MATERNAL EDUCATION, CHILDHOOD MORBIDITY AND UNDER FIVE MORTALITIES IN NIGERIA

BY

OBASI BASIL JACOB

PG/MSC/16/82185

DEPARTMENT OF ECONOMICS

FACULTY OF THE SOCIAL SCIENCES

UNIVERSITY OF NIGERIA, NSUKKA

SUPERVISOR: DR. EMMANUEL O. NWOSU

October 2018

TITLE PAGE

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CERTIFICATION

This is to certify that OBASI, Basil Jacob, a post-graduate student of the department of Economics, University of Nigeria, Nsukka and whose registration number is **PG/MSC/16/82185** has satisfactorily completed the requirements for the award of Master of Science (M.Sc) in Economics.

_____	_____
Dr. Nwosu Emmanuel	Prof. S. I. Madueme
Supervisor	Head of Department

APPROVAL PAGE

_____	_____
Dr. Nwosu Emmanuel	Prof. S. I. Madueme
Supervisor	Head of Department
Date: _____	Date: _____
_____	_____
Rev. Fr. Prof Leonard Ugwu	External Examiner
Dean, Faculty of the Social Sciences	
Date: _____	Date: _____

DEDICATION

To my lovely wife and Children

ACKNOWLEDGEMENT

All thanks to GOD Almighty who gave me the opportunity, wisdom and strength to write this thesis and complete my MSc. Programme successfully.

My sincere gratitude goes to my Supervisor, Dr. Emmanuel Nwosu for the quality of his supervision displayed in meticulous reviews of the methodology and appropriate guidance to ethical research standards.

I appreciate the effort of all my lecturers in the Department of Economics, UNN, Prof. S.I. Madueme, Dr. Urama Nathaniel, Dr. Ezebuilo Ukwueze, Dr. Ogbuabor Jonathan, and Dr. Ifelumini Innocent.

I also acknowledge the contributions, supports and encouragement I received from my colleagues, Mr. Olusegun Fadare (International Food Policy Research Institute) and Mr. Chidiebere Ibe (DFID – Partnership to Engage, Reform and Learn).

Table of Contents

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

This study examines the effect of maternal education on childhood morbidity and under-five mortalities in Nigeria using the Nigeria Demographic and Health Survey (NDHS), 2013. Empirically, the study employs instrumental variable probit regression (Ivprobit) model to investigate the relationship between maternal education and child health outcomes while the multinomial logit model was estimated to test the disaggregated effect of maternal education on the varying rate of under-five mortality across the six geopolitical zones in Nigeria. The study used data at the individual level, with a total of 18, 563 observations to test the model on under-five mortality while the model on childhood morbidity and disaggregated effect of maternal education was tested at the household level with a total of 16,536 observations. The result showed that maternal education has a significantly negative relationship with under-five mortality but not with childhood morbidity. The result from the multinomial logit regression shows that mother's level of education and wealth status exert more significant effect on regional disparity in under-five mortality in Nigeria more than religion or belief system. Intuitively, maternal education can only be effective in improving child health outcomes if such education can potentially impact positively on other socio-economic variables that determine child health outcomes especially wealth index, poor childcare attitude and obnoxious belief systems. The study concludes that policy interventions by government to address child health vulnerability and inequality in Nigeria through maternal education should coherently improve the socio-economic characteristics of would-be mothers for it to be effective.

Keywords: Maternal Education, Under-five Mortality, Childhood Morbidity

CHAPTER ONE

INTRODUCTION

1.1. Background to the study

Childhood morbidity and under five mortality are essential indicators for child health and well-being, often used as broad indicators of social and economic development of nations. Consequently, improvements in health outcomes for children especially those under the age of five years (0 – 5 years) are imperative element in national development agenda World Health Organization (WHO, 2010). Imperatively, considering children as agents of continuity of any country, childhood mortality or survival is not only a core indicator for child health and wellbeing but also a critical measure of socio-economic development in any country (Adetoro & Amoo, 2014).

The United Nations Children's Emergency Fund (UNICEF) in its 2016 edition of the on the State of the World's Children 2016: A fair Chance for Every Child"; stated that diminishing the prospects of survival or decent health of any child because of the circumstances around his or her birth is grossly unfair and a violation of that child's rights. The UNICEF in this Report reiterated that every child is born with the equal inalienable right to a healthy start in life, an education and a safe, secure childhood with all the basic opportunities that translate into a productive and prosperous adulthood. Nevertheless, around the world, "millions of children are denied their rights and deprived of the fundamental requirements they need to grow up healthy and strong, either because of their place of birth or their family of origin; because of their race, ethnicity or gender; or because they live in poverty or with a disability" (UNICEF, State of the World's Children Report, 2016).

According to the UN Inter-agency Group for Child Mortality Estimation, (UN, IGME, 2017 Report), Sub-Saharan Africa remains the region with the highest under-five mortality rate in the world. The Report stated that in 2016, the region had an average under-five mortality rate of 79 deaths per 1,000 live births which translates to 1 child in every 13 dying before his or her fifth birthday – 15 times higher than the average ratio of 1 in 189 in high-income countries, or 20 times higher than the ratio of 1 in 250 in the region of Australia and New-Zealand. The Report highlighted that about 80 per cent of under-five deaths occur in two regions, sub-Saharan Africa and Southern Asia, with Nigeria being the second largest contributor to under – five and maternal mortality rate in the world, losing about 2,300 under-five year children and

145 women of child bearing age every single day. Every year, millions of the world's children under 5 years of age die, mostly from Preventable diseases such as pneumonia, diarrhoea and malaria. The Report further revealed that every day, 15,000 children die globally, mostly from Preventable causes and preventable diseases, even though the knowledge and technologies for life-saving interventions have increased over time. (UN, IGME Report, 2017).

As evidenced in Nigeria's National Demographic and Health Survey (NDHS Report, 2013); infant mortality rate was 75 deaths per 1,000 live births in the 2004 – 2008 survey and 69 deaths per 1,000 live births in the 2009 – 2013 survey. While under-five mortality was 157 deaths per 1,000 live births in the 2004 – 2008 survey and 128 deaths per 1,000 live births in 2009 -2013 survey. At these levels of mortality, one out of every 15 Nigerian children die before reaching age 1, while one in every eight do not survive beyond their fifth birthday (UNICEF, 2013; Morakinyo & Fagbamigbe, 2017). Acute respiratory tract infection (ARI), diarrheal diseases, and neonatal syndromes (preterm birth complications, neonatal encephalopathy, neonatal sepsis, and other neonatal disorders) accounted for 54% of the total under-five deaths in 2013.

The NDHS Report, 2013 further suggested that the prevailing rates of morbidity and under-five mortality in Nigeria could be attributed to the years or levels of education especially among women of childbearing age. Consequently, under-five mortality among children born to mothers with no education which was about (180 deaths per 1,000 live births); is almost twice that of children born to mothers with secondary education (91 deaths per 1,000 live births) and three times that of children born to mothers with more than secondary education (62 deaths per 1,000 live births) (NDHS, 2013). This linkage is traceable to poor healthcare facility utilization, malnutrition in children, low levels of vaccination coverage, unsafe water, poor sanitation and hygiene; which are likely not unconnected to low levels of maternal education (Carvajal–Aguirre et al, 2017).

Observably, all indicators of child health outcomes vary with the levels of women education and other socioeconomic characteristics that education could influence. In the Multiple Indicators Clusters Survey (MICS, 2016/17), findings indicate that incidences of childhood morbidity decrease as the level of maternal education increases. For instance, while 21.5 percentage of children with reported cases of diarrhoea are born to mothers with no formal education, 11.9% are born to women who completed primary education while just 7.4% are born by women who attained higher education. Vaccination coverage also follow similar trend,

about 93% of children whose mothers have more than secondary education were fully vaccinated, compared with 23.9% of children whose mothers had no education. (MICS, 2016/17).

Also, inequality in child health outcomes exists across the six geopolitical zones in Nigeria with more of the disadvantaged children coming mostly from Northern Nigeria (Anyamele et al, 2017). In this part of the country, the level of women educational attainment is low when compared with their counterparts from the Southern part (Multiple Indicator Clustery Survey-3, 2017). Furthermore, data from the Multiple Indicators Clusters Survey, 2016/17 shows that North West which recorded the highest level of child mortality and Under – 5 mortality rate of 83 and 162 per 1,000 live births respectively, also had the least percentage of literate women of 38% while the South-West with a very high proportion of literate women (94.8%), had the least child mortality rate of 16 deaths per 1,000 of the population.

According to Cleland et al (1991), educational attainments cum socio-economic status of women impacts children's health status because they exert influence on the individual mothers' knowledge, personality codes, attitudes and behaviour, which in turn affect the health outcomes of their offspring. Nevertheless, such questions as the type and nature of education needs that would be critical for improved health outcomes in children, the degree of variability in the impact of education on health as well as the channels through which education influences morbidity and mortality for the various regional divides in Nigeria calls for research attention. From the foregoing, maternal education is a crucial policy variable through which the existing inequality in child health outcome in Nigeria could be mitigated. It is against this backdrop that the present work seeks to investigate empirically the trajectories through which maternal education influences under-five morbidity and mortality as well as the variability in the nature of impact for the different geopolitical divides in Nigeria.

1.2. Statement of the Problem

According to the UN Inter-agency Group for Child Mortality Estimation (UN IGME) Report, 2017; Nigeria was the second largest contributor to global under – 5 mortality rates in 2016 with a very low annual rate of reduction in Under – 5 mortality rates of (2.7%). The country is one of the six countries that account for half of the total global under-five deaths, including, India, Nigeria, Pakistan, the Democratic Republic of the Congo, Ethiopia and China. The Table below shows the six countries with highest number of deaths among children from 0 – 59 months with their respective annual rate of reduction (ARR). The low annual rate of reduction

in under-five mortality in Nigeria could be further linked to low national immunization coverage rates, which is traceable factors such as women education, attitude and belief system. Evidently, if nothing is done to reverse the current trends, Nigeria will be one of the countries that will miss the SDGs target for neonatal and under-five mortality by 2030.

Incidentally, the Federal government of Nigeria with support from various development partners, including the World Health Organization (WHO), UNICEF, the UK Department for International Development (DFID), the United States Agency for International Development (USAID), implemented various policies and programmes to curb the menace of childhood morbidity and mortality in various parts of the country. Some of which include the Integrated Maternal, Newborn and Child Health (IMNCH) strategy launched in 2007 to accelerate the achievement of the MDGs; the Roll Back Malaria programme (RBM) 2009 and the Nigerian National Routine Immunization Strategic Plan (2013-2015) implemented with assistance from to the United Nations International Children Emergency Fund (UNICEF), the United Nations Development Programme (UNDP), the United Kingdom Agency for International Development (UKaid) to mention but a few. Nevertheless, despite the concerted international and national efforts towards combating the undesirable levels of infant and child mortality, this threat remains a daunting challenge in Nigeria. Nigeria was unable to meet the Millennium Development Goal (MDG 4) and no research has been able to point directly to the key policy hitches that made the realization of these targets impossible.

According to the Nigeria National Demographic and Health Survey (NDHS, 2013); 15 Nigerian children die before reaching age 1, while one in every eight do not survive beyond their fifth birthday; resulting from vaccine Preventable diseases (VPD), acute respiratory infections (ARIs), diarrhoea, malaria and chronic malnutrition, which is not unconnected with the low levels of education amongst women of childbearing age. (NDHS, 2013). Though the NDHS Report suggested that Nigeria has over the years, recorded little progress in the performance of core indicators of child health outcomes but the rate of reduction is slow for the country to achieve UN Sustainable Development Goals (SDGs) by 2030 (Morakinyo & Fagbamigbe, 2017). Available statistics from various NDHS Reports (2008 and 2013) shows that the prevalence or case fatality rate of diseases such as diarrhoea, malaria and acute respiratory tract infections (ARI) has shown some level of decline from 1999 to 2013 while vaccine coverage has recorded little increase and with less percentage of children without vaccination at the end of the first 12 months of life, with under 5 mortality rates marginally declining especially from 2003 to 2013.

Interventions such as immunisation and early treatment of common childhood illnesses which have been seen to be the most cost-effective ways of preventing many under-five deaths and reducing the duration and severity of childhood illnesses are not adopted by most mothers in Nigeria. Nigeria has recorded progress in some of its health indicators, such as in infant and under-five mortality rates, while other areas showed slow progress or have worsened over the years. (UNICEF – SOWC, 2016).

Data from both the NDHS, 2013 and MICS 2016/17 reveal that, Nigerian children born to mothers with no formal education are about 3 times as likely to die before age 5 as children whose mothers have higher than a secondary education. Observably, the pattern of inequality in child health outcomes in Nigeria, place at a disadvantaged position the Northern population where the level of maternal education is relatively low, resulting to poor socio-economic status which worsen the ability to prevent or treat cases of childhood morbidity. Evidence from national survey Reports (NDHS, 2013 and MICS, 2016/17) indicates that there persists a high-level inequality in the level of women education in Nigeria with the disadvantaged regions, mostly the Northern part of the country, also recording low levels of vaccine coverage, high prevalence rate of childhood diseases as well as very low probability of child survival. For instance, data from the NDHS, 2013 shows that inequality in maternal education translates disparity in vaccination coverage which favour the residents in the urban areas where vaccination coverage is 43% as against the 16% in rural areas. Full vaccination coverage varies by zone with the regions where women education is low being the most vulnerable, ranging from 10% of children in North West Zone to 52% in South East and South-South Zones.

The Multiple Indicators Clusters Survey, MICS 2016/17; highlighted that 164-under-five mortality rate are associated with children born to women without any formal education while mothers whose level of education is more than secondary school record 55 under-five mortality rate. According to the Report, despite the fact that vaccine Preventable diseases account for 40 percent of all childhood deaths in Nigeria, over 75 percent of Nigeria's children age 0 to 59 months were not fully immunized with the North West and North East having the least percentage of literate women in 2016 which is about 38% and 41.9% respectively, also recording the highest level of under – 5 mortality rate of 162 and 115 per 1,000 live births. As shown in the Table above, child health outcome across the six geopolitical zone varies with the number of years spent in formal education by women of childbearing age (15-49 years). In many instances, full vaccination is high for any region that has high percentage of educated women and vice versa.

Nigeria has signed unto the current UN Sustainable Development Goal (SDGs) with renewed commitment to end Preventable deaths of new-borns and under five children; reducing neonatal mortality to at least as low as 12 per 1,000 live births and under-five mortality to at least as low as 25 per 1,000 live births or fewer in every country by 2030. However, a serious source of policy concern is that at the current rate of under - 5 mortality and the annual rate of reduction, the fears are that Nigeria might not be able to realize target of the UN Sustainable Development Goal (SDGs). Achieving this renewed commitment is dependent on monitoring the sources of Preventable deaths among children and tracking the channels through which they occur in order to evolve robust intervention strategies that would help close the existing gaps.

The existing high level of vulnerability among women in various parts of the country which could be due to poor levels of education, exposes their children to greater chances of morbidity and mortality. Interestingly, various research linking women education and child health outcome have been undertaken in Nigeria, but the prevalence rate of Preventable deaths is still very high. This has been attributed to the policy gap existing in the maternal and child health system in Nigeria which does not consider the pathway of influence through which maternal education could influence child health effectively.

Worthy of note is the fact that several research efforts have been directed towards identifying the proximate determinants of child mortality in Nigeria (Antai and Moradi, 2010; Adeboye et al, 2010, Adjuik et al, 2010; Becher, 2010; Okoro et al, 2009; Ekenze, 2009; Grais et al 2007; Oniyangi et al 2006). Though most of these studies analysed the relationship between the socio-economic status of women and child health, the present study takes a unique examination of the importance of maternal education in driving other socio-economic variable towards influencing child health and mortality. Also, no Nigeria specific studies known to us, have been able to examine the linkage between maternal education and child morbidity which could lead to child mortality.

Despite the general knowledge that maternal education is linked with better health outcomes in children, the potential pathways linking these two variables in Nigeria have not been sufficiently explored. Consequently, more research effort is therefore needed to trace these relationships to be able to come up with appropriate intervention policies and programmes to address the daunting challenge of child health logically. In view of this, this study aims to advance the existing knowledge by examining the critical role women education could play in

influencing the incidences and avoidance of diseases capable of causing death among children in Nigeria.

1.3. Research Questions

i. Is there a relationship between maternal education and under-five mortality in Nigeria?

ii. How does mothers' level of education affect childhood morbidity in Nigeria?

iii. Does zonal disparity in maternal education explains variations in under-five mortality across Nigeria's six geopolitical zones?

1.4. Objectives of the Study

The broad objective of this study is to investigate the effect of maternal education on child health and survival in Nigeria. The specific objectives of the study are;

i. To estimate the effect of maternal education on under-five mortality in Nigeria.

ii. To ascertain the effect of maternal education on childhood morbidity in Nigeria.

iii. To verify whether zonal disparity in maternal education explains variations in under-five mortality rates across Nigeria's six geopolitical zones.

1.5. Research Hypotheses

The study hypotheses are:

Ho 1: Maternal education has no effect on under-five mortality in Nigeria.

Ho 2: Maternal education does not have any influence on childhood morbidity in Nigeria.

Ho 3: Zonal disparity in maternal education has no influence on the variations in under-five mortality rates in Nigeria's six geopolitical zones.

1.6. Significance of the Study

Considering the position of child health status as a measure of development, it is important to focus research efforts on childhood morbidity as a trail to under 5 mortalities in Nigeria in order to generate new scientific evidence on how best to use educational policies and women empowerment as a tool for tackling this problem. This work shall be useful to key players and policy makers in Nigeria's health sector to understand the importance of mainstreaming maternal education in the implementation of strategy of the National Child Health Policy of 2016 and help in shaping other policies and programmes designed to ensure that Nigeria attains

the ‘Sustainable Development Goals’ SDGs targets by 2030. The study will also help in reducing the level of Preventable deaths among under–5 children through increasing the upscaling routine immunization coverage using maternal education programmes as a catalyst to reduce detrimental beliefs and practices capable of undermining child health and survival in Nigeria.

Clearly, Nigerian studies on infant and child mortality have examined the influence of key determinants of infant and child mortality at various levels (individual, household, and community-levels) but the present study differ in its approach by considering mother’s level of education as the trajectory through which most of the determinants of childhood mortality operates while isolating childhood morbidity as critical pathway worthy of examination. Intuitively, except for death caused by accidents or disasters, before mortality, there is usually a disease condition that could culminate into death if not managed effectively. The present study differs from others by its examination of morbidity as a pathway to mortality in under-five children. Consequently, the examination of the differential effect of maternal education on morbidity and mortality, would be valuable in vulnerability mapping and intervention planning especially as it concerns the upscale of girl child education equitably within the various geopolitical divides in Nigeria. In view of this, this study aims to uniquely extend the frontier of knowledge by examining the critical role of maternal education in influencing the health and survival of under-five children in Nigeria.

1.7. Structure of the Study

This research work consists of five chapters. Chapter one gives a general background of the study and the motivation behind the work. It includes a general introduction and trends of under-five mortality in Nigeria, statement of the problem under study, objectives of the study, justification and limitations of the study. In chapter two, selected research works that are related to under-five mortality, the logistic regression and the alternating logistic regression are reviewed. Chapter three discusses the data and an in-depth explanation of the methods used. In chapter four the data is explored, analyzed and discussed using the STATA statistical software to get results. The last chapter presents the conclusions and policy recommendations of the study.

1.8. Scope of the Study

This study is a country specific study and for convenience, representativeness and instrument reliability, employed secondary cross-sectional data from the Nigeria Demographic and Health Survey (NDHS, 2013). The 2013 NDHS sample was selected using a stratified three-stage cluster design consisting of 904 clusters, 372 in urban areas and 532 in rural areas. A representative sample of 40,680 households was selected for the survey. All women age 15-49 who were either permanent residents of the households in the 2013 NDHS sample or visitors present in the households on the night before the survey were eligible to be interviewed. The study design enabled the researcher to draw evidence-based inference into the level and nature of association existing between maternal education and childhood morbidity and mortality across the six geopolitical zones in Nigeria using a national representative statistic obtained from the 2013 NDHS dataset (Child Recode file) and (Women Individual Recode file) including both the rural and urban areas in Nigeria.

CHAPTER TWO

LITERATURE REVIEW

The review of related literature in the present study is structured into five sections which include the conceptual literature, analytical framework, conceptual framework, empirical literature, limitations of previous works and value addition; and methodological framework.

2.1. Conceptual Literature

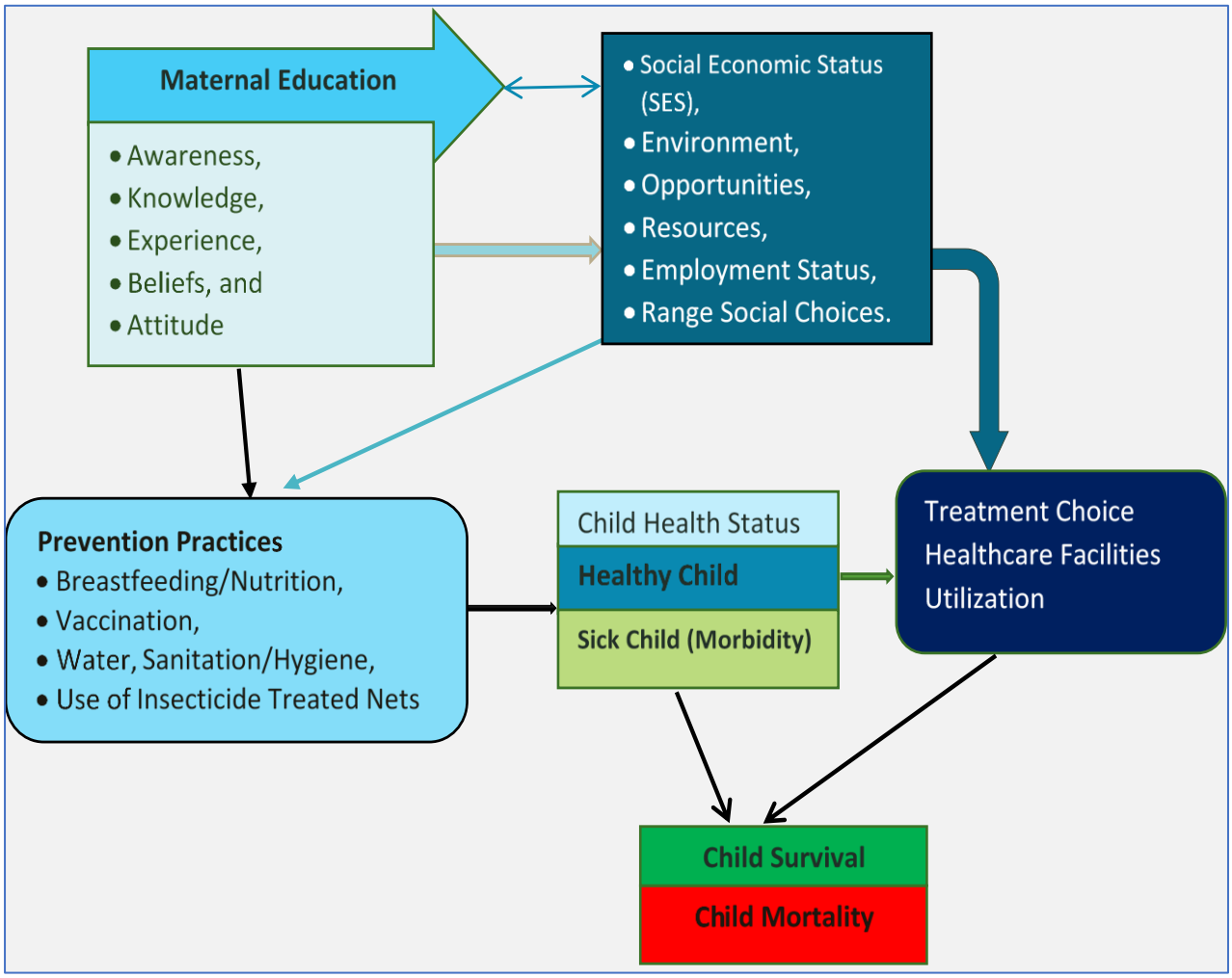
In a bid to ensure effective understanding of motivations behind this study, elucidation of critical concepts used in the work is quite compelling. Obviously, this section is designed to examine and highlight the undertones of these concepts in the body of existing literature. Different analytical frameworks and theories have been used to explain the relationship between mother's education and child mortality, though most of the studies in Nigeria did not trace the pathway of influence from morbidity to mortality using a national representative dataset collected through an evidence-based household survey.

This study was guided by the analytical framework used by Grossman, 1972; Caldwell 1979, and Mosley & Chen (1984), which focused on the interactions existing between mother's education and child health outcomes. For instance, (Grossman, 1972) stated that education and schooling remain a central factor in the demand for health. According to Grossman, the higher the levels of education obtained by a woman, the more efficient health outcomes she produces; given that health is a function of medical care, environment, and lifestyle, the health production function shifts up and becomes steeper with more education because people can produce it more efficiently. Grossman concluded that children with better health status are more likely to be borne by mothers with higher levels of education given that they understand the forces at work in shaping children's health better than less educated ones.

In a related study by Caldwell (1979), evidently, schooling by would-be mothers enables them to acquire formal education, which makes them more knowledgeable on a whole range of health issues about themselves and their children. First, an educated mother might be less fatalistic about illness and seek care. Education increases both knowledge and the capacity to deal with new ideas and import different cultures. Second, she might become able to interact with the modern world, that is, she might regard the facilities around her as a right and interact more with medical staff. Third, she might have higher bargaining power not only with her husband but also with other

family members such as parents in law. (Caldwell, 1979). Based on the aforementioned, the researcher adopted the analytical framework of Mosley and Chen (1984) blended with the evidences from Caldwell 1979 in developing the conceptual framework used in the presented study. As presented below, the study conceptualization suggests that a bidirectional connection exist between maternal education and socio-economic status of women which from evidence has been proved to influence child health and mortality both directly and indirectly.

Figure 2.1: Conceptual Framework



Source: Author's conceptual Framework Adapted from Mosley and Chen Model (1984)

The intuition behind this conceptualization draws strength from the work of previous researcher who tried to study the impact of women education on child's health outcomes; especially Mosley and Chen (1984) model, and Sastry (1997) framework. The concept and motivation behind the present study derives from the thinking that before a child mortality occurs, such a child probably would pass the stage of falling sick (morbidity) and if the situation is not effectively managed, the chances that it could result to death is invariably increased. Intuitively, maternal education increases the experience, knowledge and ability to manage infantile health outcomes by its

variable influence on the range of choices open to the child's mother or parents especially as it pertains to nutrition, water, sanitation & hygiene (WASH),choice of healthcare facilities and services to be adopted, healthcare facility utilization, quality of treatment accessible, openness to vaccination, as well as other environmental conditions that correlate with the social economic status (SES) of the family.

2.1.1. Concept of Maternal Education

Education is commonly defined in terms of the number of years in which an individual has participated in schooling, or sometimes in terms of the level of qualifications attained (Feinstein et al, 2006). Maternal education refers to every form of education that aims at improving the knowledge and skill of women and the girl child (formal, vocational, professional or health education) which positions mothers and would-be mothers to better perform their roles as mothers and actualize themselves (Gunes, 2013). In the context of this study, maternal education measures the level of educational attainment by women of childbearing age (14 - 45years); in three categories viz: no education, primary education, completed secondary school and more than secondary education as it is used in the Nigeria Demographic and Health Survey of various years.

2.1.2. Childhood Morbidity

Morbidity refers to the state of being diseased or unhealthy within a population or the incidence of ill health in a population. According to Thomas (2016), childhood morbidity refers to the incidences and prevalence of ill health, sickness or disease conditions capable of leading to death in children within the age bracket of 0-59 months. In the context of this study, childhood morbidity will be measured by prevalence and case fatality rate of death causing ailments in under – 5 children. In the context of this study, using the NDHS, a case prevalence rate shall be considered as morbidity if a child has at least any two of either malaria/fever, diarrhea and or acute respiratory tract infection (ARI) within the last two weeks before the survey and a morbidity case so defined is code 1 otherwise, zero.

2.1.3. Under-Five Mortality

Child mortality defined as the likelihood for a child born alive to die between its first and fifth birthday (Abimbola et al, 2012). It is one of the most sensitive and commonly used indicators of the social and economic development of a population. In the context of this study we shall employ the definition by UNICEF which sees under-five mortality as the probability of dying between age

0 and 5 years (i.e. the probability of dying between age 0 and 59 months), shall be used interchangeably to mean the same thing as childhood mortality. If a child dies within the range of years before 5 years (0-59 months), the dummy is coded 1, and otherwise zero.

2.2 Theoretical Literature

The theoretical model that form the basis of this study is the proximate determinants model of health dynamics of a population as developed by Mosley-Chen model (1984) and later modified by Sastry framework (1997). These theories were emerged through the preceding theories including the fertility model of health outcome, human capital and demand for health model which are explained below.

2.2.1 Fertility model

As postulated by Becker (1960); "the fertility model suggests that learning (education) increases employment opportunities and hence income, which induces women to trade-off the quantity of children they have for investments in greater child quality". Deriving from the fertility model, (Rosenzweig and Shultz, 1989) expounded that regardless of the presence of income effects, additional schooling may also provide a woman with the literacy and numeracy skills necessary to correctly implement family planning or health care or increase a woman's stock of health knowledge, such as how to effectively use contraception.

The endogenous fertility models thus include many factors that people are assumed to take into account while making choices related to fertility, particularly whether or not to have children, when to give birth to the children and how many children to have. In these models however, only the economic factors are included explicitly, and a vector of household preferences is used to model other factors implicitly (Becker, 1960). Worthy of note is the fact that in the Becker fertility model, the income elasticity is higher for quality than for quantity, and a household would correspondingly respond to an increase in income by increasing its expenditures on a child's human capital relatively more than increasing the number of children; with the postulation that an increase in household income will, through the elasticity mechanism, improve child health, reduce mortality and in most cases reduce fertility.

2.2.2. Human capital and Demand for Health Model

The human capital model of the demand for health which views health as a capital stock that has the capability of yielding an output of health time; was developed by Michael Grossman in 1972

and has been branded the human capital model because its intuition derives from the human capital theory. According to the model, health can be considered as a commodity and hence demand for health can be viewed as demand for a commodity; while in a similar manner, health can be viewed as a product that is produced from factor inputs. The theory explains that utility is derived from good health just as in the case of consumption of goods and services. Good health is therefore desirable and the more of it that an individual gets, the higher the welfare of the person; hence an individual's utility function depends on his or her health stock and all other goods consumed.

According to human capital theory, increases in a person's stock of knowledge or human capital raise his productivity in the market sector of the economy, where he produces money earnings, and in the nonmarket or household sector, where he produces commodities that enter his utility function. (Becker, 1967 and Porath, 1967). The human capital model as developed by Grossman (1972) predicts that child health will be influenced by the price of health inputs, and views health capital as a critical component of human capital and suggests that its value can be increased over time by investments which could be through medical care and schooling; and it directly contributes to utility.

According to the Grossman theory; those who have obtained higher levels of education are more efficient producers of health; given that health is a function of medical care, environment, and lifestyle, the health production function shifts up and becomes steeper with more education because people can produce it more efficiently. In line with this postulation, the benefits from improvements in health would materialize over time, as increased stocks of health capital delivered future utility flows (consumption value of good health), increased time available in each period of life for market and non-market production (akin to reduced morbidity, from the incapacitation perspective), and also potentially increased length of life (reduced mortality).

2.2.3 Mosley and Chen Model

Mosley & Chen (1984) developed an analytical framework for the study of the determinants of child survival in the developing countries, through an in-depth review of the research methods in the medical and social sciences and logically combining social variables with biological variables in designing the analytical framework on the study of child survival. This work was further reviewed in 2003. They were of the opinion that all social and economic determinants of child mortality necessarily operate through a common set of biological mechanisms, or proximate determinants (intermediate variables) to directly influence the risk of mortality. The framework was built on the premise that all social and economic determinants of childhood mortality

necessarily operate through biological mechanisms or proximate determinants that eventually influence childhood mortality.

The model explained that as long as women favour having smaller families more than their spouses, or put more weight on child-related expenditures, then gains in their bargaining power could improve these outcomes. They argued that traditionally, social scientists tend to focus child mortality studies on the relationship between socioeconomic status and mortality level in a population while the medical causes of deaths are left unaddressed. Mosley and Chen compared how socio-economic factors contribute to child health outcomes and found maternal education and income to be the most common determinants of child mortality in developing countries. Effect of socioeconomic variables is indirect and operates through biomedical factors to bring about mortality and morbidity. Biomedical factors are called intermediate variables or proximate determinants because they constitute middle step between exogenous variables and child mortality. Maternal fertility, environment contamination and injury influence the rate at which healthy children become sick.

Mosley and Chen made distinctions between variables considered to be socio-economic, cultural, community, regional factors; biomedical factors which include hygiene, sanitary measures and nutrition. The framework integrates both social and biological factors that have effect on mortality. The authors have grouped these proximate determinants of morbidity and mortality into five groups. These include; maternal factors, environmental contamination, nutrient deficiency, injury and personal illness control. The framework includes the use of a single-valued measure of morbidity and mortality and identified five intermediate variables through which all socioeconomic factors affect child survival which include maternal factors; environmental contamination; nutrient deficiency; injuries; and personal illness control (prevention, treatment). The underlying variables are expected to influence mortality by operating through the proximate factors. In the framework, the underlying factors were categorized into three levels; characteristics of the mother or father, including their cultural values or attitudes, the social and economic characteristics of the household, e.g. wealth status and municipal variables (i.e. the environment; political economy and health system).

2.3 Review of Empirical Literature

Due to the importance of childhood mortality as a crucial measure of national development, different scholars have embarked on research to investigate empirically, the association between

women education and child survival; the result of such studies have been very revealing and quite educating.

Ripon, Monoj and Shah (2014) studied the impact of maternal education on child health in Bangladesh using data from Household Income and Expenditure Survey HIES 2010, collected by Bangladesh Bureau of Statistics; the result from OLS regression showed that while father's education is positively correlated with child immunizations, mother's education is more critically associated with longer term health outcomes. Also, Agyemang (2013), tried to investigate the effect of education on the health of children under-five years in Ghana using data from Ghana Demographic and Health Survey 2008, and the result obtained from a logistic regression indicates that educational attainment of mothers affects fever, diarrhea, ARI and under-five mortality among children.

Kofi (2014) assessed the effect of education on child survival in Ghana using the data from the 2008 Ghana Demographic and Health Survey with a sample of 2099 children born to mothers within the ages of 15-49 years in the last five years preceding the survey. The result of the univariate, bivariate and multivariate statistical tools used in the analysis indicated that the mothers' level of education does not show any significant association with child survival; rather breastfeeding and number of ante natal visits were among the intermediate variables found to significantly influence the rate of child survival in Ghana.

Adetoro & Amoo (2014) used data from the Nigeria Demographic and Health Survey (NDHS) 2008 to investigate the predictors of children (aged 0-4 years) mortality in Nigeria. The findings suggested that parents' education is a significant predictor of childhood mortality. The study also indicates that occupation of fathers has no significant impact on child mortality, but mothers' occupation played significant role in reducing the risk of child mortality.

Antai (2010) also contributed to the understanding of the underlying mechanisms of child health inequalities in under-five mortality in Nigeria in relation to social context, social stratification and social position. The findings from Cox regression and multilevel logistic regression analysis of the Nigeria Demographic and Health Survey dataset for 2003, revealed that ethnic mortality differences were dependent in part on differences in individual-level socio-economic characteristics, and less directly related with inter-ethnic variation.

A study conducted in Kenya, Senegal, Nigeria and India on regional differentials in infant and child mortality in urban settings using the Measurement, Learning and Evaluation Survey, in ten years prior to the survey. The result indicated that infant mortality was higher in urban than rural

areas, this was attributed to increase in informal settlements in urban areas as a result poor socioeconomic conditions which resulted in poor health conditions especially among mothers and children and low education levels among mothers resulted in poor infant and child feeding practices (MLE, project 2010). Abuya et al (2011) studied the influence of maternal education on child health in Kenya, using data from Kenya Demographic Health Survey (KDHS, 2003) and their result revealed that maternal education significantly influence immunization but was not a significant predictor of childhood nutritional status.

Medrano, Rodriguez and Villa (2008) in a study on the effect that mother's education through the knowledge channel has on children's health using height for age Z-scores as health measure using the South Africa Integrated Household Survey of 1993 and the two-stage least square methodology. The findings from the study indicated that an increase in 4 years on mother's education (approximately 1 standard deviation) will lead to an increase of 0.6 standard deviations on her child's height for age Z-score. The evidence from the tested hypothesis suggest that mother's education is more important for children older than 24 months of age.

A study by Emily, Juan and David (2012) which sought to explore the role of health knowledge, in understanding the association between maternal education and the use of health services in Ghana; using data from 2008 Ghana Demographic and Health Survey, the result from an ordered probit regression models analyses reveal that mothers' years of formal education are strongly associated with health knowledge; health knowledge helps explain the association between maternal education and use of health services; and, net of a set of stringent demographic and socioeconomic controls, mothers' health knowledge is a key factor associated with use of health services.

Nwosu and Orji (2016), in a study on the impact of nutrition on child health, across the six geopolitical zones in Nigeria, education of mother, at both secondary and higher levels of education, was found to be statistically and negatively correlated with the probability of being stunted and underweight and the degree of correlation varies across geopolitical zones with higher negative association in the SW, SE and NW. Abimbola, Adepoju & Falusi (2012), in a study on the determinants of child mortality in rural Nigeria; employing the 2008 Nigeria Demographic and Health Survey (NDHS) data using descriptive statistics and the Logit regression model, concluded that maternal education, access to adequate health care (especially for pregnant women and children under five years) and increased awareness of benefits of breastfeeding were identified as the key factors to reducing child mortality in rural Nigeria.

Pandey (2009) in a similar study carried out in Bangladesh identified that child mortality rate was highest for the children of illiterate mothers and lowest for the children whose mother's educational level is secondary and above. Educated mothers are more likely than non-literate mothers to ensure a healthy environment, nutritious food, and have better knowledge about reproductive health at conception and health care facilities for their children. Literate mothers will give birth to healthier babies because they themselves tend to be healthier and are likely to experience lower mortality among their children at all ages.

Another research on the impact of maternal education and health awareness on child health in Kandahar Province, Afghanistan by Mohammad (2016). The result of the study indicates that maternal health awareness is a significant predictor of health-supportive behaviours regardless of geographic location. Mothers with high level of health awareness were more likely to use contraceptives, made frequent clinic visits during pregnancy, preferred hospital births, received immunization for their children in proper time, complied with World Health Organization's breastfeeding guidelines for their children, and avoided utilization of spiritual and herbal remedies for their ill children.

Bloom et al (2004) used a production function model to analyze the impact of health on economic growth through its effect on labour productivity. The result from a panel data from countries observed at 10-years intervals between 1960 and 1990. They find a strong correlation between health and economic growth, and that: "good health has a positive, sizeable, statistically significant effect on aggregate output" The study concludes that increasing life expectancy by 1 year as a result of improving health conditions contributes to increasing economic growth by about 4% per annum.

Daniel (2003) in his empirical work using Ghana Demographic and Health Survey data of 1998 and World Bank data of 2000; analyzed the effect of mothers' education on childhood mortality in Ghana. The survey established that there is an inverse relationship between mothers' education and child survivorship. The result also indicated that the use of basic health facilities that relate to childhood survival shows a direct relationship with mothers' education. Zerai (1996) employing Cox regression analysis to the 1988 Zimbabwe DHS data to analyze the socioeconomic determinants of infant mortality. The unique finding was that women's average educational levels in their community exerts a greater influence on infant survival than the mother's educational level.

Another study in Zimbabwe, Kembo and Ginneken (2009) sought to establish levels and trends of under-five mortality and to determine the impact of maternal, socioeconomic and environmental contamination variables on infant and child mortality using DHS surveys conducted in Zimbabwe between the period 1996 – 2005. The result showed that the effect of maternal education, though not significant, implied a decline in child mortality with increasing maternal schooling. Patricia et al (1994) studied on the association between maternal education and infant diarrhea in Cebu, Philippians using structured interview of 2484 participants. Their findings suggest that the protective effect of maternal education on infant diarrhea varies according to the socioeconomic environment in which the mother lives; maternal education protects against infant diarrhea in the more economically and socially advantaged communities but has no effect in the more disadvantaged communities. The results also indicate that the protective effect of maternal education is smaller in the wealthier households.

Blunch (2005) examined the impact of maternal literacy and numeracy skills, formal education and adult literacy course participation on child health inputs (vaccinations and postnatal care) and child mortality in Ghana. He adopted an Instrumental Variable (IV)-based two-stage least squares (2SLS) estimation technique to account for the potential endogeneity of maternal skills, schooling and adult literacy course participation. His preliminary results revealed that formal schooling, adult literacy course participation and literacy and numeracy skills have a positive impact on child health input demand and hence reduce child mortality. The author recommended improvement in child health knowledge through the inclusion of health topics in the curricula of adult literacy programmes.

Boachie-Yiadom (2014) in his work tried to model the determinants of under-five mortality in Tano South district of Ghana using logit regression. The results revealed that higher parity, in particular grand multi-gravidae parity has adverse significant impact on under-five mortality. Among the diseases, both anaemia and malaria showed adverse significant impact on under-five mortality. However, while there are factors that adversely impact on under-five mortality, others such as the use of treated bed net, child vaccine, and exclusive breast feeding reduce its likelihood.

Another study in Zimbabwe conducted by Joshua and Jeroen (2009) using data from Demographic and Health Survey (ZDHS, 2006) and a multivariate proportional hazards regression models to analyze the impact of socioeconomic, maternal and sanitation variables on infant and child mortality in Zimbabwe. The result obtained showed that in general the strengths of the relationships of the independent (socioeconomic, maternal and sanitation) variables with the

dependent variables (infant and child mortality) remain much smaller in the 2005-06 ZDHS survey than in the other ZDHS surveys.

Gangadharan and Maitra (2000) in their study used probit model to analyze the sex differentials impact of maternal education on child mortality in Pakistan and found that girls have a significant lower probability of dying in age group 0-1 but have a significant higher probability of dying in the age group 1-5. This higher mortality of girls in the age group 1-5 reflects discrimination against girls in the form of lower health and other resource inputs. Additionally, they found mother's education beyond a certain threshold and increased duration between births to significantly reduce child mortality regardless of the sex of the baby.

Natarajan and Devaki. (2013) using structured interview of 449 mothers who had children falling within the age group of 0-5 years to find whether maternal education really improves child health. The study was to analyze the impact of maternal education on nutritional status, morbidity factors – diarrhea, respiratory infections and personal hygiene. Employing descriptive method of analysis, the study concluded that maternal education definitely has a positive influence on the health of the child by improving the nutritional status of the child but however, it does not affect the morbidity factors and does not play a role in improving the personal hygiene.

In a study on India, Kravdal (2004), using data from National Family Health Survey (1998-1999); estimated logistic models for (15) health and health care indicators (including vaccination of children, whether the woman received antenatal care, received tetanus vaccination and had moderate or severe anemia). The explanatory covariates used to model health and health care indicators include the mother's education, religion, wealth, urbanization, availability of health care facilities and the age of the child. The results indicated that higher mother's education and average education of women in the community are significant in reducing child mortality in India.

Gyimah (2007) using pooled data from the 1998 and 2003 Ghana Demographic Health Surveys and a piecewise constant hazard model with gamma-shared frailty, found at the bivariate level that children whose mothers identified as Muslims and traditional believers have a significantly higher risk of death compared with their counterparts whose mothers were Christians. However, the religious differences disappeared after the mediating and confounding influence of socioeconomic factors were controlled.

Also, Pınar (2013) explores the effect of maternal education on child health and the channels in which education operates by exploiting a change in the compulsory schooling law (CSL) in Turkey; linear probability model was used to analyze data from the Turkish Demographic and

Health Survey (TDHS-2008). The results indicate that mother's primary school completion improves infant health, as measured by very low birth weight, and child health, as measured by height-for-age and weight-for-age z-scores, even after controlling for many potential confounding factors.

For instance, Hobcraft (1993) conducted a review of topical evidence concerning the relative importance of women's education for child health, especially child survival in the 3rd World countries. The result showed that with the exceptions of Botswana and Zimbabwe (for which some information is missing), there is fairly clear evidence of differentiation according to the level of the mother's education in the prevalence of morbidity, but more especially in the treatment of childhood diseases. Hobcraft's findings suggested that educated mothers seem somewhat more successful at reducing the prevalence of diarrhea diseases, but their children seem equally at risk of fevers and coughs. Educated mothers are better informed about ORS packets and generally more likely to make use of these for diarrhea episodes and are also generally more likely to use medical facilities for treatment of diarrhea episodes, fevers, and coughs.

Shamebo et al (1993) used conditional multiple logistic regression analysis in the Butajira project in Ethiopia to assess the relative importance of parental and environmental characteristics in determining child survival. The result revealed that there exist strong association between under-five mortality and paternal illiteracy and not being in the committee of people's organizations. Parental factors affected the infants relatively more than they did in the children especially in acute respiratory infection (ARI) which was found to one of the major causes of under-five deaths.

Pandey et al (1998) analyzing the National Family Health Survey, India, considered child's year of birth, child's sex, mother's age at child birth, residence, mother's literacy, religion/caste/tribe membership, mother's exposure to mass media, availability of toilet facilities, type of cooking fuel and ownership of goods as covariates of infant mortality. The result obtained indicated that among the socioeconomic variables, women's education has repeatedly been shown to influence the chances of infant and child survival. The educational level of the mother is closely linked to both her own and her household's socioeconomic conditions as well as to other complex factors relating to her self-esteem, coping ability, and competence in mobilizing resources for herself and her offspring.

In a related study, Caldwell and McDonald (1982) examined the impact of maternal education on infant and child survival using Nigerian data. The result of this study confirmed the importance of parental education especially mother's education for the observed decrease in infant and childhood

mortality in Nigeria. According to the study, the massive reduction in infant and child mortality observed before 1970's was not only the result of technological and economic changes but also the result of social changes of which parental education played significant role for the improved infant and child survival rate. A related study by Fadare O, Amare M, Mavrotas G, Akerele D, & Ogunniyi A. (2019); examined the association of mother's nutrition-related knowledge with nutrition outcomes of young children in Nigeria. The result strongly suggests that mother's knowledge of nutrition and health is very helpful in safeguarding young children from occasions that reduce children HAZ and WHZ scores.

2.4 Limitation of Previous Work and Value Addition

Several research efforts have been directed towards identifying the determinants of child mortality in Nigeria (Gbemisola 2017, Oniyangi et al 2006; Grais et al 2007; Okoro et al, 2009; Ekenze, 2009; Antai & Moradi, 2010; Adeboye et al, 2010, Adjuik et al 2010, Black & Liu, 2012; Gambrah & Adzadu, 2013; Antai, 2011; UNDP, 2017; Ezeh et. al, 2015). Though most of these studies examined the relationship between the socio-economic status of women and child health, none looked at the primacy of maternal education in driving other socio-economic variable towards influencing child health and mortality. There has not been sufficient examination of the linkage between childhood morbidity as a pathway through which maternal education could influence the rate of children survival. The present study aims to uniquely bridge this gap by extending the frontier of knowledge, through empirical examination of childhood morbidity not only as an outcome (dependent) variable but also as an explanatory variable; with the critical role of maternal education plays in influencing the health status and survival of children from 0 to 59 months in Nigeria.

CHAPTER THREE

RESEARCH METHODOLOGY

This section presents the methodology adopted in this research. This includes information on the theoretical framework, study area, data source, sample size, measurements of concepts, model specifications and estimation techniques.

3.1 Theoretical Review

The theoretical framework to be adopted by this work is the Mosley & Chen (1984) model developed to study the determining factors of child survival in the developing countries. The model assumes that the child might end up being sick (morbidity) and eventually gets better and regains his/her health or the state of health might get worse which then leads to death (mortality).

Deriving from the objectives of the study, there are three dependent variables namely under-five mortality and childhood morbidity; which the work empirically investigated their relationship with maternal education in relation to other intervening variables or covariates, including level of empowerment measured by mother's employment status, belief system (Christian or Muslim), geopolitical zones, wealth index used to measure socio-economic status, sanitation, source of drinking water, vaccination and use of insecticide treated mosquito net.

Following (Greene, 2007); the study employed an instrumental variable probit regression model to examine the nature of association and structural relationship existing between the set of independent (predictor) variables and the outcome variables. This statistical model provides a good description of the relationship between the probability of a response which has two outcomes and the variable or variables that influence(s) this outcome following the cumulative standard normal probability function. The functional form of the model is as presented below:

$$Y = \beta X + \mu \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (a)$$

Where:

Y = Outcome Variable which is either Under-Five Mortality, Childhood Morbidity or Zonal Disparity in maternal education.

β = Vector of parameters

X = Vector of explanatory variables

μ = error term.

3.2 Model Specification by Objectives

In line with the objectives of the study, we estimated two distinct equations; one of which seeks to investigate the association between under 5 mortality and maternal education and related indices of women socio-economic status while the other was used to trace the relationship between childhood morbidity and socio-economic variables linked to maternal education. The discussions so far presented in this work suggests that the health and survival of a child could be influenced by the level of mother's education which is the critical pathway for influencing the socio-economic status of women and in effect the wellbeing of the entire family members.

The relationship between the maternal education, mother's socio-economic status and child's survival measures shall be estimated using two different regression models as specified below:

3.2.1 Model 1, Objective One

To find the extent to which maternal education influences under-five mortality in Nigeria, we specified an instrumental variable probit model in the form:

$$UM = C + \alpha MEd_i + \beta MAg_i + \theta Mn_i + \lambda Bf_i + \delta CAg_i + \vartheta Sx_i + \psi Vc_i + \omega Dw_i + \phi Hs_i + \eta Cm_i + \gamma Wm_i + \Upsilon Rp_i + \pi GZ_i + \varepsilon_i \ldots\ldots (Model\ 1)$$

Where:

$MEd = Maternal\ Year\ in\ Formal\ Education, MAg = Maternal\ Age,$

$Mn = Use\ of Mosquito\ net, Bf = Exclusive\ Breastfeeding, Bf = Child'sAge,$

$Sx = Child's\ Sex, Vc = Vaccination, Dw = Improved\ Drinking\ Water,$

$Hs = Handwashing\ Place, Cm = Child\ Morbidity, Wm = Index\ of\ Wealth,$

$Rp = Place\ of\ Residence, GZ = Geopolitical\ Zone.$

$C = constant\ while\ \varepsilon_i = error\ term.$

The notations $\alpha, \beta, \theta, \lambda, \delta, \vartheta, \psi, \omega, \phi, \eta, \gamma, \Upsilon, and\ \pi\ are\ parameter\ estimates.$

In the above model, Under-five mortality denoted by UM is the dependent variable which is regressed on years of maternal education plus other socio-economic variables. Importantly, the Cm which denotes Childhood Morbidity functions as an explanatory variable in our model 1 while in our model 2, functioned as a dependent variable.

3.2.2 Model 2, Objective Two

The second objective of the present study is to investigate the effect of maternal education on childhood morbidity, is captured by the model presented below:

$$CM = C + \alpha MEd_i + \beta MAg_i + \theta Mn_i + \lambda Bf_i + \delta CAg_i + \vartheta Sx_i + \psi Vc_i + \omega Dw_i + \phi Hs_i + \gamma Wm_i + \Upsilon Rp_i + \pi GZ_i + \varepsilon_i \ldots\ldots (Model\ 2)$$

Model 2 above, is also estimated using the Ivprobit regression but considers childhood morbidity (the dependent variable) as an outcome variable resulting from variations in other socio-economic indicators used as explanatory variables in the model.

$$Where: MEd = Maternal\ Year\ in\ Formal\ Education, MAg = Maternal\ Age,$$
$$Mn = Use\ of Mosquito\ net, Bf = Exclusive\ Breastfeeding,$$
$$Bf = Child'sAge, Sx = Child's\ Sex, Vc = Vaccination,$$
$$Dw = Improved\ Drinking\ Water,\ \ Hs = Handwashing\ Place,$$
$$Cm = Child\ Morbidity, Wm = Index\ of\ Wealth,$$
$$Rp = Place\ of\ Residence, and\ GZ = Geopolitical\ Zone\ .$$

3.2.3 Model 3, Objective Three

To determine the extent to which zonal disparity in maternal education account for much of the variations in child health outcomes across the six geopolitical zones in Nigeria, we employed a multinomial probit model of the form presented below:

$$UMGZ_i = C + \alpha MEd_i + \beta MAg_i + \delta FEd_i + \psi Vc_i + \delta Bs_i + \gamma Wm_i + \varepsilon_i \ldots\ldots (Model\ 3)$$

In the above model, $UMGZ_i$ which denotes under-five mortality in each geopolitical zone, is the dependent variable and considering that there are six geopolitical zones in Nigeria, this dependent variable is not binary hence the use of multinomial probit. The model seeks to principally investigate the effect of maternal education and other proximate variables on the level of under-five mortality in each region in Nigeria. The explanatory variables used in the above model include:

$$MEd = Maternal\ Year\ in\ Formal\ Education, MAg = Maternal\ Age,$$
$$FEd = Fathers\ Education, Bs = Belief\ System, Vc = Vaccination$$
$$and\ Wm = Index\ of\ Wealth.$$

3.3 Variables and Variable Measurements

The use of binary probit regression models in this study requires that the dependent variable be a binary variable. For the third objective which measures the extent to which zonal disparity in maternal education account for the much variations in child health outcome across the six geopolitical zones in Nigeria, we used the multinomial probit model for the estimation of the extent and direction of effect. For the estimations for which the probit model has been adopted, all the independent variables are binary while for the multinomial probit, the dependent variable is categorical and not binary. Conversely, some of the independent variables are continuous while others are categorical values. It is important to note that for the descriptive statistics, the categorical form of the variables is employed to analyze the association between child health indicators and socioeconomic characteristic of households in the survey. The analytical framework to be used in this study was on the basis of Mosley and Chen framework (1984) while the econometric model for analysis used in the study is the ivprobit regression model.

3.3.1 Dependent/Outcome Variables

This study measured two outcome (dependent) variables namely, under-five mortality which indicates the probability of a child dying reaching age five years and childhood morbidity which measures the prevalence and case fatality rate of diarrhea and fever among under five children in the sample. The under-five mortality, the categorization of the dummy would be achieved through answering the question of whether the child is alive after the fifth birthday, with the responses categorized as; 0 = Not Dead; 1 if dead. On the second dependent variable, a child is adjudged to suffer morbidity if s/he in the last 7 days before the survey experienced (diarrhoea and or malaria/fever); implying that if the child must have witnessed diarrhoea for the case to be labelled morbidity.

The third dependent variable used in this study is zonal disparity in years of maternal education and with the six geopolitical zones, the variable is not binary in nature and the application of a binary dummy is not possible; hence, the use of a multinomial probit. The proposition of the study is that under-five mortality defined as the probability of dying between birth and the fifth birthday (0-59 months) could be influenced by maternal education probably operating through some

intervening variables such as socio-economic status, environmental conditions, preventative practices and variations in culture arising from differences in geopolitical orientation, to determine the likelihood of child survival.

3.3.2 Independent Variables

The selection of independent variables in this study was guided by the conceptual framework as well as the theoretical foundation established from the reviewed literature. It is important to note that some of independent variables were not used in estimating the econometric model (the probit and multinomial probit models) but were analysed descriptively. The independent variables which in this study also functioned as the underlying factors that determine child health outcomes are as defined in the Table below.

Table 3.3.1: Independent Variables Used in the Econometric Model

S/N	Variables	Coding
1	Maternal Education	Number of years spent in formal education by a mother age 14 – 45 years
2	Mother's Age	Mother's Age in years (15 – 49)
3	Insecticide Treated Mosquito Net	1 = Slept under ITN, 0 = otherwise
4	Exclusively Breastfed	1 = Exclusive Breastfed, 0 = otherwise
5	Child Age Bracket (in months)	1 = 7-12; 2 = 13-24; 3 = 25-59 months; 0 = Otherwise
6	Child Sex	1 = Male, 0 = Female
7	Vaccination	1 = Received vaccination; 0 = Otherwise
8	Drinking Water Sources	1=improved source, 0 = Otherwise
9	Hygiene (Handwash Place)	1= Yes, 0 = Otherwise
10	Child morbidity	1 = Morbidity (Diarrhoea, and or fever), 0 =Otherwise
11	Index of Wealth (Has Radio)	1 = Yes, 0 = Otherwise
12	Place of Residence	1 = Urban, 0 = Otherwise
13	Geopolitical Zone	1 = North-East, 2 = North-West; 3 = South-East, 4 = South-South; and 5 = South-West, and North-Central =0

Instrumental Variables Used for Maternal Education

S/N	Variables	Coding
1	Husbands' Education	Years of Education
2	Use of Condom (Family	1 = Yes, 0 = Otherwise

	Planning)	

Source: Author's Compilation

In the course of the study we observed some measurement problems inherent in some of the variables and their implication for the reliability and consistency of the parameter estimates in the econometric model. Most of the socioeconomic variables have endogeneity problems while others have multicollinearity problems which is capable of generating spurious results. Though these variables have been used in the descriptive analysis of relationships, they cannot be directly employed in the analysis of cause-effect which we used the econometric models to measure. The Table below shows these variables.

Table 3.3.2. Variables and Coding for the Descriptive Statistics

S/N	Variables	Coding
1	Maternal Education	1 = Primary Education, 2 = Secondary Education, 3 = Above Secondary Education; 0 = No Education
2	Mother's Employment Status	1= working, 0 = not working
4	Belief System (Religion)	1 = Christian, 2 = Muslim
5	Child's Sex	1 = Male, 0 = Female
6	Mothers' Age Bracket	1 = (15-24); 2 = (25-34); 3 = (35-49)
7	Child Age Bracket (in months)	1 = 7-12; 2 = 13-24; 3 = 25-59 months; 0 = Otherwise
8	Exclusively Breastfed	1 = Exclusive Breastfed, 0 = otherwise
9	Use of Treated Mosquito Net	1 = Slept under ITN, 0 = otherwise
10	Drinking Water Sources	1=improved source, 0=otherwise
11	Hygiene (Handwash Place)	1= Yes, 0 = Otherwise
12	Vaccination	1 = Received Vaccination; 0 = Otherwise
13	Wealth Index	0 = Poor, 1 = Middle, 2 = Rich
14	Place of Residence	0 = Rural, 1 = Urban Residence
15	Childhood Morbidity	0 = No Morbidity, 1 = Morbidity
16	Geopolitical Zone	I = North-Central, 2 = North-East, 3 = North-West; 4 = South-East, 5 = South-South; and 6 = South-West.

Source: Authors Compilation

Women employment status has a perfect link to maternal education leading to multicollinearity problem. The index of wealth measurement has endogeneity problem, hence in the econometric model, we used access to radio as a proxy. It is pertinent to note that for our demographic characteristics of respondents, we used levels of education rather than number of years of

education. This became critical because we wanted to show the relationship existing between maternal education and other socio-economic variables used in the study. Basically, deriving from the conceptual framework, the selected independent variables in this study are those known to have influence on child survival as established in existing literature reviewed. The background variables (e.g. maternal education, geopolitical zone/region) therefore operate through intervening variables (e.g. sanitation, source of drinking water, employment status, vaccination) to influence the morbidity status of the child and possibly mortality rate among these children.

3.4 Estimation Technique

We employed two different models to estimate the three objectives of the study. The first two objectives were estimated using an Instrumental Variables Probit (IVP) regression model while the third objective was estimated with a Multinomial Probit regression. This became expedient given that the maternal education data has endogeneity problem, thus, to ensure that the explanatory variable is uncorrelated with the error term making the estimates unbiased and consistent, we adopted the two stage least square (2SLS) instrumental variable procedure.

The use of the probit model is predicated upon the fact that our dependent variables are dichotomous and as such, we cannot predict a numerical value that are continuous for these variables, so the usual regression least squares deviations criteria for best fit approach of minimizing error around the line of best fit is inappropriate. In the two models, the dependent variables (morbidity and mortality) was dichotomized to take the value of "1" if the event occurs (i.e., death of a child), and "0" if the event does not occur (i.e., child survives). The choice of the probit model against the logit is based on the fact that the instrumental variable approach is more developed for the probit model than the logit as there is ivprobit but no ivlogit in Stata. The Probit regression models the probability that Y=1 using the cumulative standard normal distribution function. The probit model (Greene, 2012) is of the form:

$$y_{i=}\ a_i + bX_i + \mu_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1.1)$$

Y is the dependent binary variable dead/alive; α is the constant term; β is a k × 1 vector, X is an n × k matrix of covariates; μ is the error term.

However, the probit model can be biased because of endogeneity. In this case, the correlation between the regressors and the error term is not zero (E (X, u) ≠ 0), so that the results of the estimation are inconsistent

$$Prob(Y = 1|X) = \int_{-\infty}^{\chi'\beta} \phi(t)dt = \Phi(\chi'\beta) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1.2)$$

$$Prob(Y = 1|X) = \Phi(\beta_o + \beta_1 X_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1.3)$$

where the function $\phi(t)$ is a commonly used notation for the standard normal distribution function.

Given the proposition to use the 2SLS instrumental variable probit (ivprobit) model, the study employed an instrument Z_i for the maternal education variable (Ed_i) which should satisfy the conditions that $E[\varepsilon_i|Z_i] = 0$ and that $Cov[Z_i|Ed_i] \neq 0$. The variables used as instruments for generating an exogenous maternal education data are father's education and use of condom.

Accordingly, to generate the instrument Z_i; we regressed

$$Z_i = Hd_i + Cd_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (b)$$

Where:

$Z_i = Instrument\ for\ Maternal\ Education$

$Fed_i = Fathers' Education$

$Cd_i = Use\ of\ Condom$

The second model used in the study is a multinomial probit regression. The multinomial probit model is a generalization of the probit model used when there are several possible categories that the dependent variable falls into. The six geopolitical zones in Nigeria which formed the dependent variable as implied in the third objective, are not binary but has six categories which the dependent variable could fall into.

The Multinomial Logit Model is presented below:

$$P(y_i = j) = P\left(U_{ij} \geq U_{ik}\middle|\chi, \text{ЎK} \neq \text{j}\right) = P\left(\varepsilon_{ik} - \varepsilon_{ij} \leq \chi'_{ij}\beta_k\middle|\chi, \text{ЎK} \neq \text{j}\right) \ldots\ldots (2.1)$$

$$P(y_i = j) = \frac{exp(X'_{ij}\beta_j)}{\sum_k exp(X'_{ik}\beta_k)} \ldots\ldots\ldots\ldots\ldots (2.2)$$

$$P(y_i = 0) = \frac{1}{1 + \sum_k exp(X'_{ik}\beta_j)}, K = 1, \ldots\ldots\ldots\ldots\ldots, J \ldots\ldots\ldots (2.3)$$

The multinomial logit model is formed with under-five mortality in each of the six geo-political zones in Nigeria. To present the multinomial logit model in general, we have:

$Y_{ij} = 1, represents\ cases\ of\ under-5\ mortality\ in\ region\ j, (j = 0, 1, 2, 3, 4, 5, 6\ and\ 7)$

$Y_{ij} = 0, if\ otherwise$

Further, let

$$\pi_{ij} = \Pr(Y_{ij} = 1), where\ Pr\ stands\ for\ probability$$

Therefore, $\pi_{i0,}\pi_{i1,}\pi_{i2,}\ \pi_{i3,}\ \pi_{i4,}\pi_{i5,}\ and\ \pi_{i6,}$ represent the probabilities that under-five mortality occurs in region 1, 2, 3, 4, 5 and 6; while $\pi_{i0,}$ is the probability that under-five mortality did not occur. The dependent variable therefore, is the dummy of the occurrence of under-five mortality in each of the six geo-political zones in Nigeria. Note also that since this study is a disaggregated analysis, the effects of maternal education, religion and wealth on under-five mortality in each of the region was individually examined through the application of the multinomial logistic regression. Therefore, we derive the following estimates of the probabilities for the seven possible outcomes.

$$\pi_{i0} = \frac{1}{1+ e^{\alpha1+\beta1Xi} +e^{\alpha2+\beta2Xi} +e^{\alpha3+\beta3Xi} +e^{\alpha4+\beta4Xi} +e^{\alpha5+\beta5Xi} +e^{\alpha6+\beta6Xi} +e^{\alpha7+\beta7Xi}} \quad \ldots\ldots\ldots\ldots\ldots (3.1)$$

$$\pi_{i1} = \frac{e^{\alpha2+\beta2Xi}}{1+ e^{\alpha1+\beta1Xi} +e^{\alpha2+\beta2Xi} +e^{\alpha3+\beta3Xi} +e^{\alpha4+\beta4Xi} +e^{\alpha5+\beta5Xi} +e^{\alpha6+\beta6Xi} +e^{\alpha7+\beta7Xi}} \quad \ldots\ldots\ldots\ldots\ldots (3.2)$$

$$\pi_{i2} = \frac{e^{\alpha3+\beta3Xi}}{1+ e^{\alpha1+\beta1Xi} +e^{\alpha2+\beta2Xi} +e^{\alpha3+\beta3Xi} +e^{\alpha4+\beta4Xi} +e^{\alpha5+\beta5Xi} +e^{\alpha6+\beta6Xi} +e^{\alpha7+\beta7Xi}} \quad \ldots\ldots\ldots\ldots\ldots (3.3)$$

$$\pi_{i3} = \frac{e^{\alpha4+\beta4Xi}}{1+ e^{\alpha1+\beta1Xi} +e^{\alpha2+\beta2Xi} +e^{\alpha3+\beta3Xi} +e^{\alpha4+\beta4Xi} +e^{\alpha5+\beta5Xi} +e^{\alpha6+\beta6Xi} +e^{\alpha7+\beta7Xi}} \quad \ldots\ldots\ldots\ldots\ldots (3.4)$$

$$\pi_{i4} = \frac{e^{\alpha5+\beta5Xi}}{1+ e^{\alpha1+\beta1Xi} +e^{\alpha2+\beta2Xi} +e^{\alpha3+\beta3Xi} +e^{\alpha4+\beta4Xi} +e^{\alpha5+\beta5Xi} +e^{\alpha6+\beta6Xi} +e^{\alpha7+\beta7Xi}} \quad \ldots\ldots\ldots\ldots\ldots (3.5)$$

$$\pi_{i5} = \frac{e^{\alpha6+\beta6Xi}}{1+ e^{\alpha1+\beta1Xi} +e^{\alpha2+\beta2Xi} +e^{\alpha3+\beta3Xi} +e^{\alpha4+\beta4Xi} +e^{\alpha5+\beta5Xi} +e^{\alpha6+\beta6Xi} +e^{\alpha7+\beta7Xi}} \quad \ldots\ldots\ldots\ldots\ldots (3.6)$$

$$\pi_{i6} = \frac{e^{\alpha7+\beta7Xi}}{1+ e^{\alpha1+\beta1Xi} +e^{\alpha2+\beta2Xi} +e^{\alpha3+\beta3Xi} +e^{\alpha4+\beta4Xi} +e^{\alpha5+\beta5Xi} +e^{\alpha6+\beta6Xi} +e^{\alpha7+\beta7Xi}} \quad \ldots\ldots\ldots\ldots\ldots (3.7)$$

Note that in Equations (3.2) through (3.7), we use X to denote the regressors which have been defined above. Although the same regressors appear in each response probability expression, their co-efficient will not necessarily assume the same values. Equations (3.2) through (3.7), which in the form presented above are nonlinear in nature, were converted to linear functions, which define the multinomial logit relative risk ratio. The relative risk ratio in this study gives us the probability

that under-five mortality will likely occur in a region when compared with the alternative outcomes, relative to other regions in the country.

3.5 Model Justification

The use of the binary Probit regression is usually estimated using Maximum Likelihood Estimation (MLE), unlike linear regression which uses the Ordinary Least Squares (OLS) approach is crucial in undertaking this study given the type and nature of our variables. The probit regression, also called a probit model, was used to model the dichotomous or binary outcome variables of the study which include under – five mortality and childhood morbidity (Greene 2012). Because of the endogeneity problem inherent in maternal education variable and given that there is no ivlogit command in Stata, the study shall adopt the ivprobit which would enable us to employ the two stage least square (2SLS) instrumental variable approach to control for endogeneity in the two models specified. For the two models to be estimated in this study, the dependent variables; under 5 mortality and childhood morbidity could take the dummy form of 0 or 1, hence the use of the ivprobit model is apt. Conversely, because the dependent variable in the third model has more than two categories, hence not a binary dummy, it was estimated using the multinomial probit regression.

3.6 Study Area

The study area, Nigeria, lies between latitudes 4º16' and 13º53' north and longitudes 2º40' and 14º41' east in the West African sub-region. The country shares borders with Niger in the north, Chad in the northeast, Cameroon in the east, and Benin in the west and in the south by approximately 850 kilometres of Atlantic Ocean (National Population Commission, 2009). According to the 2006 population and housing census, Nigeria's population was 140,431,790 with a national growth rate of 3.2% per annum. The country is the most populous in Africa and the sixth largest in the world after China, India, USA, Indonesia, and Brazil. In 2018, female population for Nigeria was 94.8 million persons. Over the last 50 years, female population of Nigeria grew substantially from 26.8 million to 94.8 million persons rising at an increasing annual rate that reached a maximum of 2.99 % in 1978 and then decreased to 2.61 % in 2018.

3.7 Data Source and Sample Size

This study utilized secondary data from the Nigeria Demographic and Health Survey (NDHS) conducted in 2013 having obtained permission from ICF Macro Inc., USA before downloading the

datasets. It provided information about women aged 15 – 49 and children of age 0 – 5 years across Nigeria. The information in the sample survey included maternal education and child mortality at the national, geopolitical and state levels across rural and urban settlements. The 2013 NDHS sample was selected using a stratified three-stage cluster design consisting of 904 clusters, 372 in urban areas and 532 in rural areas while the total number of households interviewed was 40,680, 16,740 from urban areas and 23,940 from rural areas. Specifically, a fixed sample take of 45 households were selected per cluster. A nationally representative sample of 38,948 women in all selected households and 17,359 men age 15–49 in half of the selected households were interviewed. All women age 15-49 who were either permanent residents of the households in the 2013 NDHS sample or visitors present in the households on the night before the survey were equally interviewed. From this survey, the number of observations used in the study was 16,536 for the household level and 18,563 observation for the individual level.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1 Descriptive Statistics and Demographic Characteristics of the Respondents

To investigate the effect of maternal education on child health outcomes, this study determines the relative effect of formal education of mothers on the occurrence of mortality, diarrhoea among children below five years. The relationship between maternal education and each of these child health outcomes is expressed using the probit regression model. The hypotheses formulated for this study guided the arrangement of the Tables and the summary of the main findings follows each hypothesis. This chapter commences by first considering the descriptive statistics of the regression variables whilst the second part of the chapter focuses on the empirical estimations and discussions of the results. The study employed both descriptive and inferential statistical techniques to draw its inferences and test requisite hypotheses.

The relationship between maternal education and each of these child health outcomes is expressed using the probit regression model. The coefficient of the marginal effects of maternal education in each model explains the relative impact of mothers' formal education on child's health outcomes. The descriptive statistics made use of frequency distribution and simple percentages while the instrumental variable Probit and multinomial Logit regressions were the inferential statistics used to answer the three basic research questions.

The NDHS, 2013 child recode data was obtained by administering survey interview and questionnaire to elicit information from women who had given birth within the five years that preceded the survey questions pertaining to maternal and child health. The total number of respondents for which household level of survey data were analyzed were eighteen thousand five hundred and sixty-three (18,563) while the total number of under-five children in the sample was sixteen thousand five hundred and thirty-six (16,536). The data obtained which are relevant to this study are summarized in Tables 4.1.1 to 4.1.4.

Presented in Table 4.1.1 above is the socio-demographic characteristics of the women of child bearing age who constitute the respondents for the study.

Table 4.1.1: Selected Socio-demographic Characteristics of Respondents

Variables and Categories	Frequency	Percentages
Age Group (Mother's Age in Years)		
15 - 24	4735	25.5
25 – 34	8768	47.2
35 – 49	5060	27.3
Maternal Level of Education		
No formal Education	9809	52.8
Primary Education	4732	25.5
Secondary Education	3114	16.8
Higher Education	908	4.9
Place of Residence		
Urban	6418	34.6
Rural	12145	65.4
Geo-Political Zone		
North Central	2897	15.6
North-East	3631	19.56
North-West	5605	30.2
South-East	1567	8.4
South-South	2341	12.6
South-west	2522	13.6
Religious System		
Christian	4251	22.9
Islam	14312	77.1
Wealth Index		
Poor	12567	67.7
Middle	4975	26.8
Rich	1021	5.5
Sources of Drinking Water		
Improved Water Sources	10119	54.5
Unimproved Water Source	8444	45.5
Use of Mosquito Nets		
Yes	3972	21.4
No	14591	78.6
Handwash Place		
Observe Handwash	6876	37.0
Do not Observe	11687	63.0

Source: Author's Compilation from NDHS, 2013

The distribution shows that only 4.9% of the women attended higher education spending on the average 16 years in formal education while 52.8% of the respondents never attained any formal education; while the remaining 25.5%, and 16.8% attended only primary and secondary education respectively. The Table shows that majority of respondents about 77.1% have Islam as their religious belief, 65.4% of the mother reside in rural areas while 34.6% are urban dwellers. Also, a

greater percentage of the respondents, about 65.4%, are from the northern Nigeria, while the remaining 34.6% are from the southern part of the country with the South East having one thousand five hundred and sixty-seven (1567) maternal women representing 8.4% being the least share of women in the sample.

Table 4.1.2: Maternal Education, Socio-economic Status and Child Health Outcomes

Distribution of Levels of Maternal Education, Socio-economic Status and Child Health Outcomes				
Socio-economic Characteristics	Levels of Maternal Education			
	No Education	Primary Education	Secondary Education	Higher Education
	(n = 9809)	(n = 4732)	(n = 3114)	(n = 908)
Geopolitical Zones				
North Central	3.9%	13.5%	9.9%	25%
North-East	28.9%	20.6%	11.9%	16.7%
North-West	63.3%	21.5%	12.7%	3.1%
South-East	1.6%	16.1%	20.6%	29.2%
South-South	0.8%	16.4%	20.3%	11.5%
South-west	1.4%	11.8%	25.3%	14.5%
Under 5 Mortality				
Yes (Child died)	46.4%	39.4%	25.5%	23.2%
No (Child is alive)	53.6%	60.6%	74.5%	76.8%
Child Received Vaccination				
Yes	68.2%	83.8%	90.9%	95.7%
No	31.3%	16.2%	9.1%	2.4%
Source of Drinking Water				
Unimproved	48.9%	41.4%	23.3%	16.9%
Improved	51.1%	58.6%	76.7%	83.1%
Type of Toilet Facilities				
Unimproved	56.0%	57.8%	38.5%	19.1%
Improved	44.0%	42.2%	61.5%	80.9%
Place of Residence				
Urban	14.1%	31.6%	46.3%	66.7%
Rural	85.9%	68.4%	53.7%	33.3%
Belief System (Religion)				
Christian	6.9%	56.2%	73.2%	82.3%
Islam	93.1%	43.8%	26.8%	17.7%
Wealth Index				
Poor	81.7%	43.1%	17.3%	1.1%
Middle	13.0%	29.1%	22.6%	15.6%
Rich	5.3%	27.8%	60.2%	83.3%

Source: Author's Compilation from NDHS, 2013

The Table 4.1.2 shows the existence of widespread disparity in levels of maternal education across the six geopolitical zone in Nigeria is evident. The North West had the highest proportion of

women without any formal education experience (63.3%), followed by the North East 28.9% while South-South with (0.8%) has the least proportion of women without any formal education and the highest proportion of women that attended primary education. The South-West has the least number of women who attended only primary education (11.8%) and the highest number of women who attended secondary education (25.3%); while the South East has the highest proportion of women who attended higher or tertiary education (29.2%).

The table also shows that probably, under-five mortality varies with the level of education, thus it is possible that as the level of education increases, the proportion of under-five deaths reduces. For instance, of the total children born to women with no formal education, 46.4% died, as the level of education increased to primary school, the proportion of under-five children that died declined to 39.4% while for secondary and higher education, the proportion became 25.5% and 23.2% respectively.

Table 4.1.3: Demographic Characteristics of Under 5 children and Health Outcomes

Variables and Categories	**Frequency**	**Percentages**
Age (Months)		
0 – 11	4332	20.5%
12 – 24	3732	17.6%
25 – 59	13096	61.9%
Sex		
Male	9350	50.4%
Female	9213	49.6%
Vaccination (Ever Received Vaccination)		
Yes	8730	47%
No	9833	53%
Diarrhea (two weeks preceding the survey)		
Yes	5031	27.1%
No	19261	72.9%
Fever (two weeks preceding survey)		
Yes	2888	13.6%
No	18272	86.4%
Under 5 Mortality (Child 0 – 59 Months, died)		
Yes (Child died)	24641	14.9%
No (Child is alive)	14072	85.1%

Source: Author's Compilation from NDHS, 2013

Table 4.1.3 below shows the distribution of selected demographic characteristics of under-five children and some health outcome indicators. The total number of under five children in the sample is sixteen thousand five hundred and thirty-six (16536).

The age distribution of under-five children shows that a greater percentage of the children (61.9%) are more than two years (25 – 59 months); 17.6% are between one to two years while 20.5% are less than one year; while 50.9% of the children are male, 49.1% are female. The percentage distribution shows that the proportion of children experienced diarrhea two weeks preceding is 27.1%; 43.4% of the under five children in the sample ever received vaccination while about 15% could not survive beyond their fifth birthday.

Table 4.1.4: Distribution of Socio-economic Variables According to Geo-political Zones

Socio-economic Variables	Geo-Political Zones					
	North Central	North East	North West	South East	South South	South West
Maternal Level of Education						
No Education	38.0%	61.1%	62.8%	18.7%	13.0%	17.0%
Primary Education	22.5%	13.8%	11.6%	21.0%	23.1%	19.4%
Secondary Education	36.2%	17.0%	16.5%	59.6%	57.6%	54.9%
Higher Education	9.7%	4.9%	2.5%	14.2%	14.2%	17.4%
Mothers' Employment Status						
Unemployed	56.3%	83.9%	77.5%	49.8%	50.3%	26.7%
Employed	43.7%	16.1%	22.5%	50.2%	49.7%	73.3%
Wealth Index						
Poor	42.2%	82.4%	84.9%	13.9%	15.9%	32.4%
Middle	35.2%	11.5%	9.3%	57.6%	54.9%	39.5%
Rich	22.5%	6.1%	5.8%	28.5%	29.2%	28.1%
Child Received Vaccination						
Yes	73.2%	48.1%	52.7%	87.5%	94.4%	91.3%
No	26.8%	51.9%	47.3%	12.5%	5.6%	8.7%
Child Mortality Incidence						
Under Five Child (Alive)	68.8%	49.7%	46.7%	65.1%	71.1%	70.3%
Under Five Child (Dead)	31.2%	50.3%	53.3%	34.9%	28.9%	29.7%

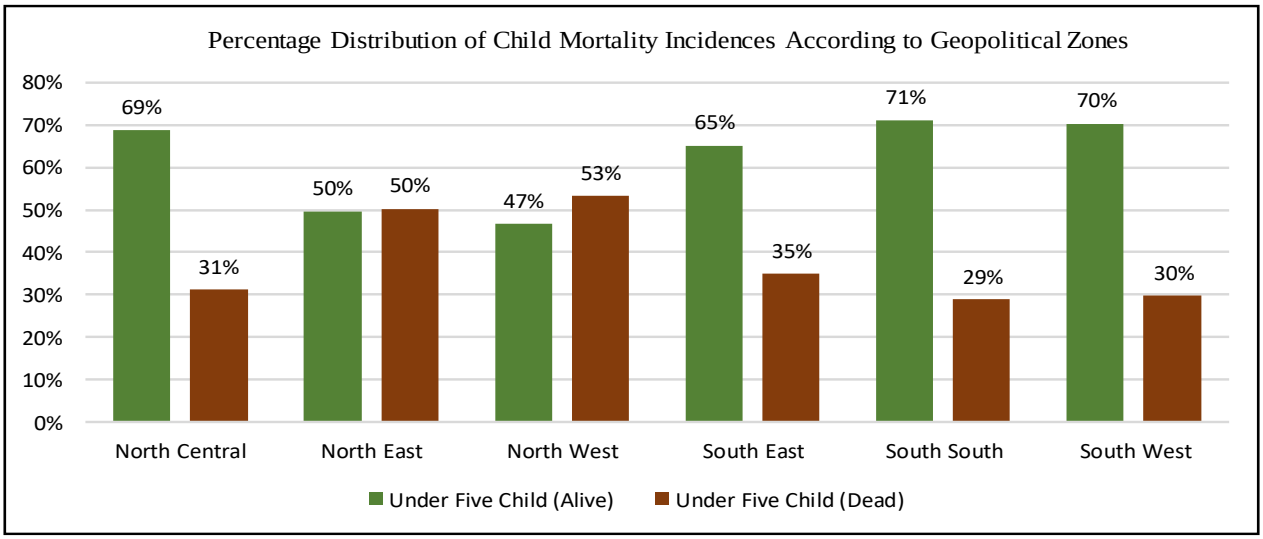
Source: Author's Compilation using NDHS, 2013

Table 4.1.4 above shows the distribution of selected socio-economic variables according to geopolitical zones and portrays the inequality in socio-economic status of women across the six regions in Nigeria. For all the regions in northern Nigeria, a greater proportion of their women population did not receive any formal education while in the Southern part of the country, a greater percentage of women acquired secondary education which is 59.6%, 57.6% and 54.9% for South East, South-South and South West respectively. The statistics shows that 38% of the total maternal women in North Central did not acquire any formal education, 22.5% had primary education, 36.2% had secondary education while only 9.7% attained higher education. Across all the geo-political zones, the least proportion of women attended higher education.

On employment status of respondents, Table 4.1.4 depicts that the entire regions in the northern part of the country as well as South-South has a greater proportion of their women not involved in any paid employment including self-employment. North-East has the higher percentage of unemployed women of about 83.9%, followed by North West 77.5%, North Central 56.3%, and then South-South 49.8%. South East with 50.2% of the surveyed women employed and South West which has 73.3% of women employed; making the two regions the only regions where with a greater proportion of their women involved in paid employment.

Child vaccination or immunization is another determinant of morbidity for which there exist differences across the six geo-political divides in Nigeria. The North East is the region with lowest proportion of under-five children who received vaccination 48.1% while South-South has the highest proportion (94.4%) of children vaccinated against diseases which closely followed by South West 91.3%. In terms of mortality (death of under-five children), North West had the highest proportion of under-five deaths (53.3%) while South-South had the least 29.7%. The North Central is a distinct region in the Northern Nigeria, is the only region where the proportion of children who are alive (68.8%) is higher than the reported cases of under-five mortality in the region. Observably, the distribution shows that the proportion of reported cases of under-five mortality in the South East (34.9%) is higher than the proportion in the North Central. The bar chart below presents a snapshot of the percentage distribution of reported cases of under-five mortality in Nigerian Six geopolitical zone as obtained in the NDHS, 2013.

Figure 4.1.1: Distribution of Child Mortality Incidences According to Geo-political Zones



Source: Authors Compilation from NDHS, 2013

4.2 Discussion of Empirical Results

The result of the empirical test of the three hypotheses of the study is discussed in sequence below.

4.2.1. The Effect of Maternal Education on Under-five Mortality

Presented in Table 4.2.1 is the regression result for model 1, which seeks to investigate whether mother's level of education has significant effect on under-five mortality in Nigeria.

Table 4.2.1: Results for Model 1

		Stage 1	Stage 2	
Under-Five Mortality	Model 1	ME Model 1	Model 1	ME Model1
mothereduyrs			-0.0383***	-0.0383***
			(0.000)	(0.000)
diarrhea (d)	-0.179	0.0334	0.0334	0.0334
	(0.051)	(0.474)	(0.474)	(0.474)
exclusivebf (d)	0.100	0.0179	0.0179	0.0179
	(0.537)	(0.832)	(0.832)	(0.832)
childage_dummy1 (d)	0.202	0.142*	0.142*	0.142*
	(0.126)	(0.037)	(0.037)	(0.037)
childage_dummy2 (d)	0.383***	0.146**	0.146**	0.146**
	(0.000)	(0.002)	(0.002)	(0.002)
childage_dummy3 (d)	0.148*	0.108**	0.108**	0.108**
	(0.037)	(0.005)	(0.005)	(0.005)
child_sex (d)	0.107*	-0.00120	-0.00120	-0.00120
	(0.050)	(0.967)	(0.967)	(0.967)
received_vaccination (d)	0.0498	-0.0161	-0.0161	-0.0161
	(0.388)	(0.609)	(0.609)	(0.609)
mother_age	-0.0498***	0.0105***	0.0105***	0.0105***
	(0.000)	(0.000)	(0.000)	(0.000)
mosquito_net_access (d)	-0.0649	0.0531	0.0531	0.0531
	(0.326)	(0.135)	(0.135)	(0.135)
has_radio (d)	0.647***	-0.00584	-0.00584	-0.00584
	(0.000)	(0.861)	(0.861)	(0.861)
drinking_water (d)	0.467***	-0.0308	-0.0308	-0.0308
	(0.000)	(0.324)	(0.324)	(0.324)
handwashplace (d)	0.166**	-0.0809*	-0.0809*	-0.0809*
	(0.005)	(0.012)	(0.012)	(0.012)
residence (d)	1.394***	-0.0709	-0.0709	-0.0709
	(0.000)	(0.083)	(0.083)	(0.083)
zone1 (d)	-1.750***	-0.0370	-0.0370	-0.0370
	(0.000)	(0.579)	(0.579)	(0.579)
zone2 (d)	-2.965***	0.239***	0.239***	0.239***
	(0.000)	(0.001)	(0.001)	(0.001)
zone3 (d)	-3.812***	0.295***	0.295***	0.295***
	(0.000)	(0.000)	(0.000)	(0.000)
zone4 (d)	1.008***	0.229**	0.229**	0.229**
	(0.000)	(0.001)	(0.001)	(0.001)
zone5 (d)	0.407***	-0.000399	-0.000399	-0.000399
	(0.000)	(0.995)	(0.995)	(0.995)
fathereduyrs	0.413***			
	(0.000)			
morthern_familyplaning	1.345***			
	(0.000)			
N	16536			
pseudo R^2	0.047			
ll	-4331.2			
rmse				

Source: Author's Estimation using Stata 13

Marginal effects; *p*-values in parentheses (d) for discrete change of dummy variable from 0 to 1 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The result obtained from the ivprobit regression supports the work of other researcher that maternal education is a strong determinant of under-five mortality in Nigeria. Inserted into the Table also, is the marginal effect coefficient for each of the variables used in the study. The result suggests that an additional year of education contributes between 3% to 4% reduction in under-five mortality. This supports the findings of Adeolu, et al (2016), Balogun et al (2017), Yaya, et al, (2017), Oyewale & Adeniyi (2017), Adewusi & Nwokocha (2018) that higher level of maternal education significantly lowers the rate of child mortality.

Another critical variable that exerts significant influence on the rate of under-five mortality in Nigeria is the age of mothers. This is likely to be the case of neonatal and child death arising from birth complication that deteriorates as women become older. The result obtained also suggests that exclusive breastfeeding does not have any significant influence on childhood morbidity. Morbidity which measures the incidences of death causing diseases in under-five children is another determinant of under-five mortality. Though not very significant, the regression result shows that morbidity increases the probability of a child dying by about 3%. This corresponds with our hypothesis that illness is a critical factor that determines whether a child dies or survives beyond age five.

Handwash attitude and access to radio are the next variables that are likely to affect under-five mortality rate negatively. If a household observes handwashing attitude, the probability of under-five mortality is likely to reduce by about 8%. One plausible reason why there exist significant negative relationship between handwash behaviour and under-five mortality might be that handwashing reduces the frequency of contamination and its associated risk of diarrhoea and other diseases. The Ivprobit result further indicated that the environment and geographical location in which a child is born into could affect the chances of surviving beyond the age of five. For instance, the result from this study indicates that residing in urban area significantly reduces the likelihood of under-five mortality by about 10% while dwelling in rural areas increases the probability of under-five deaths. Geopolitical location of the household is another crucial factor which influences child survival. The result suggests that children from North West are the most likely to die before reaching age five followed by the North East while the dwelling in South-South and South-West does not have any significant influence on the probability of under-five mortality. The result shows that while residing in the Northern part except for North Central, increases the probability of a child dying while being in the Southern part (With the exception of South East), reduces the likelihood of dying children before age five.

4.2.2 The Effect of Maternal Education on Childhood Morbidity

Presented in Table 4.2.2 below is the estimation of model 2 which seeks to investigate the relationship between maternal education and childhood.

Table 4.2.2: Results for Model 2

	Stage 1		Stage 2	
Morbidity	Model 1	ME Model 1	Model 2	ME Model 2
Mothereduyrs			-0.0105	-0.0105
			(0.092)	(0.092)
exclusivebf (d)	0.186	-0.362***	-0.362***	-0.362***
	(0.219)	(0.000)	(0.000)	(0.000)
childage_dummy1 (d)	0.149	0.116	0.116	0.116
	(0.227)	(0.061)	(0.061)	(0.061)
childage_dummy2 (d)	0.326***	0.504***	0.504***	0.504***
	(0.000)	(0.000)	(0.000)	(0.000)
childage_dummy3 (d)	0.163*	0.450***	0.450***	0.450***
	(0.014)	(0.000)	(0.000)	(0.000)
child_sex (d)	0.0707	-0.0388	-0.0388	-0.0388
	(0.169)	(0.133)	(0.133)	(0.133)
received_vaccination (d)	0.0197	0.0363	0.0363	0.0363
	(0.717)	(0.186)	(0.186)	(0.186)
mother_age	-0.0494***	-0.00418*	-0.00418*	-0.00418*
	(0.000)	(0.023)	(0.023)	(0.023)
mosquito_net_access (d)	-0.0998	0.0250	0.0250	0.0250
	(0.113)	(0.433)	(0.433)	(0.433)
has_radio (d)	0.604***	0.0218	0.0218	0.0218
	(0.000)	(0.457)	(0.457)	(0.457)
drinking_water (d)	0.475***	-0.00250	-0.00250	-0.00250
	(0.000)	(0.927)	(0.927)	(0.927)
handwashplace (d)	0.116*	-0.0542	-0.0542	-0.0542
	(0.035)	(0.052)	(0.052)	(0.052)
residence (d)	1.408***	0.0334	0.0334	0.0334
	(0.000)	(0.345)	(0.345)	(0.345)
zone1 (d)	-1.878***	0.0282	0.0282	0.0282
	(0.000)	(0.612)	(0.612)	(0.612)
zone2 (d)	-3.148***	0.694***	0.694***	0.694***
	(0.000)	(0.000)	(0.000)	(0.000)
zone3 (d)	-3.947***	0.0936	0.0936	0.0936
	(0.000)	(0.131)	(0.131)	(0.131)
zone4 (d)	0.965***	0.194**	0.194**	0.194**
	(0.000)	(0.001)	(0.001)	(0.001)
zone5 (d)	0.447***	-0.228***	-0.228***	-0.228***
	(0.000)	(0.000)	(0.000)	(0.000)
Fathereduyrs	0.397***			
	(0.000)			
morthern_familyplaning	1.406***			
	(0.000)			
N	18563			
pseudo R^2	0.080			
Ll	-55368.7			
Rmse				

Source: Author's Estimation using Stata 13

Marginal effects; *p*-values in parentheses (d) for discrete change of dummy variable from 0 to 1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The second objective of the study was to examine the extent to which mother's number of years of education affect childhood morbidity in Nigeria. This objective was estimated using model 2 with morbidity (Diarrhea) as the dependent variable. The result from the Ivprobit regression suggests that maternal education has significant influence on childhood morbidity. The result strongly suggests that an additional year of education reduces the probability of childhood morbidity occurring at least by about 1%. Other variable in the model which significantly affect childhood morbidity include exclusive breastfeeding, mother's age, child's age, handwash behaviour, and geopolitical zones.

Exclusive breastfeeding is another critical factor that has a statistically significant relationship with childhood morbidity occurrence in our model. The result shows that children born to mothers that adopt exclusive breastfeeding practice are 36% less likely to suffer childhood diseases more when compared with mothers that do not adopt exclusive breastfeeding. This is plausible given that exclusive breastfeeding reduces the risk of contamination and offers quality nutrition that help the body fight against certain diseases. The age of the mother and the child are also seen as key determinant of child morbidity.

Furthermore, the result obtained shows that as the age of the mother increases the probability of suffering morbidity decreases marginally by about 0.4% while for the age of the child, the result implies that at early childhood, there is higher probability for a child to be sick while as the child grows, this probability reduces. Also, the result suggests that there exists regional disparity in morbidity in Nigeria with the northern part of the country shown as being highly vulnerable. The marginal effect coefficients of the geopolitical zone variables indicate that apart from South East, Children form the Southern part of the country are less likely to suffer childhood diseases when compared to their counterpart from the north.

4.2.3 Zonal Disparity in Maternal Education and Under-Five Mortality Rate in Nigeria

Presented in the Table below is the result of the multinomial logit model used to investigate whether zonal disparity in maternal education accounts for the observable inequality in under-five mortality rate in Nigeria. An attempt was made by this model to examine the disaggregated impact of maternal education, index of wealth measurement and belief systems on the risk of under-five mortality in each of the six geopolitical zones in the country through the application of a cross interaction between under-five mortality and the zonal dummies. The result from the multinomial logit clearly shows that maternal education to a large extent explains the variation in under-five mortality across the six geopolitical zones in Nigeria. With

the base outcome being zero, which represents the absence of under-five mortality in the six geopolitical zone, the result shows that maternal education has varying degree and nature of influence on under-five mortality for the different geopolitical zones in Nigeria.

Table 4.2.3: Results for Model 3

Zonal-U5 Mortality	**mlogit1**		**rrrmlogit1**	
0				
North Central				
mothereduyrs	-0.000980	(0.0242)	0.999	(0.0242)
wealthdummy	-0.336	(0.237)	0.714	(0.169)
religion	0.165	(0.218)	1.180	(0.257)
_cons	-4.761***	(0.136)		
North East				
mothereduyrs	-0.0764***	(0.0201)	0.926***	(0.0186)
wealthdummy	-1.275***	(0.226)	0.280***	(0.0633)
religion	-0.779***	(0.178)	0.459***	(0.0817)
_cons	-3.099***	(0.0652)		
North West				
mothereduyrs	-0.114***	(0.0178)	0.892***	(0.0159)
wealthdummy	-0.715***	(0.164)	0.489***	(0.0804)
religion	-2.705***	(0.282)	0.0669***	(0.0188)
_cons	-2.393***	(0.0476)		
South East				
mothereduyrs	0.00860	(0.0260)	1.009	(0.0263)
wealthdummy	-0.494*	(0.237)	0.610*	(0.145)
religion	3.402***	(0.529)	30.03***	(15.87)
_cons	-7.542***	(0.504)		
South - South				
mothereduyrs	-0.0257	(0.0260)	0.975	(0.0254)
wealthdummy	-0.252	(0.241)	0.777	(0.187)
religion	2.549***	(0.360)	12.80***	(4.605)
_cons	-6.591***	(0.321)		
South West				
mothereduyrs	-0.0157	(0.0257)	0.984	(0.0253)
wealthdummy	1.584***	(0.289)	4.873***	(1.409)
religion	0.300	(0.244)	1.349	(0.329)
_cons	-6.095***	(0.234)		
N	16536		16536	
pseudo R2	0.094		0.094	
ll	-5895.0		-5895.0	

Source: Author's Estimation using Stata 13
Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

In the North Central, the result of the multinomial model indicates that none of the socio-economic variables significantly influenced under-five mortality rate while in all the regions in the Southern part of the country, maternal education does not account for the existing rate of under-five mortality. This is in line with the findings of other researchers in the field, (Morakinyo 2017, Adewuyi 2017, and Adedini 2013); which strongly suggest that in regions where maternal education is high, the risk of under-five mortality low and vice versa. Most of these studies found that maternal education functions as a fulcrum that significantly controls the outcomes of the variables that affect under-five mortality.

The result shows that in the North East and North West, if maternal education increases by one unit, the risk of under-five mortality relative to a child not dying; would be expected to decrease by a factor of 0.926 and 0.892 respectively, given that the other variables in the model are held constant. These two regions are also the regions with the lowest level of maternal education and the findings support the hypotheses that the lower the level of maternal education, the higher the probability of under-five mortality. Another critical variable in the model that showed differential effects on influencing the probability of under-five children survival is wealth index. The result suggests that the wealth status of women significantly determines the risk of under-five mortality in the North East, North West, South East and South West. For instance, the result shows that in the North East, North West regions, if the index of household wealth increases by one unit, the relative risk of under-five mortality occurring relative to it not occurring, decreases by a factor of 0.28 and 0.49 respectively while in the result from the Southern part of the country shows that additional level of family wealth significantly reduces the risk of under-five mortality in the South East by a factor of 0.61 at $p < 0.05$ level of significance while in the South West, an increase in a family's wealth index decreases the risk of under-five deaths relative to survival by a factor of 4.87, given that the other variables in the model are held constant.

The third explanatory variable considered in our model is religion which we used to capture belief system. The result indicates that religious belief is a critical determinant of regional disparity in under-five mortality in the North East, North West, South East and South -South while in the North Central and South West, the risk of under-five mortality relative to survival, is not statistically different for households where the belief system is Christianity when compared with households that practice Islam. The result further shows that while the relationship between under-five mortality and religious belief is negative for the North East and North West region, it is conversely positive in all the other regions in the country. This indicates that while being a Christian significantly reduces the risk of under-five mortality in the Northern Nigeria, it increases the risk of under-five mortality in the Southern part of the country.

From the marginal effect co-efficient, we can deduce that mother's level of education and wealth status exert more significant effect on regional disparity in under-five mortality in Nigeria. The result indicates that a 0.24 unit change in the level of education might increase the probability that under-five mortality will occur by about 5.54 points. From the result generated, the wealth index of a household must increase by about 15.9 units for it to increase the

probability of under-five children survival by about 72%. The result also shows that religious belief does not have significant strong effect on regional disparity in under-five mortality in Nigeria.

4.3 Policy Implication of Results

The results generated from this study, it is plausible to state that investment in maternal education might be one of the important ways to reduce infant mortality in the long run; it is also one of the indicators of development of a country. Therefore, understanding the long-term effect of maternal education on infant mortality may contributes to the improvement of infant health in Nigeria.

Also, the Northern part of the country presents a critical vulnerability cluster that concerted efforts should be employed in ensuring that the level of inequality in education and child health outcome is reversed. By implication policy makers should exert more efforts in the rural areas and more importantly, in the North West and North East, if Nigeria would achieve the Sustainable Development Goal Targets by 2030.

CHAPTER FIVE

SUMMARY, RECOMMENDATIONS AND CONCLUSION

5.1 Summary of Findings

The findings of this study like other empirical studies on maternal education and under-five mortality, confirmed maternal education is critical determinant of childhood morbidity and under-five mortality in Nigeria. The result of the study clearly identified that mothers' education has a significant inverse relationship with childhood morbidity and mortality; which intuitively implies that mothers who have an appreciable level of education are more likely to cater better for the health needs of their children.

Evidently, vulnerability to childhood mortality is high in regions of the country where maternal education is low and matched with low level of women empowerment. The North West and North East that had the highest proportion of women without any formal education experience (63.3%) and (28.9%) respectively, also witnessed the highest frequency of under-five mortality during the period covered by the 2013 NDHS survey and the result from the multinomial logit regression further suggests that maternal education significantly explains the existing regional disparity in under-five mortality in Nigeria. This is in line with the result obtained by Adedini S. et al; (2012), suggesting that generally, risks of childhood death were higher in the Northern part of Nigeria compared with the Southern region. In particular, the rate of under-five mortality in the North-East and North-West regions stood at 222 deaths and 217 deaths per 1000 live births respectively (NPC and ICF macro, 2009).

Apart from maternal education, other influential variables in our model include mothers' age in years, child's age group (in months), handwash behaviour which is an indicator of hygiene, place of residence (whether rural or urban) as well as region of residence; exert significant influence on under-five mortality in Nigeria. Also, maternal age at first birth is another variable that our model showed to be statistically significant determinant of under-five mortality in Nigeria. This correspondingly relates to maternal education, given that on the average, women who accomplished higher level of education are more likely to get married and bear children when they are fully grown with the capability to independently make informed choices about their child's care and total family welfare.

The study findings further suggest that childhood morbidity which measures the incidences of illness capable of leading to under-five mortality is significantly determined by variables such

as maternal education, exclusive breastfeeding practice, mother's age, child's age, handwash behaviour and regional disparity. Though our morbidity variable as a determinant of under-five mortality is found not be statistically significant, the regression result shows that morbidity increases the likelihood of under-five mortality; which corroborates with our hypothesis that illness is a critical factor that determines whether a child dies or survives beyond age five. The finding of the study also indicated that childhood morbidity does not have a significant direct influence on under-five mortality but affects the probability of childhood deaths through maternal education and other proximate environmental factors that relate to hygiene such as handwash attitude and exclusive breastfeeding.

The finding of the study indicated that under-five mortality is significantly determined by the region of residence; with children born into North-East, North-West, and South-East being at a highly disadvantageous position. At the various regions where maternal education is low, under-five mortality is also higher when compared with regions where a higher percentage of women accomplished a higher number of years in formal education. The mediating role of education is evident, given that it influences other variables including socioeconomic factors, environment and attitude/belief systems and ultimately influence the ability to make informed choices that could reduce the risk of under-five mortality.

The result of the multinomial logit regression showed that the maternal education significantly contributes to the high level of disparity in under-five mortality across the six geopolitical zones in Nigeria with wealth status of households being a critical pathway of influence in most of the regions. Although belief system (religion) is critical factor, the result indicates that education could cushion the effect of negative religious beliefs and promote the adoption of better child care principles and in effect reduce the risk of under-five mortality in Nigeria. The association between regional variation in under-five mortality and maternal education and wealth index was found to have a significant effect on child mortality (p-value = 0.000). The marginal effects result following the multinomial logit regression further suggest that maternal education, wealth index and religion are the critical factors that maternal education pass through to influence under-five mortality in most of the regions with high level of susceptibility to mortality. It is pertinent to note that though maternal education, on its own is a necessary but not the sufficient condition for a guaranteed decline in the probability of under-five mortality, all other factors in absence of maternal education cannot be fully effective in achieving the desired result in Nigeria.

5.2 Policy Recommendation

The findings of this study provide further empirical evidence that maternal education is crucial if Nigeria will achieve the UN SDGs on or before the year 2030. Intuitively, for maternal education to be effective, it must drive the other socio-economic determinants of childhood morbidity and mortality. Also, our findings suggest that maternal education is the bane of the widespread inequality in under-five children health outcome that exist across the six geopolitical zones in Nigeria. Therefore, to curb the menace of under-five mortality, the policy thrust of government should be tailored towards addressing observable imbalances in the opportunity for educating the girl-child across the length and breadth of Nigeria. Based on the findings of the study, the following recommendations are compelling:

This study strongly recommends the promotion of girl-child education especially in regions where the girl-child is at a disadvantageous situation. This could be done through focused advocacy by religious leaders and traditional rulers with government removing the existing blockages to girl-child enrolment and secondary school completion rate. The study further recommends that zonal-specific policy interventions that addresses the peculiarity of the cultural differences are needed to improve child health in Nigeria. Improving the enrolment of girls in school will have implications on maternal education in future. Otherwise, mothers who have not attended school could be given a window of opportunity through adult education classes. An improvement in the enrolment of the girl child in schools will not only raise the age at marriage and the age at first baby birth of the potential mothers but will also reduce the chances of harmful adolescent pregnancies.

The study recommends that to ensure that incidences of Preventable diseases are not prevalent in households, there is need to evolve policy advocacy that would promote exclusive breastfeeding and family regular handwashing culture as this would reduce the risk of childhood morbidity and mortality in Nigeria. Considering that the study findings suggest that children in rural areas are more likely to experience under-five mortality relative to children in urban locations, we recommend that government should pursue effective public policy intervention that would redress the imbalance in access to healthcare facilities and healthcare facility utilization which favours urban locations but places the rural areas in a disadvantageous position. The attention of government should be focused on individual and community-level interventions aimed at improving child survival in the country's socially and economically disadvantaged areas.

5.3 Conclusion

This study examined the role of maternal education in reducing childhood morbidity and under-five mortality in Nigeria. An attempt is also made to investigate whether maternal education significantly explains the regional disparity in under-five mortality in Nigeria. The model result showed that educating the girl child could reduce the risk of under-five mortality provided that such education influences the wealth status of mothers or would-be mothers and moderates the influence of religion in stimulating better decision making and proper care-giving principles that ensures that Preventable diseases do not prevail in households and when by chance, childhood morbidity arises, such conditions will not end up claiming the life of such a child.

The findings further suggest that though maternal education plays a dominant role in influencing childhood morbidity and mortality, the coordinate blend of other socio-economic cum environmental variables as well as maternal demographic characteristics such as maternal age at birth, child's age, hygiene/handwash attitude, place of residence, region of residence and wealth index; is crucial for maternal education to be effective. Furthermore, maternal education cannot supersede the socioeconomic and environmental effect on child health outcomes. Moreover, maternal education lessens its predictive ability as soon as other social determinants are introduced. Therefore, maternal education is a necessary but not the sufficient condition for achieving the level of reduction in under-five mortality required for Nigeria to meet the SDGs targets by 2030.

The study also affirms that attaining maternal education has a significant inverse relationship with both childhood morbidity and under-five mortality but morbidity itself does not have significant effect on under-five mortality. This is in line with the findings of Morakinyo, 2017 and Adedini, 2013; that morbidity can only translate into under-five mortality in a situation where other proximate determinants function negatively. Also, study reveals some important dynamics about the influence of regional differences on under-five mortality. For instance, under-five children in North East, North West and South East have less chances of surviving beyond their fifth birthday when compared with their counterpart in North Central, South-South and South West.

More importantly, the study concludes that maternal education plays a pivotal role in the obvious regional disparity in child health outcomes across the six geopolitical zones in the country and strongly suggests that for maternal education to be significantly influential in

driving the needed increase in the annual rate of reduction in under-five mortality in Nigeria, such education must be capable of ensuring improvements in the socio-economic status of women, increasing the ability of mothers to make informed choices in relation to their children wellbeing and reduce the adoption of obsolete traditions and obnoxious practices that are capable of jeopardizing their children health outcomes.

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Appendix 1

Selected Empirical Literature Reviewed

S/N	Topic	Year of Publication	Author (s)	Area/Scope of Study	Data Used	Methodology Employed	Key Findings
1	Proximate Determinants: The Pathways of Influence of Underlying Factors on Under-Five Mortality in Nigeria	2017	Samuel Gbemisola Wuraola	Nigeria	Secondary: Nigeria Demographic and Health Survey (NDHS) of 2013.	Univariate, bivariate and the multivariate analyses.	The findings of the study are that birth-spacing was indeed a highly significant proximate variable through which socio-economic factors such as mothers' education, age of the mother, her place of residence, and wealth status influenced childhood mortality in Nigeria.
2	Mothers' education and childhood mortality in Ghana	2004	Bour D	Ghana	Ghana Demographic and Health Survey data of 1998 and World Bank data of 2000.	A linear regression model	The study concluded that there is an inverse relationship between mothers' education and child survivorship.
3	Maternal Education and Diarrhea among Children aged 0-24 Months in Nigeria	2017	Desmennu A; John Akinola et' al	Nigeria	2013 National Demographic and Health Survey	Chi-square and Logistic regression models	Diarrhea prevalence is higher among children of women who have no formal education, and mothers living in the North East region.
4	Determinants of under-five mortality in Uganda: an econometric analysis	2016	Johanna Stenström Johansson	Uganda	Uganda DHS 2006 and 2011	Logit Model	Long-Lasting Insecticide Treated Nets (LLINs), wealth status and mother's education are crucial determinants of under –5 mortality
5	Social and Economic Factors Influencing Under-Five Mortality in Zimbabwe During	2009	Joshua Kembo and Jeroen K. V	Zimbabwe	Zimbabwe DHS surveys 1990-2005	Multiple-spline Regression	Maternal education affects under – 5 mortalities through other socio-economic proximate determinants like place of residence, sources of drinking water and nutrition.

S/N	Topic	Year of Publication	Author (s)	Area/Scope of Study	Data Used	Methodology Employed	Key Findings
6	Ethnicity and child survival in Nigeria	2011	Fayehun Olufunke and Omololu Obafemi	Nigeria	NDHS 2003	Cox regression Model	The study concluded that socio-cultural beliefs, practices, household and environment (functioning as pathways) had significant influence of maternal education and in effect childhood mortality in Nigeria.
7	The Role of Maternal Education in Child Health: Evidence from a Compulsory Schooling Law	2013	Pınar Mine Güne¸	Turkey	Turkish Demographic and Health Survey (TDHS-2008)	Instrumental Variable and Difference-in-Difference model	The results indicate that mother's primary school completion improves infant health, as measured by very low birth weight, and child health, as measured by height-for-age and weight-for-age z-scores, even after controlling for many potential confounding factors.
8	Maternal Education and Child Survival in Ghana	2014	Charles Kofi Som	Ghana	2008 Ghana DHS and 2010 PHC dataset	Univariate, bivariate and multivariate regression analysis.	The mothers' level of education was found not to be significantly associated with child survival
9.	The Effect of Maternal Education on Under-five Mortality in Ethiopia	2014	Kedir Yesuf Hassen	Ethiopia	2000, 2005, and 2011 Ethiopian DHS	Linear Probability Model (LPM) regressions.	The study concluded that maternal education does not affect under-five mortality directly but through other channel linked to education e.g. employment status of women, place of residence etc.
10.	Maternal education and child immunization: the mediating roles of maternal literacy and socioeconomic status	2017	Saliu Balogun A. et'al	Nigeria	2003 and 2008 Nigerian Demographic and Health Survey	Descriptive statistics (Pearson chi-square tests)	The result from this study suggest that complete immunization was higher in children whose mothers possess a higher level of education when compared with those from uneducated mothers due to knowledge and application of knowledge.

S/N	Topic	Year of Publication	Author (s)	Area/Scope of Study	Data Used	Methodology Employed	Key Findings
11.	Maternal education and child mortality: Evidence from a quasi-experiment in Malawi and Uganda	2016	Liliana Andrianoa and Christian Mondena	Malawi and Uganda	Malawi 2000, 2004, and 2010 DHS and Uganda DHS 2010	Two-stage residual inclusion (2SRI) approach23	The work concluded that there exist a negative but non-statistically significant effect of maternal education on child mortality in Malawi and Uganda.
12	Influence of Maternal Education on Child Health in Kenya	2008	Abuya, A. Benta, Kimani, K. James et'al	Kenya	Kenya Demographic and Health Survey (KDHS), 2003	Logistic regression model	The result of the study suggests that mothers' attitudinal change toward modern medicine achieved through education is pertinent in ensuring that most children in Kenya are fully immunized against childhood diseases and illnesses.
13	Determinants of Child Mortality in Rural Nigeria	2012	Abimbola O., Adepoju, Akanni O. and Falusi A. O	Nigeria	2008 Nigeria Demographic and Health Survey (NDHS) data.	Descriptive Statistics and the Logit regression model.	The study identified maternal education, access to adequate health care (especially for pregnant women and children under five years) were identified as the key factors to reducing child mortality in rural Nigeria.
14.	The Effect of Education on the Health of Children Under-Five Years: Some Evidence from Ghana	2013	Maxwell Agyeman g	Ghana	2008 Ghana Demographic and Health Survey	Logistic regression model	Mother's levels of education were found to exert negative influence on incidences of ill-health and death of children under 5 years.
15.	Mother's Education and Increased Child Survival in Madagascar: What Can We Say?	2016	Samia Badji	Madagascar	Questionnaire, FGD and structured interview conducted in rural Madagascar.	Instrumental variable and reduced form regression model	This paper assessed whether a causal effect exists between maternal education and child survival in Madagascar and found that mothers' education has a positive and strong effect on their offspring's' survival probabilities.
16.	Does Maternal Education Really Improve Child	2013	Natarajan V. and	India	Data was collected	Descriptive method of	Maternal education influences the health of the child by

S/N	Topic	Year of Publication	Author (s)	Area/Scope of Study	Data Used	Methodology Employed	Key Findings
	Health?		Devaki.P. R.		from 449 mothers using questionnaire	analysis using proforma.	improving the nutritional status but does not affect the morbidity factors and does not play a role in improving the personal hygiene.
17.	The Impact of Maternal Education on Child Health; Evidence from Bangladesh	2014	Ripon K.M., Monoj K.M., and Shah J. R.	Bangladesh	Bangladesh Household Income and Expenditure Survey 2010.	Applied the method of OLS to IV, 2SLS regression model	Both father's and mother's education influences child health outcome but maternal education exerts more control over health indicators
18.	Understanding the association between Maternal education and use of health services in Ghana: exploring the role of health Knowledge	2012	Emily Smith G. Way, Juan Leon and David P. Baker	Ghana	2008 Ghana Demographic and Health Survey	Ordered probit regression model	The work revealed that mothers' years of formal education are strongly associated with health knowledge; health knowledge helps explain the association between maternal education and use of health services in Ghana.
19.	Maternal Education and Child Health: Is there a Strong Causal relationship?	2006	Sonalde Desai and Soumya Alva	22 Countries	Demographic and Health Surveys for 22 developing countries	Fixed effect model	The work examined the effect of maternal education on three markers of child health: infant mortality, children s height-for-age, and immunization
20.	Underlying and Proximate Determinants of Under-five Mortality in Nigeria: Understanding the Pathways of Influence	2016	Samuel, Gbemisola Wuraola	Nigeria	NDHS 2013	Binary logistic regression model	Child mortality declines with increase in the mothers' education.
21	Maternal Education as a Determinant of Neonatal Mortality in Bangladesh	2012	Mostafa Kamal S.M.	Bangladesh	2007 BDHS	Bivariate and multivariate statistical analyses	The study tried to investigate the effect of maternal education on neonatal mortality in Bangladesh. Multivariate logistic regression analyses yielded strong significant negative association between maternal education and

S/N	Topic	Year of Publication	Author (s)	Area/Scope of Study	Data Used	Methodology Employed	Key Findings
							neonatal mortality.
22.	Nigeria MICS 5 Report 2016 – 2017	2017	NBS	Nigeria	Survey Questionnaire and Structured Interview	Descriptive Statistics	Variations in socio-economic environment is identified as the reason for disparity in health outcomes for the different geo-political zones in Nigeria.
23.	Feeding the African Child: Socioeconomic Variables and Child Nutritional Status in Nigeria	2016	Emmanuel Nwosu and Tony Orji	Nigeria	NDHS 2003 and 2008	Probit Model	There exists a negative correlation between education of mother, at both secondary and higher levels of education and child nutritional health indicators across geopolitical zones in Nigeria; with higher negative association in the SW, SE and NW.
24	Maternal Education and Immunization Status Among Children in Kenya	2015	Elijah O. Onsomu et'al	Kenya	Kenya DHS 2009	Multivariate Logistic Regression	There is a strong relationship between education, and in particular, better health knowledge, awareness and understanding and better child health.
25	Determinants of child mortality in Angola: An econometric analysis	2011	Ingrid Hoem Sjursen	Angola	Survey of 499 households	OLS, Poisson and binary logit models	The result of the study showed that education, number of Children in family, income, and place of residence exert strong negative influence on the levels of childhood mortality in different districts in Angola.
26	Determinants of Child Mortality in Oyo State, Nigeria	2014	Bello, R. A	Oyo State, Nigeria	Survey data using structured Questionnaire	Logistic regression	The findings reveal that Poverty, Malaria, Postnatal care, Health scheme and Breastfeeding are the major determinants of Child mortality in the state.
27	Impact of maternal education and health awareness on child health in Kandahar Province,	2016	Mohammad Azeem Z. K.	Afghanistan	Survey using structured Questionnai	Descriptive Statistics and Anova	The result of the study indicates that maternal health awareness is a significant predictor of health-supportive

S/N	Topic	Year of Publication	Author (s)	Area/Scope of Study	Data Used	Methodology Employed	Key Findings
	Afghanistan				re		behaviors regardless of geographic location
28	Global Health Status Report	2015	WHO	Global Report	Review of National Reports	Descriptive Analysis	Children in sub-Saharan Africa (SSA) are more than 14 times more likely to die before the age of five.
29	Women and Children Report, 2015	2016	UNICEF	Sub-saharan Africa	Survey Data collected using Questionnaire	Descriptive Analysis	Vaccine Preventable diseases (VPD), and chronic malnutrition contribute largely to morbidity and mortality in childhood.
30	Morbidity and Mortality Pattern of Childhood Illnesses Seen at the Children Emergency Unit of Federal Medical Center, Asaba,	2015	Ezeonwu B.U, Chima O.U et'al	Asaba, Delta State, Nigeria	Structured Interview and Questionnaire	Descriptive and inferential statistics	Preventable infections are the major causes of morbidity and mortality in CHER and children <5 years of age are commonly affected in Asaba Delta State Nigeria
31	Economic Analysis of under-five Morbidity, Mortality and Health-seeking Behaviour – Evidence from Ghana	2014	Edward Nketiah-Amponsah	Ghana	Ghana DHS 2009	Logit Model	Health-seeking behaviour were found to exert negative influence on incidences of ill-health and death of children under 5 years with education and income being the significantly associated with health seeking outcomes.
32	Association between Mother's experience of Intimate Partners violence and Under 5 morbidities in Nigeria	2016	Osifo Joy, Fawole Olufunmilayo et al	Nigeria	2008 Nigeria DHS	Probit Model	The incidence of Intimate Partners violence (IPV) increases the likelihood of under – 5 morbidities (Fever, ARI and Diarrhea) but failed to show the pathway of influence.
33	Mother's nutrition-related knowledge and child nutrition outcomes: Empirical evidence from Nigeria	2019	Olusegun Fadare, et al	Nigeria	2013 NDHS	OLS	The results show that mother's nutrition-related knowledge has a significant and positive association with child nutrition measures by HAZ and WHZ.

Appendix 2A: Probit Regression Result for Under-five Mortality

```
. *----------probit regression estimation
. foreach yvar in underfive_mortality {
  2.         probit `yvar' $y2list $x1list_b, r cformat(%9.3f)
  3. }

Iteration 0:   log pseudolikelihood = -4546.2456
Iteration 1:   log pseudolikelihood = -4335.8189
Iteration 2:   log pseudolikelihood = -4331.2271
Iteration 3:   log pseudolikelihood = -4331.2194
Iteration 4:   log pseudolikelihood = -4331.2194

Probit regression                                 Number of obs     =     16,536
                                                  Wald chi2(19)     =     394.93
                                                  Prob > chi2       =     0.0000
Log pseudolikelihood = -4331.2194                 Pseudo R2         =     0.0473
```

underfive_mortality	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
mothereduyrs	-0.027	0.004	-7.36	0.000	-0.034	-0.020
diarrhea	0.036	0.047	0.78	0.437	-0.055	0.128
exclusivebf	0.012	0.085	0.14	0.887	-0.154	0.178
childage_dummy1	0.142	0.069	2.06	0.039	0.007	0.277
childage_dummy2	0.140	0.048	2.94	0.003	0.046	0.233
childage_dummy3	0.104	0.038	2.74	0.006	0.030	0.179
child_sex	-0.003	0.029	-0.10	0.920	-0.060	0.055
received_vaccination	-0.018	0.031	-0.57	0.569	-0.079	0.043
mother_age	0.011	0.002	5.86	0.000	0.007	0.015
mosquito_net_access	0.053	0.036	1.48	0.139	-0.017	0.123
has_radio	-0.022	0.032	-0.70	0.483	-0.085	0.040
drinking_water	-0.041	0.031	-1.33	0.184	-0.101	0.019
handwashplace	-0.081	0.032	-2.52	0.012	-0.143	-0.018
residence	-0.101	0.037	-2.73	0.006	-0.174	-0.029
zone1	-0.015	0.065	-0.23	0.817	-0.144	0.113
zone2	0.293	0.061	4.80	0.000	0.173	0.413
zone3	0.366	0.059	6.16	0.000	0.250	0.483
zone4	0.226	0.071	3.20	0.001	0.087	0.365
zone5	-0.008	0.069	-0.11	0.910	-0.142	0.127
_cons	-1.802	0.092	-19.55	0.000	-1.983	-1.621

```
Marginal effects after probit
      y  = Pr(underfive_mortality) (predict)
         =  .06894341
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
mother~s	-.0035813	.00048	-7.42	0.000	-.004527	-.002635	5.45501
diarrhea*	.0049097	.00646	0.76	0.447	-.007747	.017566	.10456
exclus~f*	.0016138	.0114	0.14	0.887	-.020734	.023962	.07021
childa~1*	.0204136	.01069	1.91	0.056	-.000533	.04136	.117441
childa~2*	.0200544	.00735	2.73	0.006	.005649	.034459	.115143
childa~3*	.0144687	.00551	2.62	0.009	.003665	.025273	.208575
child_~x*	-.0003904	.00389	-0.10	0.920	-.00802	.007239	.504596
receiv~n*	-.0023522	.00413	-0.57	0.569	-.010447	.005743	.525943
mothe~ge	.0014898	.00025	5.87	0.000	.000992	.001987	29.8815
mosqui~s*	.0071844	.00496	1.45	0.147	-.002536	.016905	.21934
has_ra~o*	-.0029735	.00426	-0.70	0.485	-.011328	.005381	.677129
drinki~r*	-.0054254	.0041	-1.32	0.186	-.013466	.002615	.552189
handwa~e*	-.010533	.00412	-2.56	0.011	-.018602	-.002464	.372883
reside~e*	-.0131529	.00471	-2.79	0.005	-.022379	-.003926	.363752
zone1*	-.0020004	.00856	-0.23	0.815	-.01877	.014769	.161043
zone2*	.0445145	.01046	4.26	0.000	.024013	.065016	.185535
zone3*	.05482	.00992	5.53	0.000	.035377	.074263	.281991
zone4*	.0343297	.01212	2.83	0.005	.010576	.058083	.090348
zone5*	-.001029	.00902	-0.11	0.909	-.018709	.016651	.134313

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Appendix 2B: Ivprobit Regression Result for Under-five Mortality

```
. *----------ivprobit regression estimation
. foreach yvar in underfive_mortality {
  2.          ivprobit `yvar' $x1list_b ($y2list = $x2listalt), cformat(%9.3f)
  3. }

Fitting exogenous probit model

Iteration 0:   log likelihood = -4546.2456
Iteration 1:   log likelihood = -4334.0509
Iteration 2:   log likelihood = -4329.4463
Iteration 3:   log likelihood = -4329.4387
Iteration 4:   log likelihood = -4329.4387

Fitting full model

Iteration 0:   log likelihood = -48474.316
Iteration 1:   log likelihood = -48474.309
Iteration 2:   log likelihood = -48474.309

Probit model with endogenous regressors           Number of obs     =     16,536
                                                  Wald chi2(19)     =     392.43
Log likelihood = -48474.309                       Prob > chi2       =     0.0000
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
mothereduyrs	-0.038	0.007	-5.38	0.000	-0.052	-0.024
diarrhea	0.033	0.047	0.72	0.474	-0.058	0.125
exclusivebf	0.018	0.084	0.21	0.832	-0.147	0.183
childage_dummy1	0.142	0.068	2.09	0.037	0.009	0.276
childage_dummy2	0.146	0.048	3.08	0.002	0.053	0.240
childage_dummy3	0.108	0.038	2.83	0.005	0.033	0.182
child_sex	-0.001	0.029	-0.04	0.967	-0.059	0.056
received_vaccination	-0.016	0.032	-0.51	0.609	-0.078	0.046
mother_age	0.010	0.002	5.09	0.000	0.006	0.015
mosquito_net_access	0.053	0.036	1.49	0.135	-0.017	0.123
has_radio	-0.006	0.033	-0.18	0.861	-0.071	0.059
drinking_water	-0.031	0.031	-0.99	0.324	-0.092	0.030
handwashplace	-0.081	0.032	-2.52	0.012	-0.144	-0.018
residence	-0.071	0.041	-1.73	0.083	-0.151	0.009
zone1	-0.037	0.067	-0.55	0.579	-0.168	0.094
zone2	0.239	0.069	3.45	0.001	0.103	0.374
zone3	0.295	0.072	4.10	0.000	0.154	0.435
zone4	0.229	0.070	3.24	0.001	0.090	0.367
zone5	-0.000	0.069	-0.01	0.995	-0.135	0.134
_cons	-1.715	0.107	-16.06	0.000	-1.924	-1.505
corr(e.mothereduyrs,e.underfive_mortality)	0.054	0.029			-0.002	0.110
sd(e.mothereduyrs)	3.493	0.019			3.455	3.531

```
Instrumented:  mothereduyrs
Instruments:   diarrhea exclusivebf childage_dummy1 childage_dummy2 childage_dummy3 child_sex received_vaccination mother_age
               mosquito_net_access has_radio drinking_water handwashplace residence zone1 zone2 zone3 zone4 zone5 fathereduyrs
               morthern_familyplaning

Wald test of exogeneity (corr = 0): chi2(1) = 3.56        Prob > chi2 = 0.0592

Marginal effects after ivprobit
      y  = Fitted values (predict)
         = -1.4818361
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
mother~s	-.0382668	.00711	-5.38	0.000	-.0522	-.024333	5.45501
diarrhea*	.0333578	.0466	0.72	0.474	-.057981	.124696	.10456
exclus~f*	.0178799	.08437	0.21	0.832	-.147475	.183235	.07021
childa~1*	.1424512	.06831	2.09	0.037	.008557	.276346	.117441
childa~2*	.1463776	.04752	3.08	0.002	.053243	.239512	.115143
childa~3*	.1075438	.03806	2.83	0.005	.032943	.182145	.208575
child_~x*	-.0012026	.02938	-0.04	0.967	-.058795	.05639	.504596
receiv~n*	-.0161203	.03154	-0.51	0.609	-.077928	.045687	.525943
mothe~ge	.0104772	.00206	5.09	0.000	.00644	.014515	29.8815
mosqui~s*	.0531067	.03556	1.49	0.135	-.016598	.122811	.21934
has_ra~o*	-.0058407	.03324	-0.18	0.861	-.070996	.059315	.677129
drinki~r*	-.0307561	.03118	-0.99	0.324	-.091873	.030361	.552189
handwa~e*	-.0808588	.03209	-2.52	0.012	-.143761	-.017956	.372883
reside~e*	-.0708594	.04088	-1.73	0.083	-.15098	.009262	.363752
zone1*	-.0370273	.06672	-0.55	0.579	-.167797	.093742	.161043
zone2*	.2385183	.0692	3.45	0.001	.102891	.374145	.185535
zone3*	.2945582	.07179	4.10	0.000	.153857	.435259	.281991
zone4*	.2285552	.07049	3.24	0.001	.090397	.366713	.090348
zone5*	-.0003986	.06872	-0.01	0.995	-.135095	.134298	.134313

```
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```

Appendix 3A: Probit Regression Result for Childhood Morbidity

```
. *                                  PROBIT REGRESSION: CHILD MORBIDITY
>
. ********************************************************************************
. *----------probit regression estimation
. foreach yvar in diarrhea {
  2.         probit `yvar' $y2list $x1list_a, r cformat(%9.3f)
  3. }

Iteration 0:   log pseudolikelihood = -6303.9449
Iteration 1:   log pseudolikelihood = -5809.1288
Iteration 2:   log pseudolikelihood = -5799.0282
Iteration 3:   log pseudolikelihood = -5799.0024
Iteration 4:   log pseudolikelihood = -5799.0024

Probit regression                                 Number of obs     =     18,563
                                                  Wald chi2(18)     =     933.35
                                                  Prob > chi2       =     0.0000
Log pseudolikelihood = -5799.0024                 Pseudo R2         =     0.0801
```

diarrhea	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
mothereduyrs	-0.009	0.003	-2.88	0.004	-0.015	-0.003
exclusivebf	-0.362	0.085	-4.29	0.000	-0.528	-0.197
childage_dummy1	0.116	0.062	1.88	0.061	-0.005	0.237
childage_dummy2	0.503	0.038	13.13	0.000	0.428	0.578
childage_dummy3	0.449	0.031	14.33	0.000	0.388	0.511
child_sex	-0.039	0.026	-1.51	0.131	-0.089	0.012
received_vaccina~n	0.036	0.027	1.32	0.187	-0.017	0.090
mother_age	-0.004	0.002	-2.21	0.027	-0.008	-0.000
mosquito_net_acc~s	0.025	0.032	0.78	0.433	-0.037	0.087
has_radio	0.020	0.029	0.70	0.484	-0.036	0.076
drinking_water	-0.004	0.027	-0.13	0.897	-0.057	0.050
handwashplace	-0.054	0.028	-1.94	0.052	-0.109	0.001
residence	0.030	0.032	0.93	0.350	-0.033	0.093
zone1	0.031	0.054	0.58	0.565	-0.074	0.136
zone2	0.700	0.050	13.89	0.000	0.601	0.799
zone3	0.102	0.052	1.94	0.052	-0.001	0.204
zone4	0.194	0.060	3.24	0.001	0.077	0.311
zone5	-0.229	0.062	-3.70	0.000	-0.350	-0.108
_cons	-1.477	0.083	-17.82	0.000	-1.639	-1.314

```
. mfx

Marginal effects after probit
      y  = Pr(diarrhea) (predict)
         =   .0903445
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
mother~s	-.0014956	.00052	-2.88	0.004	-.002513	-.000478	5.16641
exclus~f*	-.0476748	.00868	-5.49	0.000	-.064694	-.030656	.070786
childa~1*	.0199982	.01127	1.77	0.076	-.002099	.042096	.119323
childa~2*	.1044767	.0096	10.88	0.000	.085652	.123302	.116199
childa~3*	.0867481	.00693	12.51	0.000	.073157	.100339	.208533
child_~x*	-.0063351	.0042	-1.51	0.131	-.014566	.001896	.50369
receiv~n*	.005866	.00444	1.32	0.186	-.00283	.014562	.52971
mothe~ge	-.0006698	.0003	-2.21	0.027	-.001263	-.000077	29.5118
mosqui~s*	.0041041	.00528	0.78	0.437	-.006246	.014454	.213974
has_ra~o*	.0032379	.00461	0.70	0.482	-.005791	.012267	.676453
drinki~r*	-.000573	.00443	-0.13	0.897	-.009261	.008115	.545117
handwa~e*	-.008727	.00445	-1.96	0.050	-.017458	4.1e-06	.370414
reside~e*	.0048981	.00527	0.93	0.353	-.005435	.015232	.345742
zone1*	.0050986	.00899	0.57	0.571	-.01252	.022717	.156063
zone2*	.1489642	.01315	11.33	0.000	.123192	.174736	.195604
zone3*	.01703	.009	1.89	0.058	-.000612	.034672	.301945
zone4*	.0351129	.01194	2.94	0.003	.011717	.058509	.084415
zone5*	-.0332052	.0079	-4.20	0.000	-.048695	-.017715	.126111

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Appendix 3B: Ivprobit Regression Result for Childhood Morbidity

```
. *----------ivprobit regression estimation
. foreach yvar in diarrhea {
  2.         ivprobit `yvar' $x1list_a ($y2list = $x2listalt), cformat(%9.3f)
  3. }

Fitting exogenous probit model

Iteration 0:   log likelihood = -6303.9449
Iteration 1:   log likelihood = -5809.0997
Iteration 2:   log likelihood = -5798.9978
Iteration 3:   log likelihood =  -5798.972
Iteration 4:   log likelihood =  -5798.972

Fitting full model

Iteration 0:   log likelihood =   -55368.7
Iteration 1:   log likelihood = -55368.695
. *----------ivprobit regression estimation
. foreach yvar in underfive_mortality {
  2.         ivprobit `yvar' $x1list_b ($y2list = $x2listalt), cformat(%9.3f)
  3. }

Fitting exogenous probit model

Iteration 0:   log likelihood = -4546.2456
Iteration 1:   log likelihood = -4334.0509
Iteration 2:   log likelihood = -4329.4463
Iteration 3:   log likelihood = -4329.4387
Iteration 4:   log likelihood = -4329.4387

Fitting full model

Iteration 0:   log likelihood = -48474.316
Iteration 1:   log likelihood = -48474.309
Iteration 2:   log likelihood = -48474.309

Probit model with endogenous regressors         Number of obs     =     16,536
                                                Wald chi2(19)     =     392.43
Log likelihood = -48474.309                     Prob > chi2       =     0.0000
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
mothereduyrs	-0.038	0.007	-5.38	0.000	-0.052	-0.024
diarrhea	0.033	0.047	0.72	0.474	-0.058	0.125
exclusivebf	0.018	0.084	0.21	0.832	-0.147	0.183
childage_dummy1	0.142	0.068	2.09	0.037	0.009	0.276
childage_dummy2	0.146	0.048	3.08	0.002	0.053	0.240
childage_dummy3	0.108	0.038	2.83	0.005	0.033	0.182
child_sex	-0.001	0.029	-0.04	0.967	-0.059	0.056
received_vaccination	-0.016	0.032	-0.51	0.609	-0.078	0.046
mother_age	0.010	0.002	5.09	0.000	0.006	0.015
mosquito_net_access	0.053	0.036	1.49	0.135	-0.017	0.123
has_radio	-0.006	0.033	-0.18	0.861	-0.071	0.059
drinking_water	-0.031	0.031	-0.99	0.324	-0.092	0.030
handwashplace	-0.081	0.032	-2.52	0.012	-0.144	-0.018
residence	-0.071	0.041	-1.73	0.083	-0.151	0.009
zone1	-0.037	0.067	-0.55	0.579	-0.168	0.094
zone2	0.239	0.069	3.45	0.001	0.103	0.374
zone3	0.295	0.072	4.10	0.000	0.154	0.435
zone4	0.229	0.070	3.24	0.001	0.090	0.367
zone5	-0.000	0.069	-0.01	0.995	-0.135	0.134
_cons	-1.715	0.107	-16.06	0.000	-1.924	-1.505
corr(e.mothereduyrs,e.underfive_mortality)	0.054	0.029			-0.002	0.110
sd(e.mothereduyrs)	3.493	0.019			3.455	3.531

```
Instrumented:  mothereduyrs
Instruments:   diarrhea exclusivebf childage_dummy1 childage_dummy2 childage_dummy3 child_sex received_vaccination mother_age
               mosquito_net_access has_radio drinking_water handwashplace residence zone1 zone2 zone3 zone4 zone5 fathereduyrs
               morthern_familyplaning

Wald test of exogeneity (corr = 0): chi2(1) = 3.56        Prob > chi2 = 0.0592
```

Appendix 3 C: Marginal Effect After Ivprobit for Childhood Morbidity

Marginal effects after ivprobit
y = Fitted values (predict)
= -1.4818361

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
mother~s	-.0382668	.00711	-5.38	0.000	-.0522	-.024333	5.45501
diarrhea*	.0333578	.0466	0.72	0.474	-.057981	.124696	.10456
exclus~f*	.0178799	.08437	0.21	0.832	-.147475	.183235	.07021
childa~1*	.1424512	.06831	2.09	0.037	.008557	.276346	.117441
childa~2*	.1463776	.04752	3.08	0.002	.053243	.239512	.115143
childa~3*	.1075438	.03806	2.83	0.005	.032943	.182145	.208575
child_~x*	-.0012026	.02938	-0.04	0.967	-.058795	.05639	.504596
receiv~n*	-.0161203	.03154	-0.51	0.609	-.077928	.045687	.525943
mothe~ge	.0104772	.00206	5.09	0.000	.00644	.014515	29.8815
mosqui~s*	.0531067	.03556	1.49	0.135	-.016598	.122811	.21934
has_ra~o*	-.0058407	.03324	-0.18	0.861	-.070996	.059315	.677129
drinki~r*	-.0307561	.03118	-0.99	0.324	-.091873	.030361	.552189
handwa~e*	-.0808588	.03209	-2.52	0.012	-.143761	-.017956	.372883
reside~e*	-.0708594	.04088	-1.73	0.083	-.15098	.009262	.363752
zone1*	-.0370273	.06672	-0.55	0.579	-.167797	.093742	.161043
zone2*	.2385183	.0692	3.45	0.001	.102891	.374145	.185535
zone3*	.2945582	.07179	4.10	0.000	.153857	.435259	.281991
zone4*	.2285552	.07049	3.24	0.001	.090397	.366713	.090348
zone5*	-.0003986	.06872	-0.01	0.995	-.135095	.134298	.134313

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Appendix 4A: Multinomial Logit Regression

Multinomial logistic regression — Number of obs = 16,536
LR chi2(18) = 1274.95
Prob > chi2 = 0.0000
Log likelihood = -5866.2514 — Pseudo R2 = 0.0980

zone_child~y	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
0	(base outcome)					
1						
mothereduyrs	-0.003	0.024	-0.12	0.903	-0.050	0.044
religion	0.205	0.215	0.96	0.339	-0.216	0.625
wealthdummy	-0.332	0.237	-1.40	0.161	-0.797	0.132
_cons	-4.774	0.138	-34.60	0.000	-5.045	-4.504
2						
mothereduyrs	-0.076	0.020	-3.83	0.000	-0.115	-0.037
religion	-0.789	0.171	-4.62	0.000	-1.124	-0.454
wealthdummy	-1.281	0.226	-5.66	0.000	-1.725	-0.837
_cons	-3.083	0.066	-47.05	0.000	-3.212	-2.955
3						
mothereduyrs	-0.118	0.018	-6.62	0.000	-0.153	-0.083
religion	-2.422	0.239	-10.13	0.000	-2.890	-1.953
wealthdummy	-0.725	0.164	-4.42	0.000	-1.047	-0.404
_cons	-2.370	0.048	-49.66	0.000	-2.464	-2.276
4						
mothereduyrs	0.006	0.025	0.25	0.799	-0.043	0.056
religion	18.951	1199.068	0.02	0.987	-2331.179	2369.080
wealthdummy	-0.481	0.238	-2.03	0.043	-0.947	-0.016
_cons	-23.074	1199.068	-0.02	0.985	-2373.203	2327.056
5						
mothereduyrs	-0.033	0.025	-1.30	0.193	-0.083	0.017
religion	3.497	0.526	6.65	0.000	2.467	4.527
wealthdummy	-0.233	0.241	-0.97	0.334	-0.706	0.239
_cons	-7.466	0.503	-14.86	0.000	-8.451	-6.481
6						
mothereduyrs	-0.013	0.026	-0.51	0.612	-0.063	0.037
religion	0.239	0.242	0.99	0.324	-0.236	0.714
wealthdummy	1.587	0.290	5.48	0.000	1.020	2.155
_cons	-6.085	0.235	-25.91	0.000	-6.545	-5.624

```
. mfx

Marginal effects after mlogit
      y  = Pr(zone_childmortality==0) (predict)
         =  .96189903
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
mother~s	.002377	.00039	6.12	0.000	.001615	.003139	5.45501
religion*	.0118161	.00457	2.58	0.010	.002852	.020781	.460692
wealth~y*	.0159606	.0038	4.20	0.000	.008512	.023409	.384011

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Appendix 4B: Multinomial Logit Regression with Relative Risk Ratio

Multinomial logistic regression — Number of obs = 16,536
LR chi2(18) = 1217.39
Prob > chi2 = 0.0000
Log likelihood = -5895.0313 — Pseudo R2 = 0.0936

zone_child~y	RRR	Std. Err.	z	P>|z|	[95% Conf.	Interval]
0	(base outcome)					
1						
mothereduyrs	.9990205	.0242129	-0.04	0.968	.9526737	1.047622
wealthdummy	.7144888	.1694525	-1.42	0.156	.4488687	1.137291
religion	1.179707	.257035	0.76	0.448	.7696866	1.808149
_cons	.0085594	.0011615	-35.08	0.000	.0065605	.0111674
2						
mothereduyrs	.9264133	.0186309	-3.80	0.000	.8906077	.9636584
wealthdummy	.2795062	.0633032	-5.63	0.000	.179312	.435686
religion	.4589384	.0816672	-4.38	0.000	.3238059	.6504652
_cons	.0450953	.0029392	-47.55	0.000	.0396873	.0512402
3						
mothereduyrs	.8920832	.0158639	-6.42	0.000	.8615262	.9237241
wealthdummy	.4892934	.0803722	-4.35	0.000	.3546088	.6751329
religion	.0668814	.0188421	-9.60	0.000	.0385036	.1161742
_cons	.0913579	.0043491	-50.27	0.000	.0832195	.1002923
4						
mothereduyrs	1.00864	.0262747	0.33	0.741	.9584354	1.061475
wealthdummy	.6103394	.1447738	-2.08	0.037	.383411	.9715792
religion	30.03109	15.87251	6.44	0.000	10.65812	84.61777
_cons	.0005305	.0002672	-14.98	0.000	.0001977	.0014234
5						
mothereduyrs	.9746239	.0253607	-0.99	0.323	.9261641	1.025619
wealthdummy	.7769167	.1874078	-1.05	0.295	.4842255	1.246526
religion	12.79934	4.605087	7.09	0.000	6.323146	25.9085
_cons	.0013721	.0004401	-20.55	0.000	.0007318	.0025728
6						
mothereduyrs	.9844113	.0252841	-0.61	0.541	.9360821	1.035236
wealthdummy	4.872992	1.408877	5.48	0.000	2.76501	8.588052
religion	1.349323	.3293343	1.23	0.220	.8362959	2.177067
_cons	.002255	.0005282	-26.02	0.000	.0014249	.0035688

Note: _cons estimates baseline relative risk for each outcome.

Appendix 5: Summary Statistics

opened on: 24 May 2019, 18:04:00

```
. sum mothereduyrs exclusivebf childage_dummy1 childage_dummy2 childage_dummy3 childage_dummy4
> child_sex received_vaccination mother_age mosquito_net_access has_radio drinking_water handwa
> shplace residence zone1 zone2 zone3 zone4 zone5 zone6 fathereduyrs morthern_familyplaning
```

Variable	Obs	Mean	Std. Dev.	Min	Max
mothereduyrs	18,563	5.166406	5.377211	0	20
exclusivebf	18,563	.070786	.2564739	0	1
childage_d~1	18,563	.1193234	.3241774	0	1
childage_d~2	18,563	.1161989	.3204719	0	1
childage_d~3	18,563	.2085331	.4062708	0	1
childage_d~4	18,563	.5559446	.4968737	0	1
child_sex	18,563	.5036901	.4999999	0	1
received_v~n	18,563	.5297096	.49913	0	1
mother_age	18,563	29.51177	7.276202	15	49
mosquito_n~s	18,563	.213974	.4101197	0	1
has_radio	18,563	.6764532	.4678419	0	1
drinking_w~r	18,563	.5451166	.4979737	0	1
handwashpl~e	18,563	.3704143	.4829287	0	1
residence	18,563	.3457415	.4756222	0	1
zone1	18,563	.1560631	.362925	0	1
zone2	18,563	.1956042	.3966757	0	1
zone3	18,563	.3019447	.4591138	0	1
zone4	18,563	.0844152	.278017	0	1
zone5	18,563	.1261111	.3319835	0	1
zone6	18,563	.1358617	.3426508	0	1
fathereduyrs	18,563	6.367236	5.905551	0	20
morthern_f~g	18,563	.1084415	.3109456	0	1

```
. sum mothereduyrs zone_childmortality_dm1 zone_childmortality_dm2 zone_childmortality_dm3 zone
> _childmortality_dm4 zone_childmortality_dm5 zone_childmortality_dm6 zone_childmortality_dm7 e
> xclusivebf childage_dummy1 childage_dummy2 childage_dummy3 childage_dummy4 child_sex received
> _vaccination mother_age mosquito_net_access has_radio drinking_water handwashplace residence
> edu_zone1 edu_zone2 edu_zone3 edu_zone4 edu_zone5 edu_zone6 zone1 zone2 zone3 zone4 zone5 zon
> e6 fathereduyrs morthern_familyplaning
```

Variable	Obs	Mean	Std. Dev.	Min	Max
mothereduyrs	16,536	5.455007	5.419508	0	20
zone_child~1	16,536	.9215651	.2688629	0	1
zone_child~2	16,536	.0074988	.0862729	0	1
zone_child~3	16,536	.0194727	.1381833	0	1
zone_child~4	16,536	.0341074	.1815105	0	1
zone_child~5	16,536	.0059265	.0767574	0	1
zone_child~6	16,536	.005866	.0763671	0	1
zone_child~7	16,536	.0055636	.0743841	0	1
exclusivebf	16,536	.0702104	.2555091	0	1
childage_d~1	16,536	.1174407	.3219545	0	1
childage_d~2	16,536	.1151427	.3192038	0	1
childage_d~3	16,536	.2085752	.4063023	0	1
childage_d~4	16,536	.5588413	.4965406	0	1
child_sex	16,536	.504596	.499994	0	1
received_v~n	16,536	.5259434	.4993416	0	1
mother_age	16,536	29.88147	7.287951	15	49
mosquito_n~s	16,536	.2193396	.4138117	0	1
has_radio	16,536	.6771287	.4675881	0	1
drinking_w~r	16,536	.5521892	.4972839	0	1
handwashpl~e	16,536	.3728834	.4835861	0	1
residence	16,536	.3637518	.481093	0	1
edu_zone1	16,536	.1923682	.5974989	0	3
edu_zone2	16,536	.1057088	.4340526	0	3
edu_zone3	16,536	.0972424	.4040642	0	3
edu_zone4	16,536	.1582608	.5477409	0	3
edu_zone5	16,536	.2204282	.6223117	0	3
edu_zone6	16,536	.2533866	.6946297	0	3
zone1	16,536	.1610426	.3675813	0	1
zone2	16,536	.1855346	.3887424	0	1
zone3	16,536	.2819908	.4499825	0	1
zone4	16,536	.0903483	.2866888	0	1
zone5	16,536	.134313	.3409986	0	1
zone6	16,536	.1467707	.3538879	0	1
fathereduyrs	16,536	6.64284	5.903706	0	20
morthern_f~g	16,536	.1165336	.3208734	0	1