing the limitations of single methods by counter-balancing the advantages of another (Rose, 1993). This study stands aside from other studies of under-five mortality by demonstrating the potential to hold methods in dialogue tension with one another in order to open up health research perspectives to the multi-dimensionality and complexity of the lived experiences of health at multiple scales. Mason (2006:12) highlights this point when she states:

"the idea of the micro-macro is of course a social scientific construction, and to a greater or lesser (and always contested) extent it may be seen to mirror other social

science dualisms including public versus private, sociocultural or collective versus individual, structure-agency, object-subject, structure-field-habitus, [risk-resilience, deficit-assets] and even qualitative-quantitative... The lived experience transcends and traverses them and, therefore, so should our methods.

The study is less concerned with the whole legacy of fraught theoretical debates about how the different domains of health determinants should be conceptualised or which side of the methodological dualism should be emphasised over another than with the idea that under-five mortality is influenced at the same time on macro and micro scales. The lived experiences of health transcend and traverse the 'macro-micro' boundary and other social sciences dualisms and so should the methods of investigation and policy strategies for addressing them. This thesis has integrated the strengths of both method to demonstrate the richness of understanding that can be gained by utilising both quantitative techniques in a complementary manner to address social issues. Whilst acknowledging that mixing methods in research can be challenging, a careful application of both methods holds good potential for the much needed context-specific evidence for advancing SDG3 health targets.

1.3 Key concepts

The main concepts that underpin this research include under-five mortality rate, neighbourhood context, health-risk, social determinants of health, health inequalities, lay perception and lay knowledge, intersectionality theory, power and agency, and social capital resources.

Understanding the factors that influence **under-five mortality rate** and how it varies across geographical areas and population groups are the core emphasis of this thesis. Under-five mortality is recognised as a good indicator for the overall wellbeing and for monitoring the development progress of countries. This is because under-five mortality rate strongly reflects the social and environmental conditions, in which people are born, grow, live and age. Under-five mortality is considered to capture the pattern of mortality for among children under the age of 18 years, making it a good indicator for identifying vulnerable populations and monitoring the health status of many countries (WHO, 2009). Under-five mortality rate is also considered as an important indicator for measuring progress in economic developments goals. In biomedical terms, under-five mortality can be defined as the probability of a child born in a specified period dying between birth and the age of 5 years that is all deaths occurring between ages 0 to 59 months. In this study, under-five mortality rate has been expressed per 1000 live births. This is in line with global conventions for expressing mortality rate among children aged under-five in order to capture the mortality rate of populations in many developed countries with low under-five

deaths (WHO, 2015, UNICEF, 2015b). This study uses the term under-five mortality rate more loosely to refer to the number of deaths divided by the number of population at risk using the NDHS pooled survey dataset (2003, 2008, 2013). Thus, the under-five mortality rate in this study is, strictly speaking, . Nigeria records one of the highest under-five deaths in the world, mortality rates could also be expressed per 100 to communicate the magnitude of risk to local populations.

In line with social science constructivism, this study recognises that health-risk cannot be conceptualised as an outcome only, commonly measured by the occurrence of a health event and fatality such as the presence and absence of disease or mortality. **Health-risk** can also be theorised as a process shaped by a unique combination of privilege and disadvantage capable of influencing the levels of exposure to the risk of disease and illness and associated health damaging consequences over time (Nygren *et al.*, 2014). **The Commission for the social determinants of health (CSDH) framework** was utilised in this thesis to identify and examine how the social and environmental conditions in which under-five mortality health-risks might occur. It is agreed in academic literature on the social determinants of health and health inequalities that the most distal determinants of health are the factors that divide the population into **socioeconomic positions** resulting from unequal access to economic and material resources (Graham, 2004, Krieger, 1992, Marmot, 2009a). The term '**health inequalities**' is used **in this study** to refer to the systemic differences in under-five mortality between more and less advantaged population groups, which are attributable to factors, both individual and neighbourhood factors that can be modified through informed action. The **neighbourhood context** is therefore used in geographical sense to understand how social and environmental determinants come together to create differential **vulnerabilities in places** and varying landscapes of health risks (Curtis *et al.*, 1996). The research then utilises the concept of **intersectionality** as a framework for understanding how multiple health determinants are co-constituted in creating differing health experiences for individuals and groups through multiple depths of analysis. **Lay knowledge, lay perception and lay narratives** are utilised interchangeably to refer to mothers' understanding and perception of health-risk, and how they respond individually and collectively to health-risk factors (Popay *et al.*, 1996, Popay *et al.*, 1998). This study utilises the notion of lay knowledge to understand mothers' narratives which, according to Coveney (2005), represent the meanings and experiences of health-risks as influenced by the social circumstances in which mothers and children live. They suggested that lay knowledge is a more appropriate concept than 'attitude' or 'beliefs' because the concept recognises the social context in which health perceptions are constructed. This study argues that incorporating the lay narratives of mothers into health research analysis

can shed important lights on the social production of health disparities. This research utilises the notion of **female agency** to incorporate the lay perspectives of women on the causes of health-risk and to examine the organisational means through which they influence the social determinants of health (Labonté *et al.*, 2005) both individually and collectively. Lastly, access to **social capital resources** is utilised in Putnam *et al.* (1994) sense to examine how women mobilise collective resources in addressing health-risk conditions and for other common goods.

1.4 Thesis Structure

This thesis is presented in two parts. **Part one** presents a review of the academic literature, the conceptual perspectives that has helped to shape this study. It also discusses the methodological approach utilised in answering the research questions. **Part two** contains four empirical chapters, which presents both quantitative and qualitative empirical evidence on the leading determinants of under-five mortality at multiple scales. Part two concludes with a summary of the main research findings, some policy implications for addressing the burden of under-five mortality in Nigeria, and comments on future research directions.

Chapter 2 presents relevant argument in the academic literature and policy documents that provide a basis and justification for this thesis. It first presents summary information on the burden of under-five mortality in terms of how under-five mortality in Nigeria compares with other countries in the Sub-Saharan African region and globally. The chapter then outlines how the fundamental principles of the concepts of social determinants of health, intersectionality and health-risk perception frameworks are utilised in the study. It then examines why the integrated approach employed in this thesis to the study of social determinants of under-five mortality is important.

Chapter 3 explains and justifies the quantitative and qualitative methods employed in each part of this study. It describes how the pooled NDHS data - 2003, 2008 and 2013 - is used to provide a decadal overview of the underlying determinants within the MDG era. The first portion focuses on the quantitative research design, secondary and primary data sources and their limitations, the sampling strategy and analysis techniques used. Three broad quantitative techniques are presented: exploratory factor analysis, regression methods (linear, geographically weighted and logistic regression) and cluster mapping (Getis-Ord-Gi* spatial autocorrelation analysis). The second portion addresses the qualitative research case selection and analysis, and ethical issues of access, language and representation in the Nigerian context. The chapter concludes with a reflective section on researching child mortality and doing fieldwork as a new mother.

Chapter 4 is the first of 4 empirical chapters that discuss the research findings. The results from the exploratory factor analysis and global linear regression are presented. The findings indicate that the determinants of under-five mortality are interrelated and multidimensional. It shows that female subordination, maternal care, domestic violence, childhood vaccination status and socioeconomic characteristic of neighbourhoods were the dominant health-risk dimensions strongly associated with under-five mortality in the MDG era. The linear regression model is demonstrated to be a useful but limited tool for measuring the spatial contribution of each domain of under-five mortality risk. The strengths and limitations of global regression methods for capturing spatially varying relationships in the study of social determinants of health are discussed.

Methodologically, **chapter 5** builds on the findings in chapter 4 and examines the geographical and socioeconomic variations and inequalities in under-five mortality in Nigeria. Spatial statistical techniques such as geographically weighted regression and spatial autocorrelation are employed to identify the spatial patterns in under-five mortality and the identified risk factors. The results show that Nigeria is a nation divided in terms of under-five health achievement. Health outcomes are best in the south, with the southwestern region achieving the lowest under-five mortality rate; and worst in the north with highest levels of under-five mortality recorded in the northwestern region. The widest gap in under-five health achievement is attributable to wealth differences and being resident in the north or south. The other differences observed in health are due to ethnic differences and religious affiliations.

Chapter 6 explores the localised determinants in under-five mortality in an attempt to advance research perspectives on what constitutes health determinants at a small scale within the Nigerian context. Using logistic regression techniques, four broad dimensions of under-five mortality risk factors are identified. These include health perception and behaviour, social network, sanitation and child clustering perception of neighbourhood socioeconomic circumstances of mothers. Overall, access to improved water source for domestic use, factors related to the utilisation behaviour of insecticidal treated mosquito bed nets and household size, are identified as the leading determinants of under-five mortality in the study population.

In recognition of the limitation of quantitative approaches (such as those explored in chapters 4-6) to provide rich contextual explanations of the 'hows' and 'whys' of social processes shaping individual experiences of health and health behaviour, **Chapter 7** complements the quantitative analyses by deploying qualitative interviewing to explore the

lay perceptions of under-five mortality determinants. This is an attempt to give visibility to the neglected agency of mothers as active agents in shaping child health-risk conditions in their local context. It provides a deeper contextual understanding on why and how some of the observed patterns of relative inequalities in under-five mortality exist. The chapter broadens research insights into the mechanisms through which neighbourhood and social vulnerabilities may intersect to amplify and create differential vulnerabilities to infectious diseases, which underlie the high-risks of under-five mortality in Nigeria.

Chapter 8 moves beyond risk narratives to examine the ways in which mothers respond both individually and collectively with the multiple aspects of under-five mortality health-risks that they have to negotiate in the everyday. It highlights the ability of women to choose informed responses to health-risk and mobilize their individual and collective social capital resources through membership of community groups.

Chapter 9 provides a summary of the main research findings and highlights the key contribution of this thesis to health geography perspectives on the social determinants and inequalities in health. It concludes with comments on where this research might lead in terms of future research projects.

CHAPTER 2

Framing the Social Determinants of Inequalities in Under-Five-Mortality

2.0 Introduction

This chapter provides an overview of the core academic literature on the relevant theoretical frameworks for understanding health inequalities. It utilises the Commission for Social Determinants of Health (CSDH) and risk perception frameworks in order to draw out 4 complementary themes for understanding the multidisciplinary and intersectional nature of health inequalities: place vulnerability, social determinants of health, lay knowledge/perception, and capability/power and agency. Specifically, this chapter begins by discussing the role of the geographical and social and environment in shaping unequal vulnerabilities to health-risks. It then discusses the interplay between macro, micro structures of power and female agency in determining unequal capabilities of mothers to choose informed responses to health-risks, and the role of lay narratives in broadening research understanding of the intersectionality of the determinants of inequalities in under-five mortality.

2.1 Defining health

Health is a key contributor to a wide range of SDGs (WHO, 2011). The impact of health on the overall functioning and participation for all persons in society is clear: good health is essential to wellbeing and full economic participation, and poor health leads to suffering, disability and death (Braveman *et al.*, 2011). Under-five mortality is a good indicator for measuring economic progress, overall wellbeing and health care systems of societies. International and national health development targets have therefore increasingly aimed to reduce health inequalities in the mortality of children aged under 5 years as a strategy for improving the overall health of populations across the world (Wistow *et al.*, 2015) but how is health defined and how is it assessed? The concept of health can be interpreted differently depending on the theoretical perspective. Conventional biomedical or quantitative view of health often treats the idea of health as ‘an outcome’: the absence or presence of diseases, a behaviour, vitality, fitness, an activity, resilience against risk factors etc. Attempts are made to identify the relationship between the dependent and independent variable(s). Whilst recognising the importance of measuring health outcomes and health determinants, qualitative researchers have questioned the idea of health determinants as ‘variables’ that

can be abstracted from the reality of social experiences of people (Atkinson, 2013, Byrne, 2012, Popay *et al.*, 1998), and pushed for broader interpretations to include the idea of health and its determinants as a complex and socially constructed phenomenon. Health has been generally described as ‘*a state of complete physical, mental, and social well-being and not merely the absence of diseases or infirmity*’ (WHO, 1946:100). The 1986 WHO Ottawa Charter recognises the complexity of determinants that contribute to health status of a population and frames health in terms of broader social, personal resources and environmental living conditions (WHO, 1986). This study recognises and integrates the strengths of both perspectives to both identify common elements in the health determinants and how widespread they are across the population, and provide important insights into social pathways through which health inequalities are both created and sustained (Solar *et al.*, 2010). This study incorporates the lay perspective of the local population in the recognition that health experiences are differently situated, with different meanings for different people depending on their historical, social and geographical context (Curtis, 2004).

This study adopts multidisciplinary perspective to understanding health inequalities. It draws on epidemiological, geographical and sociological perspectives to emphasise the interconnectedness between the factors that influence health and place. It is also informed by the academic literature on lay knowledge to demonstrate the potential for lay perceptions and narratives to extend research understanding of lay explanations of the causes of ill-health among children aged under 5 years and perceptions on how to avoid or cope with health risk conditions. This study therefore utilises the term ‘health-risk’ to broadly refer to the likelihood that individual, household, neighbourhood living conditions and broader societal factors will negatively impact health and increase their chances of contracting diseases or dying before the age of 5 years. Through integrating, the strengths of two approaches often thought to be in tension with one another – biomedical and social science epistemologies – this study demonstrates the potential synergies between quantitative and qualitative approaches (Hankivsky *et al.*, 2017) for understanding inequalities in health.

This study examines the concept of health as both an outcome and a social process. First, the quantitative methodologies incorporates the health theme in focus (under-five mortality) as an outcome – whether a child under the age of five years died or survived within a certain period – in order to assess and compare the probable outcome of under-five mortality resulting from different exposures of geographical areas and social groups to risk using large quantitative datasets. In their critical review of intersectional approaches to

health-risk research, Nygren *et al.* (2014) argued that the conception of health-risk as a social process allow researchers to account for the role of power relations, differential access to societal resources and human agency in shaping health inequalities. They argued that social aspects of health-risks are not typically at the fore in more medically-oriented public health research. Whilst social medicine and public health have long demonstrated that societal power structures can influence health outcomes, their history of close relations of quantitative approaches with biomedical and epidemiological research has meant that the in-depth analysis of the association between structure and agency are relatively rare. This study contributes to health-risk research through its sensitivity to the pathways through which the social determinants of health influence varying exposures to under-five mortality health-risks.

2.2 Explaining health inequalities

Explaining health inequalities demands an understanding of how and why health outcomes vary across segments of the population. Segments of the population could be defined in terms of socioeconomic position, cultural, gender, ethnicity and geographical characteristics. Krieger (2002:698) refers to health inequalities as *'health disparities within and between countries that are judged to be unfair, unjust, avoidable, and unnecessary (meaning are neither inevitable nor unremediable) and that systematically burden populations rendered vulnerable by underlying social structures and political, economic and legal institutions'*[sic]. Graham (2004:117) describes health inequalities as *'the systematic differences in health associated with people's different and unequal positions in society. In other words, the concept links the health of individuals to the structures of social inequalities, which shape their lives'*. According to Graham, health inequalities at both individual and population level are generally used as a shorthand for socioeconomic inequalities in health. Other forms of inequalities which relate to other structures of inequalities are labelled more specifically as, for example, gender or ethnic inequalities in health (Wistow *et al.*, 2011). For Wistow, health inequalities can be viewed as both a cause and a consequence of the distribution of resources in different societies'. Evidence into health inequalities often provide interesting insights into the dynamics of wealth distribution and the social status of the population under observation (Wistow *et al.*, 2011:1). It is recognised that geographical and social inequalities in mortality among children aged under5 years offer a clear insights into the underlying social gradient in the distribution and access to societal resources (Marmot, 2005).

Many studies have demonstrated that addressing inequalities in the under-five mortality requires an understanding of the geographical and social contexts of mothers' lives. Beyond

the successes of interventions arising from the MDG₄ in reducing under-five mortality rates, previous research findings have pointed to widening geographical disparities in the global distributions of under-five deaths (Huda *et al.*, 2016). In addition to the uneven geographical distributions of the burden of under-five mortality, past research evidence has also shown that huge geographical and socioeconomic inequalities may occur within countries (Adedini *et al.*, 2015c, Liu *et al.*, 2015, Morakinyo *et al.*, 2017, WHO *et al.*, 2017) indicating that the environmental contexts in which children are born and grow matter for survival. The physical, ecological, political, and socioeconomic structure of many sub-Saharan Africa countries account for spatial differences in the burden of under-five mortality. The identification of vulnerable groups and the reduction of health gaps between and within regions and socioeconomic groups have become central objectives of international organisations and governments in many countries in the wake of MDGs (Adedini *et al.*, 2015c, Antai, 2011b, WHO, 2013). This means that health geographers have a significant role to play in drawing attention to possible spatial determinants that might influence the risk of under-five mortality. Geographical analysis is useful for identifying most vulnerable groups or problem areas in order to target health resources for optimal results.

Health inequalities are a growing concern in public health in many countries and global health agenda (Wistow *et al.*, 2011) and the UK has led the way, in many ways internationally in policy and research debates targeted at reducing health inequalities. However, these debates have been more in developed countries (Graham, 2004) than in developing settings. A focus on health inequalities in Nigeria rightly claims attention in this study as Nigeria ranks last out of 157 countries in the world in Commitment to Reducing Inequalities (CRI) 2018 index for the second consecutive year since 2017 (Max *et al.*, 2018). The CRI index is a measure of a country's government effort towards reducing inequalities introduced by OXFAM in 2017. The index indicates that Nigeria's investment on health, education and social protection is the worst in the world, lagging behind Bangladesh, Sierra Leone, Chad and Haiti. This shameful performance calls for an urgent research attention to highlight causes of inequalities and the required evidence for addressing them. This is where this study makes a novel contribution to health geography efforts on inequalities.

A number of theoretical strands have been utilised over the years to explain cause of health differences between geographical areas and social groups (Curtis, 2004). Common social models of health inequalities include material (focuses on the influence of individual income on exposure to risk factors), cultural/behavioural (health impacts on health beliefs, norm, and values), Psycho-social (access to social support and power), life course

(accumulation of health experiences over a life time), and political economy (health effects of social and economic policies, which determine the distribution of resources, environmental quality and access to health services) (Bartley, 2004:16). It is beyond the scope of his research to elaborate on the different explanations of health inequalities that have been put forward over the years. Adopting the lenses of health geography can lead us to identify the role of 'place' as the point of convergence for many social models of health inequalities. The works of Michael Marmot is notable for demonstrating that: first, countries are more equal socioeconomically also have lower health inequalities; and secondly, health inequalities is predicated upon the social context of people lives – social determinants of health (Marmot, 2004, Marmot *et al.*, 2010a, Marmot *et al.*, 2010b, Marmot *et al.*, 2006, Marmot, 2009b); thirdly, the environmental conditions where people live impact health neighbourhood effect on health (Bernard *et al.*, 2007, Cummins *et al.*, 2005a, Macintyre *et al.*, 2002); and fourthly, the characteristics of individuals and places tend to combine to simultaneously create unequal health experiences for different regions and social groups, an intersectionality perspective to the social determinants of health (Bauer, 2014, Hankivsky *et al.*, 2017, López *et al.*, 2016, Nygren *et al.*, 2014). The rest of the discussion in this chapter focuses on the role of place vulnerability, social determinants of health, intersectionality theory and lay explanations of the causes of health inequalities.

2.2.1 Place vulnerability and inequalities

The role of geographical context in creating and reinforcing social inequalities (Cunningham *et al.*, 2015) including health inequalities is increasingly being recognised in the academic literature. This increasing recognition of the relationship between place and wellbeing has gained concerted government attention in many countries, for example, in the UK (Herrick, 2009), which has resulted to the rethinking of urban planning and design guidelines to include health concerns. It is now generally agreed among health researchers that health experiences of an individual or groups are embedded in the vulnerability of neighbourhood living conditions: physical and social environment, health care, social relationships and networks. Illuminating the role of the environmental and socioeconomic vulnerabilities of the places where people live, as a factor in health inequalities has been one of the fundamental contributions of health geographers to health inequalities research over the years (Curtis, 2004). Historically, health geographers have sufficiently demonstrated that people living in more vulnerable places are also more likely to experience worse health compared with those in less vulnerable areas and this is true on a global scale down to individual level of analysis (Oppong *et al.*, 2009). In both developed and developing countries, population health reflects the physical and environmental conditions of neighbourhoods in which people live.

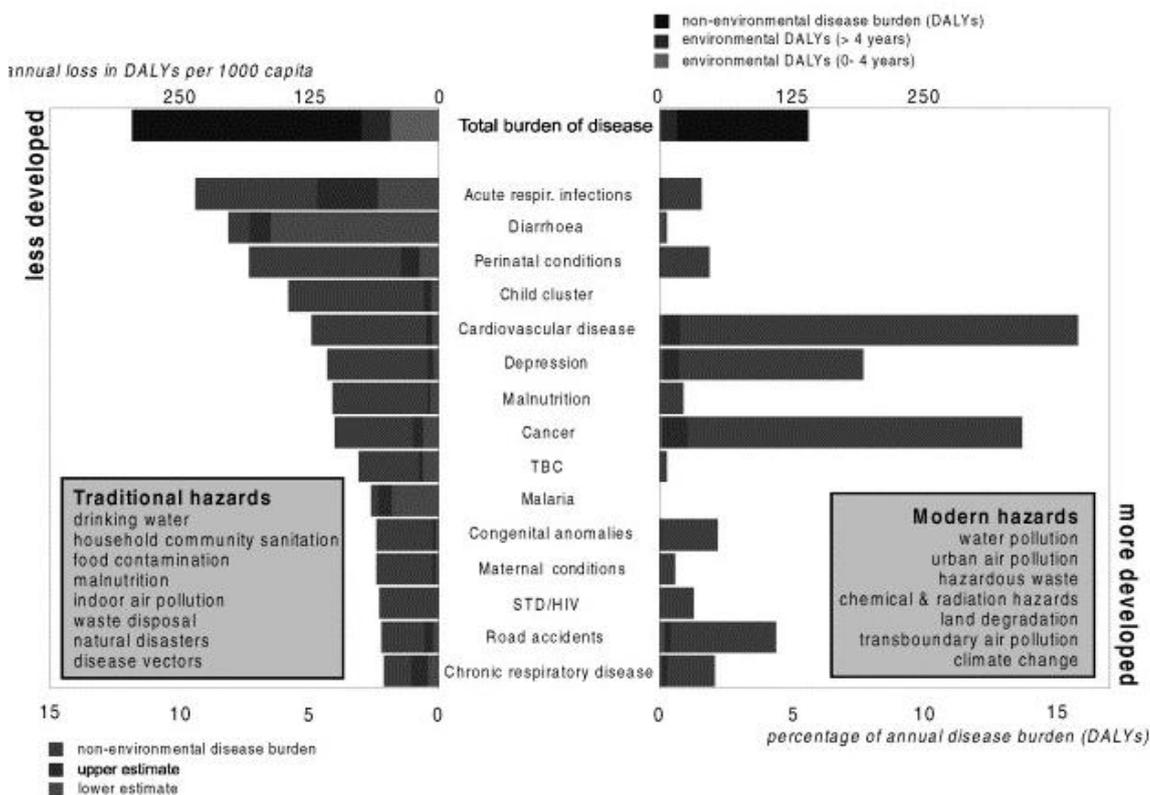
The term ‘neighbourhood’ is utilised in this thesis in a geographical sense to refer to any geographical location through which mothers access opportunities, structures and resources that shape lives and impact health (Lupton, 2003, Macintyre *et al.*, 2003). A neighbourhood has been defined as ‘the bundle of spatially-based attributes associated with clusters of residences, sometimes in conjunction with other land uses’ (Galster, 2001: 2112). From the perspective of Bernard *et al.* (2007:1839), a neighbourhood involves a geographically defined area and relational spaces where people have access to available and relevant health-resources and spend time. They identified five domains of a neighbourhood, ‘the physical, economic, institutional, local sociability, and community organisations which cut across neighbourhood environment through which residents may acquire resources that shape their life course and trajectory in health and social functioning.

A number of studies have highlighted the importance of neighbourhood factors, especially the physical environment in explaining variation in child health outcomes in many developing countries (Becher *et al.*, 2004, Kumar *et al.*, 2012, Mesike *et al.*, 2012, Qayum *et al.*, 2015). The increasing sophistication of Geographical Information Systems (GIS) has made it possible to account for spatial autocorrelation in health parameter and a number of biophysical and geographical variables. Environmental factors often cited in literature in relation to under-five mortality in the global south, the Sub-Saharan Africa, and Nigeria include rainfall, temperature, topography, availability of water resources, agricultural productivity and physical access to services through road infrastructure (Balk *et al.*, 2004, Chin *et al.*, 2011, Gayawan, 2014).

The study of Balk *et al.* (2004) found that coastal areas of West Africa with more favourable environmental factors have lower under-five mortality compared with areas further inland. However, the effects of environmental factors on health may be mediated through individual and household-level factors such as income, education, wealth levels and other factors (De Sherbinin, 2011). The Leading causes of mortality such as malaria, diarrhoea, measles, under-nutrition, acute respiratory diseases and infection are attributable to environmental factors (Adeyemi *et al.*, 2008, Lvovsky, 2001) with malaria topping the chart of infectious disease (Craddock, 2017). In 2001, the World Bank noted that environmental risk factors accounted for one-fifth of global burden of diseases resulting in 11 million avoidable child deaths yearly while in Adeyemi *et al.*, 2008, 26.5% of child deaths were attributed to environmental risk factors such as poor sanitation and hygiene, unsafe water and smoke from solid fuels.

There is evidence that more than one-third of the global disease burden among children is due to modifiable neighbourhood and maternal factors. These factors include safe drinking

water (Semba *et al.*, 2009), improved sanitation, and hygiene (Semba *et al.*, 2011), management of water resources (Atuanya *et al.*, 2018, Gbadegesin *et al.*, 2007), nutrition and food security (Campbell *et al.*, 2011, Campbell *et al.*, 2009, Campbell *et al.*, 2008), childhood vaccination (Hou *et al.*, 2014, Soura *et al.*, 2014) among other factors. Prüss-Üstün *et al.* (2016) in highlighting the role of healthy environments in intercepting the transmission pathways of communicable diseases points out that globally, the disease burden of environmentally-mediated diseases in developing countries such as malaria, measles, diarrhea and respiratory infections could be up to 45% higher than the burden of disease in developed countries (Figure 1). Most of these infectious disease burdens are commonly referred to as ‘diseases of poverty’ because they are strongly rooted in poor physical and socioeconomic living conditions of people and neighbourhoods that are characterized by lack of access to improved water sources, poor sanitation and hygiene, poor health services and associated factors (Binns *et al.*, 2012).



Environmental disease burden: more vs less developed world (source (De Hollander *et al.*, 2003).

Figure 1: Environmental disease burden

The tropical conditions, which increase the spread of disease pathogens, the rapid population explosion, derelict nature of public infrastructure, and poor health services in most developing countries, increase the health vulnerability of children in these neighbourhoods. Previous studies have highlighted the role of rapid population growth and the unplanned nature of many towns and cities in developing countries which have

generated many environmental problems that has resulted in significant health issues for those who are resident in these places especially children. (Binns *et al.*, 2012, Pelling *et al.*, 2012, Shaw *et al.*, 2009) For example, people in many Nigerian cities face a compounding health-risk from poor environmental conditions. Gandy (2006:372) in describing the environmental problems, which Lagos, the largest city in West Africa mirrors, notes that:

Over the past 20 years, the city has lost much of its street lighting, its dilapidated road system has become extremely congested, there are no longer regular refuse collections, violent crime has become a determining feature of everyday life and many staples of civic culture such as libraries and cinemas have largely disappeared. The city's sewage network is practically non-existent and two-third of childhood disease is attributable to inadequate access to safe drinking water. In heavy rains, over half of the city's dwellings suffer from routine flooding and a third of the household must contend with knee-deep water within their homes.

Although, the proportions of environmental problems indicated in the excerpt from (Gandy, 2006) is probably a slightly exaggerated account of key environmental issues in Lagos; exaggerated because there is evidence to suggest that ‘*a third of households actually contend with knee-deep water within their homes*’ in Lagos; it reflects *the* range of environmental problems that are common in many urban centres in Nigeria. Environmental indicators such as power supply and access to safe drinking water have gone worse. For example, not only have many cities in Nigeria lost lights on their streets but public power supply within dwellings have become practically non-existent with many households having to generate their own power using independent power generators which further creates inequalities between those who have the capabilities for alternative choices and those who don't. Of course, Gandy's description of Lagos was silent on the extreme inequalities in the city. The lack of attention to issues of inequalities comes across vividly with many grand reflections about places and social issues in the global south including Nigeria. Not all neighbourhoods in developing countries experience environmental problems exactly the same way. Inequalities exist in neighbourhood vulnerabilities. This is one area where this thesis makes a clear contribution. It strongly argues that socioeconomic inequalities, not just in health, are a subject for developing countries as much as it is for developed countries. The rest of the discussion presents evidence, which indicate the spatial and socioeconomic variability in the exposure of under-five children to health-risk.

It is important to note that there are academic debates on whether personal attributes of individuals (compositional factors) or the characteristics of the place itself (contextual factors) account more for health experience and variation (Bambra, 2016, Curtis, 2004). In Nigeria, there is an accumulating body of work on the relationship between place and child health. For example some quantitative studies that have examined the role of contextual

characteristics of places and compositional attributes of mothers on child health outcomes (Adedokun *et al.*, 2017, Adekanmbi *et al.*, 2015). Qualitative studies that have looked at the relationship between maternal and child health are rare within the Nigerian context (Okafor *et al.*, 2014b). In the western context, the works of Jennie Popay and Gareth Williams (Popay *et al.*, 2003a, Popay *et al.*, 2003b, Popay *et al.*, 1996, Popay *et al.*, 1998, Williams *et al.*, 1994, Williams, 2003, Williams *et al.*, 2013) are examples of qualitative approaches to understanding the relationship between structure, agency and health. They recognise that place effect on health needs more emphasis.

However, it is not the interest of this thesis to engage in the existing context-composition debates on health inequalities such as those of Adekanmbi *et al.* (2015) and Bhandari *et al.* (2017). This thesis emphasises the importance of recognising the pathways through which both the contextual attributes of places and the compositional characteristics of mothers combine to shape inequalities in under-five mortality. Macintyre *et al.* (2002) has suggested the need to move beyond the binary classification to examine the relational and collective aspects people living together on health. More recently, the concept of intersectionality has gained increasing emphasis in both quantitative and qualitative studies to advance debates on the need to understand how multiple determinants of inequalities combine and simultaneously impact health in explaining health differences among individuals and population groups (Bauer *et al.*, 2019, Hankivsky *et al.*, 2008, Kapilashrami *et al.*, 2018, Kelly, 2009, Weber *et al.*, 2003). Intersectionality theory is discussed later.

2.2.2 Social determinants of inequalities

Very little argument exists against the need to shift the assumptions of international development programmes such as the SDGs, governments, and public health policy makers alike away from a one-size-fits-all approach to addressing wider societal determinants, which may create health inequalities between population groups. Previous studies have demonstrated the need to shift attention from the aetiology of disease to more fundamental structures of power hierarchies, which determine the conditions in which inequalities occur (Herrick, 2017, Hankivsky *et al.*, 2017, Kapilashrami *et al.*, 2018, Kelly, 2009).

It is now widely recognised that health inequalities arise from the social determinants of health rather than through access to health services or medical care (Marmot, 2009a). The unequal distribution in the global burden of diseases and the leading causes of health inequalities that exist between and within geographical regions and social groups are predicated upon the circumstances in which people are born, grow, live and age (WHO, 2011). This indicates that a person's health is influenced by a range of factors: individual

factors that define who they are – age, sex, genetic factors; health behaviours such as smoking, alcohol, physical activity and diet; wider societal conditions in which people are born, grow, live and age such as social network, socioeconomic, cultural and environmental conditions and health systems. The social determinants of health models present strong evidence that geographical and socioeconomic context matters for health. The accumulation of both health risks and resources is shaped by both the physical and social environment in which we live.

Frameworks for understanding health inequalities have drawn on social and environmental risk and vulnerability of populations as possible determinants of persistent disparities. These frameworks are highly variable depending on academic disciplines, social, temporal and geographical context' (Curtis, 2004: 3). Of interest to this study are frameworks which employ the idea of health risk as being socially constructed (Pfeiffer *et al.*, 2013, Witherick, 2010). In this context, 'socioeconomic' factors have been emphasized in understanding health variation, a focus which emerged as a response to the limitations of individualistic theories of epidemiology in explaining causes illness (Kulkarni *et al.*, 2009).

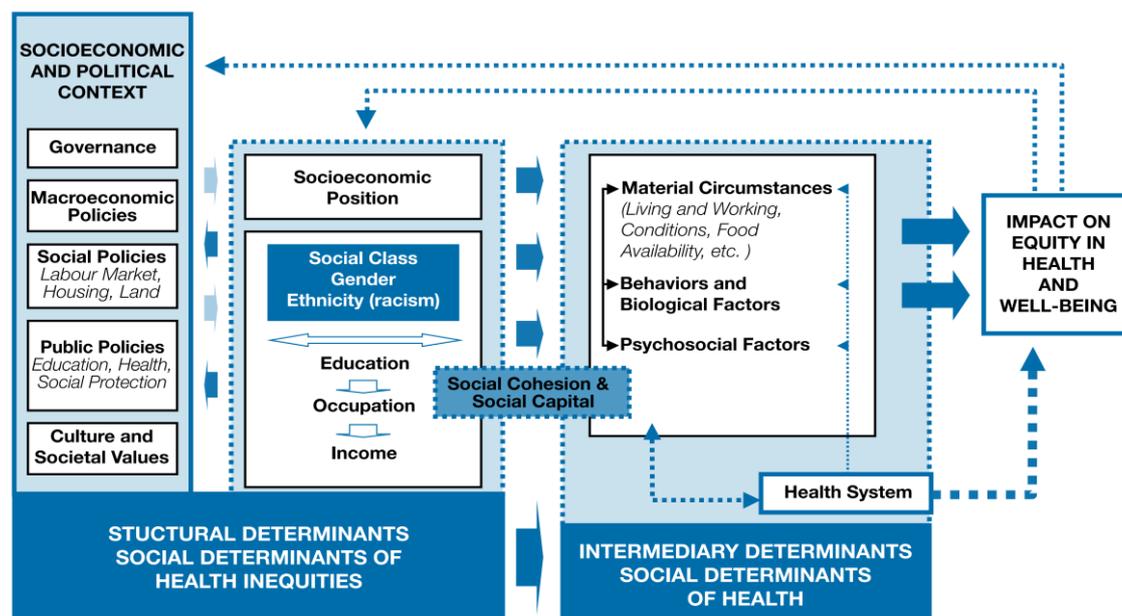
The argument here is that medical factors have limited influences on population health. Daily living conditions and varying levels of socioeconomic development are also critical in producing illness and health. For instance, there is no genetic explanation for the 48 years difference in life expectancy between Japan and Sierra Leone or 20 years difference observed between Australian ethnic groups (Marmot, 2005). Research has increasingly focused extensively on identifying genetic, socioeconomic and environmental pathways to the production of illness and wellbeing (Panter-Brick *et al.*, 2008). A widely referenced model of the different layers of contextual influences on health is the Dahlgren *et al.* (1991) 'social determinants of health model' otherwise known as 'rainbow of health model'.

As a response to the global challenges of widening health inequalities in many industrialised and developing countries, WHO launched the Commission on Social Determinants of Health (CSDH) in 2010 to review evidence and raise societal awareness on the urgency to identify and improve the health of 'world's most vulnerable' population groups through appropriate political action (Marmot, 2005:1099). The commission incorporated ideas from previous social models of health such as those of Dahlgren *et al.* (1991) and (Evans *et al.*, 2001) in framing health as socially constructed and therefore addressing health inequalities is a matter of social justice and a human right issue. The commission's work was influential in placing the need to eliminate all avoidable causes of

morbidity and mortality, especially for the most vulnerable populations at the heart of SDG3.

In the next two paragraphs below, I summarise Solar *et al.* (2010:5-7) description of the key components of the CSDH framework. The CSDH framework (shown in Figure 2) brings the factors that impact health together to demonstrate the role societal structures and power relations such as of social, economic, political and public health policies; in creating social stratification through assigning people to different social positions: income, education, gender, race, ethnicity, occupations and other factors; social positioning in turn engenders differential exposure to health damaging conditions and differential vulnerability which mirror people's place within social hierarchies of power as well as differential consequences illness between more and less privileged groups. Differential exposure, vulnerability, and consequences of illness for different groups can feedback to impact the optimal functioning of societal institutions.

The CSDH framework stands aside from the social models of health preceding it by framing health system as a social determinant of health and in recognising the role of health system in mediating the differential consequences of illness in people lives (Solar *et al.*, 2010). The CSDH framework broadly classifies the determinants of health into two: structural and intermediary determinants. Researchers like Graham (2004) has suggested the need for policy clarification of what they mean in their application to health inequalities. **Structural determinants** are those that generate social stratification and class divisions and assign individuals into socioeconomic positions and groups based on differential access to societal resources and power. These are referred to as the social determinants of health inequalities. They have been described as the means through which to understand and interpret 'the manifestation, reproduction and intensification of the social, economic and social inequalities' (Cunningham, 2017:1) Indicators of structural stratifiers include ethnicity/race, education, occupation, income, gender and social class. **Intermediary determinants** are the pathways through which the societal stratifiers impact health. Intermediary determinants include material factors (income, quality of physical environment, consumption potential), psychosocial (stressful living conditions and access to social support), and behavioural and biological factors (nutrition, physical activity, social habits and hereditary/genetic factors).



A final form of the Commission for Social Determinants of Health Framework (Solar et al., 2010:41)

Figure.2: CSDH framework

The social determinants of health as summarised in the model *'have been most influential in outlining the concept of social gradient'* (Kulkarni et al., 2009: 381). For as long as researchers have cared to look, health outcomes follow the socioeconomic gradient of the population (Adams et al., 1997, Lahelma, 2001, McDade, 2008, Townsend, 1979) and poor health are linked to poor living conditions and deprivation (Cummins et al., 2005, Petersen et al., 2011, Pickett et al., 2001). According to Friedli (2009: 13) *'The gradient effect that occurs for almost all outcomes in almost all places speaks to the critical nature of the distribution of socioeconomic resources'*. The inverse relationship between socioeconomic position and a variety of health outcomes throughout the life course is shown to be so consistent that it is termed the *'gradient effect'* (Irwin et al., 2007).

The gradient effect of geographical resources remains the most powerful explanation for differences in health and wellbeing across areas. Socioeconomic position is a key determinant of health inequalities. The concept of socioeconomic position is often utilised in an aggregate sense to refer to *'resource-based and prestige-based measures'* (Krieger, 2002:697) such as access to economic and material resources including objective and self-reported socioeconomic levels, and educational attainment. Examining health inequalities with respect to socioeconomic indicators is important for highlighting the fact that inequalities in under-five mortality are the direct causes and consequences of unequal distribution and access to power and resources among groups in society (Wistow et al., 2011), especially women. Altering inequalities in health requires a comprehensive understanding of the social context of women's lives and the multiple ways in which

economic, social, and political power combine to create differences in health experiences for groups and individuals.

The ‘neighbourhood context’ discussed in section 2.2.2 is a concept that summarises the idea of the social determinants of health. The geographical and social character of places in which people live is strongly emphasised as influencing health status. Neighbourhood spaces in geographical terms reflect how social factors and environmental health-risks combine in different ways to produce different spatial patterns of health in different places (Curtis, 2004). This thesis therefore utilises the concepts of social determinant of health to highlight both macro level and intermediary factors and pathways in the social production of under-five mortality and to make the important point that addressing the excess burden of under-five mortality, especially amongst the most vulnerable groups in Nigeria is a priority for attaining SDG targets (Graham, 2004, Krieger, 2002). See (Bartley, 2017) for writing up measures of social position.

Social position is a key structural stratifier and a major factor in health inequalities, and it seats at the heart of the CSDH framework. According to Bartley (2017), there are two common ways of representing social position: social class (groups of occupation) and social status (associated with an individual’s family background in terms of ethnicity, race, religion and independent of their occupation). The thesis utilises the concept of socioeconomic position and in an aggregate sense to refer to ‘*resource-based and prestige-based measures*’ which assign mothers into different social hierarchies in society (Krieger, 2002:697) such as access to economic and material resources including objective and self-reported wealth levels, and educational credentials of mothers, ethnic identities and religious affiliations. Socioeconomic inequalities in health are a direct cause and consequence of unequal distribution and access to power and resources among groups in society (Wistow *et al.*, 2011). Examining health inequalities with respect to socioeconomic indicators is important in this study for highlighting potential geographical and social inequalities in under-five mortality.

The social determinant of health framework is not without criticisms. There are potential difficulties in applying the model to health inequalities. Graham (2004:109) noted that attempts at using the model to explain health inequalities have resulted in the blurring of the boundaries between ‘*the social factors that influence health and social processes that determine their unequal distribution*’. This limitation can misinform policy makers to assume that health inequalities can be addressed by focusing on structural determinants of health and policy makers need to know that it is possible to improve the social

determinants of health without reducing health inequalities between individuals and within groups, if the factors that determine unequal distribution between more and less advantaged groups are not simultaneously addressed. The framework has also been critiqued for its inability to capture the complexity and intersections of causal explanations in health inequalities. Notwithstanding these limitations, this framework has offered important insights for framing this thesis by conceptualising health as a socially constructed phenomenon and a matter of social justice. It strongly signals the need for research and policy sensitivity to the differential exposures and vulnerabilities to health damaging factors between less and more advantage groups that play crucial roles in the unequal distribution of health (Graham, 2004). The framework has been influential in adopting multilevel perspectives and the attempts at understanding the relationships between social determinants of under-five mortality.

2.2.3 Intersectionality of health determinants

In the past 30 years and as a widely used interdisciplinary approach, 'Intersectionality refers to both a normative theoretical argument and an approach to conducting empirical research that emphasizes the interaction of categories of difference (including but not limited to race/ethnicity, gender, class). Much of what researchers have conceptualised as the theory of intersectionality owes its origin to the work of the African-American Feminist legal scholar Kimberle Crenshaw. The classic work (Crenshaw, 1989), which was a critique to the simplistic way in which gender and race are treated as mutually exclusive categories of experience and analysis, argued for the need to understand the complex spaces in which multiple marginalisations, for example of being an African-American and a woman may occur. Such marginalisations could not be understood by approaches, which employ a single-axis framework by treating gender and race as separate dimensions of investigation. Although originally developed as a response to feminist ideals that were essentially white and middle class, (Bauer, 2014) notes that the theory of intersectionality has the potential to advance debates in health inequalities research not only on sex and gender and race and ethnicity, but for a more comprehensive understanding the multiplicities of influence of different layers of socioeconomic and regional domains on health inequalities.

In designing this study and in the selection of methods, the comprehensive lenses of intersectionality theory offered a conceptual space for understanding the multiple ways through which the social determinants of health inequalities simultaneously interact in creating individual experiences of health inequalities. It is utilised an overarching concepts for providing a more meaningful explanation of the complex geographical and socioeconomic contexts in which under-five mortality may occur in Nigeria.

The potential of intersectionality theory for understanding health inequalities due to differently co-constituted social determinants of health and determinants of inequalities for individuals and neighbourhoods is increasingly being recognised (Bauer, 2014, Hankivsky *et al.*, 2008, Hankivsky *et al.*, 2017, Kapilashrami *et al.*, 2018, Kelly, 2009, Nygren *et al.*, 2014). The theory has been describes as holding a unique potential for health inequalities research ‘*in providing more precise identification of the complex nature of social determinants of health, in developing intervention strategies and ensuring that development programmes are relevant to unique communities*’ (Bauer, 2014: 11). While intersectionality thinking and related paradigms underlie many health research and policy discourses in Canada, United Kingdom and United States, the developmental potential of such approaches remain largely unaddressed in explaining the social determinants of health (Hankivsky *et al.*, 2008) and for designing health intervention strategies especially in the global south.

The discipline of epidemiology and allied quantitative approaches, which hold most of the influence in national and global public health polices tend to biomedical and social determinants of health as separate categories in research and policy practice. Attempts to expand research beyond such unitary approaches to capture the interaction between multiple determinants of health such as gender, race/ethnicity, social class are made using additive approaches where social categories of difference are treated as static or parallel categories whose relationships are predetermined (Hancock, 2007). In her guiding principle summarised in Table 1, Hancock (2007:64) stated that the intersectionality research demands that more than one category must be examined, that ‘*categories matter equally and that the relationships between categories is an open empirical question*’.

Table 1: Intersectionality principles

	Unitary Approach	Multiple Approach	Intersectional Approach
Q1: How many categories are addressed?	One	More than one	More than one
Q2: What is the relationship posited between categories?	Category examined is primary	Categories matter equally in a predetermined relationship to each other	Categories matter equally; the relationship between categories is an open empirical question
Q3: How are categories conceptualized?	Static at the individual or institutional level	Static at the individual or institutional level	Dynamic interaction between individual and institutional factors
Q4: What is the presumed makeup of each category?	Uniform	Uniform	Diverse; members often differ in politically significant ways
Q5: What levels of analysis are considered feasible in a single analysis?	Individual <i>or</i> institutional	Individual <i>and</i> institutional	Individual <i>integrated</i> with institutional
Q6: What is the methodological conventional wisdom?	Empirical or Theoretical; Single method preferred; multiple method possible	Empirical or Theoretical; Single method sufficient; multiple method desirable	Empirical and Theoretical; Multiple method necessary and sufficient

Conceptual approaches to the study of categories of difference (Hancock, 2007: 64)

The principle of Unitary and multiple approaches fail to consider the unique intersections and the complexities between categories and intersectional positions underlying given sets of health determinants (Bauer, 2014). Whilst the knowledge of specific biological or social determinants of health is important, it often fails to provide practical evidence base for targeting intervention strategies and solutions, for example through policy to address overall population level determinants or at a local level within the specificities of geographical and socioeconomic contexts of high risk communities.

2.2.4 Power, female agency and health inequalities

At the heart of the commission for social determinants of health framework and the theory of intersectionality is the issue of power and discrimination, especially in relation to women agency. In terms of inequalities in mortality among children aged under five years, this thesis utilises a combination of the social determinants of health and intersectionality frameworks and the multilevel power analysis of geography for understanding the combined implications the potential drivers of inequalities and structures of discrimination against women on child morbidity and mortality.

It is now widely acknowledged that there is a close connection between women's access to societal resources and levels of discrimination against their agency in bringing about change in child health inequalities. There is considerable evidence of excess child mortality for disempowered women compared to the more empowered (Monden *et al.*, 2012, Titilayo *et al.*, 2017, UNICEF, 2015a). These inequalities result from the differential exposures and vulnerabilities to health damaging factors play important role in the poor health of the poor. Sen (1999:195) has long since argued that the role of women agency is particularly important for reducing under-five mortality because of '*the importance that mothers typically attach to the welfare of their children*' in addition to the opportunities that mothers have for making informed child health decisions '*when their agency is respected and empowered*'. He went on to suggest that countries with higher gender inequalities and female disadvantage engendered through cultural and institutional discrimination tend to have higher maternal and child mortality.

Krieger (2002:293) pooled definitions together to offer a profound description of discrimination: '*Discrimination refers to the process by which a member, or members, of a socially defined group is, or are treated differently (especially unfairly) because of his/her/their membership of that group. This unfair treatment arise from socially derived*

beliefs each (group) hold about the other and the patterns of dominance and oppression, viewed as expression of a struggle for power and privilege'. Predominant forms of disempowering discrimination, especially in relation to access to societal resources and power, in many developing countries are based on gender, race/ethnicity, age, religion, and social class. Rowlands (1995:104) has therefore argued in support of the need for development programmes to prioritise empowerment of women and states: *'Poor or otherwise, marginalised women do not experience similar problems in developing countries. In both cases, their lack of access to resources and to formal power is significant, even if the contexts within which that lack is experienced are very different. Any difference is more likely to show up in the way in which it is put into practice and in the particular activities that are called for*'. Thompson (2007) has observed that the disempowering effect of gender inequalities and the underlying complexities are often underestimated and Krieger (2002) suggest that it is important for the health consequences of different domains and types of discrimination against individuals and social groups, especially female agency to be incorporated into research and policy frameworks. Discrimination is theorised to

The notion of women agency is often neglected in health research. This study extends the theoretical, conceptual and empirical boundaries of health inequalities research, especially in the Nigerian context. It represents a novel attempt at drawing out the role of mothers as active agents in shaping the conditions that shape unequal health outcomes for children less than 5 years old. Whilst demonstrating the need to address structures of discrimination against female agency to be addressed, this study also pushes against the idea of portraying women as mere powerless victims by moving beyond conventional conceptions of power which equate female agency with discrimination to explore creative aspects of female power (Solar *et al.*, 2010) based on the individual and collective efficacy of women to address health-risk conditions in their local context. It explores the lay explanations of illness put forward by mothers to understand further, the social processes underlying the social determinants of health and the causes of unequal distribution of child health-risk at different levels through lay narratives. This is important for demonstrating the need for social action targeted at reducing under-five mortality rates to sustainable levels to give more recognition and engage with the agency of disadvantage communities. This study does not aim to examine structures of women empowerment or discrimination explicitly, the social the social determinants of health and intersectionality frameworks are well suited for capturing the multiple aspects of health inequalities between and within population groups in both quantitative and qualitative sense.

2.2.5 Lay knowledge, perception, and narratives of mothers

This study employs social constructivism in order to understand the lay perception of the causes of health-risk and the range of adaptation strategies deployed by mothers to avoid risk, treat illness and maintain good health. By seeking to understand mothers articulation of health-risk and responses through lay narratives, this study demonstrates the empirical application of linking agency and place in understanding health inequalities. Popay *et al.* (1998:636) have suggested that paying attention to the notion of ‘lay knowledge in narrative form’, in terms of the meanings people attach to their experiences of places and how this shapes social action, could provide important insights into the dynamic relationships between female agency and wider social structures that underpin inequalities in health (Cummins *et al.*, 2007, Cummins *et al.*, 2005b, Garthwaite *et al.*, 2017). I argue that that incorporating the discourses, narratives and subjective conceptualizations of child health risk by mothers play important roles in complementing quantitative accounts of health inequalities. Such integrated perspectives are very revealing of how the social determinants of health may intersect, highlighting individual health concerns and relative vulnerability to morbidity and mortality and shaping public health policy (Herring, 2009, Panter-Brick *et al.*, 2009).

Social science research on health risk perception is conceptually and methodologically diverse but there is research agreement for the need to acknowledge sociocultural perspectives. These approaches, which are particularly associated with anthropology, geography and sociology, argue for the need to situate the perception of, and responses to health-risk within the context of a range of a social, cultural and political processes in which the everyday life of vulnerable populations is embedded (Bickerstaff, 2004). Perception of child health-risk is used in this thesis to refer to and explore mothers’ lay perspective is employed in this study in line with Popay *et al.* (1998) to refer to non-professional, in this case; mothers perceptions, views, and experiences of what constitute the determinants of under-five mortality at the individual level. Understanding how risk is perceived and responses chosen based on the understandings of risk is crucial to any risk reduction strategy (Eiser *et al.*, 2012) including the SDG goal 3 sub-target of ending all preventable under-five mortality by the year 2030.

The demand for reconfiguring health policy landscapes through greater local voice and local accountability, although predominantly in high income countries, the fundamental principal intersects with existing debates over the typical approaches of development interventions in the global south (Gough *et al.*, 2007) which are often ‘rhetorical’ and ‘shallow’ (Mercer *et al.*, 2003:421) and incomprehensive in postcolonial Africa. The

increasing call for giving a voice to local people as active agents in shaping the circumstances that affect their health suggests the need to address spatial scaling issues in determining the appropriate intervention targets.

In designing this study, I incorporated lay narratives as a way of understanding the multiple axes and co-constitution of inequalities in the exposures and vulnerability of child health. By asking mothers of under-five children to reflect of what health-risks means to them; how they respond individually and collectively, to the causes and consequences of health-risk factors, this study has attempted to give visibility to the notion of female agency in health inequalities. The sensitivity to the active agency of women, especially in developing countries are rare in health inequalities research.

Krieger (2002) has suggested that such explicit attentions to aetiological perspectives are important in the study of health inequalities in order to understand the diverse explanations of the causes of inequalities. Interpretations of health-risk in research and social policy need to be sensitive to lay understandings of health-risk. Lay people do not measure risks in terms of biomedical definition of risk probabilities or simple economic standards but in terms of how well the health-risk is understood and the social and geographical context in which health-risk is embedded (Curtis, 2004). The idea of 'risk society' (Beck, 1992) implies that risk perception is predicated upon knowledge about risk and experiences of risk. This is to say that risk is a sociological construct and risk perception and the way it is articulated in narrative forms are useful for understanding the role of social processes which underlie health risks (Bickerstaff, 2004).

At a technical level, risk refers to the probability of a known event occurring. Such probabilities assume that the determinants and consequences of risk can be identified, mapped and predicted (Gregory *et al.*, 2011). Such rationalist definitions, a characteristic of post modernity assumes controllability of risks devoid of uncertainties and indeterminacy. However, the complex nature of our environment limits our ability to calculate risk holistically hence the more qualitative sense of risk where risks takes a meaning more akin with uncontrollability and fluidity of threats. Risk perceptions are linked with how understanding of what constitutes vulnerability and risk are constructed and the way interventions might engage with populations at risk (Adam *et al.*, 2000).

2.2.6 Social capital resources and health inequalities

The association between social capital and health have been increasingly recognised since Durkheim *et al.* (1952) demonstrated links between suicide and levels of societal integration.

Since then several studies have demonstrated mixed findings in examining social capital as a health determinant in international research.

With an increasing recognition of the need to account for the role of social capital as a health determinant in population health (Kawachi *et al.*, 1997), the concept of social capital has become increasingly important in international health research (Harpham *et al.*, 2002). Social capital is an influential but fluid concept, which makes a single definition difficult. The complexity and diverse aspects of social capital is well illustrated by Halpern (2005). These include relationships with; family and friends; the neighbourhoods and communities people live in; workplace relationships of people in the course of daily economic activities, membership of community groups ranging from religious, cultural, savings schemes to professional bodies, leisure time and activities with people of similar interest; and membership of political parties and pressure groups. These everyday social networks and the social values and norms upon which they are formed and sustained and their contribution towards the normal functioning of society is what is often referred to in literature as social capital (Coleman, 1988, Halpern, 2005, Putnam, 1995).

Social capital is linked with health inequalities. Previous studies have shown that populations with greater access to social capital resources tend to have better health (Curtis *et al.*, 2010). Neighbourhood social capital organisations offer the social space for enhancing self-efficacy and collective mobilisation of community resources for health. It is in this sense that social capital is often regarded as a health asset (Kawachi, 2010, Kawachi *et al.*, 2003, Kawachi *et al.*, 1997). Levels of access to social capital are not the same for individuals, households and communities. Differential access to social capital resources can be a mediator for health inequalities (Wilkinson, 1997, Wilkinson, 1999, Wilkinson *et al.*, 2006).

In this research, the concept is used in Putnam (1995) sense to refer more broadly to features of the everyday social life of mothers that can improve the efficiency of society in terms of interpersonal relationships, social engagements, networks, shared norms, values and trust etc. which enable creative, collective and coordinated actions by mothers in pursuit mutual child health benefits. The central thesis of social capital is summed up in two words by John (2003:1): '*relationships matter*' for health.

This thesis recognises that the research participants in this study like most people are embedded in a series of social relationships and associations, which are believed to be relevant for enhancing and sustaining the overall well-being of children aged under 5 years. In addition, evidence suggests that there could be an underlying socioeconomic and power

structure to the common forms of community organisations in Nigeria (Lucas, 2001). It is therefore important for this study to explore the lay narratives of mothers in relation to their perception of the physical environment of the neighbourhoods in which they live; feelings of safety; interpersonal relationships; and degrees of engagement in community organisations, in order to examine the role of access to social capital resources in child health and overall wellbeing.

2.3 Conclusion

This chapter has outlined the key concepts utilised in theorising the social determinants of health. It discusses the idea of place vulnerability in relation to under-five mortality to emphasise the role of place in shaping health experiences. Place is also referred to as the neighbourhood it is theorised as encompassing both physical and social processes, which combine in multiple ways and simultaneously in shaping the child health-risk experiences of differently situated mothers. The thesis pooled a mix of theoretical strands and frameworks – social determinants of health, intersectionality theory, lay knowledge, risk perception, and social capital - from the disciplines of geography, biomedicine, epidemiology, statistic and other socialising disciplines; to make the important point that health geography holds a unique potential for providing the breadth and depth of evidence required for addressing health inequalities and achieving SDG targets (Herrick, 2014, Herrick, 2016).

The overarching argument in these theories is that there is a need *to interrogate spatial and socioeconomic heterogeneities as co-constituted dimensions of health by ‘fully incorporating the root causes inequalities, including the complex ways in which the determinants of health relate, intersect and mutually reinforce one another’* (Hankivsky et al., 2008:271). My research argues that incorporating the neglected notion of female agency and lay knowledge with conventional quantitative methods can broaden research perspectives on the social production of health, ways of addressing the systemic inequalities in society. This study therefore questions the status quo and raises interesting and important questions about the multiple systems of inequalities: interpersonal, institutional, and environmental, through multiple scales of analysis.

A combination of these frameworks influenced the selection of specific methods and analytical tools that privilege the interrogation of the interrelationships between place and social attributes of mothers in explaining inequalities in under-five mortality. The range of qualitative and quantitative methods utilised and the rationale informing their selection are presented in Chapter 3.

CHAPTER 3

Methodological Approach

3.0 Introduction

This chapter presents the overall steps undertaken in order to actualise the research objectives. Broadly speaking, this research is centred on two main objectives. First, it investigates how the variation in under-five mortality relates to socioeconomic and environmental indicators, at multiple scales and using quantitative methods. The second objective seeks to understand the multiple ways in which the determinants of under-five mortality are co-constituted in producing the relative inequalities in different segments of the population from mothers' lay narratives of child health risk. The logic of the mix of methods utilised in this thesis is to combine the strengths of quantitative methodologies in the study of the social determinants of health with the potential complementary value of qualitative methods in allowing health researchers to be critical yet providing deep understandings of the social determinants of health.

This chapter is laid out in three sections. **Part one** presents information at the national level of analysis with secondary data. This section first discusses the nature of NDHS datasets and their sources. It then presents the quantitative steps undertaken in identifying the geographical and social determinants of inequalities in under-five mortality rates at across Nigeria with global statistical methods. Given the inability of global models to predict spatially varying relationships, GIS-based Geographically Weighted Regression (GWR) and Getis-Ord-Gi* statistics were used to examine and map the spatial patterns of under-five mortality across Nigeria. Health inequalities were examined in relation to key population indicators such as ethnicity, political regions, settlement size, religion and wealth-levels.

Part two focuses on the fieldwork design. It first describes the rationale for selecting case study communities. It then presents the analytical steps undertaken in analysing the primary questionnaire and semi-structured interview datasets. The central analytical objectives of this second phase were to: examine relative inequalities in under-five mortality at a finer geographical scale; and to explore lay narratives of mothers in order to understand the perception of health-risk factors and the capability of mothers to choose informed adaptation strategies both individually and collectively.

Part three discusses the key ethical considerations made in the implementation of the field research project. Lastly, I reflect on my own positionality as a new mother researching mortality among children aged under five. I demonstrated that the researcher's identity has implications for researcher-researched relationships and encounters during fieldwork involving questionnaire survey and one-off interview and these observations are worth documenting.

3.1 Research evolution

My PhD research was originally designed to investigate the resilience factors in an area within Nigeria where health was better than the rest of the country. This was to address the need for understanding the concept of health resilience within the Nigerian context in particular and developing countries in general. The initial title of my research was 'strong in broken places: a geographical analysis of health-risk and resilience in Nigeria'. The early stages of the research project involved the analysis of secondary datasets on under-five mortality in order to identify resilient areas in Nigeria. Health resilience was defined in relation to socioeconomic deprivation. Poor areas exhibiting significantly higher than expected concentrations of low levels of under-five mortality rate (cold spots) given their levels of deprivation were labelled 'resilient' in line with Cairns (2013).

My plan was to explore further, the geographical and social resources that might shed light on understanding the relative health achievement or 'resilience factors' in those areas through finer scale quantitative and qualitative data collection and analytical procedures. However, as I explored the secondary datasets during the early stages of the research, I was struck by the high levels of under-five mortality rate and inequalities in Nigeria. I was particularly drawn towards understanding the wide health gaps I observed between geographical areas and social groups. The need to reorient my research focus became clearer to me after I started the 5-month fieldwork in January 2017 in chosen cold spots communities in the South-South region of Nigeria. I found that there were marked small area inequalities in health, which the secondary data at a larger scale had failed to uncover. In addition, women were more inclined towards discussing the health-risk factors within the neighbourhoods in which they live and what they did to address these challenges rather than talking about 'what makes them strong in vulnerable places'.

Economically and politically, Nigeria was in a bad state at the time of my fieldwork. Following the global recession in the crude oil market, which is the main stay of the Nigerian economy, exchange rates had changed dramatically and the Nigerian Naira had weakened significantly against the USA dollar and the British Pound Sterling. Being a

country with high dependence on the importation of goods and services, the prices of many products including food had tripled and unemployment rates doubled. There was a general sense of economic hardship, physical insecurity and risk that was reflected in the narratives of many research participants. I became interested in understanding the determinants of health inequalities between and within population groups, and the ways in which mothers perceived and responded to health-risk. I was also interested in exploring the differences in health experiences between urban and rural areas.

3.1.1 Research design: a mixed-methods approach

In order to critically address the research objectives presented in chapter 1, a mixed-method approach was adopted to understand the interrelationships between the social determinants of health and the neighbourhood living conditions in creating differential exposures and vulnerabilities to both the causes and consequences of socioeconomic inequalities. The empirical investigation was conducted in three phases. First, a mix of global statistical methods (bivariate correlations, Exploratory Factor Analysis - EFA, One-Way ANOVA, linear, and logistic regression methods) were applied to the pooled Nigeria Demographic and Health Survey cluster-level datasets for the period 2003-2013 in order to identify the main health-risk domains and to predict under-five mortality. Logistic regression and GIS-based spatial methods (Geographically Weighted Regression (GWR) and Getis-Ord-Gi* statistics) were used to examine and map spatially varying relationships and hot spots of under-five mortality across multiple geographical scales. The last analytical phase employed the power analysis of intersectionality theory to examine the lay knowledge and perception of health-risk factors and adaptation strategies through lay narratives in order to provide critical insights into the geosocial context in which perceptions of health-risks are constructed and informed responses are chosen. This is in line with previous studies in health geography, such as those of Cairns *et al.* (2012) and Mitchell *et al.* (2009) in both data collection, and analysis strategy. Mason's statement points out the rationale for mixing-methods in social science research when she states:

‘We need a methodology and methods that open our perspective to the multidimensionality of lived experiences’ (Mason, 2006:11).

A quantitative methodology using surveys and related instruments is important for identifying the most prevalent determinants of health across the population but limited for providing deep insights into individual experiences of health inequalities. Typically, survey-based research and associated policy practice tend to emphasise ‘what’ rather than ‘why’ and ‘how’ type of questions. For example, the Nigeria Demographic and Health Surveys (NDHS), explores issues around the impact of women socioeconomic and health attributes

on child health. Where, in terms of what type of health facilities, do women go to deliver their babies or to seek antenatal care? Do children sleep under mosquito bed nets at night or not, what types of diseases are prevalent, and what are the vaccination and nutrition statuses of children? However, these surveys and the other themes captured in the DHS do not address the reasons behind human health behaviour that is, why and how people make the choices they make. For example, why do people choose not to sleep under mosquito nets despite the prevalence of mosquitoes and high risk of malaria? Moreover, the NDHS survey does not collect sufficient information on certain indicators that are important for understanding health inequalities. For example, questions on social capital indicators that could be relevant to understanding the determinants of health variation considering the communal nature of most Nigerian societies are very limited. The primary data questionnaire and interviews were therefore designed to overcome some of the short comings in the NDHS data. The primary data incorporated questions that are similar to NDHS-type survey questions in addition to other questions that are absent from the NDHS such as access to social, capital resources, alternative malaria control measures and subjective measures of social status and health. By doing this, the research employs critical perspectives to provide a more holistic account of health inequalities in a way that accommodates marginal voices and recognises the importance of lay perspectives in understanding the social determinants of health.

A key underlying argument throughout this research, is that knowledge production and representation in health geography research can benefit from questioning the dominance of biomedical perspectives in global health research that has produced lingering subjectivities in designing global health development strategies (Hankivsky *et al.*, 2017). Incorporating qualitative methods is, therefore, of great complementary value in addressing some of the short comings of quantitative methods. Statistical procedures do not contextualize human behaviour and experiences. I consider it problematic that policy makers in Nigeria mainly tend to depend on quantitative evidence for policy actions aimed at reducing child risks, especially in culturally diverse social spaces. The point here is that incomplete information will always produce ineffective policies. There is a need to understand the complex ways in which the social determinants of health operate together to create inequalities in under-five health experience. Health geography research needs to adopt a methodological approach that integrates the strengths of both paradigms. Assessing the social determinants of health from a single perspective will impoverish our understanding and may lead to development policies which may fall short of ending all preventable under-five deaths by the year 2030. There is therefore a need to move beyond what Herrick (2016:683) describes as the '*biomedical confines of diagnosis, disease, and treatment to think about health metonymical*

terms: as representing both cause and consequence multiple, entwined social, economic, political and cultural issues'. Utilising the lenses of intersectionality aided the framing and understanding biosocial entwinements underlying inequalities in under-five mortality in Nigeria. This thesis therefore makes a rare contribution to health geography research in adopting both conventional and spatial quantitative approaches in order to provide an overview of the social determinants of health and patterns of inequalities in the last development decade (the MDG era). In addition, advances research understanding of the processes shaping health inequalities through the lay narratives of mothers, examined in a qualitative sense.

3.2 Part one: national-level quantitative analysis of secondary data

This section describes the quantitative data sources and the rationale for the broad methodological steps undertaken in this research. It presents the analytical objectives of the methods utilised and how these relate to the research questions. The statistical and GIS-based procedures are first outlined before delving into the quantitative evidence presented in the three empirical chapters

3.2.1 Quantitative secondary datasets and sources

3.2.1.1 Datasets

The main secondary data sources for this study are the consecutive 2003, 2008 and 2013 Nigerian Demographic and Health Surveys (NDHS) birth records. The year 2003 is the first year for which the NDHS data is published and 2013 is the last year in this millennium for which DHS data is published for Nigeria. The NDHS data is published every 5 years. It limits the temporary scope of information collected to the five years preceding each survey year. All three surveys were pooled together to provide an overview of contextual determinants of under-five mortality in Nigeria in a decade within the Millennium Development Goal (MDG) era. The NDHS is a nationally representative survey collected by face-to-face interviews from women of reproductive age between 15 and 49 years. The birth record data contains demographic and reproductive health information for children and their mothers for the period of survey.

3.2.1.2 Sources

The NDHS is facilitated by the United State Agency for International Development (USAID) in collaboration with National Population Commission (NPC) in Nigeria. DHS survey information and boundary datasets for regions Nigeria were obtained from the spatial data repository (ICF International, 2003 – 2013). The sub-national boundary information and

2006 population census figures for Local Government Areas (LGAs) in Nigeria utilised for mapping were obtained from the National Population Census, Nigeria. The administrative political boundaries are mainly used to provide administrative context for the cluster points and not utilised for spatial analysis. The administrative units are considered too large for the type of research questions examined. The NDHS data is a publicly available dataset. All surveys for participating developing countries are accessible at: http://www.dhsprogram.com/data/dataset_admin/download-datasets.cfm. The application procedures and conditions for accessing the data were met before I was granted access to the datasets.

3.2.1.3 Geo-Location

The geographical indicator in the NDHS data that allowed the spatial analysis of under-five mortality to be conducted are the geo-located survey positions referred to as clusters. The collection of GPS locations in most DHS surveys in developing countries has become fairly a standard practice since the year 2000. However, to protect the confidentiality of respondents, exact GPS readings are not published for each respondent or household. Rather, the average for all the GPS reading is calculated from the individual GPS locations of the 50 households. The average location value represents the GPS centroid. A GPS centroid is an estimated longitude and latitude location based on the average locations of the research participants. This centroid value is then assigned to the entire household with the cluster to protect the confidentiality of the actual location of individual households. The DHS clusters are randomly displaced as an additional step to ensure participant's confidentiality so that they cannot be identified. The distortions are managed to ensure that the new locations fall under original administrative state boundaries of research participants since the data is designed for state-level analysis. For a more detailed information of the displacement procedure for DHS cluster points, see (Perez-Heydrich *et al.*, 2013). The set parameters for displacement relocate the longitude and latitude of the cluster to a new position in a random direction between 0 and 360 degrees. The relocation distance is usually an average distance of 0-2 kilometres for urban locations and 0-5 kilometres for rural locations, with 1% or every 100th point displaced up to 10 kilometres.

The GPS sample clusters are not maintained across survey years hence making it impossible to compare clusters and households directly across survey years worthy of note at this point. However, it is possible to map and compare cluster values of selected themes on the basis of spatial contiguity across survey years since cluster points are derived using similar sample frames. This is how the wealth index and under-five mortality indicators have been compared in the 2003, 2008 and 2013 DHS surveys for Nigeria. This type of spatial

comparison allows the identification of general trends and patterns of health achievement relative to household wealth from different DHS datasets.

3.2.1.4 NDHS sample design

Surveys were based on an independent, multistage random sampling design. Sample sizes for all three surveys in the pooled sample contained 247, 232 birth records (2003, n = 23038, 2008, n = 104,808, 2013, n = 119,386) assigned to 2,144 NDHS clusters. The birth records included in the NDHS survey are limited to 5 years before each survey year. This is to ensure accurate estimation of household living conditions at the time of the survey and to limit the ages of the children included in the survey to under five years – 0-59 months (Table 2).

Table 2: Sample design
NDHS sample designs for birth recode data for Nigeria (author's compilation)

Geopolitical Regions	Number of Clusters (Respondents)						Regional Total
	2003		2008		2013		
North	56 (3753)		165 (18631)		165 (16143)		383 (38527) – 17.9%
Central	57 (5484)		140 (23995)		158 (24180)		331 (53659) – 15.4%
North East	76 (6600)		174 (29338)		164 (38757)		432 (60118) – 20.1%
North West	55 (2553)		117 (9292)		118 (11219)		1146 (152304)- 53.5%
South East	56 (2340)		141 (12006)		140 (14857)		289 (23064) – 13.5%
South South	65 (2308)		151 (11546)		159 (14230)		334 (29203) – 15.6%
South West							375 (28084) – 17.5%
South							998 (80351) – 46.5%
National Total	362		886		896		2144
	Urban	Rural	Urban	Rural	Urban	Rural	
	165 (8321)	200 (14717)	286 (26574)	602 (78234)	372 (38786)	532 (80600)	
Mean Households per cluster	50		48		45		

As described in the (NPC-ICF, 2014:7), the NDHS adopts a 'nationally representative' sample frames drawn from the enumeration areas (EAs) designed for the Nigerian decennial census for the provision of reproductive health indicator estimates at different spatial scales. The household clusters are derived from a sample frame, which uses Enumeration Areas (EAs). Administratively, Nigeria has 6 geopolitical regions (Figure 3) subdivided into 37 units called state. Each state is further subdivided into Local Government Areas (LGAs) and each LGAs embody several localities. Localities are in turn divided into enumeration areas (EAs). The NDHS primary sampling units (PSU) referred to as clusters are defined on the basis of EAs. Survey samples are selected using a multistage sampling technique made of 904 clusters (372 urban and 532 rural areas). Each cluster consists of 45 households. There are a minimum of 943 households per state and 40,680 nationally representative households. All women of reproductive age (15-49) who are either permanent residents all visitors in the household at the time of survey were selected. Information collected ranges from basic

demographic characteristics, building material of dwelling units, ownership of durable goods and agricultural land/livestock to health information such as child mortality, health care utilization, lifestyle indicators and general status of health etc. In this study, the individual survey data have been aggregated into 904 clusters and linked to the geographical location for each cluster in ArcGIS 10.2. The output (survey cluster point data with demographic register of mothers) were then utilised for further statistical analysis and mapping.

The period for which birth records refer is between 1999 -2013 as each survey covers a five-year period preceding it. The unit of analysis is the DHS clusters which is a point representing groups of 50, 48 and 45 for 2003, 2008 and 2013 households locations respectively. Datasets are statistically representative of estimates of each indicator of interest for the population within each NDHS region at the time of each survey. Since Nigeria is a country where the majority of the population resides in rural areas, the number of clusters allocated to urban areas was increased in five out of six zones to obtain a reasonable urban estimate (DHS Report 2003, 2008, 2013). The NDHS is published for more consistent geographies using the 36 State administrative units, but these are considered too large and therefore inappropriate for understanding small area differences in a diverse country like Nigeria with over 300 identifiable ethnic and cultural groups (Adedini *et al.*, 2015a, Adedini *et al.*, 2015c). The main ethnic groups and their geographical locations are shown in Figure 3a. On average, one state in Nigeria will contain 21 Local Government Areas (LGA). The area coverage of LGAs in Nigeria ranges between an average of 1,176Km² and up to a maximum 9,000km² in some areas. For example, Owan East LGA in Edo State has an estimated area coverage of 1,190km² comprising 60 communities and villages and Borgu LGA in Niger State is estimated at 9,765km². The sizes of the Nigerian states range from a minimum of 3,815km² (Lagos) to a maximum of 73,421km² (Bornu) with an average state size of 24,597km².

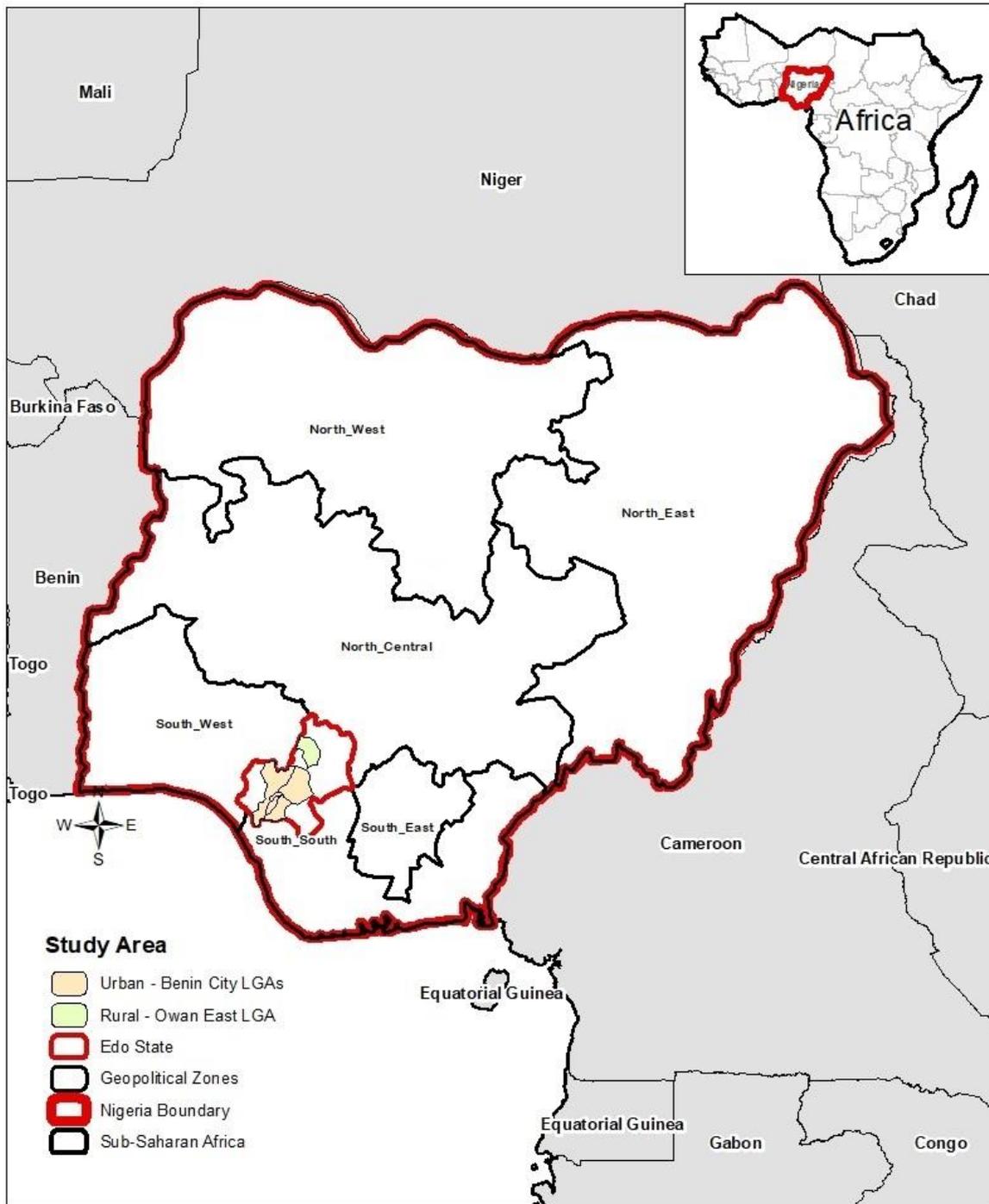
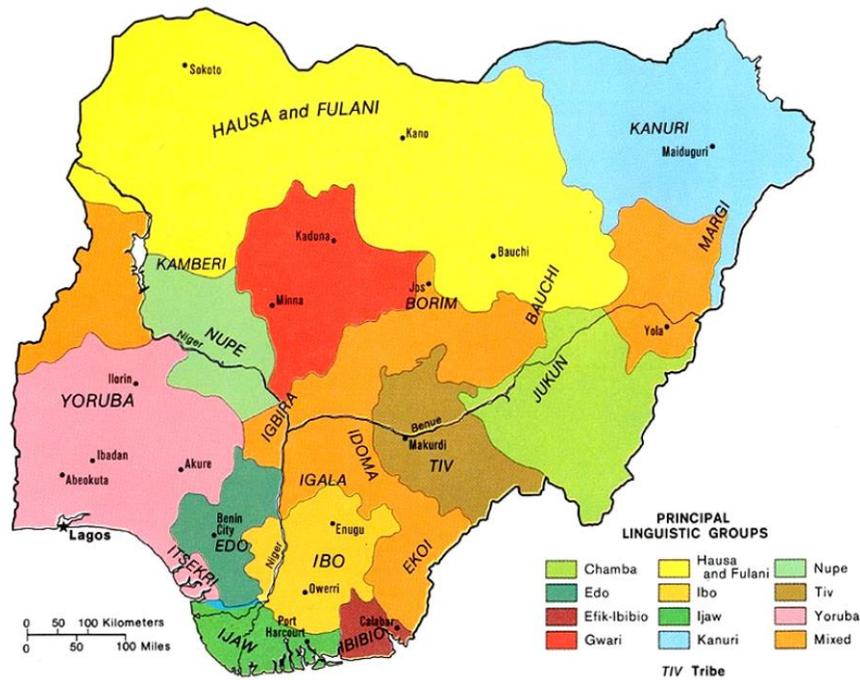


Figure.3: Study Area

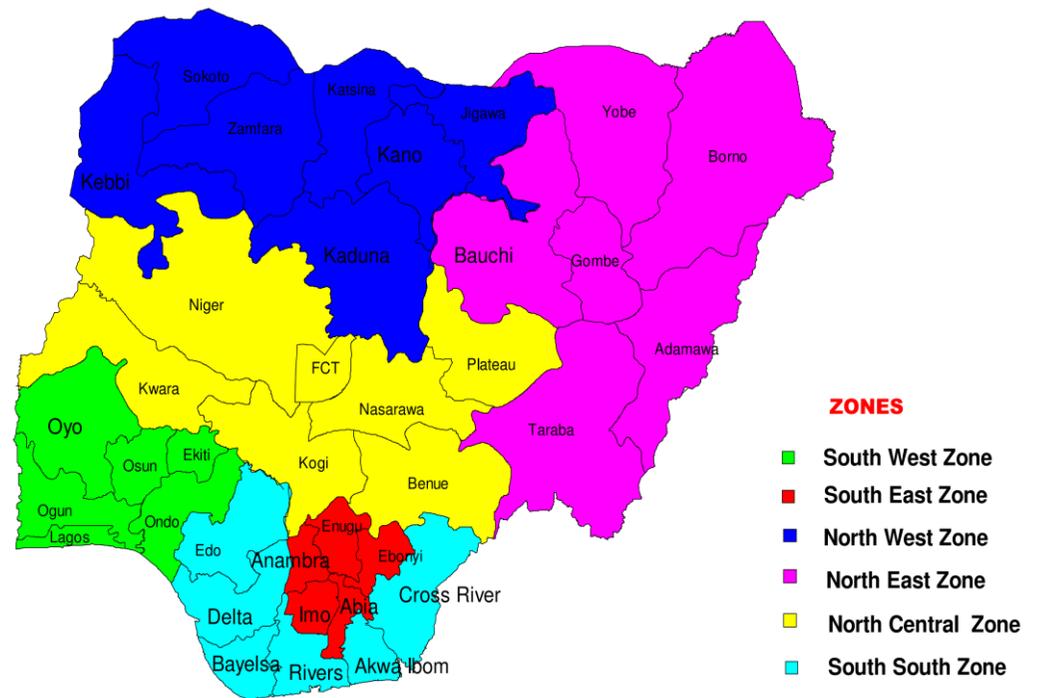
3.2.1.5 Country Profile

The Federal Republic of Nigeria is located on the West Coast of Africa with an aerial extent of 923,708 square kilometres. It is bordered by Cameroon to the East, Chad to the Northeast, Niger to the North, Atlantic Ocean to the South, and the Republic of Benin to the West. Generally, the Southern parts of Nigeria are made up of lowlands that dovetail into the highlands and plateaus and at the Centre. The Eastern region of Nigeria are characterised with mountains and the northern areas have flat plains. In terms of vegetative

cover, the coastal areas have mangroves as the dominant cover. The country's vegetation ranges from tropical rain forest in the Southern belts, Sudan and Guinea savannah in the middle belt, to the Sahel savannah in the far north. Climatically, the south has humid weather conditions with rainfall of 1,300-1,800mm and up to 2,500mm in the coastal areas. The North has arid conditions with annual rainfall of 600-1,300mm. Nigeria's population is estimated at about 180 million people. Socioeconomically, Nigeria is a very unequal country. It has consistently ranked last in the the per capital Gross National Product (GNP) is estimated at US\$582 with about 55% of the population live below the poverty line despite the rich oil resources. The main occupation of the majority of the people is farming. English is the official language of Nigeria but there are over 250 indefinable linguistic groups with Hausa, Igbo and Yoruba as the major groups. Politically, there are 6 geopolitical regions (Northcentral, Northeast, Northwest, Southeast, Southsouth and Southwest), 36 states and the Federal Capital Territory. There are 774 Local Government Areas (LGAs) and 9,555 wards.



Principal linguistic groups in Nigeria



6 geopolitical zones in Nigeria

Figure 3a: Nigeria’s linguistic groups and geopolitical zones

3.2.1.6 Data limitations

NDHS clusters are preferred in this study because they serve as proxies for small area geographies such as communities and neighbourhoods. Each DHS cluster contains summary information of birth histories for all interviewed women in approximately 45-50 households. It is worthy to note at this point that DHS cluster points are not maintained across survey years making it unfit for time-series analysis. To overcome this limitation, all clusters in the three most recent survey years are pooled together to provide a cross-sectional overview of under-five mortality risk in Nigeria in a decade. Although the actual locations for DHS clusters are distorted (by up to 2km for urban and 10km for rural areas) for confidentiality reasons, this study argues that they remain useful proxies for mapping population health patterns and observing regional differences in under-five mortality rates in Nigeria. Kravdal (2006), observed that the bias introduced by using summary information of education for predicting fertility using cluster-level data compared with population information for the PSU is very small – only about 4%. This study argues that there is no reason why other outcomes than fertility and other independent variables than education cannot be analysed successfully at the cluster level. DHS cluster points are found to successfully map patterns of distribution of fertility norms and contraceptive use between and within communities in Egypt (Storey *et al.*, 2009). The work of Weiss *et al.* (2018), demonstrates that DHS clusters are useful for quantifying small area geographical and socioeconomic inequalities both globally and nationally. They hold a great potential for responding to the increased need for fine-grained mapping necessary to track improvements throughout the duration of Sustainable Development Goals (SDGs).

3.2.2 Quantitative secondary data analysis

3.2.2.1 NDHS data management and transformation

The first step of the analysis involved deriving cluster-level summaries for all variables in the birth history data. All clusters in all consecutive surveys 2003, 2008 and 2013 were then pooled together using Statistical Programme for Social Sciences (SPSS) 24. A total of 2135 clusters with stable cluster means were included in the analysis. Indicators of interest were aggregated from the individual level birth record into cluster level data. Under-five mortality rates (1 in 100) were then for the pooled survey clusters. Measures are expressed as proportions in this study in order to compare the burden of mortality between areas and social groups. Rates allow comparisons to be made between population groups while

controlling for variation in the total size of the cluster births. Cluster-level rates in percentages and averages were derived for under-five mortality being the outcome of interest and socio-demographic characteristics of clusters demonstrated in academic literature to be related to under-five mortality.

In order to answer stated research questions and to carry out spatial measurements using DHS statistics, published datasets needed to be described, summarised, managed and visualized in a geographically meaningful way. All relevant indicators considered in this study were extracted from the original published DHS data files and transformed in IBM SPSS 22 software to formats that allow geospatial analysis to be performed. The recode to different variable tool is used to reassign new values to existing variables, collapse ranges of existing variables into new values and to derive multiple scalar variables from categorical variables where each category becomes a new variable. For examples, two new variables were derived from the sex of children ever born to a woman, which was originally a categorical variable, and then aggregated to obtain the count of male and female children born in the five years preceding the survey for each sample cluster. Cases for all indicators in DHS data files were combined using the clusters identification numbers as the grouping variable to create new files with the clusters as the unit of analysis. The compute and aggregate variable tools were used to derive averages, sums, ratios and percentages using numerical computations specified in DHS statistical manual.

A total of 2,135 NDHS clusters containing summary information for 247, 232 birth records were retained for further analysis following data cleansing. The data cleansing involved the removal of 9 clusters with missing values in both outcome and explanatory indicators were excluded from the GIS-based spatial analyses.

3.2.2.2 Outcome variable

The rate of mortality among children aged under five is the main outcome of health outcome variable of interest in this thesis. Under-five mortality rate was estimated by dividing total number of deaths among children aged 0-59 months in the pooled survey dataset (2003, 2008, and 2013) by the total number of live births by women of reproductive age (15-49) for the same period. Thus, the under-five mortality as utilised here is strictly speaking and not a rate per 1000 live births. The measure utilised here is similar to measures of proportions. This measure was chosen so that the dependent and independent variables are expressed as proportions. The average national under-five mortality rate for Nigeria was observed at 14.5%.

3.2.2.3 National-level explanatory variables

At the national level risks factors of under-five mortality were selected by identifying the indicators with the strongest correlation coefficients (Pearson's: ≥ 0.5 , $p = .05$) in relation to the dependent under-five mortality rate. The identified variables were screened for multicollinearity and highly correlated variables were removed. The 38 explanatory variables that were retained for further analysis are shown Table 6. The selected indicators broadly relate to individual, socioeconomic characteristics and contexts of mothers. These include: proportions of women and partners with no education, illiteracy – not being able to read at all; indicators of socioeconomic position such as mean wealth index, proportions of respondents at the bottom 40% wealth level, lack of access to television and newspapers/magazines, not watching TV or reading magazines at all; rates of vaccination by mothers during pregnancy (tetanus injection during pregnancy, vitamin A post-delivery), and proportions of children who have accessed preventive vaccines from childhood diseases (BCG, DPT, polio and measles vaccines); lack of antenatal, delivery and postnatal care and unattended home delivery or delivery by unskilled attendant; lack of decision making power of women within the household (with only husbands having the say regarding health care and household purchases); domestic violence rate (being beaten for refusing sex, going out unpermitted); reproductive risk behaviours such as child marriage and first births below the age of 18 years and not using any contraception; 6th or higher birth orders.

3.3 Quantitative data analysis

3.3.1 Global models

All area level indicators were standardised using proportion estimates such as simple percentages and means/averages. The outcome and explanatory variables were then tested for normality using skewness and Kolmogorov-Smirnov tests. Variables that were skewed were log transformed to near normal distributions (Ajebon *et al.*, 2015). Statistical interactions and interrelationships between indicators of deprivation and health outcomes were examined using simple descriptive and multivariable statistics such Cross Tabulations, One-Way ANOVA, Exploratory Factor Analysis (EFA), and Ordinary Least Squares (OLS) linear regression model. All the global statistical modelling were conducted in SPSS 22. Despite using a spatial data, the statistical assumptions of all the models considered in this study were largely met.

3.3.1.1 Exploratory Factor Analysis (EFA)

Exploratory Factor Analysis was used in this study to summarise the wide range of variables with moderate to strong relationships with under-five mortality in the pooled NDHS datasets. More details on the variables are in Appendix 1. Factor analysis as a multivariable method has a long history of application in the discipline of education and psychology, as well as health related disciplines in the last three decades (Williams *et al.*, 2010). EFA was conducted in SPSS version 22. All indicators of interest, which were previously aggregated as percentages at the DHS cluster level, were standardised and therefore treated as a continuous scale. An empirically-supported and widely used five/four step systematic protocol for best practices in exploratory factor analysis in published research were followed in addressing the research questions of this chapter (Costello *et al.*, 2005, Fabrigar *et al.*, 1999, Henson *et al.*, 2006, Williams *et al.*, 2010). These include establishing: the suitability of data for factor analysis; method of extracting factors; criteria for factor extraction; rotation methods for simplifying factor solutions; and interpretation and labelling of extracted factors. Further description of these five steps and the results obtained are presented in chapter 4. The EFA model identified five broad health-risk components that accounted for the maximum variation in the data that were subsequently utilised as explanatory variables in a linear regression model in order to predict under-five mortality rate in Nigeria.

3.3.1.2 Linear regression

Regression analysis is a widely used method in the social sciences to evaluate the relationship between two or more features in order to identify factors that influence the spatial behaviour of phenomena. In this study, the ordinary least square linear regression was employed to model, examine, and explore the relationships between the five health-risk components that were previously identified through the EFA. This was to understand the nature of influences of these risk-factors on the pattern of under-five mortality in Nigeria. Regression analysis is useful for predicting under-five mortality occurrence. The Ordinary Least Squares (OLS) is the most widely used regression analysis. It was used as a starting point for modelling spatial relationships in under-five mortality (ESRI Online Resources). It provided a global model and a single regression equation for understanding and predicting the relationship between the health-risk factors and under-five mortality. The linear regression model was also utilised to select key population indicators in Nigeria used to examine inequalities in under-five mortality (see section 5.3.0) across geographical areas and socioeconomic groups (see Draper *et al.* (2014); Field (2009) for more details on regression analysis).

3.3.1.3 One-Way ANOVA

The one-way analysis of variance was utilised to examine whether there were any statistically significant differences between the average under-five mortality of two or more geographical areas and population groups. For example, using the one-way ANOVA, this study was able to test the average under-five mortality between ethnic groups, wealth categories, religious identities, and geographical areas such as urban and rural areas and geopolitical zones. The Turkey's test, which utilises the studentised range distribution to make pairwise comparisons between independent categories, was used to examine which means of the population categories differed. A step-by-step guide to conducting and interpreting one-way ANOVA results in SPSS is available elsewhere (Field, 2009).

3.3.1.4 Cross tabulation

Also known as contingency tables, cross-tabulations or cross-tabs were utilised to understand the correspondence between the mutually exclusive population categories and under-five mortality categories. In section 5.2.2, cross tabs were used to examine the nature of correspondence or correlation in the clustering patterns (cold and hot spots) of under-five mortality and the clustering patterns (cold spots and hot spots) of the five health-risk determinants previously identified using EFA. The table generated provided simple insights into the nature of associations between the clustering of under-five mortality and the health-risk domains.

3.3.2 Spatial methods

Most of the global statistical methods considered above only generate summary variables for the data as a whole, and they lack capacity to provide context specific measures of the association between under-five mortality and the risk factors for each geographical cluster considered in the analyses. Moreover, many geographical datasets by nature do not sufficiently meet many statistical conventional assumptions such as equality of variance, normality and independence of individual observation. The risk factors of under-five mortality examined in this study are typically complex and are likely to vary from one region to another in Nigeria but fine scale spatial analysis of health data is limited. Spatial health models can account for changing exposure levels between risk regions can be informative for public health strategies (Czarnota *et al.*, 2015). This study utilised ArcGIS-based spatial statistical methods such as geographically weighted regression (GWR) and Getis-Ord-Gi* statistics to examine the spatially varying relationship between under-five mortality and the five health-risk factors relative to the local contexts of each NDHS cluster points and a range of health outcomes.

3.3.2.1 Geographically weighted regression

In this study the GWR is applied to the pooled DHS cluster data for Nigeria to investigate the spatial differences in the relationships between under-five mortality rate (dependent variable) and risk indicators (explanatory variables) derived from EFA. GWR was first applied to geographical studies by (Brunsdon *et al.*, 1996) in demonstrating the potential variation in spatial relationship between unemployment and social class as predictors of the rate of car ownership in Tyne and Wear in a regression model across the northeast of England. GWR is used in this study as a method for further analysis of possible spatially varying relationships between under-five mortality and risk factors. ArcGIS-based GWR is used to extend the global OLR prediction of under-five mortality to confirmatory regional analysis (Wheeler, 2014) of expected geographical variation across regions in Nigeria.

The GWR is expressed as: $Y_i = \beta_0(u_i) + \beta_1(u_i)X_{i1} + \beta_2(u_i)X_{i2} + \dots + \beta_N(u_i)X_{iN} + \epsilon_i(u_i)$

Where (u_i) represents the location of NDHS clusters i , and $\beta_i(u_i)$ suggests that the regression coefficient β_i represents the spatial relationship between under-five mortality outcome and the risks factors in the model which is specific to the cluster location i . The weight assigned to each NDHS cluster centroid is calculated based on $(\beta_i)^2$ distance decay function which is centred on NDHS cluster i and decreasing distance function is applied further away from i . The GWR places higher weightings based on spatial proximity from a focal point i . This clearly reflects Tobler's first law of geography, which states that 'everything is related to everything else, but near things are more related than distant things' (Tobler, 1970:236). The GWR is designed to resolve the assumptions of linear regression models which relate to random sampling and independence between cases in the data, and to account for spatially varying relationships which characterise geographical datasets (Fotheringham *et al.*, 2003).

The limitations associated with GWR from previous research is acknowledged (Páez *et al.*, 2011, Charlton *et al.*, 2009, Brunsdon *et al.*, 1996, Cho *et al.*, 2010, Wheeler, 2014). While GWR offers the potential for investigating varying spatial relationships between variables in a regression model, concerns have been expressed about the technique that requires caution in its application. A major critique is that GWR only assembles local geographical regressions and lacks a unified statistical framework for generalizing across the study area. Another concern is that the R^2 value derived from the GWR could be overestimated due to local collinearity. Collinearity in data may lead to an exaggerated effect magnitude of explanatory variables resulting in inflated regression coefficients in GWR. However, the variance inflation factor (VIF) result presented in Table 13 reveals that multi collinearity is

not a problem in the data. It is also acknowledged that all types of spatial analysis such as GWR that produce localised map outputs, are subject to edge effects. For example, the use of sudden cut off kernels for sample DHS clusters close to the edges of the study area may result in false calibration of the regression model for such points.

3.3.2.2 Hot spots mapping using the Getis-Ord G_i^* spatial statistics.

In order to further understand the geographical context in which under-five mortality and its underlying social determinants derived from EFA, further spatial autocorrelation analysis namely the Getis-Ord- G_i^* was performed to test for clustering in under-five mortality and relevant determinants using the ArcGIS-based spatial analysis tool. Hot spot mapping is critical in this study for identifying vulnerable populations (Iyanda *et al.*, 2018), understanding regional health inequalities, and for public health agencies to better target resources more efficiently and effectively (Mitchel, 2005, Tsai *et al.*, 2009). The ArcGIS-based hot spots analysis tool was used to calculate Getis-Ord- G_i^* for each DHS cluster in the dataset. Each cluster value for variables such as mortality rate, disempowerment, and vaccination uptake was examined in the context of values for neighbouring clusters. The local sum of a cluster and its neighbours is proportionally compared with the sum of all clusters in the study. Where a cluster has a higher than expected value, and when that value is not a result of a random chance, a statistically significant z-score results at a 95% confidence interval (Getis *et al.*, 1992). The higher the z-score, the more intense the clustering of DHS clusters with high values for the indicator of interest resulting in a hot spot. Lower z-scores indicate a concentration of clusters with low values resulting in cold spots. Getis-Ord G_i^* local is expressed as:

$$G = \frac{\sum_j w_{ij}(d)z_j}{\sum_j z_j}$$

where:

the NDHS cluster unit is assign i , z_{ij} is the spatail contiguity weight for the cluster, $w_{ij}(d)$ are the the clusters in a specified disatnnce-based matrix, \sum is summation over j in neighbourhood location, z is the observed variable value at cluster location.

The specific methods outlined so far were applied to the national-level datasets and the obtained results were very informative for identifying the risk factors of under-five mortality and the patterns of variation in relation to the key population attributes examined. However, Nigeria is a very diverse country both geographically and socioeconomically so that there is no reason to suppose that national level patterns will be the same as those at finer geographical scales. In order to examine the patterns of inequalities in under-five mortality at a finer scale, this study proceeded to collecting more localised quantitative and

qualitative primary datasets through fieldwork. Part two of this chapter discusses the data collection and analytical procedures deployed for actualising the research objectives.

3.4 Part Two: Doing fieldwork

The national-level analysis of under-five mortality revealed that health is better in the South and worse in the North. Despite the observed inequalities at the cluster level of analysis, this study argues that there may be further variations in the pattern of under-five mortality at a local level that may be worth investigating. In addition to the reasons, outlined in section 1.0, case study areas were selected from the ‘apparently’ better-off southern part of Nigeria and not the worse-off north for three reasons:

Under-five health may not be as homogeneous in the southern part of Nigeria as larger scale levels of analyses have implied. Within the health-achieving South however, health and associated determinants are not entirely homogeneous and further inequalities are observed. The Southwest exhibits the best outcomes; the Southeast has the worst health in the southern region with unexpectedly high under-five mortality hotspots and elevated domestic violence against women; and the more ethnically diverse South-South exhibits significantly lower levels of childhood vaccination. There is research evidence that health risks are exacerbated in regions with higher inequalities (Marmot, 2005, Marmot, 2009a).

The South-South geopolitical region of Nigeria where the case studies are specifically located is one of the most ethnically diverse regions of Nigeria. Given the cultural and geographical diversity of the South-South and as the geopolitical region with the highest concentration of ethnic minority groups in Nigeria, it becomes essential then to further investigate whether small area socioeconomic and spatial heterogeneities in under-five mortality can be identified.

It was logistically impossible to choose case studies from the North West region which exhibits the worst health in Nigeria due to many limitations including funding constraints, terrorism-related risks, language limitation, lack of cultural familiarity with the region, lack of access to research networks and the human resources such as research assistants in the north east

It is essential to consider the theoretical and methodological role of spatial scale in the study of population health. Theoretically, most health outcomes including under-five mortality are shaped by multiple levels of influence. The social determinant of health framework, for example, clearly shows several scales of organizations in the social

determinants of health. Methodologically, the concept of scale is akin to using visual lenses. The scale of examination of a health outcome will determine the level of variation that can be seen and the validity of generalizations that can be made (Diez-Roux, 2003). In addition to a national level analysis, a community level analysis was, therefore, an appropriate step taken in this research. The influence of factors such as social capital resources may be more evident at community and individual scales of investigation. The fieldwork was designed to meet the need for collecting finer scale data, which may reveal the small area variability in child under-five mortality. Most maternal and child health research in Nigeria rely heavily on the NDHS data with analysis units limited to national and first level administrative areas (Adedini *et al.*, 2015b, Mohammad *et al.*, 2017, Titilayo *et al.*, 2017). The larger the scale of administration of health data, the more the information that is blurred and spatial variability smoothed out. This is commonly referred to as the ‘modifiable area unit problem (MAUP)’. The fieldwork was then designed to collect quantitative primary data, using structured questionnaire design, and qualitative data with structured oral interviews

A divergent approach of using both quantitative and qualitative methods is chosen for this study as it holds potential for addressing the complex mechanisms that shape risks and resilience to child health in a developing country like Nigeria. Mixing methods this way is proven to have complementary value in providing the data needed for developing effective health policy (Weinreich, 1996).

3.4.1 Case study communities

Based on the findings from the spatial autocorrelation analysis, which are presented in chapters 4 and 5 statistically significant under-five mortality cold spots in Edo were selected for more in-depth field research aimed at deepening the understanding of perceptions with under five mortality risk and factors influencing health inequality at a smaller scale. From the distribution of the regression residual, a cluster is categorised as resilient, if:

1. 40% poorest clusters that is, classified under the first two poorest quintiles, that is having a wealth index quintile of 1 and 2. Code 5 is assigned to the richest clusters in Nigeria. All clusters meeting this criterion were rural by settlement type.
2. If the poor cluster is an under-five mortality cold spot
3. It is a ‘health over achiever’ that is, has a regression residual of -1.50 and below. -1.52 is chosen being the point of natural break in the distribution of residuals from the linear regression model. Note that negative regression residual values represent socioeconomic groups in Nigeria with lower observed/actual mortality rates than expected given the level of deprivation.

Following the above criteria, 72 (3.3%) of 2135 DHS clusters included in the model meet the above resilience criteria. Two of these clusters are located within Edo State of Nigeria. On the bases of practicalities such as physical accessibility, familiarity with the area, its culture geographical landscape, fieldwork funding and availability of research assistants, the cluster with the serial number 595 in the 2008 survey year was preferred for further field research. This cluster is located in the northern parts of Owan East Local Government Area of Edo State, Nigeria. It belongs to the 20% most deprived communities and exhibits lower than predicted child health mortality, which falls within the lowest 20% under five mortality rates in Nigeria (see Table 3 and Figure 4).

Table 3: Resilient rural clusters in Edo State

Survey Year	S/N	NDHS Cluster No.	State	Latitude	Longitude	Mean Wealth Index	% under five mortality	Mean Wealth Quintile	Under five mortality quintile	Reg. Residual
2013	1	719	Edo	6.790872	5.274930	2.21	3.45	2	1	-1.97
2008	2	595	Edo	7.102340	5.962030	1.28	9.24	1	2	-1.79

Furthermore, Edo State is my state of origin by birth and ancestry as well as my state of residence. Given the added limitation of funding conditions for the field work, it was more feasible and cost effective to conduct fieldwork in a more familiar Edo State and where I had more access to human resources. The 12 research assistants recruited for the questionnaire survey were newly graduated students of the University of Benin where I am a member of staff. I taught and mentored most of them before the start of my PhD programme. Their involvement was a two way relationship of ‘helping me’ and of the ‘continued learning and mentoring of my student’ by me with the added benefit of a stipend. The accommodation we all lived in during our stay in Owan East LGA during the data collection in the rural areas was a family house provided for free by my senior colleague Professor Monday Asikhia, who is from the area by origin. He was also very helpful in gaining access to gate keepers and in recruiting field guides and interpreters. In the rural areas, accessibility would also be easier for me being ‘a daughter of the soil’

3.4.1.1 Rural context

In order to maintain confidentiality of respondents, the geographical information available for DHS clusters is limited to a point definition of stark longitude and latitude in decimal degrees. Each point represents an estimated centre location for an average of 50 households in the survey. The cluster point is further displaced by 5km. The specific communities in which cluster points are located are also not named. To deal with this limitation, a 5km buffer zone was created around the chosen cluster in ArcGIS and all the 5 villages within the buffer zone were included in the field research. Figure 4 shows the rural case study communities. The villages are the five villages of Ivbi-Mion clan, which include Ake, Arokho, Ikhin, Ohanmi and Urhore in Owan East Local Government Area of Edo State, Southern Nigeria. Owan East Local Government Area has its headquarters in the town of Afuze. It comprises 69 towns and villages made up of eight clans (Emai, Igue, Ihievbe, Ikao, Ivbi-Mion, Ive-Ada-Obi, Otuo and Uokha). Owan-East is bordered by 6 other local government areas, in the North by Akoko-Edo LGA, in the East by Etsako-West LGA, at the West is Ekiti State, at the South-West we find the sister local government- Owan-West, while in the South are Esan Central LGA and Ugunmwonde LGA. It has an area of 1,240 km² and a population of 154,385 persons (81,847 males and 72,538 females) at the 2006 census and a 2015 projected population of 196, 900. It is important to state that population

information are not published for individual towns and communities in the Nigerian Census. Although no urban cluster met the resilience criteria in Edo State, Benin City, the administrative capital of the state was included as part of the study areas for field research. This is to provide a basis for rural and urban comparison of risk and resilience factors and to unpack differences that might exist. Urban and rural disparities in several maternal and child health outcomes is well documented in academic literature. Several authors have noted the rural-urban divide in health including under-five mortality in developing countries (Erskine *et al.*, 2010, Ettarh *et al.*, 2012, Okafor *et al.*, 2014a, Pampalon *et al.*, 2010). There seems to be an agreement in literature that rural areas in developing economies are more likely to suffer extreme deprivation and consequently poor health outcomes (Babalola *et al.*, 2009, Erskine *et al.*, 2010).

3.4.1.2 Urban context

Benin City is the present capital of Edo State of Nigeria. It is a traditional precolonial city with origin dating back to the 12th century and the present day cultural and political headquarters of the old Benin Kingdom (Ozo 1986). Although rapid urban growth began in the late 1960s and 1970s, it has grown from a population of 450,000 in 1981 (Odemerho *et al.*, 1991) to an estimated population of 1.496 million in 2015. Contemporary growth of this ancient but modernised city is attributable to several factors such as the choice of Benin City as the administrative capital of the old Bendel State and associated development of economic activities. The city is characterised by trade and commerce, craft industry, and home to a range of government establishments, banking and educational services (Ikhuoria, 1987). The implications of the rapid urban growth and colonial history are reflected in its land use patterns and the social structure of residential population. The city expands outwardly in a radial form along eight main transport arteries, most of which have origins from the city centre and linking other large urban centres such as Warri and Sapele to the South, Asaba and Onitcha to the East and Ore and Lagos to the West. These transport arteries have attracted more physical developments than interstitial areas (Omuta, 1984) which gives the city the irregular star-like appearance.

The commercial land use is located in the traditional core areas of the city, such as Igbesanwan, Urubi, Ogbelaka, Ogida, with heavy population density and high density residential development of 20-24 traditional compound houses per hectare, very few open spaces and most of the houses built before 1940 (Odemerho, *et al.*, 1991). This is followed by intermediate migrant areas such as Ugbowo, Uselu, Ikpoba, etc. most of which were originally designed for European residence. These areas are of medium density residential development 10-15 bungalow houses per hectare. Fringe areas with a mixture of structures

interposed with undeveloped plots are located in the outer parts of the city. These areas include Oluku-Isihor to the west, Aduwawa and Enyea to the north and Okha and Oha to the south.

An important social stratification that is readily noticeable in Benin City is based on ethnic differences influenced by local migration patterns from different parts of Nigeria the city and the occupational stratification based on early colonial footprint and political organisation (Onokerhoraye, 1977c, Ozo, 1986). Benin City serves as a major transportation hub with major access routes to other big cities in the Northern, Western, Eastern and the more southern parts of Nigeria. Local migration patterns has resulted in the emergence of ethnic clusters; Bini, Yoruba, Igbo, Hausa-Fulani, Urhobo. The Bini ethnic group is the indigenous ethnic groups of the city. There is evidence in academic literature that migrants from the same rural or cultural areas in Benin City tend to locate along the transport arteries, which link their villages and states of origin (Ozo, 1986). More relevant to this study is the socioeconomic structuring of the residential population of Benin City.

Three broad socioeconomic hierarchies which uses dominant neighbourhood attributes such as occupation, formal education, religion and ethnicity in labelling areas has been identified (Onokerhoraye, 1977). The upper income groups are mainly located in the (Government Reservation Area (GRA) of the city. Residents here are likely to be top administrators in government agencies, university professors, and top business executives, political and military leaders. The middle income residential population consist of prosperous traders, school teachers, university staff, and higher clerical officers in public and private firms. The lower income groups comprise lower and wage earners like petty traders, artisans, craftsmen and farmers. The high income, middle income and low income groups are labelled in this study as 'high, medium and low classes' respectively.

It is necessary at this point to mention that the aim of the classification scheme is not to accurately classify every resident within neighbourhoods into a social class. In a typical developing country city, most neighbourhoods are likely to have residents in all of the three social classes. It is common place to find poor and wealthy households living side by side. The scheme, therefore, represents a broad neighbourhood label that serves as a point of reference for making sense of geographical variations in a range of outcomes within the city. Still, this classification scheme is important for understanding area differences in child health outcomes and related socioeconomic factors that could mediate the risk of under-five mortality in across socioeconomic groups in Nigeria. The Wealth Index, which is the measure of socioeconomic stratification in the NDHS data is often criticised for masking

out urban poverty which could be more precarious than poor rural conditions. Generally, densely populated areas of Benin City are located at the city centre and mainly classified as low class.

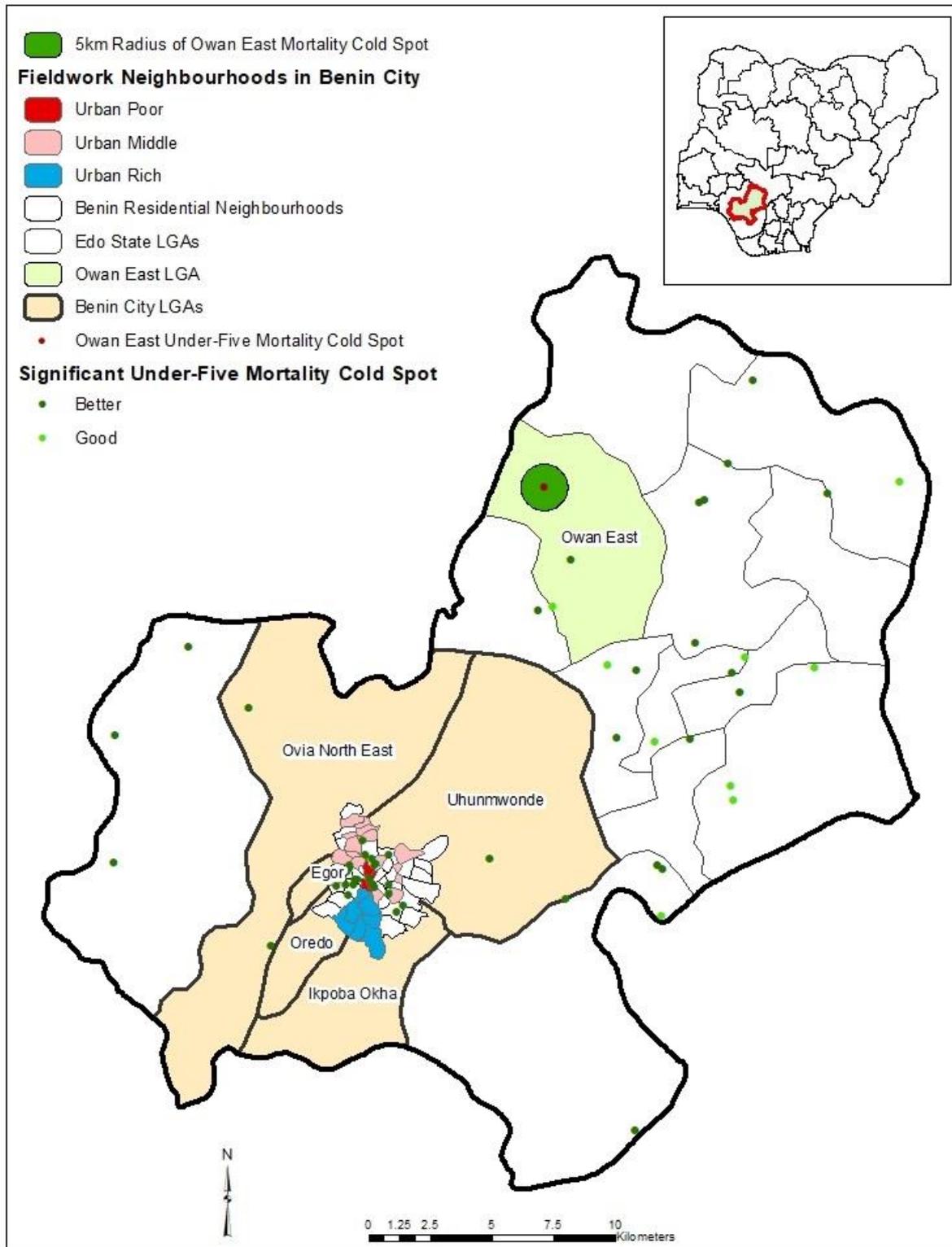


Figure 4: Edo State showing under-five mortality cold spots

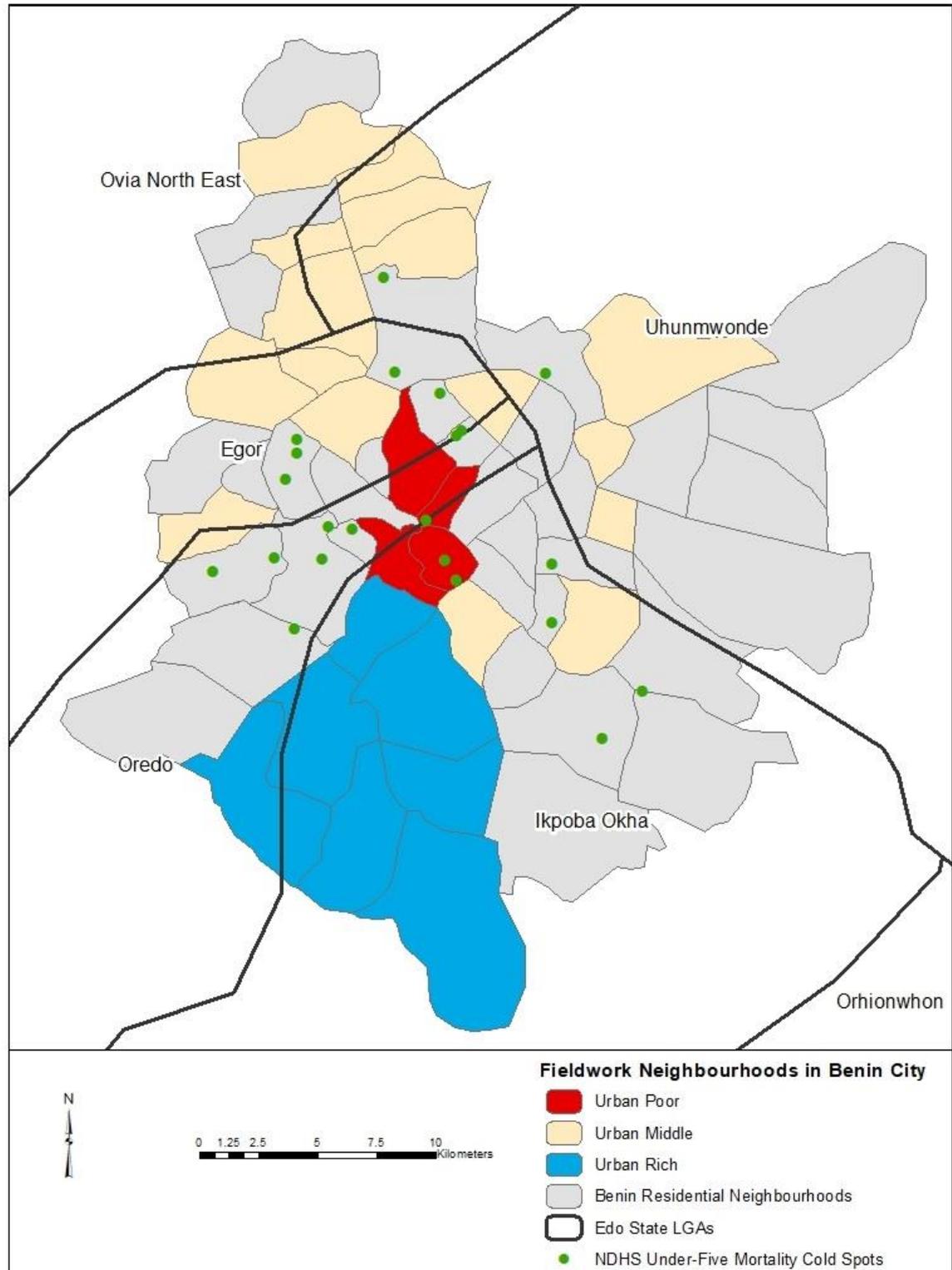


Figure 5: Selected urban study neighbourhoods in Benin City

3.4.2 Selection of research participants

The field research applies two types of sampling strategies in collection of quantitative and qualitative data. It use the stratified sampling method for choosing participants for the survey type questions while the purposeful sampling strategy was deployed in choosing respondents for the semi-structured oral interviews. The target population is adult women of reproductive age (18-49 years). Research participants for the semi-structured oral

interviews were chosen from same communities as the quantitative samples. Participants had the option of choosing between quantitative survey and oral interviews.

3.4.2.1 Sampling strategy for questionnaire survey.

This will allow local descriptions to be made about child health behaviours and key local factors shaping child health risks perceptions and coping mechanisms in selected communities. Small area level quantitative data collection is valuable for extending our understanding of child health issues that might have been partially addressed or completely absent in the NDHS cluster level data. Local survey data forms can be used for measuring the effectiveness of generalizations made with large surveys like the NDHS. It may also serve as a useful reference point for qualitative evidence. To fill this gap, stratified sampling method is favoured as a 'broad' guiding principle in choosing participants. The choice of fieldwork communities was largely based on set socioeconomic and geographical criteria where possible, in addition to the results from the analysis of secondary data described discussed previously section 3.4.1. Further stratification is done within chosen communities using major streets.

All major streets are selected, beginning from the first house, every other house on both sides of the street is chosen provided there is at least a child less than 5 years old whose mother falls into the reproductive age definition of 18-49 years. Where a woman has more than one child that is less than 5 years of age, information is elicited for the youngest child. Where there is no child or woman within the age band of interest, or where potential respondent refuses to participate, the next house on the street is selected. Sometimes, the neighbours of an eligible house who expressed interest in the survey were included in the data collection because it was difficult to explain to them that we had predetermined 'selection criteria especially in cases of illiteracy. Rejection was interpreted as 'not being good enough or qualified to participate in elite matters'. I had no choice but to include such participants in the survey. It was, therefore, totally impossible to strictly maintain the defined set stratification rules, in choosing research subjects during the fieldwork. From my experience of doing this fieldwork in Nigeria, rules of stratification could only be used as first steps in choosing research subjects, when faced with other practical selection issues, such as when a potential subject refuses to participate in the research project, alternative cases were then selected based on the researcher's judgement. Overall, 2028 people participated in the survey. 1856 final participants were retained for further analysis after the data cleansing process, which removed 172 cases with missing values for the outcome variable. Estimated response rate for the survey was 90%

The sampling strategy of the data used in this chapter flowed from the analysis of secondary data. Research participants were selected from urban and rural communities which have been identified as significant cold spots of under-five mortality with significantly lower than predicted under-five mortality rate with Gi z-scores of ≤ -2.0 standard deviations from the mean (Figure 6).

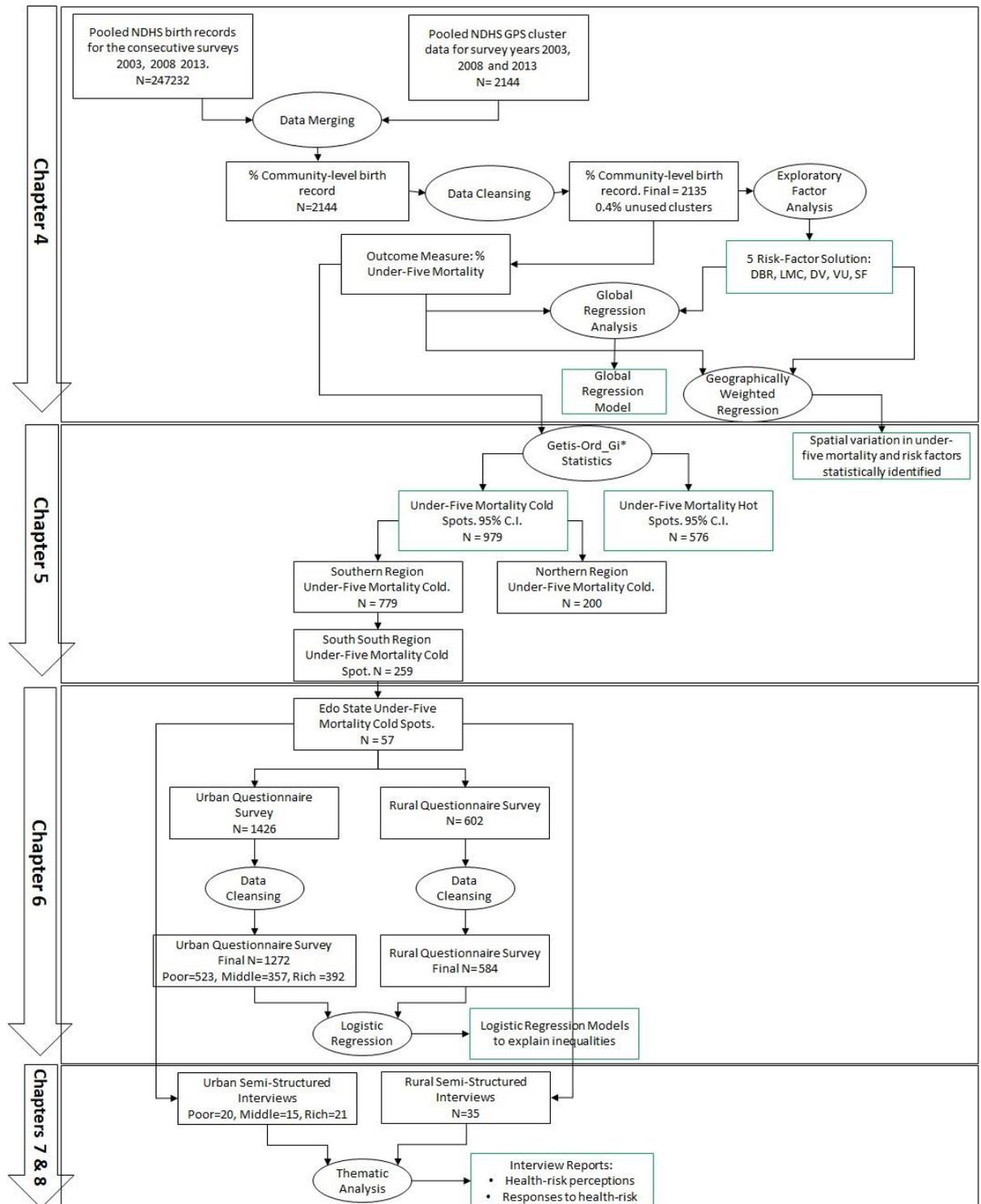


Figure 6: Sampling strategy

Cold spots are clusters of communities with significantly lower values of under-five mortality in a geographical area. Edo and Akwa Ibom States are the only states within the South-South region to have NDHS clusters across all survey years classified as significant mortality cold spots.

Where there are multiple geographical possibilities for fieldwork, the guidelines in the literature are that the choice of sampling technique should be driven by the theoretical framework that under-pins the research question, practical feasibilities in terms of the resource costs of money and time in addition to issues of accessibility, cultural and language considerations (Curtis *et al.*, 2000, Miles *et al.*, 2013). Edo State was preferred for further data primary collection because 55 of the 57 clusters in the state meet the selection criteria of a Gi z-scores ≤ -2 standard deviation away from the mean. Edo state is more ethnically and religiously diverse than Akwa Ibom state. It is a boundary state between the north and the south. It is geographically bounded in the north by Kogi State in the North Central geopolitical region; to the west by Ondo State in the South West geopolitical region; by Anambra State in the South East geopolitical region and to the south by Delta State, one of the three leading oil producing states in Nigeria. Major transportation routes connect the city centre Edo State capital, Benin City, with these regions. This explains the concentric pattern of growth of the city along major arterial routes. Ozo (1986) migrants from the east, north, south and west tend to cluster in neighbourhoods along major transportation routes that connect their places of origin. Hence cultural and language footprints from the four major ethnic groups in Nigeria, Hausa-Fulani, Igbo, Ijaw and Yoruba, for example, family names, music and religious practices are readily identifiable in boundary villages in the Edo State and urban fringes of the state capital of Benin city.

In order to examine the localised determinants of under-five mortality in Edo State, the study employs a stratified sampling of adult women of reproductive age, 18-49 years, split between participants from 15 urban residential neighbourhoods in the Edo State capital of Benin City and 5 villages or rural communities in Owan East Local Government Area (LGA). The choice of the 15 urban communities selected for questionnaire data collection in Benin City was based on the experience of previous residential surveys of the city (Omuta, 1985, Onokerhoraye, 1977a, Onokerhoraye, 1977b). These communities reflect the population density, demographic and material conditions of resident populations which have been shaped by local migration patterns into the city, early colonial housing, occupational and political footprints (Onokerhoraye, 1977c, Ozo, 1986).

Benin City has a readily identifiable concentric spatial pattern. The city has mainly expanded along major road networks most of which originate from the traditional city centre neighbourhoods within the innermost ancient Benin moats and walls (Figure 5) to connect other major urban centres in the Eastern, Northern, Southern and Western regions of the country. The urban neighbourhoods in Benin City included in the study are selected using a stratified sampling approach. These areas are broadly classified into two broad groups on the basis of geographical location, the core areas and the suburban areas (Nkeki et al and erimona); and into three socioeconomic categories namely:

- urban poor (Adesogbe, Egor, Igbesamwan, Igusi, Ogbelaka Ogida);
- urban middle income areas, (Aduwawa, Idomwina, Igue-Iheya, Iguosa, Isihor, Okunmwun, Oregbeni and Ugbowo);
- urban rich neighbourhoods (Government Reservation Areas (Airport Road, Ekae, Obe, Ogba, Oko, and Ugbor).
- Urban poor areas correspond with high density core areas in the city centre. Middle income neighbourhoods are intermediate areas and fringe zones, outlining the core areas. The rich neighbourhoods are clustered around the Southern parts of the city. The 5 selected rural communities are villages in Owan East LGA are Ake, Arokho, Ikhin, Ohanmi and Urhore, all belonging to same Ivbi-Mion clan. The five selected rural communities are located within 5km radius of the centroid (Longitude 5.962030 and Latitude 7.102340) of the chosen NDHS mortality cold spot cluster (Figures 4 and 5).

3.4.2.2 Sample size

The 2006 Nigeria census data is not published at the community level or neighbourhood. Due to the absence of community level population data in Nigeria, the number of participants is based on the overall population density estimates for each LGA. More participants are recruited from more densely populated residential neighbourhoods in the city centre than the outer suburbs where population density are sparser. The census is also not disaggregated by age at the LGA level. In order to obtain the expected study population for women of reproductive age, for the 5km buffer zone in the rural areas and the urban population in Benin City, the expected total population for each neighbourhood selected for the study is estimated based on the population density of each local government area and the neighbourhood extent in square kilometre. The expected total female population is

estimated based on sex ratio for each LGA. The total population of women of reproductive age 15-49 years are then estimated based on female age structure from the 2006 national census figures. The 2006 census estimates for the population of women of reproductive age in Nigeria is 50.6% of total female population, (Table 4-5). The LGA boundaries considered in this study cross urban and rural areas, which makes neighbourhood densities difficult to estimate. These should be interpreted as rough estimates only.

Table.4: Estimated survey population for women of reproductive age (15-49 years) and sample size

S/N	LGA	Total population	% female population for LGAs	Total female population	Female (15-49 years)	Population density	Area (km ²)	Sample size (C.I. = 95%)
1	Owan East (5km buffer)	1671	0.489	413	209	163.4	5	136
2	Egor	445842	0.504	171262	86659	4794	93	384
3	Ikpoba-Okha	487374.8	0.504	187355	94802	565.4	862	384
4	Oredo	490530	0.496	185620	93924	249	1970	384
5	Ovia north East	203500.4	0.482	74911	537904	88.44	2301	383
		1628918.24		619561	313498		5226	1671

The expected total population for each neighbourhood was calculated using proxy population density estimates for the LGA of the neighbourhood and the areal extent of the neighbourhood. The estimated total figures were then utilised in estimating neighbourhood-specific sample size. Calculating sample sizes with estimates where actual total population is unknown is not considered a problem because the mathematics of probability has shown that the actual size of a population only becomes relevant when the sample size exceeds a few percent of the target population. This means that the calculated sample size could be equally useful in examining under-five mortality outcome among the 313,498 target women of reproductive age examined in this study as it would a target population 15,000,000. For this reason, the ‘Survey System’ ignores the sample size when it is large or unknown. The sample size, which is the number of women of reproductive age to be surveyed in order for the results to be reflective of the target population, is calculated using a publicly available sample size calculator. The calculator is provided as a public service of the ‘Creative Survey Systems’. This can be accessed via <https://www.surveysystem.com/sscalc.htm#one>. Overall, the final target survey sample of 1671 was estimated based on a confidence level of 95% and a confidence interval of 5%.

Within selected communities, one eligible woman is surveyed per household in one off interviews. The survey process utilised a face-to-face interviewer administered questionnaire. The recruitment was flexible because it was not practical to pre-book

appointments or send surveys by post as practised in developed countries; there are no organised postal and property address systems. Moreover, women were involved in the informal sector and were unsure of their day-to-day availability. For example, those who were involved in open market trading were unable to determine when their produce would be sold off as their availability at home was dependent on how fast the goods are sold on any given day. In the absence of structured daily schedule, most participants preferred to be surveyed immediately rather than book appointments for a later date and thus most surveys were done ‘on-the-go’.

The research assistants and I surveyed one participants per household. Surveys were conducted straight away after obtaining informed consent. Each survey instrument took an average of 30 minutes to complete. Whilst this ‘on-the-go’ survey process saves time and resources, it presents a problem for following up and engaging in deeper conversations due to the difficulty of booking future appointments. Overall, more educated were more willing to participate in the survey compared with women with lower levels of education. In some cases, men chose to answer the survey questions on behalf of their partners especially in cases of female illiteracy. Some uneducated women refused to participate because they thought they were not knowledgeable enough to participate in ‘elite surveys’ and we could not convince them otherwise. It was ethically important for survey participant to participate voluntarily and in ways that are most convenient for them. The study sample from the fieldwork ended up being more educated than expected as conveyed with the NDHS sample for Edo State.

Table 5: Communities and number of research participants (author's work)

	Social Group	S/N	Community Name	Number of Questionnaire	Number of Semi structured Interviews	Social Class	LGA
Urban	Urban - Poorest	1	Adesogbe	42	20	1	Oredo
		2	Egor	155		1	Egor
		3	Igbesamwan	114		1	Oredo
		4	Igusi	29		1	Oredo
		5	Ogbelaka	104		1	Oredo
		6	Ogida	128		1	Egor
	Urban Middle	8	Aduwawa	68	15	2	IKpoba Okha
		9	Idomwinna	19		2	Ovia NE
		10	Igue-Iheyia	30		2	Ovia NE
		11	Iguosa	23		2	Ovia NE
		12	Isihor	40		2	Ovia NE
		13	Okhunmwun	34		2	Ovia NE
		14	Oregbeni	37		2	Ikpoba Okha
		15	Ugbowo	173		2	Ovia NE
	Urban Richest	16	GRA	430	21	3	Oredo
Rural	Rural	17	Ake	129	35	4	Owan East
		18	Arokho	127		4	Owan East
		19	Ikhin	127		4	Owan East
		20	Ohanmi	107		4	Owan East
		21	Uroe	112		4	Owan East
	Total			2028	81		

3.4.2.3 Survey questions

The range of indicators considered in this study broadly reflects the compositional and contextual characteristics, social capital, and child health risk and resilience perception of research participants. Survey questions were designed, first; to elicit similar information to the NDHS regarding health, demographic, compositional and contextual characteristics of participants and, second, to extend our understanding of the nature of localised inequalities in under-five mortality in Edo State by including questions around self-assessed health, perception and child health behaviour, wellbeing, and social networking which are considered as relevant in the social determinants of health model (Whitehead *et al.*, 2006).

3.4.3 Logistic regression analysis of primary questionnaire data

Traditionally questions regarding the prediction of dichotomous outcomes were addressed by ordinary least square (OLS) regression or discriminant function analysis. These techniques have subsequently been found to be inadequate for handling dichotomous outcomes which do not meet the strict statistical assumptions for example linearity,

normality, equality of variance required for the OLS regression methods as employed in chapters 4 and 5 for handling continuous data (Hosmer Jr *et al.*, 2013, Osborne, 2014, Peng *et al.*, 2002).

Since the 1980s Logistic regression has become routinely available in statistical packages and used increasingly for handling binary outcome measures in the social sciences (Peng *et al.*, 2002) but most of its principles are applicable to more than two outcome categories in multinomial logistic regression. Logistic regression is generally suited for testing hypotheses about relationships between a categorical outcome measure and one or more categorical or continuous explanatory variables. In this research, it is used to predict the probability of an under-five mortality event occurring or not occurring within the population examined. Logistic regression uses logarithmic transformation to express categorical outcomes in linear terms called the logit and thus overcomes the limitation of violating the linearity assumptions.

Ideally, a geographically weighted logistic regression (GWLR) model would have been more appropriate for a geographical study of this nature but this could not be used in this study for two reasons. First, it was important to protect the confidentiality of women who took part in the questionnaire data so that they are not identified. To protect the confidentiality of respondents, the questionnaire data was completely anonymised. The specific locations of research participants and other personal identifiers were removed. Secondly, the case study neighbourhoods where primary data were collected were selected purposefully from urban and rural areas and across socioeconomic groups. As a result, the neighbourhoods are not geographically contiguous making them unsuitable for spatial modelling. This data limitation arising from confidentiality issues has made it impossible to apply the GWLR model to the questionnaire data. The results of the study should therefore be interpreted with the consciousness that they do not reflect spatially varying relationships that are likely to be present in the data. Hence, the criticisms around the inability of global regression models discussed earlier in chapter 5 are recognised. More details on the principles behind logistic regression is available elsewhere (Field, 2009, Osborne, 2014, Peng *et al.*, 2002). Also see **Error! Reference source not found.** for more details on how the logistic regression model has been developed and information related to the interpretation of results

Having selected 20 variables that are above the correlation cut-off point of 10%, the models are manually classified into four sub-domains. In order to develop a domain-specific model, all the variables in the domain are entered into the Logistic Regression model and a backward elimination method is used to select a parsimonious model for the domain of interest. A parsimonious model is the model accounting for the most variation with the

fewest number of explanatory variables. A final parsimonious model is then developed using a backward elimination strategy from all statistically significant variable that were previously retained in the four health domains. The SPSS 22 backward log-likelihood elimination that is a data driven exploratory stepwise method, is used to select explanatory variables making important contributions to the model. This variable elimination strategy in a multiple logistic regression begins with an all-inclusive model with all explanatory variables of interest. Insignificant predictors are then removed one-at-a-time until only statistically significant independent variables with p -values <0.05 are retained in the final model.

The academic critique of stepwise logistic regression methods is recognised (Menard, 2002, Osborne, 2014, Peng *et al.*, 2002). However, the method is considered appropriate in this study for exploratory purposes aimed at identifying subsets of variables, which interact significantly together to predict the under-five mortality outcome because the analysis is aimed at exploring the data in order to identify the localised determinants of under-five mortality rather than testing existing theory regarding expected relationships. All variable which demonstrate significant relationships of ≥ 0.1 were explored to identify subdomains in the data.

Theoretically, there are variables, which are commonly classified in health domains different from the domains they have been grouped under in this study. For example, ‘the source of drinking water’ variable is commonly used as a sanitation indicator. It is logical that the stepwise logistic regression procedure has classified it under the neighbourhood characteristic since sources of water depend heavily on the level of public provision. The type of water sources that communities rely on are influenced by wider structural and infrastructural provision issues which may be beyond the control of households. The capacity to access alternative water sources by individual may also differ between urban and rural women and governments in Nigeria often prioritise urban water supply over rural needs perhaps because urban dwellers have a greater power or voice in influencing political actions. The stepwise method was preferred since there are no established theories and knowledge about correlates of under-five mortality and the nature of interaction that might be expected within the unique sets of variables in the study sample. *‘The criteria for stepwise inclusion or removal of variables for a model generally involve tests that are similar but less restrictive than the tests used in theory testing’* (Menard, 2002:43), for example, statistical significance of p -value based on 95% confidence interval.

Although, the analysis of the primary survey data was informative for identifying the patterns of inequalities within neighbourhoods, these needed to be complemented by

contextualised accounts in order to shed more light on the underlying processes shaping unequal health experiences. The qualitative research procedure is described next.

3.4.4 Qualitative research methods

Qualitative methods as a mode of enquiry in health inequalities research are increasingly deployed to delve into people's own account for the role of individuals as creative agents in shaping the social determinants of health (Popay *et al.*, 2003b). This thesis attempts to do this using semi-structured interviewing method and contributes to a body of health geography studies exploring lay perspectives to health.

3.4.5.1 Selection of participants for semi-structured interviews

Purposive sampling strategy was used in selecting adult women for participation in the research project being the population group that are mostly likely to have current experiences relating to child health. Participants considered eligible are those who meet a set of criteria relevant to the research project. These include, being a parent or guardian to, at least, one child that is less than five years old, be between ages 18-49 years, resident in the community of study and be willing and available to communicate child health experiences voluntarily. The experiences of participants are important for understanding what vulnerable communities perceive as risks to child health and how they engage with this risks to ensure the wellbeing of their children. 'Purposeful sampling is widely used in qualitative research because it allows the identification and selection of information-rich cases related to the phenomenon of interest' (Palinkas *et al.*, 2016:1), in this case, child health. Although purposive sampling is often criticized as a simple way of providing approval for any case chosen in qualitative research, the strategy demands that researchers 'think critically about the parameters of the population of interest and samples chosen on this basis' (Silverman, 2000: 104). All selected cases in this research project meet all of the afore-mentioned selection criteria.

Purposive sampling is neither statistical nor purely personal. It must be theoretically grounded. It is an efficient way of examining, expanding and deepening the understanding of both the similarities and variations or weaknesses in the pattern of child health indicators uncovered in the analysis of DHS data. 186 people were interviewed in all. Whilst the number of respondents selected per community is guided to some extent by the perceive population density of communities and the willingness of people to be involved in the project, everyone who was willing to communicate their experiences were interviewed.

3.4.5.2 Semi-Structured Interviewing

Interviewing has been a primary means through which qualitative researchers have attempted to delve into the context of people's lives (Crang *et al.*, 2007). In this study, semi-structured interviews are employed because it offers the flexibility to explore subjective aspects of risk and resilience factors in depth. The interviews began with exchanging pleasantries, introductions, confirming interview topics and objectives, and going through standard ethical protocols by obtaining informed consent and permission to tape record the conversations. In order to ease into friendly conversations with research participants, the interviews began with the so-called 'grand-tour' questions (Spradley, 2016). These initial questions explored issues around the socioeconomic background of the research participants, their social networks and neighbourhoods and subsequent issues around child mortality risk factors and the coping mechanisms employed to address these risk factors were introduced naturally into the conversations.

Research assistants were trained to conduct the interviews with me. Interviews were pilot tested and questions adapted for every interview. 82 research participants from 22 ethnic backgrounds took part in the study. The dominant ethnic background in the urban communities in Benin City was the Bini, ethnic group and Afenmai ethnicity was the dominant ethnic group in the rural communities in Owan East LGA. I did not understand or speak any of the 22 languages spoken by the respondents and some of my research participants could understand and speak some but not all of these. It was very difficult to completely fit into the research communities and conversing in the languages as a way of gaining access culturally. I could not be identified in any way as an insider (Crang *et al.*, 2007). However, most of the respondents understood and spoke the 'Nigerian Pidgin English' language.

There were other kinds of linguistic difficulties, which the research assistants and I encountered. For example, words 'risk' and 'resilience' were not utilised as these do not directly translate into the 'Nigerian Pidgin English and in the local languages' in which interviews were conducted. The words 'challenges' and 'problems' were used in place of risk perceptions and 'coping', 'managing', 'strength' were used to elicit information on resilience factors. There is evidence that the western concept of risk and resilience do not translate in non-western languages and researchers have had to adapt the words to the research contexts (Ruszczuk, 2014). There is more to language than words, esoteric gestures and behaviours are equally important (Crang *et al.*, 2007).

Respondents were much more open in their narratives when someone else was present such as their husbands or other members of their families were present. There were occasions

where some husbands looked disapprovingly towards the wives, signaling objection to the line of conversation with respondents changing the direction of the conversation or very withholding information. There were also instances where husbands audibly instructed their wives not to answer certain questions. Most of the women who participated in the semi-structured interview were married; 79 of the 81 women were married and two women who were aged 18 and 19 years were unmarried at the time of the interview.

Since the main aim of the interview was to gain understanding into the lay knowledge of health risks and resilience factors, the study focused on selecting ordinary adult women of reproductive age ranging from 18 to 49 years. Women from the medical and allied professions such as community health workers, nurses, midwives, pharmacists and doctors were excluded. Questions were deliberately not asked about causes of child mortality first, due to the sensitive nature of recalling traumatic events. It was my ethical responsibility not to put my research participants in harm way, emotionally and physically since I could not afford to have health professionals capable of meeting the needs of respondents. In addition, respondents were also told that they could opt out of any question or the interview at any point. It is not in the scope of the research to delve into causes of mortality.

Most interviews were very fluid with most respondent preferring to be interviewed immediately rather than booking future appointments. Most of the interviews took place in participants' homes and shops. This fluidity presented challenges for establishing trust within the period of encounter. Although, the participants were generally welcoming, relaxed and interested in the topic of discussion, it was very challenging to get them to reveal much about themselves and to respond to questions in detail despite being assured of complete anonymity. The stories were told on the spur of the moment in fluid settings while participants were cooking, selling in their retail shops or doing other household chores (Figure 7).



Figure.7: Fluid interview settings

3.4.5.3 Interview transcription and data analysis

The interviews were between 20 and 30 minutes long, and with respondents consent, they were tape recorded and transcribed. Most of the interviews were conducted in English and a few others in the ‘Nigerian Pidgin English language’. The first analytical step was to translate the interviews conducted in pidgin language to English. Two of my research assistants and me translated the recordings independently. Team translation offers the merit of working through data in a relatively shorter time and the interpretation of narratives from multiple perspectives. This does not imply that team analysis of qualitative data is better than individual analysis. It is recognised that there are challenges of proper representation of respondent narratives due to language differences, and care must be taken to ensure a vigorous practice. Given the possibility of multiple perspectives in team translations of interview narratives, a transparent management of the translation process is required (MCLELLAN-LEMAL *et al.*, 2008). The translations were compared derive the translations of interview content which were most reflective of the narratives of research participants as much as possible. However, the translations were done to maintain and

reflect the Nigerian use of English language. This means that the choice of words, dialects and grammatical patterns in the extracts from the transcript may not strictly follow the grammatical patterns and the rules of Standard English. However, it is believed that the contexts of the extracts are clear enough by all English speakers to understand. This is to ensure the original context and voice of research participants are represented and projected as much as possible.

Team translation also ensured that the limitation of individual translation and other possible biases that could have been introduced into the data are kept to minimal. Overall, the translation process was complex and uncomfortable due to the necessity to represent the respondents' narratives and the meanings attached to the narratives in a way that make visible their voices.

Deriving meanings from the contextualized narratives of respondents is a central part of qualitative analysis (Miles *et al.*, 1994). Qualitative analysis of interviews can be done in many ways as there are researchers depending on the research objective, skills, convenience and experience of the researcher. The procedure for deriving meanings from qualitative data generally involve an iterative process including ordering, categorizing data into core themes and concept that can be used to produce new theories or explain existing ones. Both Nvivo 11 and Microsoft Word software were used for management and organization of codes. The translated transcripts were first imported into Nvivo qualitative analysis software program to identify and consolidate reoccurring themes and filter out redundant words using the word frequency and word cloud tools.

The benefit of this automated approach is that it allows the researcher to identify and visualize emerging themes and commonalities in the respondent's narratives in a relatively short time. Transcripts, themes and quotes were further organised in Microsoft Word. Both iterative and inductive procedures were followed for the interview data analysis (Chandler *et al.*, 2017, Flemming *et al.*, 2018). First, I read and re-read the content of the transcripts literally to familiarize myself with respondents' narratives. Secondly, further manual analysis of data was done on paper and pens were used for highlighting and linking similar narratives and contrasting ideas in order to derive meanings and patterns in the data. Then I read the text reflexively to examine how respondents' narratives could be interpreted based on broader research objectives. Lastly, I read the transcript interpretatively in order to develop a contextual understanding in terms of producing richer explanations of the patterns and associations of the socioeconomic and contextual circumstances shaping inequalities in under-five mortality experiences among mothers. Interpreting the main thematic patterns in the interviews in terms of commonalities in the meanings attached to

respondents experiences of under-five mortality was very difficult due to the necessity to determine the appropriate spatial and socioeconomic scale of analysis, which respondents to make visible and whose voices to project. Despite the considerable diversity in their social and contextual circumstances, there were patterns in the narratives and links that can be drawn to social determinants of health and intersectionality theories. There was an iterative reevaluation of interpretation and assumptions derived from the data throughout the writing of this thesis. It is in the ability to draw links between respondents' narratives and social theory and the continuous reevaluation of meanings attached to these narratives that qualitative research findings such as those reported in this thesis are differentiated from anecdotal evidence (Popay *et al.*, 2007).

3.4.5.4 Research Instruments

A standard structured questionnaire was designed to elicit quantitative information on parameters relevant to child health and wellbeing (see appendix --- and ---). The questions asked range from general socioeconomic and background information about the respondent and the last living child in the household who is less than five years, present health status and availability of social amenities in communities, social relationships and networks to identification and perception of child health risk factors and coping mechanisms. Standard NDHS questions, e.g. antenatal care and delivery services, treatment events for common childhood diseases etc., were mirrored where necessary. Some questions are the multiple option type, others use likert scale and some have binary classifications such as 'Yes and Nos'. Most importantly, the questionnaire contains open-ended questions which is designed to explore the reasons behind child health care behaviour which is absent from DHS surveys. The indicative semi-structured questions asked during oral interviews are around similar themes covered in the survey but interview questions are frame in a way that allows research participants to share their experiences and for the emergence of new child health knowledges. Unlike the survey questions which cover a wide range of questions. The interview emphasizes perception of child health risks and associated coping mechanisms. Risk perceptions and ways of mediating them is a key aspect of this research project. Other interview questions focused on themes around social capital, treatment experiences from childhood diseases within communities, treatment options etc. On the average, interviews lasted for 35 minutes with the longest being 57 minutes. Interviews were tape-recorded and written notes were taken.

3.5 Ethical issues and dilemmas

This section addressed two contentious ethical issues, among others, which emerged during the fieldwork and how they were addressed: informed consent and the role of identity in

shaping researcher-researched encounters. These issues reminded me of the importance of being reflexive, adaptive and sensitive to the local values and what constitute culturally appropriate behaviour (Herrick, 2010).

3.5.1 Informed consent and participant's confidentiality

The secondary datasets that were used for initial statistical analysis are public domain datasets that do not present further concerns about confidentiality. Upon registration and description of the research objectives, I was granted access to the datasets after a brief application process. However, written and oral informed consent was obtained at all levels of access during the primary questionnaire data collection. Informed consent was obtained from community gate keepers such as traditional rulers and community chiefs. This is a customary ethical research engagement/requirement especially in rural areas in Nigeria with predominantly traditional and informal leadership structures. I worked with 12 research assistants in 5 small neighbouring villages with estimated average population of 1500. In order not to create the feeling of 'invasion of the community's spaces', it was important first, to make our presence and intentions known to community gate keepers. We obtain informed consent from community gate keepers in all survey communities as first steps in negotiating access and establishing trust and cooperation of community members.

Most of the rural participants only gave consent because we had already obtained consent from their traditional leaders. From an African perspective, the 'I/We emphasizes respect for the self, the other, and others; it implies a unification of the self with the environment' (Chilisa, 2012:195). According to Chilisa, the western idea of individualism emphasises a one-on-one contractual agreement where researcher-researched relationships are defined by signed consent forms. This was not a problem for this study but rather challenges western normative presumptions about how this sort of individual informed consent works. This raises interesting ethical conundrums that are worth reflecting on. This experience of conducting fieldwork in the rural areas of Nigeria suggests that informed consent might not be essentially individual. There are different layers of consent and power structures to be negotiated: first, in negotiating access into the field and second, in recruiting research participants in a way that is respectful of community structures and cultural values. Written informed consent was obtained from most of the literate research participants who participated in the questionnaire survey and oral interviews. In cases of illiteracy, informed oral consent was obtained before participants were enlisted voluntarily in the research. Informed consent was also obtained before audio recordings of interviews and all the photographs taken.

3.5.2 Positionality: researching child health-risk as new mother.

Qualitative health research is vulnerable to bias through interpersonal and contextual components of research (Hewitt, 2007). The implications of the identity of the researcher on the research process may vary with the research context (2005, Keikelame, 2018). It is crucial for researchers to be transparent about how their identities and the specific circumstances in which knowledge is produced, influence the research process (Rose, 1997). Researchers need to critically examine different aspects of their positionality – in terms of their personal qualities and attitudes – ethnicity, race, gender, levels of education, age, disability, parenthood - in relation to the ways in which research is conducted and power relations are shaped between the researcher and the researched (Skelton, 2001) and document these in their research. It is common for researchers to strategically navigate multiple identities in the field, projecting or concealing different aspects of their identities in order to gain credibility on the part of research assistants. For example, Godbole (2014), in conducting research with rural women in Western India documented how she had to cleverly choose between revealing or hiding aspects of her identity, especially as a single woman in her late thirties, in order to build rapport with research participants. Whilst there were multiple instances where aspects of my multiple identities as a researcher in the field – age, educational level, ethnicity, gender, marital status, ‘privileged international student’, and institutional affiliations - influenced the course of this research and the expectations of research participants that I could discuss here, I have chosen to reflect on the dilemma of researching child health-risk factors as a new mother who was accompanied by her own 5-months old son. The implications of motherhood for female researchers have been less emphasised and thus I feel a need to address this gap by briefly documenting my experiences in this thesis.

3.5.2.2 Motherhood before fieldwork

My PhD research started with a focus on child health issues. One of my main concerns of conducting interviews with mothers of children aged under five years was whether they will be open to sharing their experiences with someone who was not a mother. My husband and I had tried medically for children without success for over 3 years before we both decided to undertake our PhDs at Durham University but in different academic departments. I was anxious about potential attitudes usually reflected in phrases like ‘it takes a mother to understand’ getting in the way of honest conversations. As a married woman in her thirties doing research at home, I was well aware of the subtle stigma of not having a child at my age in a culture where a majority of women mostly have their children in their twenties. I was aware and worried that my many years of education as a woman, might be considered

as amounting to almost nothing without children. However, I became unexpectedly but happily pregnant at the start of the second year of my PhD. I had to deliver my long awaited son before starting my fieldwork in January 2017. My son was 5 months old and exclusively breastfed when I started fieldwork. Conscious of my strict funding and visa conditions, I had no choice but to begin my fieldwork with my child as an accompanied researcher. This image of an accompanied researcher is rarely documented in social science research methodology. The account of Lunn *et al.* (2014) is an exception. In sharing their experiences of the different dimensions of accompanied fieldwork in India, they recognised that fieldwork images in the global south are predominated with images of the solitary researcher conducting research in distant places. Whereas in reality, accompanied status - family member, friends and colleagues - was more common and more significant for female researchers than documented. It is also often assumed that researchers have the power to decide whether they are accompanied for fieldwork. I argue that this might not be the case. The power of female postgraduate researchers to choose whether to be accompanied may depend on access to social capital and child care resources for which I was depleted. I had no power to choose. My husband could not come with me because as a student he could be away from studies beyond 4 weeks. I also had to impose the decision on my child because I was conscious of my international student status in the UK subject to the UK Home Office regulations, which also deprived me of access to maternity leave. It is beyond the scope of this thesis to provide further details of the ethical implications of the Home Office regulations on doing fieldwork for female international postgraduate students with young families.

3.5.2.1 Motherhood during fieldwork

As a new mother and a researcher interested in understanding the agency of women in relation to child health-risks, I have to acknowledge that my research participants and I are not mere research objects but subjects with agency, distinct histories and personal idiosyncrasies (Godbole, 2014). Our shared experiences of motherhood, influenced the interview trajectories, perceptions, the memories created and how child health-risk knowledge was shared.

Being a credible researcher: As a researcher that was accompanied by an infant, I was perceived by many mothers as having the credibility to conduct research on child health-risk. A majority of my research participants agreed to participate in the research because they saw me as both a poor student and a mother who needed their support to fulfil an important requirement of earning a degree. Many mothers thought it was very brave of me to be schooling and raising a young child at the same time. There was a general feeling of

pity for my son who they thought was being inconvenienced in the process. As the researcher, I felt similar emotions too, not just during fieldwork but also throughout the research process. I was often asked by participants if I needed to conduct the interviews to graduate from the university. I was not sure if they understood the difference between a first degree and a postgraduate research programme but I tried to explain. I was also often asked to specify how I wanted the questions to be answered because they thought it was to be accessed as either right or wrong like an elementary home work. I was not also sure if I succeeded in convincing all participants that I was genuinely interested in understanding the health-risk issues they faced or whether they merely saw me as a mother who was eager to learn for the sake of my own child. Being in the company of many research assistants also contributed to my respondent's perception of me as a 'young mother' (Figure 8a). All my 12 research assistants either were final year students or newly graduated from the University of Benin where I am also a staff. Being in the company of so many young students made many participants assume that I was probably in my early twenties, which might have influenced their feeling of pity. It also made me to realise in a good way that my age was not as obvious as I thought.

Whilst my motherhood status in no doubt earned me more credibility and empathy with many of the interviewed mothers, in discussing the subject of child health-risk within their neighbourhoods with me, this status often placed me in uncomfortable positions and reminded me of my position and the need for researches to be sensitive and behave in a culturally appropriate manner during fieldwork (2005, Greer-Murphy, 2018). I recall two independent conversations I had with separate women in May 2017.

Being culturally inappropriate: The first instance that resonates strongly with me involved a potential participant who was an older woman being offended because I used a baby carrier like an 'oyibo woman' (white woman). She thought it was culturally inappropriate that I strapped my baby with a baby carrier in front of me rather than the traditional way of strapping babies with wrappers in Nigeria. She was particularly upset by how my child's hands and head were positioned with the carrier. She said that she had observed the baby and me for some time before I approached her but could not hold back her anger. She felt I was being too 'western' and that I had put my status before the child's comfort. She felt that the 'innocent baby' was being '*punished*'. I apologised and tried to explain that I genuinely did not know how to 'tie wrappers' in the Nigerian way let alone strap a baby with it. I related how I had tried over the years to learn without success and that I was not very practical to travel around my case study areas with a baby strapped on my back. I am not sure she was convinced. Many people including friends and relatives back

home in Benin City previously expressed their disapproval for the baby carrier when I arrived. My reaction was usually that of ‘this is what works for me so mind your business’. Most people who verbally voiced their disapproval thought baby carriers were unsafe for the baby but I did not care much. The perception and reaction from a potential participant in a rural setting carried more weight than what the non-participants thought which speaks to the importance of power-relations in social interactions during fieldwork. I subsequently had to strap my baby on my back with the ‘Oyibo’ carrier and put a wrapper over it (Figure 8b) for the rest of the fieldwork period in the rural areas to avoid similar occurrences. My perception and utilisation of baby carriers changed significantly after that encounter.

A prim and proper city mother: the second example involved an encounter with a participant in a rural case study area during a questionnaire survey. She was educated up to secondary level and more educated than most of the participants I had interviewed in community. She wanted me to stay with her a little longer before leaving because she was concerned that the heat from the ‘hot sunshine’ would make my baby sick. I sat back just to please her. Her daughter was about a year old and was playing in a wet bare ground in front of her small grocery shop. It did not rain that day so I was not sure where the wetness in front of the shop came from. Then she said,

Participant: ‘You have been carrying him in your hands since you got here. Put your son down and let him play with my child’

Interviewer: ‘... thank you Ma’am, he is still too young, he cannot seat without falling yet’

A few minutes later, she offered me packaged water in a sachet to give to my child. I was hesitant and she knew it.

Participant: ‘give your son some water to drink, [hands me the packaged water] It is very hot today, you need to give him water regularly to avoid illness’

Interviewer: ‘Thank you so much madam for your kindness but he cannot drink water yet, he is on exclusive breastfeeding’ [interviewer began drinking the water].

Participant: laughs,... you these city mothers eh!, always wanting to be prim and proper. You really don’t want him to drink the water, do you?

I am not sure she was offended because we both laughed and I carried on explaining. Luckily, one of my research assistants helping with the questionnaire survey arrived. I used the opportunity to excuse myself, thanked the participant very well for her kindness, and departed. I realised that although I was doing fieldwork in my home country, Nigeria was too diverse to be entirely considered an insider. Although I altered the way I dressed and the research participant and I communicated in Pidgin English, I could not entirely fit into the informality of rural living. Perhaps it was also obvious to her that I was being over-protective of my child. Despite being very selective of what my son ate, drank or touched; and judiciously sleeping under-bed nets throughout the fieldwork, he still had three serious episodes of malaria that landed him in A & E, one episode of diarrhoea and skin rashes on his face (Figure 8c) that left two scars that are yet to disappear as I write this. My husband and I call these scars, PhD scars. I did not remember seeing any rash on the skin of any of my research participants including the baby girl that was playing in the mud, which speaks to the issue of adaptation. Researchers and those who accompany them do not always get scarred physically from doing fieldwork. However, the series of encounters and varied experiences, both expected and unexpected influence the way in which we derive meaning from the research output, our world views, who we are and perhaps who we become.



Research Assistants (a), researcher and her child. Child is strapped with both a baby carrier and a traditional Nigerian wrapper (b), researcher's child developed rashes on his face during fieldwork (c).

Figure.8: Ethical issues of accompanied fieldwork

Although, the issues of positionality are of more fluently reported in ethnographic research, which is increasingly been portrayed as the gold standard of social science research methods, in comparison to semi-structured interviewing methods, which are often critiqued as constituting only shallow and tightly regulated few encounters, (Kuus, 2013), I have clearly demonstrated, in support of Kuus' work, that issues of positionalities and quality observation are also important for questionnaire survey methods and one-off opportunistic semi-structured interviews. Like other personal interactions, questionnaire surveys and interviews like ethnographies involve encounters and the richness of data dependent on the quality of observations. Although there were many instances where my

status as a mother, and different aspects of my identity, shaped my encounter with research participants, a more detailed reflexive account of these experiences is beyond the scope of this mixed-methods chapter.

3.6 Conclusion

This chapter has presented the overall rationale behind the integrated approach and the specific methods utilised in addressing the research questions. Considering the diversity of the population of Nigeria and the complex nature of health inequalities, a combination of a variety of quantitative methods and qualitative approaches were needed to identify the geographical and spatial inequalities in under-five mortality at multiple scales and to shed more light on the context in which health inequalities are produced. The chapter first described the datasets and the analytical procedure followed for interrogating the secondary data. It then presented the primary questionnaire and semi-structured interview data collection and analysis. Lastly, I reflected on some ethical issues that emerged in the field and demonstrated the importance of the researcher's identity in survey research and semi-structured interviews. I have argued for researchers to be sensitive to the cultural and 'contentious' interpretations of what it means to obtain 'informed consent' and the local standards of 'reasonable behaviour in a research environment and the context' (Herrick, 2010:114).

CHAPTER 4

Identifying the Social Determinants of Under-Five Mortality at the National Level

4.1 Introduction

An improved understanding of the multiplicities and intersectionality of under-five mortality risk factors is central to reducing under-five mortality globally. An enhanced knowledge of the ways in which health-risk factors are co-constituted is crucial for meeting the United Nations (UN) Sustainable Development Goal 3.2 (SDG 3) of ending preventable deaths of new-borns and children under the age of five years in all countries by the year 2030. This chapter makes an important contribution to this agenda by exploring the underlying structure of the leading determinants of under-five mortality in Nigeria. The pooled Nigeria Demographic and Health Surveys (NDHS) cluster level data between 2003 and 2013 was used to provide a decadal overview of the main dimensions of under-five mortality at the national level within the Millennium Development Goals (MDGs) era. Exploratory Factor Analysis (EFA) was used to group 38 explanatory variables in to 5 dimensions of under-five mortality health risks. These five health-risk domains were then used to predict under-five mortality outcome in a linear regression model. The results reveal that children born to disempowered women who are unable to make basic household and health care decisions and domestic were more likely to die before their fifth birthday in the last decade. The results indicate that under-five mortality reduction efforts in this SDG era should move beyond biomedical approaches - for example, focus on vaccination programmes and the distribution of Insecticidal Treated Nets (ITNs) - to address the social context of women's lives. The discussion in this chapter is laid out in three broad sections. First, the analytical procedure is presented. The results of the EFA and the linear regression model are discussed next. The chapter then concludes with a discussion of results.

4.2 Dimensions of Interest

4.2.1 Outcome Variable

Out of 247,232 births recorded in the pooled survey data, 41,226 (16.7%) under-five deaths occurred and 206,006 (83.3%) children survived. However, this chapter focuses on the distribution of these deaths across communities. The proportion of under-five mortality at the community level represented by NDHS cluster points is the main measure of health thus serving as the outcome variable. As explained earlier in Chapter 1 under-five mortality is demonstrated to be an important indicator of population health and widely used by

international agencies to monitor progress in development due to growing evidence linking under-five health with the material and socioeconomic conditions of countries (Reidpath *et al.*, 2003, Silva, 2012, UNICEF., 2011). Under-five mortality rate was estimated for the 5 years preceding the survey. All children aged 0-59 months born within the time frame of the survey were considered as person-time exposures with all dead children aged 0-59 months at the time of death regarded as cases.

4.2.2 Risk Factors

In this part of the analysis, 38 explanatory variables with moderate to strong correlation coefficient (Pearson's: ≥ 0.5 , $p = .05$) with under-five mortality (in a single variable model where only one predictor variable is included with the dependent variable) were selected for further analysis (Table 6).

The procedures employed for selecting the 38 factors shown in the table above are described in chapter 3. These risk factors relate to possible causal pathways that may influence under-five mortality such as geodemographic attributes of women, the contextual socioeconomic characteristics of neighbourhoods in which they live and maternal and child care behaviour. For example, the proportions of women and partners with no education, illiteracy – not being able to read at all; indicators of socioeconomic position such as mean wealth index, proportions of respondents at the bottom 40% wealth level, lack of access to television and newspapers/magazines, not watching TV or reading magazines at all; rates of vaccination by mothers during pregnancy (tetanus injection during pregnancy, Vitamin A post-delivery), and proportions of children who have accessed preventive vaccines from childhood diseases (BCG, DPT, Polio and measles vaccines); lack of antenatal, delivery and postnatal care and unattended home delivery or delivery by unskilled attendant; lack of decision making power of women within the household (with only husbands having the say regarding health care and household purchases); domestic violence rate (being beaten for refusing sex, going out unpermitted); reproductive risk behaviours such as child marriage and first births below the age of 18 years and not using any contraception; 6th or higher birth orders.

Table 6: Descriptive statistics for items included in EFA

	Items	Mean	Std. Dev.	Skew	Kurtosis	
Disempowerment and reproductive behaviour	1	Only partner has the final say on large household purchases	50.50	28.75	.205	-1.139
	2	Only partner has the final say on respondent's health care	13.25	18.22	2.200	5.674
	3	Respondent has no education	40.82	36.72	.389	-1.409
	4	Partner has no education	34.20	33.10	.663	-.947
	5	No delivery assistance by anyone	11.03	17.79	1.943	3.286
	6	First marriage before 18 years	38.09	29.21	.202	-1.167
	7	Total births in the last five years (3 or more)	98.31	57.46	.833	.061
	8	No prenatal care by anyone	28.50	32.99	.975	-.459
	9	Only partner has the final say on visiting relatives	22.12	27.72	1.125	.122
	10	No antenatal visits to a health facility	24.36	30.97	1.231	.169
	11	First birth before 18 years	41.17	21.92	-.067	-.838
	12	No contraception used currently	79.79	20.85	-1.036	.520
Lack of maternal care	13	No tetanus injection before birth	75.69	30.16	-1.777	1.566
	14	Prenatal care by unskilled personnel	9.52	7.76	.540	-.347
	15	No health card	78.67	23.57	-1.954	3.397
	16	Vitamin A not taken 6 months before survey	81.48	25.82	-2.252	4.100
	17	No Vitamin A taken 2 months post delivery	89.91	15.12	-3.128	11.031
	18	Delivery assistance by unskilled personnel	81.01	23.17	-2.036	3.910
	19	Home delivery	46.11	36.50	.233	-1.514
Domestic V.	20	Respondent beaten if she goes out unpermitted	34.09	25.57	.541	-.517
	21	Respondent beaten if she argues with partner	28.52	23.32	.772	-.051
	22	Respondent beaten if food gets burnt	18.82	21.38	1.464	1.945
	23	Respondent beaten if she refuses sex	25.97	24.90	.930	.003
Vaccine uptake	24	Taken Polio 2 Vaccine	13.34	9.60	.656	1.426
	25	Taken Measles Vaccine	9.64	8.72	1.156	3.491
	26	Taken DPT2 Vaccine	11.00	10.31	.920	1.093
	27	Taken DPT1 Vaccine	12.36	10.75	.778	.715
	28	Taken DPT3 Vaccine	9.26	9.57	1.185	2.192
	29	Taken BCG Vaccine	12.85	11.21	.744	.507
	30	Taken Polio 0 Vaccine	13.80	15.56	3.185	3.490
	31	No pregnancy complications awareness	99.69	30.87	1.594	3.529
	32	Birth order number 6 and above	16.95	9.10	-.002	-.823
Socioeconomic Fac.	33	Has electricity	50.56	43.18	-.113	-1.797
	34	Mean Wealth Index	3.07	1.23	-.092	-1.256
	35	Does not watch TV at all	51.64	35.94	-.005	-1.504
	36	40% poorest clusters by wealth index quintiles	27.09	39.95	1.024	-.756
	37	Does not read newspaper/Magazine at all	39.69	94.76	23.154	5.819
	38	Literacy Level - cannot read at all	54.07	34.30	-.082	-1.411

4.3 Analytical Procedure

Given the independent nature of clusters, no trend analysis is carried out between survey years but rather broad patterns are shown in maps in order to demonstrate the consistency in regional pattern of under-five mortality rates and its determinants in Nigeria.

4.3.1 Descriptive Statistics

The analysis began by grouping 38 explanatory variables into broad health-risk components that represent the nature of interrelationships between risk factor using Exploratory Factor Analysis (EFA). See section 3.3.1 for the description of EFA.

4.3.1.1 Sample Size.

Sample size is important for factor analysis and academic literature on the subject is '*replete with recommendations pertaining to the minimum sample size necessary to obtain adequately stable factor solutions that closely approximates the population factors*' (Hogarty *et al.*, 2005) Hogarty *et al.* 2005: p:203. However, opinions regarding minimum number of cases required for EFA vary and strict guidelines have mostly disappeared from literature (Costello *et al.*, 2005). Williams *et al.* (2010) presents evidence from literature suggesting varying thresholds ranging from a minimum of 50-1000 and more. Comrey *et al.* (2013) book recommends: 100 as poor, 200 as fair, 300 as good, 500 as very good and 1000 or more as excellent. Studies have shown that the adequate sample size necessary for EFA should be subject to the nature of the data (Fabrigar *et al.*, 1999).

Varying opinions also exist regarding the rule of thumb for determining the adequacies of sample size for a researcher's data. There seems to be some form of consensus in literature that EFA is a large sample procedure in which more is better for generalizability and replicability of results (Costello *et al.*, 2005, Fabrigar *et al.*, 1999, Henson *et al.*, 2006, Tabachnick *et al.*, 2007, Williams *et al.*, 2010). Larger sample sizes are more likely to produce more accurate estimation of the population and improved factor recovery (Hogarty *et al.*, 2005). (Costello *et al.*, 2005, Tabachnick *et al.*, 2007) offer three guidelines for accessing best practices for factor analysis. These include; low to moderate item communalities in the social sciences of .04 to .70 correlations; a minimum item cross-loading lower than .32; and a factor with greater than three items as strong and stable factors. A cross-loading item is an item that loads at .32 or high for more than one than one item. All values are correlation figures and should be interpreted as such. Published research have also suggested examining the ratio of research cases to variables included in the factor analysis with recommendations ranging anywhere from a minimum of 3:1 to 20:1 (Tabachnick *et al.*, 2007, Thompson, 2004, Williams *et al.*, 2010). The sample size for this

research is 2144 and 38 variables are included in the EFA. The number of cases to variables ratio for this study is 50:1 which is considered well suited for EFA.

Although DHS samples are considered to be representative of the Nigerian population at the state level and not at the cluster level, this study argues that the cluster level information in the DHS data remains a good geography for gaining insight into small area health differences in a geographically diverse county like Nigeria where health and other social outcomes are likely to vary greatly (Table 7). High factor loadings of greater than .50 and up to .90 are observed for 33 of the 38 items with only two items namely, home delivery without skilled personnel, and illiteracy item showing a cross-loading of .36 and .39 respectively (see table 4.4).

Table 7: sample size per geopolitical zone of Nigeria

Geopolitical zones of Nigeria				
	Frequency (sample size)	Percent	Valid Percent	Cumulative Percent
North Central	383	17.9	17.9	17.9
North East	331	15.4	15.4	33.3
North West	432	20.1	20.1	53.5
South East	289	13.5	13.5	66.9
South South	334	15.6	15.6	82.5
South West	375	17.5	17.5	100.0
Total Sample	2144	100.0	100.0	

4.3.1.2 Extraction

Although some researchers have argued that there are no significant differences between Principal Component Analysis (PCA) and Principal Axis Factoring (PAF), the latter is the preferred method of factor extraction in this study. Evidence in the literature shows that PAF is well suited for determining the latent structure in social science data because it focuses on the common variance between variables (Costello *et al.*, 2005, Thompson, 2004, Williams *et al.*, 2010) compared with PCA, which is largely a data reduction method. Widely supported best practices in literature recommend using multiple rules to determine the number of factors to retain. Five rules were used to determine the number of factors to retain in this study. These include: eigenvalue > 1 rule (Kaiser, 1960); scree test (Cattell, 1966); Bartlett's Chi square test; cumulative percentage of variance explained; and Cronbach's Alpha measure of internal consistency for items in each factor.

Researchers have cautioned that all of these methods could yield inconsistent results. Often, the researcher will need to make a judgement based on interpretability and theoretical construct of the research (Field, 2009, Zwick *et al.*, 1986). (Velicer *et al.*, 1990) cautioned that the eigenvalue > 1 rule is an unreliable method for selecting the number of

factors to retain and suggest the use of a scree test. The scree test in this study was interpreted by drawing a straight line through the smaller Eigenvalues. The number of factors above the natural breakpoint where a departure from this line occurs or where the data begins to flatten out were retained (Costello *et al.*, 2005, Hogarty *et al.*, 2005). However, the outputs from the scree test and eigenvalue > 1 rule are inconsistent. While the initial eigenvalue rule suggest a five-factor solution (see Figure 9), the scree plot is less clear given the presence of double inflection points indicating that 4-7 factors could be retained. The data was re-run four times setting the number of factors to be extracted at four, five, six and seven. The five factor solution was retained.

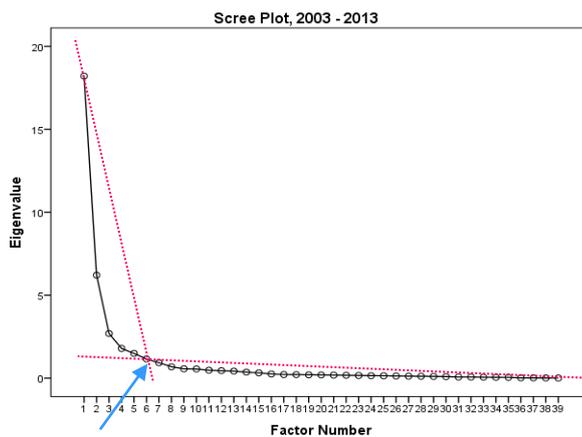


Figure 9: Fitness indices for EFA model

2003 - 2013 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.947
Bartlett's Test of Approx. Sphericity	122770.325
df	741
Sig.	0.000

4.3.1.3 Rotation

Direct Oblimin, which is an oblique rotation method, was used in this study because it is expected that social determinants of under-five mortality and reproductive behaviour be correlated with one another. This rotation method is well supported for studies in social sciences and humanities (Comrey *et al.*, 2013, Fabrigar *et al.*, 1999, Henson *et al.*, 2006). This method produced high loadings for most items in this study. After rotation, the five factor solution produced the 'cleanest' (Costello *et al.*, 2005) factor structure with only two items related to home delivery and lack of literacy having cross-loadings greater than .32. However, these were not discarded because of the accumulated evidence demonstrating the conceptual significance of place of delivery (Kitui *et al.*, 2013) and literacy levels (Monden *et al.*, 2012) as social determinants of under-five mortality in developing countries. No factor has fewer than four items. Items with low loadings and high cross loadings such as type of cooking fuel variable were discarded. A very high KMO and Bartlett's test of .947 was obtained with .50 considered suitable for factor analysis (Williams *et al.*, 2010). All five factors cumulatively explained 75% (Table 8) of variance. A 50-60% explained variance is considered as an acceptable minimum threshold in the social sciences. The internal consistency of items classified under each factor was examined using reliability analysis. A

reliable Cronbach's alpha coefficients ranging from .827 to .927 (Table 9) were observed for all factors indicating high internal consistency of the structural items of the factors. Recommended minimum threshold range from 0.6 to 0.7.

Table 8: Total variance explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings ^a
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
	1	18.204	46.678	46.678	17.970	46.076	46.076	12.484
2	6.203	15.904	62.582	6.061	15.541	61.617	7.797
3	2.688	6.892	69.474	2.473	6.342	67.959	6.884
4	1.789	4.587	74.061	1.540	3.949	71.908	13.292
5	1.490	3.821	77.882	1.213	3.112	75.020	13.137

4.3.1.4 Interpretation

The labelling and meaningfulness attributed to factors are highly subjective and inductive processes largely dependent on the researcher's interpretation of the data (Henson *et al.*, 2006, Hogarty *et al.*, 2005). As already discussed, of all fit indices of the four models tested, the 38 item and five-factor model fits the data and theoretical framework best. All factors have a minimum of four items loading strongly (.50 and greater) indicating that factors are solid. All items observed under each factor are examined and appropriate themes assigned (Table 9). From the first factor to the last, the themes are disempowerment and reproductive risk behaviour (DRB), maternal care (LMC), domestic violence (DV), vaccine uptake (VU) and socioeconomic factors (SF).

All factors from EFA and other sociodemographic variables of interest were classified into three sub-groups for further descriptive analyses. The number 1 is assigned to survey clusters with worse outcomes for all outcome and explanatory factors with 3 indicating better outcomes. For example, 1 indicates cluster with the highest (worst) mortality rate for the outcome variable that is under-five mortality, and clusters with the lowest (best) rates are classified as 3. Similarly, clusters with the highest levels of female disempowerment in Nigeria are classified as 1 and therefore considered high risk areas for under-five mortality rates. Clusters with relatively low levels of disempowerment that is considered better for under-five survival rates are classified as 5.

Table 9: Pattern structure of factor scores from EFA

2003 - 2013 Pattern Matrix ^a		Factor (>. 30)					Reliability	
		1	2	3	4	5	Cronbach's Alpha	Cronbach's Alpha if Item Deleted
S/N	Child and Maternal Health Indicator	Disempowerment	Maternal Care	Domestic Violence	Vaccine Uptake	Socioeconomic Factors		
1	Only partner has the final say on large household purchases	.908						.916
2	Only partner has the final say on respondent's health care	.850						.916
3	Respondent has no education	.626						.912
4	Partner has no education	.595						.913
5	No delivery assistance by anyone	.575						.923
6	First marriage before 18 years	.487					.927	.916
7	Total births in the last five years	.464	.304					.933
8	No prenatal care by anyone	.454						.920
9	Only partner has the final say on visiting relatives	.452						.930
10	No antenatal visits to a health facility	.422						.920
11	First birth before 18 years	.351						.921
12	No contraception used currently	.303						.922
13	No tetanus injection before birth		.949					.898
14	Prenatal care by unskilled personnel		.922					.898
15	No health card		.915					.902
16	Vitamin A not taken 6 months before survey		.903				.921	.909
17	No Vitamin A taken 2 months post delivery		.866					.915
18	Delivery assistance by unskilled personnel		.860					.903
19	Home delivery	.355	.419					.937
Extraction Method:		Principal Axis					Factoring.	
Rotation Method:		Oblimin with Kaiser Normalization.						
a. Rotation converged in 12 iterations.								

Table 9 (contd).

2003 - 2013 Pattern Matrix ^a		Factor (> .30)					Reliability	
		1	2	3	4	5	Cronbach's Alpha	Cronbach's Alpha if Item Deleted
S/N	Child and Maternal Health Indicator	Disempowerment	Maternal Care	Domestic Violence	Vaccine Uptake	Socioeconomic Factors		
20	Respondent beaten if she goes out unpermitted			.879				.779
21	Respondent beaten if she argues with partner			.864			.934	.776
22	Respondent beaten if food gets burnt			.854				1.000
23	Respondent beaten if she refuses sex			.817				.816
24	Taken Polio 2 Vaccine				.977			.840
25	Taken Measles Vaccine				.967			.835
26	Taken DPT2 Vaccine				.965			.826
27	Taken DPT1 Vaccine				.963			.826
28	Taken DPT3 Vaccine				.948		.870	.829
29	Taken BCG Vaccine				.923			.826
30	Taken Polio 0 Vaccine				.823			.871
31	No pregnancy complications awareness				.589			.870
32	Birth order number 6 and above				-.370			.936
33	Has electricity					.897		.867
34	Mean Wealth Index					.876		.756
35	Does not watch TV at all					-.810		.763
36	40% poorest clusters by wealth index quintiles					-.617	.827	.808
37	Does not read newspaper/Magazine at all					-.548		.780
38	Literacy Level- Cannot read at all	.389				-.482		.778
Extraction Method:		Principal			Axis		Factoring.	
Rotation Method: Oblimin with Kaiser Normalization.								
a. Rotation converged in 12 iterations.								

4.4 Dimensions of risk for under-five mortality

A total of 2,135 NDHS clusters containing summary information for 247,232 birth records were included for spatial analysis in the GWR and Getis-Ord_Gi* statistics. Clusters with less than 25 records and missing values in any of the indicators were excluded from the GIS-based spatial analyses. About 2,135 NDHS clusters containing summary information for 247,232 birth records were included for spatial analysis in the GWR and Getis-Ord_Gi* statistics. Clusters with less than 25 records and missing values in any of the indicators were excluded from the GIS-based spatial analyses.

The results from the EFA show a 38-item five-factor model (previously shown in Table 6). The descriptive statistics associated with the 38 items are shown in Appendix 1. The five factors explained 75% of total variability in the pooled DHS cluster data, 2003-2013. Underlying themes uncovered relate to: female disempowerment and reproductive behaviour, maternal care, domestic violence, vaccination rates and socioeconomic status. The observed latent factors of under-five mortality can be broadly classified into two broad themes: namely, female disempowerment and care behaviour. For the 10 year period, 2003-2013, female disempowerment appears to be the most dominant factor accounting for 46% of total variability explained in the data selected for EFA. Lack of maternal care and domestic violence are found to account for 16% and 6% respectively. Vaccine uptake and socioeconomic risk indicators account for 4% and 3% respectively.

4.4.1 Female disempowerment and reproductive behaviour

Figure 10 shows the 12 Items that are loaded into the disempowerment factor. These include clusters containing high proportions of women where only male partners have the final say on large household purchases, respondent's health care choices and visits to respondent's family. The disempowerment factor also reflect that 41% of women in the survey and 34% of their partners have no education, indicating a 7% gender gap between couples to the disadvantage of women. 51%, 13% and 22% do not have a final say on large household purchases, their own health care decisions or visits to relatives respectively. 38% and 41% got married and gave birth before the age of 18 years. 80% of women do not use any modern contraception and 98% had 3 or more children within five years, 24% had no antenatal services of any kind, 46% delivered at home and 11% had no assistance by anyone during delivery. This factor shows a strong positive relationship (.584, $p = .000$) with the dependent variable indicating that under-five mortality will increase as more women become disempowered.

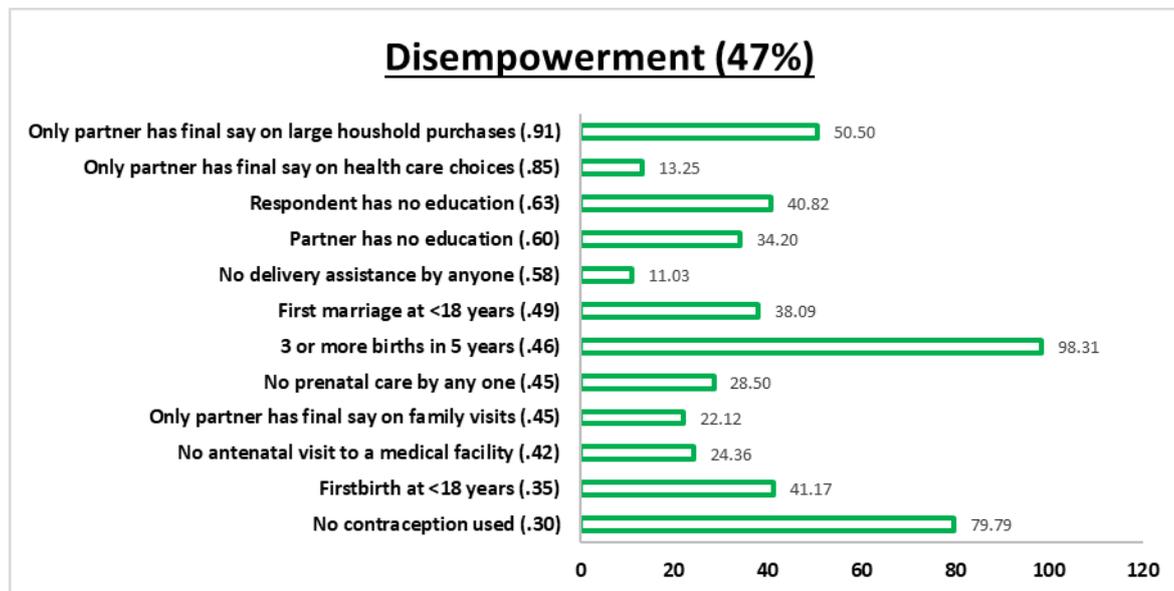


Figure 10: Female disempowerment indicators

The figures indicated in the variables labels in Figures 10-14 are the factor loadings derived from EFA.

4.4.2 Lack of Maternal Care

As shown in Figure 11, the second factor which relates to lack of maternal care comprise 8 items such as not taking relevant preventive vaccines during pregnancy indicating poor maternal health care in Nigeria. 76% of women did not take tetanus injections during their last pregnancy, 81% delivered without the assistance of skilled personnel, 90% did not take vitamin A within two months after delivery and 79% did not have health cards at all. Lack of pregnancy care health services shows a positive but weak association ($.242, p = .000$) with under-five mortality rate in Nigeria.

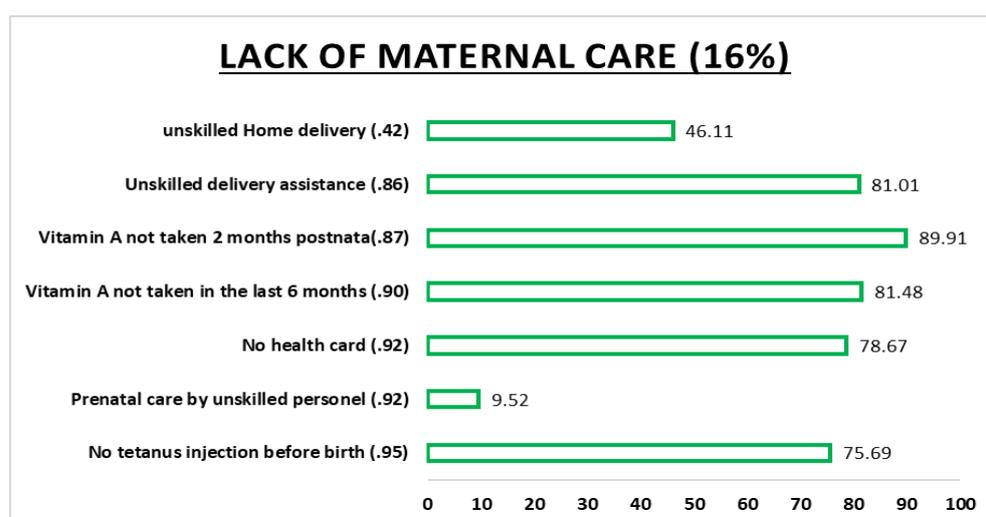


Figure 11: Lack access to maternal care

4.4.3 Domestic Violence

The domestic violence factor shown in Figure 12, accounts for 6% of the variation in the pooled NDHS data. It shows a moderate association ($.420$, $p = .000$) with under-five mortality rate indicating that more children are likely to die before their fifth birthdays as more women suffer abuse from abuse in their relationships with their partners. 4 items loaded into the domestic violence factor which signals high prevalence of domestic abuse of women by their partners in Nigeria. This factor define women who are likely to get beating justified by their partners for going out without their permission ($M = 34\%$, $SD = 25.57$), arguing ($M = 28\%$, $SD = 23.32$), refusing sex ($M = 26\%$, $SD = 24.90$) or burning food during cooking ($M = 19\%$, $SD = 21.38$) in the five years preceding the survey.

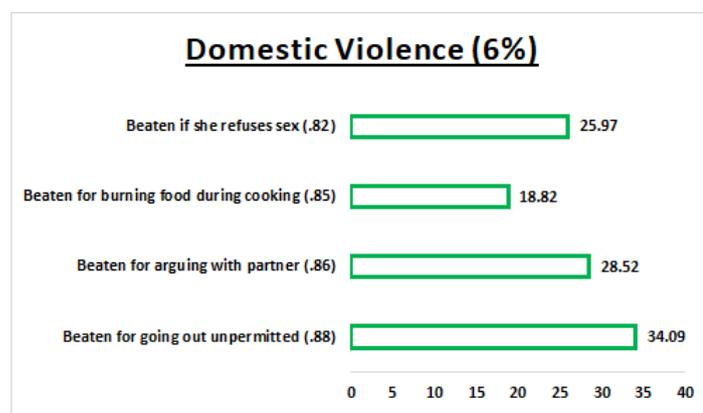


Figure 12: Spousal domestic violence

4.4.4 Childhood Vaccination

Figure 13 indicates that there are rather low rates of vaccinations in Nigeria. The vaccination rate indicator, which is the 4th factor from EFA accounts for 4% of variability in the pooled data. It indicates levels of access to child preventive vaccines such as polio (13.8%), Bacille Camette Guerin (BCG – 12.8%), and Diphtheria, Pertussis and Tetanus (DPT₁ – 12.36%) with measles recording the least uptake (9.6%). 99.7% had no pregnancy complications awareness during their last pregnancy. Like the domestic violence factor, the vaccination rate in the study data is moderately but negatively associated ($.499$, $p = .000$) with under-five mortality rate indicating that under-five mortality will reduce as more children within surveyed communities access vaccines from childhood diseases.

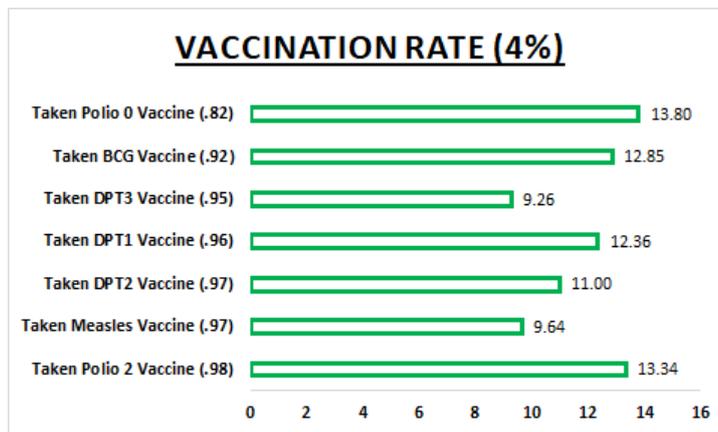


Figure 13: Childhood vaccinations

4.4.5 Socioeconomic Factors

The 5th factor is indicative of area socioeconomic characteristics (Figure 14). Although it accounts for the lowest variability in the data (3%), it shows a negative but strong association (.557, $p = .000$) with under-five mortality rate. This means that the under-five mortality will reduce as socioeconomic circumstances of communities improve. Items loaded into this factor include: presence of electricity in the community (51%), mean wealth index quintile (3.07), illiteracy levels (54%) and never watching television (52%) or reading magazine at all (40%) and 27% belonging to the poorest 40% quintiles. Vaccination rate and socioeconomic factors show some inverse relationship with under-five mortality, which means that as these factors' vaccination rates and socioeconomic advantage increase, under-five mortality rate, will reduce. The other three factors have positive relationships so that under-five mortality rate will increase as they increase (Table 10).

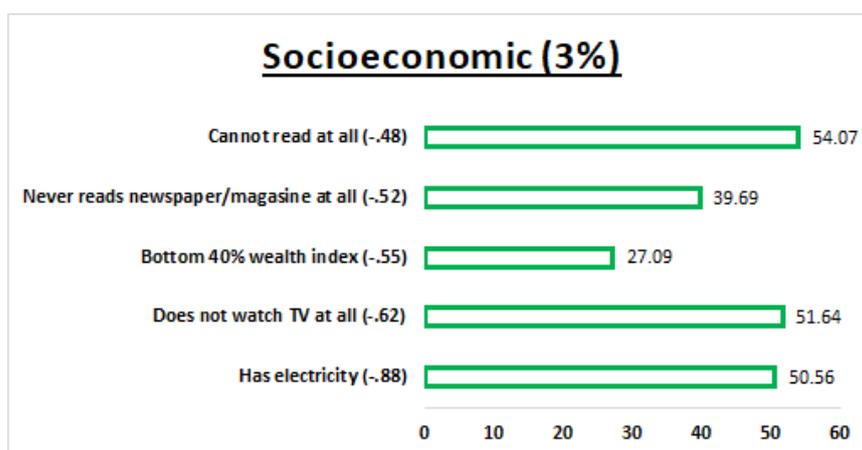


Figure 14: Female socioeconomic factors

Table 10 shows the average mortality rate and all five underlying risk factors. The cluster level under-five mortality rate for Nigeria is 145 per 1000 live births. While some cluster recorded no under-five mortality at all in the five years prior to the survey, some recorded maximum under-five mortality rate as high as 513 per 1000. The output returned from the

EFA model are standardised values indicating the relative position of each cluster to the mean, which is 0. For example, while some clusters will have high levels of women who are likely to be disempowered with poor reproductive choices up to the value of 2.18, others appear to be relatively less disempowered exhibiting lower than average disempowerment values of -1.89. Similar dispersion patterns for all risk factors are observed with minimum and maximum values of .97 and 1.00 respectively. Vaccination patterns are more likely to be variable between clusters compare with the rest of the risk factors.

Table 10: Descriptive statistics for under-five mortality rate and risk factors

	Min	Max	Mean	Std. Dev.	Variance	Skew	Kurtosis
Under-Five mortality rate (DV)	0.00	51.26	14.50	8.44	71.266	.677	.110
1. Disempowerment & reproductive behaviour (IV)	-1.89	2.18	0.00	0.97	.950	.526	-1.066
2. Lack of maternal care (IV)	-3.95	1.02	0.00	0.99	.981	-2.006	3.514
3. Domestic violence (IV)	-1.56	3.88	0.00	0.97	.936	.885	.568
4. Vaccine uptake (IV)	-1.37	7.06	0.00	1.00	.993	.984	1.476
5. Socioeconomic factors (IV)	-2.18	2.24	0.00	0.99	.983	-.034	-1.246

Valid N (listwise) = 2032.

Maximum standard error for skewness and kurtosis are .054 and .109 respectively. For the shaded role represents the dependent variable (DV) & independent variables (IVs) 1-3, lower values are better for health, while 4-5, higher values are better for under-five health

4.5 Multivariable Statistics

It is recognised that none of these five risk factors can operate in isolation from other factors. Therefore, a multivariable analysis of the data was performed to confirm the collective influence of identified risk factors on under-five mortality. This study hypothesises that; as; levels of female disempowerment increase in a DHS cluster, under-five mortality will increase; as lack of maternal care increases, under-five mortality will increase; as more women suffer domestic violence, under-five mortality will increase; as the child vaccination rate increases, under-five mortality will decrease; and as the socioeconomic status of women in a DHS cluster increases, under-five mortality will decrease, *ceteris paribus*.

4.5.1 Multiple Linear Regression

As an initial step in the analysis of relationships, a traditional or global regression model is estimated for under-five mortality rate in Nigeria in line with the hypothesis. The specified hypotheses are supported by the Ordinary Least Squares (OLS) regression results given in Tables 11-13. The results of the analysis indicate that there is a strong association between all factors collectively with under-five mortality confirmed by a strong Pearson's correlation

coefficient of 0.67. The R^2 value for the model is 0.45 indicating a moderate fit to the data. Overall, the regression model explains 45% of the variability ($R^2=.45$, $p<.005$) in under-five mortality in Nigeria for the 10 year period, 2003-2013. All parameter estimates are significantly different from zero at the 95% confidence interval and all indicators have the expected direction of association with under-five mortality rate.

Table 11: Regression model summary

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	.671a	.450	.449	6.108	.450	331.568	5	2026	.000

Table 12: Multiple linear regression significance test

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	61843.066	5	12368.613	331.568	.000b
	Residual	75576.656	2026	37.303		
	Total	137419.722	2031			

a. Dependent Variable: Under-Five Mortality Rate

b. Predictors: (Constant), (Dis)empowerment and Reproductive Behaviour, Lack of Maternal Care, Domestic Violence, Vaccine Uptake, Socioeconomic Factors

The slope of the coefficient for all factors was 14.188% indicating that under-five mortality increases by approximately 14% when all underlying factors are accounted for (table 13). The model is expressed as:

$$U_5M(Y) = 14.19(\beta_0) + 2.58(DRRB) + 0.56(LMC) + 1.43(DV) - 1.17(VU) - 1.7(SF) + \epsilon$$

Table 13: Multivariable regression coefficients

Coefficients ^a									
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	14.327	.136		105.710	.000	14.062	14.593		
Disempowerment and reproductive behaviour	2.612	.187	.316	13.933	.000	2.244	2.979	.546	1.830
Lack of maternal care	.384	.163	.046	2.355	.019	.064	.703	.738	1.355
Domestic violence	1.298	.160	.155	8.098	.000	.984	1.612	.767	1.303
Vaccine uptake	-1.144	.191	-.139	-5.992	.000	-1.518	-.770	.523	1.911
Contextual socioeconomic	-1.694	.201	-.207	-8.432	.000	-2.088	-1.300	.468	2.139

factors

a. Dependent Variable: Under-five mortality outcome

Tolerance and variance inflation factor (VIF) values are well below the frequently used range of cut-off points of 1.0 and 9. This result suggests that collinearity is not a significant problem with this data and can be used for further spatial regression modelling like geographically weighted regression (GWR). The scatter plot of standardised residuals versus standardised predicted values in Figure 15a-b shows that the data met the assumptions of homogeneity of variance, linearity and normality of residuals.

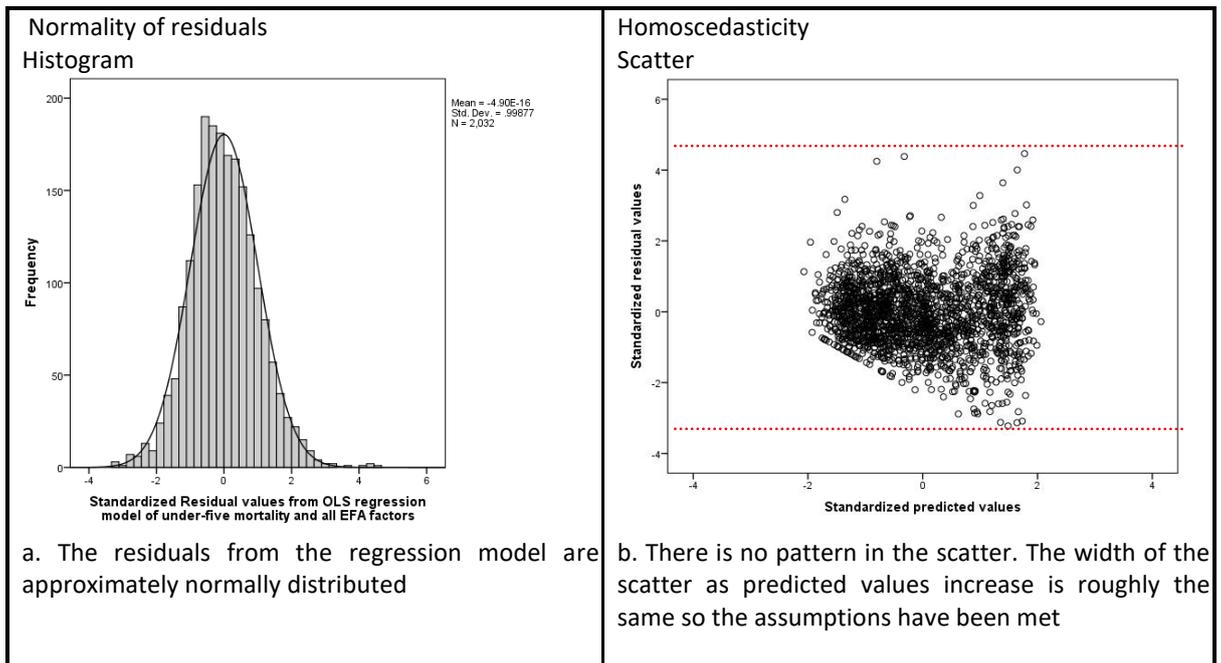


Figure 15: Regression assumptions are adequately met

The result of the multiple linear regression calculated to predict under-five mortality rate using identified risk factors shows a significant regression equation ($F(5, 2026) = 331.568$, $P < .000$), with an R^2 of .45. This means that the five risk factors together explained 45% ($R^2 = .45$, $p < .000$) of variability in under-five mortality rate with 55% of variability in under-five deaths unexplained. Thus under-five mortality can be predicted with the equation:

$$\text{Predicted under-five mortality} = 14.19 + 2.58(\text{Disempowerment \& Reproductive Risk Behaviour}) + 0.56(\text{Lack of Maternal Care}) + 1.43(\text{Domestic Violence}) - 1.17(\text{vaccine Uptake}) - 1.7(\text{Socioeconomic Factors}).$$

Under-five mortality increased by 2.58%, 0.56%, 1.43% for each unit increase in the factors scores of disempowerment and reproductive risk behaviour, lack of maternal care domestic violence respectively and increases by 1.17% and 1.7% for reduction in vaccination uptake and socioeconomic advantage.

4.6 Discussion

Under-five mortality research is important in health geography discipline because it is a widely used indicator of overall wellbeing and progress in society (or lack of it). It also reflects the state of health care delivery and cultural practices in many countries (Mohammad *et al.*, 2017) including Nigeria. This chapter attempted to examine the underlying structure of under-five mortality risk from 38 community risk factors which demonstrate above average Pearson's correlation coefficient with under-five mortality rate using a pooled NDHS cluster level data from 2003, 2008 and 2013 surveys. The findings in this study show that under-five mortality remains a public health emergency in Africa including Nigeria as the region continues to record disproportionately high rates of mortality compared to other developed regions. The observed average mortality rate is 14.5%. This means that estimated 15 out of every 100 children born in Nigeria will die before their 5th birthday compared with 8 in 100 in Sub-Saharan Africa and 1 in 189 for high income countries in Europe and North America. The results of the exploratory factor analysis confirm the multi-dimensional nature of social determinants fuelling observed high risk of under-five mortality in Nigeria. The structure of the five underlying determinants revealed relate to women decision making power within the household, maternal care choices, domestic violence, vaccination rates and contextual socioeconomic factors.

The results of the exploratory factor analysis highlight the multi-dimensional nature of social determinants of under-five mortality in Nigeria. The structure of the five underlying determinants revealed is interesting and they relate to politics of decision making within the household, maternal care choices, domestic violence, vaccination rates and contextual socioeconomic factors. The first factor accounts for 56% of variability in the data and indicate that the level of disempowerment of women in communities is the most dominant risk factor (56%) for under-five mortality in Nigeria in the 10-year period. It is informative that items relating to lack of education of women and their partners, influences of household decision making and reproductive behaviour of interviewed women have been linked together under the most dominant factor in one decade of pooled data examined. Interrelationships between educational levels of women and their partners, women's influence in daily household politics and reproductive choices evident in the findings of this study is supported in literature. The findings from the study of (Brinda *et al.*, 2015) which examines the association between gender inequality and child mortality rates of 138 countries, supports the results in this study which indicate that female disempowerment is a multidimensional construct. Their study points out that gender-based stereotype can lead to inequalities in health care access, education, employment, autonomy and freedom, and

slow down national and global economic growth and overall social development. Increasing educational levels of women have been demonstrated as being central to women's empowerment (Becker *et al.*, 2006, Caldwell, 1979, Caldwell, 1986). Accordingly, the findings of this study show that the educational level of the husbands of interviewed women is an important factor in female disempowerment and subordination. The SDGS must prioritise increasing women's power to influence domestic and health decisions because doing so could help reduce the mortality risk of under-five children and improved reproductive behaviour. Women should be able to make independent health care decisions relating to their own health and the health of their children (Bloom *et al.*, 2001, Osamor *et al.*, 2016).

Education provides women with tools to make healthy reproductive and child health choices, challenge stereotypes, support positive social interactions and healthy decision making (Bambra, 2016). The educational level of a woman and that of her spouse is a frequently used indicator in spatial epidemiology as an important predisposing factor for fertility, maternal (antenatal, delivery and postnatal) health outcomes and a strong determinant of women's employment opportunities, social class and overall empowerment. Babalola *et al.* (2009) observe that education serves as a proxy for improved maternal health awareness and cognitive functioning. Women that are more educated are more receptive to maternal health information and more likely to communicate with and access available health services. (Solar *et al.*, 2010). Improved education is demonstrated in the literature to have a positive association with enabling factors: better employment, improved access to material resources, nutrition, self-worth, and affordability of cost of medical care, enhanced level of decision making autonomy and increasing freedom to make maternal health related choices. Female empowerment is:

*'a process whereby women become able to organise themselves to increase their own self-reliance, to assert their independent right to make choices and to control resources which will assist in challenging and eliminating their own subordination'.
(Keller et al., 1991:76).*

The Nigerian Demographic Health Surveys (NDHS) and several other findings show that women with more than secondary education are more likely (97%) to have stable employment and to receive antenatal care from a skilled provider in a public hospital as compared with 36% of women with no formal education. 95% of women in the highest wealth quintile received antenatal care from a skilled provider compared with 25% in the lowest quintile (Nash *et al.*, 1992, Ogu *et al.*, 2012, Okafor *et al.*, 2014b, Peters *et al.*, 2014). The study of (Titilayo *et al.*, 2017) highlights the relationship between age of marriage and the risk of under-five mortality. They observed that women who married before the age of

18 years in Nigeria are 3 times more likely to experience under-five mortality compared with women who married after the age of 25 years.

Child marriage is likely to reduce the educational development of women and stall social development and social mobility of women and functioning within society with consequences for lack of autonomy and household poverty. Overall, female disempowerment reflects educational, employment and social status of women and social networks and may be influential on reproductive and health care behaviour and access to certain privileges. Opposite patterns such as reduced influence in household politics, positive social network, economic opportunities, and limited maternal and child care choices are expected for communities with high proportions of uneducated and disempowered women so that lack of education, decision making power and maternal care indicators are rightly classified into the most dominant risk factor for under-five mortality in this study. (Nash *et al.*, 1992, Ogu *et al.*, 2012, Okafor *et al.*, 2014b, Peters *et al.*, 2014). Female disempowerment reflects social standing and networks and may be related maternal health seeking behaviour through the lack of access to certain privileges. However, the influence of social networks on health seeking behaviour remains largely unattended (Magadi *et al.*, 2003, Phillips *et al.*, 1998).

The second risk factor, which accounts for 16% of variability in the pooled data, relates to pregnancy and delivery care behaviour. The findings in this study support research agreement strongly linking lack of skilled antenatal attendance and delivery care with increased risk of child mortality (Alam *et al.*, 2015, Anwar *et al.*, 2008, Rai *et al.*, 2012). The observed weak but positive association (.242) between lack of maternal care and increased risk of under-five mortality with access to maternal care is the lowest of all risk factors in this study. This could indicate that progress has been made in the provision of pregnancy and delivery care services in communities compared with female disempowerment and reproductive risk behaviours. However, more needs to be done in improving access to maternal care for vulnerable groups and rural populations. Health service provision is not measured in NDHS surveys, which is a major limitation of this study. Studies have shown that the poorest groups in these Sub-Saharan Africa may not be able to afford the out-of-pocket payments for maternal care services at the time they use them (Adeyemi *et al.*, 2014, Chirdan *et al.*, 2013).

In Nigeria, most maternal and child health services are poor and utilization rates for all three components of maternal health care: antenatal care (ANC), skilled delivery and postnatal care (PNC), remain low. The existing pattern of utilization is demonstrated as

closely linked to inadequate health care infrastructure and positions of populations on the socioeconomic ladder. Even in developed western regions, where health care systems are sufficiently developed with high access rates, evidence suggests that there is a limit to which improvements in the provision of health services will lead to better health outcomes for all in the absence of a wider strategy to change the socioeconomic deprivation and environmental circumstances in which risks of non-use arise (Davey, 1993).

Domestic violence accounts for the 3rd largest variability in the data (6%). The descriptive statistics reveal shocking high estimates of domestic violence (between 19% and 34%) in Nigeria including the inability of interviewed women to negotiate sex and lack of freedom of movement. The observed positive association between spousal violence and controlling behaviour (.420) suggests that increased violence against women increased the risk of under-five mortality within the decade of study. This indicates that protecting women's right and freedom from physical and sexual violence could be an indirect pathway to accelerating gains in under-five survival in order to meet SDGs in Nigeria. Unfortunately, domestic violence has been largely neglected in public health strategies by researchers, policy makers and practitioners (Hove *et al.*, 2011). The findings of this study are supported in the literature as several studies have linked violence against women with mortality in children in many developing countries. This link persist across cultures and religious affiliations (Åsling-Monemi *et al.*, 2008). There is an academic evidence that domestic violence could be part of a larger female disempowerment landscapes of women and reflecting limited access to economic and health resources (Roman *et al.*, 2013), physical and social mobility and lack of autonomy (Amoroso *et al.*, 2018).

Uptake of childhood preventive vaccines (4%) and community socioeconomic factors (3%) account for the lowest variability in the pooled data but continue to present moderate and strong risks (-0.499 and -0.557, $p = .000$) to under-five health. The negative associations with the under-five mortality rate indicate that the under-five mortality rate will reduce with their improvements. These statistics suggest that Nigeria needs to do more in tackling persisting challenges relating to vaccination coverage and community socioeconomic conditions. Although Nigeria has achieved significant progress in reducing mortality from childhood diseases through vaccinations, for example, an estimated 15.6 million deaths have been averted through measles vaccines since the year 2000, sustaining and improving the health gains from community socioeconomic development in Nigeria might require that the social context of women's lives are addressed. Recent development reports point out that, not only has Nigeria failed to meet MDG₁ of eradicating poverty, more people may be falling into extreme poverty as we approach 2030. According to the 2018 Brookings report (Kharas *et al.*, 2018), Nigeria has overtaken India as the country with the highest concentration of

extremely poor people and growing poverty in the world. Nigeria has also been classified as one of the 31 ‘off-track’ countries that are not making positive gains in towards the SDG 1 (ending poverty in all its forms and everywhere) by 2030.

In the context of MDGs, the findings in this study suggest that maternal care programmes and strategies targeted at improving community socioeconomic circumstances may have been more successful in Nigeria compared with female empowerment and female reproductive health interventions. This is not surprising as the MDGs strategies in Nigeria and globally, disproportionately emphasized one-size-fits-all biomedical approaches and lacked recognition for the role of context-specific agency in influencing conditions that determine their health (Labonté *et al.*, 2005). It could be argued that the impact of biomedical programmes are much easier to assess in the short term compared to socioeconomic and cultural impacts which require a long term multidimensional strategy.

The relative ‘ease’ of assessing the impact of biomedical interventions such as delivering vaccines particularly makes it more suitable for the short lifespan, usually 4-5 years, of most politicians. This study points out that beyond the much needed quick impact biomedical interventions, efforts to eliminate all preventable deaths of children must eliminate wider-social economic disadvantage within which under-five mortality is likely to occur. Longer-term incremental approaches have been demonstrated as being more successful in achieving development goals. For example, Rwanda, one of the few low income countries to meet MDG4 by 2015, achieved an estimated 68% decrease in under-five mortality between 2002 and 2012. According to the study of (Amoroso *et al.*, 2018:2)

Rwanda’s success was attributable to integrating the quick impact short term initiatives into a *‘longer-term strategy, and included the elimination of user fees for some health services, the expansion of access to sexual and reproductive health information and services, and the training and support of community health workers’*. Nigeria clearly has a lot to learn from countries like Rwanda which have made significant gains and must develop institutions that could work together to reduce persisting poverty and wealth inequalities, empowering women through skills and education (not just literacy), increasing access contraceptive, pregnancy and delivery care services, eliminating out-of-pocket payments by providing health insurance and addressing social inequities and cultural barriers to healthy and affordable reproductive care.

4.7 Study Limitations and Strengths

Several limitations need to be considered in interpreting the findings of this study. The first sets of limitation relate to the weaknesses inherent in the NDHS cluster level data. First, the

NDHS is based on self-reported information from interviewed women so that there are possibilities for reporting bias in the observations. Secondly, the national representativeness of the NDHS sampling designed must be understood in the context of the politics shaping the creation of administrative units in Nigeria. The creation of Nigerian states and LGAs are a product of ethnic tensions and political interests and may not reflect actual heterogeneity of the existing population. NDHS cluster locations are distorted therefore presenting the risk of misclassifying individuals into inappropriate administrative boundaries.

NDHS cluster centroids are not maintained for all survey years so that the data cannot be utilised for time series analysis. In order to overcome this limitation, this study utilises a pooled cluster-level data between 2003 and 2013 that provides an overview of the pattern of under-five mortality over a decade. The communities where clusters are located are not named making it difficult for confirmatory small area studies to be carried out. Cluster points across survey years might be too few to capture, more comprehensively, the demographic, cultural and ethnic dynamics of a diverse country like Nigeria. In Owan East LGA for example, only **one** NDHS cluster is available in an LGA with over 60 communities with diverse ethnicities and religion some local governments, e.g Communities in Akoko-Edo Local Government area in Edo State, where I come from, are not represented in the 10 year period unless the clusters belonging to Akoko-Edo have been misclassified into another LGA following distortion of actual cluster locations. The NDHS programme might benefit from increasing and maintaining cluster points across survey years in Nigeria. This will increase the potential reliability of the dataset for the spatial heterogeneity of Nigeria in a way that is nationally representative and more useful for temporal patterns in reproductive health to be assessed for communities.

Despite challenges relating to NDHS data limitations, this study offers a novel insight into a broad range of persisting risk factors of under-five mortality rate in a decade. This study represents one of the first attempts at examining under-five mortality hot spots and related risk factors at a neighbourhood scale in a decade within the Millennium Developed Goals (MDG) era. By examining a pooled cluster-level NDHS data from 2003-2013, this study provides a baseline for tracking improvements in under-five deaths in Nigeria through the duration of Sustainable Development Goals (SDGs). The study also has the merit of using NDHS clusters points, which provides the opportunity to examine the risk of under-five mortality for small geographical areas. Although NDHS cluster centroids are distorted to ensure confidentiality of respondents, they remain spatial datasets in their own right that can be utilised as neighbourhood proxies for analysing small area geographical variation in under-five deaths. Potential intervention programmes are likely to be more effective when

planned at the local level hence the need for fine grain analysis (Gayawan, 2014). The methods used are straightforward and can be easily replicated or revised in future studies.

4.8 Conclusion

This study represents one of the first attempts at presenting evidence on the multidimensional and relational nature of community-level risk factors for under-five health in a decade within the MDG era. The EFA results revealed five underlying domains of under-five mortality. These underlying factors are reflected in the MDG broad themes and are informative, not just for highlighting some priority areas in reducing under-five mortality if Nigeria must make positive acceleration towards the SDGs but also for monitoring future progress. The findings suggest that female disempowerment, maternal care and domestic violence against women were the most strongly associated with under-five mortality for the time-period 2003-2015. Contextual socioeconomic factors and vaccination were less associated with under-five mortality compared with the first three factors..

The global linear regression results in this study demonstrate the explanatory and predictive potential of the five underlying health indicators derived from the EFA in relation to under-five mortality. A 45% cluster-level prediction power of these five risk indicators in a linear regression model is considered high considering the absence of health care provision indicators in the data. The findings in this study indicate that SDG initiatives targeted at reducing under-five mortality must go beyond biomedical interventions and prioritize female empowerment and the right of women (Brinda *et al.*, 2015) to take ownership of health care decisions for themselves and their children and freedom from spousal violence.

Although this chapter has effectively unpacked the wide range of risk factors of under-five mortality and demonstrated ways in which these factors could work together to influence under-five mortality rate in Nigeria, questions remain about the nature of spatial and social relationships that could modify the experience of under-five mortality across regions and social groups in Nigeria. The OLR model which was used to examine interrelationships between under-five mortality and all risk factors produced a set of constant regression coefficients for all communities in this chapter and therefore, cannot be used to effectively model possible spatially varying relationships (Wheeler, 2014) in under-five mortality. Since understanding geographical variations in the risk of under-five mortality is a central objective in this study, ArcGIS-based Geographically Weighted Regression and Getis-Ord-Gi* statistics could be applied to further analyse the data in order to detect spatially varying

relationships. As under-five mortality rate is extensively used as a major reflection of wider socioeconomic development and general wellbeing within countries, it is important to investigate whether group differences in the risk of under-five mortality rate also exist between regions and socioeconomic groups in Nigeria. *Poor or otherwise marginalised women do not experience similar problems in developing countries. In both cases, their lack of access to resources and to formal power is significant, even if the contexts within which that lack is experienced are very different. Any difference is more likely to show up in the way in which it is put into practice and in the particular activities that are called for.* (Rowlands, 1995:104). As a logical next step in this study, the next chapter examines the varying socioeconomic and geographical contexts in which women experience under-five mortality in Nigeria.

CHAPTER 5

Mapping Inequalities in Under-Five Mortality

5.0 Introduction

Expanding upon the initial findings of the previous chapter, this chapter explores relative inequalities in under-five mortality in relation to the social and economic conditions of mothers, as well as geographical locations of areas. This chapter, therefore, aims to address the following research question: how does variation in under-five mortality relate to indicators of social and geographical determinants in Nigeria?

It was well established in the previous chapter that the determinants of under-five deaths are likely to be multi-dimensional and interrelated. Evidence in the academic literature suggests that the risk factors, which were derived from EFA in chapter 4, are likely to have spatially varying influences on under-five mortality. It is expected that the under-five mortality outcome is likely to be unevenly distributed within Nigeria (Adedini *et al.*, 2015c, Antai, 2011b). Given Nigeria's diverse geographical and socioeconomic attributes, it is logical to expect varying spatial and socioeconomic distributions in the under-five mortality rate in line with more extensive regional and socioeconomic differences.

The analyses is conducted at the NDHS cluster level in order to provide a clear impression of the variation in the burden of under-five deaths between and within segments of society and regions. First, the key indicators are entered into a linear regression model to examine the relative contribution and independent association of each indicator with under-five mortality outcome. Secondly, the average proportions of under-five mortality and the risk factors for the population groups are compared using one-way ANOVA in order to determine whether the observed mean differences in under-five mortality for population groups are statistically significant. Thirdly, Geographically Weighted Regression (GWR) and Getis-Ord_Gi* spatial autocorrelation models are used to examine the spatially varying relationships in the pattern of under-five mortality in Nigeria. This chapter represents one of the first attempts at an ecological mapping of mortality hot spots and identifying health gaps at the NDHS cluster level. The underlying argument in this chapter is that geographical context matters for understanding and addressing inequalities in under-five mortality. And that beyond understanding disparities in under-five mortality between regions, it is also important to understand how inequalities may be manifested within regions given the cultural, ethnic and socioeconomic diversity of Nigeria. As expected, the

results reveal very distinct socioeconomic and geographical divide in the risk of under-five mortality within the populations groups examined. Wealth levels, geographical locations, settlement size of communities where clusters are located, ethnicity and religion highlight differences in under-five mortality. These findings are informative for identifying mortality hot spots and for developing context-specific policies in order to target intervention resources more efficiently in Nigeria.

5.1 Results

Nigeria is a very diverse country spatially and socioeconomically. The pooled NDHS data shows that ethnic and religious identities are closely linked with geopolitical regions. The North West and North East are predominantly made up of the Hausa-Fulani ethnic group who is mainly Muslims. The South West is predominantly Yoruba with equally mixed Christian and Muslim populations. The South East is a predominantly Igbo and Christian region and the South South is a predominantly Christian ethnic minority region. The North Central is an ethnic minority geopolitical entity with mixed Christian and Muslim groups. The South-South and the North Central regions together are comprised of over 250 identifiable ethnic minority groups making them the most diverse regions of Nigeria.

Inequalities in under-five mortality were examined with respect to six key spatial and socioeconomic indicators: whether a cluster is located in the northern or southern part of Nigeria; the geopolitical regions which clusters belong; whether cluster settlement type is urban or rural; wealth levels; ethnic identities; and religious affiliations (Tables 14). It is important to note that when all the six key determinants were entered into a linear regression model, religion and settlement size became redundant. This indicates that cluster size and religion do not have independent associations with variation in under-five mortality when considered with the other four indicators. However, descriptive statistics were computed based on religion and size of settlement because they are significant attributes by which the population of Nigeria is structured. Listed in the order of statistical effect on inequalities, the effects of membership of population categories stand at: mean wealth levels indicator, north-south location of clusters, ethnicity and geopolitical zones account for 36% of in under-five mortality (Tables 14b-d).

Table 14: Model selection
Contribution of key socioeconomic and geographical indicators to under-five mortality

Model		B	R	R2	Adjusted R2	F	t	Sig	Lower	Upper
Model 1	MWI + NS + GeoZ + ETH + REL+ UR	24.763	0.625	0.391	0.384	61.862	8.148	0.000	18.793	30.732
Model 2	MWI + NS + GeoZ + ETH + UR	33.286	0.604	0.364	0.361	114.551	22.488	0.000	30.381	36.190
Model 3	MWI + NS + GeoZ + ETH	33.129	0.064	0.364	0.362	143.326	41.373	0.000	31.558	34.700

M-Model; MWI-Mean Wealth Index; NS-North-South; GeoZ-Geopolitical Zones; ETH-Ethnicity; REL-Religion; UR-Urban-Rural.

Table 14b: Linear regression model result

Model Summary										
Model 3	R	Adjusted R Square	Std. Error of the Estimate	Change Statistics			df1	df2	Sig.	F
				R Square	R Square Change	F Change				
	.604a	.364	.362	6.817	.364	143.326	4	1000	.000	

a. Predictors: (Constant), Ethnicity, Percentile Group of Mean Wealth Index, Geopolitical zones of Nigeria, North and south regions

Table 14c: Linear regression model significance test

ANOVA ^a						
Model 3	Sum of Squares	df	Mean Square	F	Sig.	
Regression	26639.399	4	6659.850	143.326	.000 ^b	
Residual	46466.592	1000	46.467			
Total	73105.991	1004				

a. Dependent Variable: Under-five mortality outcome
b. Predictors: (Constant), Ethnicity, percentile group of Mean Wealth Index, Geopolitical zones, North-South regions

Table 14d: Linear regression coefficients

Coefficients ^a									
Model 3	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	33.129	.801		41.373	.000	31.558	34.700		
Mean Wealth Index	-4.080	.294	-.395	-13.902	.000	-4.656	-3.504	.789	1.267
North-South	-6.778	1.129	-.397	-6.004	.000	-8.993	-4.562	.145	6.891
Geopolitical zones	.841	.313	.172	2.686	.007	.227	1.455	.154	6.474
Ethnicity	-.957	.242	-.130	-3.953	.000	-1.432	-.482	.592	1.690

a. Dependent Variable: Under-five mortality outcome

The Mean Wealth Index (MWI) indicator appears to have the strongest and the only indicator with a negative association of -0.532 with under-five mortality.

Model 3 in Table 14 shows that four of the indicators namely, MWI, north-south, geopolitical zones and ethnicity indicators are the most dominant with and explains most of the variation in under-five mortality. Tables' 15a-f show the key univariate descriptive statistics for under-five mortality outcome and the key population groups used to assess relative inequalities in under-five mortality in Nigeria. In Nigeria, the NDHS wealth index is the most frequently used measure of household socioeconomic status.

Disparities in under-five mortality rates are evident across socioeconomic groups. The results of the *F*-statistics show the disparities in the under-five mortality outcome and the five risk domains. Statistically, Table 15a reveal that the greatest disparity in under-five mortality rate is attributable to inequalities in wealth levels with up to 99 extra deaths per 1000 for poorest groups compared with richest groups. Tables 15b-f also show the risk domains are also not equally distributed across population groups both geographically and socioeconomically. For example, Table 15b shows that the political region of residence and religion account for the widest gaps in female disempowerment. Inadequate access to maternal care varies greatly by religion and settlement size. The political region of residence and wealth levels account the highest variation in health risk domains such as self-reports of domestic violence, childhood vaccination rates and the contextual socioeconomic status of clusters. Although the descriptive statistics indicate some disparities within population groups, the relative inequalities within population groups are discussed in more detail later in Section 5.3.

Table 15a: Under-five mortality One-Way ANOVA result

Descriptive statistics for under-five mortality in relation to key population attributes in Nigeria

(Cohen's d is only calculated for a 2X2 table). Lower mean values indicate lower under-five mortality rate.

Under-five mortality outcome										
Population Groups	N	Mean (Per 1000)	SD	95% confidence interval for mean				F	Cohen's d (2X2)	
				Lower Bound	Upper Bound	Skew	Kurtosis		r	r
National average	2135	145	8.44	14.407	15.115	0.68	0.11			
North	1146	174	9.02	16.892	17.938	0.292	-0.498	339.405	0.811	0.376
South	989	111	6.22	10.749	11.525	0.872	1.863			
North Central	383	112	6.41	10.560	11.848	0.711	0.626	172.648		0.288
North East	331	197	7.63	18.854	20.505	0.052	0.083			
North West	432	212	9.10	20.326	22.048	-0.035	-0.569			
South East	289	120	6.38	11.231	12.708	0.609	0.968			
South South	325	113	5.69	10.667	11.909	0.635	0.663			
South West	375	104	6.46	9.709	11.021	1.259	3.501			
Urban	808	129	8.09	12.287	13.405	0.928	0.773				51.402	0.321	0.159
Rural	1327	155	8.51	15.060	15.977	0.549	-0.102			
Poorer	663	202	8.25	19.567	20.826	1.043	2.395	341.274		0.643
Middle	610	143	8.27	13.654	14.969	0.407	-0.049			
Richer	862	103	5.77	9.883	10.655	-0.097	-0.275			
Hausa-Fulani	279	230	8.03	22.020	23.913	0.209	-0.011	13.116		0.365
Ethnic Minority	269	152	7.45	14.274	16.061	0.760	0.710			
Igbo	177	129	6.61	11.904	13.866	0.569	1.087			
Yoruba	301	92	5.49	8.610	9.856	0.680	0.377			
Christian	433	122	6.01	11.605	12.740	0.426	0.559	182.475	0.863	0.396
Islam	693	187	8.88	18.046	19.370	0.203	-0.382			

Table 15b: Disempowerment One-Way ANOVA result

Descriptive statistics for female disempowerment across population groups (Cohen's *d* is only calculated for a 2X2 table). Lower mean values indicate lower levels of female subordination.

Disempowerment										
Population Groups	N	Mean	SD	95% confidence interval for mean				F	Cohen's <i>d</i> (2X2)	<i>r</i>
				Lower Bound	Upper Bound	Skew	Kurtosis			
National average	1998	0.011	0.978	-0.319	0.054	0.505	0.11			
North	1072	0.627	0.906	0.584	0.670	-0.391	-1.043	1693.447	1.891	0.687
South	926	-0.702	0.409	-0.728	-0.675	0.719	1.045			
North Central	363	-0.181	0.685	-0.252	-0.111	0.626	-0.137	822.267		0.674
North East	310	0.751	0.707	0.672	0.830	-0.696	-0.035			
North West	399	1.265	0.613	1.205	1.326	-1.673	3.293			
South East	270	-0.777	0.398	-0.825	-0.730	0.566	0.716			
South South	308	-0.595	0.387	-0.639	-0.552	0.407	-0.321			
South West	348	-0.737	0.418	-0.781	-0.693	1.185	2.746			
Urban	745	-0.329	0.811	-0.388	-0.271	0.910	-0.226				146.845	0.945	0.427
Rural	1253	0.214	1.051	0.156	0.272	0.231	-1.367			
Poorer	664	0.799	0.939	0.727	0.870	-0.545	-1.034	494.476		0.331
Middle	671	-0.189	0.876	-0.255	-0.123	0.663	-0.602			
Richer	663	-0.574	0.609	-0.621	-0.528	1.293	1.373			
Hausa-Fulani	248	1.406	0.430	1.352	1.459	-0.682	0.187	881.146		0.741
Ethnic Minority	238	-0.042	0.733	-0.135	0.052	1.184	2.629			
Igbo	158	-0.661	0.418	-0.727	-0.596	0.391	0.697			
Yoruba	283	-0.753	0.427	-0.806	-0.706	0.644	-0.352			
Christian	422	-0.599	0.404	-0.637	-0.561	0.586	-1.058	1553.301	2.597	0.792
Islam	691	0.991	0.766	0.934	1.048	1.107	0.521			

Table 15c: Lack of maternal care One-Way ANOVA result

Descriptive statistics for lack of maternal care across population groups (Cohen's *d* is only calculated for a 2x2 table). Lower mean values indicate better access to maternal care

Lack of maternal care										
Population Groups	N	Mean	SD	95% confidence interval for mean		Skew	Kurtosis	F	Cohen's <i>d</i> (2x2)	
				Lower Bound	Upper Bound				r	r
National average	1998	0.018	0.969	-0.024	0.061	-2.026	3.637			
North	1072	0.270	0.813	0.221	0.318	0.336	-0.424	168.044	0.577	0.277
South	926	-0.272	1.051	-0.339	-0.204	0.833	0.981			
North Central	375	-0.436	0.884	-0.135	0.048	-2.027	3.360	57.264		0.126
North East	330	0.338	0.754	0.254	0.422	-2.319	4.788			
North West	431	0.502	0.690	0.434	0.570	-2.736	7.225			
South East	282	-0.340	1.117	-0.474	-0.206	-1.740	1.625			
South South	329	-0.017	0.907	-0.119	0.084	-2.271	4.599			
South West	359	-0.444	1.076	-0.557	-0.330	-1.851	2.192			
Urban	745	-0.346	1.054	-0.421	-0.270	-1.696	1.921				179.724	0.605	0.236
Rural	1253	0.236	0.861	0.188	0.284	-2.492	6.160			
Poorer	664	0.428	0.813	0.365	0.489	-2.809	7.593	160.256		0.138
Middle	671	0.087	0.850	0.022	0.151	-2.477	5.606			
Richer	663	-0.458	1.047	-0.538	-0.378	-1.775	1.984			
Hausa-Fulani	248	0.420	0.797	0.320	0.520	-2.101	3.409	38.814		0.112
Ethnic Minority	238	-0.211	1.175	-0.361	-0.061	-1.351	0.360			
Igbo	158	-0.642	1.394	-0.861	-0.423	-1.019	-0.700			
Yoruba	283	-0.398	1.022	-0.517	-0.278	-2.092	3.270			
Christian	422	0.218	0.346	0.185	0.251	-0.795	0.725	322.898	1.105	0.484
Islam	691	0.591	0.329	0.566	0.615	-1.393	2.001			

Table 15d: Domestic Violence One-Way ANOVA result

Descriptive statistics for domestic violence across population groups (Cohen's *d* is only calculated for a 2X2 table). Lower mean values indicate lower incidents of domestic violence.

Domestic violence											
Population Groups	N	Mean	SD	95% confidence interval for mean				Kurtosis	F	Cohen's <i>d</i> (2X2)	
				Lower Bound	Upper Bound	Skew				<i>r</i>	
National average	1998	0.017	0.998	-0.027	0.060	0.882	0.569				
North	1072	0.333	1.067	0.269	0.397	0.605	0.074	262.602	0.7356	0.345	
South	926	-0.349	0.761	-0.398	-0.300	0.991	0.849				
North Central	375	0.063	0.982	-0.039	0.164	0.306	-1.105	84.823		0.176	
North East	330	0.754	1.239	0.615	0.892	0.509	-0.261				
North West	431	0.251	0.887	1.164	0.339	0.469	-0.446				
South East	282	-0.173	0.833	-0.273	-0.073	0.949	0.543				
South South	329	-0.228	0.696	-0.306	-0.150	0.770	0.219				
South West	359	-0.593	0.694	-0.667	-0.520	0.770	0.219				
Urban	745	-0.310	0.958	-0.379	-0.241	1.434	2.175				136.053	0.540	0.261
Rural	1253	0.211	0.970	0.157	0.265	0.711	0.348				
Poorer	664	0.449	0.996	0.373	0.525	0.550	0.178	228.328		0.186	
Middle	671	0.171	0.978	0.097	0.245	0.937	0.889				
Richer	663	-0.573	0.694	-0.626	-0.520	1.346	1.825				
Hausa-Fulani	248	0.728	0.954	0.609	0.847	0.387	-0.083	119.451		0.280	
Ethnic Minority	238	0.439	1.053	0.305	0.574	1.009	1.079				
Igbo	158	-0.103	0.855	-0.238	0.031	0.591	-0.624				
Yoruba	283	-0.623	0.647	-0.689	-0.547	1.475	2.978				
Christian	422	-0.047	0.790	-0.123	0.028	0.638	-0.015	19.099		0.017	
Islam	691	0.190	0.930	0.121	0.259	0.375	-0.733				

Table 15e: Vaccination One-Way ANOVA result

Descriptive statistics for child vaccination status across population groups (Cohen's *d* is only calculated for a 2X2 table). Lower mean values indicate reduced vaccination rates and bad for under-five health

Vaccination										
95% confidence interval for mean										
Population Groups	N	Mean	SD	Lower Bound	Upper Bound	Skew	Kurtosis	F	Cohen's d (2X2)	r
National average	1998	-0.014	0.985	-0.057	0.030	0.973	1.520			
North	350	-0.455	0.713	-0.530	-0.380	1.203	1.131	449.316	1.258	0.532
South	234	0.597	0.944	0.476	0.719	0.728	0.553			
North Central	100	0.224	0.760	0.074	0.375	0.393	0.013	154.515		0.279
North East	85	-0.604	0.301	-0.722	-0.486	1.232	1.113			
North West	165	-0.790	0.417	-0.854	-0.726	1.415	2.199			
South East	106	0.517	0.959	0.332	0.701	1.117	1.932			
South South	51	0.460	0.841	0.223	0.696	0.413	0.240			
South West	77	0.800	0.967	0.580	1.019	0.341	-0.723			
Urban	169	0.628	1.044	0.470	0.787	0.533	0.021				285.212	1.001	0.451
Rural	415	-0.303	0.782	-0.378	-0.227	0.981	0.744			
Poorer	232	-0.644	0.616	-0.724	-0.564	1.586	2.562	456.250		0.314
Middle	196	-0.045	0.698	-0.143	0.054	0.770	0.683			
Richer	156	0.889	0.946	0.740	1.039	0.531	0.373			
Hausa-Fulani	205	-0.816	0.382	-0.869	-0.763	1.350	1.608	151.466		0.330
Ethnic Minority	166	0.062	0.789	-0.059	0.183	0.607	0.092			
Igbo	111	0.521	0.944	0.343	0.698	1.102	1.993			
Yoruba	102	0.782	0.897	0.606	0.958	0.468	-0.388			
Christian	276	0.442	0.901	0.335	0.548	0.800	1.026	340.540	1.054	0.466
Islam	308	-0.459	0.806	-0.549	-0.368	1.662	2.796			

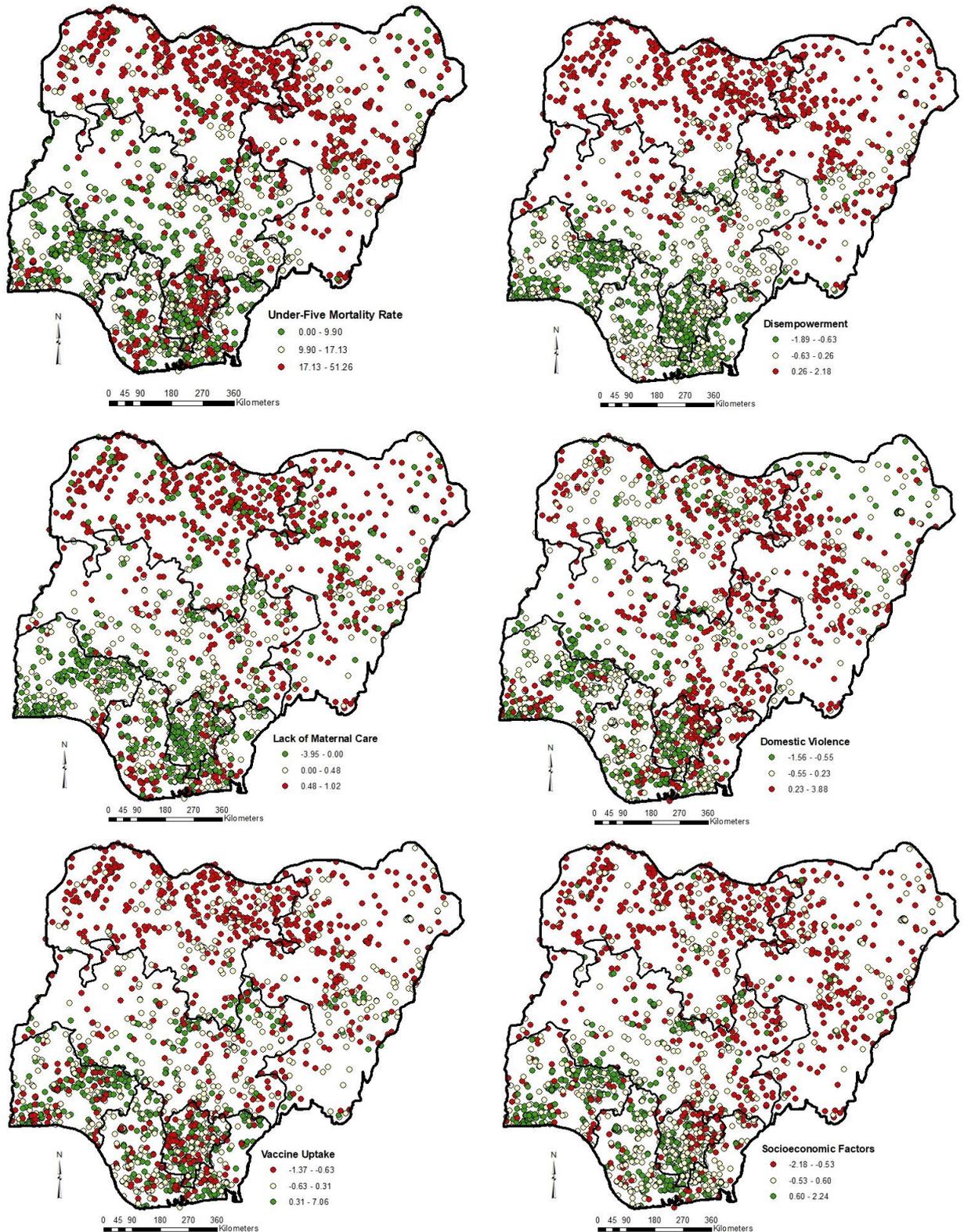
Table 15f: Socioeconomic factors One-Way ANOVA result

Descriptive statistics for contextual socioeconomic factors across population groups (Cohen's *d* is only calculated for a 2X2 table). *Lower mean values indicate lower cluster socioeconomic status.*

Contextual socioeconomic factors										
95% confidence interval for mean										
Population Groups	N	Mean	SD	Lower Bound	Upper Bound	Skew	Kurtosis	F	Cohen's <i>d</i> (2X2)	<i>r</i>
National average	1998	-0.017	0.995	-0.061	0.026	-0.019	-1.242			
North	350	-0.752	0.818	-0.838	-0.666	-0.878	-0.181	546.773	1,471	0.593
South	234	0.410	0.761	0.312	0.508	-0.625	-0.302			
North Central	100	-0.323	0.778	-0.498	-0.148	0.309	-1.114			
North East	85	-1.045	0.628	-1.181	-1.240	1.298	1.328			
North West	165	-0.861	0.763	-0.978	-0.743	1.047	0.416	158.915		0.285
South East	106	0.335	0.776	0.186	0.485	-0.476	-0.196			
South South	51	0.278	0.771	0.061	0.495	-0.501	-0.929			
South West	77	0.599	0.705	0.439	0.759	-1.032	0.530			
Urban	169	0.668	0.650	0.569	0.766	-1.015	0.825	1196.457	2.061	0.717
Rural	415	-0.675	0.653	-0.753	-0.597	0.630	-0.622			
Poorer	232	-1.273	0.325	-1.315	-1.231	0.542	-0.177			
Middle	196	-0.124	0.443	-0.186	-0.061	0.125	-0.921	5652.011		0.850
Richer	156	0.977	0.309	0.928	1.026	0.155	-0.719			
Hausa-Fulani	205	-0.917	0.738	-1.019	-0.815	1.131	0.648			
Ethnic Minority	166	-0.451	0.868	-0.584	-0.318	0.470	-0.938	182.963		0.373
Igbo	111	0.324	0.783	0.177	0.472	-0.474	-0.298			
Yoruba	102	0.586	0.700	0.448	0.723	-1.105	0.872			
Christian	276	0.093	0.889	-0.013	0.198	-0.214	-1.042	139.002	0.791	0.368
Islam	308	-0.626	0.929	-0.730	-0.522	0.665	-0.846			

5.2 Geographical distribution of under-five mortality and risk domains

The descriptive statistics presented above indicate both geographical and social variations in the under-five mortality rates and the five underlying domains. A visual representation of their spatial distribution in maps in Figure 16 suggests some inherent spatially varying relationships that could be interrogated further with spatial statistical methods. The maps show that clusters in the southern region of Nigeria tend to generally have lower proportions of under-five deaths compared with the more northern. Higher levels of disempowerment and reproductive risk behaviour and socioeconomic disadvantage are also found in the north. The distributions of domestic violence, lack of maternal care and vaccine uptake exhibit a less obvious pattern but reflect that interviewed women represented in the northern DHS clusters may exhibit lower uptake of maternal health services and child vaccination, and experience more domestic violence compared with women in the southern clusters. Clusters in the central region of Nigeria generally show average patterns compared to the southern clusters with better outcomes and the relatively worse-off north.



Spatial Distribution of Under-five mortality rate and its explanatory factors (Red colour indicate worse and green depicts better outcome for each indicator).

Figure 16: GWR maps

5.2.1 Geographically weighted regression

The GWR model in this study has confirmed that regional variations exist in under-five mortality and associated risk factors in Nigeria. A higher R^2 coefficient of 0.62, $p < 0.005$ is obtained from the results of GWR compared with the .42 from the global ordinary least squares regression model obtained in the previous chapter. This indicates that spatial interrelationships exist in the prevalence under-five mortality and its risk factors in Nigeria. Distinctive spatial patterns can be observed across regions in Nigeria for the disempowerment and reproductive risk behaviour, vaccination rates and socioeconomic factors. The GWR model R^2 value of 0.62 indicates a 62% explanation of the variability ($p < 0.005$) in under-five mortality in Nigeria is explained by the examined five covariates (Table 16). The major outputs of GWR, which are the parameter estimates for under-five mortality and its risk factors, are shown in Figures 17 for the intercept, disempowerment and reproductive risk behaviour, lack of maternal care, domestic violence, vaccine uptake and socioeconomic factors. The intercept map in Figure 17a confirms that a clear spatial pattern in under-five mortality exists with clusters of high values located in Sokoto, Katsina, Kano, Jigawa, Yobe, Bornu States in the northern region of Nigeria. Lack of maternal care and domestic violence risk factors show more disperse patterns.

Table 16: GWR model result

Bandwidth	0.733577501
Residual Squares	57723.71452
Effective Number	312.0960086
Sigma	5.627237397
AICc	13605.64934
R^2	0.621306327
R^2 Adjusted	0.556678628

Results suggest that further questions can be asked to further understand the magnitude and spatial instability of relationships. For example, only 208 of the 2135 cluster points successfully processed in the GWR model have R^2 values that lie between the R^2 values obtained from the global regression model and GWR, that is, 0.45 – 0.62. The GWR shows that for a majority of the cluster points (1909) depicted in green in Figure 17, GWR predicts that the five underlying risks factors together account for less than 45% variation in under-five mortality with the exception of the 18 clusters located in Sarduana Local Government Area (LGA) of Taraba State and Kukawa, Guzamala and Monguno LGAs in Bornu State. In these LGAs (depicted in red), the five risk domains explain much higher variability in under-five mortality with the model showing local R^2 values of 62% and 86%.

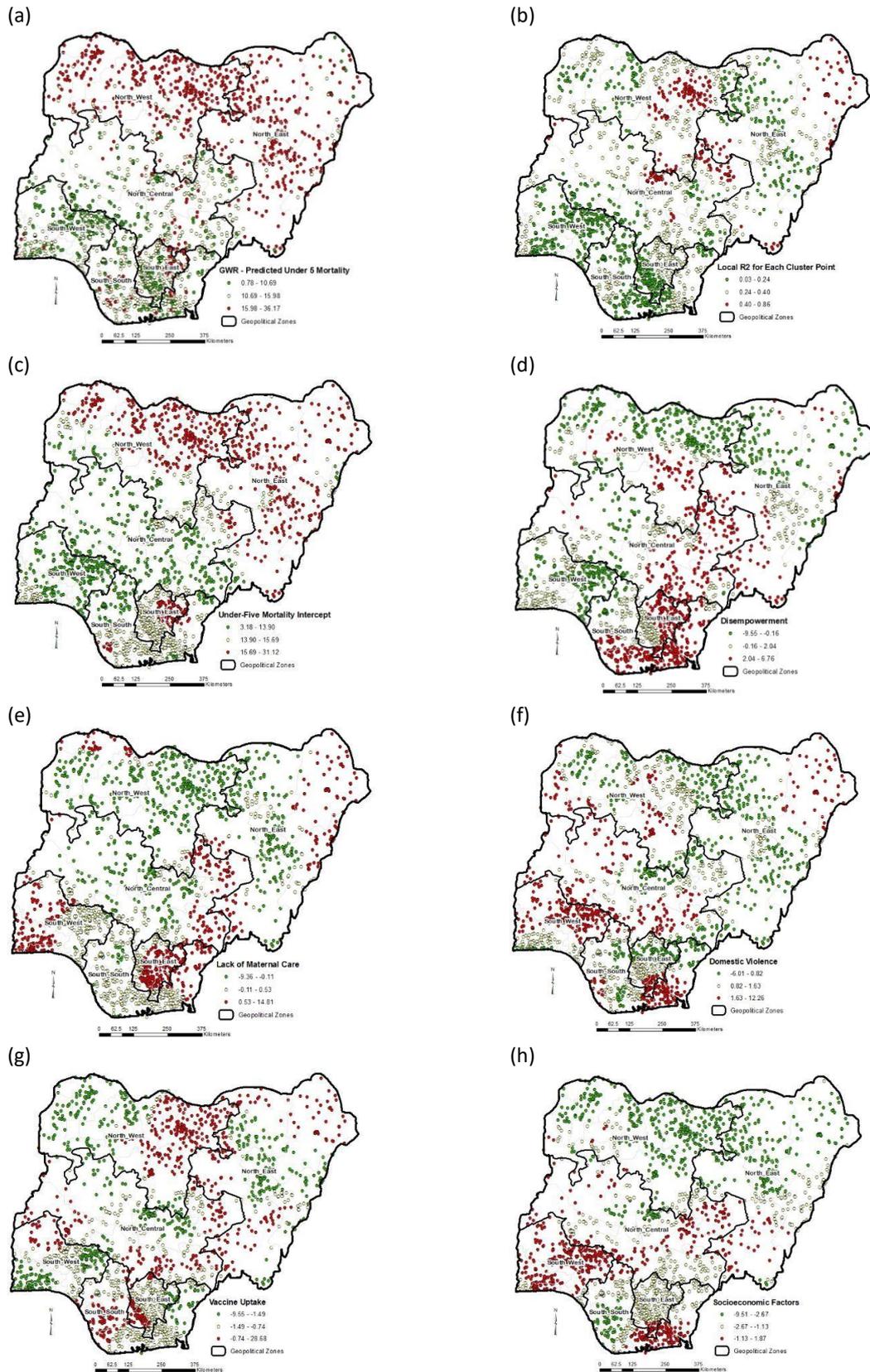
Figure 16a, shows the predicted under-five mortality values obtained from the GWR model. Under-five mortality rate for the clusters located in the northern region is predicted to be above the national average compared with southern areas which to achieve better health, that is, below the national average. This confirms the results of the analysis of variance presented in section 5.1 showing higher risks of under-five mortality for northern clusters. Map (b) shows the obtained locally weighted regression coefficients (R^2) for each NDHS cluster point. This depicts the relationship between under-five mortality and the explanatory variables. The model did not fit well for many clusters in Nigeria, especially the clusters in the southern areas where the five risks factors explained less than 25% of variability in under-five mortality. This could imply that additional risk factors might be needed to explain the patterns of under-five mortality risks in those areas. The five risk domains appeared to have greater explanatory power ranging from 40% to 86% in the spatial variation in the local patterns of under-five mortality in some northern states namely, Bornu, Jigawa, Kaduna, Kano, Katsina, Plateau, southern parts of Taraba State and the Federal Capital Territory (FCT).

The spatial variation in parameter estimation for intercept, disempowerment, lack of maternal care, domestic violence, vaccination and socioeconomic factors are shown in Figure 16b-f). The map of the intercept term in 16b represents the distribution of under-five mortality when each of the risk factor equal zero for each cluster. Higher intercept values are located in the North East, North West and South East and lower intercept values are located in the North Central and South West. This spatial heterogeneity indicates that beside the five risk domains entered into the GWR model, there are other factors that can influence spatial differences in under-five mortality.

The intercept maps for the five explanatory domains (c-h) show that; for the disempowerment indicator shown in 16d, positive intercept values are observed for clusters in the South East, South South and some central states, indicating that higher disempowerment tended to be associated with under-five mortality in those areas. The lack of access to maternal care was more positively related with increased risk of under-five mortality in the South West and Eastern regions of Nigeria (16e). Domestic violence is positively associated with under-five mortality risk in the North Central, South South and South West (16f) and the increased risk of under-five deaths to vaccination tended to be more widespread across all regions (16g) compared with the increased risk of under-five deaths from high risks of socioeconomic deprivation which showed a more Southern pattern (16h). Overall, the GWR results appear to be more suited for the data and clearly indicate that local variations in the spatial relationships between under-five mortality rate

and its explanatory factors exist. What it does not show is the levels of statistical significance of the spatial clustering in under-five deaths and potential risk factors and for this, the Getis-Ord-Gi* statistics is applied.

The maps of disempowerment and reproductive risk, lack of maternal care and socioeconomic response indicators reveal regional differences in under-five deaths (Figure 17). The relationships between under-five mortality with domestic violence and child vaccination rates appear less variable at the DHS cluster level with clusters points in Bornu State revealing high values of domestic violence, lack of maternal care but high rates of child vaccination. Clearly, they may be other interpretations to this analysis but GWR appears to be a useful way of exploring the varying spatial relationships in this data. It has revealed underlying geographical patterns, which will be explored further using



Spatial mapping of locally weighted regression coefficient (R^2) by GWR modelling of under-five mortality outcome (a-c), and the coefficients of intercept for the five underlying risk domains at zero values (d-h). Interpretation: in Figures b-h, green areas indicate poor model fit and red areas depict high model performance. The opposite is the case for predicted mortality values in (a).

Figure 17: GWR outputs

5.2.2 Hots spots results (Getis-Ord-Gi*)

The Getis-Ord G_i^* statistics measures the degree of clustering for either high values or low values in a feature class. When low values tend to cluster together, in the case of this study, under-five mortality, the region is classified as cold spots depicted as green. The clustering of high values, which depict worse conditions, is classified as hot spots (Figure 18). Hot spots are depicted in red. The z-score obtained from the Getis-Ord-Gi* statistics is classified into three broad categories then mapped for visualization in ArcGIS 10.3. These include Significant cold spot, $N = 979$ depicted with white on the map, Not significant clusters, $N = 580$ depicted light grey and significant hot spots, $N = 576$ depicted with dark grey. The interpretation of the hot spots and cold spots vary in this study depending on meaningfulness of the indicator. For example, the under-five mortality hot spots indicate vulnerable populations with high concentration of under-five mortality. Hots spots of vaccine uptake on the other hand refer to areas with significantly higher rates of vaccination, which is considered a good health achievement in this study (Figure 18). Cold spots of vaccination represent problem areas with low uptake or preventive child health. Applications of Getis-Ord-Gi* can be found in epidemiology of infectious diseases, retail, crime analysis, voting patterns, traffic events and within the demographic literature.

Spatial clustering of under-five mortality and its covariates. Darker shades represent hotspots and white areas indicate cold spots. (Red colour indicates worse and green depicts better outcome for each indicator).

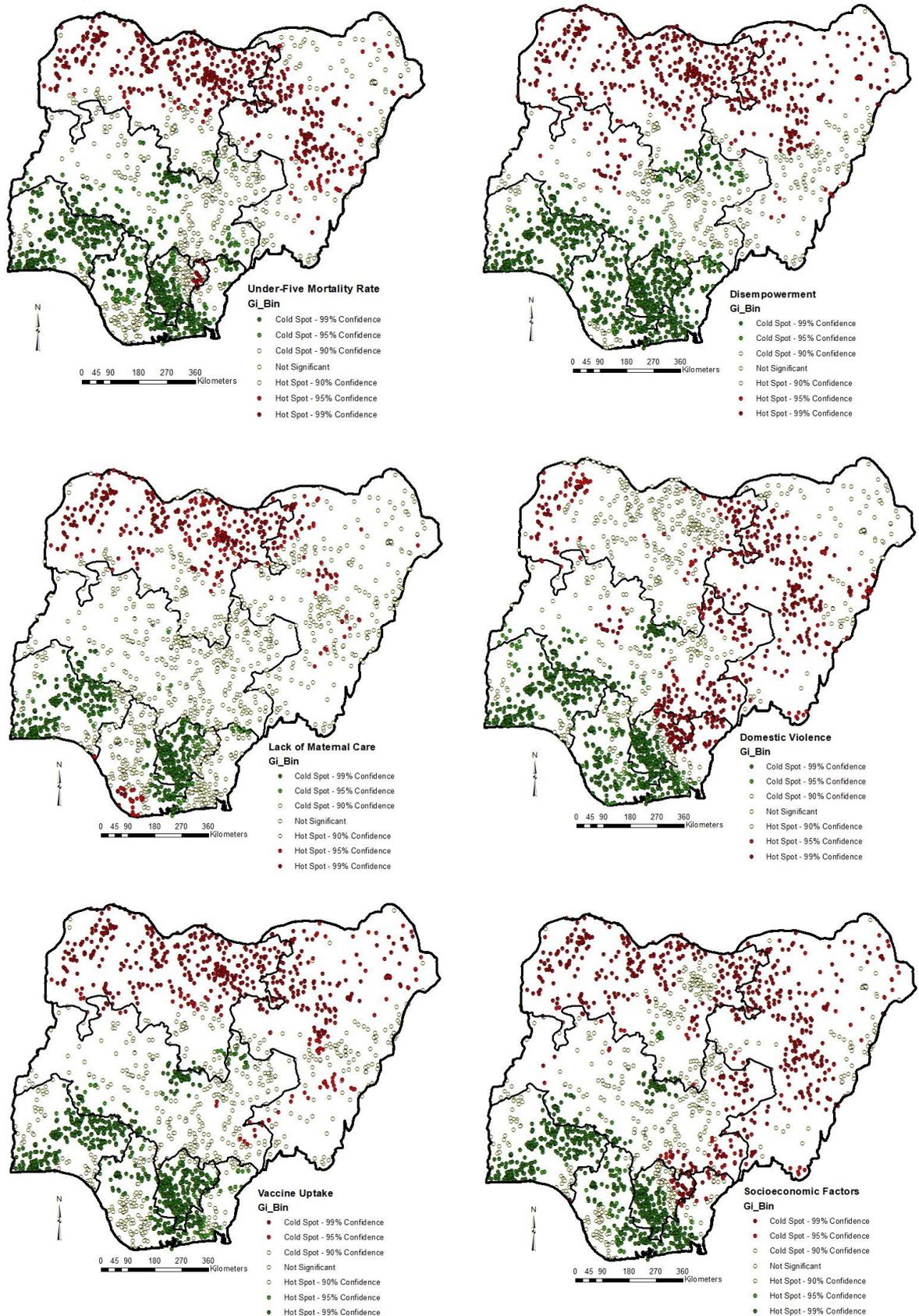


Figure 18: Under-five hot spots

The result of the Getis-Ord-Gi* confirms that under-five mortality rates are not just unevenly distributed across geographical regions in Nigeria but that statistically significant spatial clustering exists in under-five mortality and uncovered risk factors. Figure 19 shows a significant spatial clustering of high (hot spots) and low (cold spots) values of under-five and risk factors between the north and south. Table 17 shows a cross-tabulation of the hot spots of under-five mortality with risk measures. The italic values are the cells in the leading diagonal of the matrices representing NDHS cluster points that have been cross-classified into the same hot spot groups for disempowerment and reproductive risk behaviour and other risk measures. Cells away from the leading diagonal identify where NDHS have been classified into different groups.

The higher the number of cells contained in the leading diagonal, the more consistent the spatial pattern of the risk factor with under-five mortality. The results for all cross tabulations show that more than 64% of all NDHS clusters have been grouped into similar hot spots or cold spots as the case may be. These indicate strong similarities in spatial concentration of risk factors and under-five deaths. The risk factor that demonstrates the most similar pattern with under-five mortality is the vaccine uptake with 77% of clusters classified into similar hot spots and cold spots. Next is disempowerment, socioeconomic factors, lack of maternal care, and domestic violence with 76%, 74%, 68% and 64% in the leading diagonal respectively. A threshold of contingency coefficient of 0.62 - 0.70 is observed suggesting strong spatial interrelationships and similarity in spatial pattern of clustering of under-five mortality and risk factors. Very few NDHS clusters are classified into one hot spot or cold spot away from the diagonal. Although all risk measures are strongly interrelated with under-five mortality, the most dispersed risk measures are domestic violence and maternal care. Cross-tabulation results confirm the patterns shown by the distribution and GWR and hot spots maps

Table 17: Cross tabulation of hotspots of under-five mortality with risk factors

		Under-Five Mortality Hot Spots, 2003-2013 (P<0.005)		
		Cold Spot	Not Significant	Hot Spot
Disempowerment & reproductive behaviour	Cold Spot	891	249	4
	Not Significant	87	277	34
	Hot Spot	1	142	450
	75.78% on leading diagonal Contingency Coefficient = 0.68			
Lack of maternal care	Cold Spot	611	63	0
	Not Significant	368	577	231
	Hot Spot	0	28	257
	67.68% on leading diagonal Contingency Coefficient = 0.64			
Domestic violence	Cold Spot	829	70	0
	Not Significant	112	346	297
	Hot Spot	38	252	191
	63.98% on leading diagonal Contingency Coefficient = 0.62			
Vaccine uptake	Cold Spot	1	147	443
	Not Significant	230	457	45
	Hot Spot	748	64	0
	77.19% on leading diagonal Contingency Coefficient = 0.70			
Socioeconomic factors	Cold Spot	27	269	397
	Not Significant	143	376	91
	Hot Spot	809	23	0
	74.10% on leading diagonal Contingency Coefficient = 0.68			

The cells represent counts of NDHS clusters points in a particular Getis-Ord-Gi* cluster group. The italic values represent NDHS clusters that have been classified into the same group of under-five mortality by risk measures

5.3.0 Inequalities in under-five mortality

Figure 18 shows a clear regional variation in the pattern of under-five mortality. Whilst the national average of under-five deaths at the NDHS cluster level in Nigeria is 145 per 1000 live births, a clear uneven distribution of under-five deaths can be seen across population groups and regions. Inequality in under-five mortality rate in Nigeria is investigated ecologically. The rest of the chapter examines relative inequalities in under-five mortality in terms of the key population and attributes previously described in section 5.1. These groups were controlled for separately in a linear regression model in order to assess their independent influence on the risk of under-five deaths. All six classifications were found to be significantly associated with under-five deaths with the north-south, urban-rural and geopolitical regions, wealth quintiles, ethnicity and religion explaining 15% ($R^2=.15$, $p<.000$), 9% ($R^2=.09$, $p<.000$), 5% ($R^2=.05$, $p<.000$), 31% ($R^2=.31$, $p<.000$), 6% ($R^2=.06$, $p<.000$) and 14% ($R^2=.14$, $p<.000$) of variation in under-five mortality respectively. Regional factors account

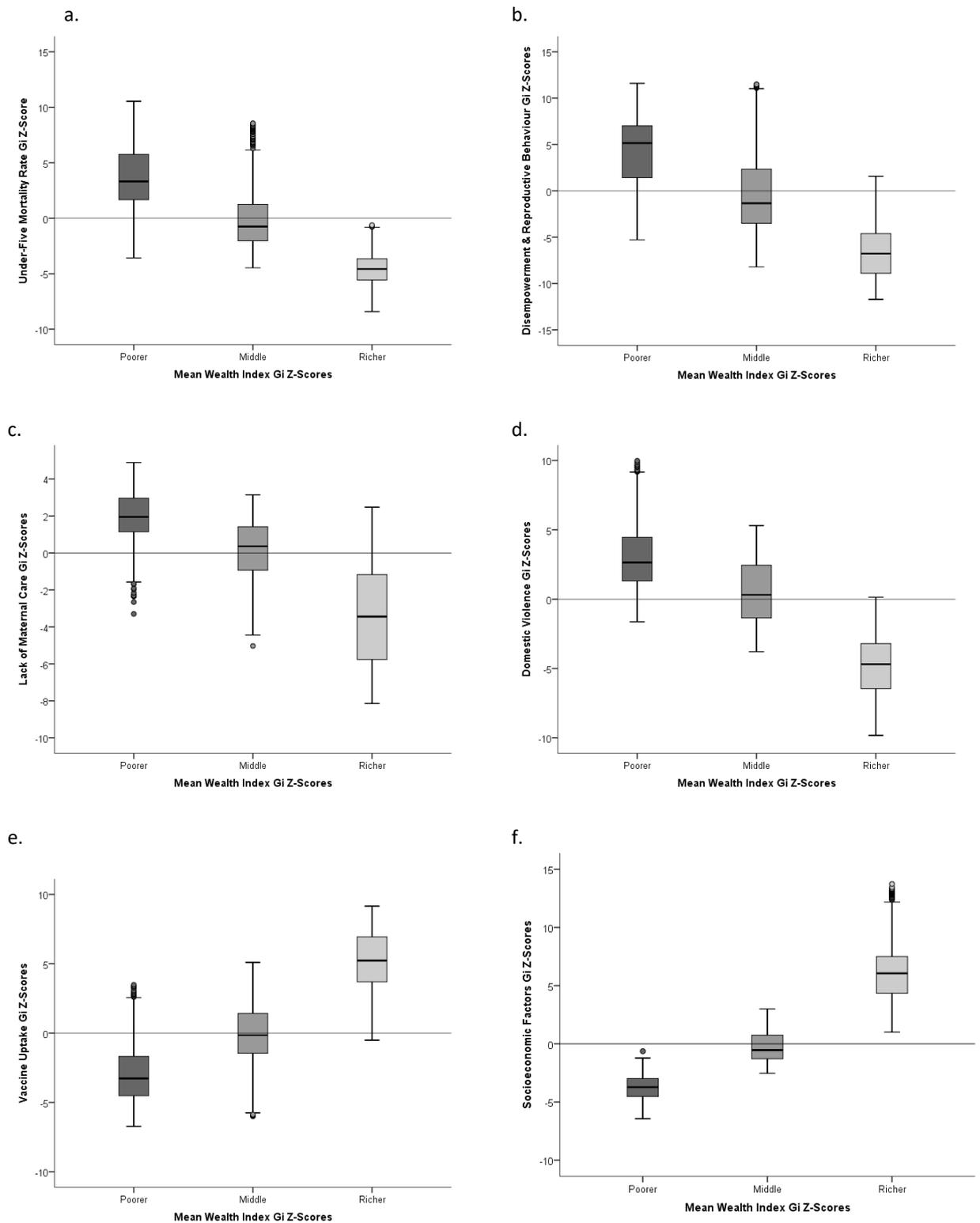
for 41% ($R^2=.41$, $p<.000$) in cluster level variation in under-five mortality rate. Inequalities in under-five health achievement are also observed within groups. The descriptive statistics associated with the relative inequalities in under-five mortality and its social determinants across segments of the population in Nigeria are reported in Tables 15a-f.

5.3.1 Wealth inequalities in under-five mortality

The 2135 pooled DHS clusters for the year 10-year period, 2003-2013 were classified into three wealth groups, poorer ($N = 663$), middle ($N = 610$) and richer ($N = 862$). Table 15a shows that the wealth differences in under-five mortality and risk factors derived from EFA was the greatest divide in the data. Under-five deaths in Nigeria are mostly divided along wealth lines with a 10% gap in health achievement between poorer and richer groups. Poorer clusters are associated with higher under-five mortality rates ($M = 202$, $SD = 8.25$) compared with richer clusters ($M = 103$, $SD = 5.77$).

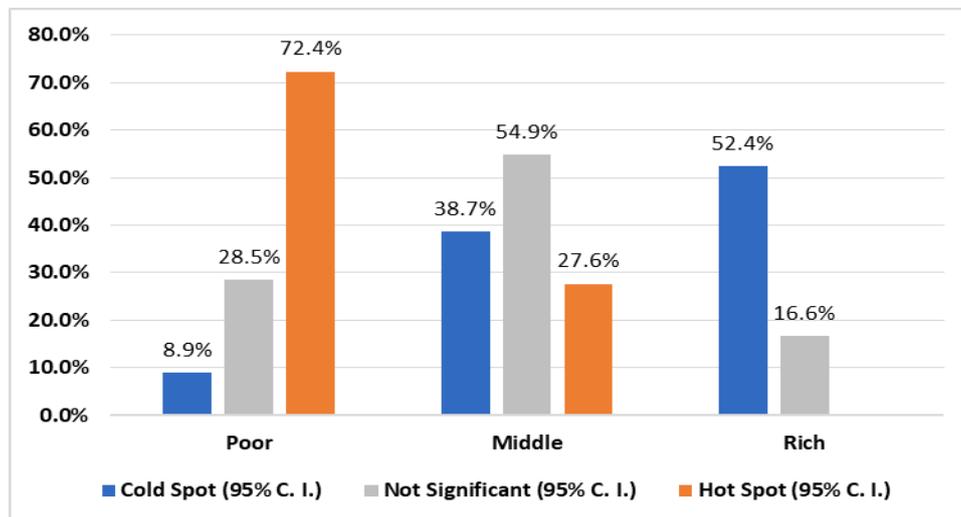
Clusters with average wealth levels also exhibit mortality rates ($M = 145$, $SD = 8.27$) similar to the national average. There is a statistically significance difference between poorer and richer groups as determined by one-way ANOVA $F = (2, 2132) = 341.274$, $P = 0.000$, $r = .643$). The effect size ($r = .643$) indicate that the between group means of the three wealth groups differ by at least 0.6 standard deviation. The effect size associated with the statistical significance is considered large based on (Cohen, 1992) guidelines (Appendix 1). Figure 19a provides boxplots that depict the wealth divide in under-five mortality and all risk factors. A clear wealth inequality can be seen in the distributions of under-five mortality, and the related risk factors between the three wealth groups. Richest clusters tend to be located below the Nigerian average mortality level compared with poorer groups with consistently higher than national average under-five deaths. This pattern is generally true for all child health risk factors.

It is important to note here that the bars in Figure 19b, 20a, 21a, 21b, 22a and 23a do not indicate under-five mortality rates. They represent the percentage of correspondence between geographical clusters or communities that are classified as hot and cold spots of under-five mortality versus those of hot and cold spots of wealth groups respectively. For, examples, poorest geographical clusters/units are mostly classified as hot spots (orange) of high under-five mortality rates. Spatial clusters of rich communities on the other hand, were predominantly classified as cold spots (blue) of low mortality. It is important to point out here that the percentages shown in the afore-mentioned Figures do not refer to mortality rate but percentages of communities classified as cold spots, not significant and hot spots respectively.



Clustering of higher wealth indicate: lower under-five mortality (a), lower subordination (b), reduced barriers to maternal care (c), lower domestic violence (d), higher vaccination (e), and socioeconomic status (f). Darker shades represent lower wealth levels

Figure 19a: Wealth divides

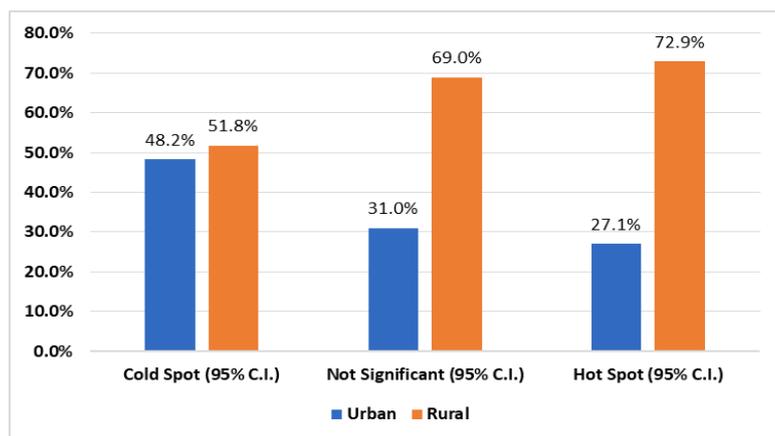


Hotspots of poverty tend to be classified as hotspots of under-five mortality.

Figure 19b: percentage of correspondence between clusters of wealth index vs mortality hot spots

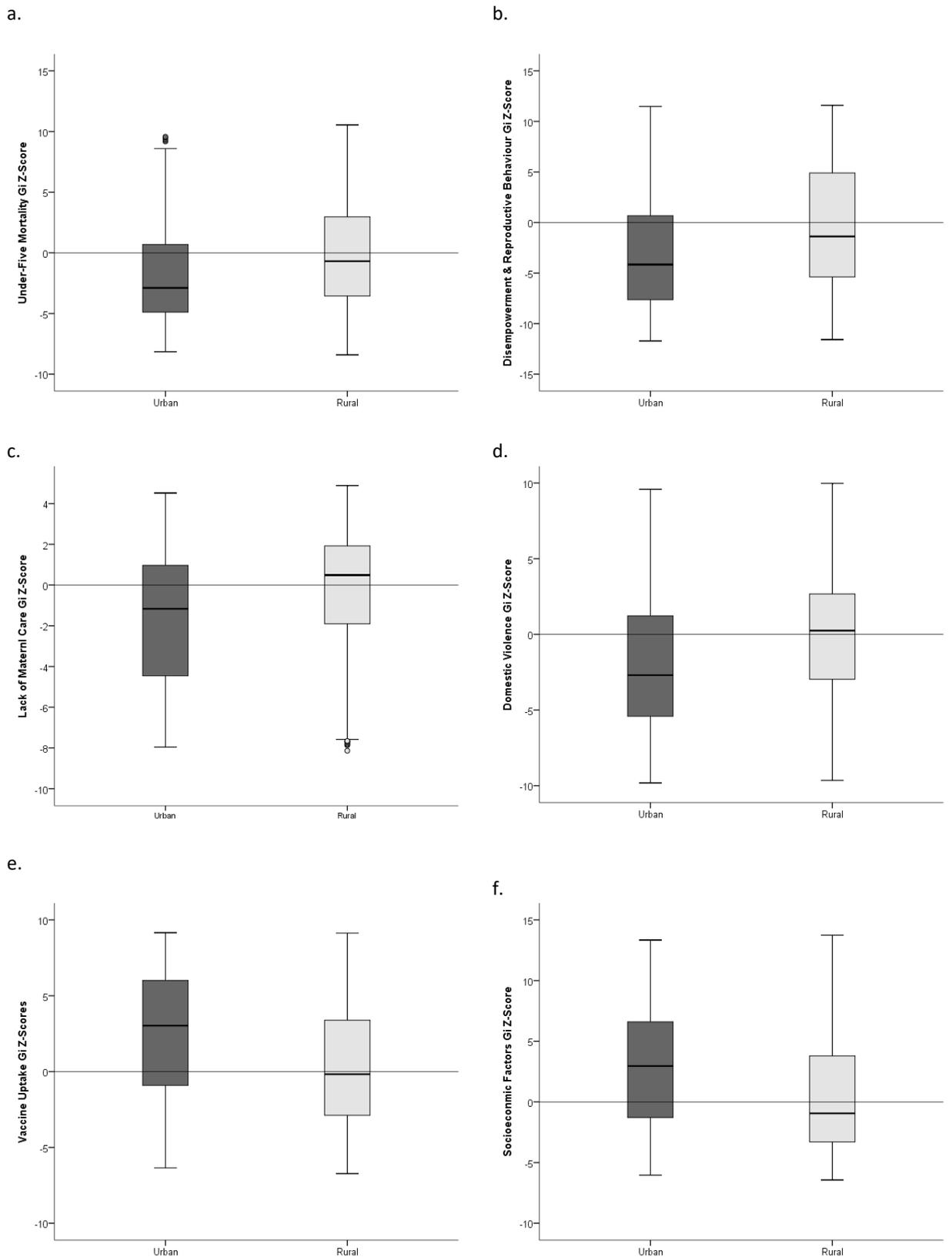
5.3.3 Rural-Urban divides in under-five mortality

Under-five mortality is also divided according to the size of the region of residence, rural clusters ($N = 1327$) urban clusters ($N = 808$). Rural clusters are associated with a numerically higher average under-five mortality ($M = 15.52\%$, $SD = 8.51$) compared urban clusters ($M = 12.85\%$, $SD = 8.09$). A one-way ANOVA test for statistical significance in the mean difference in under-five between rural and urban clusters indicated a significant small effect $F(1, 2133) = 51.402$, $p < .000$, $r = .159$). These results show that rural clusters are significantly associated with worse under-five rate compared with urban clusters (Figures 20a-d).



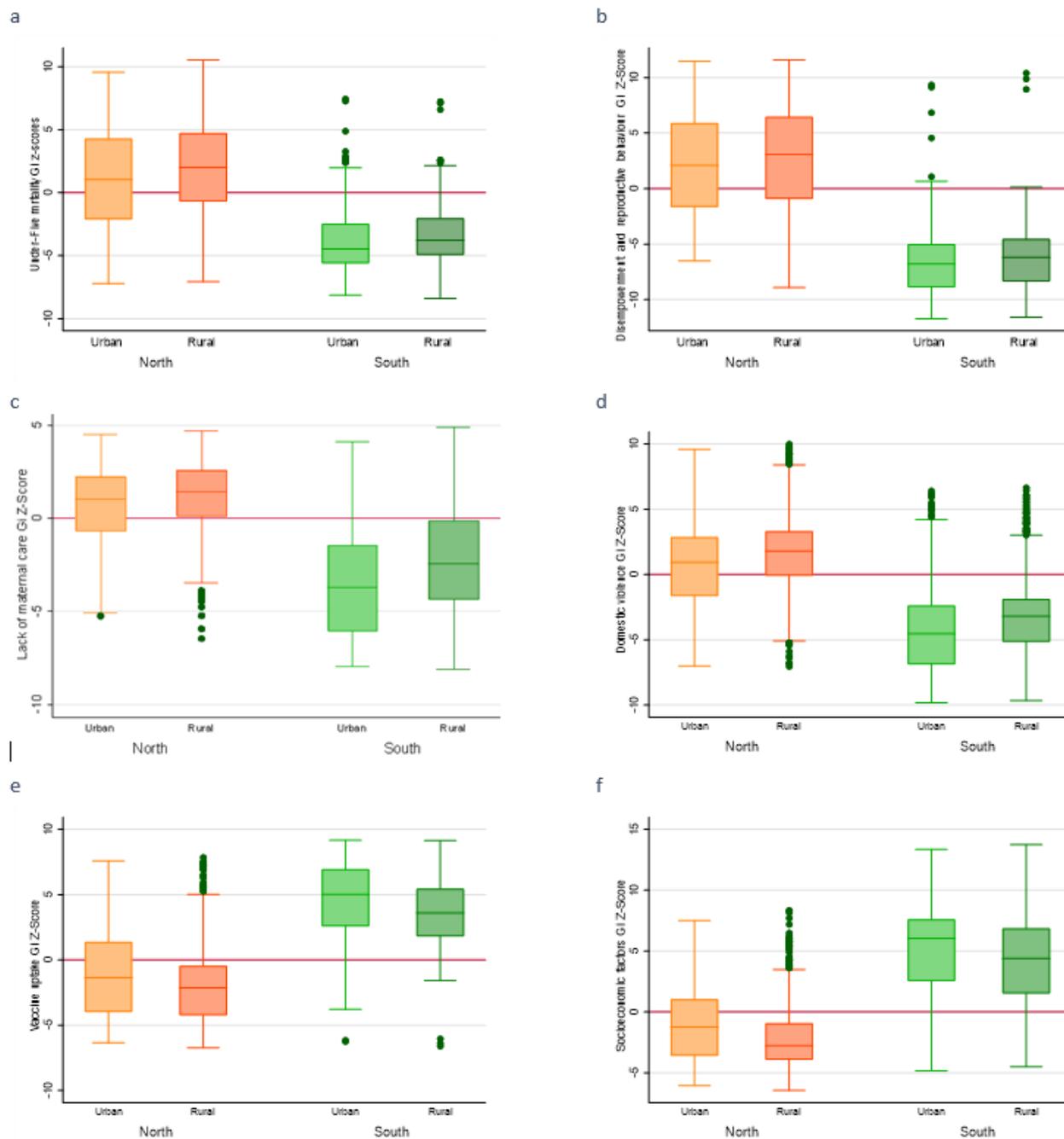
Percentage clustering in under-five mortality: Rural communities tend to be classified as significant hot spots compared with urban communities.

Figure 20a: percentage of correspondence between clusters of wealth index vs settlement size



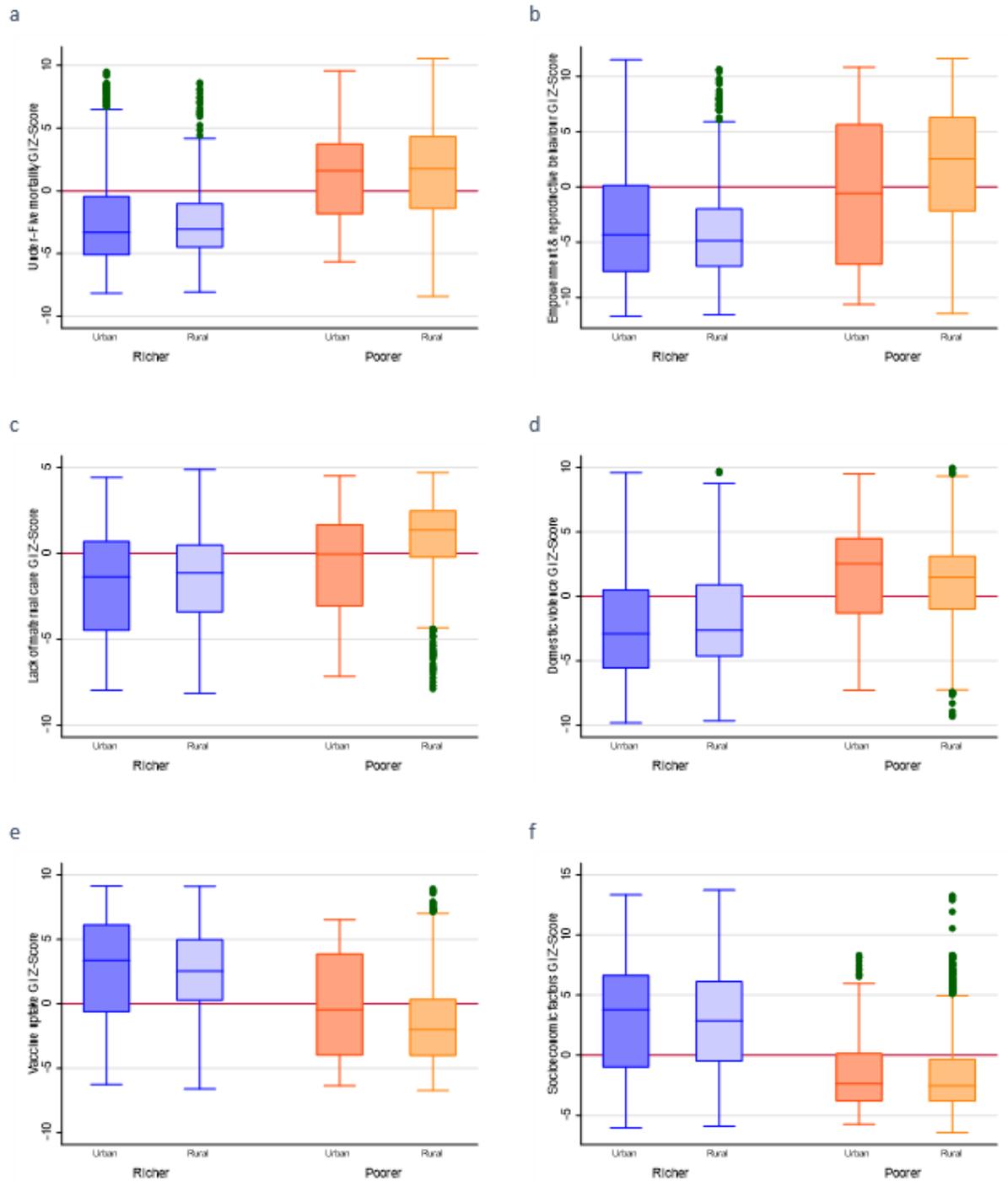
Under-five mortality is higher in the rural areas and lower in the urban areas (a), disempowerment is higher in rural areas and lower in the urban areas (b), inadequate access to maternal care is higher in rural areas and lower in the urban areas (c), domestic violence is higher rural areas and lower in the urban areas (d), vaccination rate is lower rural areas and higher in urban areas (e), and the average cluster socioeconomic status is lower in rural areas and higher in the urban areas.

Figure 20b: Rural-Urban divides



Pattern of Urban-Rural divide in hot spots under-five mortality is altered by political region. (a) Under-five mortality hot spots, (b) disempowerment and reproductive behaviour hot spots, (c) lack of maternal care hot spots, (d) domestic violence hot spots, (e) vaccine uptake hot spot and (f) Socioeconomic factors hot spots

Figure 20c: settlement size-political region intersection



Political region of clusters notwithstanding, urban areas perform better than rural areas. Rural areas appear to be associated with greater health and socioeconomic disadvantage

Figure 20d

However, it is not in all cases that urban clusters achieve better under-five health outcomes compared with rural clusters. Figure 20b-c show that being located in the north or south could make a difference in the initial rural-urban pattern in under-five health achievement observed. Northern urban clusters consistently exhibited worse outcomes in under-five mortality and its determinants related compared with southern rural clusters. When wealth levels are taken into consideration, rural-rich clusters tended to have lower under-five mortality rate compared with the urban-poor clusters. Although poorer clusters are generally associated with worse under-five mortality outcomes when all clusters are accounted for, the observed health disadvantage in the poorest groups in this study does not translate to all poor areas necessarily having higher mortality rates than more affluent groups. Figure 20e shows that 73 NDHS clusters in the pooled data belonging to the bottom 40% wealth quintile exhibited significantly lower than expected under-five rate (-1.5 standard deviation from the mean) given the deprivation level (Appendix 1). The average mortality for this group is 5.8% which is much lower than the average mortality rate (10.27%) observed for the 40% richest clusters.

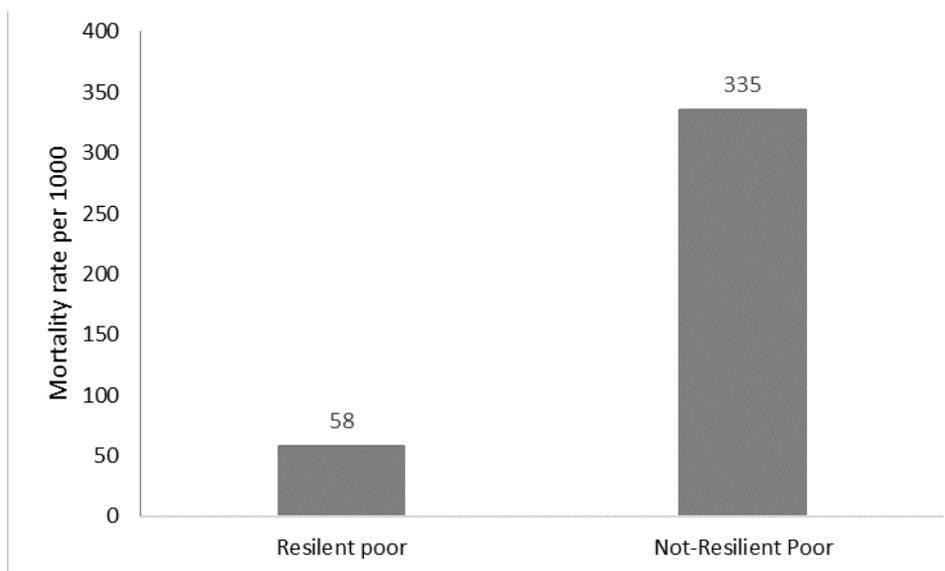


Figure 20e: resilient poor clusters

This result suggests that there could be some contextual factors protecting or exacerbating the effect of neighbourhood deprivation on under-five mortality within the observed communities that are worth further investigation. Chapter 6 fills this gap by exploring the social determinants of health and relative inequalities in under-five mortality for smaller area geographies located in predominantly health-achieving areas of southern Nigeria. The NDHS samples, even when pooled together, remain too coarse for adequately representing detailed spatial variations in under-five mortality in diverse settings in Nigeria.

5.3.2 North-South divides in under-five mortality

Beyond wealth divides in under-five deaths, inequalities between the two political regions in Nigeria, north and south are the second largest. NDHS clusters in the northern region of Nigeria ($N = 1146$) are associated with under-five mortality rate ($M = 17.42\%$, $SD = 9.03$). By comparison, the south ($N = 989$) is associated with a numerically smaller under-five mortality rate ($M = 11.14\%$, $SD = 6.22$). A 6% mean gap in the pooled under-five mortality rate is observed between the two groups in the 10-year period. The 17.42% mean under-five mortality rate in the north is higher than the national average of 14.5%. The south has a lower than national average under-five mortality of 11.14%.

A between-group one-way ANOVA test yielded a statistical significance in mean difference between the two groups over the 10-year period. Northern clusters are more likely to have higher concentration of under-five mortality hot spots compared with southern clusters $F(1, 2133) = 339.406$, $p < .000$. A large effect size is also observed ($r = .375$, $d = .81$) associated with the statistical significance are considered large based on (Cohen, 1992) guidelines. Findings also show that Northern communities tended to be located on at the bottom of the wealth quintile (Figures 21a-d). Based on the Getis-Ord G_i^* statistics, 576 NDHS clusters were classified as under-five mortality hot spots of which 554 are located in the North. 979 clusters are classified as cold spot. 779 (78.8%) of these cold spots are in the South. However, it is not entirely grim up north or universally pleasant down south. The hotspots maps presented earlier indicated that the North Central geopolitical zone and some states in the poorer North East region exhibit some mortality cold spots while the more affluent and oil-rich South South geopolitical zone has some unexpected concentration of high mortality hot spots. Domestic violence risk factor demonstrates a more eastern pattern.

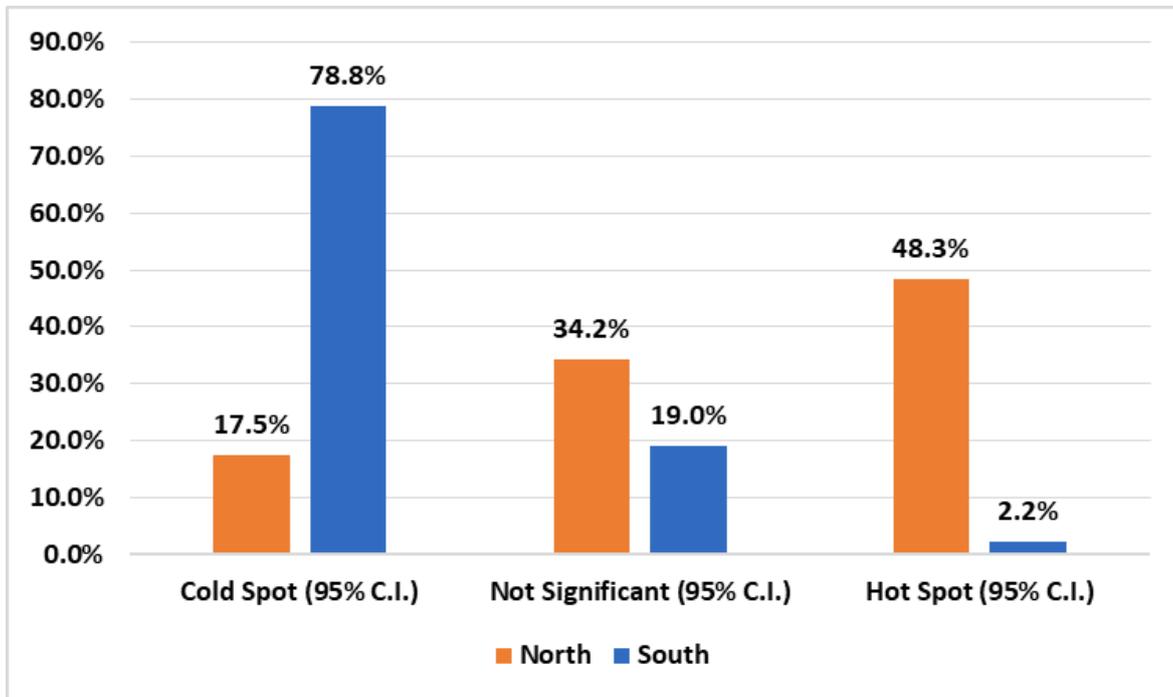


Figure 21a: percentage of correspondence between Lower mortality hot spots in the south and higher mortality hot spots in the north.

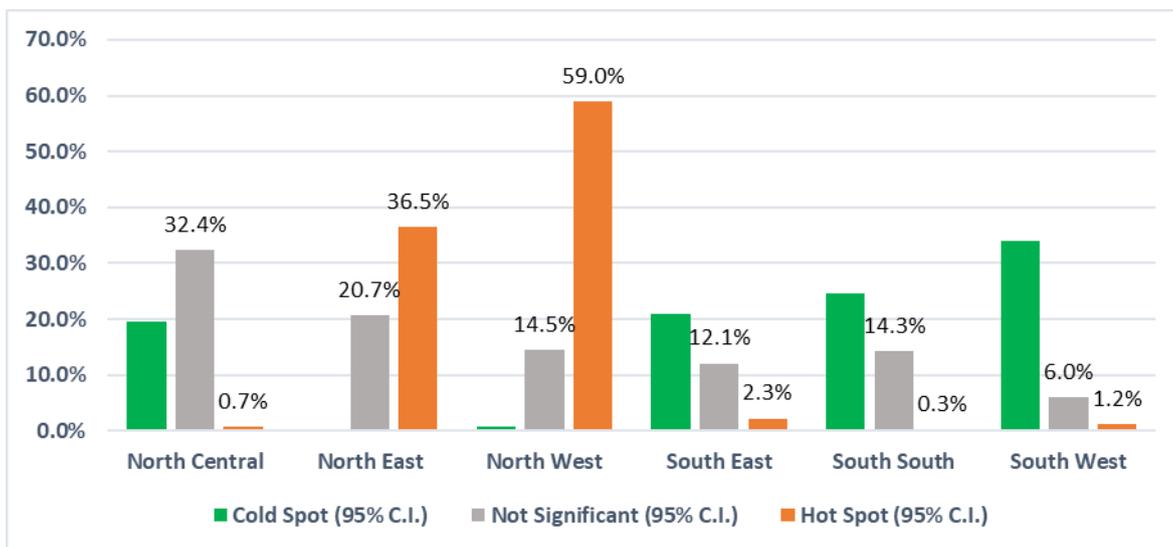
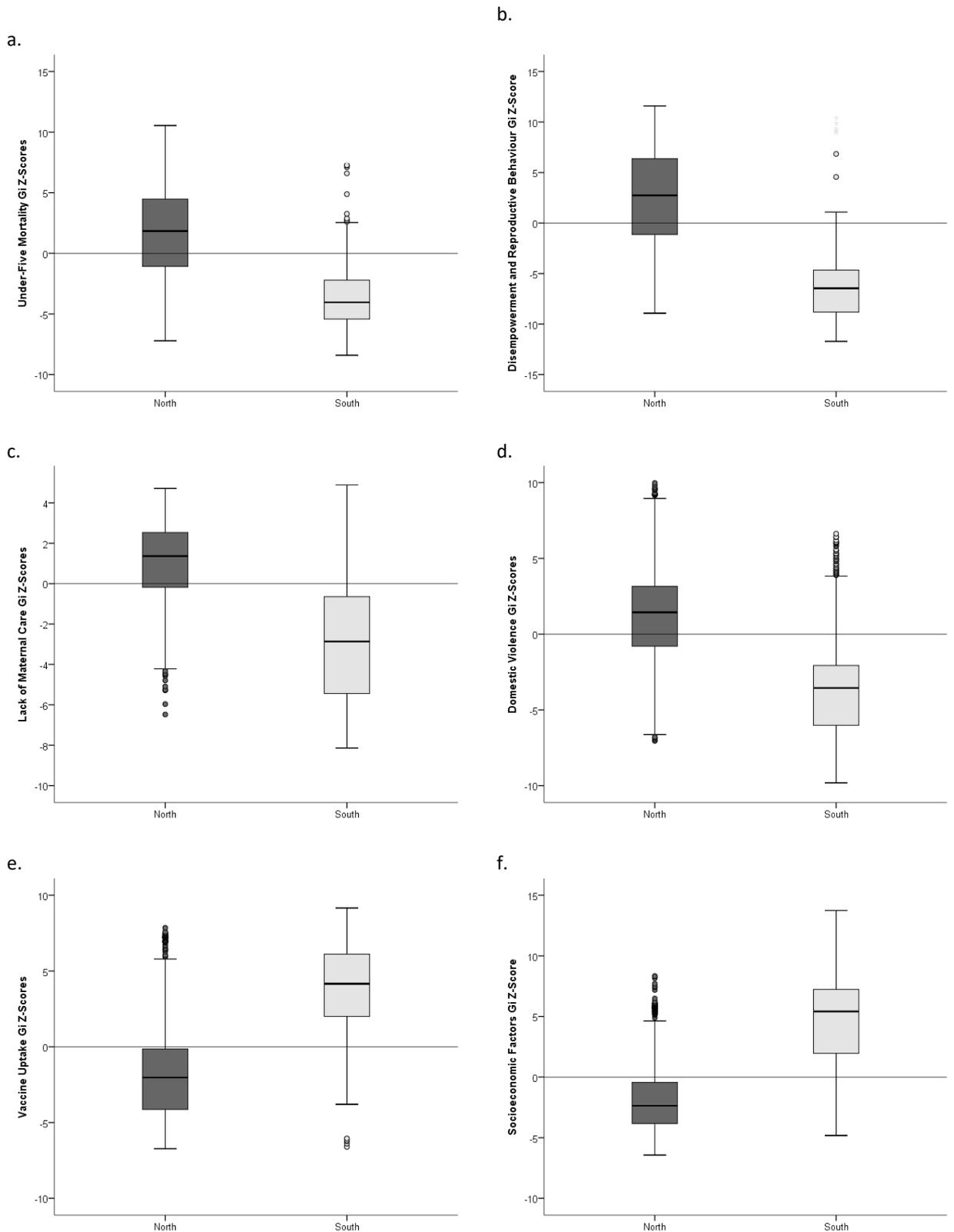
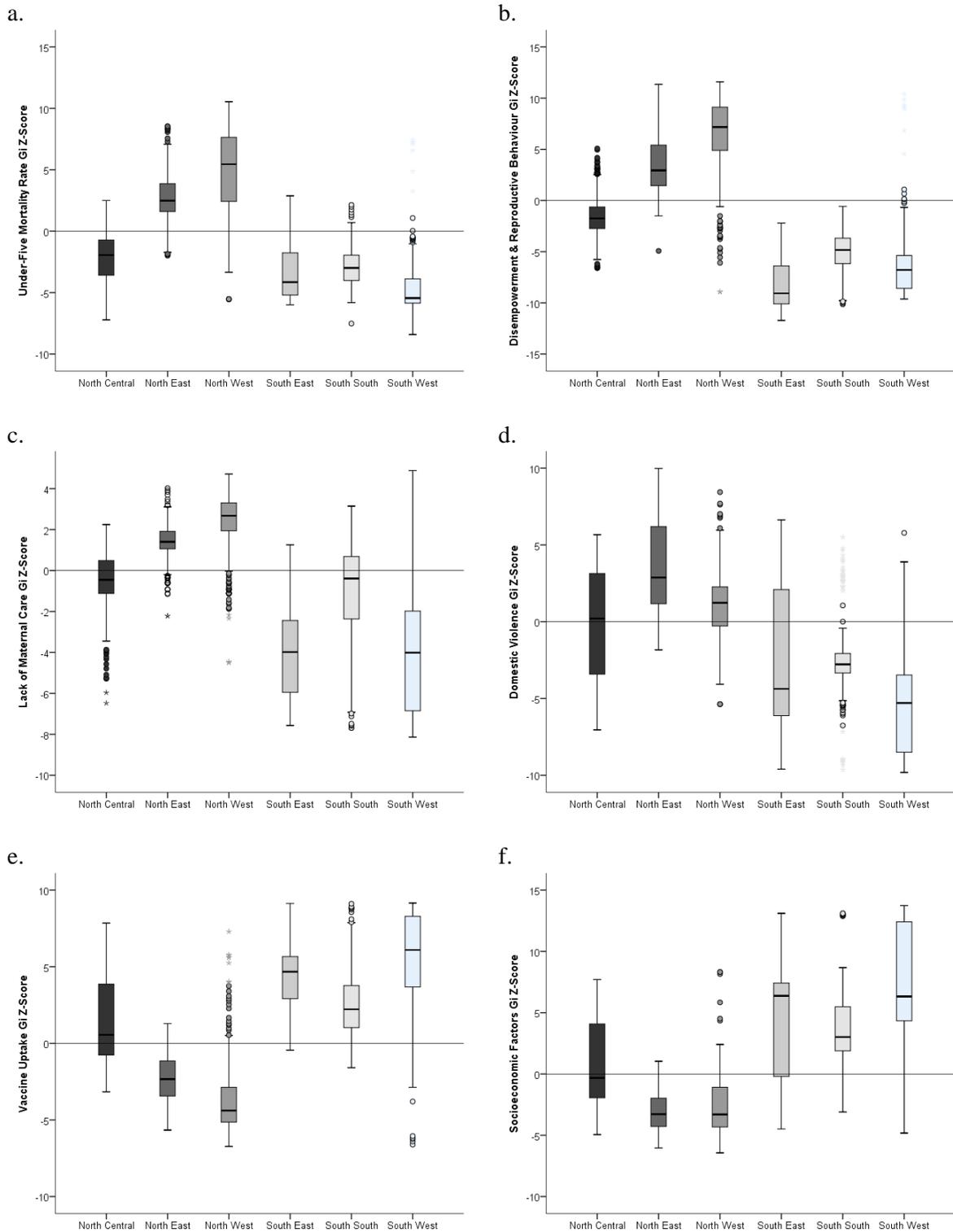


Figure: 21b: percentage of correspondence between highest mortality hot and senatorial regions



Under-five mortality is higher in the north and lower in the south (a), disempowerment is higher in the north and lower in the south (b), inadequate access to maternal care is higher in the north and lower in the south (c), domestic violence is higher in the north and lower in the south (d), vaccination rate is lower in the north and higher in the south (e), and the average cluster socioeconomic status is lower in the north and higher in the south.

Figure 21c: North-South divides



Under-five mortality is highest in the North West and lowest in the South East (a), disempowerment is highest in the North West and lowest in the South West (b), inadequate access to maternal care is highest in the North West and lowest in the South West (c), domestic violence is highest in the North West and lowest in the South West (d), vaccination rate is lowest in the North West and higher in the South West (e), and the average cluster socioeconomic status is lowest in the North and highest in the South West.

21d: regional health divides

The boxplots shown in Figures 21c-d show a clear significant health divide within the north and south. The results indicate a significant variation in under-five mortality across the six geopolitical regions of the country. There is a 10% gap in under-five deaths within the north. The table shows that under-five mortality was highest in the North West ($M = 21.18\%$, $SD = 9.10$) and North East ($M = 19.68\%$, $SD = 7.63$) and lowest in the North Central ($M = 11.20\%$, $SD = 6.41$). The North East and the North West exhibited consistently worse outcomes in under-five mortality and the all risk factors. Within the southern region, under-five deaths were highest in the South East ($M = 11.42\%$, $SD = 6.38$) and South South ($M = 11.29\%$, $SD = 5.69$) and lowest in the west ($M = 10.37\%$, $SD = 6.46$). There is a wider health gap in under-five health within the north ($M = 9.98\%$, $SD = 2.69$) compared with the south ($M = 1.60\%$, $SD = .08$). Overall, the South West region and the North West had the highest and lowest mortality rates respectively for the 10 year period. Using the South West region as the reference group, a statistically significant mean difference $F(5, 2129) = 172.648$, $p < .000$, $r = .288$) and a large effect size were observed for the six geopolitical regions in Nigeria.

5.3.4 Ethnic divide in under-five mortality

Ethnicity is an important social determinant of health especially in feminist research because differential exposure and vulnerability to health risk factors due to ethnic differences result from social divisions and discriminatory practices against women in many contexts (Krieger, 2002, Solar *et al.*, 2010). Four rather broad ethnic classifications are used to assess ethnic differences in under-five mortality rate. There are 3 major ethnic groups in Nigeria, Hausa-Fulani, Igbo and Yoruba, with over 250+ identifiable ethnic minority groups. A cluster is arbitrarily classified into an ethnic group if 7 out of 10 babies are born to mothers of a particular ethnicity. 70% majority is considered appropriate for ethnic labelling given the diverse nature of the country. Thus, a Hausa-Fulani cluster will comprise 70% of interviewed mothers and children who were less than five years of age in the 10-year period, 2003-2013. Numerically, the highest rate of under-five mortality was observed for clusters with predominantly Hausa-Fulani ethnic clusters ($N = 279$, $M = 22.97\%$, $SD = 8.03$) mainly located in the northern region of Nigeria and Ethnic Minority group ($N = 269$, $M = 15.17\%$, $SD = 7.45$) mainly distributed between the North Central and South South regions. Figures 22a-b show that the Yoruba ethnic clusters and Igbo ethnic clusters which are located with the western and eastern regions of Nigeria are associated with lowest mortality rate ($N = 301$, $M = 9.23\%$, $SD = 5.49$) and ($N = 177$, $M = 12.89\%$, $SD = 6.61$) respectively. A between-group one-way ANOVA indicated a statistically significant ethnic divide and a large effect size in the average under-five mortality rate $F(3, 1022) = 13.116$, $p < .000$, $r = .365$)

in Nigeria. The boxplots of hot spots by ethnicity (Figure 22b) show that higher clustering of Hausa-Fulani ethnicity is also associated with higher clustering of under-five mortality hot spots.

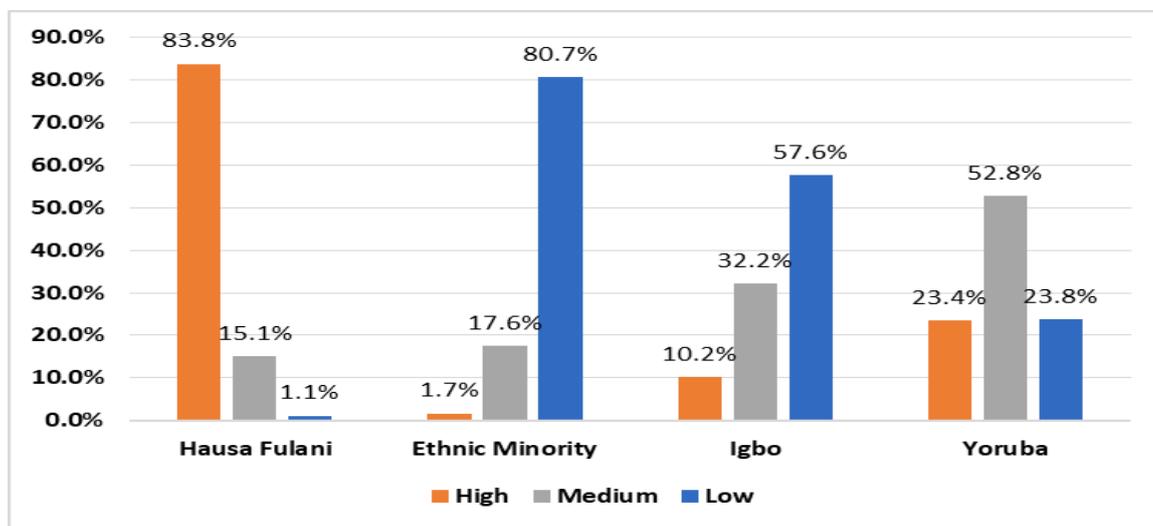
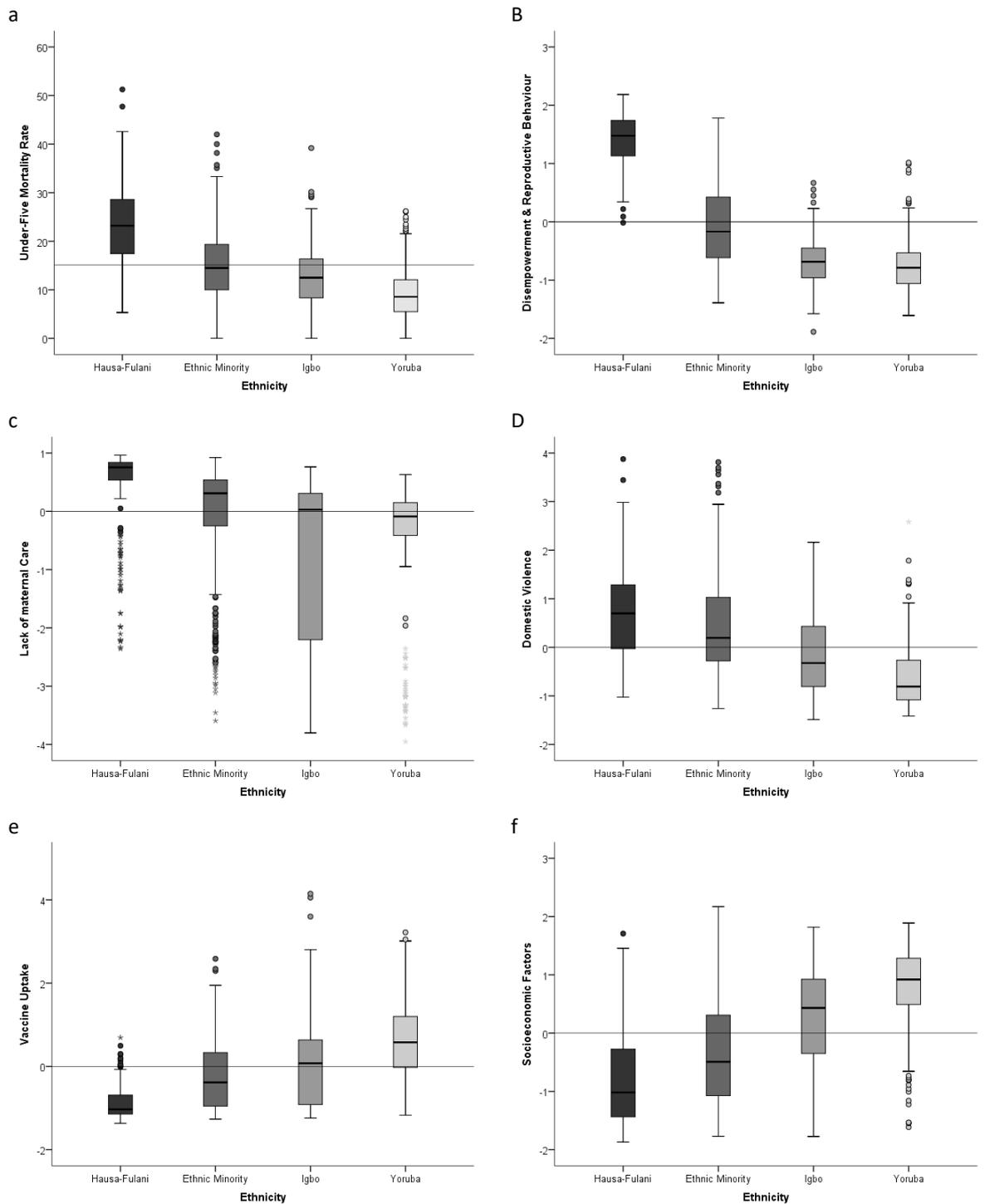


Figure 22a: percentage of correspondence between under-five mortality hot spots and ethnic clusters



Disparities in hot spots under-five mortality by ethnicity (a) Under-five mortality hot spots, (b) disempowerment and reproductive behaviour hot spots, (c) lack of maternal care hot spots, (d) domestic violence hot spots, (e) vaccine uptake hot spot and (f) Socioeconomic factors hot spots

Figure 22b: Ethnic divides in under-five mortality

5.3.5 Religious affiliation and inequalities in under-five mortality

The 70% majority rule used for the ethnic classification of clusters was also utilised for classifying clusters into categories of religion. Nigeria has three dominant religious groups namely, Christianity (N = 433), Islam (N = 693) and traditional religion (2). However, only Christian and Islam groups are considered in this study. Traditionalists were omitted from the analysis since only two clusters had 70% or more people identifying as traditionalists. Results indicate lower associations with under-five deaths for Christian clusters ($M = 12.17\%$, $SD = 6.01$) and higher associations for clusters where Islam ($M = 18.71\%$, $SD = 8.88$) is predominant. The mean differences between the two religious groups are considered large and statistically significant as indicated by the between-group one-way ANOVA $F(3, 1125) = 182.475$, $p < .000$, $d = .863$). The bar chart and boxplots shown in Figures 23a-b shows that Christianity hot spots correspond with mortality cold spots. Hot spots of Muslim communities are associated with hot spots of under-five mortality.

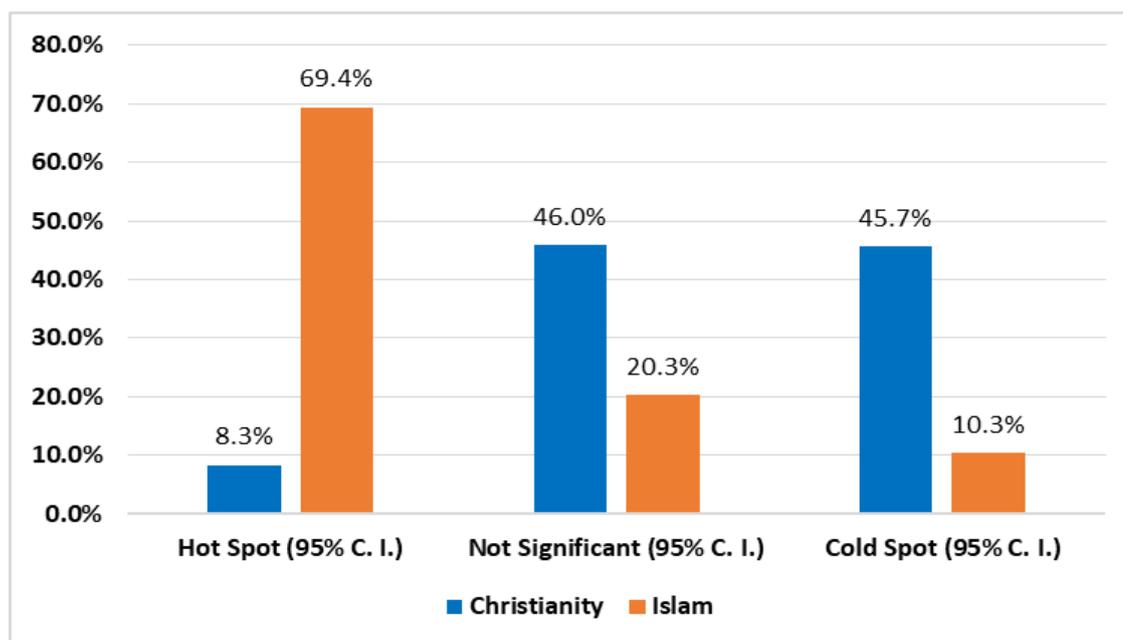
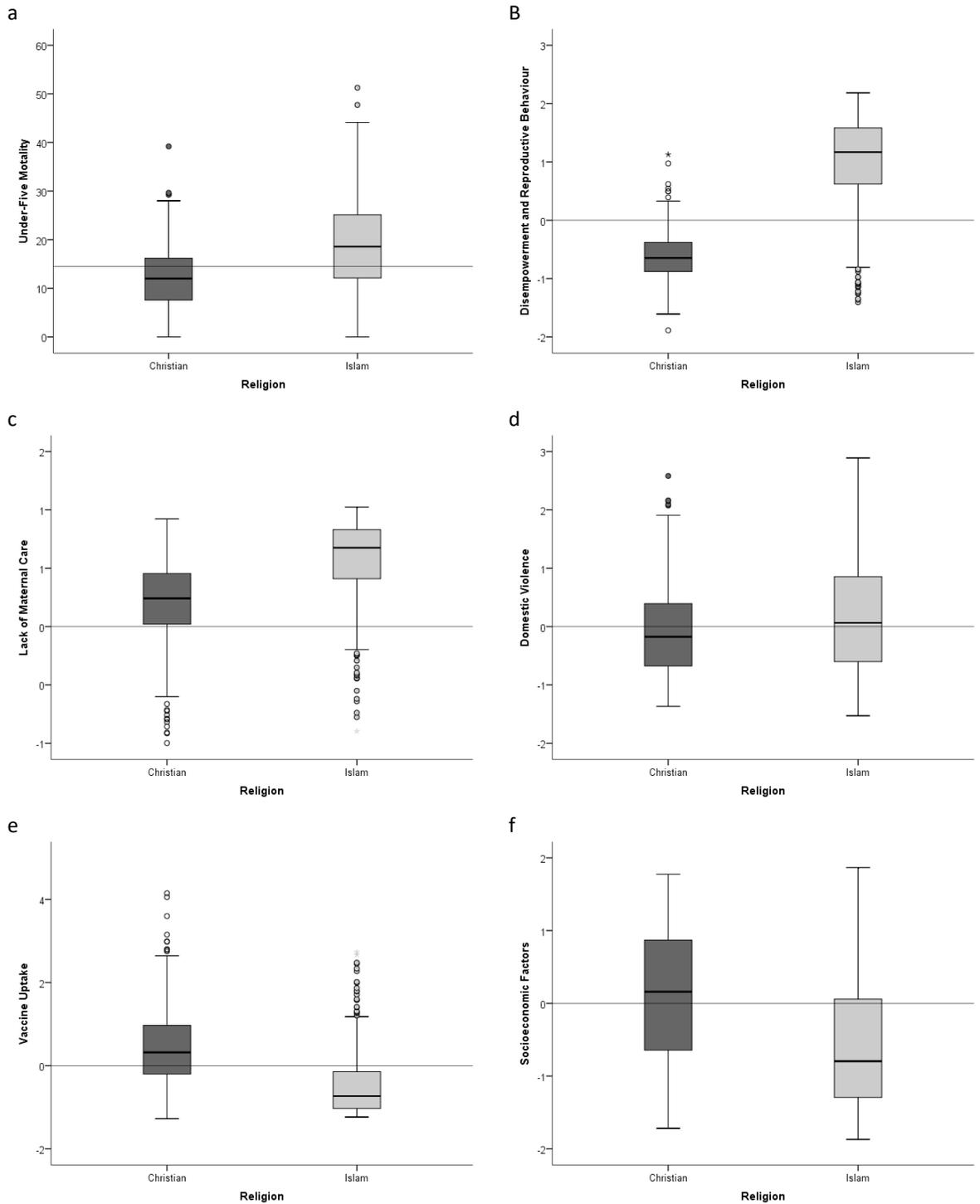


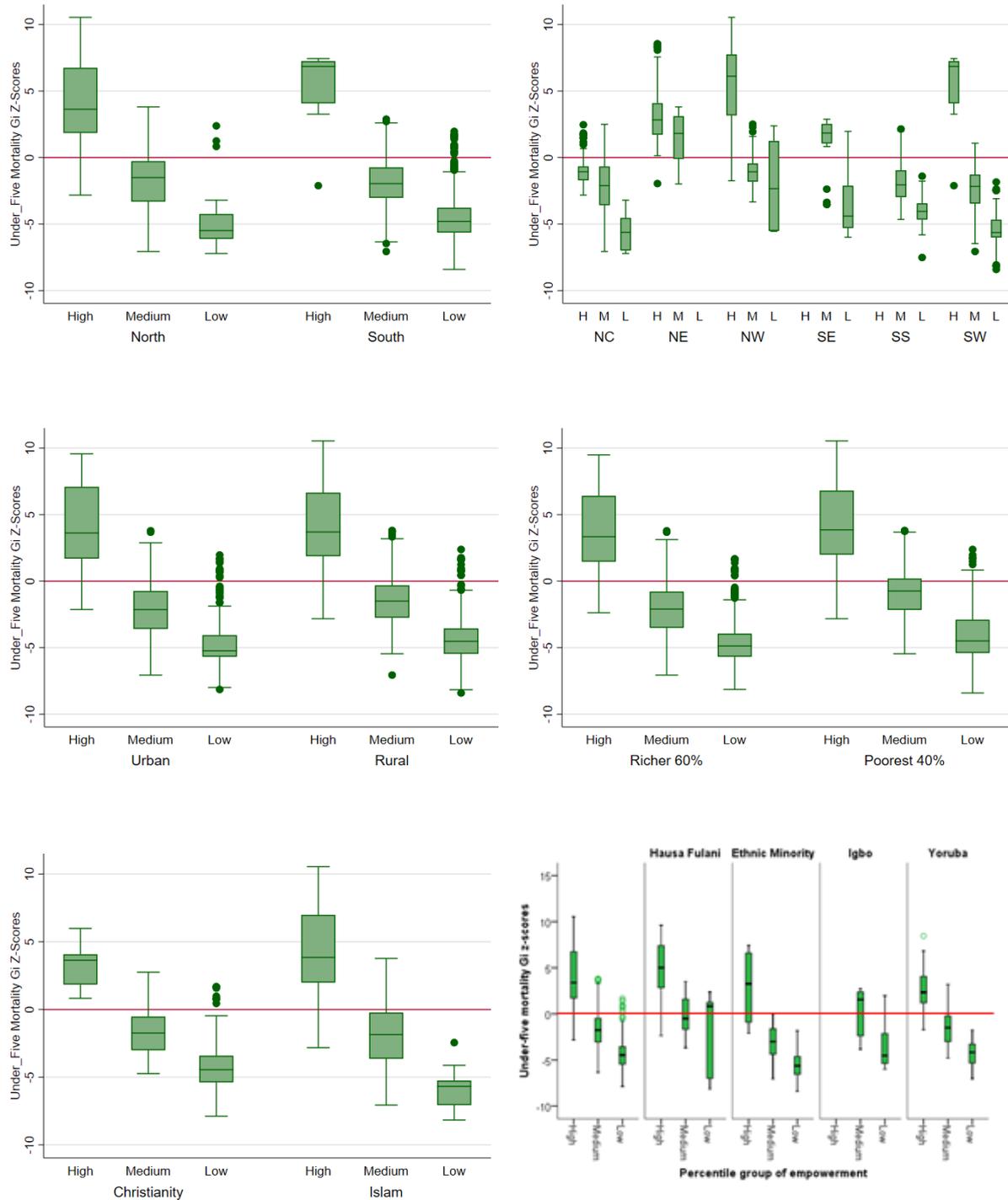
Figure 23a: percentage of correspondence between under-five mortality and religious affiliations

Overall, results show that significant social gradient and regional disparities exist in under-five mortality with the widest gaps observed between wealth groups, political and religious groups. The boxplots in Figures 24a-b show that the disparities in under-five mortality across key population characteristics persist when risk domains are added to relationships between these attributes and under-five mortality. For example, the effect of disempowerment on under-five mortality is also clearly stratified across population groups.



Disparities in hot spots under-five mortality by religious affiliation (a) Under-five mortality hot spots, (b) disempowerment and reproductive behaviour hot spots, (c) lack of maternal care hot spots, (d) domestic violence hot spots, (e) vaccine uptake hot spot and (f) Socioeconomic factors hot spots

Figure 23b: Religious divides



The effect of female disempowerment on mortality rate clearly varies along geographical regions, wealth levels, ethnicity and religion.

Figure 24a: Multiple axes of determinants

5.4 Discussion

This chapter attempted to examine the spatial and social inequalities in under-five mortality and associated determinants. This study represents one of the first attempts at examining under-five mortality hot spots and related risk factors at a neighbourhood scale and in a decade within the Millennium Development Goals (MDG) era. The results confirm that the socioeconomic and environmental living conditions of daily life may create unequal spaces of (Dahlgren *et al.*, 1991) risks which in turn may influence under-five mortality experience between areas and social groups. The correlation matrices of the G_i^* z-scores for under-five mortality and all five multi-dimensional risk factors provided in Table 13 shows very strong relationships between high concentrations of neighbourhood risk factors such as disempowerment, lack of adequate reproductive care, domestic abuse, low vaccination rates and socioeconomic disadvantage with hot spots of under-mortality.

Table 18: Hot spots correlation matrices

	Under-Five Mortality Gi Z-Score	Disempowerment & Reproductive Behaviour Gi Z-Score	Lack of Maternal Care Gi Z-Score	Domestic Violence Gi Z-Score	Vaccine Uptake Gi Z-Score
Under-Five Mortality Score Gi Z-Score	1				
Disempowerment & Reproductive Risk Behaviour Gi Z-Score	.901**				
Lack of Maternal Care Score Gi Z-Score	.820**	.860**			
Domestic Violence Gi Z-Score	.712**	.634**	.720**		
Vaccine Uptake Gi Z-Score	-.890**	-.907**	-.886**	-.746	
Socioeconomic Factors Score Gi Z-Score	-.815**	-.784**	-.869**	-.903**	.891**

The health divide and the spatial clustering of under-five mortality rates between the north and south political regions of Nigeria are readily distinguishable. The Northern region demonstrated significantly worse clustering in under-five health and higher levels of risks compared with its southern counterpart. Wide regional inequalities also existed within these regions with the North West and North East recording the worst outcomes in the North. Given the relative security stability of the North West region over the North East, it is unexpected that the North West in fact exhibits the worst mortality rates in Nigeria

compared with the more political fragile North East. This is because the North East has been facing the challenges and devastating effect of terrorist activities from the self-acclaimed Boko Haram terrorist organisation. The North West on the other hand benefits from the disproportionately higher numbers of administrative units such as states and LGAs that means that more national revenue allocation compared to other non-oil producing regions. However, the North West exhibited significantly worse off under-five health outcomes than its North Eastern counterpart and ranks as the region with the worst under-five mortality rates in the country. It is important for future research to examine qualitatively, the contextual factors in the North West that could be exacerbating the risk of under-five mortality in the region. There is also a future research potential for investigating the extent to which the risk of terrorism influences health on the one hand, and the contribution of terrorism-related intervention programmes to under-five health on the other hand.

The analysis of within-region differences in the southern political region revealed that the South South and South East geopolitical zones exhibited the worst outcomes in the Southern political region. The poorest health region in the southern part of Nigeria (South East – 11.97%) was 9% better than the worst health region in the North (North West – 21.18%). Overall, the South West region comprising the Yoruba ethnic group, demonstrated relatively better under-five health achievement compared with other regions in this study. These statistics reveal that under-five mortality rate remains unacceptably high in both political regions. The 9% under-five mortality rate observed for the best performing region (North West/Yoruba ethnicity) remains higher than the Sub-Saharan African average of 8%. This means that an estimated minimum of 9 and a maximum of 23 deaths per 100 live births occurred among the Yoruba ethnicity in the south western region and Hausa-Fulani ethnicity groups in Northern region within the decade investigated.

However, it is not entirely pleasant down south and grim up north. Within the southern region, the South East demonstrated the worst mortality outcomes, the South South demonstrated unexpectedly high levels of under-five mortality hot spots, and unexpectedly poor maternal and child vaccination spots are observed in the South South region given that the region accounts for over 90% of national revenue from crude oil and gas resources. The sub regional disparities in under-five risks in Nigeria has been previously observed (Adedini *et al.*, 2015c, Antai, 2011b). Although the specific causal pathways of regional differences is yet to be fully known, the observed divide may be related to wider inequalities in socioeconomic, infrastructural development, political and religious situations within regions. For example, the unexpected poor access to maternal care and vaccination uptake

for children under the age of five in the South South region may be due to the deficiency in; social infrastructure and health care services; high unemployment rates; and protracted oil-related conflicts in the oil-rich Niger-Delta region; in addition to extensive networks of swamps, mangroves, and lagoons; and the environmental pollution from crude oil spillage (Antai, 2011b). The striking elevated risk of under-five mortality observed in the North West and North East could be attributable to living in communities with demographic characteristics such as high birth orders (6 and above), high prevalence of child marriage (before the age of 18 years), high proportions of mothers with no education and employment, low proportion of mothers who receive skilled antenatal and medical facility delivery and overall differences in material circumstances and social development.

The results in this study indicate that women in the NDHS clusters in the north which are more likely to be disempowered, exhibit higher reproductive risk behaviour, and may experience higher rates of domestic violence from their male partners. The hot spots maps of domestic violence clearly shows an eastern pattern. In addition to regional inequalities, this study also shows a rural-urban divide in under-five health. The children born to women living in rural communities are 7% more likely to die before their fifth birthday compared with those born in urban communities regardless of region of residence. However, the size of region of residence that is living in rural or urban area has the least effect (.159) in the pooled data. The health disadvantage for rural populations is well documented in the literature (Ettarh *et al.*, 2012, Pateman, 2011, Okafor *et al.*, 2014a).

Beyond regional clustering, the under-five mortality rate is also observed to be markedly divided along ethnic identities and religious affiliations with large effect sizes of .396 and .365 respectively. Ethnicity and religion are good proxies of cultural and behavioural influences in health (Antai *et al.*, 2009). Table 19 shows that NDHS cluster that are predominantly classified as Hausa-Fulani ethnicity are also classified as predominantly Muslim clusters.

Table 19: Cross tabulations between ethnicity and religion

		Ethnicity				Total
		Hausa-Fulani	Yoruba	Igbo	Ethnic Minority	
Religion	Christian	0	52	113	118	283
	Islam	205	55	0	49	309
Total		205	107	113	167	592

The analyses in this study indicate that the Yoruba ethnic group that is predominantly found in the western region of Nigeria with nearly equal proportions of children born to

Christianity and Muslim mothers, has the lowest rate of under-five deaths and the Hausa-Fulani ethnic group has the highest rate. A 13% divide in health between the Fulani-Hausa and Yoruba ethnic groups. Past studies have found the Yorubas to be the most educated group in Nigeria. They have an embedded culture of seeking timely medical attention, and medical facility delivery, and only small proportions of women getting married before the age of 18 years. They are less likely to have preceding birth interval of less than two years or higher birth orders of 5 and above. In contrast, there is evidence in the literature that Northern Hausa-Fulani ethnic groups do not access health care in a medical facility on time (Adedini *et al.*, 2015a, Antai, 2011a). In addition, the 6% gap between Christians and Muslim groups could suggest that there are underlying cultural processes mediating the differential health experiences of population groups that needs further investigation. Brown *et al.* (2009) argues that the environment in which health risk is constructed has several societal determinants ranging from prevailing social ideologies and cultural codes of ethnic groups, power, gender relations, beliefs, and perceptions that define the entitlements and levels of empowerment or the lack of it of different groups in society. Based on varying spatially and socially constructed capacities, communities could be exposed differently to health risks that may create inequalities in under-five mortality outcomes.

Although ethnic minority groups achieved 8% better health outcomes than ethnic Hausa-Fulanis, they perform 6% worse than the best health achievers, the Yorubas. The relative health disadvantage observed for ethnic minority groups and geographical regions in Nigeria is supported in literature (see for example, Adedini *et al.*, 2015a, Antai, 2011a, Bamba, 2016). This could indicate that ethnic minority groups may experience poor health because of wider disadvantages in society, such as having reduced access to; wider developmental privileges, political power and economic resources in Nigeria even when those resources are in their backyard as reflected in the experience of the oil-rich South-South region. However, I must warn that the health pattern observed for ethnic minority groups must be interpreted in context. In this study, over 200 identifiable ethnic minority groups have been classified together. There could be more heterogeneous health achievements when specific ethnicities are examined.

Previous bodies of literature have suggested that ethnic identities and religious affiliations may have implications for female disempowerment through embedded gender norms and cultural practices. Gender is '*socially constructed with culture-bound conventions, roles and behaviours that shape social relations between men and women*' (Solar *et al.*, 2010). In Nigeria, gender-based social hierarchies serve as fundamental basis for female discrimination with deleterious consequences for health via pathways such as reduced access to education, decision power, prestige, resources, higher birth orders, polygyny, and

widowhood practices (Adedini *et al.*, 2015a, Antai, 2011a). Gender disadvantage is manifest in women's often reduced ability to obtain education in developing countries leading to fragmented forms of employment and uncertain work trajectories that may increase the risk of household poverty. The relevance of religion as a possible determinant of under-five mortality was partly triggered in Nigeria's public health literature within the MDGs period due to the refusal of polio vaccinations in Nigeria by some Muslim communities in the North (Antai *et al.*, 2009) and the role of religion in influencing economic and health behaviours. Religious involvement may help shape beliefs, health perceptions and attitudes which are likely to influence health care utilization behaviours through physical and psychosocial processes, coping strategies in dealing with the burden of health care utilization, family planning, maternal and child vaccinations, and social relationships and networking (Chatters, 2000).

Nigeria is well recognised as a country of great extremes, where absolute poverty stands side-by-side with great wealth. The findings in this study also show that health gap resulting from differences in wealth is the largest in the study compared with differences in geographical locations, ethnic identities and religious affiliations. The poorest groups exhibited 10% worse rates of under-five deaths compared with the most affluent in Nigeria. Community socioeconomic position had the largest observed effect (.643) on child survival beyond the age of 5 years in 2003-2013 based on Cohen *d* standards (Cohen, 1992). The influence of community wealth on the health of children is found to be twice as large as the effect of living in the northern or southern geopolitical regions (.376). This is not surprising since majority of women in Nigeria do not have access to health insurance. It is expected that women in deprived areas might not be able to afford the out-of-pocket payment for maternal and child health services most of the time. Wealth effects persisted regardless of living in a particular political region of residence. This means that poorest groups living in the north and south, rural and urban areas of Nigeria face disproportionately higher risks of under-five mortality compared with groups that are more affluent in these regions. This findings adds to the accumulating evidence on the social gradient in health and the role of the material context of places as a major health determinant in both developed countries (Havard *et al.*, 2008, Turrell *et al.*, 2001, Singh *et al.*, 2006) and less affluent societies (Antai, 2011b, Boutayeb *et al.*, 2011, Singh *et al.*, 2012).

For several decades, research has demonstrated that adverse socioeconomic and environmental circumstances of areas where people live are intimately linked with poor health outcomes (Saito *et al.*, 2014, Townsend, 1987, Turrell *et al.*, 2001). The health of population groups from the lower end of the socioeconomic ladder is markedly worse than groups at the upper end. This relationship exists across a broad range of health indicators

and has been observed at varying spatial scales and contexts (McKnight *et al.*, 1997). There is sufficient evidence that poorer people are more likely to live in places with multiple socioeconomic problems (poor access to health care, poor education, unemployment, low income etc.) with damaging effects on health and well-being. (Norman *et al.*, 2011, Saito *et al.*, 2014, Townsend, 1987). It is not surprising therefore that society has low expectations for the health of people living in deprived areas and that research and policy practice have tended to focus on deficit perspectives. MDG intervention programmes have disproportionately employed deficit public health models and aid-oriented risk narratives compared to building contextual resources and health assets.

Research findings have also shown that some places do not follow this typical pattern of positive association between poor health and area disadvantage, suggesting that deprivation does not always damage health as expected, and does not always predict health outcomes as anticipated (Cairns *et al.*, 2012, Stafford *et al.*, 2003, Walsh *et al.*, 2010). Persistently disadvantaged populations could have better than expected health outcomes or be resilient depending on the presence or absence of health promoting resources in specific contexts (Mitchell *et al.*, 2009). More research efforts are needed in order to tease out the factors working together to protect the health of some poor communities.

There is also a need to further investigate group-specific barriers to health in order to reduce within country inequalities are important for enhancing the successes of public health intervention strategies. This is crucial going forward with the SDG3 targets in Nigeria. The relevance of spatial and social heterogeneities was not emphasized in the MDGs. Although the MDGs made substantial gains in reducing global under-five mortality steadily, one of its main short-comings was the reductionist view of development adopted by implementation strategies. The MDGs were grossly misinterpreted as one-size-fits-all targets MDGs in many countries in Sub-Saharan Africa including Nigeria, was the failure to expand the MDGs beyond conventional macroeconomic narratives and biomedical intervention (as evident in the mosquito bed net and vaccination intervention programmes), largely influenced by aid politics and misused to reinforce a donor-centric view of development. The consequences being the failure to shift development beyond income-poverty; from a narrow biomedical intervention paradigm to a more comprehensive agency-oriented perspective of sustainable and equitable wellbeing.

‘The MDGs implied fundamental transformations in society which are invariably driven by domestic politics and local actors. The world is off track, not because of insufficient economic growth but mostly because people in the bottom quintiles have benefitted disproportionately little from national progress. As long as the world continues to turn a blind eye to the growing inequalities within countries, the MDG agenda was mission impossible whose meaning is best described as minding development gaps’. (Vandemoortele, 2011: 1).

5.5 Limitations and strengths

The inherent weaknesses in the DHS data has already been acknowledged in the previous chapter. Another limitation of the NDHS data relates to the NDHS wealth index measure. Although, the NDHS wealth index makes it possible to examine inequalities in under-five mortality experience between economic groups in this study, the index is a rather blunt tool for assessing urban poverty. Asset ownership based on the information from the DHS does not reflect the quantity and quality of durables goods owned by households and the reliability of the supply services such as electricity or water. It could be argued that those better off may have superior quality or more technologically advanced assets than poorer groups. For example, a well off household may be able to generate power for longer hours in the event of power cuts with more advanced generators compared with the poor and may be able to receive satellite or digital transmission with smart television sets rather than an analogue black and white.

The index also has a problem of generalizing indicators of welfare across rural and urban areas. For instance, while urban slum dwellers generally live in brick or concrete houses, they may be in far more precarious living conditions than rural dwellers in mud houses. Also, the NDHS wealth-index does not include information on income, health status, environmental and social variables that might contribute to deprivation. These limitations highlight the need for further work on either the modification of the NDHS subset indicators of welfare or further studies on wealth differentials in under-five mortality in a way that is sensitive to different levels of poverty within urban centres. A third and more general limitation with this study is that the NDHS data and most public health data bases are risk-oriented. This means that broad and blunt indicators that fit biomedical ideas of what constitute health risks are privileged in such surveys. Although, the wider DHS design makes room for country-specific indicators to be collected on certain themes which are hardly ever utilised in the NDHS, it could be argued that the data, like most quantitative health data sources, lacks recognition for subjectivities of health and wellbeing. These critiques stem from broader methodological debates relating to the positivist assumption of objectivity in research for which qualitative approaches have challenged the notion of detached objective researcher (Labonté *et al.*, 2005). Furthermore, some social determinants of health such as social relations and social network, self-assessed health socioeconomic status, wellbeing and indicators relating to contextual resources for building resilience relevant to most developing health context like Nigeria either are absent or not sufficiently measured.

5.6 Conclusion

This study makes an important contribution to the understanding of the social determinants of health at the population level by presenting evidence on the existing socioeconomic and cultural divides in under-five mortality experience on the basis of the geographical locations of areas, settlement size, wealth levels, religious affiliations and ethnicity. The evidence supports the revised social determinants of health model in that the conditions that create inequalities in health at the population level may relate to wider societal factors in which people are born, live, grow and age (Marmot *et al.*, 2008). The findings in this study shows the key aspects of social and geographical differentiation in health. Although effects of settlement size and religious affiliation have independent and statistically significant effects on the risk of under-five mortality, these indicators became redundant when examined together with the other four indicators. There are no known studies in Nigeria that has examined geographical and socioeconomic inequalities in a decade using a wide range of categories of difference as demonstrated in this study. Past studies examining population-level inequalities in under-five mortality in Nigeria have mostly focused on unitary indicators based on single survey years. For example, (Adedini *et al.*, 2015a) examined ethnic differentials, (Amouzou *et al.*, 2010) focused on wealth differences, (Antai *et al.*, 2009) focused on religious affiliations, (Adedini *et al.*, 2015c, Antai, 2011b) examined regional inequalities and (Antai, 2011a) attempted to examine inequalities in ethnicity and socioeconomic position. The breadth of groups examined in this study makes it possible to priorities efforts on reducing inequalities. This study suggest that reducing health inequalities should become a public health agenda going forward with sustainable development goals.

The findings reveal a range of well-recognised geographical and socioeconomic inequalities in under-five mortality throughout Nigeria with many risk factors and under-five deaths occurring more among the poor compared with affluent groups; northern regions compared with their southern counterparts; rural than urban areas, Muslims than Christians; and Hausa-Fulani compared with the Yoruba ethnic group. The study also demonstrates that deprivation does not always kills as fast as predicted. The 73 NDHS clusters with the 40% poorest quintiles have demonstrated ‘apparent resilience’ and achieved better than expected child health outcomes given the level of deprivation. Based on the findings in this research and evidence in the academic literature, it is important to go beyond a one-size-fits-all approach to evidence gathering and to incorporate spatial heterogeneities and intersectionality thinking for development strategies in developing countries. If there are any lessons to be learnt from the many failures and success stories of the MDG health

targets in moving forward with the SDGs in Nigeria, they would revolve around eliminating geographical and social inequalities within Nigeria, and creating longer-term policy spaces that are sensitive to existing spatial and social heterogeneities.

Although these findings are informative for identifying the health disparities within population groups, the patterns indicate the need to reassess current strategies for improving health and the assumption on which they are routed. The results suggest that public health policy aimed at addressing the social determinants of health must prioritise the reduction of inequalities in its core strategies. The results open up potential for further examining interesting questions regarding how different factors interact in co-producing health inequalities.

The next two chapters demonstrate that it could be informative to include the voices of local people in research and recognise the organisational structures through which the conditions that affect their health is perceived and influenced. Using mixed-methods this thesis, attempts to respond to the weaknesses inherent in solely assessing the social determinants of health from NDHS data by additionally examining wellbeing and social capital indicators as social determinants of under-five mortality, which are not included in the NDHS data. Chapter 7 presents results on perceived factors of under-five mortality risks and coping resources from the perspective of mothers. It is hoped that the everyday health concerns identified by mothers through responding to a questionnaire assessing a range of health and wellbeing perceptions and self-reports of health behaviours, will inform strategies addressing practical concerns child health-risks shared by the interviewed women.

Chapter 7 explores lay narratives of mothers in order to deepen research perspectives on why and how health inequalities are perpetuated in different population groups. Incorporating the local voice and the theory of intersectionality to understand how the simultaneous interactions between the social determinants of health create unequal health outcomes is in recognition of the role of human agency in shaping the conditions that affect health.

CHAPTER 6

Localised Determinants of Inequalities in Under-Five Mortality

6.0 Introduction

This chapter attempts to explore the social determinants of under-five mortality at finer geographical and socioeconomic scales beyond the small area geographies for which the NDHS data is published. Methodologically, this chapter builds on identified weaknesses inherent in the NDHS dataset for interrogating small area health inequalities. These NDHS data limitations relate mainly to the absence of finer level geographies and the absence of certain health indicators such as social capital and perceived wellbeing indicators that are important social determinants of health. The case study areas include selected urban and rural study communities in Edo State Nigeria. These regions were previously identified in chapter 5 as belonging to a predominantly under-five mortality ‘cold spots’ region in Southern Nigeria using the spatial auto-correlation analysis.

The cold spot region in the southern Nigeria contains communities that exhibit statistically significant clustering of lower than the national average of under-five mortality. More detail on the rationale for selecting case studies are available in chapter 3, section 3.4.1. Descriptive statistics and logistic regression models are used to examine the leading domains of health determinants in the study population. Case study findings reflect four broad domains of health determinants at the local level: perception and health behaviour, contextual social capital, neighbourhood context, sanitation and child clustering factors. As suggested by the social determinants of health model, the potential risks for under-five mortality that emerged at the local level reflect more immediate living conditions (geographical, socioeconomic and social networking) of women and their children compared with wider societal factors that emerged in chapter 5.

The underlying argument in this chapter is that it is important to account for factors shaping differences in health experiences, as there is no reason to suppose that the risk of under-five mortality will be the same across geographical scales. There are suggestions that structure of social inequalities at micro levels can be informative for predicting a range of social outcomes (Cunningham, 2017). The case areas chosen for analysis that is more detailed are mortality cold spots. This means that on average, under-five mortality rates

that are relatively lower compared to northern areas that have higher clustering of high mortality rates. I was also interested to know whether within these areas, there were, nevertheless, some groups of individual families (represented here by their mothers) where risk of under-five mortality were significantly worse than other groups. This study has therefore used detailed information on individual responses from the fieldwork questionnaire (shown in Appendix 2.2) designed by the author. Using this data on individual responses, this study has examined whether mothers of children who died under the age of five years during the study period differed from other mothers in terms of their self-reported living conditions. The overall aim of this chapter is to identify which self-reported living conditions were mostly associated with the risk of death of a child under 5 years.

A major limitation in this study is the absence of information on the actual geographical locations of respondents that made it impossible to utilise Geographically Weighted Logistic Regression (GWLR) model to capture spatially varying relationships in Under-five mortality in the study population. As discussed earlier, the regression coefficients derived from the global logistic regression coefficients assumed a constant association between the risk factors of under-five mortality examined and under-five mortality making it less ideal for geographical studies. However, the results are informative for development action by identifying the range of social determinants that are shaping inequalities in under-five mortality in the study population. The study makes an innovative contribution in an under-researched area in Nigeria by demonstrating that community social capital and subjective aspects of wellbeing are significantly associated with under-five mortality in Nigeria. The results suggest that quantitative health geography research can benefit from interrogating spatial heterogeneities from a macro level down to micro level in the social determinants of health. This suggests the need for surveys to be generated and published at micro levels especially in diverse settings like Nigeria.

6.1 Results

6.1.1 Under-five mortality outcome

The research questions examined in this chapter call for the prediction of a dichotomous outcome: whether a child died ($N = 222$, 12.0%) coded '1' or survived ($N = 1634$, 88.0%) coded '0', before their fifth birthday within the 5 years preceding the survey year 2017 (Table 20). 1634 (88.8%) of interviewed persons had no experience of under-five mortality and 222 (12.0%) deaths were recorded within the five years preceding the survey year 2017.

Table.20: Under-five mortality outcome

	Frequency	%	Valid %
Child is alive (0)	1634	88.0	88.0
Child is dead (1)	222	12.0	12.0

6.1.2 Selecting explanatory variables

The range of explanatory variables can be broadly classified into two categories. The first category relates to the contextual characteristics of neighbourhoods where mothers, aged 18-49 and their children live. These include socioeconomic, environmental, community infrastructure. The second category relates to compositional qualities of mothers and children. These include demographic, socioeconomic, perception/child health behaviour and social network and community engagement (see Appendix 3).

The analysis began with a data cleansing process to remove the missing data. Overall, 2028 participants completed the survey; 602 in the rural areas and 1426 urban participants that is above the required sample size. The data were cleaned and 172 (8.4%) participants removed who had missing values for the outcome variable which measures under-five mortality outcome. The number of participants included in the final analysis reported in this chapter is 1856. These included 1272 urban women and 584 rural women. Thus, the sample size requirement of 1671 was met.

The analysis in this chapter is designed to achieve two objectives:

- i. Identify the localised determinants of under-five mortality in the study population
- ii. Investigate the nature of relative inequalities in under-five mortality experience given the compositional and contextual characteristics in the study population

6.1.3 Descriptive statistics of questionnaire data

Spearman's Rho correlation tests were initially conducted across subset explanatory variables. Explanatory variables with statistically significant Spearman's Rho correlation of ≥ 0.1 with the under-five mortality were retained for further analysis. It is customary to examine the strength of associations between the dependent variable and potential explanatory variables in quantitative health geography research in order to reduce redundancy in the data (Jephcote *et al.*, 2014). Spearman's Rho is preferred to the alternative non-parametric correlation method 'Kendall's tau-b' because it is sensitive to outliers in detecting associations between categorical variables (Hauke *et al.*, 2011). In order to reduce

redundancy in the data, 22 significant variables were identified based on the >10% association principle. Single model logistic regression model was further applied to each of the identified significant variables in order to explore whether they made significant contribution to the baseline model containing no explanatory variables. The contribution of all 22 variables to the explanation of under-five mortality event in the sample were found to be significantly >0 suggesting that they could be retained for further model development. The significant variables broadly reflect child factors, mother compositional and contextual factors, perception/child health behaviour and social network aspects of inequalities. Since it was not statistically possible to obtain a model where all 22 explanatory variables interact together to significantly predict whether a child in the sample died or survived, the explanatory variable were classified into four main domains namely, socioeconomic, contextual, perception/child health behaviour and social network domains. Appendix 3 shows the statistically significant variables, in the order of significance, and the relative inequalities between sub population categories in the variables.

Several socioeconomic factors of mothers and their households with >10% association with under-five mortality include the type of toilet facilities in the household, household/family size and age category of child were found to be positively associated with under-five mortality. Other socioeconomic determinants of under-five mortality such as highest level of education of mothers, monthly income, rent, occupation and child school attendance were found to be negatively associated with under-five mortality outcome. The main source of household drinking water and region of residence were positively associated contextual variables with under-five mortality. Household waste disposal method and access to electricity also showed positive associations. Objective and perceived community social class were the most significant perception indicators to be negatively associated with under-five mortality outcome. The availability of mosquito bed net for sleeping at night and the perceived priority areas for child's wellbeing were the two additional child health behaviour variables associated with under-five mortality. The social network related determinants to meet the association cut-off of >10% include, the type of community organisation that mothers belonged to, the degree of participation in community organisations, length of residence in the neighbourhood and participant's knowledge of people in the local area. The contributions to under-five mortality and the relative health inequality indicated in the four domains of health determinants are further discussed in the result section.

6.1.4 Baseline characteristics of study participants

The distribution of the study participants included in the final analysis after the removal of missing data is presented in Table 21. In terms of child-level factors, child sex in the study

sample is broadly in keeping with the pooled NDHS with estimated male and female children at 51% and 49% compared with Edo State (51%), South South (52%) and national samples (51%). The study sample has more infants aged 0-11 months (27%) compared with the pooled Edo State (17%), South South geopolitical region (17%) and national (17%) NDHS sample. However, the vaccination rates in the study sample (71%), although higher than the national rates (68%), appears to be much lower than South South regional estimates (91%) in the NDHS data.

The NDHS data estimate the educational levels of women within the South-South region and Edo State to be much higher than the national averages. Nationally, the NDHS cluster data estimate 54% of women are without education and only 5% of women have higher education compared with the DHS sample for Edo State at 14% and 8% respectively. The women in the fieldwork study sample are even more educated than the NDHS sample. In the fieldwork sample, only 4% of women have no formal education and 22% have higher education compared with the NDHS estimates for Edo State (14% and 8%) and the South-South Region (13% and 7%). The sample ended up being more educated than the NDHS sample. The average household size in this study sample appears to be smaller than the NDHS estimates with 89% of participants reporting a household size of ≤ 6 compared with estimates for Edo State (56%), South-south (59%) and national data (47%). In terms of contextual characteristics, the proportion of participants assessing their neighbourhoods as poor (37%) were numerically higher than the proportion of people objectively classified as poor in the pooled NDHS wealth index for Edo State (15%), South South region (20%). The average subjective poorest group is also lower than the objectively measured national-level poverty (49%).

Table 21: Demographic characteristics of mothers

Key socioeconomic and contextual measures from the primary survey compared with the pooled 2003-2013 NDHS findings for Edo State, South-South and Southern geopolitical region and the whole of Nigeria

	Number (%)					Field Survey
	Nigeria	North	South	South-South	Edo State	
2006 census female population (count)	100	53.6	46.4	15.0%	2.3	N/A
NDHS individual woman - 2003, 2008, 2013 (count)	100	58.7	41.3	14.8	2.6	N/A
Pooled NDHS birth record 2003, 2008, 2013 (count)	100	67.5	32.5	11.8	2.1	100
	DHS Data (2003, 2008, 2013)					Fieldwork
Under-five mortality rate	16.7	19.2	11.4	11.3	10.3	11.7
CHILD						
Age of living child						
0 - 11 months	16.8	16.9	16.6	16.8	17.3	26.7
12 - 23 months	22.4	22.5	22.4	22.7	22.0	25.6
24 - 35 months	19.9	19.7	20.3	20.0	20.7	17.9
36 - 47 months	21.8	21.9	21.8	21.7	21.5	13.5
48 - 59 months	19.0	19.0	19.0	18.8	18.6	16.4
Age of death						
0 - 11 months	54.3	51.2	65.4	65.6	63.5	66.0
12 - 23 months	19.9	20.7	17.3	16.7	17.6	16.5
24 - 35 months	15.1	16.7	9.1	9.5	9.2	12.4
36 - 47 months	7.3	7.8	5.4	5.5	7.3	2.6
48 - 59 months	3.4	0.7	2.8	2.7	2.5	2.6
Sex of child						
Male	51.4	51.3	51.3	51.7	51.4	50.6
Female	48.6	48.7	48.7	48.3	48.6	49.4Edo
Vaccination						
Yes	67.5	63.3	63.3	78.0	91.1	71.1
No	32.9	36.7	36.7	22.0	8.9	24.6
SOCIOECONOMIC FACTORS						
Age of respondent						
Less than 20 years	1.5	1.8	0.8	1.2	0.4	1.3
20 - 29 years	22.4	24.4	18.3	20.0	15.4	27.3
30 - 39 years	38.1	37.8	38.7	39.2	41.5	63.5
40 - 49 years	38.0	35.9	42.3	39.5	42.7	7.9
Highest level of education						
No education	53.7	71.5	16.6	12.6	14.4	3.6
Primary	23.5	16.6	37.9	43.4	39.9	18.2
Secondary	18.1	9.1	36.8	36.7	38.1	56.1
Higher	4.7	2.8	8.7	7.3	7.6	22.1
Employment Status						
Employed	73.3	66.0	88.5	86.6	88.2	84.8
Unemployed	26.7	34.0	11.5	13.4	11.8	15.2

Table 21 (continued)

	Percentage (%)					
	Nigeria	North	South	South South	Edo State	Primary Survey
	DHS Data (2003, 2008, 2013)					Fieldwork
Marital Status						
Single/Never married	0.8	0.3	1.9	3.3	0.9	5.3
Married	93.0	95.5	87.7	84.7	89.7	93.1
Divorced/Separated	5.1	0.5	2.3	4.0	2.6	0.8
Widowed	4.1	3.7	8.1	8.0	6.8	0.8
Household size						
<= 4 persons	19.6	15.1	29.9	26.9	23.8	33.1
5 - 6 persons	27.5	24.7	35.0	32.1	32.6	53.8
7 - 10 persons	35.8	38.3	30.6	34.7	35.0	12.3
> 10 persons	17.1	22.7	5.4	6.3	8.5	0.7
Religion						
Christianity	42.9	22.0	84.0	92.6	84.3	93.1
Islam	57.1	78.0	16.0	7.4	15.1	6.9
Type of toilet facility						
Flushed	11.6	6.0	23.2	10.3	31.6	66.3
Pit/latrine	34.3	30.7	41.8	21.2	23.6	21.3
Other, none	54.1	63.2	35.0	45.4	45.1	12.3
Materials for house wall						
Modern/Finished	46.4	33.0	74.3	70.1	80.1	89.5
Rudimentary/Unfinished	53.6	67.0	25.7	29.9	19.9	10.5
Materials for house floor						
Modern/Finished	52.9	42.0	75.6	73.8	76.9	94.7
Rudimentary/Unfinished	47.1	58.0	24.4	26.2	23.1	5.3
CONTEXTUAL						
Household has electricity						
Yes	42.1	33.6	59.9	55.6	73.5	83.3
No	57.1	66.1	38.8	42.4	23.9	16.7
Region of residence						
Urban	29.8	22.6	44.7	27.2	50.1	69.2
Rural	70.2	77.4	55.3	72.8	49.9	30.8
Main source of domestic water						
Piped	10.3	10.2	10.5	9.6	4.3	11.2
borehole	27.7	24.3	34.9	31.0	40.8	55.4
well	33.8	41.0	18.3	16.1	15.7	24.2
Surface (stream/River, other)	28.3	24.5	36.4	43.3	39.2	9.3
Waste disposal method						
Organised (public & private)	56.1	60.9	44.4	36.8	60.6	53.2
Unorganised	43.9	39.1	55.6	63.2	39.4	46.8
Community socioeconomic status						
	DHS Wealth Index					Subjective
Poorer	48.9	62.4	20.8	19.9	14.5	37.2
Middle	20.4	18.7	23.9	28.0	18.7	48.8
Richer	30.7	18.8	55.3	52.1	66.8	14.0

6.2.2 Geographical and socioeconomic patterns of under-five mortality

Table 22 shows the geographical comparison of the proportion of under-five mortality in this study sample and the NDHS data. The study population is compared with the NDHS regions of Edo State, South-South, and the national-level data. In terms of the overall pattern of under-five mortality identified by demographic and socioeconomic factors, this study is in keeping with the NDHS data. For example, in all data samples compared numerically, children born to the uneducated, larger households, Muslims and poorer mothers are more likely to die before the age of 5 years. In this study sample, 29.1% of all the children born to uneducated mothers died before their fifth birthdays compared with 7.6% deaths in children born to mothers with higher education. These mortality figures disaggregated by educational levels with respect to maternal education are very reflective of national patterns. The table also shows that similar patterns of infant mortality are identified with respect to the age distribution in this study sample (66%) and the NDHS samples for Edo State (64%), South-South (66%) region and national-level (54%) data. Mortality rates tend to decrease with increasing child age. Households with a flushed toilet facility recorded lower mortality rates (7.9%) compared with latrine toilet systems (15.7%) or those with no toilets at all (25.5%). Contextually, women with access to improved water supply such as piped water (6.9%), organised waste disposal (7.6%), electricity (22.2%) and urban (8.0%) women recorded lower under-five mortality compared with women relying on surface water (28.3%), unorganised waste disposal (16.6%) such as throwing waste in open and vacant plots (%), without electricity (29.5%) and rural (20.2%) counterparts respectively. No difference in under-five mortality was recorded by child sex.

Table 22: Patterns of under-five mortality

Key socioeconomic and contextual variables from the survey compared with the pooled NDHS data (2003-2013) for Nigeria, Southern, South-South, and Edo State regions

	Average Under-Five Mortality Rate (%)					
	Nigeria	North	South	South-South	Edo State	Field Survey
	NDHS survey data					Fieldwork
Survey population (Count)	247232	166881	80351	29203	4747	1575
Average under-five mortality rate	16.7	19.2	11.4	11.3	10.3	11.8
CHILD FACTORS						
Age at death						
0 - 11 months	54.3	51.2	65.4	65.6	63.5	65.4
12 - 23 months	19.9	20.7	17.3	16.7	17.6	17.3
24 - 35 months	15.1	16.7	9.1	9.5	9.2	12.2
36 - 47 months	7.3	7.8	5.4	5.5	7.3	3.2
48 - 59 months	3.4	3.6	2.8	2.7	2.5	1.9
Sex of child						
Male	53.8	20.0	12.2	12.2	11.0	11.5
Female	46.2	18.4	10.5	10.5	9.7	11.5
MATERNAL FACTORS						
Antenatal service attendance						
Yes	17.2	20.2	11.5	11.4	10.4	11.8
No	8.2	8.1	8.4	9.1	5.1	10.3
Delivery health facility						
Public	7.9	8.5	7.3	6.6	6.8	14.4
Private	7.2	7.6	7.1	7.3	6.6	7.7
Non-Medical	11.4	11.9	8.9	9.4	7.3	12.5
SOCIOECONOMIC FACTORS						
Highest level of education						
No education	29.9	21.6	15.5	13.9	15.0	29.1
Primary	14.1	15.7	12.7	12.5	11.9	17.1
Secondary	10.0	10.3	9.8	10.0	7.9	10.6
Higher	7.1	7.3	6.9	7.3	5.7	7.6
Household size						
<= 4 persons	19.0	23.7	10.7	14.1	13.4	6.5
4 - 6 persons	16.1	19.9	9.9	10.4	8.9	11.8
7 - 10 persons	15.7	17.9	11.0	10.3	9.0	25.1
>= 10 persons	17.1	17.7	11.4	10.3	12.7	25.0
Religion						
Christianity	12.0	13.5	11.3	11.1	10.3	11.2
Islam	19.4	20.3	10.7	12.8	9.8	18.5
Traditional, other	22.3	23.5	16.0	15.4	13.6	66.7
Type of toilet facility						
Flushed	8.6	8.7	8.5	8.5	7.4	7.9
Pit/latrine	15.7	17.6	12.7	13.0	12.9	15.7
None (Bush, field, other)	19.1	21.0	11.8	11.0	10.9	25.5

Table 22: Continued

Variables	Average Under-Five Mortality Rate (%)					
	Nigeria	North	South	South-South	Edo State	Field Survey
	NDHS survey data					Fieldwork
Household has electricity						
Yes	12.9	15.5	9.9	10.0	13.0	22.2
No	19.5	21.1	13.8	13.1	19.6	29.5
Main materials for house wall						
Modern/Finished	11.6	13.0	10.4	10.2	9.7	10.6
Rudimentary/Unfinished	20.5	21.7	13.7	12.8	10.8	21.0
Main materials for house floor						
Modern/Finished	13.1	15.3	10.6	11.0	10.2	11.4
Rudimentary/Unfinished	20.7	22.1	13.9	12.3	10.4	18.8
CONTEXTUAL						
Region of residence						
Urban	12.3	14.1	10.4	9.6	9.0	8.0
Rural	18.5	20.7	12.2	12.0	11.7	20.2
Main source of water						
Piped	13.8	15.5	10.3	9.7	11.8	6.9
borehole	15.2	18.5	10.3	9.0	8.0	7.4
Well	19.0	20.6	11.2	12.6	10.3	17.7
Surface (river, stream, other)	16.3	18.5	13.1	13.1	13.1	28.3
Distance to water Source						
Within premises	16.0	17.9	10.6	10.1	9.0	9.6
< 5 minutes	16.7	20.0	11.2	1.7	10.2	14.6
>15 minutes	16.9	19.0	12.1	11.4	11.3	18.8
Waste Disposal Method						
Organised (public & private services)	15.4	17.4	8.7	9.1	9.2	7.6
Unorganised (throw into vacant plots/streams/drains, burn, bury, other)	14.0	15.7	11.0	11.1	9.0	16.6
Community socioeconomic status	NDHS wealth index					Perceived
Poorer	21.4	22.4	14.7	14.1	14.0	16.5
Middle	15.1	16.6	12.5	12.6	12.9	8.6
Richer	10.3	11.1	9.7	9.6	8.8	9.7

Overall, the descriptive statistics shows that the general pattern of under-five health found in my fieldwork data is similar to the overall pattern demonstrated in the NDHS data. As expected, the proportion of under-five mortality increases with decreasing socioeconomic position. For example, lower proportions of children born to women with higher education, access to improved water and of Christian religious affiliations died before the age of 5 years compared to more disadvantaged segments in the study sample that demonstrates higher risks. Under-five mortality risk is higher among children born to rural mothers compared

with their urban counterparts and more children died in the neonatal period and under-five deaths generally decreased as child age increased. However, there are significant deviations in my survey on a number of measures from the NDHS estimates in terms of the distribution of deaths among sub population groups. These deviations could be attributable to the study participants being more educated than expected or may be a reflection of the diversity of small area population dynamics that the coarser NDHS data was unable to capture, suggesting the need to collect data for smaller geographical units.

6.2.3 Domains of inequalities in under-five mortality

This section outlines the main domains of relative inequalities with case study neighbourhoods. It first presents the relationship between each of the selected indicators with under-five mortality in a single logistic regression model. It then presents the underlying models depicting the interactions between the models and their combined effects on under-five mortality risk.

Table 23: Under-five mortality baseline model

This table shows the baseline model. This is also known as the intercept-only or null model.

β	S.E.	Wald	df	Sig.	Exp(β)
-1.996	0.072	778.745	1	0.000	0.136
Cox & Snell $R^2 = 0.000$, Nagelkerke $R^2 = 0.000$, -2loglikelihood = 1359.154					

The baseline model serves as a good reference model because it contains no explanatory variable. In this model, all children are predicted to belong to the largest outcome category, that is, to have survived since the children who survived (1634) are more than those who died (222) in the study population (see Table 20). Subsequent models containing explanatory variables are examined with reference to their improvement on the baseline model using three recommended evaluation guidelines discussed on pages 16-18. These include, overall model evaluation, statistical tests of individual predictors and goodness-of-fit statistics. All three tests lead to similar inferences in this study. Descriptive statistics, which are the equivalent of the R^2 measures of associations between predicted probabilities and the data, are used as supplementary evaluation criteria. Levels of health inequalities between groups are interpreted using the odds ratio that is a relative measure of health inequality. All predictions have been made based on SPSS default classification cut-off point of 0.5. Using stepwise logistic regression method, only 12 of the 20 variables with greater than 0.100 Spearman correlation were retained for model development. Table 24 show the descriptive statistics of the 12 predictors and the distribution of under-five mortality among the sub population groups.

Table 24. Descriptive statistics of the 12 variables used for modelling under-five mortality risk

Predictor	Child is alive	Child is dead	df	Chi ²	Sig.	LR	Sig	Spearman
Perception and health behaviour								
Bed net always available for sleeping			2	10.454	0.005	9.418	0.009	0.033
Yes	192 (81.7%)	43 (11.2%)						
No	195 (89.9%)	22 (10.1%)						
Subjective household social class								
Poorer	539 (83.1%)	110 (16.9%)	2	24.397	0.000	23.759	0.000	-0.114
Middle	936 (90.5%)	101 (9.5%)						
Richer	109 (93.2%)	8 (6.8%)						
Perceived priority for child wellbeing								
Health and health care	901 (90.5%)	95 (9.5)	4	21.306	0.000	19.545	0.001	0.101
Employment	100 (89.3%)	12 (10.7%)						
Food	363 (86.2%)	58 (13.8%)						
Physical security								
Politics/public infrastructure	217 (81.0%)	51 (19.0%)						
Contextual social capital								
Degree of participation in community organisation			1	19.651	0.000	18.863	0.000	0.163
Not active	429 (90.3%)	46 (9.7%)						
Very active	209 (78.6%)	57 (21.4%)						
Length of residence in Neighbourhood								
<= 5 years	787 (92.7)	62 (7.3%)	2	44.161	0.000	43.462	0.000	0.153
6-10 years	350 (87.9%)	48 (12.1%)						
> 10 years	481 (81.1%)	112 (18.9%)						
Type of community organisation membership								
None	352 (87.1%)	52 (12.9%)	4	28.618	0.000	24.060	0.000	0.100
Religious	315 (88.5%)	41 (11.5%)						
Sociocultural	122 (84.7%)	22 (15.3%)						
Professional	26 (86.7%)	4 (13.3%)						
Cooperative/Savings	80 (69.0%)	36 (31.0%)						
Contextual factors								

Table 24 (contd).

Predictor	Child is alive	Child is dead	df	Chi ²	Sig.	LR	Sig	Spearman
Source of domestic water			3	76.280	0.000	69.245	0.000	0.191
Piped	189 (94.0%)	12 (6.0%)						
Borehole (artesian well)	932 (92.1%)	80 (7.9%)						
Well	373 (82.0%)	82 (18.0%)						
Surface water (River, streams)	126 (72.8%)	47 (27.2%)						
Subjective community social class			2	31.287	0.000	30.559	0.000	-0.109
Poorer	563 (82.7%)	118 (17.3%)						
Middle	819 (91.8%)	73 (8.2%)						
Richer	229 (89.5%)	27 (10.5%)						
Electricity Source			3	46.578	0.000	41.139	0.000	0.124
Public only	600 (92.0%)	52 (8.0%)						
Private only	397 (89.9%)	54 (12.0%)						
Public and private	393 (89.9%)	44 (10.1%)						
No Electricity (lamps, candles)	230 (76.9%)	69 (23.1%)						
Sanitation and child clustering								
Type of toilet facility			2	60.358	0.000	53.415	0.000	0.174
Flush	1119 (91.7%)	101 (8.3%)						
Pit/Latrine	329 (84.1%)	62 (15.9%)						
None (fields, bush)	166 (74.4%)	57 (25.6%)						
Child attends crèche'/nursery/school			1	21.087	0.000	20.415	0.000	-0.107
Yes	956 (85.2%)	166 (14.8%)						
No	654 (92.4%)	54 (7.6%)						
Household Size			2	62.673	0.000	54.912	0.000	0.165
<= 4 persons	557 (93.1%)	41 (6.9%)						
5-6 persons	857 (88.2%)	115 (11.8%)						
>= 7 persons	173 (73.3%)	63 (26.7%)						

Tables 25-29 show logistic regression models containing explanatory variables. In the order of model significance, these reflect the four broad dimensions of localised under-five mortality determinants namely, perception/child health behaviour, social network, contextual and socioeconomic determinants.

6.2.3.1 Perception and child health behaviour

Table 25 shows a three-predictor model with indicators assessing whether (52%) or not (48%) participants who use their bed nets for other purposes such as food processing use them for their children at night; the perceived household socioeconomic status of a study participant relative to other households in the neighbourhood, more participants rated their households as belonging to the average neighbourhood social class (58.1%) compared with those who self-rated as poorer (35.5%) or richer (6.4%) than their neighbours; the perceived priority areas of concern for child's wellbeing with most of the research participants identifying health and health care as their priority concern (55.4%). Other areas of concern include food and nutrition (23.4%), employment (6.2%) and 14.9% of the research participants identified other concerns such as physical security, inadequate infrastructure, bad governance and social relations.

The perception/child health behaviour is one of the four domains of under-five mortality highlighted in the data. This conclusion was reached with reference to multiple sources of evidence: the significant test of overall logistic regression model measured with the likelihood ratio chi-square test ($X^2=31.594$, $df = 7$, $P = 0.000$); score statistic ($X^2=31.061$, $df = 7$, $P = 0.000$); and insignificant H-L test of goodness-of-fit ($X^2=1.718$, $df = 7$, $P = 0.975$). These tests are all significant at 95% confidence interval suggesting that the model is a good fit for the data. The descriptive statistics including Cox and Snell (0.070) and Nagelkerke (0.125) R^2 results show significant associations between predicted probabilities and the data. Recall that smaller values of the likelihood ratio, score tests, and larger values of the descriptive statistics indicate better fitting models.

The statistical significance of the contribution of individual regression coefficient (β) is measured using the Wald chi-square test. Bed nets availability, self-rated household socioeconomic status and perceived wellbeing priority factors have significantly contributed to the prediction of under-five mortality outcome ($P < 0.05$). Mosquito bed net availability for sleeping is a significant predictor of the under-five mortality outcome in the model (Wald $X^2 = 4.607$, $df = 1$, $P = 0.032$). The model suggests a decreasing predictive probability (-0.639) of under-five mortality with increasing mosquito bed net availability to children for sleeping. The odds 0.528 ($C.I. = 0.295, 0.946$) suggests that children born to participants

who use their bed nets for other purposes and also use them for sleeping at night have 50% elevated risk of under-five mortality compared to those whose mothers use their bed nets for other purposes and do not have them available for their children to sleep under at night. This result indicates an almost 50% decrease in odds for the comparison group than the reference group. A positive regression coefficient (2.260) was observed for the self-rated household wealth (Wald $X^2 = 4.605$, $df = 2$, $P = 0.010$) variable indicating an increasing predictive probability. A unit increase in the study participants who rated their households as poor will lead to increased odds of under-five mortality occurring from 1 to 9.579 ($C.I. = 1.216, 75.437$) in these poor households compared with the rich. This indicate that children born to women who perceive their households as poorer than other households in their neighbourhoods are 10 times more likely to experience under-five mortality compared to household who rated themselves as richer than most households in their neighbourhoods. In terms of perceived areas of priority for child's wellbeing (Wald $X^2 = 19.167$, $df = 4$, $P = 0.001$), children born to research participants who reported physical security as their priority concern for child wellbeing are more 3 times more likely to die before their fifth birthdays compared with those who reported health and health care as priority areas for child wellbeing (Wald $X^2 = 5.665$, $P = 0.017$). This suggests that the odds of under-five mortality occurring increases from 1 to 3.306 ($C.I. = 1.235, 8.849$) with every increase in physical security concern. Hence, participants facing physical security or safety challenges may have an elevated risk of under-five mortality of 300% holding other explanatory variables constant.

Table 25: Perception and child health behaviour model

Predictor	β	SE β	Wald's X ²	df	p	e β (odds ratio)	95% C.I. for EXP(B)	
							Lower	Upper
Bed net always available for sleeping (Ref = Yes)						1		
No	-0.639	0.298	4.607	1	0.032	0.528	0.295	0.946
Self-Assessed household socioeconomic status			4.609	2	0.010			
Poorer	2.260	1.053	4.605	1	0.032	9.579	1.216	75.437
Middle	2.113	1.041	4.119	1	0.042	8.277	1.075	63.711
Richer (Ref)						1		
Priority-area/concern for child's wellbeing			19.167	4	0.001			
Health and health care (Ref)						1		
Employment	0.112	0.795	0.020	1	0.888	1.118	0.235	5.309
Food/nutrition	0.260	0.372	0.489	1	0.484	1.297	0.626	2.689
Physical Security	1.196	0.502	5.665	1	0.017	3.306	1.235	8.849
Infrastructure/governance	1.470	0.375	15.405	1	0.000	4.351	2.088	9.067
Constant	-4.011	1.046	14.714	1	0.000	0.018		
Test			X ²	df	p			
Overall model evaluation								
Likelihood ratio test			31.594	7	0.000			
Score test			31.061	7	0.000			
Goodness-of-fit test								
Hosmer & Lemeshow			1.718	7	0.975			
Cox & Snell R ² = 0.070, Nagelkerke R ² = 0.125, -2loglikelihood = 327.637								

Overall, the result of the perception and behaviour model demonstrate a link between self-rated social status of mothers and their perceived areas of concerns for child wellbeing, and mothers' misuse of ITNs. Mothers who reported using ITNs for other purposes other than malaria prevention, such as for food processing, demonstrated higher risks of under-five mortality compared to mothers who use their bed nets solely for other purpose and not for mosquito prevention. The interesting insight here is that not all mothers who own mosquito bed net may necessarily use them for mosquito/malaria prevention purposes and mothers who live in challenging neighbourhoods with physical security, infrastructural and governance as main priority areas for child wellbeing are more likely to be at risk of under-five mortality.

6.2.3.2 Contextual social capital

Table 26 shows a model containing three self-reported contextual social capital indicators assessing; the degree of participation in community organisations, inactive (64.1%) and very active (35.9); length of residence in the neighbourhood, ≤ 5 years (46.1%), 6 – 10 years (21.6%), >10 years (32.2%); type of community organisation membership, none (38.5%), religious (33.9%), sociocultural (13.7%), professional (2.9%) and cooperative/savings groups (11.0%). The model is proven to be significant at 95% C.I. and a good fit for the data based on the likelihood ratio chi-square test ($X^2=51.897$, $df = 7$, $P = 0.000$), score statistic ($X^2=54.705$, $df = 7$, $P = 0.000$) and an insignificant H-L goodness-of-fit test ($X^2=2.944$, $df = 7$, $P = 0.890$). Two additional descriptive statistics, the Cox and Snell (0.69) and Nagelkerke (0.124) indicate a significant association between predicted probabilities and the data.

The Wald's chi-square test of the significance of the contribution of the regression coefficient (β) for each explanatory variable in the social capital model indicate that the three indicators make significant contributions to the prediction of the probability of an under-five mortality event occurring ($P < 0.05$). An unexpected increasing predictive probability (0.653) of under-five mortality occurring with increasing units of participation in community organisations is observed (Wald $X^2 = 7.680$, $df = 1$, $P = 0.006$). The model suggests that the degree of mothers' community participation as a measure of community engagement is significantly associated with under-five mortality. There is a 1.921 (2 times) increase in the odds of under-five mortality occurring in children born to mothers who are very active in community organisations compared with the inactive (OR = 1.921, C.I. = 1.211, 3.048). The length-of-stay indicator is also significant predictor of under-five mortality (Wald $X^2 = 10.062$, $df = 2$, $P = 0.007$) which demonstrates an increasing predictive probability of 0.851 and 0.773 of under-five mortality in the study population.

For every unit increase in research participants who have lived in their neighbourhoods for 6-10 years and >10 years, the odds of under-five mortality increases from 1 to 2.342 (C.I. = 1.286, 4.268) and 2.167 (C.I. = 1.254, 3.742) respectively. These values indicate an elevated under-five mortality risk by 200% for mothers who have lived above 5 years in the same neighbourhood. The model shows that the risk is highest for mothers who in the 6-10 years residency group and the risk falls by 17.5% for those who have lived above 10 years compared to mothers in the 6-10 years of residence group. The type of community organisation a research participant belongs is also a significant determinant (Wald $X^2 = 15.217$, $df = 4$, $P = 0.004$) of whether or not a child will survive beyond the age of 5 years. The model indicates a significant increasing probability of under-five deaths for the children of

mothers in cooperative societies/savings groups compared with the reference group comprised of mothers who are not in any community organisation ($\beta = 1.449$, Wald $X^2 = 9.349$, OR = 4.260 C.I. 1.683, 10.788, $P = 0.002$). The odds ratio suggests a 400% increased risk in the odds of under-five deaths occurring in children born to mothers who belong to savings/cooperative groups compared with the reference group. Children to mothers who are members of other types of community organisations exhibit lower but insignificant relative risk of dying before their fifth birthdays; religious ($\beta = 0.409$, Wald $X^2 = 0.851$, OR = 1.505, C.I. 0.631, 3.589, $P = 0.356$); sociocultural ($\beta = 0.544$, Wald $X^2 = 1.238$, OR = 1.723, C.I. 0.661, 4.494, $P = 0.266$); and professional ($\beta = 0.343$, Wald $X^2 = 0.245$, OR = 1.409, C.I. 0.362, 5.476, $P = 0.621$).

Table 26: Contextual social capital model

Predictor	β	SE β	Wald's X2	df	p	e β (odds ratio)	95% C.I. for EXP(β)	
							Lower	Upper
Degree of participation in community organisation Not active (Ref), very active	0.653	0.236	7.680	1	0.006	1.921	1.211	3.048
Length of residence in the neighbourhood <= 5 years (Ref)			10.062	2	0.007	1		
6 - 10 years	0.851	0.306	7.731	1	0.005	2.342	1.286	4.268
> 10 years	0.773	0.279	7.690	1	0.006	2.167	1.254	3.742
Type of community organisation membership None (Ref)			17.440	4	0.002	1		
Religious	0.409	0.443	0.851	1	0.356	1.505	0.631	3.589
Sociocultural	0.544	0.489	1.238	1	0.266	1.723	0.661	4.494
Professional/Skill	0.343	0.693	0.245	1	0.621	1.409	0.362	5.476
Cooperative/Savings	1.449	0.474	9.349	1	0.002	4.260	1.683	10.788
Constant	-3.222	0.414	60.634	1	0.000	0.040		
Test			X2	df	p			
Overall model evaluation								
Likelihood ratio test			51.897	7	0.000			
Score test			54.705	7	0.000			
Goodness-of-fit test								
Hosmer & Lemeshow			2.944	6	0.890			
Cox & Snell R2 = 0.69, Nagelkerke R2 = 0.124, -2loglikelihood = 538.924								

Given the unexpected findings of a positive association between contextual social capital; and under-five mortality and given that mothers in savings organisations have a relatively higher risks of under-five deaths compared with membership of other groups; the individual indicators in the contextual social capital model were further disaggregated based on the subjective social class of mothers in order to examine whether there was an underlying social gradient in community engagement in the first place. Figure 25 shows the

descriptive analysis of membership of community organisation disaggregated by self-assessed household social class of mothers. This indicates that numerically, mothers who rated their households as poorer than other households in their neighbourhoods are more likely to join community organisations compared with richer mothers. A likelihood ratio test finds a statistically significant association between subjective social class and community organisation membership ($LR = 6.401, df = 1, p = 0.011$). This is confirmed by a significant Fisher’s Exact test at $p < 0.05$.

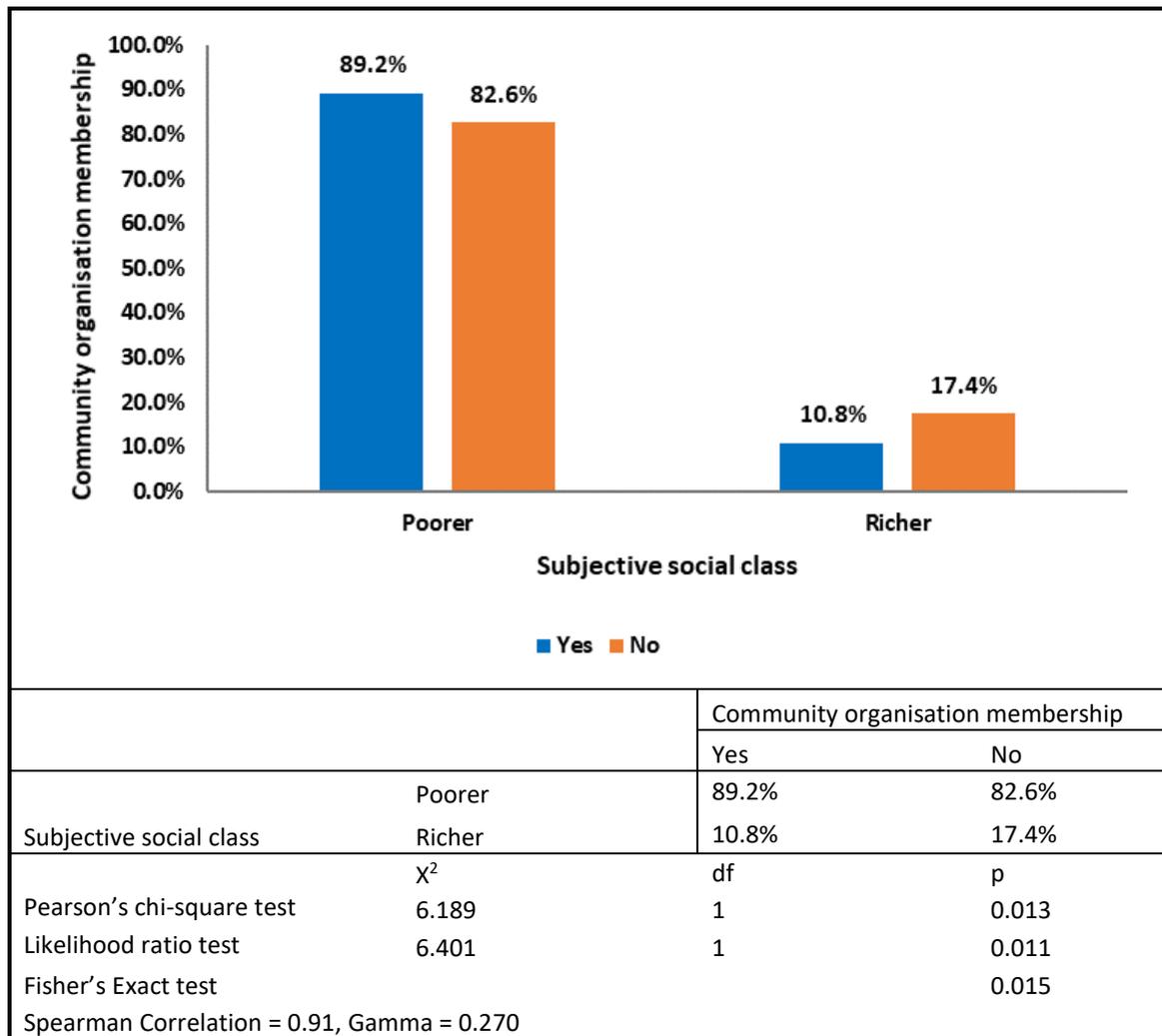


Figure 25: Community organisation membership by social class

When the type of community organisation is disaggregated by mothers’ subjective social class, the result shows that poorer mothers are more likely to join cultural and savings community groups compared with richer mothers who are more likely to be members of professional groups. These descriptive analyses could suggest that there may be underlying socioeconomic inequalities in women community engagement. Figure 26 shows a statistically significant association between the type community organisation membership that mothers join and their subjective social class ($LR = 37.800, df = 8, p = 0.000$). This indicates that although mothers who lack access to socioeconomic capital may be more

inclined to joining community organisations, such contextual social capital although positively associated with the wellbeing (General Life Satisfaction Levels) of mothers (Figure 28, may not necessarily translate to protecting the health of under-five children from the risk of dying before their fifth birthday. The ‘length of residence’ indicators could reflect housing mobility of research participants. Further disaggregation of this indicator by social status of mothers shows that mothers who perceive themselves as poorer than the average household in their community may be more likely to reside longer in their local areas perhaps due to the lack of capacity to change residence compared to richer mothers (Figure 27).

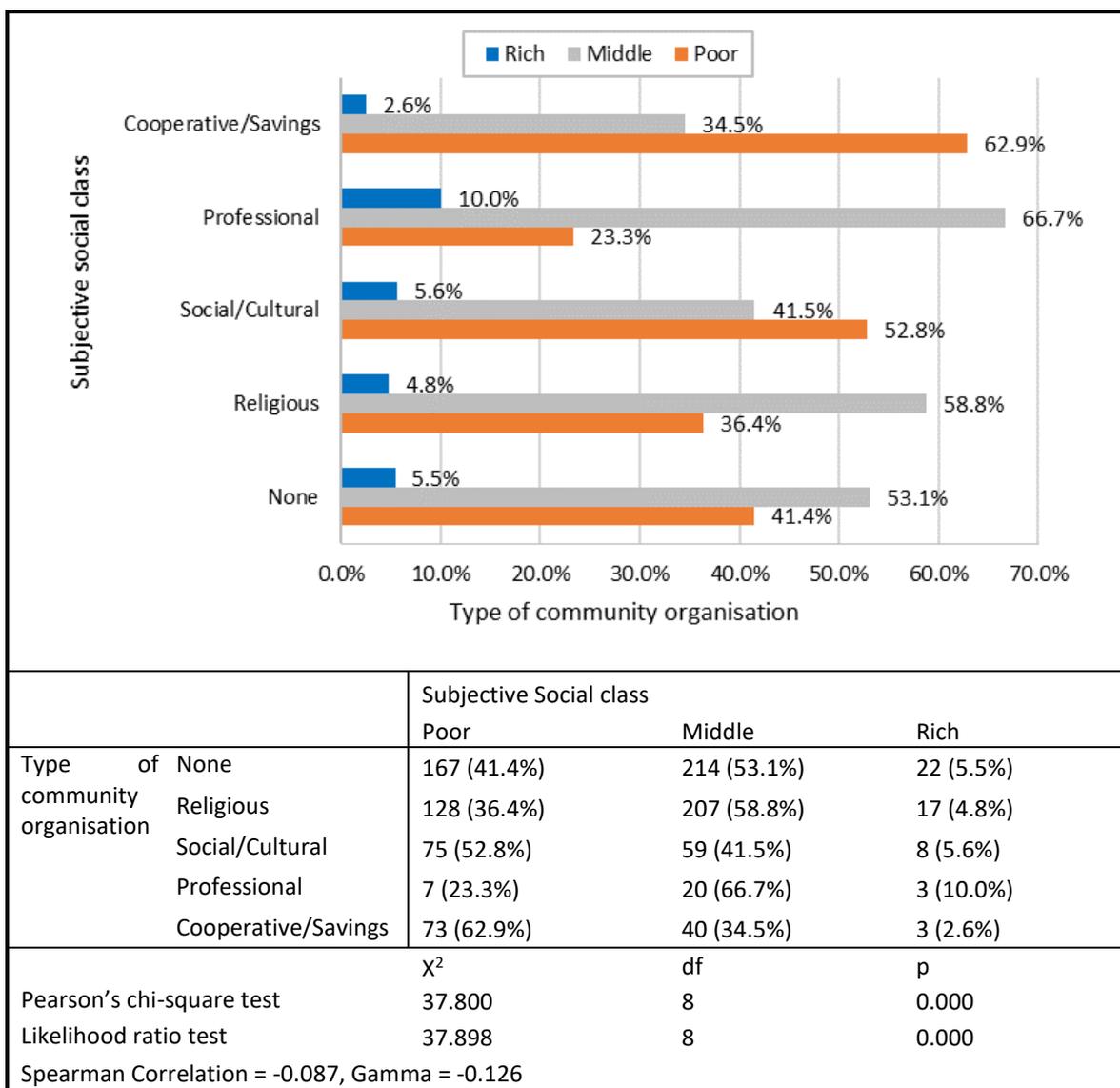


Figure 26: Type of community organisation by subjective social class

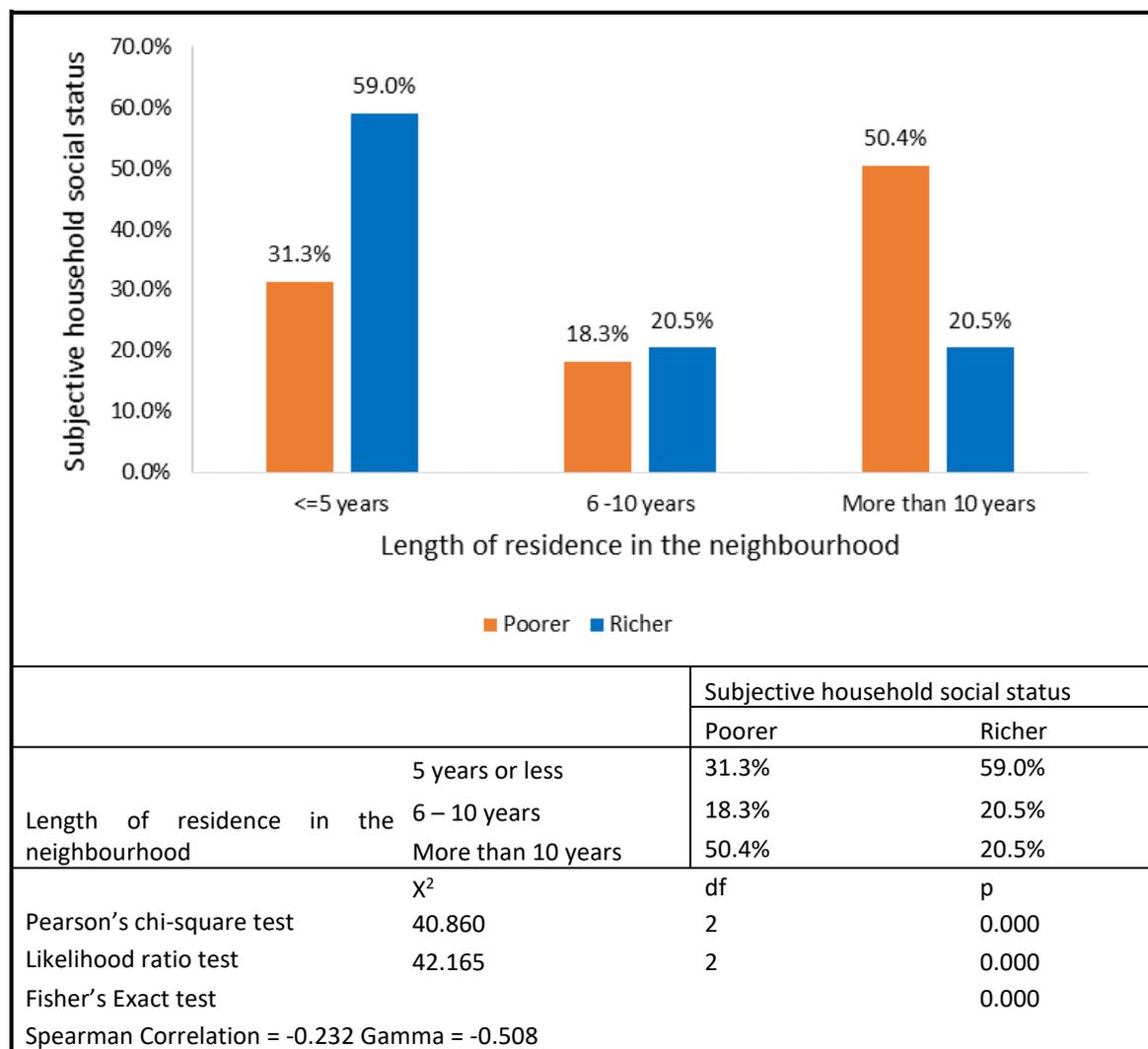


Figure 27: Length of residence by subjective social class

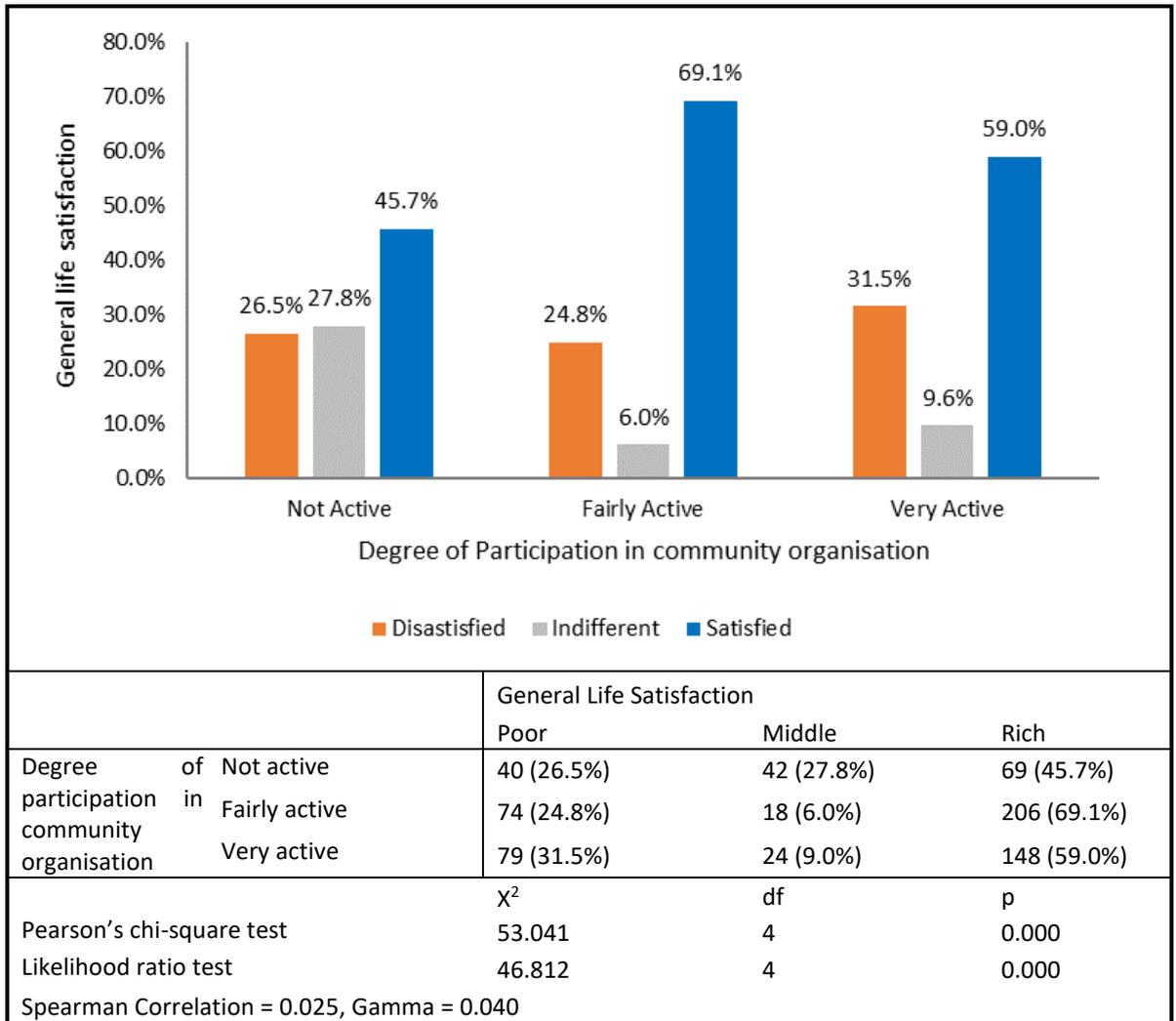


Figure 28: General life satisfaction by degree of participation in community organisation

The statistical evidence presented in the contextual social capital model indicate that although most mothers engage in community organisations, this engagement in community networks, has not necessarily provided the expected safety net against the risk of under-five mortality in the study population. On the contrary, the model shows that children born to mothers in saving groups and cultural groups were more at risk of dying before their fifth birthday compared with mothers who are not members of any community organisations or in professional groups. It is not entirely clear why this might be the case but this model suggests a social gradient in the membership of community organisations. The descriptive statistic performed to gain insight into the social profile of community organisation membership reveal that disadvantaged mothers are more likely to access community support compared to more independent and less disempowered mothers in professional groups. More evidence is needed to unpick the intersection between contextual social capitals of mothers and under-five mortality.

6.2.3.3 Contextual factors

Table 27 presents the three significant contextual determinants retained in the logistic regression model. The main source of domestic water; piped (10.8%), borehole (55.0%), well (24.7%), surface water (9.4%); main source of electricity; public (35.5%), private generator (24.3%), public & private generator (23.8%), no electricity (16.1%); and the perception of community socioeconomic status relative to other communities; poorer (37.2%), average (48.8%) and richer (14.0%) are the significant contextual determinants of under-five mortality to be retained in the logistic regression model. The statistical evidence used to evaluate the contextual model is shown in Table 27. These include the likelihood ratio chi-square test ($X^2 = 84.768$, $df = 8$, $p = 0.000$); score test ($X^2 = 91.799$, $df = 8$, $p = 0.000$) and an insignificant H-L goodness-of-fit test ($X^2 = 3.209$, $df = 8$, $p = 0.921$). The Cox & Snell (0.046) and Nagelkerke (0.089) R^2 descriptive statistics indicate a good fit between predicted probability and the data.

Main source of domestic water supply is a significant predictor of under-five mortality in the study population (Wald $X^2 = 31.548$, $df = 3$, $p = 0.000$) and it makes a significant improvement on the null intercept-only model. For example, using the piped water source as the reference category, a positive regression coefficient ($\beta = 1.614$) is observed for the 'surface water' sub-group suggesting an increasing predictive probability for under-five mortality with every unit increase in surface water as the main source of domestic water. Furthermore, children born to research participants who depended on surface water such as streams and rivers are 5 times ($OR = 5.022$, $C.I. 2.393, 10.538$) more likely to die before their fifth birthday compared to those born to research participants with access to improved domestic water source such as piped water. Children whose mothers rely on well water are almost 3 times ($OR = 2.705$, $C.I. 1.315, 5.564$) more likely not to live beyond 5 years compared to the reference group. Although the subjective community socioeconomic status measure is a significant predictor of under-five mortality in the contextual model (Wald $X^2 = 6.015$, $df = 2$, $p = 0.049$) and a decreasing predictive probability is observed with increasing socioeconomic status rating, no significant difference was observed in the risk of under-five mortality.

Table 27: Contextual model

Predictor	β	SE β	Wald's X^2	df	p	e^{β} (odds ratio)	95% C.I. for EXP(β)	
							Lower	Upper
Main source of domestic water			31.548	3	0.000			
Piped (Ref)						1		
Borehole (artesian well)	0.294	0.334	0.774	1	0.379	1.342	0.697	2.585
Well	0.995	0.368	7.315	1	0.007	2.705	1.315	5.564
River/Stream, Other	1.614	0.378	18.216	1	0.000	5.022	2.393	10.538
Self-assessed community socioeconomic status			6.015	2	0.049			
Poorer	-0.060	0.267	0.050	1	0.822	0.942	0.558	1.589
Middle	-0.441	0.246	3.211	1	0.073	0.643	0.397	1.042
Richer						1		
Electricity source			10.181	3	0.017			
Public only (Ref)						1		
Private only	0.184	0.219	0.709	1	0.400	1.202	0.783	1.845
Public and private	0.503	0.228	4.864	1	0.027	1.654	1.058	2.587
No Electricity (Gaslight, lamps, candles)	0.606	0.236	6.575	1	0.010	1.833	1.154	2.914
Constant	-2.753	0.380	52.492	1	0.000	0.064		
Test			X^2	df	p			
Overall model evaluation								
Likelihood ratio test			84.768	8	0.000			
Score test			91.799	8	0.000			
Goodness-of-fit test								
Hosmer & Lemeshow			3.209	8	0.921			
Cox & Snell $R^2 = 0.046$, Nagelkerke $R^2 = 0.089$, -2loglikelihood = 1231.917								

Women who live communities perceived as poorer than neighbouring communities are 6% more likely to experience under-five deaths compared to those who live in perceived richer communities. However, this difference is not statistically significant ($OR = 0.942$, $C.I. = 0.558, 1.589$). Source of electricity is also found to be a significant contextual determinant of under-five mortality (Wald $X^2 = 10.181$, $df = 3$, $p = 0.017$) and demonstrating significant differences in the risk of under-five deaths across varying sources of electricity. For example, an increasing predictive probability ($\beta = 0.606$) of under-five mortality is observed for every unit increase in research participants who do not have electricity at all compared with those who mainly rely on public electricity sources. Thus, children born to research participants without electricity are almost 2 times more likely to die before the age of 5

years ($OR = 1.833$, $C.I. = 1.154, 2.914$). The observed health inequalities based on the type of electricity source presented in Table 27 is statistically significant ($p = <0.05$).

The leading neighbourhood conditions influencing the risk of under-five mortality in the study population include the main source of domestic water, power supply and subjective community socioeconomic status. As expected, the research participants who live in communities perceived as richer than nearby neighbourhoods, those with access to improved sources of water and electricity demonstrate statistically significant lower under-five mortality compared with poorer communities and localities without access to electricity and improved water sources.

6.2.3.4 Sanitation and child clustering

Table 28 shows that the type of toilet facility in the household, flush (66.5%), pit/latrine (21.3%), none/other (12.2%); child nursery/school attendance status, yes (61.3%), no (38.7%); and household size, ≤ 4 persons (33.1%), 5-6 persons (58.3%), >7 persons (13.1%); are main socioeconomic determinants of under-five mortality rate. The socioeconomic domain represents the least contributor to under-five mortality compared with the wellbeing, social network and contextual determinants earlier discussed. This conclusion is of course based on inferences from the three evaluation statistics such as the likelihood ratio chi-square test ($X^2 = 103.058$, $df = 5$, $p = 0.000$); score test ($X^2 = 113.038$, $df = 5$, $p = 0.000$) and an insignificant H-L goodness-of-fit test ($X^2 = 0.860$, $df = 7$, $p = 0.997$). The Cox & Snell (0.057) and Nagelkerke (0.108) R^2 descriptive statistics indicate a good fit between predicted probability and the data.

The results of the tests of the statistical significance of each explanatory variable indicate that the three indicators retained in the model offer significantly more contribution to the predictive power of under-five mortality than the null model. The type of toilet facility in the household significantly influences the chances of child survival (Wald $X^2 = 39.447$, $df = 2$, $p = 0.000$). Using research participants who live in houses with flushed toilet facilities as the reference category, a positive regression coefficient ($\beta = 0.606$) is observed for households without any toilet facility who mainly empty their bowels and bladders on nearby bushes, fields and streams. This indicates that a unit increase in the number of participants without any toilet facility will lead to an increase in the probability of under-five mortality occurring. Participants without any toilet facility are also found to be 3 times ($OR = 3.115$, $C.I. = 2.137, 4.540$) more likely to experience under-five mortality compared to those with flush toilet.

Table 28: Sanitation and child clustering model

Predictor	β	SE β	Wald's X^2	df	p	95% C.I. for EXP(β)		
						e $^{\beta}$ (odds ratio)	Lower	Upper
Type of toilet facility			39.447	2	0.000			
Flush (Ref)						1		
Pit/Latrine	0.709	0.179	15.662	1	0.000	2.031	1.430	2.885
None (Field, Bush, Other)	1.136	0.192	34.928	1	0.000	3.115	2.137	4.540
Child attends nursery/ school (Yes = Ref)								
No	-0.566	0.174	10.564	1	0.001	0.568	0.404	0.799
Household size			36.133	2	0.000			
<= 4 persons (Ref)						1		
5 - 6 persons	0.437	0.198	4.863	1	0.027	1.549	1.050	2.285
>= 7 persons	1.313	0.230	32.704	1	0.000	3.716	2.370	5.827
Constant	-2.645	0.196	182.418	1	0.000	0.071		
Test			X^2	df	p			
Overall model evaluation								
Likelihood ratio test			103.058	5	0.000			
Score test			113.038	5	0.000			
Goodness-of-fit test								
Hosmer & Lemeshow			0.860	7	0.997			
Cox & Snell R ² = 0.057, Nagelkerke R ² = 0.108, -2loglikelihood = 1209.352								

The second significant variable in the socioeconomic domain is the 'child school attendance status' (Wald $X^2 = 10.564$, $df = 1$, $p = 0.001$). This indicator has a negative regression coefficient ($\beta = -0.566$) suggesting a decreasing predictive probability of under-five as the children who do not attend nursery or school increased. Thus a 50% decrease in the risk of under-five mortality is observed for children who do not attend nursery/school compared to those who attend ($OR = 0.568$, $C.I. = 0.404, 0.799$). This indicates that common childhood diseases, in developing countries where hygiene and sanitation levels are low, may spread more quickly among children in close proximity to one another compared with children with less contact. Household size also shows a significant contribution to the predictive probability of under-five mortality in the study population (Wald $X^2 = 36.133$, $df = 2$, $p = 0.000$). The predictive probability decreases as household size increases. A positive regression coefficient ($\beta = 1.313$) is observed when the >7 persons household group is compared with <=4 persons group. This suggests that the predictive probability of under-five mortality will increase as the >7 household group increases. Significant health inequality also exists by household size. Households with >7 persons are almost 4 times

more likely to experience under-five mortality compared to smaller households with ≤ 4 persons ($OR = 3.716$, $C.I. = 2.370, 5.827$).

It is not surprising that child clustering and sanitation factors such as; the type of toilet facility; and whether a child has close contact with other children as expected in larger household sizes and child care and education centres; are interlinked with one another and are positively associated with under-five mortality. The elevated risk of mortality due to poor sanitation is expected in developing countries where infectious diseases are prevalent due to poor sanitation conditions and where children are more likely to be clustered together due to high fertility rates where households are likely to be larger and high populations. This suggests the need to address sanitation conditions within the household and child care centres.

6.2.3.5 Final Model

The identified four main dimensions of under-five mortality presented in Tables 25-28 show important thematic areas that could be informative for policy action, for example in moving forward with the SDGs. However, the determinants of under-five mortality do not work separately in stark domains to influence health in real life. The intersectionality thinking, which underpins the methodological approach, adopted throughout this PhD demands a further analysis, which accounts for multiple domains in investigating inequalities in the risk of under-five mortality. All the significant explanatory variables were then entered into a logistic regression model in a step wise backward loglikelihood method to develop a final model that incorporates multiple domains in a single model.

The final model is presented in Table 29. The model shows a four-predictor model in which sub-groups interact significantly to predict the probability of under-five mortality outcome occurring in the study population. These include the main source of domestic water, priority area for child's wellbeing, household size and the availability of mosquito bed net to under-five children for sleeping. The likelihood ratio chi-square test ($X^2 = 50.465$, $df = 9$, $p = 0.000$); score test ($X^2 = 56.971$, $df = 9$, $p = 0.000$) and an insignificant H-L goodness-of-fit test ($X^2 = 5.724$, $df = 9$, $p = 0.678$) indicate a good fitting model. The Cox & Snell (0.112) and Nagelkerke (0.197) R^2 are supplementary descriptive statistics which further support the conclusion that there is a good fit between predicted probability and the data. The test of the significance of individual variable contribution to the model shows a statistical improvement over the intercept-only model by; the source of domestic water (Wald $X^2 = 13.547$, $df = 3$, $p = 0.004$); priority area for child's wellbeing (Wald $X^2 = 12.498$, $df = 3$, $p =$

0.006); household size (Wald $X^2 = 9.497$, $df = 2$, $p = 0.009$); and mosquito bed net availability (Wald $X^2 = 4.768.564$, $df = 1$, $p = 0.029$) indicators.

A positive logistic regression coefficient ($\beta = 2.557$) was observed for research participants who mostly rely on surface water sources for domestic uses when compared with participants who have access to piped water as the main source of domestic water. This suggests that for every unit increase in the group of research participants who depend on surface water, there will be an increase in the predictive probability of under-five mortality. The risk of under-five mortality is observed to be 13 times ($OR = 12.892$, $C.I. = 2.266, 73.351$) higher for those who rely on surface water compared to piped water holding other indicators constant.

Using the research participants who consider health and health care as the area of priority for their child's wellbeing as the reference group, an increasing predictive probability ($\beta = 1.087$) and almost 300% increased under-five mortality risk ($OR = 2.965$, $C.I. = 1.597, 9.341$) are observed for those who identify infrastructure and politics/governance as main concern for child's wellbeing. The regression coefficient (β) of 1.351 indicate an increasing predictive probability of under-five mortality as more people become concerned with the state of infrastructural deficit and dysfunctional political governance. An approximately 300% ($OR = 2.965$, $C.I. = 1.504, 5.843$) increased risk is also observed for the comparison wellbeing group over the reference group. When the >7 persons household group is compared with the ≤ 4 persons category, a positive regression coefficient results ($\beta = 1.351$) suggesting an increasing predictive probability with every unit increase in the >7 persons household category. Households with >7 members are almost 2 times ($OR = 3.862$, $C.I. = 1.597, 9.341$) more likely to experience under-five mortality compared with smaller households of ≤ 4 persons. The availability of bed net indicator is the only variable in the final model with a decreasing predictive probability ($\beta = -0.675$) for under-five mortality and 50% decrease ($OR = 0.509$, $C.I. = 0.278, 0.933$) in the risk of under-five mortality are observed for children who always have mosquito bed nets for sleeping compared to those who do not.

Table 29: Final model

Predictor	β	SE β	Wald's χ^2	df	p	e^β (odds ratio)	95% C.I. for EXP(β)	
							Lower	Upper
Main source of domestic water			13.547	3	0.004			
Piped (Ref)						1		
Borehole/artesian well	0.890	0.777	1.312	1	0.252	2.435	0.531	11.166
Well	1.332	0.791	2.835	1	0.092	3.788	0.804	17.854
River/Stream, other	2.557	0.887	8.307	1	0.004	12.892	2.266	73.351
Priority area for child's wellbeing			12.498	3	0.006			
Health and health care						1		
Employment	-0.171	0.852	0.040	1	0.841	0.843	0.159	4.474
Food	-0.015	0.395	0.002	1	0.969	0.985	0.454	2.134
Other (infrastructure, governance)	1.087	0.346	9.857	1	0.002	2.965	1.504	5.843
Household size			9.497	2	0.009			
<= 4 persons						1		
5 - 6 persons	0.452	0.372	1.471	1	0.225	1.571	0.757	3.259
>= 7 persons	1.351	0.451	8.988	1	0.003	3.862	1.597	9.341
Mosquito net always available for sleeping (Yes - Ref, No)	-0.675	0.309	4.768	1	0.029	0.509	0.278	0.933
Constant	-3.360	0.811	17.146	1	0.000	0.035		
Test			χ^2	df	p			
Overall model evaluation								
Likelihood ratio test			50.465	9	0.000			
Score test			56.971	9	0.000			
Goodness-of-fit test								
Hosmer & Lemeshow			5.724	8	0.678			

Cox & Snell $R^2 = 0.112$, Nagelkerke $R^2 = 0.197$, $-2\log\text{likelihood} = 306.545^a$

The final model retained water source, household size, perceived child wellbeing concern and the misuse of bed nets as the four main indicators which accounted most for variation in under-five mortality in the study population.

6.3 Discussion

The main objective of this chapter was to explore the localised determinants of under-five mortality in selected urban and rural communities in Edo State in an attempt to investigate small area socioeconomic and spatial heterogeneities in the determinants of under-five mortality within the diverse Nigerian context. The findings demonstrate that logistic regression models can be powerful analytical techniques for assessing dichotomous outcome variables such as whether a child died or survived beyond their fifth birthday and for investigating the relative health inequalities within segments of society using a wide

range of indicators. The effectiveness of the logistic regression model was evaluated using the significance of the contribution of the logistic regression model to the null model, the significance test of each determinant and the inferential and descriptive goodness-of-fit statistics. In the order of significance, the four broad domains of under-five mortality determinants identified include perception/behavioural domains, social network, contextual and socioeconomic. In addition to the identified domains of under-five mortality in the study population, the discussion is outlined to reflect the broad themes that cut across the results of all the logistic regression models considered in this study. These sub-domains are briefly discussed below. A more detailed discussion is available in Chapter 8.

6.3.1 Neighbourhood and socioeconomic effects on under-five mortality

First, this study highlights socioeconomic position as a significant determinant of health that can be observed at multiple scales confirms the widely reported association between health status and numerous diseases with compositional and contextual characteristics of populations in both developed (Cummins *et al.*, 2007, Macintyre, 1994, Pickett *et al.*, 2001) and developing countries (Adedini *et al.*, 2015c, Adekanmbi *et al.*, 2015). Pickett *et al.* (2001) in their review of evidence from academic research of the influence of socioeconomic and contextual characteristics for health note that there is a consensus that in all populations, health outcome is related to socioeconomic positions across the socioeconomic gradient.

This social gradient in health persists even in countries with relatively high socioeconomic status. Richer members of society are expected to have better health outcomes than poorer people (Macintyre, 1994) and more economically unequal societies tended to have worse health and steeper social gradient in health (Marmot, 2004). This study adds to accumulating evidence from academic research on the association of health status with the socioeconomic and contextual circumstances in which children are born in Nigeria by demonstrating that although socioeconomic and contextual conditions continue to be associated with variations in under-five mortality at the micro level observed in this chapter, the influences of the behavioural and immediate environmental and sanitation dimensions of health such as the use of bed nets, water sources, sanitation issues, spatial clustering of children, which are more immediate are highlighted more than more distant or higher order social determinants of health.

The findings in this chapter demonstrate the effect of scale on the social determinants of health. More immediate personal and contextual circumstances of mothers are highlighted at the micro level of analysis than more structural or wider societal and structural conditions, which were prominent at the broader scale of analysis, considered in chapters 4

and 5. It is important to mention at this point that the determinants of health exhibit complex interactions across scales in shaping under-five health. For example, the effect of socioeconomic position, measured in terms of material resources in the NDHS sample and assessed subjectively in the field sample, traverses and transcends the scales of investigation considered in this thesis and, thus, wider health gaps are attributable to wider differences in access to material resources at both the macro and micro scales. Those who perceive their communities as poorer than other neighbourhoods are demonstrated to have higher odds of experiencing under-five mortality compared with those who rated their communities as richer than surrounding neighbourhoods.

6.3.2 Contextual social capital and under-five mortality.

Access to social capital is recognised as a multi-faceted determinant of health. The dynamics of human relationships and social networks could have either protective or damaging effects on health through multiple pathways and depending on underlying mechanisms (Poortinga, 2012, Uphoff *et al.*, 2013). However, the association between under-five mortality and the contextual social capital of communities in Nigeria remains largely under researched. Methodologically, this study fills this gap by including several indicators of social capital which were deconstructed into bonding, bridging and linking components in line with guidelines in literature (Uphoff *et al.*, 2013, Harpham *et al.*, 2002, Islam *et al.*, 2006). An unexpected significant ‘negative’ association is observed between mothers’ contextual social capital and the risk of under-five mortality in the study population.

This indicates that increasing participation of mothers in community groups is associated with increasing risk of under-five mortality and especially for mothers in cultural and savings community groups. This negative association is unexpected. The effects of contextual social capital on under-five mortality observed in this chapter raise more questions than answers. Although, it is not uncommon to find such negative effects of community capital on health, mixed findings and inconsistent health effects of community social capital well documented (Field, 2003, Halpern, 2005). It is not entirely clear why increasing social relationships and engagement by mothers within their neighbourhoods for example is failing to provide the safety net for child survival in the study population. Several questions remain; why is contextual social capital not providing safety nets or buffering the risk of under-five health in the study population despite mothers’ engagement? Who is likely to engage in community organisations? What is the child health value of social engagement in poor resource settings, non-welfare states, poor health service delivery and unaffordable health care cost to most vulnerable families find very burdensome to bear?

Qualitative methods are utilised to further understand why contextual social capital appears to be failing to buffer the risk of under-five mortality amongst research participants. More research efforts are needed in order to unpack the complex pathways in which contextual social capital influence health status of children especially in non-welfare states with poor health care settings such as Nigeria. Chapter 7 focuses on the analysis of mothers' narratives of under-five mortality determinants. The chapter provides further insights into the complex relationship between contextual social capital and under-five health-risks.

6.3.3 Environmental determinants of under-five mortality

The findings of this study are consistent with previous studies in revealing that the physical environment continues to be a significant contributing factor to disease and mortality. Environmental risks factors especially access to improved drinking water and sanitation have been widely demonstrated to influence the health status of children especially in developing contexts (Hutton *et al.*, 2004, Prüss-Üstün *et al.*, 2006). The unique patterns of exposure and biological sensibilities can contribute to both infectious and chronic diseases in childhood and across the lifespan (Ghosh, 2006). This study shows that lack of access to safe drinking water, poor environmental sanitation and hygiene and the irregular use of insecticidal mosquito bed nets for sleeping at night are the leading modifiable determinants of under-five mortality. This finding is supported by previous studies which have indicated that, in developing countries, contaminated water, household air pollution and environmental sanitation are strongly linked with the leading causes of under-five mortality such as malaria, diarrhoea, pneumonia and a wide range of parasitic infections in children (Bartram *et al.*, 2010, Eneh, 2011, Fewtrell *et al.*, 2005, McCreesh *et al.*, 2015). There is ample research evidence that childhood morbidity and mortality can be prevented through effective policy intervention aimed at addressing environmental determinants (Ghosh, 2006, Prüss-Üstün *et al.*, 2016) alongside other social determinants. There is a need to address the poor environmental conditions where children are born and grow and create the environment that give children the opportunity to live healthy lives (Foundation, 2018). Preventive health strategies require a combination of research efforts to identify and prioritise context-specific environmental and risk factors with advocacy programmes.

6.3.4 Perception and health behaviour

This study finds a significant association between the availability of mosquito nets among mothers who use their bed nets for other purposes in addition to malaria prevention purposes and the risk of under-five mortality in the study population suggesting that access

to bed nets continues to be a factor in under-five mortality despite recent interventions (Imo *et al.*, 2016). This study makes a unique contribution in that it goes beyond NDHS measures of ownership of mosquito bed nets to access, first, whether the bed nets are used for other purposes such as food processing and used for under-five children for sleeping at the same time. This is important because, the field sample suggests that ownership of mosquito bed nets may not necessarily equate expected utilization. Children may not always sleep under bed nets at night (Table 30) even when households possess nets, nets may also be used for other purposes than what was intended, there may be an underlying socioeconomic stratification in the ownership use, reliance on bed nets and different capacities to make other mosquito prevention choices such as the use of insecticides and mosquito repellents, whether mosquito nets are complemented with nets on windows and doors. There may also be differences in the exposure to mosquito parasite depending on immediate sanitation conditions of the immediate environment of mothers and we need to understand how and why inequalities in under-five health continue to be perpetuated despite recent interventions in the MDG era.

An estimated 28.3% of respondents who owned nets reported not using them regularly and using bed nets for other purposes such as food processing. Chapter 7 explores qualitative evidence on how and why local levels of inequalities occur at the local level despite efforts by mothers to engage with their communities by participating in organisations and savings groups and why mothers who own nets may not necessarily use them for preventive purposes.

Table 30: Mosquito bed net utilisation

		Mosquito bed net used every night	
		Yes	No
Mosquito bed net ownership	Yes	837 (71.70%)	399 (28.30%)
	No	0 (0%)	246 (100%)

It is also informative that subjective social economic status are automatically grouped together in the same domain by the exploratory stepwise logistic regression method utilised. The model suggests linkages between a woman's self-rated social economic status and child health behaviour. There is evidence that there child mortality, morbidity, mortality are linked with health perception and health behaviour. For example Kimbi *et al.* (2014) and Mitiku *et al.* (2017) find that the perception of the malaria symptoms influenced early treatment seeking behaviour of mothers in Cameroon and West Ethiopia respectively.

There is evidence that subjective socioeconomic status can sometimes predict health status over traditional measures of socioeconomic position such as education, income and occupation (Euteneuer, 2014).

6.4 Conclusion

This study advances health geography research perspective in Nigeria by demonstrating that the micro-level determinants of under-five mortality may differ significantly from the national level determinants. The study finds that the determinants and the spatial pattern of under-five mortality could vary with the scale of investigation especially in diverse populations like Nigeria. This result suggests that there could be some policy value in investigating both socioeconomic and spatial heterogeneities in the determinants of under-five mortality. At the local level, subjective community social economic status, malaria preventive behaviours such as Insecticidal Treated Nets (ITNs) utilization behaviours, contextual social capital, sanitation, and child clustering indicators are found to be the main domains of the social determinants of under-five mortality. This finding corroborates the social determinant of health model in confirming that micro environmental and social factors are likely to be the leading determinants of health at smaller geographical scales. However, wider societal conditions such as water, sanitation, and socioeconomic factors which are usually mediated by macro-level structural factors continue to play leading roles in shaping health differences at more micro area levels. Wider health inequalities are observed by access to improved sources of domestic water and subjective community social economic status.

An unexpected negative association between contextual social factors and under-five mortality is found. Mothers who appear to engage more in community networks surprisingly exhibited higher under-five mortality risks compared with those who do not belong to community organisations. The contextual social capital model highlights that, in the 5 years preceding the survey year of 2017, children born to mothers who belong to savings and cultural groups had elevated risk of mortality compared with those who are non-members of any organisation. Further descriptive statistics of the membership of community associations reveal a significant positive association between perceived household socioeconomic status and community organisation membership, indicating that poorer mothers may be more likely to belong to community organisations in the first place. This could suggest that poorer mothers are more likely to rely on external capital given their household deprivation. Richer mothers appear to be more independent as the results show that richer mothers are more likely to belong to professional organisations and less likely to participate in cultural or informal women's savings groups. We conclude that

although mothers may demonstrate some forms of collective action by joining community networks and organisations, the benefits that may accrue from accessing such contextual social capital in mitigating the more structural and environmental risk factors on under-five health may not be enough to buffer the effects of structural socioeconomic and contextual risk factors on under-five health.

Although the findings reported in this chapter provide important insights into the leading micro determinants of health in the study population, these insights are limited for offering rich contextual information into the depth and variation in the individual experiences of health. This critique relates, more generally, to quantitative health research which has been increasingly criticised for stripping away the context of people's lives through identifying single sets of biological and social determinants for entire populations in an additive manner (Bauer, 2014) and for the failure to recognise the role of creative human agency as active participants in shaping the condition that influence health (Labonté *et al.*, 2005). Large survey datasets by their very nature do not ask 'how' and 'why' and, thus, limited for sufficiently explaining health behaviours.

Researchers ranging from survey data collection agencies such as the DHS to individual researchers like myself being a PhD student, reduce the health experiences of participants into set often static statistical variables thereby excluding local voice from the outcome of our research. The methods of data collection utilised in chapters 4-6 therefore reflect the researcher's preconceived notion of what constitutes health risks. In addition quantitative research places less emphasis on teasing out the 'hows' and 'whys' of health relative inequalities production. For example, there are a many questions, which remain unaddressed from the empirical evidence on the pattern of under-five mortality determinants presented in chapters 4 to 6, which may demand further explanations. For example in there is a need to understand the pathways in which the unequal access to improved water and electricity sources contribute to health vulnerability amongst children, especially for poorer members of society. Chapter 7 responds to these criticisms by exploring the lay perception and knowledge of child health-risk and how responses to health-risks are chosen based on mothers experiences. It focuses on understanding pathways through which health inequalities may be exacerbated in individuals. Such lay perspectives are important in health geography for gaining a richer perspective into the under-five health experiences of mothers and for addressing under-five mortality, which remains a public health emergency globally.

CHAPTER 7

Local Perception of Health-Risk

7.0 Introduction

The previous chapter provided some useful insights into the determinants of under-five mortality at a more localised level than the Nigeria Demographic and Health Survey (NDHS) clusters. Inequalities in micro-level environmental risk factors were identified as accounting for most of the variability in under-five mortality. These include: the lack of access to clean water, improved sanitation; contextual socioeconomic factors and contextual social capital (CSC); household wellbeing priorities and health behaviour, especially the regular use of mosquito bed nets by under-five children. Some unexpected higher associations were also found. For example, child nursery attendance status and higher participation in community organisations were linked with unexpected elevated risks with under-five mortality. The magnitude of relative inequalities and the unexpected associations found in chapter 6 raises further questions, which are worth exploring amongst other questions. For example, it was not entirely clear why differential access to clean water, electricity and perceived socioeconomic status, accounted for the widest gaps in under-five mortality or why CSC failed to provide the expected safety net against mortality risk. These and many questions remain unanswered.

The quantitative approaches and population-level surveys demonstrated in chapters 4-6 are useful for a broad overview of the relative risk in under-five mortality across several scales in Nigeria. Results obtained are valuable for informing under-five mortality reduction targets for population groups but they offer limited and incomplete explanations for understanding the underlying processes producing unequal health patterns within population groups and individuals. Quantitative approaches also fail to explain the role of mothers as active agents in shaping the geographical and social determinants of health. This is because, the survey datasets used by most studies of population health inequalities including those used in the previous empirical chapters by nature do not ask 'how' and 'why' questions, and are limited for providing individual-level understanding about health behaviour. These criticisms around the inability of quantitative methods to sufficiently account for the role of human agency in shaping the social determinants of health relate to a wider critique of the positivist quantitative tradition which holds up scientific methods as the assumed model of knowledge in the development of their approach (Massey, 1999).

Qualitative approaches are deployed in this chapter in order to gain further insights as to why differential exposures to under-five mortality risk may occur (Green *et al.*, 2007). To fill this gap, this chapter draws on risk perception through semi-structured interviews in order to gain further insights into mothers' perceptions of the social determinants of health (SDH). Perceptions of health-risk, whether through expert or lay knowledge, are important aspects of any risk management efforts, including under-five mortality reduction strategies especially in developing countries like Nigeria with diverse ethnic and cultural population groups.

The central premise in this chapter is that the lay knowledge of mothers has a role to play in contributing to a richer understanding of the dynamic relationship between creative human agency and the wider societal structures that underpin vulnerabilities and inequalities in under-five mortality that we have observed so far. Lay perception of the social determinants of health as such remain largely unaddressed within the health inequalities literature more broadly and are almost absent within the Nigerian context.

Lay narratives are important for understanding how people locate themselves within the places they live in (Popay *et al.*, 1998) and how they negotiate associated child health challenges. More importantly, incorporating lay narratives in Social Determinant of Health discourses is a way of empowering local people to talk about their health experiences, thus projecting women's voices and agency (Lagarde, 2014) in health research and encouraging a bottom-up approach to health policy development. In addition, lay narratives offer the unique advantage of widening health geography research perspective on the multiple ways in which the different layers in the SDH model work together to reinforce inequalities. This chapter explores the range of risk factors which interviewed mothers considered as substantial to child health and wellbeing and the causes of health-risks. It examines how health-risks and sources of health-risks are articulated in narrative forms. One central question was explored during the risk perception interviews. Mothers were asked to identify any aspect of their personal, household and neighbourhood circumstances that they considered a major risk factor(s) for under-five mortality. The articulated responses are discussed in the next chapter. The chapter therefore aims to address the following research questions:

1. How is under-five health-risk perceived by mothers?
2. What do mothers identify as the sources of health-risk?

The presentation of results mainly focuses on the health-risk factors which dominate mother's narratives and how perceptions and responses differ between regions and socioeconomic groups. Building on the previous chapter, I employ a constructivist approach and I argue that the perception of health-risk is multifaceted and complex. Health-risk is not perceived in the same way by different people in different places. The risks which mothers consider important may vary according to socioeconomic circumstances and local context. A combination of quotations from the narratives of mothers which are situated within existing evidence in academic literature are used to present the empirical data in the context of environmental health-risk and infectious diseases. It is important to note here that a small number of participants thought that there were no substantial risks to the health of their children and such discourses are briefly discussed later in the chapter.

7.1 Discussion of results

7.1.1 Perception of health-risks

Many of the interviewed mothers' demonstrated good awareness of the child health-risks conditions within their contexts, especially the risk-conditions thought to amplify the vulnerability of children under the age of 5 years to infectious diseases. The lay perspectives of mothers in many ways correspond with biomedical conceptions of health-risk conditions that challenge the overall wellbeing of children. However, health-risk was mainly framed in the context of the wider neighbourhood, environmental and structural conditions rather than individual circumstances. The study argues that biomedical understanding, which takes a reductionist approach to health and illness by emphasising the physiology of the human body, and social science constructivism, which focuses on social, economic and historical perspectives shaping the determinants of health, is not always at tangent with one another. The two perspectives can be utilised in a complementary manner to offer rich contextual understanding of health and illness (Hankivsky *et al.*, 2017). Mothers tended to frame child health-risk in the context of wider physical neighbourhood conditions and contextual social circumstances thought to be amplifying the risks of infectious diseases relative to local contexts. It was observed that for cultural and religious reasons and perhaps due to one-off interview method discussed in chapter 3, a majority of the research participants were more inclined towards distancing themselves in framing risk by employing a passive voice in articulating risk conditions and by referring to other people or the area in general.

Overall, the findings show the several categories of health-risk that mothers have to negotiate for child health and wellbeing in their everyday life (Table 31 and Figure 29). I

present what the interviewed mothers considered as substantial child health-risks and what they think are causing the health-risks.

Table 31: Perceived risk factors to child health

Perceived child risks by mothers				
Poor Environmental conditions	Inadequate health infrastructure and poor service	infectious diseases: Malaria, cholera and diarrhoea	Socioeconomic status	No risk perceived
942 (61.45%)	265 (17.29%)	449 (29.29%)	134 (8.74%)	158 (10.31%)

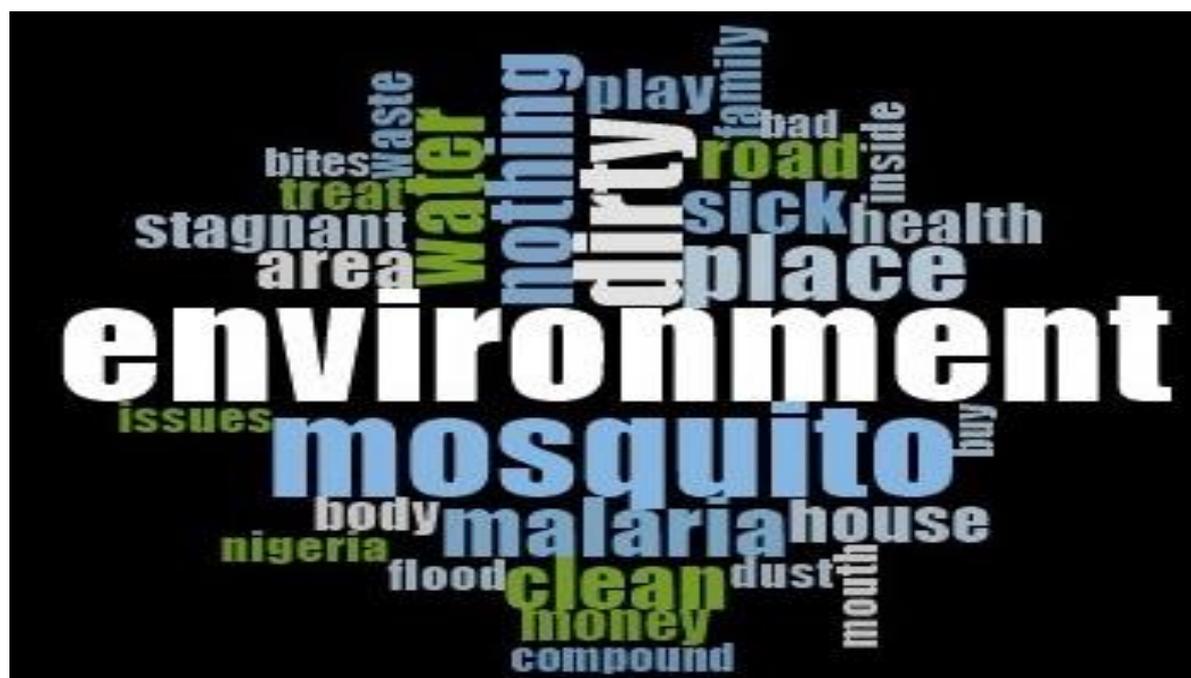


Figure 29: Thirty most frequently used words in describing major health-risks

7.2 Vulnerable Neighbourhood

The perceived poor conditions of neighbourhoods where mothers and their children are embedded emerged in this study as the most dominant health-risk factor which mothers talked about. This finding adds to the mounting body of evidence linking neighbourhood context and health-risk in both developed and developing countries (Oppong *et al.*, 2009, Pickett *et al.*, 2007). In line with these studies, respondents' narratives indicated that the vulnerability of the neighbourhood where children are born grow and live are strongly linked with the risk of under-five morbidity and mortality. There are several aspects of the neighbourhood environment, which the interviewed mothers perceived as child health-risks. These include, the lack of access to improved water supply, poor solid waste management, blocked drains and floods, and air pollution from independent power

generators. Further reflections on the key sub-themes of neighbourhood vulnerability are highlighted below.

7.2.1 Lack of access to improved water sources in vulnerable countries

“Water in the city is better than the village ...but home is home” (31 year old, secondary education Ohanmi village)

The lack of access to improved water sources emerged as major vulnerability to infectious diseases. The lack of equitable access to safe drinking water sources is recognised as an important health-risk factor particularly for children globally but more so in developing countries with limited resources for infrastructural development. Microbial contamination of drinking water is more prevalent in Africa and South-East Asia and affect all sources of water supply especially in rural areas (Bain *et al.*, 2014) which increases the burden of water-borne diseases such as diarrhoea. One-tenth of the global burden of disease could be prevented through better management of water resources and improving access to safe drinking water especially for the poor (Pruss-Ustun *et al.*, 2008). In Africa for example, most people especially in rural areas continue to rely on unimproved water sources such as unprotected dug wells, unprotected springs and surface water.

Despite recent improvements in access to sustainable safe drinking water through a range of development efforts in Africa, over 62% of the region’s population continue to lack access to safe drinking water and sanitation (Binns *et al.*, 2012) with the poor especially at risk. The regional statistics in Africa are very reflective of the Nigerian situation. For example, the NDHS statistics reported in Table 32 in chapter 6 of this thesis clearly shows that 62% of women in Nigeria reported reliance on wells and surface water sources as their main sources of drinking water. The proportion of women who reported dependence on unimproved water sources in Edo State is 55%. The field survey conducted in the case study communities showed similar patterns with local statistics indicating that reliance on unimproved sources of drinking water is at 34%. Artesian wells, popularly known as boreholes in Nigeria, are the most common sources perceived by respondents as safe for drinking but there are research indications that borehole water may not be as safe as most people think. More reflections on this are presented later.

According to (Gandy, 2006), when the famous Nigerian musician, Fela Anikulapo-Kuti recorded his song in 1975 titled ‘water no get enemy’ (which means ‘water has no enemy’), in advocacy for government to take action on the water crisis in Nigeria, little could he have

anticipated that neighbourhood living conditions in Nigeria would be much worse four decades after: “If you want to wash, na water you go use

T’o ba se se’be omi l’o ma’lo

If you want to cook soup, na water you go use

T’o ori ba ngbona o omi l’ero re

If your head dey hot, na water go cool am

T’omo ba n’dagba omi l’o ma’lo

If your child dey grow, na water he go use

T’omi ba p’omo e omi na la ma’lo

If water kill your child, na water you go use

T’omo ba pomo re o omi na no

Ko s’ohun to le se k’o ma lo’mi o

Nothing without water”

(Fela Anikulapo-Kuti, 1975) in Gandy 2006: page 371

The popular song which some respondents also referred to during interviews, highlights the importance of safe water in the life of a child from birth, growth and that water continues to be relevant even when a child dies. The problem of access to potable water has become a real cause for concern, not just in Lagos but in most Nigerian neighbourhoods including the urban and rural areas where this study was conducted. In all countries, significantly more people in urban areas continue to have better access to improved sources of drinking water and sanitation compared with rural areas although the dire conditions in many urban slums may be masked by regular urban data. For example, the statistics derived from NDHS data 2003-2013 reported in chapter 6 also shows that 71% of women in rural areas in Nigeria reported relying on unimproved sources of drinking water compared with 41% in urban areas. Table 32 below shows that this rural-urban divide in access to safe drinking water is even higher in my fieldwork locations with 93% of rural women reporting reliance on unimproved sources of drinking water compared with only 7% of their urban counterparts.

Table 32: Sources of drinking water by type of place of residence (Source: Author’s work)

Main source of water supply				
	Piped	Borehole	Well	Stream, River, other
Urban	198 (15.7%)	973 (77.1%)	33 (2.6%)	58 (4.6%)
Rural	3 (0.5%)	39 (6.7%)	422 (72.9%)	115 (19.9%)

Inequity in access to domestic water source was also strongly linked with relative inequalities in under-five mortality in chapter six. Studies have pointed out that water plays an important role in food and general household hygiene where children are raised (Hutin *et al.*, 2003, Idowu *et al.*, 2012, Pruss-Ustun *et al.*, 2008). The lack of sanitation infrastructure especially in rural areas means that the surface water sources where women collect water become polluted with waste and become unsafe for drinking. Mothers' narratives regarding access to good drinking water as a major determinant of health reflect not only a very distinctive urban-rural divide but also socioeconomic differences. Inadequate access to good drinking water emerged as a predominantly rural problem in Edo State as most rural people identified poor water as a major risk factor to child health. For example, one of the interviewed mothers is a 35 year old mother, married with 2 children from Ake village, which is also her place of origin and birth. She was on a 3-month official trip to the village from Lagos when I interviewed her. She describes herself as financially comfortable being a graduate employee in Lagos. She receives a monthly salary category of 100, 000 – 150, 000 naira making her richer than most of the mothers in Ake village. Like many mothers we interviewed in all the rural communities included in this study, she identified the lack of access to clean drinking water as a major health concern especially the poor in her area:

“The main health problem that I can think of is ‘water wahala’ (water problem). Water is a big, very big problem for us in this village. There is no government water [piped water] anywhere these days. People who have money have boreholes. The poor man’s child drinks from the well and sometimes the river. Sometimes, people who have boreholes like us sell to those who don’t but where is the money for villagers to buy water always eh? Sometimes, the Church down the road allows people to fetch for free in the morning and evening time but only when there is light [power] and as you know, the light in this place is not regular at all”.

Most of the mothers that were interviewed from the other rural communities such as Uroe, Arokho and Ohanmi villages shared similar concerns and identified the lack of access to safe water as one of the leading concerns for the wellbeing of children. There were suggestions that poorer members of the society were more likely to rely on unimproved water sources compared with the rich. Some participants made comparisons between urban and rural areas and indicated that rural areas were more disadvantaged. The 31 year old Ohanmi mother quoted at the beginning of this section, reported that waters sources were likely to also be polluted because the rivers were also used by villagers for washing and

bathing. In describing her experience of both urban and rural water access, she stated that the water situation in her village was worse compared with Kaduna, a city located in the northern part of Nigeria, where she previously lived:

“The issue of water should be looked into by the government because the water here is not that good especially in this community but we drink it like that. Most people in this community cannot drink the well water if it is not raining, we go to the river to fetch water to drink. People also bathe, wash and sometimes through garbage in the river making it taste bad. Water was not a big problem like this in the city when I was there. Kaduna is different from this place because this place is a village. Water in the city is better than the village but you know home is home”. (31 year old, secondary education Ohanmi village)

Many mothers in the other villages expressed similar opinions and confirmed that villages generally lacked access to clean water. For example, a 30 year old mother from Uroe village reported that surface water sources such as rivers and unprotected wells were the main sources of domestic water. She suggested that not all rivers were considered clean enough and that villagers only extracted water from rivers which were thought to be clean:

“We don’t have so much water here, it is the well and river that we fetch from in Uroe, we don’t have piped water, we don’t have anything. We drink from some rivers but only some but not all, the one that is clean is the one we drink, the one that is not clean we don’t drink it”. (Garri seller, 30 years, incomplete primary education, Uroe village)

Some mothers linked bad water to some infectious diseases in their children. Like some mothers, a research participant in Arokho village felt that the bad quality of well water used for bathing her children was responsible for the ‘skin rashes’ which the child recently had:

“The water in all the wells in the community is salty tastes and heavy in the mouth. We get drinking water from the stream on the farm; those ones are sweet. We use the well water for bathing and washing plates, soap doesn’t lather in the water at all. My child had skin rashes recently which I think was caused by bad water. It was like chicken pox but it is no more now”. (Farmer, 36 years, Arokho village)

These narratives suggest that access to improved water sources is a very serious concern for most of the interviewed mothers who are resident in the rural areas compared with their urban counterparts. This finding supports previous studies in Nigeria which have documented rural-urban differences in access to improved water sources. For example, (Gbadegesin *et al.*, 2007) in their assessment of rural water supply management issues in Oyo State noted that the government prioritised urban water provision compared with rural water supply which was largely neglected. Many studies have also demonstrated the potential health impact of the pollution of surface and underground water sources in Nigeria. For example, (Erah *et al.*, 2002) finds that all the six boreholes and the three wells he examined in Benin City in 2002 were contaminated with abnormal levels of lead,

chromium, zinc and cadmium in addition to dangerous levels of aerobic bacteria and fungi such as faecal coliform, E.coli and faecal streptococci which were observed in all the boreholes. Similarly, (Akpoveta *et al.*, 2011) who examined borehole water from neighbourhoods in Benin City and Agbor, observed that although, most of the water parameters fell within acceptable WHO standards, the pollution index for heavy metals like calcium and manganese indicated significant degrees of pollution. (Beshiru *et al.*, 2018) noted that pollution levels of surface water sources were at more dangerous levels in the dry season compared with the rainy season. Although these studies have emphasised urban areas compared with rural areas using positivist approaches, what is clear is that the subjective evidence in this study supports existing evidence on the potential health-risk associated with the pollution of unimproved water sources such as unprotected wells and surface water from environmental contaminants. Poor solid waste management and poor sewage systems were implicated as major causes of pollution of water resources in Nigeria. (Hardoy *et al.*, 1992) indicate that not only does pollution from solid waste and sewage damage aquatic life in available water resources, but has serious health consequences for those who rely on them. Poor waste management emerged as a major health-risk issue amongst a majority of the participants and this is discussed as the next sub-theme below.

7.2.2 Waste management in vulnerable places

Poor waste management and sanitation emerged as one of the main environmental health issues that many mothers talked about. Waste management is recognised as a significant environmental health issue in many developing countries including Nigeria. Improving access to sustainable waste management services remains a challenge for most governments in developing countries. (Abubakar, 2017) describes an improved sanitation and waste management service as a system, which ensures disposal or recycling of animal, human, domestic and industrial waste in a way that protects public and environmental health. Most of the developed countries in the world that have succeeded in drastically eliminating preventable causes of morbidity and mortality have done so through drastic improvements in the physical and social conditions of the environment where people live. Up to 62% of populations in developing countries continue to rely on unimproved sanitation facilities and waste collection system (Abubakar, 2017).

The poor waste management problem in Nigeria has been attributed to poorly implemented environmental policy and the lack of capacity of environmental agencies to handle increasing solid waste (Agunwamba, 1998), especially in urban areas characterised by unsustainable levels of population growth due to high levels of fertility and migration from rural areas. Waste is not sorted at source that increases the amount of waste to be

collected and transported to dump sites. It is very common to find piles of waste on open dump sites on vacant plots, along streets and by rivers causing significant health challenges to local residents (Achankeng, 2003, Ogwueleka, 2009). These piles of waste not only deface most Nigerian cities but also filter into domestic waters sources such as rivers, wells and artesian wells popularly known as boreholes in Nigeria.

It was not surprising to find that the unorganized waste management was considered as a major health concern by many research participants that were interviewed in this study. Rural and urban residents alike identified the indiscriminate disposal of solid waste into vacant plots, drainages and around market places as a major health issue for their children. Although the hygiene conditions within the interior of dwellings and immediate surrounding compounds were also perceived as potential risk factors to child health, respondents tended to emphasize poor environmental conditions in the wider context of their surroundings, neighbourhoods, villages and cities in the framing child health-risk factors that are attributable to the environment. For example, one of the interviewed mothers was a 35 years old mother of four children from the rural village of Ikhin. Her last child was 26 months old at the time of the interview. She reported living in the village most of her adult life and runs a family small scale business with her husband. Like many others, she reported that poor solid waste management was a major disease risk for children in her area:

“A dirty house and a dirty environment that is not clean, all these can cause diseases in children. Look at that refuse dump close to that house over there (pointing to heap of refuse in a vacant plot nearby), the wind carries the odour to this place especially in the rainy season. It is not so bad now because the villagers burnt it a few weeks ago like they normally do every dry season. All these reckless dumping of waste spread germs around and causes sicknesses”.

The refuse dump site mentioned in the extract above is shown in Figure 30a. The respondent also reported that the dump site is also used for open defecation by children during the day and by adults at night time.



Figure 30a: Refuse by the roadside
Refuse dump on a vacant plot in a rural case study area



Figure 30b
Piles of waste by the road in New Benin Market, Benin City

Open defecation contributes to the offensive odour which I perceived myself during the interview. The picture was taken in the dry season by the researcher, a few weeks after the dump site was burned. The image shows an unidentified child in the background trying to move away after defecation. The dump site is usually burned with fire in the dry season to reduce the heap of waste as the only method of waste management. Disposal of solid waste on vacant plots and burning of refuse dumps in the dry season were reported by most mothers as the only method of waste management in the five villages included in this study. The practice of dumping waste in vacant plots is typical in most rural areas in Nigeria. There were no organized or formal systems in place for waste management in any of these rural areas where interviews were conducted. As an interviewed mother who is resident in Ohanmi village put it:

“We don’t have any other way of disposing solid waste in this village. No government agency collects refuse here. We normally look for a vacant plot far away from houses and dump the waste there”.

The lack of capacity of environmental agencies in Nigeria to handle increasing solid waste, provide full and efficient cover to all areas especially in urban areas has previously been reported (Agunwamba, 1998, Imam *et al.*, 2008, Ogwueleka, 2009). The environmental agencies in many major cities in Nigeria such as Lagos, Abuja, Port Harcourt and Benin City inclusive, do not have the required capacity to deal with the levels of waste in their corridors. These studies reveal that the environmental health impact of poor waste disposal and management system reflects an urban bias in most developing countries with rapidly urbanising cities without corresponding improvements in infrastructure to cope with the population explosions. Although environmental agencies have more presence in urban areas compared with rural neighbourhoods, they are unreliable, completely overwhelmed with increasing solid waste management demands and, poor funding among other issues.

Many respondents in urban areas echoed this viewpoint and thought that waste collection services were not reliable. For example

“People pay money to these waste managers to pack their refuse but they don’t come regularly and according to schedule. So you find big heaps of refuse most of the time. The heap of refuse encourages mosquitoes to breed faster and all that. How will fever and malaria not disturb children in an environment like this?”

Figure 30b is a picture of refuse dump site in New Benin Market in Benin City. This image represents typical dump sites along major urban areas. Open dump sites are usually located along major streets in urban areas. Indiscriminate dumping of waste and the inefficiency in the waste collection by environmental agencies equally dominated the experiences of many mothers in urban areas. Poor living environmental conditions were reported to adversely impact child health across all spectrum of the urban neighbourhoods included in the study. Most mothers from poor, middle and high class urban residential areas in Benin City suggested that poor waste disposal was a significant concern for under-five morbidity and mortality: The three extracts below come from interviewed mothers living in an urban poor, middle and high income areas. These indicate the shared concern for poor waste management as a significant health-risk factor for most mothers with different socioeconomic backgrounds. A research participant aged 30-39 who has lived in an urban poor areas for over 20 years was concerned about the health effects of the heap of waste near her house and blamed the environmental agency for failing to evacuate the market waste regularly:

“This place that I live in is a market area. The environmental agency does not evacuate the waste in the market regularly and it causes malaria because mosquitoes breed there and bite us here. Too much filthiness causes sickness for children because of the many flies perching on food, even before I finish cooking; germs are already inside the food. These things cause sicknesses in children. Apart from that, there is really nothing else”.

Some research participants thought that the environment agencies were not solely responsible for poor sanitation and thought that residents were also to be blamed for dumping waste indiscriminately on streets and gutters. One of such views was expressed by an urban mother living in a middle income area of Isiohor. She thought that it increased the vulnerability of children to malaria:

“Waste is not well disposed in our area. Some of the tenants in this neighbourhood just throw dirty things anyhow, along the road or street or even into the gutter. The way people litter this place sometimes is not good and it can cause diseases that affect the health of children in our area. You see waste bins exposed anyhow, they just dispose waste any how and you know all this filth contributes to sickness especially malaria especially for small children”.

High income areas were also not left out of the poor health concerns that could result from littering and poor waste disposal. Although many mothers living in these areas were okay with the sanitation levels of their neighbourhoods, a few thought sanitation levels in their neighbourhood were below expectation. Like these mothers, one of the research participants in a high-income area was worried that her neighbourhood was a bit unsafe for her children to play in:

“The environment is a bit dirty. You see how waste has been disposed in open plots. The breeze blows all these filth around, it litters the whole place making it a bit unsafe for children to play outside the gate because children will be children and can pick them and fall ill. Waste is not well managed around here as you would expect”.

The sanitation of children play areas was considered very important to many urban mothers across both urban and rural areas and the socioeconomic spectrum. Many mothers were concerned that children were no longer able to play around their neighbourhoods because of deteriorating sanitation conditions and the fear of infectious diseases. Although the perception of poor waste management as an environmental health-risk problem emerged as both a rural and an urban problem, the views regarding the adverse impact of poor sanitation on the health of under-five children were more widespread among urban mothers across all socioeconomic spectrum. Poorer mothers living in more congested urban core areas particularly expressed more concerns about the health damaging effects of poor waste management problems in their neighbourhoods. Mother living in poorer neighbourhoods related the poor management of waste in relation to the risk of malaria compared with mothers in richer neighbourhoods who appeared to emphasis litter on the streets that prevent their children from playing outdoors beyond the confines of the huge fences that surround their houses. These findings support existing evidence indicating that poor waste management remains a major health concern in Nigeria. For example, (Abubakar, 2017) has documented quantitative evidence on not just the decline in access to improved sanitation and rise in open defecation in Nigeria but also demonstrated existing rural-urban divide in access to improved sanitation services as well as stark socioeconomic gradient in access to sanitation.

7.2.3 Vulnerable infrastructure

The lack of resources in many developing countries to deal with waste and provide other required sustainable infrastructure which adequately serves the needs of their populations has resulted in characteristically poor quality infrastructure which increases the vulnerability of resident populations, especially children, to ill-health and preventable deaths which in both rural and urban areas (Hardoy *et al.*, 1992). Although the health-risk

of many aspects of the derelict nature of infrastructure in the neighbourhoods where interviewees live is already implied in the preceding segments of this chapter, this section briefly considers three aspects of the poor state of public infrastructure which have been directly implicated and emphasised as under-five health-risk factors by the interviewed mothers. These include inadequate access to electricity, pollution from generators and blocked storm water drainage channels.

a. Blocked drains and stagnant water pools

Closely related to the problem of solid waste management in urban areas is the issue of blocked and open drain channels popularly referred to as ‘gutters’ in Nigeria. Blocked drains emerged as an environmental health issue in mothers’ narratives because they were perceived to encourage the breeding of female anopheles mosquitoes which carry the malaria parasite. Like most urban areas in developing countries, Benin City mainly has a storm water system with open channels along main roads for the discharge of rainwater. Compared with the underground sewerage systems, open drains are low cost solutions for draining off storm water in low income settings. The channels are designed to drain rainwater into rivers. However, respondents reported that they are illegally used as convenient places for open defecation, dumping domestic wastewater, greywater and solid waste that often results in surface water pollution and therefore facilitates the spread of water borne diseases and other pathogens (Figure 32). Benin City is located on a relatively flat terrain, which increases the high risk of clogging from unauthorised waste disposal in open channels and silt causing blockages and stagnant water pools. Stagnant water pools have been described as one of the suitable conditions for the breeding of female anopheles ‘mosquitoes which breed on stagnant or slow-moving water’ (Binns *et al.*, 2012: 228). The storm water drains into open depressions and pot holes on streets and around residential areas resulting to stagnant pockets of water for mosquitoes to breed on. One of the urban mothers living in a poor city centre neighbourhood thought that the poor quality of roads and open drain were a risk factor for malaria disease:

“The roads are bad. I believe that if the roads are constructed very well and the drainage covered, then, we won’t have any stagnant water in potholes and open drains in the rainy season and that will stop the breeding of mosquitoes and it will reduce the rate of malaria in our children. Apart from these, I don’t think there is any other thing in this area that is bad for health”.

The problem of stagnant water in blocked storm water drainage systems and streets water due to blocked drains from indiscriminate dumping of waste emerged as a typical problem in urban areas. Only one (Uroe) of the five rural areas included in this study had open drain channels along the only main road which runs through the village (Figure 31). However, the

risk of blockage of the open channels from silt and waste disposal exists for all open channels globally, the small population sizes of Uroe village may mean that, open channels are less likely to become clogged compared with those in Benin City.



Figure 31: Open rural drains

Open drains in the rural case study areas, a, town centre in Arokho. b, typical roads in rural areas without side drain. c and d, newly constructed road with side open channels in Uroe (author's work).

As expected, stagnant water pools in depressions and clogged open drain channels were perceived to serve as easy breeding sites for the malaria parasite carrying mosquitoes such as *Plasmodium falciparum* with the absence of a drainage system or poor drainage networks. Blocked and open drains filled with solid waste in both residential and commercial areas are a typical feature of the derelict nature of most urban neighbourhoods in Nigeria. As one of the interviewed urban mothers living in a poor urban neighbourhood in Second East Circular Road, Benin City points out:

“Well, we have flood problems in this area especially in the heart of the raining season. Pockets of stagnant and muddy water on our streets increase mosquitoes, which cause malaria. There is just no space in the gutter for the storm water to pass through”.



Figure 32: Blocked urban drains

Blocked open storm water channels in Benin City (author's work)..

The views linking blocked drains to the risk of malaria and other infectious diseases were very prominent in urban areas, especially in neighbourhoods located along majors' roads. Since all the rural areas we visited but one, had no storm water channels and stagnant water pools at all, the health vulnerability from blocked drains did not emerge in the discourses of rural participants.

b. Poor access to electricity

"If there is light I put on the fan and if there is no light, I open my window and bear mosquito bite because I just need to sleep well". (34 years, Aroko, educated to primary level, house has no mosquito nets on windows and door and no bed nets are used)

Another infrastructural deficiency linked with malaria by the majority of the interviewed mothers is the lack of access to electricity. The irregular nature of power supply that now characterises many Nigerian towns and villages was perceived as a substantial health-risk to

under-five children by many research participants. These views, which were widespread among majority of mothers in both rural and urban areas, surfaced mainly in relation to use of mosquito bed nets for malaria prevention purposes. Poor access to electricity was considered as a major barrier to the use of insecticide treated nets (ITNs) especially during dry season which participants commonly referred to as the 'heat period'. The dry season spans the months of October to March and the raining season extends from April to Septembers with highest amount of rainfall in the months of July and August. It is important to point out here that Nigeria is a tropical country and has only two seasons, dry and wet seasons. The average midday air temperature at during the dry season time typically range from an average of 30-40 centigrade in southern and northern Nigeria respectively. Humidity is higher in the south than north all year round and indoor temperatures at night are hot. The hot night temperature is compounded by; overcrowding, poor ventilation resulting from poor housing development standards, congestion and electricity infrastructure which is not designed to cope with the heat and teeming population and which makes sleeping at night very uncomfortable for children. One of the respondents who describes her profession as a children's worker and who is resident in a middle income neighbourhood describes her experience of indoor discomfort at night as follows:

"Heat and mosquito affect children seriously here. I work with children and we do not have power supply most times. They cannot sleep very well at night without power. Sometimes they cry all through the night and sometimes I hear neighbours' children crying and things like that".

Another participant from one of the rural neighbourhoods echoed this view and suggested that even in rural areas, the discomfort from the indoor heat during the dry season and the lack of electricity sometimes makes sleeping indoors at night impossible. The only choice they have during such nights is to sleep outdoors:

"Sometimes the room becomes so hot at night that you can even stay indoors let alone sleep under a bed net. The only choice is to sleep outside in the pavement and endure the mosquito bite".

Research participants were unanimous about the health dilemma that the poor access to electricity and the risk of malaria from mosquito bite presented them. The trade-off practices between night discomfort from heat and the risk of malaria from not sleeping under mosquito bed nets was a common viewpoint expressed by many research participants. The malaria preventing capability of bed nets was well recognised by many respondents but the poor utilization rate was blamed on poor power supply. Bed nets were viewed as increasing night time heat, restricting freedom of movement in attending to the

needs of children and other forms of inconveniences. For example, an urban mother and a civil servant in an unnamed public agency reported the use of mosquito bed net at night is a physical burden to her:

“I know that using a bed net is good but it inconveniences me. It gives me heat and it gives a constraint to my movement. if am on the bed and I want to shift to the other side, or get up to attend to my child like feed him, it does not allow me to move freely. I feel like I am caged and in bondage. I have to also constantly tuck net in under the mattress each time I get up. It is too much stress period”.

The importance of a good night sleep for mothers and their children was considered as a more immediate wellbeing necessity and therefore was prioritised over the health-risk which may result from not utilising mosquito bed nets for sleeping in the longer term. One of the mothers’ resident in a rural area suggested prioritising a good sleep over the use of mosquito bed nets when she stated:

“We experience too much heat in this hot weather. First, we don’t have good power supply and my children do not sleep well under the mosquito bed net without power. They cry all through the night because of heat. You know sleep is something that you cannot deny anybody. If children do not sleep well at night, that is when they will fall sick. The body deserves rest. Poor power supply is the major reason why malaria affects little children a lot in this area. Thank God, with the help of paracetamol, they become okay”.

For a small number of participants however, there were no trade-offs to be made between heat and sleeping under a mosquito bed net. Such mother reported prioritising the use of mosquito bed net for malaria prevention at all times over comfort and night sleep. These mothers reported that their children were particularly susceptible to malaria so that they considered such trade-offs as too much of a health-risk to make. For example, a mother resident in a middle income area reported that sleeping under a bed net was a priority for her and her children at all times:

“I always lock my door to prevent mosquitoes from entering my room and if I want to sleep, I use mosquito net too. Even when the heat is much, I still put the mosquito net just for him because I know if the mosquitoes should bite him, they will give him malaria. He was always falling ill with malaria when I gave birth to him so I use the mosquito net regularly to prevent it”.

Many first-time mothers reported using mosquito bed nets and recognised the importance of malaria preventive measures over curative measures. For example, a 30 year old first time mother from Delta state who lives in a poor neighbourhood in Benin City reported using mosquito bed nets regularly for her 13 months old daughter to avoid the emotional trauma which she experiences when the child fall ill with malaria:

“It is often said that prevention is better than cure. She is my first baby and I am always very bothered whenever she has malaria. I don’t sleep when she is ill and any little thing I will start crying. Her daddy will start shouting at me for crying unnecessarily. So instead of me to treat I will rather prevent it. I make sure she always sleeps under the net”.

Many mothers with two or more children on the other hand reported using mosquito bed nets less frequently as they had more children compared their first child. The reported decrease in frequency with increasing parity because they learned to cope with malaria risk through using other methods of prevention as they had more experience with more children. This suggest that the frequency of mosquito bed nets may decrease with parity. There were also indications that richer mothers were had the resources to enable them to take these alternative measures of preventing against the risk of malaria for their children. And that children born to more wealth mothers do not necessarily have to sleep under a bed net to prevent mosquito bite. Alternative ways of malaria prevention and heat moderation such as the installation of nets on house windows and doors and the spraying of mosquito insecticides were reported by more wealthy mothers. This perspective, of more choices being available to wealthier mothers, was expressed by one of the interviewed mothers living in one of the GRA neighbourhoods of Etete in Benin City:

“In this heat period, there is electricity supply. I don’t use the mosquito net anymore because it does not allow breeze to reach my body whenever I use it. ...respondent laughs.. Let them provide us with mosquito bed nets that will permit free movement of breeze and not mosquitoes. The truth is, I really tried the mosquito bed net for my first child, but the heat was just too much because of lack of electricity supply. The heat persists even when the fan is on save air conditioner but there is no electricity to run the air conditioner. We use generators as an alternative. Since, I can’t use generator throughout the night because of the loud noise, the best thing is to have nets on doors and windows and I endeavor to spray the rooms with insecticides occasionally”.

Few mothers challenged the emphasis on the use of bed nets in the bed room and the assumption that mosquitoes were only active at night. Such mothers reported not using mosquito bed net because contacts with mosquitoes were possible in other spaces outside the bed room. In their view, mosquitoes also bite children during the day and in other spaces indoors even before children go to bed so that the risk of malaria continue to be present and beyond their control. They felt that there was no point using mosquito bed nets for sleeping at night since mosquitoes were not restricted to their bed rooms:

“I have a mosquito bed net which I obtained when I was going for antenatal for my last baby. They gave me one to prevent them from getting mosquito bite; but you know it is in not only the bed room or night that mosquitoes bite children these days. Mosquitoes are everywhere at all times of the day even though they more active at night. Children cannot take the mosquito bed net to school; neither can

they play with it outside the house, so the mosquito will surely bite them. That is why I don't bother using the bed net".

It is evident in the accounts above that there may be some socioeconomic stratification in the use of alternative measures for malaria prevention. Some participants indicated that those who can afford private generators and the cost of fuelling them with available fossil fuel rely on them as alternative sources of electricity.

"It is the big [rich] men who can afford to burn generator fuel through the night that can use mosquito net. As for me, I simply open my windows because my flat is upstairs and I have net on my windows and doors. My neighbours downstairs do not open their windows at night for security reasons so the heat affects them more".

Nevertheless, this way of coping with power cuts opens up a new layer of health-risk for those living in richer neighbourhoods. This is related to the problem of air and noise pollution, which also emerged as a major health-risk reported, by many mothers who are residents of middle and high income neighbourhoods. This is presented in the next section.

c. Noise and air pollution in vulnerable places

Up to this point, the chapter has provided evidence that, demonstrated that the lack of access to improved water sources reflected more of a rural pattern. The health-risk problem attributable to poor waste management and blocked drains emerged mainly in the narratives of urban mothers living in poor neighbourhoods. There are other ways in which mother' narratives on perceived risk factors have illuminated socioeconomic and regional differentials. One of such areas of clear inequalities in neighbourhood health vulnerabilities is the problem of pollution from power generators (Figure 33) that appeared to have been framed more as a significant concern by many mothers in middle and high-income neighbourhoods compared with mothers in poorer locations.



Figure 33: Electric power generators

Electric power generators in a residential setting (left) and a commercial setting (right) in Benin City. Note that the net frame installed on the window in residential building to prevent mosquitoes entry.

The night-time noise and air pollution from independent power generators was a very common health-risk concern reported by many mothers living in higher income urban mothers in middle and high income neighbourhoods. Noise is described as an unwanted sound or set of sounds (Muzet, 2007). Many research participants perceived the fumes which generator emit and the loud noise they make as having significant effect on the respiratory health and general wellbeing of mothers children. In her account of this problem, a Muslim mother of 4 children whose family has lived in a rented flat in the urban middle income neighbourhood of Aduwawa for over 5 years, emphasised the possible health damaging effects of generator fumes on the respiratory health and wellbeing of children which have led to fatalities in a few cases:

“Generator smoke is the main problem that we have here; no light everywhere is so hot, noisy and children cannot sleep well at night. I don’t sleep well most nights myself. It is a dilemma for me, whether to put on generator and endure the noise or to put it off and endure the heat. Since my children cannot sleep under the mosquito under the hot weather, I will rather endure the generator noise to reduce malaria wahala. The whole neighbourhood is lighted up by generator and the noise as well as the smoke is too much. It is common to find children coughing these days. I suspect that generator smoke is a factor in this. Moreover, you know that generator smoke also kill people. Sometimes, a whole family gets wiped out. We here that in the news very often these days but what can we do? Then there is the added foul smell from a poultry nearby; whenever they clean the place, the whole environment smells; then the gutters are not flowing because people dump waste into the gutters. The refuse disposal system is not very effective”.

It is important to point out that these finding do not suggest that the pollution from electric generators is only a risk factor that is confined to more wealthy people and areas. The

problem of generator-induced pollution in major cities in Nigeria is increasingly being recognised. However, it was common for many mothers living in high-income areas to report the night-time noise problem from electric generators. Wealthier households are more likely to power their generators for longer periods. Increasing bodies of work internationally have pointed to the health effects of noise pollution in many cities. For example, data from the Netherlands Study of Depression and Anxiety Depression (NESDA), *Generaal et al.* (2018) demonstrated that inequalities in neighbourhood socioeconomic characteristics were significantly associated with increased levels of depressive and anxiety disorders.

Other studies have linked unsafe levels of ambient noise with mental health in adults (Edsell, 1976, Standing *et al.*, 1980) and children (Lercher *et al.*, 2002). Safe levels of neighbourhood noise are defined by WHO to be at 34 to 47dB(A) and a maximum of 60dB(A) is recommended for industrial areas. Many Nigerian cities including Benin City, exceed WHO safety thresholds. Ighoroje *et al.* (2004) reported 90dB(A) as the average ambient noise levels of industrial areas in Benin City. Baloye *et al.* (2015) in their comparative study of two cities, Ibadan and Ile-Ife, in western Nigeria found that 79% of sample residential locations exceeded WHO recommendations. Electric power generators, transportation noise, music and food processes are the leading sources of noise pollution in many Nigerian cities (Akindele *et al.*, Ibadode *et al.*, 2018). Although, studies have reported the dissatisfaction of people to noise pollution levels in Nigeria, low levels of awareness of the health impact of noise pollution have been reported (Emenike *et al.*, 2017). For example, Ajiboye *et al.* (2014) have documented carbon monoxide and fire accidents resulting from the inflammable hydrocarbon that are used to power generators across all socioeconomic spectrums of urban spaces.

Overall, the data from the risk perception interviews have highlighted that coping with the energy crisis by using fossil fuel sources such as generators, could open up what has been described as an 'emerging health-risk'. This increases the likelihood of poor health in vulnerable neighbourhoods in addition to the crippling economic effects of the chronic electricity crisis in Nigeria which has been well documented (Aliyu *et al.*, 2015, Okereke, 2016). Nigeria only produces about 3000MW of electricity which is well below what is required by a country with over 180 million people compared with Japan with an estimated population of 127 million with a production capacity of well over 1,009TWh according to estimated production of electricity in 2015 (IEA, 2016). Fossil-fuel-based electric generators are used by households and businesses as backup coping mechanisms for the irregular power supply in Nigeria (Akindele *et al.*, 2016, Emenike *et al.*, 2017, Ibadode *et al.*, 2018).

A majority of the studies that have attempted to examine the problem of noise pollution have tended to focus on daytime analysis and studies examining the health-effect of the energy crisis in Nigeria and the consequent night-time noise using qualitative methods are scarce. From a public health perspective, sleep disturbance is part of the extra-auditory effects of night-time harmful effects of noise pollution. From a public health perspective, chronic, partial sleep deprivation may lead to a poor quality of life (Zannin *et al.*, 2002), cause low daytime performance, marked tiredness and a state of low vigilance (Muzet, 2007). The intensity of noise pollution could vary both spatially and temporally. For example, residential areas could generate more noise at night while commercial city centres, may experience higher intensities of noise pollution from music, traffic and generator noise etc. In this study, I find that many richer mothers talked about the stresses and poor quality sleep resulting from the night-time noise from generators compared with poorer. This could be because, richer mothers may have more resources to fuel generators and keep them on longer into the night and generally have better awareness of the health effects from electric generators.

It is from this perspective that we have reported this findings, not to privilege biomedical perspectives over lay perspectives of mothers, but to demonstrate that a combination of both perspectives are important for understanding explanations of the causes of illness. Through this finding, this study makes an important contribution to this area by highlighting that the irregular power supply and the use of generators as alternative sources of power could open up new layers of risks which may increase the health vulnerabilities of populations, especially more vulnerable groups such as children under the age of 5 years. More studies are needed measure evening and night-time noise pollution levels from electric generators and to understand the health-effects on wellbeing of resident populations in many Nigerian cities.

7.3 Vulnerable neighbourhoods and infectious diseases

It is evident from the accounts of mothers presented up to this point that discourses of health-risk perception have revolved around the vulnerable nature of the living environment, infrastructure and socioeconomic conditions of the neighbourhoods in which mothers and under-five children live. Reliance on unsafe drinking water sources, exposure to air pollution and the poor sanitation conditions of neighbourhoods were thought to accentuate the vulnerability of under-five children to infectious and respiratory diseases such as cholera, measles, malaria, diarrhoea and pneumonia. This finding is well supported by previous studies which have demonstrated the relationship between poor environmental and social conditions of neighbourhoods in developing countries with the spread of many

communicable or non-communicable disease pathogens among at risk populations (Oppong *et al.*, 2015). Children under the age of five years are particularly vulnerable to common infectious disease pathogens.

The burden of infectious diseases attributable to the modifiable environmental and social conditions is recognised as a global health challenge (Batterman *et al.*, 2009, Ejezie, 1983, Hutin *et al.*, 2003, Idowu *et al.*, 2012, Oguntoke *et al.*, 2009). Compared with developed economies, many developing countries in tropical areas including Nigeria, continue to bear most of the global burden of infectious disease (Woodburn *et al.*, 2009). Diarrhoea, Malaria and measles, remain the leading causes of preventable deaths in children under the age of five years (Binns *et al.*, 2012, Prüss-Üstün *et al.*, 2006) making the health-risk from communicable diseases a public health emergency. According to Pruss-Ustun *et al.* (2008), the proportion of the disease burden of malaria attributable to modifiable features of neighbourhoods is 42%. Their study also suggested that place vulnerability to malaria is associated with public policies, practices and behaviours regarding insecticide treated nets, water resources management, housing, waste disposal, improved drainage land use and deforestation.

In support of previous studies such as Ejezie (1983), the majority of the mothers that were interviewed across urban and rural areas identified all three forms of communicable diseases; bacterial (cholera and diarrhoea), viral (measles), and parasitic (malaria) as significant risks to under-five health with many ranking the risk of malaria as the most common childhood disease, accounting for the greatest health burden especially in the rainy season. Malaria emerged as the most important infectious disease which mothers talked about. The most important risks have been defined as the ones that are most frequently talked about by research participants (Atkinson *et al.*, 1995). As indicated by one of the interviewed mothers' resident in Adesogbe area of Benin City, measles and malaria remained major threats to children in her area but she felt that malaria was the most frequently occurring and serious childhood disease most people in her area were concerned about and which imposed a higher treatment burden on households than measles:

"I think the major risks to the health of our children here is only malaria and then measles. These two diseases are the most common childhood illnesses in children in this area. Although measles can be very serious when children get it but malaria is the most common disease that my children get treated from all the time. There are just too many mosquitoes breeding on dirty, stagnant water around his place.

Some research participants thought that the vulnerability of children to infectious diseases was higher in certain geographical spaces than others. The two excerpts presented below

were extracted from the narratives of mothers who are resident in a rural and an urban poor neighbourhoods of Ohanmi and Urubi respectively. Some of the interviewees from the urban poor and rural neighbourhoods were concerned that the poor sanitary conditions of residential areas, play grounds and child care centres where children share close contact with one another, may exacerbate the spread of infectious diseases spread among populations at risk. For example, the mother in a rural area felt that children spread infectious diseases among their peers as they play together around the neighbourhood:

“Our children suffer from measles although it is not as common malaria. Malaria, stooling and vomiting are the most common because of poor hygiene and most people do not want to change their ways. The moment a child stools and vomits, the rest children in the neighbourhood must experience it because they all play together. These are communicable diseases especially measles; if a child is infected with measles, other children usually get infected also. My children play with other children in the neighbourhood that is also very dirty by the way. If a child has cough, my children will also contract it. However, I am able to treat my children regularly because I am close to a nurse but the villagers, when they buy aspirin, they end the treatment there”. (31 years, mother of a 19 month old child, Ohanmi village)

Urban mothers on the other hand felt that child care centres and nurseries were particularly vulnerable to the spread of infectious diseases among children due to close contact. Like these mothers, a 29 year old graduate felt that the risk of infectious diseases was higher among children who attend day care centres.

“Malaria parasite and all the common diseases that children normally experience also spread easily in the nursery schools, one mosquito can bite several children at the same time and give them malaria. Cough and catarrh spread quickly in the day care centres too. If one child come to the nursery with cough, diarrhoea or measles, the rest children there that child end up getting the infections”. (29 year old graduate and mother of 2 from an urban poor neighbourhood in Urubi, Benin City)

In addition to geographical vulnerability of play areas and child care spaces, there were also some indications of socioeconomic divides in the exposure of neighbourhoods to infectious diseases. Children in poorer neighbourhoods that are typically characterised by worse infrastructural and housing conditions compared with neighbourhoods that are higher up in the socioeconomic ladder were more likely to be exposed to amplified risk of infectious diseases. For example, a mother of two children who has lived in Adesuwa, one of the rich urban GRAs, for two years suggested that the frequency of malaria infection in her children was much higher when they lived in a lower income neighbourhood of Evbuotubu. Evbuotubu is a middle income urban area whose environmental conditions have worsened in recent years due to a myriad of environmental degradation problems and poor infrastructure such as gully erosion, flooding, bad roads and irregular power supply. She

suggested that malaria risk for under-five children was much lower in Adesuwa than in Evbuotubu:

“Malaria is not much here although my children fall ill occasionally but it was a very serious issue for me when we lived in Evbuotubu for many years. We lived not very far from that heavily flooded part of Evbuotubu main road. You know that the roads in Evbuotubu are very bad now, lots of gully erosion and flooding and power supply is horrible. The houses there are closer together than GRA. A particular street is always flooded. I cannot remember the name now. If you go there, you can literally see the signs of mosquito bites on the skin of the children there. When we lived there, my children and I were always in the hospital for malaria. I had to beg my husband for us to move here. Initially he refused because the house rent here is almost twice, what we were paying in Evbuotubu. I had to beg him. Even he became fed up with the way the children were suffering from malaria every now and again. I was very happy when we moved here. I can sleep better now and we don't treat malaria very often”.

One theme that comes across very evidently in these narratives is that infectious diseases are indeed diseases amplified by place poverty. Oppong *et al.* (2009) has noted that infectious diseases are expected to be higher in certain neighbourhoods because people with similar socioeconomic conditions tend to cluster together. Richer people live in richer and better neighbourhoods and poorer people characteristically live in poorer and more crowded neighbourhoods with a myriad of environmental conditions that tend to favour the spread of diseases. It is logical then to expect the risk of infectious diseases to be higher in poorer neighbourhoods which are often more vulnerable because of poor environmental conditions which favour both the growth and spread of pathogens.

However, the differences in diseases vulnerability between the rich and poor may not always be as distinct in Nigeria. Whilst there are some exclusive areas for the rich and poor, it is common for households from different socioeconomic backgrounds to live side by side in many neighbourhoods. For example, many neighbourhoods in Benin City, do not have market socioeconomic distinctions in terms of the social hierarchies in the society. Even in developed countries whose neighbourhoods appear to be more distinctive socioeconomically, the vulnerability to certain infectious diseases such as tuberculosis may transcend the socioeconomic profiles of places due to contact and linkages between richer and poorer members of society. For example, (Oppong *et al.*, 2009) in discussing pathways in which infectious diseases like tuberculosis may transcend socioeconomic boundaries points out that poorer members of society who are likely to live in poor neighbourhoods with poor environmental conditions often work as domestic staff in richer households.

7.5.1 Environment-disease nexus

“Ohhhhh diseases! There are too many diseases here. The common diseases we have is diarrhoea because of lack of pure [safe] water. The water is not always okay for us to consume that is why we always have this disease”.

The complex link between environmental conditions and health status has long since been recognised. In health studies for example, the famous story of the removal of the pump handle on Broad Street in 1854 by ‘John Snow to stop the outbreak of cholera is a story of nearly mythical proportions amongst epidemiologists. It marked the beginning of current public health practices in which environmental factors are regarded as a major determinant of health status of a population’ (Melse *et al.*, 2001:7). The geographical distribution of health and disease is expected to vary spatially in reflection of underlying environmental conditions, socioeconomic development of societies (Oppong *et al.*, 2009) and cultural beliefs and dominant values (Melse *et al.*, 2001). Hence the environmental effect on health has changed substantially throughout history.

In high-income countries, chronic disease at older ages dominate the picture compared with developing countries where acute infectious diseases continue to account for most of the preventable causes of mortality including (De Hollander *et al.*, 2003) under-five mortality. It is not surprising then that the role of poor environmental conditions of neighbourhoods has been linked with in the high burden of infectious diseases and disease vectors in mothers’ narratives. The health-risk posed by disease vectors and related preventive health behaviour have been shown to vary between the two seasons in Nigeria. Respondents reported that the burden of malaria was higher in the rainy season compared with the dry season because mosquitoes are more prevalent in the rainy season. One of the interviewed women like others in both rural and urban areas, reported that her children were more inclined to sleep under a bed net at night in the rainy season when the air temperature is lowest compared with the dry season when the temperature is highest:

“In the dry season, mosquitoes are not much, but in the rainy season, they are everywhere so my children fall ill from malaria more in the rainy season. So I use the mosquito net to keep the mosquitoes at bay in the rainy season. The weather is usually too hot to use mosquito net in the dry season”.

In addition to the natural environmental elements such as rainfall, the absence of a regular power supply meant that bed nets could not be used as desired in the dry season (Figure 34).



Figure 34: Bed nets is inconvenient

A 9-month-old child sleeping under a bed net when there was light. The windows and doors have protective nets.

Beyond the natural environmental elements, the social environment, poor solid waste management system and locked drainage channels emerged as important factors in the burden of malaria among children across the geographical and socioeconomic spectrums.

7.4 I don't see any risk here

Up to this point, I have presented what the majority of mothers have identified significant as child health-risks. Most mothers talked about multiple risk factors and the way in which they are co-constituted to shape child health-risk experiences. However, it is important to mention that a minority of mothers reported that there were no significant risks to the health of their children. They felt that their personal and contextual circumstances did not put the health of their children at risk. This was particularly evident among women in richer urban neighbourhoods who reported that their personal and contextual circumstances did not pose any significant risk to the health of their children. One of the interviewed urban women living in a relatively affluent GRA in Benin City reported no health-risk to her children:

“I don't see any risk here; including the neighbourhood where he goes to school, I don't see any risk there either...”

She attributes her perceived absence of risk to the good environmental conditions of the neighbourhood she lives in;

“This is because there is no stagnant water around there and there is no bush around there either”.

However, the perceived absence of health risk is not peculiar to rich urban mothers, some women living in rural areas also perceived no risk. For example, A rural participants from Ikhin village was among the rural residents interviewed. She is a 37 year old mother of 4 who relocated into Ikhin village which is also her place of origin because she could not find a job in the state capital. She too was of the opinion that there were no major risks to the health of her children and those of others in the neighbourhood. She goes further to explain that rural areas are generally safer than urban neighbourhoods where she once lived in terms of disease risk and physical safety:

“As far as I am concerned, I see nothing major in this place that affects children’s health negatively. You know that city and village life styles are not same. I have lived in the city also and you know that in the city, heat causes sickness but it is not like that here. You can open your windows and doors at night should in case you feel heat, no armed robbery attack. So sickness is not much here; we just immunize our children for protection in case any person contacts the sickness from the city and brings it here, it cannot affect the children. So that is it. You can go out and come back any time; there is no harassment of any kind”.

Other mothers who perceived no substantial risk to child health attributed the perceived absence of lack of risk and the good general health of their children to supra-natural factors such as the ‘*help of God*’. Some mothers acknowledge that God has protected them from prevailing adverse personal and neighbourhood circumstances despite other children within their neighbourhoods being affected. This is expected because Nigeria is a deeply religious country with three main religious affiliations. The questionnaire data that I collected through primary fieldwork in the case study communities reveal that Christianity as the largest grouping (92.7%), Islam (7.0%) and Traditional Worship (0.3%) as the second and third respectively in the case study communities.

For example, a 33 years old tailor and a mother of five children who has lived in one of the poorest neighbourhoods in the city centre for 10 years, recognised that there are several challenges to child health in her area but that she is able to cope with them with the help of God:

“We are able to cope on a daily basis because of God”.

A young urban mother and trader in Uselu Market in Benin City who has lived in a middle income neighbourhood for six months explains that her children’s sustenance comes from God despite the ongoing economic recession in Nigeria which was affecting her business negatively.

“It is just God. Like I told you; these children, it is not because of money or anything, it is just God that has been sustaining them; because i know of other children that are of their age, I know how sometimes they are rushed to the hospitals but God has just kept these children’s health in peace; so it is just God that is keeping everybody in this recession period, but with God, to me I don’t see anything. God has a way of sustaining us in the midst of whatever that may be out there”.

A research participant who identified her age group as within the 30-39 year-old bracket and her ethnicity as Owan also attributed the reason for thriving to God despite the risk of malaria and bad drinking water:

“It is only God that helps me to take care of my baby most, I don’t put her under anything [mosquito net]. Even the water we drink is not good but we are already use to the water; we do not boil it, we do nothing to it; God has blessed the water for us”.

7.5 Discussion: health-risk is multidimensional and intersectional

The findings presented in this chapter have demonstrated that examining the contexts in which mothers situate themselves in framing child health-risk can broaden research perspective into the complex nature of health-risk intersections and the production of health inequalities. Mothers’ narratives indicated an awareness of the environmental and social aspects of health-risk in their local contexts. For example, logical associations were made which linked neighbourhood vulnerabilities and the risk of infectious diseases. Linkages between contaminated water and diarrhoea, poor sanitation and sewage system with malaria, and child clustering was linked with the spread of infectious diseases in children. These lay perceptions appeared consistent with biomedical research understandings of health vulnerabilities and the causes of infectious diseases documented in previous studies such as those of Prüss-Ustün *et al.* (2014), Prüss-Üstün *et al.* (2016), suggesting that epidemiological approaches and social science methods could be used in a complementary way for a more holistic perspective to the social determinants of health.

Although the interview data showed that mothers tended to highlight and prioritise certain aspects of health risk in their articulation of perceived health-risk factors, most mothers that we interviewed indicated that there were multiple aspects of child-health risks due to personal, household and neighbourhood circumstances which worked together to influence the experiences child health and wellbeing. This was deftly articulated in an interview extract from one of the interviewed rural mothers who reported that the risk to child health was wide-ranging and multiple:

'Hmmm! Bringing up a child within this environment has always been a challenge for many of us because we don't have access to good education, we don't have access to good health facilities and roads and power supply is very poor, no clean water and the government doesn't care. In fact, we are our own government. We have to provide our own water, buy generators and expensive fuel to get power, pay for our hospital bills, and feed your family whether you have a job or not. There are too many problems facing the ordinary person every day in Nigeria today. It makes me angry just talking about it, what do our leaders do with our oil money? They live lavish lifestyles at the expense of the common man who remains poor. Most children around here come from poor families and poverty limits a child's potential. All these things affect their health way into the future.

This viewpoint concerning the multiplicities of health-risk was also shared by an urban mother who identified the economic and nutritional challenges that many women face:

"Okay; firstly, let me start by saying the financial status of a man has a way of affecting the health his family positively or negatively. Let's give an instance here, the salary structure of every Nigerian is fixed and it is stagnant but the economy is not stagnant, it changes. Let's put it this way; in a developed nation like America, once the economy changes, the salary structure also changes; in the sense that if the standard of living is high, the income also becomes high to match up with the standard of the living. But here in Nigeria, the reverse is the case in the sense that if the standard is very high, you will see someone earning the same salary he or she was earning five years back; nothing has changed, it is still stagnant and such kind of things can still affect children in the sense that the man might not be able to provide three square meals for the children and cannot cater for the wife and children. Also, here in Nigeria, you discover that people feed more of carbohydrate foods because that is the only available thing that we can easily afford. Too much carbohydrate can lead to diabetes. Then talking about the environment, if the environment is not clean enough, not properly taken care of, a lot of things can happen; a child can encounter snake bite and mosquito bite from surrounding bushes, which will lead to malaria and emmm! you know there are different stages of malaria; advance stages of malaria can have psychosocial effects.

This chapter has offered an added advantage to identifying health-risk factors. It has further illuminated how differential exposures to health-risks might be produced within, between population groups, and for different individuals in a unique context. I utilised the guidelines of Kapilashrami *et al.* (2018) which was presented in their argument for why intersectionality matters for tackling inequalities in health to illustrate the added value of using an intersectionality approach to understanding the multidimensionality and multiplicities of the social determinants of health-risk and how the identified determinants might be co-constituted in shaping unequal health-risk experiences for individuals, households and communities. Adopting the lenses of intersectionality theory in this study achieved the two crucial aims of highlighting issues within group differences and shedding light on how power structures in society may interrelate to create inequalities.

First, the study highlighted important inequalities in the vulnerabilities to health-risk within population groups in Nigeria which have often been portrayed as homogeneous. For

example, intersectionality approach allows us to understand that a child born to a poor mother resident in a urban poor neighbourhood of Benin city may face a higher risk of dying from malaria due to poor waste management poor sanitation but has the relative advantage of urban residence with better access to improved water sources and electricity over a child born to a poor mother resident in a rural area who mainly rely on contaminated surface drinking water from unprotected wells and rivers. These different geographical and social contexts of women and children's lives – region of residence, socioeconomic status, sanitation, access to electricity - do not work independently or separately but inform each other in dynamic ways over time in creating unique malaria experiences. Second, it sheds light on the fact that individual and group health inequalities are produced through the multiple and complex interactions between many landscapes of risk and power structures: households, institutions and public policies. For example, what global or national policy landscape shapes the capacity of women, households, communities, institutions and regions to avoid or respond appropriately to health-risk factors? Chapter 8 examines this aspect in more detail.

The role of an intersectionality informed research process is to highlight inequalities and map more effective policy strategy. In order to illustrate the research and policy value of intersectionality, I consider two infectious diseases that account for the highest burden of child morbidity and mortality in the world: diarrhoea and malaria.

Diarrhoea is a water-borne disease, which the interviewed women highlighted as a major concern for child health in health-risk discourses. Diarrhoea accounts for over 15% the national burden mortality in children under the age of 5 years in Nigeria (Oguntoke *et al.*, 2009) and 94% of diarrhoeal disease is attributable to environmental factors such as sanitation and hygiene and access to safe drinking water. The risk of diarrhoea is not equally distributed across different areas. Inequalities in the risk of diarrhoea are also true on a global scale. The inequalities in the distribution of diarrhoea risk and associated health-seeking behaviour by geography, access to improved water sources, socioeconomic position, education, population density and age etc. are well recognised (Oguntoke *et al.*, 2009, Oloruntoba *et al.*, 2014, Prüss-Ustün *et al.*, 2014). A common practice is for researchers to consider such factors separately using quantitative approaches (such as those used in chapters 4-6) without sufficiently accounting for within-group differences in terms of the aetiology, onset, treatment trajectory and outcomes across differently situated mothers. The intersectionality lens used in this study builds on such quantitative methodologies to account for the multiple risk of diarrhoea disease simultaneously and emphasises the synergy of the different risk dimensions in creating unique experiences. For example, the

mothers in rural areas were more concerned with the growing burden of water-borne diseases compared with their urban counterparts due to unique intersections of risk factors such as reliance on surface and unprotected dug wells, lower knowledge of immunisation regimes due to lower educational attainment of mothers, lower hygiene standards, lower and incomplete immunisation rate, lack of power to influence policies on infrastructure, absence of organised waste management, and inadequate access to and utilization of health services. Thus the burden of diarrhoea will be experienced differently by different households living in these rural areas over time.

The multiple intersections between health-risk factors, whether positive or negative, vary among mothers living in a given rural area because the mothers in rural areas have distinct cultural differences, social networks, hygiene standards, levels of education, health care utilization behaviours etc. By providing a more nuanced understanding of the risk of diarrhoea disease across rural populations considered in this study, intersectionality shows why preventive strategies that target immunisation against diarrhoea but fail to account for the social context in which the disease occur and spread - the safety of drinking water, sanitation, and access to treatment facilities, treatment choices - might be ineffective. Sustainable interventions targeted at reducing water-borne disease must simultaneously address the interconnected and broader structures of economic and environmental health sustainability.

In a second example, I use malaria to demonstrate why policy strategies must incorporate the social context of people's lives in reducing health-risk determinants and within group inequalities. The interview data showed that the malaria burden was the most frequently talked about child health burden by both urban and rural participants with many linking the risk of malaria with modifiable environmental factors like drainage and waste management. Mothers identified the poor living conditions of their neighbourhoods, public infrastructure and sanitation as exacerbating malaria risk for their children. Malaria, as a leading infectious disease, is well documented. Erhun *et al.* (2005) note that malaria remains one of the most severe global health issues. Malaria accounts for more deaths than other infectious diseases in tropical areas. In Nigeria, malaria from (female mosquitoes carrying *plasmodium falciparum* and *plasmodium vivax*) accounts for more deaths and remains the leading causes of child mortality (Prüss-Üstün *et al.*, 2016) than any other endemic country in the world (Abah *et al.*, 2017). Nigeria also accounts for one of the highest malaria exports to other regions (Lai *et al.*, 2019) and global progress in malaria reduction in recent years leaves much to be desired. Malaria is not equally distributed. Numerous determinants combine uniquely in creating unequal risk for malaria. (Abah *et*

al., 2017, Booth *et al.*, 2004, Ng *et al.*, 2017, Onah *et al.*, 2017) The distribution of malaria pathogens varies significantly by geography, region of residence and sanitation conditions of neighbourhoods. Inequalities in the differential exposures and vulnerabilities to malaria are related to determinants such as; the utilisation of bed nets; insecticides spraying; capabilities of individuals and households to bear the costs of both preventing and the procurement of prophylactic antimalarial drugs for treating malaria at home; cost of accessing out-of-pocket payments for health services; the ability of health institutions to cope with treatment burdens; and the priorities of public health intervention programmes against malaria. A common practice is for these factors to be researched individually (Aju-Ameh *et al.*, 2016, Imo *et al.*, 2016, Jegede *et al.*, 2016, Ng *et al.*, 2017, Okeke *et al.*, 2010, Okeke *et al.*, 2006, Onah *et al.*, 2017). Less attention is paid to within group differences in a way that is sensitive to how a unique combination of these risk-factors may create inequalities in malaria experience in differently situated mothers and children.

An intersectionality thinking will be sensitive to the fact that malaria risk among urban populations, children born to urban poor mothers living in slums may suffer more frequently from malaria disease due to more vulnerable sewage infrastructure, clogged drains, high population density, and poor housing standards and reduced geographical and economic access to health facilities compared with urban rich mothers with better neighbourhood infrastructures and access to health services. Further, intersectionality also cautions that malaria risk within urban poor mothers may also vary because people living in socioeconomically poor neighbourhoods are made of different socially distinct individuals in terms of ethnicities, religious affiliations and health care utilization cultures. For example, Yoruba-Christian mothers may have more autonomy to make timely health care decisions and better access to medical health facilities for child and reproductive care compared with Hausa-Fulani-Muslim mothers (Adedini *et al.*, 2015a, Antai, 2011a) even though they share similar socioeconomic disadvantage and exposures to environmental health-risks in their neighbourhoods. The deeper insights that intersectionality brings to the social determinants of health is relevant for not only identify the social determinants of health but to understand why and how inequalities in under-five mortality and associated determinants are being simultaneously shaped by the interaction between multiple spaces and power hierarchies in the Nigeria.

7.6 Conclusion

This chapter has examined perceptions of health-risk and found that the interviewed mothers have awareness of the wide range of health-risk and their causes, which are prominent in their neighbourhoods. The main health-risk factors emphasised by mothers

are attributable to deficiencies in physical infrastructure, sanitation, and an inadequate and unaffordable health service. However, not all children are equally exposed to the damaging health consequences of these identified risk factors. Inequalities in exposures to health vulnerabilities have emerged very strongly from mothers' narratives of their experiences of child health-risk. For example, there are inequalities in the perception of neighbourhood vulnerability to infectious diseases in ways that strongly reflect the socioeconomic differences of households.

Certain health-risks are more prominent in certain geographical locations than others are. For example, the lack of access to clean water and sanitation reflects a rural pattern while pollution from solid waste was mainly perceived as a health-risk in urban areas. In both urban and rural areas, people in lower socioeconomic groups may be more exposed to the range of environmental health-risk conditions and may be less able to mitigate or avoid risks. Overall, I have used the intersectionality framework to illustrate that individual social position and other attributes work together simultaneously to influence susceptibility to risks in a given setting. Health-risk factors do not just map onto one another in an additive manner. I call for research sensitivity, especially in the global south, to the multiple ways in which health-risk factors work together simultaneously to determine unique experiences of health and illness. Intersectionality has helped to demonstrate the need to do away with the simplistic one-size-fits-all approach to the understanding of health risk vulnerability that fails to incorporate the social context of people's lives in risk analysis.

It could be argued that the presence of an environmental risk factor does not necessarily translate to harm equally for all persons who are exposed to that health-risk. Hardoy *et al.* (2001), suggested that the vulnerability of a person, household and community to the health-risk is mediated by socioeconomic factors which influence the capabilities of people for making alternative choices to avoid the risk and the ability to cope with the given risk such as being able to afford and access health services. Whether or not a health-risk factor significantly impacts a child's health or has fatal consequences depends on the range of capabilities, the extent of freedom and number of choices available to women to both avoid, protect against and cope with the said risk. Overall, children born to mothers that are more privileged are expected to be less vulnerable to infectious diseases compared with those born to mothers who are themselves socially vulnerable. Accordingly, the ability or inability to choose the type of response and prioritise certain responses over others is also embedded in the social contexts of people lives. Chapter 8 therefore, examines the role of power and agency in responding to health-risks.

CHAPTER 8

Household and Community Responses to Health-Risk

8.0 Introduction

The previous chapter explored individual level perceptions of the social determinants of health. The findings indicated that the interviewed mothers demonstrated an awareness of the health-risk conditions that are examined in large-scale statistical surveys like the ones considered in the previous chapters of this thesis. This chapter advances research argument on risk-perception by demonstrating that responses to health risk do not operate in a vacuum. Intersectionality framework also helps us to understand that the capacity of individuals, households, communities and institutions to respond appropriately to health-risk factors are embedded in the sociocultural context in which health-risk is experienced. This chapter highlights ways in which households and communities modify their actions and mobilise their collective capital in reducing the health damaging effects of the health-risks previously outlined. The chapter therefore aims to address the following research questions:

1. Who takes responsibility for health-risk?
2. How do households, communities and institutions respond to health-risk?

Previous studies have suggested that perceptions of risk are intricately linked with people's experiences. Households and communities are likely to decide and prioritise courses of action for risk mitigation and adaptation based on preconceived notions of the risk they have to negotiate (Curren *et al.*, 1986). Both psychometric and constructivist perspectives on the epistemology of risk are in agreement with the perspective that responses to risk factors are based on peoples' evaluation of their own capability to modify risk conditions and the willingness to take action (Jasanoff, 1998). Constructivism underlines the arguments in this chapter and the previous one. The chapter also employs sociocultural perspectives which recognises risk responses are situated within the spatial and sociocultural contexts in which risk perceptions are formed (Slovic, 1987, Slovic *et al.*, 1981). I argue here that it is important for health-risk research and management efforts to understand the intersections between the spatial and social contexts in which responses to health-risks are chosen or prioritised. I also suggest that further insights can be gained by incorporating the often-neglected notion of women's agency into the analysis. I argue that this allows researchers to attend to how differently situated individuals and groups may act. To achieve this, the risk response

interviews were designed to assess what mothers usually do in response (in terms of coping with, mitigating or eliminating) the identified health-risks such as infrastructural deficits and exposure to infectious disease pathogens discussed in the previous chapter. This chapter therefore, is designed to excavate ways in which responses of people to health-risk factors are embedded in the multiple identities and social positions of research participants; and within systems of inequality and power (López *et al.*, 2016).

The findings show that the interviewed mothers emphasised a wide range of infrastructural and environmental deficits that are considered to have substantial influence on child wellbeing in their geographical and social contexts. The perceived health-risk issues that emerged mainly relate to the differential access to clean water, proper sanitation, standard infrastructure and poor health services based on the relative social position of mothers. The point that the identified risk factors do not affect all individuals equally was clearly made.

Intersectionality theory informed this research and led me to understand that the determinants of health-risk tend to combine in unique ways to determine individual experiences of health. The findings are laid out in two sections. First, I discuss the actors to which the responsibility and the obligation for health-risk management are attributed. Secondly, I discuss the responses of institutions, households and communities to health-risk factors.

8.1 Attributing responsibility for health-risk

Studies have shown that many of the persistent and complex forms of environmental risk, such as technological and industrial hazards including health-risk, are co-produced not just through the actions of private and public institutions but also through the behaviours and practices of individual members of society (Bickerstaff *et al.*, 2002). Health-risk management agencies globally have continued to advocate for the need to incorporate individual and collective actions in the management of risk across several scales.

Bickerstaff *et al.* (2008) have identified two key aspects of risk responsibility construction. They argue that people tend to first, identify actors or agents contributing to environmental health-risks and then identify a normative sense of responsibility as a duty or obligation which actors are morally bound to perform or have the power to influence in order to mitigate potential health damaging effects from risk factors. Previous studies such as that by Connolly (1993), have indicated that these two principles are not necessarily separate but interrelated. He argued that the identification of agency (that is, identifying individuals or institutions that are to be blamed for directly contributing to health-risk conditions) is a necessary precondition for both the attribution of risk-responsibility and the assumption of

obligation to reduce harm in different social and institutional contexts. In support of his argument, this study finds that the interviewed mothers tended to identify both the agency thought to be increasing the vulnerability of children to poor health and the actors perceived to have the power to perform certain risk reduction obligations. Generally, the research participants perceived governmental institutions and individual members in their communities as the main agents responsible for risk conditions who also have obligations in risks reduction. These are discussed in two sub-themes: institutional responsibilities and obligations for health-risk management and public/individual responsibility for health-risk.

8.1.1 Institutional responsibilities and obligations for health-risk management

As already discussed in the health-risk discourses presented in chapter 7, many participants recognised that the central role of the government and the public institutions under her was to mobilise collective natural (mainly crude oil resources) and human resources for social intervention purposes including health care intervention.

Many mothers were of the opinion that governmental institutions did very little to address the health-risk issues in their communities. As a result, very scant positive reference was made to community health care workers in relation to polio vaccination through community outreaches:

“I know that once in a blue moon, that these W.H.O people come around to give emm polio vaccines; but so far, I have not heard that something like polio has happened to any child”.

The government and the agencies under it, were blamed for the persistence of many environmental health-risk by failing to provide adequate infrastructure and health services. A majority of the research participants felt that the government and public institutions were failing in their obligation to resappropriately respond in terms of providing the necessary physical, health and social infrastructure needed to reduce the vulnerability of under-five children to infectious diseases. The public health service and environmental agencies **were** framed as partly responsible for the unsafe living environments of most neighbourhoods. The existing health care intervention services and environmental sanitation were problematized by research participants who tended to emphasise more of the deficiencies in the sanitation and health service intervention efforts compared with the risk reduction benefits of the programmes.

Many participants used the term ‘government’ to refer more broadly, to public institutions and public agencies. The interview extract from a rural mother that was first presented in section 7.6, captures what many participants described as the failure of the Nigerian

government in its responsibility to provide basic infrastructure and affordable health service for all:

“...In fact, we are our own government. We have to provide our own water, buy generators and expensive fuel to get power, pay for our hospital bills, and feed our families whether we have jobs or not. There are too many problems facing the ordinary person every day in Nigeria today. It makes me angry just talking about it. What do our leaders do with our oil money? They live lavish lifestyles at the expense of the common man who remains poor...”

The above extract reflects the widespread feeling of the failure of governments to effectively mobilise collective resources to provide effective waste management system, affordable infrastructure, basic health services and infrastructure which can only be undertaken cost-effectively either by or with their support of government (Hardoy *et al.*, 1992).

In addition to the perception of the general failure of government as a political institution on a number of its obligations, environmental agencies were implicated in their perceived failure to meet their sanitation obligations that include regulating pollution and managing waste. As discussed in section 7.2.2, many participants in rural areas reported a complete lack of coverage of environmental services and their urban counterparts felt that environmental services were unreliable. For example, a rural participant from Ohanmi village was earlier quoted as saying:

“...No government agency collects refuse here...”

An urban participant resident near New Benin Market, was concerned about irregularities in the collection of waste by the relevant authorities. She felt that most people do not get value for money:

“People pay money to these waste managers to pack their refuse but they don’t come regularly and according to schedule”.

Many participants in the urban areas blamed environmental agencies for the heaps of refuse that characterised the streets of city center areas in Benin City. They linked the failure of environmental agencies to deal with waste with high levels of exposure to infectious diseases pathogens. It was also a widespread view that the public health agencies, which are responsible for managing the risk of infectious diseases resulting from poor sanitation conditions, were also failing in their responsibilities to deliver effective preventive and curative services. The need to expand upon current levels of child health education services especially immunisation was emphasised by many mothers:

“I feel the level of information they spread for immunisation is not enough. I know that the government is trying but they can try harder... ...Some people do a nice

work on radio stations. So in addition to immunisation, it will be good if they can teach parents more about other aspects of health protection...”

Many participants thought it was the duty of government to address existing inadequacies in both geographical and economic access to immunisation services:

I had to pay for certain doses of vaccines ... Many women cannot afford these vaccines if they have to pay for it but through the help of the government these mothers will be able to get the vaccines for their children.

The perceived poor attitudes of public health workers were thought to be responsible for the poor uptake of the already limited public health services that further excludes vulnerable groups and increases their vulnerability to poor health.

8.1.2 Individual responsibility for health-risk

Beyond the perceived institutional roles in risk management outlined above, some research participants emphasised what Bickerstaff *et al.* (2008) describe as ‘a sense of self-efficacy’; that is the belief and potential for individuals to improve environmental risk conditions through their behaviour. This sense of individual agency and the recognition of the responsibility to change one’s behavioural context is what Eden (1993) refers to as ‘actionable responsibility’, which engenders the sense that individuals have a duty to take action in modifying risk conditions. The sense of self-efficacy and actionable responsibility in modifying the determinants of health were mainly articulated in relation to the sanitation conditions of the neighbourhood in which they live. For example, an urban research participant felt that all parents have a role to play in modifying the poor sanitation of neighbourhoods towards safer conditions:

“Parents need to take responsibility for sanitation and hygiene. What are the parents themselves doing to make the environment hygienic for their children despite the fact that the environment is not clean, what are they doing? You will discover that most of the refuse that is being dumped around are dumped by the parents of these children not knowing that they are exposing children to risk”.

Another participant alluded to this viewpoint and emphasised that everyone in society, not just parents, has an obligation to contribute their quota to improved sanitation efforts:

“...actually we all need to come together to keep the environment clean and tidy so that our children will not get contaminated from all these rubbish we are seeing today like refuse dumps and other things”.

The next section explores how the perception of institutional roles in health-risk reduction and the sense of self-efficacy and actionable responsibility is demonstrated by research

participants in managing the myriad of health-risk conditions within their geographical and social contexts.

8.2 Geographical and socioeconomic access to health services

Although the role of the health care system is considered in many models as an important social determinant of health, the role of access to available health services in the social production of health inequalities has not been made sufficiently explicit (Solar *et al.*, 2010). The health care system, by tackling geographical and economic barriers to access, is expected to play a major intervening role in mediating possible differential consequences of illness that could result from differences in the underlying exposure and vulnerability of people to health-risks (*ibid*). The problem of differential access to health services based on regional and socioeconomic vulnerabilities emerged very strongly, as one of the perceived child health-risks from the interview data. Four key aspects of health service barriers dominated discourses on poor health responses to illness. These include physical accessibility, poor communication of immunisation information, poor public health service especially poor, attitude of public health workers in urban areas and the burden of out-of-pocket payment for health services. Studies have shown that these key issues, which mothers have identified, are part of the fundamental and multidimensional process in health service utilisation. Titus *et al.* (2015) point out that health service utilisation is mediated by the socioeconomic structure of users.

Providing universal coverage for child health services to improve the survival of and quality of life remains a public health challenge in many developing countries partly because available health services are often under-utilised by vulnerable populations who are in greatest need (Adedokun *et al.*, 2017, Adewuyi *et al.*, 2017, Becker *et al.*, 1993).

8.2.1 Geographical accessibility to a health facility

The lack of proximity to a health facility amongst vulnerable populations was one of the critical health-risk issues which emerged from the interview data. Geographical accessibility was perceived in terms of physical proximity, reliability and affordability. As indicated by this extract from the narrative of an urban woman living in Ebo neighbourhood, located in the outskirts of Benin City reported the absence of a health facility with residents in the area having to rely on small pharmaceutical shops also known as ‘Chemist shops’ in Nigeria for the treatment of ailments:

“We do not have any hospital in this area at all! In fact, the only one that is even close by at all is the one at Aruogba; it is down there but very far from here; but

here, we don't have any health centre at all apart from all this emm! Small retail pharmaceutical and chemist shops where we normally treat our children”.

This reflects the inefficiencies and inequities in health care resource allocation between rural and urban areas in Nigeria. Okpani *et al.* (2015) noted that the allocation of health resources in Nigeria is skewed in favour of secondary and tertiary care that are located in urban areas, thus leaving many rural areas disadvantaged. He argues that inequalities in health care provision are compounded by the inability of the Nigerian government to control the physical location of public and private health facilities. This leads to allocation inefficiency – overprovision in areas that are more affluent with the capacity to pay and under provision in poorer areas.

Most rural participants felt that the absence of a standard health care system was a problem for the wellbeing of their children. Like most mothers in the rural areas, a 33 year old farmer in Ikhin village reported that there was only one maternity facility run by a nurse and without any doctors in the area. Villagers have to journey for over one hour to a nearby hospital in a small town to treat sick children:

“We only have one maternity centre in this area. If the children are sick, we take them to the maternity. If the nurse can't treat them, we treat them and if the nurse says that the sickness is too hard for her, we take them to Afuze hospital which is over 1 hour from here”.

The problem of a lack of physical proximity to health facilities, especially in rural areas has been previously reported. Ayeni *et al.* (1987) noted that improving geographical access to a health facility is likely to improve utilisation and poorer segments of the society are more likely to access a health facility if they are closer to it. He recognised that providing equitable access in many rural parts of Nigeria is an expensive but necessary venture in order to attain full coverage for rural populations. Okafor (1990) also noted the rural health facilities in Nigeria are generally ill-equipped to handle complicated inpatient cases with many poor rural residents having to travel long distances to access subsidised health services in general hospitals which are generally located in larger towns. This is compounded by the lack of incentives for health care workers to accept postings to rural areas (Okpani *et al.*, 2015).

Even in urban areas where secondary and tertiary care are available, they tend to be clustered in more affluent areas. Poorer mothers reported travelling longer distances to access a public health facility. This was indicated by an urban mother living in a low income

urban area of Egor. She reported that the only available public clinic in the area was very far from her residence and offered only basic child immunisation services:

There is no clinic close-by that treats children; you only see a primary health care centre just for immunisation at Egor local government at Uselu market and it is very far from here.

Unlike these rural and urban poor mothers, a mother living in a more affluent university neighbourhood conversely reported having access to the best health services, most of which were located around her neighbourhood:

“I think that because I live in a university environment, there is this teaching hospital that is attached to the school so that has aided emmm en health emmm treatment; so which in the country today is one of the best; and there are very many other health facilities like; clinics, emmm that we have in this area, which are very effective also”.

The inequalities in the spatial allocation of health facilities and those under-funded and ill-equipped for primary health care (PHC) provision result in many people bypassing PHCs to access primary care in secondary and tertiary centres which are usually too expensive for poor people, especially in the absence of social security and health care insurance, which therefore exacerbates inequalities in access and payment for health services. Some of the direct consequences of people bypassing PHCs is the overcrowding of secondary and tertiary facilities which operate patient drop in systems. Private health care providers are reported to cash in on some of these deficiencies in public health services to offer their services at even more expensive rates than the high cost of provision in public services. In addition to the inflation of health care costs that the pressure on secondary facilities create, patients also wait long hours to be attended to by health care professionals who are generally overwhelmed, leading to poor quality service delivery.

8.2.2 Attitude of health workers: private over public

Beyond geographical accessibility to a health facility, evidence emerging from the interview data also suggests that the quality of health services available in primary, secondary and tertiary health facilities is important for both retaining access and shaping patients' experience. Many studies have argued that a critical factor in delivering quality health services to vulnerable populations is the attitude of health workers to patients during visits to a health facility (Abubakar *et al.*, 2018, Fagbamigbe *et al.*, 2015, Okonofua *et al.*, 2017). A poor or unsympathetic attitude on the part of health workers towards patients and long waiting time emerged as perceived barriers to health care utilisation in public hospitals. Most of the interviewed mothers had very many negative comments on the poor attitudes

of health professionals and suggested instances of medical negligence towards patients in public hospitals, especially in urban areas. This finding is supported by evidence in the academic literature on the negative effects of the poor attitudes of health professionals on health services utilisation with many researchers reporting patients, especially those of lower socioeconomic status not being treated with dignity and respect in health centres (Abubakar *et al.*, 2018, Odetola, 2015, Okeke *et al.*, 2010). The findings of this study also adds to the accumulating body of evidence indicating that perceived poor physical and social environment such as hygiene, long waiting time and perceived poor attitude of health professionals especially during labour and child delivery emerged as potential risk factors to child health. An urban mother who reported earning slightly above the minimum wage reported a preference for private health care services because of better hygiene and care:

“I use a private hospital because they are neat and caring. In government hospitals, health care professionals treat someone like a-nobody. Maybe because in a government hospital you don’t pay as much as in private hospital they treat you the way they like”.

Another urban mother echoed the importance of hospital hygiene for continued utilisation of public health service:

“The hygiene conditions in government hospitals are very poor. For example, I delivered my first two children in a government hospital but this last one here, was delivered in a private hospital. I noticed that the hygiene I wanted in the government hospital, I was not given so I had to change. I changed to a private hospital due to the unpleasant experience of the dirty environment where I delivered my first child and the second child”.

Another urban mother who is a business woman in her early thirties reported her preference for a private hospital that is located much farther than the nearest public health facility in order to avoid long waiting hours:

“I go to private hospital. It is not even close to my house. Why I prefer there is because if I go to central hospital that is nearby, I won’t be attended to very quickly. I like the private hospital because if I go there, I would be attended to quickly. So I choose to go there because they attend to me very quickly”.

The perceived poor service delivery in public hospitals and the typical negative encounters with public health professionals as the main reasons for choosing private health services over public despite the limited resources of mothers was echoed by another urban respondent. The research participant described herself as female church group leader who earns slightly above the minimum average from doing a low grade administrative job in the

private sector. She gave a comprehensive account of the typical health care utilisation barriers at a public tertiary hospital in the case study area:

“We do not have access to good public health service in this country. I use a private hospital because it is more accessible and affordable. The public hospital, which is government hospital [...sighs], there are lots and lots of issues there like long, delay. I can't trust them during emergency because they always go on strike. If you want to go there to treat yourself or your child, they will demand much money from you. They are so lackadaisical and so unserious. In fact let me tell you something, 80% of the deaths in Nigerian hospitals is caused by the lackadaisical attitude of our health practioners and medical doctors and nurses. I believe when any sickness or disease attacks someone, it can be treated but when someone is lackadaisical and highly unserious, no sense of urgency even in emergencies. Why won't people just die of preventable diseases?”

There was a day I have went to a public hospital and I saw someone bleeding and they told her to deposit some amount of money and told her to buy health card. I was appalled by the way they spent a long time asking some irrelevant questions that were not needed at that time whereas the person was dying and needed an urgent attention.

Unfortunately, you can now find these attitudes in a private hospital, because the private hospitals are now imitating public hospitals. They now also demand payment for card. They will say you have to register, deposit some money before they begin treatment. It was not like that a few years ago. If you go there, they treat you first and at the end of the day they will give you your bill, you then pay and get out of there but now it is no longer like that. Private hospitals now also ask for some payment to be made before treatment begins. I believe that the public hospitals are showing bad examples to them. Health service is now seen as a means of generating funds. Hospitals are meant to cater for people's health, which is the primary thing to me, not money making”.

Three dominant themes run across her rather detailed narrative of access barriers in public medical service provision. These include; 1) the poor attitude of health workers; 2) the burden of out-of-pocket payment for health service; and 3) long waiting times. Like most of the interviewed mothers the importance of treating patients with care and dignity was reiterated by a 30 year old self-employed mother of 3 children:

“I prefer private hospitals because when you get to government hospital, the long process of waiting for them to attend to you and; they show I-don't-care-attitude; you could shout for all you want and all that but they don't just care; and the way they treat you is quite different from the care you get in private hospitals; They make hasty decisions for child birth C-Section. I prefer private hospitals. Although I usually register in a government hospital and attend antenatal classes there but I deliver my babies in a private hospital because of the good care and everything. They are more patient with you unlike government hospitals. I put to birth in a private hospital with the help of God successfully”.

It was not all tales of woe, as a small number of respondents reported positive experiences of health services in public hospitals. There were respondents who recognised that sanitation conditions and attitudes of workers in public hospitals were poor, but continued

to utilise public services because public health workers were more professional ‘qualified’ and equipped to handle complications and emergencies. For example, this viewpoint was expressed by a university lecturer in her thirties who reported prioritising competence and safety in her choice of a public health service:

“The doctors in UBTH are well trained. They have consultants in all areas. They can easily handle complications better than other hospitals and that is why I go there. The bad side is that the workers are not kind at all and the place is a bit dirty but I can endure for those for few days. For me there is really no other choice, it is safety first”.

However, more mothers from higher socioeconomic backgrounds appeared to have reported experiencing better attitudes from health professionals compared with poorer mothers:

“I delivered my last baby at Stella Obasanjo hospital. It was okay, they tried their best. You know the way we hear bad reports about government hospitals, but that was not my experience. That was the first time I had to deliver a baby in a government hospital. Their approach to me and everything else was very good”.

Most mothers suggested the problem of differential access to health services in public hospitals based on socioeconomic status. This view was echoed by one of the mothers living in a higher socioeconomic neighbourhood in the GRA of Benin City. She is a self-employed business woman who considers herself as richer than most mothers in her area, and she reported that health workers in public hospitals were more likely to treat mothers differently based on perceived socioeconomic status with uneducated and poorer mothers more likely to experience poor attitudes from health workers in public hospitals. She suggested that the quality of health services people get depends on their socioeconomic status:

“The health workers are usually nice; they were nice to me but I think it is all about the level of your education. They treat you with more respect if you are educated. Mothers without education tend to patronise unqualified health professionals. When you are dealing with quacks, you should not expect the best but when you are dealing with professional medical doctors, I think you should expect a good service. I get the best from them. Also, your cash [implying socioeconomic status] that is, the money you pay also determines the kind of service you get”.

This highlights Bourdieu’s idea of symbolic violence in terms of the sense of ease and entitlement with which privileged groups tend to feel in engaging with public services, thus tending to obtain better returns (Bourdieu, 1979, Weininger, 2002). There is a clear indication of differential access to and experiences of available health care based on socioeconomic status. This finding is supported by previous studies such as those of

(Adedokun *et al.*, 2017) and (Fagbamigbe *et al.*, 2015, Okonofua *et al.*, 2017) which have demonstrated that the likelihood of seeking medical care increases with socioeconomic status with poorer members of society less likely to seek professional medical care for their children. Poorer mothers are more likely to live farther away from health facilities and also lack the financial capacity to pay for the cost of treatment for their children. They are also more likely to be treated with disrespect and without dignity compared with mothers of higher socioeconomic status.

Most mothers resident in rural communities perceived the available health services in their communities as satisfactory even though the only available health facilities in all the five rural communities included in the study were maternity services for child delivery, immunisation and the capacity only treat minor ailments. There was no hospital in any of these areas and I was rather surprised that the women thought the facilities and services were okay and satisfactory. Figure 35 below show the best health facility in the urban area compared with the only available maternity Centre in one of the case study villages indicating huge urban-rural gap in health infrastructure.



Figure 35: Urban (a) and rural (b) health facilities compared

Most rural mothers reported being treated with respect and dignity by the health workers. Perhaps the small populations in these villages could mean that both health workers and resident mothers know one another more informally thus translating to better relationships between patients and health care providers. The opposite was the case suggested by urban poor mothers who tended to report poor attitudes on the part of health workers.

8.2.3 Poor communication of general preventive health care for children

The problem of poor communication of preventive child health: for example, the use of mosquito nets, immunisation in the health centres and the role of traditional media in health education; was considered insufficient by most urban mothers. Some mothers reported the distribution of expired mosquito nets and others buying them from ‘chemist’

shops. Like many urban mothers with children aged under 5 years old, a 33 year old graduate urban mother in who has lived in one of the rich GRA neighbourhoods in Benin City indicated the need for better preventive child health communication. She emphasised the the need to go beyond the emphasis on immunisation and mosquito bed nets to include sanitation and nutrition information:

“I am close to the people in the medical profession. I have friends that are matrons so I know; I feel the level of information they spread for immunisation is not enough. For example, there was a time they distributed mosquito net in my office, when I read through, I found out that it was expired, so why are they sharing expired mosquito net? I know the government is trying but if they can try harder. Some people do a nice immunisation campaign work on radio stations. so in addition to immunisation, it will be good if they can give parents more publicity about other aspects of health protection; hygiene, what to eat, how to eat, what to feed your children with because it is more than immunisation and mosquito nets, what the children eat also affects their health”.

This indicates that effective health communication is very central to health promotion but this may not be currently sufficient to reach at-risk populations. Most rural areas in Nigeria do not have access to adequate information due to high level poverty, poor education, inadequate access to communications infrastructure and irregular power supply (Ezema, 2016). It is important to educate and empower mothers in vulnerable areas to relevant information on the benefits of available health services (Abdulraheem *et al.*, 2012). Effective communication of preventive and curative services is important for addressing unnecessary deaths and the burden of diseases. Martin (1992) notes that most of the avoidable maternal and child mortality could be avoided through the provision of simple and affordable health care information to parents and child-care users.

8.2.4 The burden of out-of-pocket payments for immunisation

One of the key attributes of a functional health care system is the capability to ensure that health problems and illnesses do not further cripple people socioeconomically or deteriorate their social status in society. Solar *et al.* (2010:40) note that developing an ‘appropriate model health financing [for both curative and preventive health care services] that can prevent people from being forced into (deeper) poverty by the cost of medical care’ is crucial the social production of inequalities in health. The interview data show that many participants are aware that it is the primary responsibility of government to provide affordable and equitable access to health care for all groups in this society. The failure of government in this role has meant that the burden of out-of-pocket payment is passed to individuals. This viewpoint emerged very strongly in the framing the inadequacies in health service intervention discourses.

Nigeria relies heavily on out-of-pocket payments for virtually every form of health service provision and both public and private hospitals demand upfront payments. In 2012 for example, private out-of-pocket payment for health services was 70% of total health care expenditure in Nigeria (Okpani *et al.*, 2015). One of the first conditions many patients and their relatives are therefore greeted with on arrival to a health facility in Nigeria is ‘*You have to make a deposit before we can treat the patient*’ (Aregbeshola, 2016:1). The challenge of out-of-pocket payments to child-health emerged in relation to the cost of the preventive vaccines that are not freely available. Some mothers reported that there were inadequacies in the dissemination of information on immunisation.

It was suggested that there was a lot of ignorance on the range of preventive vaccines which under-five children need for protect against common infectious diseases. Whilst most of the vaccines given to children under the age of 9 months were freely available to mothers such as BCG, MMR₁ and Polio vaccines, the cost of the other vaccines beyond the age of 9 months are borne by mothers and most mothers are not adequately informed about them. For example, the Rotavirus, MMR₂, pneumococcal pneumonia and meningitis vaccines are not freely available to children in Nigeria. With the low coverage of insurance in Nigeria, most mothers have to make out-of-pocket payments for these vaccines. There were concerns by many educated mothers living in more affluent areas that poorer mothers especially those in rural areas cannot afford the cost of these vaccines and in most cases do not even know about them. Talking about this issue, an urban interviewee living in a middle-income neighbourhood of Isiohor which borders the University of Benin and University of Benin Teaching Hospital (UBTH), reported paying high charges for certain vaccines for her daughter after the age of nine months:

“The government should try and improve the access to the immunisation process, not all vaccines are free and some people can’t afford the money for the vaccines that are not free. There is even one vaccine. I can’t remember the name now o, that is even more than 10,000 naira. How can you expect poor people to pay that for a single vaccine in a country where our minimum wage is 18, 000 naira per month? The worst thing is that most poor people, especially the ones without enough education, do not even know that there are other vaccines apart from the free ones. They are only told about the free vaccines in the health centres and they go about thinking that their children have been fully immunised”.

Another Urban interviewee living in the same area, the UBTH staff quarters, which is a high-income residential estate occupied by medical doctors and their families, alluded to the notion of poor communication and the unaffordable cost of certain preventive vaccines and said:

“I had to pay for certain doses of vaccines in UBTH such as rota virus, MMR2, Meningitis and others vaccines for my daughter. I cannot remember the exact prices now but I remember that none of those vaccines was less than 9,000.00 naira. Many women cannot afford these vaccines if they have to pay for it but through the help of the government these mothers will be able to get the vaccines for their children”.

However, not a single mother resident in all the rural areas where interviews were conducted seems to be aware that there were other preventive vaccines for children that they need to pay for beyond the age of 9 months. Most respondents in rural areas reported completing all necessary vaccination regimes for their children up to the age of 9 months. For example, a young mother of two in her mid-twenties puts it this way:

“My children have completed all the necessary vaccines. They have taken all the vaccines that we get at the health centre up to 9 months of age. So they are okay”.

Another mother in Ikhin village in her account of her knowledge of available immunisation programmes and her compliance vaccines regimes for her children stated that:

“I don’t play with immunisation for my children at all. You know they say prevention is better and cheaper than cure. The maternity here gives free immunisation and mosquito net to children until the age of 9 months. So I make sure that they take all of them”.

Many mothers were not aware that there are other vaccines, which they have to pay for in order to get their children fully immunised. The uneducated and the poor in both rural and urban areas are especially at risk of not completing the necessary doses of childhood vaccines, due to ignorance for those that are unaware and unaffordable cost for those who are aware. Some respondents in urban areas reported having to pay for certain vaccines for example MMR2 - the second dose of mumps, measles and rubella -, Meningitis and Rotavirus.

The national minimum wage was 18,000.00 (estimated £40.00) monthly at the time of the interview. The minimum wage was increased to 27,000 (estimated £60.00) in 2018. The survey data utilised in chapter 6 show that 54% of the women of reproductive age who participated in the questionnaire survey earned below the monthly minimum wage indicating that most mothers are located in the lowest income category. It is expected then that if certain vaccines cost more than half of Nigeria’s monthly minimum wage, the cost of such vaccines might be too burdensome for most mothers to bear.

Although, the cost of vaccination and the poor communication of vaccination information were the dominant themes relating to the burden of out-of-pocket payments for health

services, especially for the poor, there were indications from some mothers to suggest that beyond the burden of immunisation costs, there was also differential access to treatment options for childhood illnesses based on socioeconomic status. There were views that health care professionals sometimes suggest treatment options for illnesses based on the perceived socioeconomic status of mothers during their hospital visits. Sharing a very detailed account of her experience of treating diarrhoea for her child, an urban mother living in one of the high-class neighbourhoods of Benin City reported being asked by the doctor if she could afford to pay for ‘good quality’ medicines before prescriptions were made:

“I rushed my 6 months old son to UBTH on a Friday afternoon last month because he had diarrhoea which I suspected he got from another child in his crèche because all the children there subsequently came down with diarrhoea one after the other that week. Needless to say that I waited for several hours before being attended to by a doctor who was a friend during university days. He called me out when he saw me waiting at the reception. I had waited for over 2 hours at this point with a child that was stooling non-stop. He asked me if I could afford to buy good quality drugs for my child. I answered in the affirmative and then he prescribed some foreign drugs that I later bought for 11,000.00 naira at a private dispensary opposite the hospital. The hospital dispensary didn’t even have the drugs. That was more than half of a monthly minimum wage of 18,000. When I asked what kind of drugs he would have prescribed if I didn’t have money for the kind he prescribed, he said, in a sad way, ‘cheaper options my sister, not a lot of mothers can afford the drugs I just wrote for you just for diarrhoea. Many mothers don’t even come to the hospital for it, they simply buy cheap drugs from the dispensary”.

Many mothers reported that they self-medicate especially in relation to the treatment of what are perceived as minor or frequent childhood illnesses and diseases especially malaria which is also locally known as fever. For example, one of the interviewed mothers reported resulting to self-medication for the home management of fever with drugs from the shops just to avoid the high cost of treatment and long waiting times in public health facilities:

“My child falls sick of fever a lot. Whenever she falls sick and I take her to the hospital, they will always say it is fever so I just treat her for fever from time to time at home with drugs from the chemist rather than experience the hassles of to the hospital for treatment such as long waiting time and paying high hospital charges just to treat fever” (29 year old, fish seller, educated to primary level, urban resident).

Some mothers reported only accessing hospital treatment for very serious health conditions, and only when the child becomes very ill. Untimely access to treatment in medical facilities due to poverty or a lack of education have been widely reported as major risk factor for many preventable causes of under-five mortality:

“Our children suffer more from mosquito bite during the raining season because of the many flood water ponds we have around us. Considering the many issues with treatment for common malaria in the hospital, we only take our children to the

hospital when they are very ill and I see that their health is kind of deteriorating, then we will go to hospital for treatment”

Overall, the narratives presented in this section, which describes some of the challenges of health services, indicate some considerable socioeconomic gradient in access to health facilities and treatment options. These differential patterns of access and experience as determined by the socioeconomic status of patients could in no doubt be exacerbating the shocking levels of inequalities that the findings in this study have demonstrated so far.

8.3 Household and community responses to health-risk

“It is very challenging to raise a child in this environment. So as the challenges come, we look for a way to overcome them or live with the ones we cannot overcome. That is what we are born to do”. (30 years, secondary education, mother of 3, self-employed, urban resident)

The response interview data shows that the attitudes of research participants towards risk and adaptation strategies are premised on existing perception of risk, the feeling of power or the lack of it, to influence risk conditions and the actor to which risk mitigation obligations have been attributed (Adam *et al.*, 2000, Beck, 1992, Bickerstaff, 2004, Jasanoff, 1998, Lupton, 1999, Panter-Brick, 2014). The urban resident quoted above is well aware of the many challenges to be negotiated within her context in raising her 13-month-old child but she also recognised her limited capability to modify risk conditions. She felt powerless towards other kinds of risk that were beyond her control. Respondents were universal in describing their power to respond and mitigate household health-risks but there were general indications of a lack of control over wider environmental risk conditions. Research participants identified different forms of collective actions for the risk mitigation within their households and communities. Figure 36 is a word cloud derived from QSR Nvivo 12.0 showing the thirty most frequently used words by respondents in describing their responses to child health risk within the household and wider community.

8.3.1.1 Household sanitation and hygiene

It was common for mothers to perceive the hygiene and sanitation conditions within their dwellings and immediate surroundings as within their control while they feel powerless about the wider sanitation conditions of the neighbourhoods in which they live. Many thought that they lacked the power to influence other people's behaviour towards the wider environment. The narrative of one of an educated urban mothers living in a middle-income area reflects the common forms of household sanitation and hygiene practices which households perform in order to reduce the risk of infectious diseases:

“I ensure that my house is clean all the time. I clean and disinfect regularly. I prepare my children's food in clean environment so that it is not contaminated and lead to diarrhoea. As for the sanitation condition of the compound, all the women in the other flats in this compound take turns in sweeping using a roster. We leave the ones that we cannot do for the men. As you can see, the compound is neat. The men do their part and try to cut the grasses around the compound from time to time so that people don't pour refuse near us. We also dispose our refuse properly through a private waste manager. As for the way other people in this area litter the streets, and dump refuse into the gutters, there is nothing I can do about that. I cannot control how other people behave. That ought to be the work of the environmental agency who don't seem to be doing anything these days”.

Her narrative echoed many of the sanitation and food hygiene practices reported by respondents who viewed themselves as active agents capable of influencing the risk conditions in their immediate environments especially within the households. Respondents also reported some form of collaborative risk reduction practices between different households living in the same residential properties like flats and roomy compounds. These collective efforts reflected gendered roles with men and women assuming different responsibilities. There were widespread suggestions that women were mostly responsible for sweeping, fetching water and keeping the house/compound clean and tidy in order to reduce the risk of infectious diseases at home. The men on the other hand assumed responsibilities for cutting down grasses and surrounding bushes to prevent the indiscriminate dumping of waste which encouraged mosquito breeding. Such gendered roles also emerged in collaborative community-based adaption efforts reported later in the chapter.

Whilst many households reported the ability to engage in simple collaborative sanitation practices in the effort to reduce the exposure to infectious disease pathogens, a few households living in roomy compounds and multi-flat properties failed to collaborate with each other because the absence of a sense of personal responsibility and obligation for perceived risk conditions. This was common where participants perceive other agents as responsible for the risk and the lack of willingness for risk-causing agents to take action to reduce risk. A 20 year old married undergraduate student who had lived in the compound

for 4 years at the time of the interview, reported resulting to physical restriction of the movement of her 14 month old son as a way of protecting him from undesirable sanitation conditions in her compound for which no one took responsibility:

“My neighbours have poultry and keep other livestock within the compound so nobody wants to clean their mess. I can’t even allow my child outside my flat. They are always inside. It is more like am caging my child. At his age, he ought to be able to come out and play. I don’t allow it because the compound is too dirty especially with our neighbour’s within the compound, I am always afraid that he could pick up pick anything, especially the poultry dung littering the compound into his mouth which is not so good. So I see that as a health-risk”.

8.3.1.2 Physical restriction of children to Indoor spaces

This view of restricting children indoors which respondent living in compounds perceived as filthy was surprisingly common among many urban mothers. For example, a 35-year-old sales representative who moved into middle-income neighbourhood from a neighbouring state, one year prior to the interview also reported physically restricting her children indoors:

“They are always indoors after school hours; so that they are not too exposed to the dirty environment of this compound. (35 years mother of 2 year old male triplets)

8.3.1.3 Safety of drinking water

Many rural households talked about the simple practices they adopt to improve the safety of drinking water such as boiling water from unimproved sources before drinking. Inadequate access to safe drinking water emerged largely as a rural problem in chapter 7. It follows that the strategies to improve the safety emerged largely from the narrative of participants in rural areas. Many rural mothers with others reporting purchasing sachet water popularly referred to as ‘pure water’ (Figure 37) for their children. Like many of such mothers, a 27 year old mother who is educated to a secondary level and resident in Uroe village reported boiling as the major form of treatment for bad water:

“Water in this village is bad because it is from the river. I boil the water before drinking but I mostly buy pure [sachet] water for my child. I and my children were always falling ill when we first moved here until I started boiling the drinking water”

Many mothers considered boiling water before drinking on a daily basis was too much of a laborious and cost intensive routine for many households. Alternatively, they reported purchasing ‘pure water’ (sachet water) which was considered a more convenient option.

“I use to boil water for my children but it was too much work for me and waste of kerosene. I mostly buy pure water these days. I only boil water for my children when I am broke”.

Most urban mothers mainly rely on borehole water. Many urban mothers did not think that 'boiling' borehole water before drinking was necessary because many perceived borehole water sources as safe and clean enough for drinking:

"We have good water, we use borehole water. Does government give water? We have borehole water so at least we are not drinking water from the river. There is no need to boil it. It is very clean"

However, many mothers were concerned about the safety standards of sachet and borehole water, which are largely, perceives as safer alternatives:

" Pure water is not pure again o! We don't know the kind of water to give to a child again. If we give them pure water, they will say the water is not pure". (Rural mother, Arokho village, owns small scale retail grocery shop)

A small number of educated urban respondents thought that borehole water may not be safe enough for drinking because of storage factors and felt it was necessary to treat the water before drinking. For example, an urban mother with higher education and a legal practitioner, reported boiling borehole water for their children as an extra safety measure:

"We get our water from the borehole but we boil it before we drink it. You know the borehole tank is on top of the roof so it is not possible to wash it regularly. It think it can be a little bit contaminated. We boil it before putting it in the feeding bottle for the child to drink".

Many studies have suggested that the lack of trust for sachet and borehole water is well founded. Several studies have reported the presence of impurities and other forms of contaminants in sachet borehole water sources in the case study areas and other parts of the country (Ajayi *et al.*, 2009, Akinde *et al.*, 2011, Atuanya *et al.*, 2018, Daniel *et al.*, 2016, HA *et al.*, 2009, Omalu *et al.*, 2011, Oyedeji *et al.*, 2010). However, it is also recognised that packaged water has filled important gap in household water security in many West African countries including Nigeria. The consumption of drinking water in plastics and sachets has increased drastically in the last decade (Stoler *et al.*, 2012) because of the non-availability of safe public water and they offer a convenient and refreshing alternative to unsafe water sources (Oyedeji *et al.*, 2010).



Figure 37: Packaged water (left) and a borehole facility (right).

Packaged sachet water (a), Borehole storage facilities (b). Source: (author's work)

8.3.1.4 Malaria risk prevention

The use of mosquito bed nets was another common household risk-adaptation measure reported by respondents. As reported earlier in the chapter, the use of bed nets was well recognised as a necessary preventive measure against the risk of malaria but the erratic nature of power supply in both rural and urban areas was reported as a significant barrier to the regular use of nets. As a result, some households do not use mosquito bed nets at all while others, usually the more privilege households, reported adopting alternative measures to the use of insecticidal treated nets. These alternatives include fixing mosquito nets on windows and doors, the use of insecticides and occasional fumigation of compounds have already been implied in the earlier discussions (see section 7.1.1.3a). For example, a first time young mother of a higher socioeconomic status perceived many people in her area as capable of adapting to the minor conditions around them and having the power to deploy alternative preventive methods against malaria risk:

“This environment here is safe for children because parents in this neighbourhood are well-to-do. They have the necessary things to keep children safe from the minor challenges around here. I believe that they are very safe. Although the main problem we have here is mosquito that causes malaria but we have bed nets on windows and doors, we use insecticides, fumigate the compound from time to time and we are able afford regular treatment, so we are safe”. (21 year old undergraduate married to a professional).

What is not already emphasised so far is how widespread self-medication practices for the treatment of infectious diseases especially malaria were in both urban and rural populations. Self-medication is the use of drugs for the treatment of self-diagnosed diseases without prescription from a qualified health professional (Lawan *et al.*, 2013). Many mothers reported obtaining malaria drugs from over the counter in patent drugs stores for the routine treatment of malaria. These drugs are dispensed most times without the required diagnostic testing or medical prescription, and of course, almost every drug is available

without prescription in Nigeria. In exploring why the practice of self-medication was so widespread, it was found that first; there was a tendency to perceive all feverish conditions in children as malaria symptoms. Malaria is also commonly described as ‘iva’ a local word for fever. This was indicated in the quote below in discussing how the burden of out-of-pocket payment for endemic and frequently occurring infectious:

“My child falls sick of fever a lot. Whenever she falls sick and I take her to the hospital, they will always say it is fever so I just treat her for fever from time to time at home with drugs from the chemist rather than experience the hassles of going to the hospital for treatment such as long waiting time and paying high hospital charges just to treat fever”.

Secondly, due to the high frequency of occurrence of malaria among children and its endemic nature in Nigeria, many respondents adopted the practice of routine treatment on a self-medicated basis as a way of avoiding the heavy financial burden of hospital treatment. The comment from a self-employed respondent quoted below confirmed this view:

“When I gave birth to my first son, he was always falling sick from malaria always malaria. I got to understand the interval between the malaria episodes. I started with treating him every 3 months that is 12 weeks apart. After a while, I realized that I needed to treat him more frequently during the rainy season the risk of malaria is always something else. I noticed that it was better to treat my son and my other children more frequently, every 2 months for them not to break down. Whenever I try to leave the next treatment until the third month, they fall sick during the third month. So I just take it mandatory to treat them of malaria every 2 months and give also them their multi vitamins. I am already too stressed because of my job so I cannot afford my children breaking down all the time from malaria. I just have to give them multi vitamins, feed them well, and treat them of malaria if I have to”.

Many respondents echoed the practice of routine self-medicate treatment for malaria with many identifying treatment intervals of 2-4 months. For example, an uneducated 29 year old farmer living in Ake village though it was good to treat children, including her 7 months old daughter for malaria regular basis:

“It is also good to give the child anti malaria drugs every four months to avert any threat of malaria illness”.

A 33 year old mother who has lived in an urban poor neighbourhood for over 5 years, reported a more frequent treatment intervals for malaria on self-medication. She reported treating malaria monthly:

“I do give them malaria medicine often. I buy antimalarial drugs from the chemist [patent medicine stores] and I treat them for malaria like once in a month”.

All the respondents quoted above reported not testing for malaria medication and buying malaria medication without prescription from medicine stores. Studies have warned that

the practice of self-medication may result in side effects and a diminution in resistance to disease pathogens and a delay in seeking care (Nworie *et al.*, 2018, Ocan *et al.*, 2015). There is a need to make malaria diagnostic testing more accessible and affordable in addition to educating mothers on the danger of self-medication practices.

8.3.2 Community responses health-risk

In addition to the household measures for safer drinking water, and food hygiene, better environmental sanitation and coping with malaria by households, participants indicated that health-risk mitigation strategies or coping mechanisms involved some form of collective action among community members and social networks through pooling of resources together to address the physical environmental and socioeconomic risk to child health-risk. Social networks can be described as the relationships between people which facilitate cooperation and coordinated action among members in pursuit of mutual benefits (Mazzucato *et al.*, 2002). Understanding the nature of human relationships has been central to many social science disciplines including geography. In risk research, studies have argued that insights into the way in which communities respond to environmental risk might be broadened by utilising the concept of contextual social capital (Dynes, 2002, Wade, 1987, Wakefield *et al.*, 2001). For example, Adger (2003: 388) points out that adaptation to risk events is a social process which requires collective efficacy and ‘the interdependence of agents through their relationships with each other, with the institution in which they reside, and the resource base on which they depend’. Collective efficacy has been described as the ‘ability of community members to undertake collective action for mutual benefit’. (Kawachi, 2010:169).

The ability of community members to organise themselves for collective action for the purpose of addressing some environmental health-risk within their neighbourhoods was identified by mothers. The presence of local organisations was assessed by self-reports of social participation in community organisations by mothers and the ways in which they work together for the mutual benefit of the health of children under the age of five years. Many participants in rural areas suggested that community member’s work together to clean up domestic water sources by removing silt from wells, dredging rivers manually, and cutting down bushes by riverbanks:

“We all come together to maintain the community well and stream on a regular basis. Every December period when the water in the well is very low, the men remove the sand from the well so that it will be very clean. They also lock it during that time of the year to ration the water for everybody. As for the stream people in the community go to clean it up about two to three times in a year. We remove sand and clear the bush around it, so that it will be clean for everybody to use”. (35 years, non-illiterate, a tailor, Ikhin village, child is 26 months old)

Such informal and unstructured cooperation between community members for the purpose of reducing environmental health-risks appeared less emphasised in the narratives of urban mothers. However, many participants from both urban and rural areas emphasised more structured forms of collaboration through membership of community organisations such as religious, professional, cultural, and savings groups. Membership of a church organisation was the most commonly reported form of social participation. Being a predominantly Christian region, almost every participant reported belonging to a church community with a minority reporting membership of Muslim organisations. In addition to membership of religious communities, many interviewed mothers also reported additional membership of professional, cultural and savings groups. These organisations were perceived as providing both geographical and social spaces for women to harness their collective capital for mutual benefit including child wellbeing.

8.3.2.1 Women groups and the mobilisation of collective capital

It was very common for women from poor households to report mobilising one another to establish savings groups as a form of insurance for a range of household needs, including health emergencies. In all case study communities, members of savings groups contribute certain amounts on a regular basis, usually weekly or monthly. Mothers can borrow money from the common funds and repay at a stipulated time in accordance with organisational guidelines. For example, an urban mother who reported over 5 years of membership in a savings group, reported saving the profit from a small-scale grocery business (popularly called ‘provision stores’ in Nigeria) in such groups in order to meet health care cost:

“Covering the cost of health has been a challenge for my family. I had to join a savings group where I save my profit with every week. I lend money from there, and then use it to treat my family, just to make sure that my children are alright”.

In all cases, interviewed mothers reported that their community organisations had some form of savings schemes (in addition to other forms of collective human capital) for members to draw on in times of need, including childcare related needs. For example, mothers talked about the various ways in which members of social groups work together to promote child health. These include when a child is delivered, or sharing routine childcare preventive and curative information for minor illnesses and contributing towards the cost of treating major child health issues that require hospitalisation.

8.3.2.1 Child birth

Many mothers reported that members offer practical support to women whenever they have a new baby. It is customary for women’s groups to offer cash donations and assist new mothers with their domestic chores in the early days following delivery. A 35 year urban old

mother from a poor neighbourhood who has been a member of her savings group described the help she received when she had her last child who was about 26 months old at the time of the interview:

“When I gave birth to my child, the union I belong to, once they heard that I was at the hospital, number one: they assist me in prayers; number two, they taxed themselves and brought something [money] for me. There was a separate envelop [cash gift] for the child too. They made sure I had someone by me at home day and night to assist. This one would come to help with washing today, another person the next day, and so on. That is how we do it in our own group”.

8.3.2.2 Information sharing

Other participants reported that members of same organisations shared relevant childcare information amongst themselves. An urban respondent who reported membership of a community organisation for over 17 years and suggested that community members adopted communal approaches in the pursuit of mutual benefits for the wellbeing of all children:

90. You know a child belongs to everybody in the community not just the parents. If any of the member of your organisation came to meet you that her child was not feeling well, you ask what is wrong with the child and give some information or advice that can help the child get well. (39 years, Benin, self-employed)

The role of members who are health professionals and who are members of community groups was also emphasised. There was a widespread appreciation for community organisation members in the health profession who routinely educate mothers on general child care safety and general hygiene. Many mothers reported benefitting from the informal and free medical advice from health professionals for the management of minor everyday health problems in children.

“Most organisations have health specialists as members. In my church, I know one or two matrons. They educate parents on how to take care of their children during meetings. They also offer one-on-one advice that I have benefited from myself. Sometimes, when the children are behaving funny and I am not too sure, what’s wrong with them, I usually call her and say, mummy this and that, and explain my concerns to her. Most times, she calms my fears down. She would say relax! This is part of the stage they are in. So having free access to someone like her has been of great help to me”.

Such informal and free medical advice was thought to help mothers overcome some of the many barriers to seeking hospital treatment for minor health problems discussed earlier in section 7.1.3. A 35-year-old educated mother in a middle-income neighbourhood echoed this view and said:

“We do help each other in various ways including financial support. We have different professionals with different occupations in my church. For example, we have medical doctors and nurses among us. We don’t need to visit the hospitals

and wait for long hours or pay heavily for minor issues. We just ask them, they give advice on treatment options and prescribe drugs, and the child will be okay. They really help us a lot”.

In addition to informal information sharing, it was suggested that many churches also run maternity homes in rural areas and smaller towns at subsidized rates to fill existing gaps in both geographical and socioeconomic access to child health services. Some mothers expressed a preference for such health facilities because of the additional spiritual support and prayers they receive during delivery:

“I prefer to deliver my children in my church maternity centre. The quality of care is better and more affordable than most public hospitals. The nurses there are very always kind us because we know they and ourselves also support women with prayers to avert any complications doing delivery. I feel safer with them”. (Trader, urban, poor neighbourhood, educated to secondary level)

8.2.2.3 Helping with hospital bills

In addition to sharing relevant child care information informally, community groups also intervene in serious health complications requiring the hospitalisation of a child. Most members in community organisations identify the role of community organisations in mobilising collective financial capitals to help cover the cost of treatment where a member could not afford it. For example, an urban participant in her account of the forms of coordination of collective capital for financial intervention in health emergencies suggested that mothers sometime required social support to meet the health care costs for major health problems in children:

“Many members do not request for financial assistance with minor sicknesses from the association. We don’t quickly announce minor issues to members as a whole to help but if the health problem becomes serious to the point of hospitalisation, then members will come together to help through voluntary donations for the child. If it is a very serious problem and the parents don’t have enough, the group will provide for the member. For example, there is a child of one of our members that is in UBTH presently. He was rushed there when he became seriously ill few weeks ago. Since this child had a serious health issue, I don’t know the detail of the sickness anyway, so we all contributed money for him, we do go there to visit him. So it is out of the money from the association that we use to assist such persons”. (30-39 year group, unemployed, primary education)

8.3.3 Supernatural responses to health risk

“Can a mother really cope with all these problems? We are only coping by the grace of God”.

In addition to household and community responses already discussed, some research participants articulated a number of supernatural responses to child health risks. Just like the interviewed mother in Arokho village and quoted above, many mothers felt that individual and collective capabilities were insufficient for adequately addressing the risk

factors in their respective contexts. They identified the help of God as the reason for thriving despite the many health-risks they have to negotiate:

“Ultimately, it is just God that is sustaining these children. Like I told you earlier, it is not because of money I have or anything I do, it is just God that has been keeping them. I know of other children in the same age group as my children, I know how sometimes they are rushed to the hospitals but God has just kept these children’s health in peace. It is just God that is keeping everybody in this recession period. God has a way of sustaining us in the midst of whatever it is”.

Many mothers reported a combination of medical and supra-natural responses to child health. Although, spiritual responses such as offering prayers for a child’s quick recovery during illness was a usual practice in many religious societies like Nigeria, many mothers identified spiritual responses as the last resort when available medical options fail:

“I will take him to the hospital when he is sick but if it is beyond what the hospital can treat, I will take to my pastor and my pastor will pray for him and I believe that he would be healed”. (26 years first time mother, educated to secondary level, a secretary).

Whilst a majority reported oscillating between medical and supra-natural responses to child health-risk, a small number of those interviewed suggested ‘doing nothing’ to address the risk factors. Some felt that they have adapted to the health risk condition or that they rely on God to take away the health damaging effects from the sources of risks. Such ‘do-nothing’ narratives were mostly mentioned in relation to malaria and the risk from unsafe drinking water by uneducated women resident in villages. For example, the 37 year old farmer from Ikhin village reported doing nothing to reduce the risk of diseases from unimproved water sources because she believed that God has blessed the water for the villagers:

“You know we are already use to drinking the river water. We do not boil it, we do nothing to it. God has blessed the water for us.

Another interviewee who alluded to the do-nothing approach to risk management, and reported not using mosquito bed nets for her faith in God to help her care for her child:

“I do not put her under a mosquito bed net of anything like that. It is only God that helps me take care of my baby most”.

Whilst a few research participants reported only supra-natural responses, many reported a combination of medical responses and spiritual responses especially in severe illness conditions. Supra-natural responses were deployed as the last resort where medical responses fail to resolve the health conditions in children.

8.3.4 Responses to health risk need to be multidimensional

There were some suggestions that indicated that vaccination programmes targeting measles may have been effective in reducing the risk of measles in the population. For example, a mother aged 30-35 in Uroe village who echoed the view that malaria was more prevalent than measles, also indicated that the vaccination programme for measles may have contributed to reducing the vulnerability of children in her area to the disease:

“Measles was the biggest problem in this place for some time but since the health workers started giving free immunization a few years ago, it doesn’t affect children as such anymore”.

Some mothers highlighted the successes of vaccination programmes targeting cholera disease. Most of the mothers in Uroe emphasised the success of a borehole water intervention scheme (Figure 38) by a privileged individual in the village, in reducing the risk of cholera outbreak:

“There was a time we had cholera outbreak, about 4-5 years ago. It was a serious problem. The health people came here to attend to the sick children then. Some children died from serious vomiting and stooling accompanied with blood stains at that time. So one big man who is an indigene of this community helped us with five big boreholes and we have not experienced that disease since then”.

However, many mothers recognised the need to move beyond vaccination programmes to employ multidimensional approaches that simultaneously address the root causes of infectious diseases. For example, the need to address cholera risk through improved water infrastructure such as the provision of boreholes was well recognised by many mothers. They also acknowledge that such efforts should ideally be complemented by simultaneously addressing power shortages that may threaten the intended health benefits of improved potable water infrastructure:

“...but I am afraid that cholera may come back because we no longer have light in this community. We have not had light for over 3 years now because the community youths beat up some NEPA officials for bringing high bills without supplying power. So they cut us off from the grid about 3 years ago. We have not had power ever since. As a result we can no longer pump water with the boreholes which the big man gave us. We are appealing to the government and other big men to help us with solar panel. Some people have said that with solar power, we can pump water regularly but I also hear that it is very expensive”.

These narratives reflect the need to employ more holistic approaches to health-risk responses in order to achieve sustainable changes to health-risk conditions.



Figure 38: Donated borehole from a private individual.

8.4 Discussion

This chapter has attempted to examine the range of responses to health-risk factors which the interviewed mothers tended to emphasize during the semi-structured interviews. The findings revealed three broad levels of health-risk responses: household-based, community-based and institutional responses. Institutional level responses were mainly articulated in the form of access barriers to available health services. In line with previous studies, the findings demonstrated that the capacity to respond to a given child health-risk is embedded in the social context of mother's lives. The sense of obligation for adopting an actionable risk reduction strategy is preceded by the normative perception towards the said health-risk (Bickerstaff *et al.*, 2008, Bickerstaff *et al.*, 2002, Eden, 1993).

Beyond its potential to identify and highlight the interconnectedness in the way in which multiple aspects of people's lives determine vulnerabilities to health-risks, this chapter has demonstrated that intersectionality theory can provide deep insights into how multiple identities and structures of power combine to simultaneously influence the capacity and efficacy of households, communities and institutions to address risk conditions. Employing an intersectionality perspective to demonstrate interlinking, complex causal pathways, which involve the interactions between, attributes and assets of individual mothers and conditions in their local community and in service agencies, which they may need to draw upon, contributed to understanding the range of risk mitigation strategies that can be deployed in a given geographical and social context. I have argued that a better understanding of the intersections of multiple factors influencing the ability of people to adequately address or avoid risk altogether will shed more light on how and why inequalities are exacerbated between and within groups often represented as homogeneous. Intersectionality thinking also offers more effective pathways for achieving sustainable improvement in health by targeting different levels of interventions more effectively at populations at risk.

I return to the malaria example used in chapter 7 to demonstrate the value add of intersectionality approach in disentangling the intersecting inequalities in health-risk conditions. Intersectionality is valuable for unpicking the multiple ways in which the social context of people's lives may determine the range of response strategies that are available to them for coping with the burden of illness. This helps us to understand why research and policy practices that tend to focus on the distribution of insecticidal treated nets for example, may fail to achieve the much-anticipated sustainable reduction in malaria risk in endemic areas.

Common malaria risk reduction and treatment strategies at the household-level which the interviewed participants emphasised include: sleeping under a mosquito net at night; using spraying insecticides; installing mosquito bed nets on windows and doors; using alternative sources of power such as electric generators to enable children sleep under bed nets more comfortably; procurement of antimalarial drugs (prescribed and self-medicated) from chemist shops for routine treatment at home; and testing for and treating severe malaria events through out-of-pocket payments at a medical facility. In addition, mothers also articulated some significant barriers to the adoptions of coping strategies for malaria risk. Common strategies include: night-time indoor heat conditions, especially during the dry season due to inadequate power supply, which makes sleeping under a mosquito bed net less practicable; poor ventilation which increases indoor heat; high treatment burden for malaria events; and poor attitudes on the part of health workers towards patients during hospital visits. As noted in Chapter 7, the determinants of malaria risk and barriers to the uptake of common intervention strategies have often been researched individually and mainly from epidemiological perspectives that tend to pay a very limited attention to the underlying processes shaping the capabilities of household to adequately choose appropriate response towards malaria risk reduction in their local contexts.

This chapter advances research argument in this area by demonstrating that employing such narrow perspectives that do not to consider how the unique combination of both the enabling factors and barriers to malaria risk reduction efforts to malaria enquiry and policy design for example, will achieve sub-optimal results.

For example, many years of global intervention programmes aimed towards malaria risk reduction has made bed nets mostly available to many mothers regardless of socioeconomic efforts in endemic regions, as bed nets are now freely distributed. During interviews, many mothers indicated ownership of bed nets in their households. However, the ownership of mosquito bed nets did not automatically translate to equal utilisation behaviours. Using an

intersectionality lens to build on bed net ownership sheds more light to understanding how a combination of household enabling factors and disadvantages may interlock to create inequalities in bed net utilisation or the capacity of households to access alternative prevention and curative strategies for malaria where bed nets are not used. For example, let us consider differently situated children born to mothers in urban poor, middle and high income neighbourhoods who both own bed nets. The urban poor child may suffer more significantly from the damaging health consequences of malaria disease. In addition to poor neighbourhood conditions encouraging faster breeding of female anopheles mosquitos in urban slums, the urban poor child may also suffer simultaneously from other social disadvantages over time compared with urban middle and high income households. Socioeconomic disadvantage may mean that the urban poor household that the poor child belongs is unable to procure electric generators or afford to fuel generators as required to provide the needed access to electricity to enable children sleep under mosquito bed nets more comfortably at night.

Urban poor mothers may also lack the capacity to access timely care for severe malaria treatment in a medical facility due high costs at the same time. She may have wait for longer hours during visits to public hospitals for malaria treatment in addition to being penalised for her socioeconomic status by health care workers who were reported to treat people who they perceive as poor. In comparison, urban middle income households that can afford to power their electric generators throughout the night, may not be able to do so because of the proximity of dwelling units to one another and the possibility of neighbours objecting the night-time noise pollution but have an added advantage of accessing a private hospitals to save time. Urban middle and high income mothers are more likely to have personal relationships with medical doctors due to shared socioeconomic status and can as a result pre-arrange visiting time to avoid long waiting hours in public hospitals. The study finds that urban rich mothers who may have all or most of the outlined advantages may experience reduced malaria risks compared with urban poor and middle income mothers. However, the urban rich may suffer more from the health damaging consequences which may sometimes result from elevated night-time noise and air pollution from electric generators because they are able to power their electric generators throughout the night.

Adopting an intersectionality framework makes us to recognise that the capability to adequately respond to malaria risk is not the same for all households who share similar socioeconomic status. For example, the capability of urban poor mothers to cope with the heavy burden of out-of-pocket payment for malaria treatment, especially where hospitalisation is involved, may be different between mothers according to the degree of

participation in religious, cultural or savings groups. An urban poor mother who belongs to a women's group in church or wider community savings groups may have a relative advantage of access to collective capitals which such networks offer through information sharing, distributing the burden of out-of-pocket payment among mothers or the free medical advice from health professionals who are members of her group compared with an urban poor mother who is not a member of any social organisation. These simultaneous interactions are not limited to malaria risk reduction strategies alone. They are relevant to other infectious diseases, health outcomes for children and adults and other social science problems in general.

Intersectionality thinking, therefore, lays bare, the shortcomings of malaria intervention programmes which have overemphasised the ownership of bed nets for example, to the detriment of other social and environmental factors that need to be simultaneously tackled alongside bed net distribution. Whilst the ownership and utilisation of bed net remain important and have been proven to have significant benefits for malaria risk reduction, they are insufficient for addressing the multidimensional nature of the determinants and inequalities in the burden of malaria between and within groups. Focusing on the distribution of bed nets alone without simultaneously addressing the structural roots causes - the geographical and social determinants e.g. waste and sewage infrastructure, health insurance for equitable and timely access to health service - of malaria risk and understanding how inequalities in exposure levels are being produced may be an effort in futility.

8.5 Conclusion

The chapter has examined how mothers situate themselves, their household, communities and governmental institutions as active agents in risk management efforts. The findings showed that participants felt more capable of addressing the health-risk conditions at micro scales such as household spaces. There appeared to be a more limited sense of obligation and less feeling of control over wider neighbourhood risk conditions, which were perceived as institutional obligations for which those institutions have failed. By establishing women's groups however, mothers demonstrated a strong ability to mobilise their collective resources in addressing structural health-risk conditions especially in responding to the burden of out-of-pocket payments on poorer members.

Community organisations are heavily relied upon for intervention in complicated health conditions requiring hospitalisation. Overall, forms of responses and adaptation practices at the household scale were both preventive and reactive compared with risk reduction efforts

at the community level that were mostly reactive in nature. Accessing contextual social capital through memberships of savings groups and religious organisations was mainly articulated as a way of avoiding what a respondent described as the ‘hassles of hospital treatment procedures’. By employing an intersectionality lens, this chapter has challenged the focus on biomedical approaches to child health-risks and infectious disease management, for example such as emphasizing the distribution bed nets where utilisation is not practicable under the environmental and social circumstances high indoor heat at night, poor power supply and inequitable access to health services. This chapter and the broader thesis it belongs, has demonstrated that employing health intervention strategies which neglect the social context of health and illness will fail to achieve the sustainable reduction in under-five mortality required to meet the SDG targets in the year 2030.

CHAPTER 9

Summary of Findings and Conclusion

We can only understand the world, and improve it, if we can accurately portray it (page 36)... but the choice of geographical area frames how we see the world – a poor choice of frame will present [an incomplete or] a misleading perspective (Johnston et al., 2019:32).

9.0 Introduction

This thesis has employed an integrated approach to investigate the social determinants of health and inequalities in under-five mortality in Nigeria using multiple depths of analyses. Through the quantitative analysis of secondary and primary survey datasets, in addition to the thematic evaluation of semi-structured interviews, a top-down approach was chosen in an attempt to both identify the social determinants of health-risk and to understand the multiple ways in which they are co-constituted in creating inequalities in under-five mortality experience between population groups and individuals. Four main research questions were investigated:

1. What are the social determinants of under-five mortality in Nigeria?
2. How do the patterns of variation in under-five mortality relate to indicators of social and geographical attributes of population groups?
3. How do mothers of under-fives perceive health-risk in their local contexts?
4. How do mothers respond both individually and collectively, to perceived health-risk factors?

By critically exploring these questions, I demonstrated the potential of mixed-method approaches for gaining a rich contextual understanding of health divides and the processes shaping unequal health experiences.

This final chapter is laid out in four parts. Section 1 presents the research synthesis that summarises the methodologies and how the set research questions were addressed. In section 2, I critically evaluate the strengths and limitations of the study. Section 3 highlights the unique contributions the study has made to health geography knowledge and policy.

Lastly, section 4 outlines where this research might lead us in terms of future research directions/horizons.

9.1 Research synthesis

The main objectives of this research project, which were outlined in Chapter 1 are twofold: to explore the spatial heterogeneities in the social determinants of under-five mortality; and to understand the underlying processes shaping inequalities in under-five mortality across population groups and individuals. This section provides a synthesis of the major line of enquiry that I followed in implementing the set research objectives and a summary of the main research findings.

9.1.1 Summary of methods

This research utilised a mixed-methods approach in addressing the research objectives. The wide range of data collection and analytical procedures utilised in this thesis were broadly classified into two phases. The first phase was quantitatively driven in order to identify population-level health determinants at multiple scales, and to map the spatial patterns of health inequalities in under-five mortality. The second phase was qualitatively oriented in order to broaden research understanding on how health determinants may combine in shaping unequal individual health experiences in selected case study areas. The need to account for the multidimensionality of lived experiences (Mason, 2006) of the determinants of health-risks into the main stream of health research and policy are increasingly being recognised (Bauer, 2014, Hankivsky *et al.*, 2008, Kapilashrami *et al.*, 2018, Nygren *et al.*, 2014).

The empirical investigation was conducted across three geographical levels in Nigeria: sub-national, community, and individual level of analyses. In each level of analysis, this research has adopted methods that allowed for the interrelationships in the data to be identified. This is in line with the increasing recognition in the literature that strict specificity along separate indicators may limit the consideration of other domains for advancing health inequalities knowledge (Kelly, 2009, Nygren *et al.*, 2014).

As a necessary first step in identifying the national level determinants of under-five mortality in Nigeria, the quantitative analysis presented in Chapter 4 began with the initial selection the most influential variables on under-five mortality using bivariate correlation matrices. 38 sociodemographic and reproductive explanatory variables found to have the strongest correlations (≥ 0.5 , $p < 0.05$) with under-five mortality from a pooled NDHS cluster

data for the period 2003-2013 were selected. Using the 2144 NDHS cluster points in the identification and grouping of the underlying domains of under-five mortality in this study was of paramount importance. I considered the 36 state-level geographical units to be extremely large for portraying health variation in an extremely diverse and populated country like Nigeria. State boundaries contain heterogeneous geographical areas and as such tend to miss within-state and Local Government Area (LGA) variations that make it impossible for at-risk populations to be effectively identified and targeted. The 774 LGAs units were also not used because the NDHS data are not collected for every LGA. They are not designed to be representative at the LGA level, and as a result, the LGA indicator is not geographically referenced

The selected variables were then entered into an Exploratory Factor Analysis (EFA) model and were used to identify the underlying structure and commonalities between the selected factors. The five components that represented the structure of the variation in the data were: (1) female disempowerment, (2) lack of maternal care, (3) domestic violence, (4) vaccination rate, (5) neighbourhood socioeconomic disadvantage. These factors were then utilised as explanatory variables in a global linear regression model in order to examine their predictive power on the under-five mortality outcome. The identification of these five underlying domains provided a general overview of the leading thematic risk areas that shaped the variation in under-five mortality in Nigeria in the decade of study. Although the five risk domains suggest some important areas of priority for advancing SDG efforts in reducing under-five mortality as a whole, it was acknowledged that not all women and children and all places will be exposed in the same way to the identified health-risk domains. It is a widely accepted geographical fact that globally, inequalities in health exist between and within countries. Addressing within-country health inequalities is a central aim of this thesis. The social determinants of health model which is used as the major theoretical framework for this thesis suggests that social and political mechanisms produce differential social positions in society. This differential social stratification in turn determines differences in exposure and vulnerability to health-risk factors (Solar *et al.*, 2010). Based on this premise, Chapter 5 employed the One-Way ANOVA to examine the magnitude of differences in population vulnerability to under-five mortality. Health differences were examined with respect to six key geographical and socioeconomic indicators in Nigeria: North-South political zones, Settlement size – urban or rural, geopolitical zones, wealth levels, ethnic and religious identities

Given the limitations in global statistical models to predict spatially varying relationships between under-five mortality for each geographical unit included in the study, spatial

statistical models such as the Geographically Weighted Regression Models (GWR) (Brunsdon *et al.*, 1998, Fotheringham *et al.*, 2003) were used in Chapter 5, section 3.3.2 to predict under-five mortality for each cluster point. The Getis-Ord-Gi* statistics (Gi*) (Getis *et al.*, 2010) was utilised to identify the spatial clustering or hot spots of under-five mortality across areas in Nigeria. The GWR and Gi* statistics together, offered the added advantages of expressing the spatially varying relationships between under-five mortality and the explanatory factors relative to the local context of NDHS cluster points. These spatial methods enabled the visualisation of the changing exposure levels between risk regions. Further statistical analyses such as the Analysis of variance (One-Way ANOVA) and cross tabulation techniques were utilised to examine the significant geographical and social variations in under-five mortality hot spots.

Research evidence suggests that there is no reason to suppose that the national-level determinants of health will be the same as the local-level factor (Johnston *et al.*, 2019, Jones *et al.*, 2015, Popay *et al.*, 1998). Chapter 6 therefore, incorporated a more in-depth quantitative analysis within a predominantly ‘cold spot’ region of southern Nigeria. The aim of this analytical step was to demonstrate the utility of greater depths of analyses in investigating spatial heterogeneities in the social determinants of health in culturally diverse settings like Nigeria. The cold spot regions were previously identified from the hot spot mapping with Gi* statistics in chapter 5 and the case study areas were selected for funding, access and time limitations discussed in Chapter 3, section 3.4.1. The backward log-likelihood elimination strategy of the logistic regression model was used to automatically group variables with the strongest Spearman’s correlation with under-five mortality into four main domains, which indicated: (1) perception and health behaviour, (2) social capital resources that individual women draw upon, (3) participants’ perception of neighbourhood context (4) Sanitation and child clustering. The pattern of health inequalities in the case study areas was measured using the value of the odds ratio (OR).

The second part of the research process was therefore, qualitatively driven to explore the lay knowledge of mothers about causes of child health-risk. The aim was to gain further insights through lay perspectives into the multiple ways in which the social determinants of health previously identified in the quantitative models are co-constituted in shaping inequalities in under-five mortality. The secondary and primary survey datasets utilised in this thesis represent the preconceived ideas of health-risk that research elites like myself and survey agencies prioritise according to their agenda. The choice of indicators included in these surveys is shaped under different canopies of power relations. This research recognises that lay perspectives to health-risk is important for enhancing research

understanding about explanations for illness (Brown, 1992, Popay *et al.*, 1996). This research stands aside from the traditional top-down models through integrating the strengths of both methods to understand local knowledge and the lived realities of health. Understanding the local processes and the context in which health inequalities in under-five mortality are produced requires research recognition of individual human agency, especially the agency of women, in shaping the social determinants of children's health. Incorporating the lay perspective of mothers in the research project is important for highlighting the long neglected notion of female agency, especially amongst women in developing countries who are often characterised as 'vulnerable'. This study contributes to this research necessity by giving the research participants the opportunity and a voice to identify and articulate what they perceive to be the causes of child health-risks in their personal, household and neighbourhood contexts. Chapter 7 utilised semi-structured qualitative interviewing to explore questions around mothers' perceptions and understandings of child-health risk and Chapter 8 moved beyond risk-narratives to examine the individual and collective responses of mothers to perceived health-risk conditions. The analytical procedure ended by highlighting women's agency in risk response. I examined the range of coping mechanisms deployed by mothers either during a child's illness or in order to avoid illness altogether. Employing mixed-methods in such a complementary manner allowed me to investigate a wide range of questions, which provided further insights into the determinants as well as processes creating wide health disparities between groups within the Nigerian context. The findings to these investigations are summarised in the next section below.

9.1.2 Summary of research findings

The key findings that emerged from investigating the research questions are presented below.

1. What are the social determinants of under-five mortality in Nigeria?

The findings in Chapter 4 demonstrated the multidimensional and interrelated nature of the national-level determinants of under-five mortality. A 38-item-five-factor EFA model was identified. Listed in the order of magnitude of the percentage of variance explained, these include: female disempowerment (47%), the lack of access to maternal care (16%), domestic violence (6%), vaccination rate (4%) and neighbourhood socioeconomic characteristics (3%). The result of the global regression model indicated that these underlying structures accounted for 45% of the variation in under-five mortality in 2003-2015. All five indicators had independent influences on under-five mortality. These factors reflect

three critical themes associated with health disparities globally: structures of discrimination and female subordination; access to maternal and child health services; and neighbourhood socioeconomic disadvantage. These are discussed briefly later.

The results of the logistic regression models that were applied to the case study data show that the leading determinants of under-five mortality at the neighbourhood level were attributable to perceptions of neighbourhood factors, household resources, and health behaviours. The main risk factors highlighted include: access to improved water sources, the provision of neighbourhood sanitation, electricity, and infrastructure; preventive health behaviour; and self-reported socioeconomic status of households and communities in which mothers live.

2. How do the patterns of variation in under-five mortality relate to indicators of social and geographical attributes of population groups?

The findings in chapters 5 and 6 indicated that under-five mortality rates and associated risk factors shaping them were not experienced in the same way in all regions and by everyone. Marked health divides were observed along key geopolitical and socioeconomic lines. In terms of geographical variation at the national-level, the findings suggested a marked north-south divide in under-five mortality with northern clusters recording predominantly higher concentrations of under-five mortality hot spots compared with their southern counterparts which tended to have lower than national rates (14.5%) of under-five mortality. The North West region has the worst under-five mortality rate with up to 21 deaths per 100 live births. The South West had the best health with 9 deaths per 100 live births observed. However, the ‘apparently lower’ under-five mortality rate of 9 deaths per 100 live births observed in the best performing western region of Nigeria remains higher than the regional average of under-five mortality in Sub-Saharan Africa which stands at 7 deaths per 100 live births. In all geographical regions, rural areas demonstrated higher risks than urban areas. Taking Nigeria as a whole, a health gap of up to 6% is observed between the north and the south and a 3% gap exists between rural and urban areas.

In terms of health inequalities due to variations in the socioeconomic characteristics of population groups, the results revealed that the differences in wealth account for the widest gap in under-five mortality in Nigeria. The North West, which is a hot spot of poverty, had the worst health compared with the South West, which demonstrated a statistically significant clustering of higher wealth levels, and which had the best under-five health. A 10% gap was observed between the poorest and wealthiest clusters. The gaps in under-five

mortality due to ethnic and religious differences were 6% and 10% respectively. When compared with other ethnic groups nationally, the Hausa-Fulani ethnic group had the worst under-five mortality outcome (22%) compared with predominantly Yoruba ethnic clusters that tend to have better health (9%). The Igbo (13%) and ethnic minorities (15%) groups exhibited near national average patterns of 14.5%.

The GWR results indicated that spatially varying relationships exist, not just in the distribution of under-five mortality but also in the nature of associations between explanatory variables. The GWR model was better fitted in the northern regions of Nigeria compared with the Southern area. The results suggested that further questions could be asked to investigate spatial heterogeneities in the determinants of under-five mortality at a finer geographical scale in order to unpack other risk factors of under-five mortality that could not be captured in the national-level analysis. This was particularly important because of the micro-level geographical and socioeconomic diversity of many areas in Nigeria.

A more in-depth analysis of neighbourhood level variations in under-five mortality revealed that the determinants of health inequalities at the neighbourhood level highlight inherent inequalities in infrastructural resource provision, perceptions of household and neighbourhood context, health behaviour, and access to social capital resources. For example, people who lack of access to safe drinking water and improved sanitation had elevated risks of under-five deaths compared with those with better provisions. Those who perceive their households and neighbourhoods as poorer than their neighbours' recorded more under-five mortality than those who perceived themselves as better off.

Some unexpected results were also found. For example, the finding revealed elevated under-five mortality risks for children born to women who more participating in community groups such as women's savings unions and who had more reliance on insecticidal treated bed nets as the main preventive strategy for malaria prevention. It was not entirely clear, from the quantitative analyses in chapter 6 why these patterns occurred. Further descriptive statistics suggested a socioeconomic gradient in the membership of community organisations but questions remained about the specific pathways through which differential access to community resources mediated unequal child health experiences. The third and fourth research questions shed more light on the social production of inequalities.

Although the above findings revealed on the range of health determinants and the factors related to differential experiences in under-five mortality, examining the domains of health

risks in such as additive manner has limitations. Adopting an integrated research paradigm as a way of evaluating health inequalities helps me to recognise the limitations of considering health variation using multiple sets of categories for making visible the processes through which broader geographical and social structures combine to create inequalities. Kelly (2009), while acknowledging the utility of quantitative categorisation in health research, noted that the types of categorisations and the homogenisation of health-risk factors in the quantitative phase of this thesis might obfuscate the processes underlying individual differences. McCall (2008:1773) describes fixing quantitative categories in this way as nothing but “*simplifying social fictions*”. I then incorporated qualitative methods in a complementary way in order to maximise the strengths of both research paradigms for addressing the research questions ‘*in answering that one or other leaves in suspension*’ (Popay *et al.*, 1996:759). The results of the qualitative analysis are presented next.

3. How do mothers perceive and understand under-five health-risks?

Chapter 7 drew attention to a wide range of child health issues that have resulted in the burden of ill health and high under-five mortality rates of 12 deaths per 100 live births in the case study areas. The evidence from the interview data showed that a majority of the interviewed participants highlighted a more nuanced relationship between child health problems. The chapter has highlighted mothers’ concern about poor environmental health-risks, particularly the lack of access to improved water sources and sanitation, which continue underlie the high prevalence of infectious diseases, sicknesses and death.

The findings show that the perceptions of these health-risk factors were mainly formed from previous health experiences of illness and/or from health services encounters. The range of health-risk factors emphasised by the interviewed women broadly reflected the physical infrastructural deficiencies, poor sanitation, and poor quality and unaffordable health services. The lack of access to safe drinking water for children and the poor geographical access to good quality child health services were framed more as a rural problem compared with noise pollution and poor waste management that reflected urban patterns. Infrastructural deficiencies especially in urban poor areas were perceived as the underlying causes of many infectious diseases which the children under-the age of five years were particularly susceptible to. Childhood diseases like malaria, diarrhoea and measles emerged as the most frequently occurring infectious diseases and many mothers perceived these as the direct consequences of the failed and inadequate infrastructural system to sustain a healthy environment. Many mothers recognised that vast majority of these

infectious diseases could be prevented through increased investments in public health infrastructure and child health education.

Mothers' articulations of health-risk narratives revealed the ways in which geographical and socioeconomic privileges and under privilege influence the exposure to health-risks and their potential damaging health effects. Whilst children born to mothers in more well-off neighbourhoods demonstrated less exposure to health vulnerabilities and more capabilities to either avoid or cope with existing ones, those born to poorer mothers appeared to be more burdened with basic health needs such as: access to safe water, improved sanitation, and access to health services. A recurrent theme in Chapter 7 and the rest of the thesis has been how the poor and subordinated who have less choices to make informed decisions about maternal and child health are more likely to be impacted by disease and ill health. Ill health in turn compounds poverty and marginalisation in a vicious cycle (Binns *et al.*, 2012, Brinda *et al.*, 2015). This study therefore confirms that the socioeconomic privilege of parents may protect children from the fatal risk from infectious diseases and the children born to the under privilege may be more vulnerable to morbidity which could sometimes lead to fatal consequences.

Using these findings to build on existing debates such as those of Hardoy *et al.* (1992), the thesis has argued that the presence of risk factors alone do not necessarily lead to debilitating health consequences equally for all people who are exposed. The vulnerability of individuals, whether adults or children under the age of five years, households, and communities to health-risk is influenced by the capability for making alternative choices to mitigate or eliminate the sources of health-risks. Whether or not a given health risk factor adversely impacts a child's health or leads to fatal end may depend on the range of capabilities available to mothers to respond appropriately to the said health-risk. In addition, this thesis has demonstrated that the capability to respond health-risks can be mediated by structural determinants, notably the economic, social, or cultural capital to make alternative choices and informed decisions.

4. How do mothers respond to under-five health-risk?

Responses to health-risk were found to be closely associated with preconceived notions and experiences of health-risk factors; the perception of the scale and severity of the consequences of exposure to health-risk conditions; and the agency for which risk-responsibility is attributed and the feeling of power or the lack of it, to modify health-risk conditions. The empirical evidence suggested that people who felt powerless about their

own ability to mitigate health-risk conditions are less likely to assume what Eden (1993) describes as a sense of self-efficacy for actionable risk responsibility and risk obligation. Overall, mothers felt more capable towards mitigating minor risks occurring within the vicinities of residential dwellings, tended to assume responsibility for the general sanitation, hygiene, and improving the safety of drinking water within the household. There was a general feeling of lack of control and responsibility for health-risks occurring in the wider society and general neighbourhood spaces. These were perceived as the failure of government and institutional agencies to effectively mobilise collective resources for a healthier environments and affordable health services.

Although mothers recognised the importance of health services intervention in responding to common infectious diseases, the inadequacies in health service provision dominated mothers' discourses of health services as institutional forms of responses. The poor attitudes on the part of health professionals towards patients and the burden of out-of-pocket payments for health services were perceived as major barriers for timely health care seeking for both preventive and curative health care services for infectious diseases, especially for poorer women.

There were also indications of supra-natural responses to health-risk. Many mothers reported supra-natural responses to health-risk. There were indications of dependence on God for the safety and survival of the children, especially during ill-health, as an additional measure to medical responses. For example, many mothers reported combining supra-natural responses such as undergoing prayers for a sick child at the last resort, especially where available medical options fail.

Nevertheless, community members and mothers demonstrated a high sense of collective efficacy in mitigating environmental risk conditions occurring in common neighbourhood spaces and in responding to the burden of out-of-pocket payments for serious health conditions for poorer members of society. Poorer mothers reported joining savings groups as a way of coping with health care cost. Many mothers talked about the crucial roles of religious, cultural and savings organisations in responding to health care poverty of their members and offering spaces for childcare knowledge sharing and mass immunisation of children. Whilst the benefits of such collective efficacy are evident at the individual level, it could be argued that individual and collective social capital may not be enough to mitigate against negative health consequences and inequalities produced by the persistence of structural risk factors that are attributable to structures of power, which determine the way resources are distributed in society.

Through these findings, I argued that under-five mortality risk factors are multiple and interrelated and that reduction efforts in this SDG era most move beyond biomedical strategies, which tended to emphasise vaccinations and insecticidal treated nets to also prioritise the social contexts of women's lives.

9.2 Strengths and Limitations

There are a number of strengths and limitations to the research, which need to be outlined in order to place the research findings and the extent of their generalisability in proper contexts. These are outlined below.

9.2.1 Limitations

Given the way that this research has evolved (see section 3.1), I will like to start by acknowledging the difficulty of implementing a mix-methods research. It was difficult to determine the level of emphasis that each of the methodological paradigms deserved. This was more writing up the methodology chapter, especially one with a multilevel analytical focus. It was challenging to determine the level of technical detail required for documenting the quantitative procedures undertaken whilst being deeply reflexive on the ethical challenges and details of qualitative research. I tried to overcome this by focusing on the rationale for integrating methods, documenting the relevant information on the range of datasets and methods utilised, according to the sequence in which the research was conducted. I have also pointed the reader to external resources where appropriate.

The specific limitations to this study that need to be considered in interpreting the transferability and generalizability of the research findings are outlined below.

Secondary data limitations

The first set of limitations relate to the weaknesses of the NDHS survey data which is the main source of the secondary data used for this study. The NDHS is based on self-reported information from women of reproductive age and is subject to reporter bias. Observations could be affected from reporting bias. The potential bias in the data was mitigated to some extent by pooling survey datasets conducted over time together. This research is less interested in less interested in absolutes than relative levels of health inequalities: questions remain about whether self-reporting 'bias' changes over time and/or geographical/ethnic groups (both of which are possible). Previous studies have shown that self-reporting causes of illness can be reliable. For example, Euteneuer (2014) suggested that self-reported

socioeconomic position predicted self-rated health over and above traditional objective measures of socioeconomic position such as educational credentials. Secondly, the actual locations of the NDHS clusters points that are the only geographically referenced information in the data that can be used for spatial modelling are distorted for 2 km in urban areas and up to 5km in rural locations. This is why this study could not use the Local Government Area (LGA) boundaries in order to avoid misclassifying individuals into inappropriate administrative boundaries. In addition, NDHS cluster points are not maintained across surveys. Cluster points are independent to each survey thus limiting the utility of the data for trend analysis of health inequalities between survey years. However, by pooling the data together, the study was able to partially address these limitations to provide a decadal overview of the determinants of health and inequalities in the MDG era. A third data limitation relates to the coarseness of the distribution of the NDHS cluster points. An average of 900 clusters is surveyed in each survey year that comes to about 1 cluster point per LGA in Nigeria. Most LGAs in Nigeria are very diverse. For example, the Owan East LGA where I conducted my fieldwork has over 60 communities and over 10 ethnic groups. This LGA has only one NDHS cluster point for survey year 2008 and none for the other survey years considered in the study. Some LGAs are not captured at all. Considering the geographical and sociocultural diversity of the Nigerian population, a single cluster point may be insufficient to accurately portray the health pattern of such areas. The NDHS cluster point will definitely benefit from increasing the geographical representativeness and the utility of the cluster points for spatial analysis.

Identifying and measuring health determinants

Although this study has utilised statistical methods that allow inherent relationships in the survey datasets to be identified, on reflection it could have been more informative to construct risk indicators to reflect those at the crossings of the multiple axes of inequalities. The studies of (Bauer *et al.*, 2019) and (Schein *et al.*, 2019) contain guidelines on how this can be achieved. However, the quantitative methods utilised here revealed some underlying social structures of inequalities that can be addressed going forward with the SDGs. Such patterns would have been difficult to identify if I had examined the separate factors using univariate methods.

Scale issues

This study acknowledges that in relation to the patterns of health revealed at the national level, although informative for designing national policy avenues in tackling under-five

mortality in Nigeria, a wider transferability and generalisability of the results may be limited. This study acknowledges that the geographical frames used in modelling both the secondary and primary quantitative datasets determined the health patterns that have been identified in this study. This limits the extent of transferability and generalisations that can be made from the results across the whole country, especially in diverse settings in Nigeria. For detailed discussions of scale limitations in geographical research are available elsewhere (Johnston *et al.*, 2019, Jones *et al.*, 2015, McCarty *et al.*, 1956, Openshaw, 1981). For example, Johnston *et al.* (2019:34), advised the need for quantitative human geographers to apply caution in making sweeping generalisations with the results from quantitative data analyses when they state; *'human geography is the result of processes and decision-making procedures operating at different scales. The inferences derived from studies at a particular scale should not be expected to apply to problems whose data are expressed at other scales. Every change in scale will bring about the statement of a new problem'*.

Comparative Analysis

One of the main limitations of this research is the absence of a comparative case study. Considering other case study areas with different combinations of demographic and sociocultural characteristics (particularly in a hot spot mortality region in the North, East or West) would have been helpful for extending the understanding the localised determinants of under-five mortality in Nigeria. It was not feasible to add a comparative study to this research given the limited time-frame for this PhD in addition to funding limitations. Notwithstanding, this study has used rich multi-level datasets collected through rigorous processes, to make important contributions to the social determinants of health research.

One-Off/opportunistic interviewing limitations

A second set of limitations relate to the challenges presented by the qualitative data collection approaches in this study. The semi-structured interviewing was conducted in a one-off encounter with mothers. If I had the opportunity to immerse myself, being an outsider, into these case study communities, I believe I could have earned more trust on the part of research participants for more open conversations. These trust issues might have prevented mothers from engaging with me more openly about potential gender power relations, personal, household and material circumstances amongst other factors. that might be exacerbating child health-risks. Mothers tended to talk about general environmental health risk issues, disease burdens and health services access barriers. Discourses of personal and material conditions were mostly framed using impersonal and a

passive voice. Thus, we cannot conclude from the qualitative analysis in this study that mothers are less concerned about personal household and material factors that may have health damaging consequences to vulnerable populations such as children under the age of 5 years. Secondly, being embedded in the local women's groups would have given me a richer understanding of how different women groups more specifically mobilise their collective resources to for health and wellbeing and the power struggles they engage in.

Notwithstanding these limitations and despite its exploratory nature, this study has employed reflexive and multidisciplinary approaches to offer some insights into the patterns of under-five mortality and to highlight some of the underlying socioeconomic processes exacerbating health inequalities between different geographical areas and population groups.

9.2.2 Strengths

One of the main strengths of this study is that it has examined the social determinants of health, in addition to examining the processes shaping inequalities of under-five mortality, across different geographical scales in Nigeria. This has not previously been done in researching under-five mortality within the Nigerian context. Previous studies have tended to focus on multi-level analysis of quantitative data, which emphasize separate compositional and contextual factors, to examine inequalities in under-five mortality (Adedini *et al.*, 2015c, Adekanmbi *et al.*, 2015, Babalola, 2014). I have argued in line with the commission for the social determinant of health framework that the scale of observation influences the nature of health-risk factors that can be identified whilst also acknowledging that factors across multiple levels combine uniquely to define individual health experiences. The findings show that inequalities in under-five mortality exist across different scales in Nigeria, at the national-level down to individual lived experiences. The observed health disparities in under-five mortality are not just artefacts of the methods or scales used. Through examining one decade of national level from the past, 2003 -2015 and more recent data collected through fieldwork in 2017, the study has shown that inequalities existed in the recent '*past and we can also see it in the present – and if nothing changes, we will continue to see it in the future*'. We can see it at a country level and in every local neighbourhood (Dorling, 2016: xii).

Secondly, by employing mixed-methods in a complementary manner, this study also demonstrates the ability of health geography research to hold methodological approaches in dialogic tension with one another (Mason, 2006, Morgan, 2007). By incorporating the lenses of intersectionality to examine the lay perspectives of mothers, the findings provided

deeper contextual information, which enriched research understanding of the multiple ways in which under-five mortality health-risks are intersected and situated.

Overall, this thesis makes a strong empirical and methodological contribution to a new form of research in health inequalities that goes beyond traditional approaches employing single methods to synthesise the best attributes of quantitative and qualitative approaches that develops understanding at scale but also critically evaluates the differential impact of health inequalities on individuals based upon the ability of those individuals to articulate their own lived experiences and personal life trajectories.

9.3 Research contribution

This research has made important contributions both methodologically and theoretically to existing debates on health geography knowledge and policy.

9.3.1 Methodological contribution

To date, geographical research employing multidisciplinary approaches to the study of under-five mortality in particular and the social determinants of health in general remain limited. This study is the first within the Nigerian context to take the spatial analysis of under-five mortality down to very high spatial and social resolution, from the national level to individual interviews.

Methodologically, this thesis builds on the identified weaknesses inherent in the NDHS data for interrogating small area heterogeneities in the social determinants of health. Previous bodies public health research, especially in Nigeria, typically employ multilevel models to evaluate the separate effects of contextual and compositional factors on health in a single modelling procedure (Adedini *et al.*, 2015c, Adekanmbi *et al.*, 2015, Babalola, 2014, Bhandari *et al.*, 2017, de-Graft Aikins, 2006, Jones *et al.*, 2015, Meijer *et al.*, 2011). Whilst such studies play important roles in identifying the social determinants of health at population levels, they offer limited explanations on why and how health determinants might be creating the observed patterns. My approach signifies a sharp point of departure from many typical health inequalities research methods, which tend to adopt either quantitative or qualitative methods in examining individual components and social factors. For example, the works of Adedini *et al.* (2015a) and (Antai, 2011b) are typical examples of public health approaches to the study of under-five mortality in Nigeria. In these types' of studies, the dialectical relationships between local context and health are less emphasised and women remain largely invisible. This study not only presents evidence on the social determinants of

under-five mortality across multiple geographical scales, it also highlights the underlying social processes that are shaping the unequal distribution of under-five deaths amongst the most vulnerable people and places in Nigeria. It strongly draws out the neglected notion of women's agency in developing countries often depicted as victims of disease and poor health in academic research and popular media. This study has shown that despite the structures of power that might be subordinating, disempowering, and marginalising vulnerable women in society, women are active agents with capabilities for influencing the health-risk conditions in the neighbourhoods they live in. In addition, this study has also demonstrated that these structural factors in turn, determine the ability to choose informed responses to health-risks in a vicious cycle.

9.3.2 Theoretical contribution

This study contributes significantly to existing knowledge on place vulnerability and health inequalities. The central argument in this study was that in health geography research spatial perspectives on under-five mortality have offered very limited explanations on the processes creating group inequalities because they fail to address the relationship between place, agency and structure. Popay *et al.* (1998) have long observed that lay knowledge, in the form of lay narratives, form important contributions to unpacking the hidden processes in the production of inequalities. The findings in this research have clearly demonstrated that moving beyond the biomedical 'risk factor' research tradition to incorporate contextualised accounts of mothers' experiences can open up research conversations on how social structures at multiple level impact health (Atkinson, 2013, Labonté *et al.*, 2005, Williams *et al.*, 1994). By integrating quantitative and lay narratives in a complementary way, this research has shed light on the nature and causes of childhood infectious diseases. Furthermore, these lay narratives have broadened the understanding of how and why mothers respond both individually and collectively. Through a robust empirical evidence base obtained from a critical research process, this thesis has argued that lay narrative of mothers provided an important but neglected perspective on how spatial and social vulnerabilities intersect in shaping under-five mortality between and within population groups and shape individual experiences. Understanding how multiple determinants of health combine simultaneously to create inequalities is important for providing context-specific evidence to inform policy action on reducing health inequalities, not just in Nigeria but globally.

9.3.2 Policy contribution

There is agreement that development programmes need to be context-specific (Power, 2004) and for the scale of intervention to match the scale of investigation. This research has demonstrated the importance of investigating the determinants of health at multiple scales, from national and sub-national levels down to smaller geographies and individual levels. This research has demonstrated the need to move away from the popular one-size-fits-all single disease programmatic approach to health development for a push towards more improved contextual knowledge of the complex intersections of the health determinants that produce inequalities in multicultural settings in developing countries. Global health has overwhelmingly focused on vertical (single) disease programmes mainly in response to infectious disease risks such as malaria (Brooks *et al.*, 2019). Brooks and Herrick argued that huge inequalities have remained despite the health achievements of single disease-oriented programmes such as the distribution of Insecticidal Treated Nets (ITNs) in many malaria endemic regions which, in no doubt, has achieved substantial improvements in morbidity and mortality rates have been recorded globally (Deaton, 2014). Global health interventions have not sufficiently addressed the structures of discrimination against women. Existing policies have failed to respond to the underlying causes producing the social spiral of health inequalities relative to social context (Brooks *et al.*, 2019, Farmer *et al.*, 2004).

The ability for researchers to provide evidence base that can inform targeted policies require the collection of relevant context-specific information that allows social processes to be collected. For example, the NDHS does not collect information on social capital that can allow the access of mothers to social capital resources. In a second example, questions on the utilisation of bed nets only assess ownership and frequency of usage. Given the low utilisation rates among mothers who own bed nets, this study has demonstrated the need to without include further questions that assess alternative mosquito control measures and factors that influence utilisation.

This research has also demonstrated the need for more data disaggregation for small areas in Nigeria. NDHS and census data will significantly benefit from providing better disaggregated and geographically referenced datasets that are relevant for spatial research purposes. At the moment, the data appears to be designed for traditional public health research purposes with little emphasis on explaining spatially varying relationships. The NDHS needs to provide geographically referenced data that are designed to be representative at the small areas level while also maintaining confidentiality of the interviewed participants. Spatial data needs to be consistent across surveys, to more

specifically monitor social and spatial trends in under-five mortality and other health indicators over time.

The findings also suggest that the SDG-informed intervention programmes in Nigeria could benefit more by focusing attention on eliminating the wider environmental risk factors through investment in public health infrastructure. The few developing countries like Rwanda that achieved the MGD₄ of cutting under-five mortality by a third in 2015 employed multisector and multiscale strategic plan which integrated short term impact initiative into longer term investments. These involved the elimination of out-of-pocket payments for childcare services; initiating universal health insurance schemes; improving access to reproductive rights and sex education; training and supporting community health workers; in addition to addressing gender inequalities through female education and economic empowerment (Amoroso *et al.*, 2018). Nigeria has a lot to learn from countries like Rwanda. The findings in this research suggest that addressing the power structures that subordinate and disadvantage marginalised groups and adopting a multidimensional perspective to rethinking health development is a good place to start. Addressing the practices of discrimination, that manifest through unhealthy cultural and religious practices and health behaviours is important, but it is also vital to incorporate lay perspectives of mothers while working with existing female community networks in delivering health education and implementing child health care intervention programmes. It I argued that these actions could be highly beneficial for achieving SDG targets.

9.4 Future research direction

This research has highlighted the importance of integrating methods for understanding inequalities in under-five mortality health-risks and drawing out the agency of women in responding to these risk factors. There is an ongoing need to focus more on the processes shaping inequalities in diverse regions. My first suggestion for further research relates to the absence of a comparative case study in an under-five mortality hot spot region of Nigeria to complement this research. It would have been informative to carry out a comparative localised analysis of the social determinants of health and inequalities between a predominantly cold spot area and some hot spot communities especially in the northern areas. This could not be done due to funding limitations and other practical considerations discussed in Chapter 3. In addition, more comparative analysis through mixed-methods are needed in order to unpack the localised determinants of under-five mortality and the local processes creating unequal health experiences in other regions within Nigeria with different demographic, cultural and social contexts.

Women's access to social capital resources as a way of responding to health-risks, especially the burden of health care costs, emerged strongly in the research findings. It could be interesting to employ ethnographic and participatory research methodologies in order to shed more light on the internal power processes and struggles that might be shaping the way in which women appropriate their collective resources for health and wellbeing.

The findings relating to the psychosocial and other effects on health of night-time noise and air pollution from electric generators health is an emerging area in understanding sonic inequalities in health, which deserves further work. Whilst many studies have employed biomedical approaches to examine the magnitude of pollution from electric generators in Nigeria in the day time (Adeniran *et al.*, 2017, Akindele *et al.*, 2016, Ibadode *et al.*, 2018, Idiata *et al.*, 2016), studies employing mixed-methods and qualitative approaches to examine the health effects at night are currently lacking. It could be interesting to understand the power relations and processes shaping whether or not a household utilises electric generators throughout the night.

In reflection on the choice of research participants, it could be more informative for future research to employ multidisciplinary approaches to examine lay narratives of mothers who have lost children under the age of five years in recent times. Exploring the specific circumstances surrounding the deaths of under-five children could provide a richer understanding of the health-risk conditions than this research has been able to provide. Researching such sensitive topics requires ethical considerations for the specialist support that participants who might become distressed during interviews might require. This research project did not have access to specialist support for researching such sensitive topics, hence the decision to involve adult mothers of reproductive age (18-49) with children under the age of five years at the time of the interview.

Lastly, it is important to extend intersectionality discourses on the social determinants of health and inequalities to developing contexts. The use of intersectionality frameworks on the social determinants of health and health inequalities is currently a western dominated health research agenda. Its potential application to understanding how the multiple axes of: power and discrimination in wider society, privilege and under-privilege, social position, and historical trajectories all combine to simultaneously create health intergroup and intragroup inequalities in diverse regions such as Sub-Saharan Africa requires far greater attention.

9.5 Concluding comments

Through a detailed mixed-methods research, this thesis has demonstrated the potential of health geography perspectives to highlight the relationship between place, structure and agency in understanding the social determinants of under-five mortality at multiple scales in Nigeria. The results of the statistical analysis support the core argument of the conceptual framework of the social determinants of health in reinforcing the importance of scale in unpacking how health determinants may combine to shape health experiences. This research has also demonstrated the potential of lay perspectives to extend research understandings on the processes contributing to unequal health experiences between places and people. The results from the qualitative analysis of lay narratives of mothers highlighted some of the processes shaping unequal vulnerabilities to infectious diseases, and draws out very strongly, women's individual agency and collective efficacy in responding to child health-risks.

The data and methodological limitations to the research are recognised. The findings in this research may or may not apply to different contexts with different demographic characteristics. It is suggested that a further intersectionality informed research design is needed in order to: examine the localised determinants and processes shaping health inequalities in predominantly hot spots localities in different parts of Nigeria; and further understand the power dynamics shaping women's access to social capital resources for health in the neighbourhoods in which they live.

Despite these limitations, the findings unarguably demonstrated the need to do away with the one-size-fits-all approach to health research and policy practices. It calls for research sensitivity to the local processes shaping health inequalities, not just in Nigeria, but also in all other developing regions. It challenges the common practices of simplistic and uncontextualised accounts of health determinants, and the neglect of the notion of women's agency especially in developing countries, as active participants in modifying child health-risk conditions.

One of most valuable conclusions that can be drawn from this study is that under-five mortality health-risks and the capabilities of mothers to choose informed responses are deeply rooted in the structures of discrimination and power relations in the wider society and preconfigured by the distal pathogenic effects of inequalities (Brooks *et al.*, 2019, Herrick, 2017). This research has highlighted that addressing inequalities in health is a matter of global urgency in both developed and developing countries alike. Global health development efforts will benefit from employing holistic approaches that simultaneously

address the social and geographical vulnerabilities relative to the local context in which people live. This study has contributed to longstanding health geography research debates on '*dialectical relationships*' between health and place, such as those of Cummins *et al.* (2007) and Macintyre *et al.* (2002). It has highlighted the need for a global health development agenda to incorporate the transformative potential of integrated approaches and intersectionality frameworks to make visible the complex processes shaping health-risks relative to local context (Herrick, 2014:185). These insights are essential for charting new policy directions in global health at national, sub-national, and local levels. As emphasised by Kapilashrami *et al.* (2018:2591), it is only by mainstreaming the power analysis which integrated approaches entail for understanding where, why and how inequalities in health exist can we further the 'no longer leave anyone behind' SDG agenda.

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Appendices

Appendix 1: Outputs from the PhD

Ajebon M. O. (2018) Who has the final say? Women power and landscapes of under-five mortality in Nigeria. Royal Geographical Society with Institute of British Geographers (RGS-IBG) Conference 2018, 28th August - 31st August, 2018, Royal Geographical Society Building, University of Cardiff, United Kingdom. <http://conference.rgs.org/AC2018/277>.

Ajebon M. O. (2017) Health Risk and Resilience in Nigeria: A postcolonial Perspective. Royal Geographical Society with Institute of British Geographers (RGS-IBG) Conference 2017, 29th August - 1st September, 2017, Royal Geographical Society Building, Imperial College, South Kensington Campus, London, United Kingdom. <http://conference.rgs.org/AC2017/205>.

Ajebon M. O. (2017). Utilizing the concepts of risk and resilience in a non-western setting: experience from doing fieldwork in Nigeria. Institute of Hazard, Risk and Resilience Postgraduate Forum, Durham University, 25th October, 2017.

Ajebon M. O. (2017). Health risk and resilience in Nigeria: a postcolonial perspective. Institute of Hazard, Risk and Resilience Postgraduate Forum, Grey College, Durham University, 11th November, 2016.

Ajebon M. O. (2016) Strong in Broken Places? Geographical Analysis of Health Risk and Resilience in Nigeria Wolfson Research Institute of Health and Wellbeing Early Stage Research Conference 2016, 8th June, 2016, Durham University Queens Campus, Stockton-on-Tees, United Kingdom

Ajebon M. O. (2016) Health and Wealth of Areas: Understanding Spatial Variations of Under-Five Mortality in Nigeria Durham University Global Health Symposium 22nd March, 2016, Durham University, United Kingdom

Ajebon M. O. (2015). Strong in broken places, geospatial analysis of health risk and resilience in Nigeria. Institute of Hazard, Risk and Resilience Postgraduate Forum, Grey College, Durham University, 30th October, 2015.

Appendix 2: Main predictors of under-five mortality at the local level

Factors	Spearman's Correlation Coefficient ($P = 0.05$)	Ref Group	(β)	S.E. β	Wald	df	Sig. (P- value)	Odds Ratio - EXP β		
								lower	upper	
Baseline	0.000	Survived	-1.996	0.072	778.745	1	0.000	0.136		
Water Source	0.191	piped	0.714	0.088	65.906	3	0.000	2.042	1.719	2.426
borehole			0.302	0.320	0.890		0.346	1.352	0.723	2.530
well			1.242	0.322	14.903		0.000	3.462	1.843	6.505
Rivers/streams			1.771	0.343	26.608		0.000	5.875	2.998	11.513
Region	0.176	urban	1.066	0.145	53.836	1	0.000	2.904	2.185	3.862
Community social class - Theoretical	-0.140	High	-0.385	0.070	30.042	1	0.000	0.681	0.593	0.781
Rural			-1.075	0.191	31.728		0.000	0.341	0.235	0.496
Urban poor			-1.267	0.235	29.077		0.000	0.282	0.178	0.446
Urban middle			-0.898	0.201	19.974		0.000	0.407	0.275	0.604
Waste disposal - 2 groups	0.135	Organised	-0.365	0.440	0.688	1	0.407	0.694	0.293	1.644
Electricity/Power Source	0.124	public only	0.358	0.066	29.874	3	0.000	1.431	1.258	1.627
private generator only			0.451	0.205	4.845		0.028	1.569	1.051	2.345
private and public			0.256	0.215	1.420		0.233	1.292	0.848	1.968
None, use Gaslight, candles, other			1.242	0.199	28.800		0.000	3.462	2.342	5.116
Mosquito bed nets used for other purposes but always available for sleeping	-0.116	Yes	-0.686	0.281	5.948	1	0.015	0.504	0.290	0.874
Self-Assessed household socioeconomic Status	-0.114	Rich			23.655	2	0.000			
Poor			1.023	0.381	7.207		0.007	2.781	1.318	5.867
Middle			0.357	0.381	0.878		0.349	1.429	0.677	3.015
Self-Assessed community socioeconomic Status	-0.109	Rich			30.131	2	0.000			
Poor			0.575	0.227	6.407		0.011	1.778	1.139	2.775
Middle			-0.280	0.237	1.389		0.239	0.756	0.475	1.204

Appendix 4b: Main predictors of under-five mortality at the local level (Contd.)

Factors	Spearman's Correlation Coefficient (P = 0.05)	Ref Group	β	S.E. β	Wald	df	Sig. (P- value)	Odds Ratio - EXP β		
								lower	upper	
Priority for child's wellbeing	0.990	Health			19.097	3	0.000			
Employment			0.129	0.324	0.159	1	0.690	1.138	0.603	2.148
Food			0.416	0.178	5.462	1	0.019	1.515	1.069	2.147
Other (Safety, infrastructure, governance, social relatn)			0.802	0.189	17.921	1	0.000	2.229	1.538	3.231
Degree of participation in community organisation	0.172	Not Active	0.723	0.159	20.592	2	0.000	2.061	1.508	2.816
Fairly Active			0.701	0.371	3.564		0.059	2.016	0.974	4.174
Very Active			1.435	0.359	15.987		0.000	4.200	2.078	8.487
Length of residence in the local area	0.153	<=5 years	0.541	0.084	41.737	2	0.000	1.718	1.458	2.024
6 - 10 years			0.554	0.203	7.479		0.006	1.741	1.170	2.590
>10 years			1.084	0.169	41.344		0.000	2.956	2.124	4.113
Type of community organisation membership	0.100	None			26.494	4	0.000			
Religious			-0.127	0.223	0.323		0.570	0.881	0.569	1.363
Sociocultural			0.199	0.275	0.525		0.469	1.221	0.712	2.093
Professional			0.041	0.557	0.005		0.942	1.041	0.349	3.104
Cooperative/savings/other			1.114	0.250	19.900		0.000	3.046	1.867	4.969
Knowledge of people in the local area	0.100	None			17.619	2	0.000			
Few			0.595	0.608	0.956		0.328	1.812	0.550	5.968
Many			1.222	0.598	4.178		0.041	3.393	1.052	#####
Type of Toilet Facility	0.174	Flush	0.676	0.090	55.155	2	0.000	1.966	1.647	2.346
Pit/latrine			0.736	0.173	18.086		0.000	2.088	1.487	2.931
Bush, field, other, none			1.336	0.185	51.953		0.000	3.804	2.645	5.471

Appendix 4c: Main predictors of under-five mortality at the local level (Contd.)

Factors	Spearman's Correlation Coefficient (P = 0.05)	Ref Group	β	S.E. β	Wald	df	Sig. (P- value)	Odds Ratio - EXP β		
								lower	upper	
Household size	0.166	Less than 4	0.781	0.107	53.276	1	0.000	2.184	1.770	2.693
4-6 people			0.600	0.190	10.003		0.002	1.823	1.257	2.645
7 - 10 people			1.563	0.222	49.396		0.000	4.775	3.088	7.385
10 and Above			2.139	0.593	13.028		0.000	8.491	2.658	27.126
Respondent Highest Educational level	-0.133	Secondary & above	-0.704	0.120	34.680	2	0.000	0.494	0.391	0.625
No education			1.295	0.300	18.672		0.000	3.653	2.030	6.574
Primary			0.784	0.170	21.341		0.000	2.189	1.570	3.053
Cost of Rent	-0.120	Higher			13.825	2	0.001			
Lower			0.911	0.269	11.452		0.001	2.486	1.467	4.214
Middle			0.245	0.302	0.656		0.418	1.277	0.706	2.309
Child age in years	0.155	0 -1 year			28.289	4	0.000			
1-2 years			-0.070	0.237	0.086	1	0.769	0.933	0.586	1.484
2-3 years			0.341	0.235	2.112	1	0.146	1.406	0.888	2.227
3-4 years			0.738	0.234	9.988	1	0.002	2.093	1.324	3.308
4-5 years			0.861	0.216	15.853	1	0.000	2.366	1.549	3.616
Major occupation	-0.109	professional	-0.230	0.066	12.138	4	0.000	0.794	0.698	0.904
Farming			0.546	0.262	4.352		0.037	1.727	1.034	2.885
Trading/retail, other			-0.184	0.244	0.567		0.451	0.832	0.516	1.342
unskilled labour			-1.303	0.755	2.978		0.084	0.272	0.062	1.194
semi-skilled/skilled			-0.891	0.333	7.151		0.007	0.410	0.214	0.788
Child attends school	-0.107	yes	-0.743	0.165	20.377	1	0.000	0.475	0.344	0.657
Income (grouped into 3)	-0.106	Above 60,000	-0.533	0.124	15.708	2	0.000	0.587	0.451	0.764
Less than 18, 000			1.210	0.401	9.076		0.003	3.352	1.526	7.363
18,000 - 60,000			0.728	0.413	3.112		0.078	2.071	0.922	4.652

Appendix 3: Effect size

Population effect sizes (ES) and their values for small, medium and large effects

Test	ES index	Effect size		
		Small	Medium	Large
1. m_A vs. m_B for independent means	$d = \frac{m_A - m_B}{\sigma}$	.20	.50	.80
2. Significance of product-moment r	r	.10	.30	.50
3. r_A vs. r_B for independent r s	$q = z_A - z_B$ where $z = \text{Fisher's } z$	.10	.30	.50
4. $P = .5$ and the sign test	$g = P - .50$	.05	.15	.25
5. P_A vs. P_B for independent proportions	$h = \phi_A - \phi_B$ where $\phi = \text{arcsine transformation}$	.20	.50	.80
6. Chi-square for goodness of fit and contingency	$w = \sqrt{\frac{\sum_{i=1}^k (P_{1i} - P_{0i})^2}{P_{0i}}}$	.10	.30	.50
*7. One-way analysis of variance	$f = \frac{\sigma_m}{\sigma}$	* .10	*.25	* .40
8. Multiple and multiple partial correlation	$f^2 = \frac{R^2}{1 - R^2}$	.02	.15	.35

Source: (Clark *et al.*, 2013:157)

Appendix 4: Logistic regression analysis procedure

Traditionally questions regarding the prediction of dichotomous outcomes were addressed by ordinary least square (OLS) regression or discriminant function analysis. These techniques have subsequently been found to be inadequate for handling dichotomous outcomes which do not meet the strict statistical assumptions for example linearity, normality, equality of variance required for the OLS regression methods as employed in chapters 4 and 5 for handling continuous data (Hosmer Jr *et al.*, 2013, Osborne, 2014, Peng *et al.*, 2002).

Ideally, a geographically weighted logistic regression (GWLR) model would have been more appropriate for a geographical study of this nature but this could not be used in this study for two reasons. First, it was important to protect the confidentiality of women who took part in the questionnaire data so that they are not identified. To protect the confidentiality of respondents, the questionnaire data was completely anonymised. The specific locations of research participants and other personal identifiers were removed. Secondly, the case study neighbourhoods where primary data were collected were selected purposefully from urban and rural areas and across socioeconomic groups. As a result, the neighbourhoods are not geographically contiguous making them unsuitable for spatial modelling. This data limitation arising from confidentiality issues has made it impossible to apply the GWLR model to the questionnaire data. The results of the study should therefore be interpreted with the consciousness that they do not reflect spatially varying relationships which are likely to be present in the data. Hence, the criticisms around the inability of global regression models discussed earlier in chapter 5 are recognised.

Since the 1980s Logistic regression has become routinely available in statistical packages and used increasing for handling binary outcome measures in the social sciences (Peng *et al.*, 2002) but most of its principles are applicable to more than two outcome categories in multinomial logistic regression. Logistic regression is generally suited for testing hypotheses about relationships between a categorical outcome measure and one or more categorical or continuous explanatory variables. In this research, it is used to predict the probability of an under-five mortality event occurring or not occurring within the population examined. Logistic regression uses logarithmic transformation to express categorical outcomes in linear terms called the logit and thus overcomes the limitation of violating the linearity assumptions. More details on the principles behind logistic regression is available elsewhere (Field, 2009, Osborne, 2014, Peng *et al.*, 2002).

Model Development

Having selected 20 variables that are above the correlation cut-off point of 10%, the models are manually classified into four sub-domains. In order to develop a domain-specific model, all the variables in the domain are entered into the Logistic Regression model and a backward elimination method is used to select a parsimonious model for the domain of interest. A parsimonious model is the model accounting for the most variation with the fewest number of explanatory variables. A final parsimonious model is then developed using a backward elimination strategy from all statistically significant variable that were previously retained in the four health domains. The SPSS 22 backward log-likelihood elimination which is a data driven exploratory stepwise method, is used to select explanatory variables making important contributions to the model. This variable elimination strategy in a multiple logistic regression begins with an all-inclusive model with all explanatory variables of interest. Insignificant predictors are then removed one-at-a-time until only statistically significant independent variables with p-values <0.05 are retained in the final model. The academic critique of stepwise logistic regression methods is recognised (Menard, 2002, Osborne, 2014, Peng *et al.*, 2002). However, the method is considered appropriate in this study for exploratory purposes aimed at identifying subsets of variables which interact significantly together to predict the under-five mortality outcome because the analysis is aimed at exploring the data in order to identify the localised determinants of under-five mortality rather than testing existing theory regarding expected relationships. All variable which demonstrate significant relationships of ≥ 0.1 were explored to identify subdomains in the data. Theoretically, there are variables which are commonly classified in health domains different from the domains they have been grouped under in this study. For example, 'the source of drinking water' variable is commonly used as a sanitation indicator. However it also acceptable that the stepwise logistic regression method has classified it as a contextual characteristic. The type of water source that communities rely on are influenced by wider structural and infrastructural issues which may be beyond individuals. The capacity for alternative choice of water source by individual may also differ between urban and rural women and governments in Nigeria often prioritise urban water supply over rural needs perhaps because urban dwellers have a greater power or voice in influencing political actions.

The stepwise method is preferred since there are no established theories and knowledge about correlates of under-five mortality and the nature of interaction that might be expected within the unique sets of variables in the study sample. *'The criteria for stepwise inclusion or removal of variables for a model generally involve tests that are similar but less restrictive than the tests used in theory testing'* (Menard, 2002:43), for example, statistical significance of p-value based on 95% confidence interval.

Evaluation of the Logistic Regression Model

The output from SPSS 22 allows the three indicators of effectiveness of models fitted into the data used in this study to be examined. These evaluative guidelines are also recommended by scholars (Menard, 2002, Peng *et al.*, 2002);

(a) First, the overall adequacy of the model is examined, that is, how well the overall model works in predicting under-five mortality in the study population.

(b) Secondly, if the overall model predicts under-five mortality well, what is the confidence that there is a relationship between all the individual explanatory variables, taken together, and the under-five mortality in the model? The study also examines whether the identified relationships are significant and not merely by coincidence. The strength of the relationship and the power of each explanatory variable to predict under-five mortality outcome within the study population is also evaluated in order to establish which variables are weaker or stronger in predicting under-five mortality.

(c) Thirdly, the goodness-of-fit statistics are computed in order to establish whether the assumptions of the model are met.

Overall model evaluation

A logistic regression model provides a better fit for the data if it exhibits improvement to the intercept-only-model or the null model. A null model is a model that contains no predictors such that all observations would be predicted to belong to the largest outcome category. In this study, the largest outcome category is the child survival category ($N = 1634$). The smallest outcome category is the under-five mortality event group ($N = 222$). The null or intercept-only model predicts all children included in the study to have survived. This null model serves as a reference or baseline model for measuring the contribution of subsequent models with predictors or explanatory variables. The contribution of a logistic regression model is measured by considering three inferential statistical tests. These are the likelihood ratio test, score and Wald tests (Osborne, 2014, Peng *et al.*, 2002). It is expected that these three tests lead to similar inferences for the researcher's datasets. However, there are cases where these three tests may lead to different conclusions. For such datasets, researchers have been advised to prioritise the likelihood ratio and the score tests (Menard, 2002). The disadvantage with Wald statistic is that the estimated standard error for the regression coefficient (β) may be inflated if the value of ' β ' is large. This may lead to the

failure to reject false the null hypothesis. Logistic regression uses log-likelihood statistics to assess the fit of the model. The log-likelihood is based on summing up the values of the probabilities associated with the predicted and actual outcomes. However, unlike the R^2 in OLS regression which indicates the amount of variability explained by the model, the log-likelihood in logistic regression represents the level of correspondence between predicted and observed values of under-five mortality. This means that larger values of the log-likelihood statistics indicate poorly fitting models and suggest that there are more unexplained variation not captured in the model. It is worth pointing here out that quantitative models have many weaknesses (Popay *et al.*, 1998, Williams, 2003) due to the inability to capture the richness of variability in the human experience of health and that such model estimations and associated interpretations must indeed be taken as partial knowledge and must ideally be complemented with qualitative discourses.

Statistical test of individual predictors

The statistical significance of the regression coefficient of individual explanatory variable with under-five mortality is tested using the Wald chi-square statistics. The Wald statistics tells us whether the coefficients of individual explanatory variables represented by ' β ' are significantly different from zero. The interpretation is similar to the *t*-statistic in linear regression. It is used to examine whether a variable is a significant predictor of an outcome. However, the Wald statistics presented in this chapter should be interpreted cautiously because the tendency for the standard error to become inflated when the regression coefficients are large leading to the under-estimation of the Wald statistic (Menard, 1995). The inflation of the standard error increases the probability of rejecting predictors as being significant when in reality it is making a significant contribution to the model (the researcher is more likely to make a Type II error) (Field, 2009).

Goodness-of-fit statistics

The goodness-of-fit statistics is used to examine the fit of the logistic regression model against under-five mortality outcome, i.e. whether a child is born in the five years preceding 2017 died. One inferential test, the Hosmer-Lemeshow (H-L), and two descriptive statistics (Cox & Snell and Nagelkerke) are used for this assessment. The p-value for H-L inferential goodness-of-fit test which is a Pearson chi-square statistics can be used as effect size measure of the model. This must be insignificant (>0.5) to show that the null hypothesis is a good model fit to the data, thus, is tenable and the conditions were met for reporting the H-L test statistics. The Cox & Snell (Cox *et al.*, 1989) and Nagekerke (Nagelkerke, 1991) descriptive statistics are a variant of the R^2 in linear regression indicating model fit with

higher values indicating better model fit. However, they do not indicate the proportion of the variance explained in the under-five mortality outcome in the same manner that the linear regression R^2 explains. For this reason, the Cox & Snell and Nagelkerke indices are used as supplementary to other recommended evaluative tests such as the loglikelihood, score, Wald and the H-L tests.

There is a fourth evaluative indicator based on the classification table derived from the logistic regression model which documents the validity of the predicted probabilities (Peng *et al.*, 2002) which has not been considered for model evaluation in this study. It is recommended that the classification table is used as part of the model evaluation process if classification is a stated goal in the analysis objective (Hosmer *et al.*, 2000) otherwise it is best considered as a supplementary test for more rigorous evaluation statistics such as those already considered.

Interpretation of logistic regression results

Having chosen specific models based on the recommended guidelines for model evaluation, the relationships and contributions of explanatory variables to the under-five mortality outcome are then expressed based on the logistic regression coefficients represented with the symbol ' β ' which indicates the unit measure for the log odds. This measures the direction of association between explanatory variables and the independent variable. A positive β indicates an increase in under-five mortality as the log odds increases and a negative β shows that as the log odds reduces, under-five mortality decreases. The p -value that is less than 0.05 indicates that the explanatory variable is a significant predictor of under-five mortality in the model. More crucial to the interpretation of logistic regression is the value of the odds ratio (OR) expressed as $\text{Exp}(\beta)$, which is a relative measure of health inequality between sub-categories in explanatory variables. Odd ratios indicate the change in odds resulting from the unit change in the predictor. In examining the risk of under-five mortality occurring between a reference group and comparison group, an odds ratio value that equals 1 indicates that the odds of under-five mortality occurring are the same in both the reference group and comparison group. When this is the case, the p -value will be insignificant (>0.05) and the values of the confidence interval (CI) will include 1. If the value is greater than 1, then the comparison group have increased odds of experiencing under-five mortality compared with the reference category. Conversely, a value less than 1 indicates reduced odds of under-five mortality occurring in the comparison group compared with participants in the reference group. The farther the value of the odds ratio away from one, the wider the inequality and the stronger the association between the predictor variable and

under-five mortality. The lower and upper CI indicate that 95% of cases, the obtained coefficients in the model will fall between the lower and upper limits of the CI.

Appendix 5: Fieldwork questionnaire (author's work)

Fieldwork Questionnaire:

Sample of fieldwork questionnaire designed and administered by the author. It replicates many NDHS type questions but contains many indicators relevant to child health that are absent from the NDHS.

FIELDWORK QUESTIONNAIRE

TITLE: Understanding Child Health-Risks & Responses to Health-Risks

ABOUT THE RESPONDENT

State ----- Local Govt. Area (LGA) ----- Ward -----
 Community Name ----- Street Name -----
 ----- House No: ----- Survey Number ----- Date -----

Age of Child under 5 (in months) **Sex of Child**

<p>1. Ethnicity (Specify) ----- ----</p> <p>2. Sex/Gender of Respondent (a) Male [] 1 (b) Female [] 2</p> <p>3. Age of respondent (Years) (a) Less than 20 years [] 1 (b) 20 - 29 [] 2 (c) 30 - 39 [] 3 (d) 40 - 49 [] 4</p> <p>4. Highest Level of Education (a) No Education [] 0 (b) Primary [] 1 (c) Secondary [] 2 (d) Post-Secondary [] 3</p> <p>4a. If you are not educated, please give reasons you have no education ----- ----- -----</p> <p>5. Religion (a) Christianity [] 1 (b) Islam [] 2 (c) Traditional [] 3 (d) Others (specify) ----- [] 4</p> <p>6. Marital Status (a) Single/Never married [] 1 (b) Married [] 2 (c) Divorced/Separated [] 3</p>	<p>(d) Widowed [] 4</p> <p>7. Are you presently employed? (a) Yes [] 1 (B) No [] 2</p> <p>8. If employed, what is your major occupation? (a) Farming [] 1 (b) Trading/Retail [] 2 (c) Unskilled labour [] 3 (d) Managerial [] 4 (e) Skilled/Semi-Skilled [] 5 (f) Others (Specify) [] 6</p> <p>8a. If you are not employed, please give reasons for your unemployment ----- ----- -----</p> <p>9. Which of these vehicles do you own? (a) Car/Truck [] 0 (b) Motor Cycle [] 1 (c) Bicycle [] 2 (d) None [] 3</p> <p>10. Where do members of this community generally sell their produce? (a) Community market [] 1</p>
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Appendices

- (b) Markets in neighbouring areas []
- 2
- (c) Local stores and shops []
- 3
- (d) Cooperatives []
- 4
- (e) Self-Consumption only []
- 5
- (f) Others (Specify) []
- 6

11. What is the size of your household?

- (a) < 4 [] 1
- (b) 4-6 [] 2
- (c) 7-10 [] 3
- (d) >10 [] 4

12. Number of children less than five years in the household?

- (a) 1 - 2 [] 1
- (b) 3 - 4 [] 2
- (c) >5 [] 3

HOUSING

13. Do you rent or own your house?

- (a) Owner [] 1
- (b) Rented [] 2
- (c) Others (Specify)..... [] 3

14. Are you happy with your housing condition?

- (a) Yes [] 1
- (b) No [] 2
- (c) Don't Know [] 3

Please give, reasons for answer -----

15. Type of House

- (a) Individual House []
- 1
- (b) Flats/Apartments []
- 2
- (c) Room(s) in a compound House []
- 3
- (d) Others (Specify)..... []
- 4

16. What is the main construction material for the exterior walls of the house or building?

- (a) Concrete/brick/stone/Tiles []
- 1
- (b) Mud/Earth []
- 2
- (c) Wood []
- 3
- (d) Canes/sticks/straws []
- 4
- (e) No walls []
- 5
- (f) Others (Specify)..... []
- 6

17. What is the main material for most of the roof of the house or building?

- (a) Concrete/Cement/Tiles []
- 1
- (b) Metal (Zinc, Aluminium, etc.) []
- 2
- (c) Wood []
- 3
- (d) Straws/Thatch []
- 4
- (e) Others (Specify)..... []
- 5

18. What is the main material for most of the floor of the house or building?

- (a) Concrete/Cement/granite/Tiles []
- 1
- (b) Wood/Canes []
- 2
- (c) Earth/Mud/Sand []
- 3
- (d) Others (Specify)..... []
- 4

19. How many rooms do you have _____ and how many are used for sleeping only _____?

SANITATION

20. What type of toilet facility does this household for sleeping only?

- (a) None []
- 0
- (b) Flush []
- 1
- (c) Pit/Latrine []
- 2
- (d) Field/Bush []
- 3
- (e) Others (Specify)..... []
- 4

21. What is the main source of water supply for this household?

- (a) Piped water system []
- 1
- (b) Borehole []
- 2
- (c) Well []
- 3
- (d) Surface rivers/streams []
- 4
- (e) Others (Specify)..... []
- 5

22. How long does it take you to get to the source of water supply from your place of residence?

- (a) Within the house/compound []
- 1

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- (a) Less than 15 minutes [] 2
- (b) 15-30 minutes [] 3
- (c) 31-60 minutes [] 4
- (d) More 60 minutes [] 5

23. How does this household dispose most of its waste/garbage?

- (a) Public garbage service [] 1
- (b) Private garbage service [] 2
- (c) Throw in vacant plots [] 3
- (d) Throw in river/streams/drains [] 4
- (e) Burn/Bury [] 5
- (f) Others (Specify)..... [] 6

24. In the last five years, the environmental conditions of this community have:

- (a) Improved [] 1
- (b) Worsened [] 2
- (c) Remain the same [] 3

25. Overall, the current environmental condition of this community is:

- (a) Very poor [] 1
- (b) Poor [] 2
- (c) Average [] 3
- (d) Good [] 4
- (e) Very good [] 5

26. What type of lighting does this household mostly use?

- (a) Electricity (public source) [] 1
- (b) Electricity (private/generator) [] 2
- (c) Electricity (public and private) [] 3
- (d) Kerosene/gas/candles [] 4
- (e) Others (Specify)..... [] 5

HEALTH STATUS AND HEALTH FACILITY

27. How would you describe your health in general?

- (a) Very bad [] 1
- (b) Bad [] 2
- (c) Fair [] 3
- (d) Good [] 4
- (e) Very good [] 5

28. How would you describe your child's health in general?

- (a) Very bad [] 1
- (b) Bad [] 2
- (c) Fair [] 3
- (d) Good [] 4
- (e) Very good [] 5

29. Are there child health facilities in this community?

- (a) Yes [] 1
- (b) No [] 2
- (c) Don't Know [] 3

30. How long does it take you to get to the nearest health facility from your place residence?

- (a) Less than 15 minutes [] 1
- (b) 15-30 minutes [] 2
- (c) More 30 minutes [] 3

31. How would you describe the quality of the child health services in your area?

- (a) Very bad [] 1
- (b) Bad [] 2
- (c) Fair [] 3
- (d) Good [] 4
- (e) Very good [] 5

32. What is the main mode of transportation to the health Centre?

- (a) Walking [] 1
- (b) Cycling [] 2
- (c) Private motor cycle/cars [] 3
- (d) Public motor cycle/Cars/Buses [] 4
- (e) Others (Specify) [] 5

33. What health facility was your child delivered?

- (a) Govt. hospital/clinic/doctor [] 1
- (b) Private hospital/clinic/doctor [] 2
- (c) Traditional Birth Attendant [] 3
- (d) Home [] 4
- (e) Others (Specify)..... [] 5

33a. Please give reasons your choice of health facility: -----

<p>34. What is the most common disease or health problem affecting children under five years of age in this community?</p> <p>(a) Malaria [] 1</p> <p>(b) Diarrhoea [] 2</p> <p>(c) Pneumonia (chest infection common cold, cough, difficulty in breathing) [] 3</p> <p>(d) Measles [] 4</p> <p>(e) Under Nutrition [] 5</p> <p>(e) Others (Specify)..... [] 6</p>	<p>(b) No [] 2</p> <p>37a. Why/why not? ----- ----- -----</p> <p>38. If you have a mosquito bednet(s), how did you obtain your bednet(s)?</p> <p>(a) Govt. maternity Clinic/hospital [] 1</p> <p>(b) Free from an NGO [] 2</p> <p>(c) Purchased [] 3</p> <p>(d) From a friend/family member [] 4</p> <p>(e) Others (Specify)..... [] 5</p>
<p>34a. Why do you think this disease is the most common?</p> <p>----- ----- -----</p>	<p>39. Do all your children (under-5) sleep under mosquito bednet every night?</p> <p>(a) Yes [] 1</p> <p>(b) No [] 2</p>
<p>35. Has your child suffered from any of these diseases recently (e.g. in the last six months)?</p> <p>(a) Not at all [] 0</p> <p>(a) Malaria [] 1</p> <p>(b) Diarrhoea [] 2</p> <p>(c) Acute Respiratory Illness [] 3</p> <p>(d) Measles [] 4</p> <p>(e) Under Nutrition [] 5</p> <p>(e) Others (Specify)..... [] 6</p>	<p>38a. Why/why not? ----- ----- -----</p> <p>40. What occasion might you or might you not use the bednet? ----- ----- -----</p> <p>41. What else do you use your mosquito bednet(s) for? ----- ----- -----</p> <p>42. If you use the mosquito bednet for other purposes, is always available to sleep under every night?</p> <p>(a) Yes [] 1</p> <p>(b) No [] 2</p>
<p>36. What health facility do you mostly take your child to for treatment?</p> <p>(a) Govt hospital/clinic/doctor [] 1</p> <p>(b) Private hospital/clinic/doctor [] 2</p> <p>(c) Pharmacy [] 3</p> <p>(d) Shops/markets [] 4</p> <p>(e) Others (Specify)..... [] 5</p>	<p>43. Has your child received all immunization vaccines?</p> <p>(a) None [] 0</p> <p>(b) All [] 1</p> <p>(c) Some [] 2</p> <p>43a. Why/why not? ----- ----- -----</p>
<p>36a. Why do you prefer your choice of health facility for your child's treatment?</p> <p>----- ----- -----</p>	<p>44. Does your child benefit from free drugs, treatment, vaccines, mosquito bednet? If yes, from what organisation?</p> <p>(a) None [] 0</p> <p>(b) Government Organizations [] 1</p>
<p>37. Do you have a mosquito bednet in your household?</p> <p>(a) Yes [] 1</p>	

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- (c) NGOs [] 2
- (d) Politicians [] 3
- (e) Prosperous Citizens [] 4
- (f) Others (Specify)..... [] 5

EDUCATIONAL FACILITIES

45. Is there any school facility for children younger than five years old in your community?

- (a) Yes [] 1
- (b) No [] 2
- (c) Don't Know [] 3

46. Do your under-five children attend any school?

- (a) Yes [] 1
- (b) No [] 2
- (c) Don't Know [] 3

46a. Why/why not? -----

47. How would you describe the quality of the service in your child's school?

- (a) Very bad [] 1
- (b) Bad [] 2
- (c) Fair [] 3
- (d) Good [] 4
- (e) Very good [] 5

PERCEPTION OF LOCAL AREA (local area is defined as within 15 - 20 minutes' walk)

48. How long have you lived in this community?

- (a) Less than 0-5 years [] 1
- (b) 6-10 years [] 2
- (c) More than 10 years [] 3

49. Would you say this is an area you enjoy living in this community?

- (a) Yes [] 1
- (b) No [] 2
- (c) Don't Know [] 3

50. Are there job opportunities for people like you/with your level of skill in this area?

- (a) Yes [] 1
- (b) No [] 2
- (c) Don't Know [] 3

51. How would you describe the socioeconomic status of majority of people living in this community?

- (a) Very Poor [] 1

- (b) Poor [] 2
- (c) Middle [] 3
- (d) Rich [] 4
- (e) Very Rich [] 5

52. How would you describe the socioeconomic status of your own household compared with other households in your area?

- (a) Very Poor [] 1
- (b) Poor [] 2
- (c) Middle [] 3
- (d) Rich [] 4
- (e) Very Rich [] 5

53. Looking at your life as a whole, how would you describe your satisfaction with your life in general at the present time?

- (a) Very dissatisfied [] 1
- (b) Fairly dissatisfied [] 2
- (c) Neither satisfied or dissatisfied [] 3
- (d) Fairly Satisfied [] 4
- (e) Very Satisfied [] 5

53a. Why/why not (give reasons for your answer)? -----

CRIME AND FEELING OF SAFETY

54. Does your community have a local police service?

- (a) None [] 0
- (b) Government Police [] 1
- (c) Community Vigilante [] 2
- (d) Others (Specify) [] 3

55. Have you been a victim of any crime, violence, abuse including domestic abuse?

- (a) Yes [] 1
- (b) No [] 2
- (c) I will rather not say [] 3

55a. If yes, please specify the type Crime? -----

56. How safe do you feel walking alone in this area during the day?

- (a) Very safe [] 1

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- (b) Fairly safe [] 2
- (c) A bit unsafe [] 3
- (d) Very unsafe [] 4
- (e) Never walk alone in the day [] 5

57. How safe do you feel walking alone in this area after dark?

- (a) Very safe [] 1
- (b) Fairly safe [] 2
- (c) A bit unsafe [] 3
- (d) Very unsafe [] 4
- (e) Never walk alone in after dark [] 5

COMMUNITY ENGAGEMENT

58. Did you vote in the last election (Give reasons for your answer)?

- (a) Yes [] 1
 - (b) No [] 2
- Why/Why Not

59. Do you belong to any community organization?

- (a) Yes [] 1
- (b) No [] 2

60. What is your degree of participation in the main community group you belong to?

- (a) Not active [] 1
- (b) Fairly active [] 2
- (c) Very active [] 3
- (d) Leader [] 4

61. What type of community organisation do you belong to?

- (a) None [] 1
- (b) Religious [] 2
- (c) Social/Cultural [] 3
- (d) Professional [] 4
- (e) Cooperative/savings [] 5
- (f) Others (Specify) ----- [] 6

62. What is the main purpose of the organization? -----

63. What is the main benefit of the organization to you and your community (why are you a member)? -----

64. Should you have challenges with your child's health, how will the group you belong to help you? -----

65. What buildings do you regularly use for your group meetings and gatherings?

- (a) Community centres/halls [] 1
- (b) Homes of group leaders only [] 2
- (c) Government buildings [] 3
- (d) Any Member's home [] 4
- (e) Community leaders homes [] 5
- (f) Religious buildings [] 6
- (g) Others (Specify) ----- [] 7

66. Which members participate most in community group?

- (A) By gender**
- Men [] 1
 - Women [] 2
 - Men and women equally [] 3
 - Neither participates [] 0
- (B) By Age**
- Youth and adolescents [] 1
 - Adults [] 2
 - Older Persons [] 3
 - All age groups [] 4
 - None participates [] 0
- (C) By employment Status**
- Workers [] 1
 - Unemployed or nonworkers [] 2
 - Workers and nonworkers [] 3
 - Neither participates [] 0
- (D) By profession/occupation**
- Farmers [] 1

Traders 2	[]	(f)	Good governance	[]
Craft and vocation 3	[]	(g)	Good social relationship	[]
Formal Profession NGOs	[] 4 []	(h)	Others (Specify) -----	[]
5	[]	72.	Did you vote in the last election (Give reasons for your answer)?	
67. Overall, are the same people members of these different groups or is there little overlap in membership?		(a)	Yes	[] 1
(a) None	[] 0	(b)	No	[] 2
(b) Little overlap	[] 1			
(c) Some overlap	[] 2			
(d) Much overlap	[] 3			
68. Do you participate in community meetings?		73.	How many people do you know in your area (e.g. your street and areas around it)?	
(a) Yes	[] 1	(a)	None	[] 1
(b) No	[] 2	(b)	Few	[] 2
68a. Give reasons for your answer ----- -----		(c)	Many	[] 3
		(d)	Most	[] 4
69. Which members/bodies participate most in solving problems facing the community?		74.	Would you say that you trust people you know in your area?	
(a) Local Government	[] 1	(a)	None	[] 1
(b) National/State Government	[] 2	(b)	Few	[] 2
(c) NGOs	[]	(c)	Many	[] 3
3		(d)	Most	[] 4
(d) Community societies/groups	[]	75.	In the past 6 months, have you a favour for a neighbour?	
4		(a)	Yes	[]
(e) Politicians	[]	1		
5		(b)	No	[]
(f) Prosperous Citizens	[]	2		
6		(c)	Just moved into the area	[] 3
(g) Religious Institutions	[]	76.	In the past 6 months, have any of your neighbours done favours for you?	
7		(a)	Yes	[]
(h) The community as a whole	[] 8	1		
70. Have you and others in this community taken any action to solve any problem relating to child health?		(b)	No	[]
(a) Yes	[] 1	2		
(b) No	[] 2	(c)	Just moved into the area	[] 3
71. What do you consider as most important for the daily wellbeing of your child and household?		77.	Excluding the people you live with in your household, how often do you do any of the following?	
(a) Health and health care	[]	(A)	Speak/communicate with relatives (e.g. on the phone)	
1		(a)	Everyday	[]
(b) Employment	[]	1		
2		(b)	3 days a week	[]
(c) Food	[]	2		
3		(c)	Once a week	[]
(d) Security and safety	[]	3		
4		(d)	Once a month	[]
(e) Community infrastructure	[]	4		
5				

Reciprocity and Trust

SOCIAL NETWORK

Appendices

(e)	Once every couple of months [] 5		(d)	Once a month 4	[]
(f)	Twice a year 6	[]	(e)	Once every couple of months 5	[]
(g)	Not at all in the last 1 year 0	[]	(f)	Twice a year 6	[]
			(g)	Not at all in the last 1 year	[] 0
(B)	<u>Visit relatives</u>		78.	Apart from the people you live with in your household, how many relatives that you feel close to live within a 15-20 minute walk or 5-15 minute drive, if any?	
(a)	Everyday 1	[]	(a)	1 - 2	[] 1
(b)	3 days a week 2	[]	(b)	3 - 4	[] 2
(c)	Once a week 3	[]	(c)	5 or more	[] 3
(d)	Once a month 4	[]	(d)	None	[] 0
(e)	Once every couple of months [] 5		79.	How many close friends live within a 15-20 minute walk or 5-15 minute drive, if any?	
(f)	Twice a year 6	[]	(a)	1 - 2	[] 1
(g)	Not at all in the last 1 year 0	[]	(b)	3 - 4	[] 2
			(c)	5 or more	[] 3
(C)	<u>Speak/communicate with friends (e.g. on the phone)</u>		(d)	None	[] 0
(a)	Everyday	[] 1	<u>SOCIAL SUPPORT, CHARITY AND INTERVENTIONS</u>		
(b)	3 days a week 2	[]	Questions 77 to 83 are lists of situations where people might need help. For each one, could you choose who you would ask for help?		
(c)	Once a week 3	[]	80.	If you needed a lift to take your child for treatment urgently, who would you ask for help?	
(d)	Once a month 4	[]	(a)	Prefer not to ask for help	[] 0
(e)	Once every couple of months [] 5		(b)	Husband/wife/partner	[]
(f)	Twice a year 6	[]	(c)	Other household member	[] 2
(g)	Not at all in the last 1 year 0	[]	(d)	Relative (outside household)	[]
			(e)	Friend	[]
(D)	<u>Visit friends</u>		(f)	Neighbour	[]
(a)	Everyday 1	[]	(g)	Others (Specify)	[]
(b)	3 days a week 2	[]		6	
(c)	Once a week 3	[]	81.	If you are in financial difficulty and needed money relating to your child's health, who would you ask for help (e.g. borrow, free donation etc.)?	
(d)	Once a month 4	[]	(a)	Prefer not to ask for help	[] 0
(e)	Once every couple of months [] 5		(b)	Husband/wife/partner	[]
(f)	Twice a year 6	[]	(c)	Other household member	[] 2
(g)	Not at all in the last 1 year 0	[]	(d)	Relative (outside household)	[] 3
			(e)	Friend	[]
(E)	<u>Speak/communicate to neighbours</u>			4	
(a)	Everyday	[] 1			
(b)	3 days a week 2	[]			
(c)	Once a week 3	[]			

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(f)	Neighbour	[]	(h)	Others (Specify)	[]
	5			7	
(g)	Others (Specify)	[]	85.	Do you receive any form of charity (kind or cash) regularly from anyone (friends, family, relatives, social group etc.)?	
	6		(a)	Yes	[] 1
82.	If you had a serious personal problems (e.g. relating to your child's health), who would you turn to for support?		(b)	No	[] 2
(a)	Prefer not to ask for help	[] 0	(c)	Don't know/It depends	[] 3
(b)	Husband/wife/partner	[] 1	86.	Do you give charity to anyone on a regular basis?	
(c)	Other household member	[] 2	(a)	Yes	[] 1
(d)	Relative (outside household)	[] 3	(b)	No	[] 2
(e)	Friend	[] 4	(c)	Don't know/It depends	[] 3
(f)	Neighbour	[] 5	<u>COPING WITH CHILD HEALTH CHALLENGES</u>		
(g)	Others (Specify)	[] 6	87.	What aspects of your personal, household and neighbourhood circumstances do you consider as major child risks and challenges to child's health?	
83.	If you needed urgent information (e.g. relating to your child's health, treatment and welfare), who are you likely to ask first?		i.	-----	
(a)	Prefer not to ask anyone	[] 0	--		
(b)	Would search the internet	[] 1	ii.	-----	
(c)	Husband/wife/partner	[] 2	--		
(d)	Other household member	[] 3	iii.	-----	
(e)	Relative (outside household)	[] 4	--		
(f)	Friend	[] 5	iv.	-----	
(g)	Neighbour	[] 6	--		
(h)	Others (Specify)	[] 7	v.	-----	

84.	If you needed to be away from the house urgently for several hours/days, is there anyone you could leave your child(ren) with?		88.	How do you cope/respond to these challenges?	
(a)	Prefer not to leave with anyone	[] 0	i.	-----	
(b)	Husband/wife/partner	[] 1	--		
(c)	Nanny/Sitter outside the house	[] 2	ii.	-----	
(d)	Other household member	[] 3	--		
(e)	Relative (outside household)	[] 4	iii.	-----	
(f)	Friend	[] 5	--		
(g)	Neighbour	[] 6	iv.	-----	
			--		

			--		

Please indicate if you wish to be contacted for further oral discussion

1. Yes, I wish to participate further in a one-on-one conversation

Suitable Date: __ / __ / __ __ __ Suitable Time:

2. Yes, I wish to be participate in a focus group discussion with other people to talk about child health promotion in my community:

Suitable Date: __ / __ / __ __ __ Suitable Time:

Contact (E.g. mobile number):

Appendix 6: Interview guide for conducting the semi-structured interviews

Semi-structured interview guide

Research TOPIC: Perceptions and responses to child health-risk

PART 1: SOCIOECONOMIC CHARACTERISTICS OF RESPONDENTS

Survey No: _____ Place/Location of interview.....

Latitude: _____ Longitude: _____ Elevation: _____

Name of community _____ LGA _____ Time . . pm/am

Date ___/___/_____ Place of interview _____ Serial Number _____

Age of Child less than 5 years Sex of Child

Sex: Male [] Female []

Age Group: Less than 20 [] 20-29 [] 30-39 [] 40-49 []

Marital Status: Married [] Unmarried []

Ethnicity: _____

Religion: Christianity [] Islam [] Traditional Religion []
Other _____

Employment Status: Employed [] Unemployed []

Main Occupation: _____

Monthly Income: <18,000 [] 18,000-60,000 [] 61,000-100,000 [] 101,000-150,000 []
151,000-200,000 [] 201,000-250,000 [] Above 250,000 []

Monthly Rent (Monthly/Annual) _____

Part 2: Interview Questions

A. Introduction

Introduce myself

What is the research about?

Obtain consent (written or verbal)

Establish anonymity levels

Ask for permission to record or take photos

Any question before we start?

B. Perception of local area

1. How long have you lived in this area?
2. What is your perception and experience of living in this area (e.g. trust and relationship with neighbours, access to local amenities)?
3. Do you feel safe in this area? Is there much crime?
4. How does living in this area affect the health and wellbeing of your children?

C. Employment

5. What is the main occupation of people in this community?
6. Are you currently employed?
7. Given your level of skill, are there employment opportunities for people like you in this community?

D. Health Status, Health Facility and Behaviour

8. How would you describe your health in general?
9. Could describe any major ailment you have received treatment for in the last 6 months
10. How would you describe your child's health in general?
11. Could describe any major ailment your child has received treatment for in the last 6 months
12. Are there health facilities in this community?
13. Could you share your experience of delivering your child in the health facility he/she was delivered?
14. What types of childhood diseases are common in this area?
15. What's your experience of treating or preventing these diseases?
16. Have you suffered the loss of a child less than five years recently?
17. Do you have a mosquito bednet, Why/why not?
18. If you own a mosquito bednet, how did you obtain one?
19. Has your child received any/all immunization vaccines for his or her age, why/why not?

E. Membership of social organisation

20. Do you belong to any social, cultural, religious or professional group?
21. Tell me about the main purpose of this group and your experience (e.g. benefits) of being a member
22. How does this group assist members with child's health and wellbeing?

F. Social Network and Social Support

23. Please tell me about your relationship with your friends and family, who do you feel close, visit etc. And why?
24. Could you describe your experience of a situation where you had to go somewhere for several hours or days, and who you left your child(ren) with and why?

G. Child health Risks and Coping mechanisms

- 25 What aspects of your neighbourhood or other circumstances (e.g. family or personal socioeconomic issues) might be sources of risk or pose challenges to your child's health and wellbeing?
- 26 How do you cope with these challenges?
- 27 Is there any other thing relating to your child health, which you wish to talk about?

Appendix 7: Research subject information sheet

A. Purpose of the Research and your Involvement

This research is being carried out by a PhD student. The aim of the study is to understand factors that contribute to risk and resilience of the health of children less than 5 years of age in your community. **We are looking for women (mothers or guardians) of children less than five year to interview.** If you decide to participate in this research, you will be asked some questions about what features in your local area you believe are important to the health and wellbeing of children (under-five) through any or all of the following; a questionnaire, in-depth interview and focus group discussion. Such questions will relate to health care services and use, what family and/or community resources you access to take care of your children's health especially in times of need. The interviewer or the focus group leader will ask you to talk about your experience and opinion of the local area and what is important for child health, any challenges relating to child health and how you generally manage these challenges. The interview and the focus group will be confidential and tape/video-recorded with your permission. The written transcripts of the tapes will only use pseudonyms (a code or substitute for your real name) so that you are not identified. You can give a verbal consent or a written one by signing the consent form.

B. Risks and Discomforts: We do not expect any risks to you. Your participation is voluntary. You do not have to talk about any issues you do not wish to talk about.

C. Benefits and Cost of taking part in this research: You will be contributing to understanding what aspects of your community and health resources are beneficial to the health of children. There are **no costs** for participating in this research.

D. Confidentiality: The information is being collected only for research purposes only. Your personal information will be treated as anonymous so you are not identified. All electronic versions of the information will be password protected. Access to data will be limited to my supervision team.

E. Research Findings and Feedback: The information will be used in the PhD thesis, in report to sponsors, at conferences and publications that may emerge from the research. All your personal information will be anonymous in these disseminations. We may not be able to provide personal feedback to every participant in this research project, however, you community will be acknowledged in any publication which may emerge from the research.

- I have been invited to participate in this research and given the chance to hear and read about this study. I understand that my participation is voluntary and I understand what it involves. All the questions I wanted to ask have been answered. I am aware that I am free to withdraw from the research at any time or refuse to answer any question.
- I am aware that the researcher may ask for permission to record the interview or discussion and take the GPS location and photograph of the place of interview and it is my decision whether to allow the tape and GPS recordings. I am free to stop the recording at any time.
- I am aware that all my personal information will be confidential and will not be passed to anyone else not involved in the project. I understand that the findings from this research may be used in the thesis, conference presentations and publications.
- I have agreed to participate in this study. My signature or verbal approval proves that I am willing to participate in this study.