PROXIMATE DETERMINANTS: THE PATHWAYS OF INFLUENCE OF UNDERLYING FACTORS ON UNDER-FIVE MORTALITY IN NIGERIA

By

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B.Sc; M.Sc Demography and Social Statistics (Covenant University)

MARCH, 2017

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A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES OF COVENANT UNIVERSITY, OTA, OGUN STATE, NIGERIA

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DOCTOR OF PHILOSOPHY (Ph.D.) DEGREE IN DEMOGRAPHY AND SOCIAL STATISTICS, IN THE DEPARTMENT OF ECONOMICS AND DEVELOPMENT STUDIES, COLLEGE OF BUSINESS AND SOCIAL SCIENCES, COVENANT UNIVERSITY, OTA

MARCH, 2017

ACCEPTANCE

This is to attest that this thesis is accepted in partial fulfillment of the requirements for the award of the degree of **Doctor of Philosophy in Demography and Social Statistics** in the Department of **Economics and Development Studies,** College of Business and Social Sciences, Covenant University, Ota.

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DECLARATION

I, **SAMUEL Gbemisola Wuraola** (06AE03580), declare that this research was carried out by me under the supervision of Prof. Gbolahan A. Oni of the Department of Economics and Development Studies, Covenant University, Ota, Ogun State and Dr. Akanni I. Akinyemi of the Department of Demography and Social Statistics, Obafemi Awolowo University, Ile-Ife, Osun State. I attest that the thesis has not been presented either wholly or partly for the award of any degree elsewhere. All sources of data and scholarly information used in this thesis are duly acknowledged.

SAMUEL Gbemisola Wuraola **....……**

Signature & Date

CERTIFICATION

We certify that the thesis titled "Proximate Determinants: The Pathways of Influence of Underlying Factors on Under-five Mortality in Nigeria" is an original work carried out by **SAMUEL Gbemisola Wuraola** (06AE03580), of Demography and Social Statistics Programme in the Department of Economics and Development Studies, College of Business and Social Sciences, Covenant University, Canaan land, Ota, Ogun State, Nigeria. We have examined the work and found it acceptable for the award of a degree of Doctor of Philosophy in Demography and Social Statistics.

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DEDICATION

This thesis is dedicated to the Almighty God who never changes and has remained faithful to me throughout the research work; “Jesus Christ the same yesterday, and today and forever” (Hebrews 13:8).

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SAMUEL Gbemisola Wuraola, 2017

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Abstract

Nigeria is a country with one of the world's highest rate of under-five mortality. Any innovative research aimed at bringing solutions to this problem should be considered worthwhile. This study examined how socio-economic, demographic and cultural factors (called underlying factors), influence under-five mortality in Nigeria by identifying some other direct factors (called proximate determinants) through which the underlying factors influence under-five mortality. It used data from the Nigeria Demographic and Health Survey (NDHS) of 2013. Mothers of 31,482 children born during the previous five years of the survey were interviewed on survival status of their children and also on their own characteristics and child healthcare practices. The Mosley and Chen framework for child survival was adopted to explore the pathways of influence of the underlying factors on under-five mortality. The underlying factors considered are mother's age, marital status, education, occupation, geographical region of residence, urban/rural residence, wealth status and religious affiliation. The proximate determinants examined are, child's birth order, number of births mother had within the previous five years of the survey, whether or not the child was ever breastfed, the household source of drinking water, type of toilet facility, type of cooking fuel and the place where the child was delivered. Statistical analyses used were the univariate, bivariate and the multivariate analyses. Due to the binary nature of the dependent variable (Dead or Alive), the multivariate analysis technique adopted was the "binary logistic regression". The level of significance was set at 5 percent. Findings showed that all the nine underlying factors had a significant indirect bivariate relationship with under-five mortality. At the multivariate analysis level, all the underlying factors except religion and occupation maintained their significant indirect effects on under-five mortality. Further, the children who were never breastfed were twenty times more likely to die before five years of age than children who were ever breastfed ($P < 0.001$). The Log Likelihood Ratio (LR) test used to examine the overall level of importance of the proximate determinants as pathways of influence of the underlying factors on under-five mortality found them to be highly significant (Chi-square = 3222.423 on 12 degrees of freedom, $P < 0.001$). However, several of the underlying factors still maintained their significant relationships with under-five mortality after adjustments for the seven proximate variables. The result implies that, in addition to the seven proximate determinants used, there must be other proximate variables not included in the study through which the underlying factors are also influencing under-five mortality. Given that proximate determinants (e.g., child spacing), have direct effects on mortality, policies and programmes targeted to influence them will be more effective and in reducing under-five mortality than those targeted to influence underlying factors (e.g., providing higher education for women). The study conclude by recommending programmes such as those that create awareness of mothers about practices that prevent childhood mortality including extensive and prolonged breastfeeding and use of contraceptives which help to prevent frequent or multiple births within short intervals, thereby reducing the high under-five mortality in Nigeria.

Keywords: Under-five mortality, Underlying factors, Proximate determinants and Pathways

List of Abbreviations

FMOH	Federal Ministry of Health, Nigeria
MDGs	Millennium Development Goals
NDHS	Nigeria Demographic and Health Survey
NPC	National Population Commission
SDGs	Sustainable Development Goals
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
USAID	United State Agency for International Development

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Under-five mortality refers to the death of children below the age of five years (National Population Commission (NPC) [Nigeria] and ICF International, 2014). Though most of the deaths that occur at the early stage of life are preventable, under-five mortality continues to be a topical issue in the field of public health (Oyefara, 2013; United Nations Children's Fund - UNICEF, 2014; UNICEF, 2015). Goal number 4 of the recently concluded Millennium Development Goals (MDGs), focused mainly on reducing under-five mortality worldwide by 66 percent between 1990 and 2015 (Federal Ministry of Health, Nigeria- FMOH, 2010; Sawyer, 2012; UNICEF, 2013). Although a global decline from 91 deaths per 1,000 live births in 1990 to 43 deaths per 1,000 live births in 2015 was recorded (i.e., a decline of 53 percent), child survival in developing countries had not improved appreciably, especially in South Asia and sub-Saharan African countries (United State Agency for International Development-USAID, 2014; UNICEF, 2015).

The MDG progress report of 2013 showed that at the country level, only one-fifth of the countries with the high mortality rate of 40 deaths per 1000 and above had the chance of achieving MDG Goal 4. Hence, the world would still not have met the target until 2026 (11 years behind the MDGs schedule) if the trends in 2013 had continued in all countries (UNICEF, 2015). It was because of this lack of sufficient progress to reduce under-five mortality by many of the developing countries at the target year, that the issue remains one of the focus of the newly adopted Sustainable Development Goals (SDGs), which aim at reducing under-five mortality to 25 per 1,000 or fewer by 2030 (United Nations, 2015).

Among the countries in sub-Saharan Africa with high under-five mortality is Nigeria (NPC and ICF, 2014; UNICEF, 2014). The under-five mortality rate in 1990 was 201 deaths per 1000, which later declined to 128 deaths per 1000 in 2013 (NPC and ICF, 1999). That is 36 percent decline within the 23 years period. Nigeria, therefore, was far short of achieving the MDG 4 (NPC [Nigeria] and ICF, 2014). However, the progress being made in reducing under-five mortality in Nigeria will continue to be intensified and monitored in the post-2015

Millennium Development Goals (MDGs) global agenda (National Bureau of Statistics, Nigeria, 2014).

Socio-economic, environmental, cultural and behavioural factors are known to influence under-five mortality. For Nigeria to achieve the SDG 3, it is important to have a good understanding of the way and manner these factors operate to influence under-five mortality in Nigeria so that effective policies and programmes can be put in place to accelerate the reduction of under-five mortality. Although some studies had attempted to examine the factors of childhood mortality in Nigeria, only a few had tried to explain or disentangle the process by which these factors operate to exert their effects on under-five mortality. For example, Fayehun and Omololu (2009), examined the effects of the ethnicity of the mother on childhood mortality in Nigeria, but their study failed to show how ethnicity could be interacting with other factors to produce the observed effects on under-five mortality.

Other studies that have identified the determinants of under-five mortality in Nigeria are Antai (2010) and Adedini (2013). Using Nigeria Demographic and Health Survey (NDHS) data of 2003, Antai examined the effects of social context and position of the mother on under-five mortality, but he also failed to clearly disentangle how those factors operate to influence under-five mortality. Adedini focused on the contextual determinants of under-five mortality using the NDHS data of 2008. His study examined the independent effects of characteristics related to the child, mother, household and the municipal factors where the child resides on under-five mortality. Even though he used some maternal and biological factors as intervening variables, he did not clearly show their pathways of influence on under-five mortality.

1.2 Statement of the Research Problem

The loss of a child can constitute a deeply distressing or disturbing experience for a parent or family. For a population or community where the frequency of child death is high (i.e., high childhood mortality rate) the potential economic loss can be very huge, not talk of the social and psychological implications or consequences of such losses. In such a population, any efforts or investments to reduce childhood (under-five) mortality will be considered to be

worthwhile. The welfare or health status of a population may be judged by the level of its childhood mortality. As it was stated earlier, Nigeria is one of the countries of the world with the highest under-five mortality rate. She, therefore, has a high urgency to reduce her level of under-five mortality. This study provides a means of doing that.

Studies have shown that under-five mortality is influenced or determined by various social, economic, demographic, environmental, cultural or behavioural factors. Some of these factors influence under-five mortality directly and others affect it indirectly (Antai, 2010; Buwembo, 2010; Kuate-Defo, 1993; Mosley and Chen, 1984). Those factors that have indirect effects on under-five mortality are referred to as the underlying (or background) factors (Mosley and Chen, 1984; Mosley, 2006). Examples include; mother's education, wealth status, place of residence, religion, etc. While, those factors that have direct effects on under-five mortality are called the proximate determinants (Mosley and Chen, 1984; Mosley, 2006). Examples of such variables include; birth order, type of birth - i.e., single or multiple, breastfeeding, immunization, the source of drinking water, etc.

According to the analytical framework designed by Mosley and Chen (1984), the underlying factors necessarily operate through the proximate determinants to influence under-five mortality. However, not many studies have considered the link between the underlying and proximate factors when examining under-five mortality in developing countries with varying nuances. While some had taken underlying factors as if they had direct relationship with under-five mortality (Ogunjuyigbe, 2004; Uddin, Hossain and Ullah, 2009; Mondal, Hossain, and Ali, 2009; Tette and Owusu, 2014), others had only tried to explain the direct effect of the proximate determinants on under-five mortality without any consideration for the underlying factors (Buwembo, 2010; Bello and Joseph, 2014; Rutstein, 2005). These are major gaps in the understanding cause-effect relationship in under-five mortality studies.

The study by Ogunjuyigbe (2004), examined the traditional beliefs of the mother on under-five mortality. He treated the socio-economic variables (underlying factors) as if they have direct effects on under-five mortality. Further, Kayode, Adekanmbi and Uthman (2012) in their own study examined maternal and biological factors that constitute a risk or are predictors of

under-five mortality. They presented in their multivariate analysis using the cox hazard proportional regression the direct effects of those medical factors on the outcome variable without considering the link they might have with the background or underlying factors before they can influence under-five mortality.

Some studies even end up surmising the underlying and proximate factors, with the assumption that they both influence under-five mortality in similar ways (Fayehun and Omololu, 2009; Antai, 2010; 2011). There is, therefore, scarcity of studies that have used the approach of underlying and proximate factors linkage in examining under-five mortality in Nigeria. Researches that have been able to bring to use the proximate determinants approach in studying under-five mortality in Nigeria had in most cases used only descriptive or bivariate analyses to explain the variables. Caldwell (1979), examined the effects of mothers' education on under-five mortality in Nigeria and he was able to adequately use the proximate determinant approach in his study. His findings showed that an educated mother is more likely to utilize health care services compared to an illiterate mother who may not be able to communicate the health conditions of her child to the health personnel. But the study was limited in that, he only used bivariate analysis to explain the relationship that existed between the background factors (underlying factors) and the proximate determinants before they can influence under-five mortality. That is, he failed to look at other background factors that may be confounding or interfering with the influence of maternal education on under-five mortality.

Also, Olisaekee (2014) investigated the effects of energy poverty (i.e., types of cooking fuel used in the households) on under-five mortality using the proximate determinants approach. Her work was mainly a review of previous studies on under-five mortality in Nigeria. Hence, she was unable to statistically or independently establish her main objective/hypothesis that, energy poverty influence under-five mortality through proximate determinants such as exposure to smoke (i.e. environmental factors) by using the appropriate multivariate statistical technique.

This present study therefore, is unique, because, it examined the link between underlying factors and proximate determinants in order to understand and explain the causes of under-five mortality among Nigerian children by subjecting the selected variables to appropriate

multivariate statistical testing, thereby closing a major gap that had existed in several previous studies on determinants of under-five mortality in Nigeria. The findings of this study will be helpful in the formulation of effective policies and programmes that have the capacity to reduce under-five mortality in Nigeria. For example, policies and programmes that are directed to influence the proximate determinants (i.e., breastfeeding, birth spacing, immunization, etc.) will be much easier and cheaper to implement and also more likely to make greater and quicker impact in reducing under-five mortality than policies and programmes that are exclusively directed to influence changes in the underlying factors such as increasing women's formal education.

1.3 Research Questions

This study attempted to answer the following research questions:

1.) Which of the selected underlying factors (socio-economic, demographic and cultural factors) in this study have significant (indirect) effects on under-five mortality in Nigeria?
2.) Through which proximate determinants do these underlying factors operate to influence under-five mortality?
3.) To what extent do the proximate determinants help to explain the effects of the underlying factors on under-five mortality?

1.4 Research Objectives

General Objective

The general objective was to examine the underlying factors that indirectly influence under-five mortality in Nigeria and to explain how those effects are transmitted through some more direct variables called the proximate determinants of under-five mortality.

The specific objectives of this study are to:

1. examine the underlying factors that have an indirect association with under-five mortality in Nigeria;

2. determine the proximate determinants through which the underlying factors affect under-five mortality; and
3. measure the extent to which the selected proximate determinants in the study help to explain the indirect effects of the underlying factors on under-five mortality;

1.5 Research Hypotheses

The following hypotheses which were stated in the null form were tested in the study:

1. Underlying factors do not have significant indirect effects on under-five mortality in Nigeria.
2. Underlying factors do not have a significant relationship with the proximate determinants; hence, the later cannot help to explain the relationship of the former with under-five mortality.
3. There is no significant reduction in the indirect effects of the underlying factors on under-five mortality, after taking into account the direct effects of the proximate determinants on under-five mortality.

1.6 Significance of the Study

As presented in the Statement of the Research Problem, Nigeria's under-five mortality rate is one of the highest in the world with attendant social and economic implications and consequences. The need to significantly reduce under-five mortality rate in Nigeria is therefore very urgent. To achieve this, it is very important to identify those proximate determinants through which the underlying factors operate to influence under-five mortality in Nigeria. Government policies in most cases had focused on improving the socio-economic conditions of mothers (e.g., women's education). Many of these factors are more suitable and realizable for long-term goals and not short term. It takes a long time to train a woman (or man) to a level of education high enough to produce the desired impact on the survival of her child. It is also usually a capital intensive venture. Evidence of this had been established by the findings of several studies on the determinants of childhood mortality. For example, their findings showed that mothers with secondary education and above reported a lower occurrence of under-five deaths compared to their counterparts who had below secondary education (Antai, 2010;

Adedini, 2013; Caldwell, 1979; UNICEF, 2014). Investment in programmes such as promoting breastfeeding, birth spacing, and child immunization (proximate factors) are quicker to yield the desired results and at a far less cost than those aimed at influencing the underlying factors (Caldwell, 1979; Olisaekee, 2014; Oni, 1985). Considering the situation of Nigeria that needs to embark on programmes to quickly reduce her under-five mortality within a short period of time, identifying the relevant proximate variables on which policies and programmes can be focused, will help in achieving the Sustainable Development Goal (SDG 3).

This is essential because a rapid improvement is needed to attain the Sustainable Development Goal (SDG) on child survival, specifically in countries with high risk of mortality in sub-Saharan Africa. In order to reduce deaths of under-five children to 25 per 1,000 or fewer by 2030, a total of 47 countries that did not meet the MDG goal 4 needs to increase their pace of progress, if they are to meet the SDG 3 (UNICEF, 2015). United Nations classified these 47 countries into three categories, the first 17 countries must increase appreciably, but not necessarily double the current rate by 2030. The second category consists of 19 countries that need to achieve more than double their rate of under-five mortality decline by 2030 (UNICEF, 2015). The third and last category of 11 countries must intensify their efforts at least three times if they are to meet the SDG 3 requirement. Nigeria happens to fall in the third category (UNICEF, 2015). That is a decline in the current childhood mortality rate of 128 per 1000 to 25 per 1000 by 2030 (i.e., in a period of just 14 years). Hence, findings from a study such as this one will help to inform policies and appropriate programmes to meet this great challenge.

1.7 Organization of the Study

In order to achieve the purpose of this study, the work was divided into six chapters. The first chapter introduced the research work and it includes the background information, statement of the research problem, research questions, research objectives, research hypotheses, the justification for the study, organization of the study and definition of terms. Chapter two centered on literature review, theoretical review, empirical review and the conceptual framework. Chapter three focused on the research methods, which comprises of the information on the study area, data source, methods, sample size, analytical framework,

measurements of concepts, model specification and estimation technique. Chapter four presents the results of the data analyses which include the estimates of under-five mortality and the results of the three main hypotheses testing. Chapter five focused on result discussions, while Chapter six centered on the recommendations and conclusion, contribution to knowledge and areas for further study based on the findings from the study.

1.8 Definition of terms

Under-five Mortality: This is defined as deaths that occur before children reach age five. In this study, the term is used interchangeably as childhood mortality

Underlying Factors: These are variables that affect under-five mortality indirectly. That is, in order for them to affect under-five mortality, they must first influence some other variables or factors that are known to affect under-five mortality directly. They can also be referred to as socio-economic/distal factors or background variables. Examples of such variables are; educational attainment, place of residence, wealth index, religious affiliation and marital status.

Proximate Determinants: These are variables or factors that have direct effects on under-five mortality. They operate as intermediaries or media through which underlying factors influence under-five mortality. They are also called intervening variables of under-five mortality in this study. Examples of such variables are; birth interval, breastfeeding, type of cooking fuel and child immunization.

Pathways of Influence: Identification of the proximate determinants through which the underlying factors operate to influence the outcome variable (i.e. under-five mortality).

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CHAPTER TWO

LITERATURE REVIEW

2.1. Preface

This section focuses on the relevant literature review on the determinants of under-five mortality and this includes the theoretical, empirical and conceptual reviews. Relevant literature for the purpose of this study was obtained from the following sources: Web of Science, Jstor, Ebsco, PubMed, Science direct, Google search engine, Monographs, Reports, Conference Proceedings and Edited books. Keywords for literature search included: under-five mortality, proximate determinants and underlying factors. The following terms were also used to search for important materials: proximate determinants, underlying factors of under-five mortality, determinants of child mortality. The time spread of literature spanned from 1979 to 2017 and the geographical coverage includes sub-Saharan Africa, South Asia, Latin America, North America, South America and Northern Europe.

2.2. Overview of Under-five Mortality

Under-five mortality rate at the global level had been reported to have declined in the last 20 years than any other period. Further, the percentage of reduction tripled within 2005 -2013 (4.0 percent) when compared to what it was within 1990-1995, that is, 1.2 percent (UNICEF, 2014). In spite of the improvement in the level of child survival recorded within 2005 and 2013, the progress made was insufficient to achieve MDG 4 particularly in sub-Saharan Africa, Oceania, Central Asia, Caucasus and Southern Asia (UNICEF, 2014; You, Jones, Hill, Wardlaw and Chopra, 2010).

The main killer diseases of children under the age of five years in the world as at 2015 include; pneumonia, preterm birth complications, neonatal intrapartum-related complications, diarrhea, neonatal sepsis and malaria (UNICEF, 2015; Black and Liu, 2012). Rapid progress in child survival is required in order to put an end to preventable child deaths in the regions of Southern Asia and sub-Saharan Africa. UNICEF Report in 2015 showed that out of every 12 under-five children in sub-Saharan Africa, one child likely dies before his or her fifth birthday compared

to 1 child out of every 147 children who die in high-income countries (Marx, Coles, Prysones-Jones, Johnson, Augustin, MacKay, *et al*, 2005; UNICEF, 2015).

In Nigeria, under-five mortality is primarily influenced by ethnic disparities and these disparities are in the form of mothers' education, birth order, the age of mother, place of residence and wealth index (Fayehun and Omololu, 2009). Further, Ogunjuyigbe (2004) reported that beliefs and behavioural practices played a significant role in determining child mortality. That is, mothers, do not have a clear perception of illness and treatment, while some linked deaths of children to cultural beliefs. Statistics show that there is a wide variation in the rates among the six major geopolitical zones in Nigeria. The rates range from 185 per 1000 in the North West to 90 per 1,000 in the South West (NPC and ICF, 2014). The Northern region of the country contributed largely to the high rate of under-five mortality experienced in the country (i.e. a rate above 100 per 1000) when compared to the Southern region (NPC and ICF, 2014).

2.3 Underlying Factors of Under-five Mortality

As previously defined they are referred to as socio-economic, demographic and cultural factors that indirectly influence under-five mortality. This section discusses some of the selected socio-economic factors for the purpose of this study.

2.3.1 Educational Attainment and Under-five Mortality

Maternal education has been referred to as one major social determinant of under-five mortality and was reported to vary at different levels of mother's education (Adetoro, 2013). Although other socio-economic factors influence childhood mortality, the effect of maternal education has been proven stronger than them (Caldwell, 1979; Feyisetan, 1988; Ojewunmi and Ojewunmi, 2012; Olumide and Odubanjo, 2009). Education has the ability to influence the choices of a mother and empower her to make the right decision in terms of nutrition, preventive care and disease treatments for her child.

Also, father's educational attainment relates strongly to his occupation which eventually influences the household income (Buwembo, 2010; Mosley and Chen, 1984). Studies have

shown that the higher the educational attainments of mothers, the lower the rates of under-five mortality (Fayehun and Omololu, 2009; Uddin, Hossain and Ullah, 2009; Ojewunmi and Ojewunmi, 2012; Olumide and Odubanjo, 2009). It was established in the Nigeria Demographic and Health Survey Report in 2013, that mothers who had no education reported highest under-five mortality rates (i.e., 180 deaths per 1,000 live births), when compared with their counterparts who had secondary education and above (i.e., 62 deaths per 1,000 live births) (NPC and ICF International, 2014).

This was because mothers who are educated were more likely than non-educated mothers to ensure a hygienic environment, healthy food, and have better knowledge about antenatal care visits during pregnancy and utilization of health care services for their children (Kuate-Defo, 1993, Buwembo, 2010). Hence, enlightened mothers will give birth to healthy babies because they are also likely to be healthier and have chances of experiencing lower mortality among their children (Pandey, 2009; Uddin *et al.*, 2009). Research has shown that the higher the educational attainments of mothers the better their health knowledge, which includes; awareness of the importance of boiling water, hand washing after latrine use, use of oral rehydration therapy to treat diarrhea, and a lifestyle of personal cleanliness that prevents diseases (Frost, Forste and Haas, 2005).

2.3.2 Wealth Status and Under-five Mortality

It has been documented that absence or shortage supply of assets and substances that make life comfortable in the household, has an effect on child's health (Antai, 2010; Shen and Williamson, 1997). Low birth weight, the high death of children within the first three weeks of life and chronic diseases are attendant consequences of a poor socio-economic level. Although, breakthroughs in medical technology can stop infectious diseases causing most of the deaths in early childhood years, the effect of socio-economic factors cannot be undermined (Antai, 2010).

Poverty makes children from less privilege households vulnerable to inadequate water, poor sanitation, air pollution, undernourishment, etc., which are some of the risks of mortality unlike those who were born to "better off" families. As a result of this exposure, they suffer diverse

diseases (Adepoju, Akanni and Falusi, 2012; Policy project/Nigeria, 2002; UNICEF, 2010). Children born to financially deprived and less educated homes are at greater risks of dying within the first three weeks of life. Mothers of such children were probably undernourished during pregnancy and might not have received antenatal care, nor delivered under the supervision of a trained health care personnel. Poverty might limit the access of the household to quality health care services, often leading to non-immunization of the child or treatment when sick.

2.3.3 Place of Residence and Under-five Mortality

Children living close to health care facility experienced less risk of deaths when compared to their counterparts who lived some distance away from the facility (Tette and Owusu, 2014). This is typical among households in the rural areas of most developing countries. Urban areas usually have better infrastructures for health care facilities and are built close to the residential areas. Rural-urban residence has been found to be another strong determinant of child's well-being (Mutunga, 2004; Macassa and Burstrom, 2006). For example, in Nigeria, the south-western region reported greater improvements in child survival than the northern regions (Fayehun and Omololu, 2009). Mothers who lived in well-developed communities reduced the odds of neonatal deaths and eventually, under-five deaths. Hence, community infrastructures may improve hygienic practices.

Also, as mothers interact among themselves in the same neighbourhood, they learn from one another, thereby culminating in improved behaviour with respect to the upbringing of their children and in this case developed communities may have better access to right information as a result of aggregation of enlightened women in the neighbourhood (Buwembo, 2010). Some characteristics present in the neighbourhood where children are raised might likely influence the mortality risks of such children (Antai, 2011; Adedini, 2013). For example, children raised in economically and socially deprived communities are at higher risks of dying before reaching age-five years when compared with those living in developed communities (Adedini, Odimegwu, Ononokpono, Ibisomi, Elwange and Imasiku, 2012).

2.3.4 Parental Occupation and Under-five Mortality

Parental occupation determines the wealth status of the household. This invariably affects the amount and quality of food intake the children are entitled to, type of shelter and access to health care services available for children living in that household (Ahonsi, 1992). A study conducted in 1979 in Ibadan showed that there were similar effects between mothers' engagements in white-collar jobs and their educational attainments on child mortality reduction. This effect was independent since over 90 percent of women in that occupation only attained secondary school level. In the same study, father's occupation had more effect on under-five mortality reduction (Ahonsi, 1992).

A study in India revealed that mother's working status has a negative influence on child survival. That is if the mother's work is some distance from the home, the absence of the mother rather than employment status is what affects the child's health. If the mother's occupation activities are around the home where the child resides, the outcome might be different (Buwembo, 2010).

2.3.5 Maternal Age and Under-five Mortality

Studies have shown that the relationship between maternal age and child survival is highly significant. This association was intermediated by other factors such as sanitation, immunization, breastfeeding and previous child deaths (Hobcraft *et al.*, 1985; Kayode *et al.*, 2012). In a study conducted by Buwembo (2010), under-five mortality was higher for teenage mothers than those who were well matured (20 years and above) before having their first birth. This was because, mothers who were 20 years and above before having their first child would have acquired adequate knowledge about child care either formally or informally (Buwembo, 2010).

Late entry into sexual union for women might be as a result of years of schooling. As previously discussed in sub-section 2.3.1, literate mothers are more likely to report little or no deaths of children, since they have better knowledge of hygiene, nutrition and child care practices, compared to their counterparts who may not have access to such information.

2.4 Proximate Determinants of Under-five Mortality

Examples of proximate determinants also called intervening variables, which have direct effects on mortality are discussed below.

2.4.1 Birth Interval and Under-five Mortality

Short birth interval has a strong relationship with child survival because this leads to early weaning of a child and may cause reduction in the mother's strength (maternal depletion syndrome) resulting in preterm birth and low birth weight (Stover and Ross, 2013; Ross and Stover, 2005). This further manifested in undernutrition for children and competition for the household wealth (Rafalimanana and Westoff, 2001; Stover and Ross, 2013).

Birth interval is a key determinant of childhood mortality and influences it through breastfeeding, survival status of the preceding child, multiple pregnancy etc., (Fayehun, Omololu and Isiugo-Abanihe, 2011; Kayode *et al.*, 2012). The birth spacing of at least 36 months helps to reduce deaths of children. In Nigeria, the median birth interval was 31.7 months (which was approximately two and half years) as at 2013. About 213 infants out of every 1000 whose birth interval from the preceding birth was two years were reported to have died, unlike 103 infants who died and whose birth spacing was three years from the preceding birth (NPC and ICF, 2014).

Further, earlier studies had established that a decline in childhood mortality was a requirement for fertility decline (Chowdhury *et al*., 1976; Matthiesson and McCann 1978; Pritchett 1994; Wolpin 1997). Other studies emphasized the reverse direction of this causation, e.g., high fertility and the close birth-spacing associated with it cause an increase in child mortality (Bamikale and Akinrinola, 2002; Cleland and Sathar, 1984; Curtis *et al*., 1993).

2.4.2 Nutritional Status and Under-five Mortality

Black, Allen, Bhutta, Caulfield, de Onis, Ezzati, Mathers and Rivera (2008), reported that, under-nutrition had contributed to the deaths of more than 3.5 million mothers and their children who were below age five years, and thousands of thousands were permanently incapacitated by the physical and mental effects of malnourishment within the first eleven

months of life. They further said that, if malnutrition continues into the second year of the children, they might suffer permanent physical and mental damage, affecting their later life outcomes, welfare and economic well-being. This can eventually result in low birth weight, stunting, wasting, and less visible micronutrient deficiencies (Black *et al.*, 2008; Rafalimanana and Westoff, 2001).

The Nigeria Millennium Development Goals Progress Report in 2010 (FMOH, 2010), reported that the prevalence rates of stunting were routinely highest in the poorest households, and its relationship with household wealth varies (Akombi, Agho, Hall, Merom, Astell-Burt and Renzaho, 2017; Darteh, Acquah and Kumi-Kyereme, 2014). According to Wright and Garcia (2012), the nutritional status of children has a strong impact on their health. Hence, children who suffer from malnutrition are more likely to be exposed to disease. Further, malnutrition results in the breakdown of essential minerals and prevent the body of the child from efficiently absorbing and assimilating the nutrients necessary to grow and fully develop into adulthood.

2.4.3 Environmental Contamination and Under-five Mortality

The extent to which a child is exposed to the risk of death determines if the child lives or not. The length of exposure is intervened by other variables that influence the probability of a child surviving. Mortality experience varies from time to time, hence children born at different periods are exposed to different risks of death (Gayawan and Turra, 2012). Some of the deaths of under-five children in developing countries (Nigeria inclusive) are caused by environmental factors such as unclean water, contaminated food, poor sanitation, inadequate housing, beliefs and cultural practices of their parents, dirty environment thereby enhancing inbreeding of mosquitoes and animal disease vectors, etc. (Adepoju, Akanni and Falusi, 2012; Samuel, Ajayi, Idowu and Ogundipe, 2016**)**. Studies have established that water supply, hygiene and sanitation are largely low in poor countries as several persons are inadequately sheltered, more than 1 billion lack access to good drinking water and over 2.9 billion do not have access to adequate sanitation (Rutstein, 2000; WHO, 2005; WHO, 2009; Fayehun, 2010).

Further, according to the World Bank (2001), one-fifth of the total burden of diseases in low-income countries can be associated with environmental risks. Among the top 10 countries with

high risks of under-five mortality in developing countries, about 3 percent of these deaths can be linked to environmental risk factors (Mutunga, 2004). Children in unhealthy or polluted environments are likely to be exposed to disease-causing agents, thereby making them vulnerable to high risks of dying (Antai, 2011; WHO, 2010; WHO 2012).

2.4.4 Antenatal Care and Under-five Mortality

Antenatal care, family planning, prenatal, delivery and postpartum care are major components of Safe Motherhood Initiatives (Family Care International, 2007). Antenatal care status is known to be characterized by the number of visits. This is important in order to ensure speedy access to immediate medical intervention when obstetric emergencies arise. In urban areas, health care facilities might be closer to where pregnant women reside, but there still exist the scarcity of trained medical personnel especially in critical situations. One of the importance of antenatal visits during pregnancy for women is the opportunity to appreciate the benefits of delivering under the supervision of a trained attendant (Bloom, Lippeveld and Wypij, 1999). Adequate antenatal care (ANC) attendance and delivery under the supervision of a professional in most cases result in better obstetric and child survival outcomes. The cost of service, lack of transportation, to name a few are factors that hinder women from making up to the required number of antenatal visits and utilization of health care services. (Adedini, Odimegwu, Bamiwuye, Fadeyibi, and De Wet, 2014; Wablembo and Doctor, 2013).

2.4.5 Health Seeking Behaviour and Under-five Mortality

Mothers' utilization of health care services is very crucial and such services which are often obtained in healthcare facilities includes; prenatal and delivery care, immunization, family planning services, information on the right proportion and type of nutrition for children.

There is high risk of under-five mortality when mothers have no good health practices, such as poor personal hygiene, use of dirty utensils for preparing child's food, etc. (Deribew, Tessema and Girma, 2007). Although there are several benefits that proper health care interventions have for the survival of young children, not so many women are utilizing such services in most of the African countries (Adepoju, 1984). Use of modern health care services

are associated with under-five survival, but quite a number of barriers prevent mothers from accessing such services. The ripple effect of this poor utilization of health care services contributed to the low level of performance in achieving the MDG goal 4 in 2015 (Adedini, Odimegwu, Bamiwuye, Fadeyibi, and De Wet, 2014).

2.4.6 Family Planning and Under-five Mortality

Family planning is the ability of couples to decide the number of children they want to have, so as to adequately cater for them and taking appropriate action to achieve their decisions. This include: fertility control and proper birth spacing. The area of emphasis in this study among other components of family planning was proper spacing of births. Family planning methods allow couples to delay birth and this leads to adequate care and attention for each child. As a result, infant and child mortality is prevented, because the resources of the household can go round in meeting the needs of each member. Hence, the child enjoys good health care and is shielded from undernourishment which might make him or her vulnerable to certain diseases (Masuy-Stroobant, 2001). The decline in desire for many children brings about reduction in childhood mortality and to achieve this, there is need for well-planned health care system. This include access to the right information and family planning methods. Access to such information will enable the young population who are just entering the reproductive age groups to adequately plan their families. For example, close to 215 million women globally, who desired not to get pregnant were unable to protect themselves through the use of modern contraceptives (Sippel, *et al.*, 2011).

Research revealed that women in Nigeria begin childbearing at an early age, with about 50 percent of the women having children before age 20 years (Bledsoe and Cohen, 1993; Liskin, 1985; NPC and ICF, 2014). These teenage mothers in most cases suffer from severe difficulties during delivery, leading to higher levels of diseases and deaths for both themselves and their child (Bledsoe and Cohen, 1993; Liskin, 1985; Makinwa-Adebusoye, 1991).

Most women in Nigeria keep large family size and usually, these children are the outcome of unexpected pregnancy, having been born within short birth intervals much less than the recommended standard of 3 years birth spacing by Safe Motherhood Initiatives. The findings

from a study that examined the effects of birth intervals on under-five diseases and deaths reported that most Nigerian mothers do not space their births properly according to the recommended standard by Safe Motherhood Initiatives (Adegbola, 2008; Kayode *et al*, 2012). This reproductive behaviour may constitute high risks to the mother or even the child, thereby leading to malnutrition and death for children (Rutstein, 2002; Stover and Ross, 2013). The Nigeria Demographic and Health Survey Report for 2013 showed that the Contraceptive Prevalence Rate (CPR) in the country was 16 percent. Out of the 16 percent, 12 percent used it for spacing and the remaining 4 percent used it to control births (NPC and ICF International, 2014).

under five prevented women from using contraceptives in Nigeria. Some of the factors include socio-cultural and economic factors such as religious beliefs, little or no educational attainments, financial deficiency, misinformation, and inadequate communication between husband and wife. Similarly, the Catholic Church that has the largest followers in the South-eastern region, teach members only to use natural family planning methods (Adedini, Odimegwu, Bamiwuye, Fadeyibi and De Wet, 2014).

2.5 Theoretical Framework

The concept of proximate determinants was first used by Davis Kingsley and Judith Blake in 1956 in the study of fertility. The proximate determinants were then called "Intermediate Variables".

Davis and Blake identified 11 intermediate fertility variables:

A. **Factors affecting exposure to intercourse**
    1. Age of entry into sexual union
    2. Permanent celibacy: proportion of women never entering sexual union
    3. Time spent in reproductive period after or between union
    4. Voluntary abstinence
    5. Involuntary abstinence
    6. Coital frequency (excluding period of abstinence

B. **Factors affecting exposure to Conception**

7. Fecundity or infecundity, as affected by involuntary causes
8. Use or nonuse of contraception
9. Fecundity or infecundity, as affected by voluntary causes (sterilization sub-incision, medical treatment, etc)

C. **Factors affecting gestation and successful parturition**

10. Fetal mortality from involuntary causes (spontaneous abortion or miscarriages)
11. Fetal mortality from voluntary causes (induced or forced abortion)

The concept was later modified by John Bongaarts in 1978 who referred to the intermediate variables as "Proximate Determinants".

Bongaarts Proximate Determinants of Fertility

- **Exposure Factors**
  1. Proportion married
- **Deliberate Fertility Control Factors**
  2. Contraception
  3. Induced abortion
- **Natural Marital Fertility Factors**
  4. Lactational Infecundability
  5. Frequency of Intercourse
  6. Sterility
  7. Spontaneous intrauterine mortality
  8. Duration of fertile period

This same idea was used to design a framework for the study of mortality by Henry Mosley and Lincoln Chen in 1984 (Bongaarts, 1978; Mosley and Chen, 1984). The analytical framework was designed to study the determinants of child mortality in developing countries. The proximate determinants of fertility are the biological and behavioral factors through which social, economic, and environmental variables affect mortality. The principal characteristic of a proximate determinant is its direct effect on mortality. If a proximate determinant changes, then mortality necessarily changes also (assuming that the other proximate determinants

remain constant). Several studies have attempted to examine the determinants of under-five mortality in developing countries using the framework of Mosley and Chen as the theoretical base for their study.

2.5.1 Mosley and Chen Framework

The framework for examining determinants of child mortality in developing countries was first designed by Mosley and Chen in 1984. The approach include both social and biological variables and it integrated research methods used by both social and medical scientists. Morbidity and mortality were both measured in a single variable. This was considered as the outcome variable, that is, depending on the interaction of the factors in the model. 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).

The framework was built on the principle that all socio-economic determinants of childhood mortality necessarily operate through biological mechanisms or proximate determinants that eventually influence childhood mortality (Antai, 2010; Buwembo, 2010; Hill, 2003, Kuate-Defo, 1993). The proximate determinants (also called intervening variables) approach to child survival parallels the method used by Davis and Blake (1956) in designing an analytical framework for the study of fertility. The framework was designed so as to increase scientific study of medical interventions and social policy that will help to improve understanding of factors affecting child survival. Several social science researches have unraveled the association that exists between socio-economic status and patterns of mortality in the population.

Some specific biological causes of deaths have not being examined by researchers in the social sciences, and the processes by which underlying factors operate to bring about differences in mortality are often not disentangled. The major focus of medical research is on biological processes and the outcome variable is morbidity. The result is obtained by observing the incidence and prevalence of a disease rather than deaths in a population. The Epidemiological studies focus on the pathways through which diseases are spread in the environment and

studies on nutrition dwell on nutritional practices, breastfeeding and food availability as they relate to nutritional status (Mosley and Chen 1984, Saha, 2012). But the framework designed by Mosley and Chen bridged the missing links that existed among these fields of health research.

In the framework, the underlying factors were categorized into three levels and are stated as:

i.) Characteristics of the mother or father, including their cultural values or attitudes;

ii.) The social and economic characteristics of the household, e.g. wealth status

iii.) Municipal variables (i.e. the environment; political economy and health system).

The underlying variables are expected to influence mortality by operating through the proximate factors (Mosley and Chen, 1984).

The Proximate Determinants Approach

The use of a proximate determinants method to study childhood mortality was based on the following premises:

1. In an ideal situation, more than 97 percent of newly born infants might be able to live up to age five years.
2. Decline in the level of survival might be as a result of the interaction among social, biological, economic, and environmental factors.
3. Background variables necessarily operate through the proximate determinants, which might directly influence mortality.
4. Observed morbidity and malnourishment in a living population can be classified as biological indicators (proximate determinants).
5. Stunting and deaths in children are the aggregate outcomes of several morbidity processes. Only a few cases of child's mortality occur due to a specific disease experience (Mosley and Chen, 1984).

The proximate determinants are categorized into five groups:

- **Maternal- related factors**: birth interval, age at birth, parity
- **Environmental pollution**: air, insect vectors, water
- **Nutrient shortage**: protein, calories, micronutrients

- **Accident**
- **Personal preventive measures/medical treatment**

In this study, the Mosley and Chen framework was adopted, because of its appropriateness and relevance to this work. That is the examination of the effects of underlying factors on childhood mortality through the proximate determinants. Hence, the conceptual and analytical framework for this study were based on Mosley and Chen framework.

2.6 Conceptual Framework

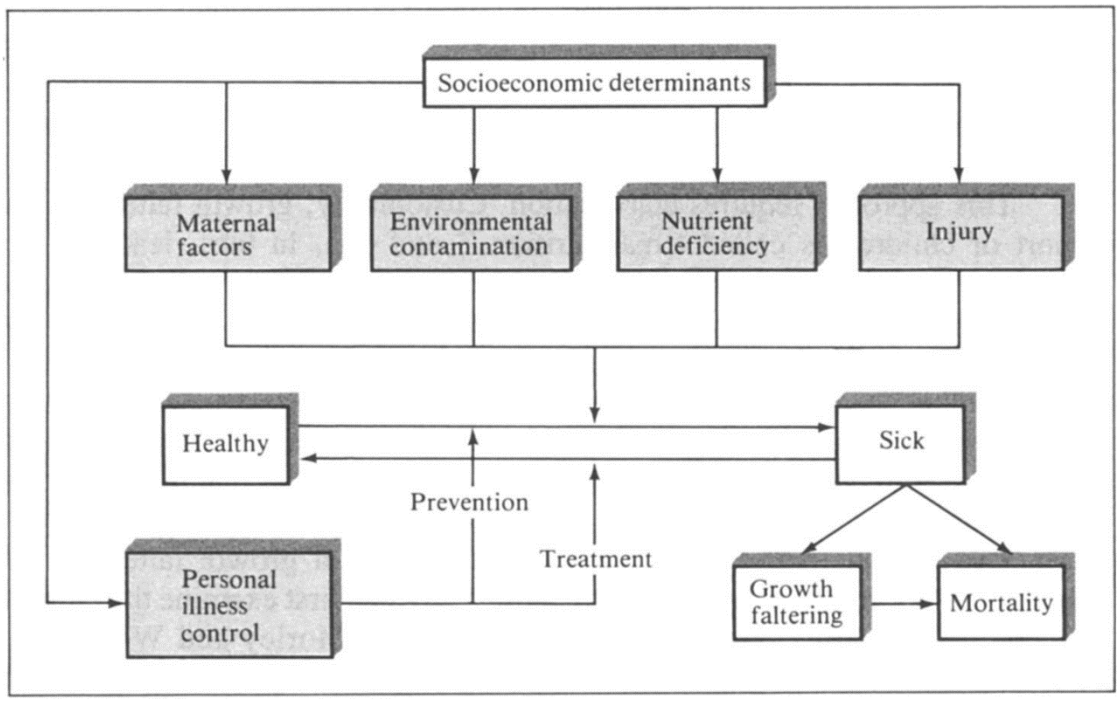

Figure 2.1: Operation of the five groups of proximate determinants on the health dynamics of a population

(Source: Mosley and Chen, 1984; Pp. 29)

2.7 Empirical Review

Disentangling the determinants and also explaining the effects of the same on under-five deaths in the less developed countries is complex (Adedini, 2013; Rodgers, 2002). Further, the pathways through which the factors operate is multifaceted (Antai, 2010; Kuate-Defo, 1993), thereby, raising several debates on the determinants of under-five mortality particularly in developing countries. Factors ranging from biological, demographic to social and economic have been associated with the huge differentials in the risks of childhood mortality (Antai, 2010; Adedini, 2013).

Caldwell (1979) carried out a study on the effects of mother's educational attainment on child mortality using Nigerian data. In his findings, Caldwell argued that an educated mother was more capable of influencing the new-age world than her counterpart who has little or no education. Further, she is able to seek for medical intervention from health care professionals, because of her ability to communicate on issues relating to the health of the child. The study was limited, because, it assumed only the effect of mother's education on under-five mortality without considering the combined effects of other socio-economic factors that operate through the proximate determinants.

Studies have shown that other factors may be playing a role that negate the influence of mother's education on under-five mortality; for example type of residence (Oni, 1988). Oni, carried a study in Ilorin examining the socio-economic determinants of under-five mortality. His findings showed that an educated mother who lives in a traditional setting with her in-laws, for example, with the mother-in-law, may lose her autonomy to those in-laws on the care of her children. Although Oni was able to explain that mother's education was associated with other factors to influence under-five mortality, he did not subject the relationship to further statistical testing (i.e. multivariate analysis).

Kuate-Defo in 1993 conducted a study on the regional and socio-economic variations in infant and child mortality in Cameroon. In his study, he examined differences in infant and childhood mortality by mother's education, region of residence, ethnicity, marital status and union type, and religion, in an attempt to isolate the mechanisms through which those differences are

perpetuated. He adopted Caldwell and, Mosley and Chen frameworks of 1979 and 1984 respectively in his study, while the piecewise logit regression was used in the analyses to show the mechanisms that took place at each stage of life before the child reached age five years.

His findings revealed that the effect of place of residence varies among the under-five age periods. For example, the rural disadvantage was concentrated in the neonatal period and in the segment 12-23 and 24-59 months**.** These results are virtually unaffected by controls for socio-economic background, ecological and regional differences, ethnic and religious differences, maternal reproductive patterns and obstetric history, child's characteristics and health services utilization. His study found that ethnicity had effects on infant and child mortality, although, the statistical significance, magnitude and direction of their effects were age-dependent and sometimes confounded by other variables.

Further, the effects of religious affiliation was reported to be mediated by other factors in the analysis. In his result, there was no specific direction in the effects of religion by age for infant children. But after the first year of life, it was found that the Protestants and Catholics and few Muslims experienced fewer deaths of children than their counterparts who were affiliated with other religions. The reason for this outcome was associated mainly to the socio-economic status of the mother (e.g. education, employment and polygamy). The study showed that maternal background characteristics explained all the religious differences in mortality. After controlling for one important factor - the mother's education, some variation persisted across religious groupings. That is, the higher the effect of socio-economic factors the lower the level of religious differentials in infant and child mortality.

Lastly, mother's education had direct effect on mortality within ages 1-4 completed years (child mortality). The major contribution of the study was the examination of the pathways by which the socio-economic factors operate to affect infant and child mortality in Cameroon. But the study was limited in the area of analysis, in that, the effects of the socio-economic factors were examined individually on the outcome variable, rather than measuring the combined effects of the socio-economic factors through which the proximate determinants operate. The major weakness of the Piece-wise logit technique used in the study was that variables not

showing significant association was dropped and this does not allow for a combined effects testing of the independent variables on the outcome variable.

Antai (2010) examined child health inequities in relation to under-five mortality in Nigeria focusing on the environment where the child was raised, the region and religion which the mother belonged and her wealth status. He used the Nigeria Demographic and Health Survey dataset of 2003, while the Cox regression and multilevel logistic regression were used in the analysis of data. His findings revealed that ethnic mortality variations were as a result of differences in the individual-level, social and economic characteristics, and very limited association with the health behaviour of the mothers. Furthermore, urban dwellers living in deprived areas experienced increased risks of under-five deaths. Hence, the higher the level of deprivation of social, economic and infrastructural amenities in these areas, the higher the risks of childhood mortality.

Further, variations in mortality among the migrant groups were related to the interference in the migrant's social and economic welfare, inequalities in utilization of maternal health care services, their demographic, social and economic choices. This was due to the differences between the underlying/socio-economic factors of the migrant and non-migrant populations, including the influence of community factors. Although Antai included proximate determinants in the selected variables for his study, he failed to place emphasis on them during the analyses. The findings from the study focused more on levels of determinants of under-five mortality. That is the child's characteristics, the mother's characteristics and the community characteristics. Hence, the pathways of influence among the variables were not clearly explained, because the study more or less assumed the direct effect of the explanatory variables.

Olisaekee (2014) was able to bring to the fore the concept of proximate determinants. She examined the interaction between energy poverty and type of cooking fuel in influencing under-five mortality. This she explained can bring about exposure to harmful emissions of biomass smoke, unsafe source of drinking water which can contribute to the risk of having

diarrhea and lack of better health care services/ diagnosis. Her work reported that this might be partly caused by poor electricity supply, etc., which contributes to childhood mortality.

Olisakee's work was simply a review on understanding the pathways of influence of energy poverty on under-five mortality in Nigeria. She reported that Nigeria is endowed with abundant natural energy resources, but the country has suffered from poor energy supply. In 2008, almost half of the households in the country had no access to electricity. There was also a wide disparity in the lack of access to electricity between rural and urban areas (66% versus 16% respectively), which has lingered since 2008 according to her study.

Although energy poverty is a prominent socio-economic concern in Nigeria, according to Olisaekee (2014), in most cases, it has been neglected as a determinant of human health, even by some international organizations. Her findings explained that infants and young children were traditionally carried on their mothers' backs while cooking in Nigeria. With about 70% of households relying on solid fuels (e.g. wood) for cooking, the majority of these susceptible children are regularly exposed to harmful emissions of biomass smoke, which significantly increases risk for acute lower respiratory tract infections, upper respiratory tract infections and asthma, and pneumonia. The study reported that the predominant use of firewood for cooking and the fact that pneumonia was the single most important cause of under-five mortality in Nigeria implicates energy poverty as a significant determinant of under-five mortality. The study was a review of previous research on the subject matter and as a result, there were no statistical analyses to back up the findings from the study.

Ogada (2014) adopted the proximate determinants approach in his study of under-five mortality in major cities of three countries which were Nairobi in Kenya, Kigali in Rwanda and Dar-es-salaam in Tanzania. The data source for the three countries whose cities were the target population in the study was the Demographic and Health Survey data. Ogada's results showed that the background factors did not have direct effects on under-five mortality, but operated indirectly through the intervening variables. For example, the findings from the study established that a variable like type of birth (single/multiple births) helped to transmit the effects of selected socio-economic factors on mortality.

His results further showed that under-five children who were multiple births and were from rich homes are less likely to die before reaching age five years when compared to children from poor homes. Also, the age of the mother at birth had significant influence on under-five mortality. Hence, older mother (35 years and above) who were wealthy, educated and were at paid jobs were less likely to lose their under-five children. He reported the similar experience for households which had improved sanitation. Lack of toilet facilities was a significant predictor of under-five mortality among the households in the three major cities. Though Ogada (2014) was able to use the concept of proximate determinants in his study, he was not able to clearly explain the extent to which these factors (proximate determinants) helped to explain the effects of the underlying factors on under-five mortality.

This study, therefore, took some steps further to improve on previous studies by appropriately using the proximate determinants approach as designed by Mosley and Chen in examining the determinants of under-five mortality in Nigeria.

CHAPTER THREE

METHODOLOGY

3.1 Preface

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

3.2 Study Area

Nigeria is a West African country, it is bordered by Cameroon to the east, Niger to the north, Chad in the northeast, and Benin in the west, the Atlantic Ocean in the south. With a total land area of 923,768 square kilometers, Nigeria is the fourteenth largest country in Africa by area. As at 2015, the country's population was estimated as 186.5 million, with a growth rate that lies above 2.0 percent (Population Reference Bureau [PRB] 2016). The country is made up of 36 states and a Federal Capital Territory (FCT). These states are classified into six geopolitical zones; North West, North East, North Central, South East, South South, and South West. Further, there are 774 constitutionally accepted local government areas (LGAs) in the country (FMOH, 1988; NPC and ICF, 2014).

Although Nigeria is blessed with the abundance of human and natural resources, ironically, the country ranked 152nd position by the Human Development Index in the world (United Nations Development Programme –UNDP, 2016). The index measures the expectation of life, ability to read and write and the welfare status of persons living in a country. Further, about 34 percent of urban residents in the country live below the national poverty line, while 53 percent live in the rural areas as at 2013 (PRB, 2015b). On the average, the total fertility of a woman in Nigeria is 5.5, while infant mortality rate stood at 69 deaths per 1,000 live births (PRB, 2015a; PRB, 2016). Life expectancy for male and female in the country as at 2016 was 53 years respectively (PRB, 2016). All these indicators show that standard of living in the country still remain very low. Under-five mortality has been a national concern in the country and statistics shows that 43 percent of the country's population are below age 15 years (PRB, 2016). The under-five

population represents a significant percent of Nigeria's population, this is, because the age- sex pyramid for the country is "bottom-heavy".

3.3 Data Source and Sample Size

This study used the Child Recode file of the Nigeria Demographic and Health Survey (DHS) data (2013). Respondents were selected from the six geopolitical zones in the country, thereby making the sample nationally representative. The study covered several areas (Cross Sectional data) and information was obtained from respondents through face-to-face interviews from women aged 15-49 years. The data was released in 2013 and information were based on five years experiences before the survey year. The survey was said to be the fifth and largest survey conducted as part of the Demographic and Health Surveys (DHS) Programme in Nigeria by the National Population Commission of Nigeria in conjunction with ICF International, USA (NPC and ICF, 2014).

The 2013 Demographic and Health Survey obtained information on demographic and health indicators at the national, state and local government levels. In this study the children's recode data was used, this was due to the fact that, it contained all the relevant information required in this study on under-five children. The total sample size was 31,482, out of which 2,886 children were reported dead as at the time of the survey. For the purpose of this study, the unit of analysis was birth of child in the previous five years before the survey (NPC and ICF, 2014).

3.4 Sample Design

The NDHS 2013 sample size covered the entire population residing in official and unofficial residential divisions in the country. The 2006 Population Census enumeration list for Nigeria which was provided by the National Population Commission was used as a sampling frame for the NDHS. Health and population indicator estimates were provided for the sample selected at the national, zonal, and state levels (NPC and ICF, 2014).

This means that exact indicators were calculated for each of the six zones. The sample design allowed for specific indicators to be calculated for each of the Federal Capital Territory, Abuja, the six zones and the 36 states. In terms of administration, Nigeria was sectioned into states;

while each state was further divided into local government areas (LGAs), and each LGA was subdivided into units. Besides these administrative units, in 2006 in preparation for the population census, each unit was sectioned into census enumeration areas (EAs). The primary sampling unit (PSU), which was referred to as a cluster in the 2013 NDHS, was defined based on the list of EAs from the 2006 enumeration area census frame. A stratified three-stage cluster design was used in selecting the 2013 NDHS sample and this consist of 904 clusters, with 372 in urban areas and 532 in rural areas (Adedini, 2013; NPC and ICF, 2014).

A minimum target of 943 completed interviews per state was conducted on a representative sample of 40,680 households that were selected for the survey. A mapping exercise and complete listing of households were carried out for each cluster within the period of 2012 (December) to 2013 (January), with the lists of households being used as the sampling frame for selecting households. All regular households were listed. The Global Positioning System (GPS) receivers was used by the NPC listing enumerators after they were trained and this was used in order to compute the coordinates of the 2013 NDHS sample clusters (NPC and ICF, 2014).

In each cluster, a fixed sample take of 45 households was selected. Women within the reproductive ages of 15-49 years who usually reside or were visitors on the night before the survey in the households in the 2013 NDHS sample were eligible to be interviewed. Similarly, all men within the age group of 15-49 years who usually reside or were visitors on the night before the survey in the households were eligible to be interviewed in a sub-sample of half of the households (NPC and ICF, 2014; National Bureau of Statistics, [Nigeria], 2014).

3.5 Research Instrument

The DHS questionnaire is standardized such that it allows for cross comparison between countries and within a period of time. In the 2013 survey in Nigeria, three types of questionnaires were used namely; the men's questionnaire, the women's questionnaire and the household questionnaire. The data generated through the women's questionnaire was used for this study. Information elicited from the women's questionnaire cover details on the whole birth history of women aged 15-49 years, socioeconomic information, fertility preferences,

nutritional status of women and children, breastfeeding practices, vaccination, infant and child morbidity and mortality, knowledge and use of contraceptives etc. Women who had at least a live birth within the preceding five years before the survey were eligible for inclusion in the analyses (NPC and ICF, 2014).

3.6 Measurement of Variables

The dependent and explanatory variables used in this study were available in the 2013 NDHS dataset (Child Recode file). The relevant variables were selected and kept in a separate file from the irrelevant ones using the Statistical Package for Social Sciences (SPSS version 20). The analytical framework designed for this study was on the basis of Mosley and Chen framework (1984).

3.6.1 Dependent Variable

The dependent variable used in this study was under-five mortality (i.e. number of children who died before reaching age five years). Question on whether the child was alive, with the responses categorized as; 0= yes (Alive) or 1= no (Dead), represent the dependent variable in the dataset.

3.6.2 Underlying Factors (Independent Variables)

The independent variables which were also the underlying factors are sub-divided into socio-economic, demographic and cultural factors. Thus, the underlying factors are defined in Table 3.1.

Table 3.1: Definition of the selected underlying factors			
S/N	**Variable**	**Definition**	**Coding**
	Socio-economic Factors		
1	Mother's Educational Attainment	The highest level of education attained by mothers.	Nominal No Education=0; Primary=1 Secondary=2; Higher=3
2	Mother's Occupation	The type of job the mother is doing	Nominal Not working= 0; Manual =1; Sales=2; Agric./household = 3; Professional/Services/Clerical= 4
3	Region	The geographical background where the mothers belong.	Nominal: North central=1; North east=2 North west=3; South east=4 South south=5; South west=6
4	Wealth Index	A proxy for standard of living of women.	Ordinal: Poor =0; Middle=1; Rich=2
5	Place of Residence	Where the mother lives with the child	Nominal Urban =1; Rural=2
	Demographic Factors		
6	Mother's age	Mother's age as at the time of the survey	Nominal: Below 20=0; 20-29=1; 30-39=2; 40+ = 3
7	Marital Status	Marital position of the mother	Nominal Currently married =0: Not currently married =1
	Cultural Factors		
8	Religious Affiliation	Belief of the respondent in a deity	Nominal: Christianity=0; Islam=1; Others=2
Source: NDHS, 2013			

3.6.3 Proximate Determinants (Intervening Variables)

The proximate determinants used in this study are defined below as; biological/ maternal factors, environmental factors and maternal health-seeking behaviour:

Table 3.2: Definition of the Proximate Determinants			
S/N	**Variable**	**Definition**	**Coding**
	Maternal Factors		
1.	Birth Order	The position of the child in the family	Nominal Birth order 1 = 1; Birth order 2-3 = 2; Birth order 4-6 =3; Birth order 7+= 4
2.	Number of births in last five years	Number of births the woman had within the five years period before the survey	Nominal 1 birth= 1; 2 births= 2; 3 births=3; 4+ births= 4
	Nutritional Factors		
3.	Breastfeeding	If the child was ever breastfed or not	Nominal Breastfed =0; Never breastfed=1
	Environmental Factors		
4.	Source of drinking water	Source of Drinking water	Nominal Improved source=0; Non-improved source= 1
5.	Toilet facility	Type of toilet used in the household	Nominal Improved Sanitation=0; Non-improved Sanitation=1
6.	Type of cooking fuel	What the household used for cooking	Nominal Kerosene/Electricity/Gas =1; Wood/ Charcoal/Coal= 2; Animal dug/Agric. =3
	Maternal Health Seeking Behaviour		
7.	Place of delivery	Where respondent give birth to her last birth	Nominal Healthcare facility=0; Non-health care facility=1
Source: NDHS, 2013			

3.7 Analytical Framework

Figure 3.1 below shows the analytical framework for this study. It was derived or based on the broad conceptual framework of Mosley and Chen (1984). The analytical framework shows the links that exist in the processes of operation, particularly between the underlying factors and the proximate determinants, as well as between the proximate determinants and the outcome variable (i.e., under-five mortality). There is a direct link between the underlying factors and the proximate determinants which in turn have a direct link with under-five mortality. The outside (broken) arrow linking the underlying factors to the outcome variable was put there to acknowledge the fact that the proximate variables that were chosen in this study are not exhaustive of all possible proximate determinants that the underlying factors could be impacting in order to produce changes in under-five mortality. Hence, some of the underlying factors may still indicate significant indirect effects on under-five mortality, even in the presence of the proximate determinants in our study.

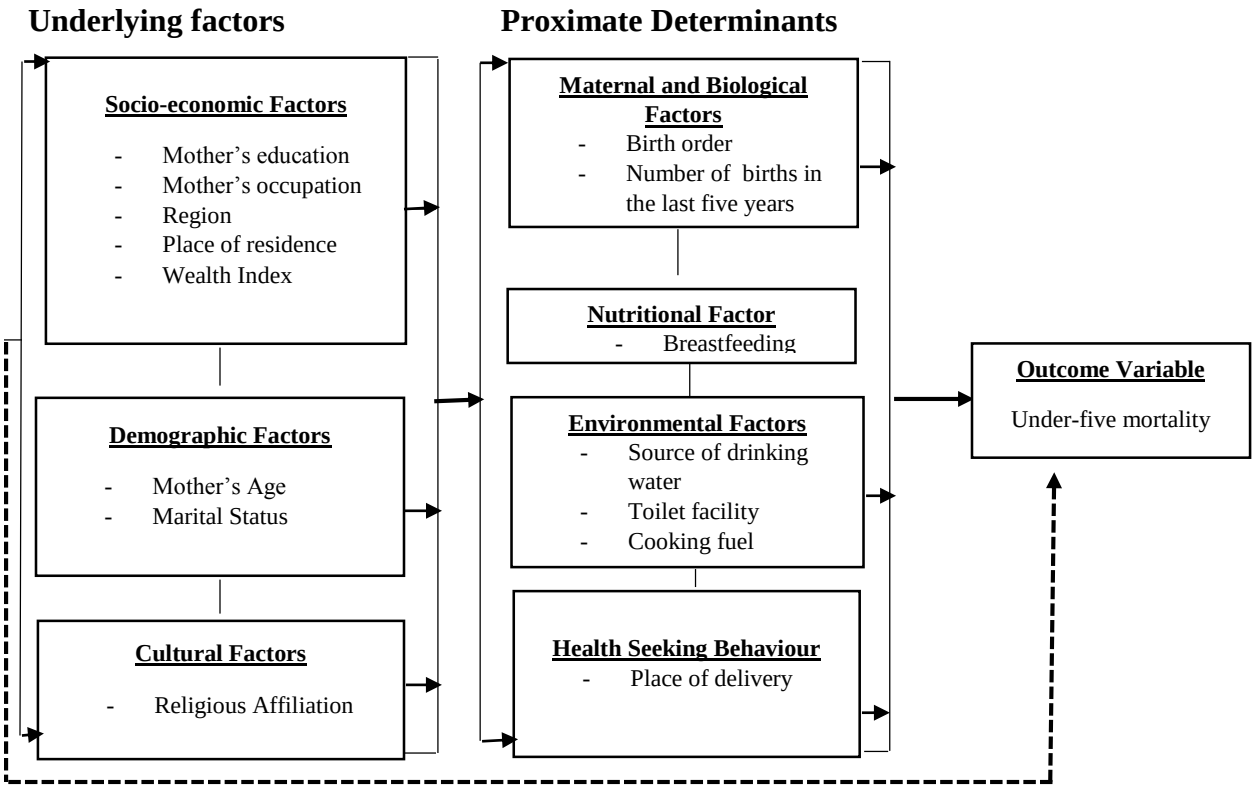

Figure 3.1: Analytical Framework showing the proximate determinants through which the underlying factors operate to influence under-five mortality in Nigeria

One can also use this framework to try and explain some of the earlier works on the determinants of childhood mortality. For example, in the study of Fayehun and Omololu (2009), mothers who lived in the urban centers reported fewer cases of under-five deaths than their counterparts who lived in the rural areas. It should be noted that it wasn't just because a mother resides in the urban center that made her child be less likely to die than another child whose mother resides in rural area, but because of residing in the urban center she had access to better health care services where she could deliver her baby under the supervision of a trained and experienced health personnel, take the child for immunization as at when due, give the child safe water, particularly for drinking, etc. These are some of the benefits that may not be readily available in the rural areas which render their children more vulnerable to diseases that might eventually claim their lives.

Another example is the educational attainment of the mother and how it influences under-five mortality. In the study of Antai (2010) and Adedini (2013), it was reported that educated mothers were more likely to feed their children with balanced diets more than mothers who have little or no education. From the framework presented above, an educated mother is more likely to go for antenatal care when pregnant and deliver her child in a health care facility, unlike her counterpart who is not educated. Further, she is also more likely to know the value and importance of immunization to the health status of her baby, space her births adequately and appreciate small family size, etc. when compared with a mother who is an illiterate and lack information on the essence of balanced diets, utilization of health care services for delivery, immunization of her child, etc.

3.7.1 Understanding the Pathways of Influence

The analytical framework presented in Figure 3.1, shows the relationships between the underlying factors, proximate determinants and the outcome variable. The analytic relationship can be explained thus:

If an underlying variable X is known to have a relationship with an outcome variable Z, in order for a variable Y to be called a proximate variable for the effect of X on Z, two conditions must be satisfied.

1. First, variable X must have a relationship with variable Y and
2. Secondly, variable Y must have a relationship with variable Z.

If either or both of these two conditions are not met, variable Y cannot qualify as a proximate determinant when trying to explain how X affects Z. It is, however, important to add here that Y may not be the only proximate variable through which X affects Z. That is, X may have multiple proximate variables through which it is affecting Z.

i.e., if **X==➔Y==➔Z**

then X -----Directly affects--------->Y

and Y-------Directly affects-------> Z

Where X represents the underlying factors

Y represents the proximate determinants and

Z represents the outcome variable (under-five mortality)

3.8 Estimation Techniques

The following levels of analyses were employed. The first was the univariate analyses which present the frequency/percentage distribution of the respondents according to the background characteristics of interest. The second level focused on bivariate analyses for the purpose of examining the unadjusted effects of the underlying and proximate variables on the outcome variable.

The essence of the bivariate analyses was to identify those underlying factors that have significant bivariate effects on under-five mortality. It was also used to test for the association that exists between the underlying factors and each of the proximate determinants, and lastly between the proximate factors and the outcome variable. The chi-square statistic was used to test for significant bivariate associations.

The third and final level of analysis was the multivariate analyses. The binary logistic regression was used to determine the adjusted indirect effects of the underlying factors on under-five mortality. All analyses were done using Statistical Package for Social Sciences

(SPSS version 20). Oversampling and undersampling of some sections of the population were accounted for, through the weighting factor provided by the Measure DHS where necessary [weight =V005/1000000].

3.9 Binary Logistic Regression

This model was first introduced by David Cox in 1958 and it can be used not only to identify risk factors but also to predict the probability of success or failure of an event (Cox, 1958; Kleinbaum and Klein, 2010). This type of logistic model is used primarily to predict an event with binary outcomes. For example, 'survival vs. mortality', 'yes vs. no'. The predictor variables can either be metric or non-metric or combination of both in the model. The effect of individual predictor variable can be measured while adjusting for the predictive ability of other factors in the model.

The binary logistic model was used in this study in order to examine and predict the likelihood that a child will die before getting to the age of five years in Nigeria. The regression model enabled the estimation of risks of death relative to the various underlying or proximate characteristics of interest. In the model, the outcome variable 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). Since the probability of occurrence or non-occurrence of an event cannot be less than 0 or greater than 1, the event probability distribution is restricted between 0 and 1.

3.9.1 Justification for the use of Binary Logistic Regression

Binary Logistic Regression is a non-linear model developed in the 1940s as a substitute for Fisher's 1936 linear discriminant analysis (Fisher, 1936; Kleinbaum and Klein, 2010). Similar to other regression models, logistic regression accommodates different types of variables measured on any of the four types of measurement scale (nominal, ordinal, ratio and interval). One distinct advantage that logistic regression has over most other traditional statistical models or techniques is that, unlike those models, it's not restricted by the normality assumptions that must be satisfied on the independent variables in the model in order to make statistical inferences, thereby making it a very robust method (Kleinbaum and Klein, 2010).

Unlike ordinary linear regression and two-stage least squares regression (structural equation models), logistic regression is essentially used when predicting an event with two possible outcomes. Due to this function, the logistic regression model must necessarily take the natural logarithm of the exponential of the outcome variable (known as the logit). The purpose of this was to create a continuous criterion as a transformed version of the dependent variable called the link function in logistic regression.

Other forms of regression models cannot tolerate this kind of variables, due to the dichotomous nature of the predicted values (i.e., 0 and 1). Hence, binary logistic regression is used when the variables involved have binomial distribution (double peak), unlike other regression models that must satisfy the normality distribution assumption (single peak). The logistic model solves this problem by determining the "odds ratio" or simply 'odds' of an event occurring (i.e., taking a value of 1) against its non-occurrence (i.e., taking a value of 0). For example, if the chances of an event "X" occurring is p_x and the probability of non-occurrence of the event is q_x (where $q_x = 1 - p_x$), then "odds" of occurrence of the event against its non-occurrence is p_x/q_x *or* $p_x/(1 - p_x)$. In the logistic model the natural logarithm of the Odds Ratio called the "log odds" (or logit) are related to a set of explanatory (or independent) variables to obtain a regression equation of the form:

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n \qquad \ldots\ldots\ldots\ldots\ldots (3.1)$$

Where the X_i's are the explanatory (independent) variables and the β_i's are the regression coefficients or the odds ratios.

3.9.2 Assumptions of Logistic Regression

Sample Size

The number of observations in the sample and explanatory variables in the model are crucial. If the sample size is small, but have numerous explanatory variables, the analysis will encounter problem, one of which is non-convergence. This is common when there are non-numeric variables with few cases in each category. To deal with this problem, descriptive statistics was conducted on each predictor, and those with limited numbers were collapsed or deleted.

The Problem of Multicollinearity

Multicollinearity happens when the effects of more than one independent variable cannot be separated on the dependent variable. The estimated regression parameters become unreliable when there is multicollinearity. Hence, it was of utmost importance to take note of high intercorrelations among the explanatory variables. It was expected that the independent variable will have a strong relationship with the dependent variable, but not relating significantly with each other. It was, therefore, necessary to carry out a collinearity diagnostics to check for multicollinearity. A collinearity test with tolerance values that are very low (less than 0.1) shows that a variable was highly correlated with other variables in the model (Pallant, 2011). It was essential to reassess the selected variables included in the model and exclude any of the highly correlated variables.

Another method of identifying highly correlated covariates was by producing their correlation matrix. Most linear statistical regression models are sensitive to any form of correlation among the independent variables. However, logistic regression (a non-linear model) can tolerate correlation that is as high as 0.8 to 0.9 among its variables. In this study, any two variables that have a correlation coefficient which was greater than 0.85 was considered to be highly correlated (Oni, 1985; Pallant, 2011). In this study, none of the correlation coefficients was up to 0.85 or 0.9. Hence, no variable was dropped.

Outliers

There was need to carefully look out for outliers or observations that were not clearly defined by the model. These outliers can be known by examining the residuals. This was vital, especially when there are problems with the extent to which the model predicts the data (i.e., goodness of fit).

3.9.3 Description of Binary Logistic Regression Model

$$\text{Log}\left[\frac{\text{P}}{1-\text{P}}\right] = \alpha + \beta_1 \text{X}_1 + \beta_2 \text{X}_2 + \cdots + \beta_\text{k} \text{X}_\text{n} + \mu \quad \ldots\ldots\ldots\ldots\ldots (3.2)$$

The model shows the odds of under-five mortality. In this study, P is the probability of under-five mortality occurring, (1-P) is the probability of under-five mortality not occurring. While $X_1 \ldots X_n$ represent the independent variables and $\beta_1 \ldots \beta_k$ are the regression parameters; α is a constant that gives the value of under-five mortality when all the independent variables are absent in the model, and μ is the residual or random error term. Log $\left[\frac{\text{P}}{1-\text{P}}\right]$ is referred to as the logistic transformation of probability of an event (i.e., under-five death) occurring. A binary regression model was used in this study to predict the odds of occurrence of under-five mortality in Nigeria as influenced by the underlying factors with or without adjusting for the proximate determinants.

3.9.4 Creating Dummy variables from Categorical Variables

The use of binary logistic regression models in this study required that the dependent variable is a binary/dichotomous variable. Though logistic regression allows the independent variables to take continuous or categorical values, however since it was of interest to estimate and compare the odd ratios of under-five deaths within and between categories of the underlying variables, all the independent variables in this study were made categorical. From each categorical variable, "dummy" variables are then created and fitted in the logistic regression analysis.

Dependent Variable

The dependent variable in this study was "whether a child who is under-five years of age was alive" The answer to the question was; Yes, the child is alive = 0; No, child is dead = 1.

Dummies for Independent Variables (Underlying Factors)

The following independent variables were selected for the purpose of this study:

Socio-economic Factors

Mother's Education (E_i)

$$E_i = \begin{cases} 1\text{: if level of education of mother is } i \\ 0\text{: if otherwise} \end{cases}$$

Where i = 0, 1, 2 representing no education, primary and secondary. "Higher education" is the reference category.

Mother's Occupation (O)

$$O = \begin{cases} 1\text{: if mother's occupation is i} \\ 0\text{: if otherwise} \end{cases}$$

Where i = 0, 1, 2, 3 representing not working, manual, sales and agriculture/household workers. "Professional/Services/Clerical is the reference category.

Region (R_i)

$$R_i = \begin{cases} 1\text{: if mother's region is i} \\ 0\text{: if otherwise} \end{cases}$$

Where i = 1, 2, 3, 4, 5 representing, northeast, northwest, southeast, southsouth and southwest. "Northcentral" is the reference category.

Wealth Index (W_i)

$$W_i = \begin{cases} 1\text{: if mother's wealth index is i} \\ 0\text{: if otherwise} \end{cases}$$

Where i = 0, 1 representing the poor and the middle-class. "Rich" is the reference category.

Place of Residence (L)

$L = \begin{cases} 1: \text{if mother (including the child) lives in a rural area} \\ 0: \text{if otherwise} \end{cases}$

Where "Urban" is the reference category.

Demographic Variables

Mother's Age (A_i)

$A_i = \begin{cases} 1: \text{if mother's age is i} \\ 0: \text{if otherwise} \end{cases}$

Where i = 1, 2, 3 representing 20-29, 30-39 and 40+. "Below age 20 years" is the reference category.

Marital Status (H)

$H = \begin{cases} 1: \text{if the mother is not currently married} \\ 0: \text{if otherwise} \end{cases}$

Where "Currently married" is the reference category.

Cultural Factor

Religion (G_i)

$G_i = \begin{cases} 1: \text{if mother's religion is i} \\ 0: \text{if otherwise} \end{cases}$

Where i = 1, 2 representing Muslims and Others. "Christianity Religion" is the reference category.

Dummies for Intervening Variables (Proximate Determinants)

Maternal Factors

Birth Order (Y_i)

Y_i = 1: if the birth order of the child is i
0: if otherwise

Where i = 0, 1, 2, representing birth order 1, 2-3 and 4-6 birth order. "7+ birth order" is the reference category.

Number of births in the last five years(B_i)

B_i = 1: if the number of births of mothers within the past five years is i
0: if otherwise

Where i = 1, 2, 3 representing 2 births, 3 births and 4+ births. "1 birth" is the reference category.

Nutritional Factor

Breastfeeding (N)

N = 1: if the child was never breastfed
0: if otherwise

Where "Ever breastfed" is the reference category.

Environmental Factors

Source of Drinking Water (K)

K = 1: if the source of drinking water in the household is a non-improved source
0: if otherwise

Where "Improved source" is the reference category.

Toilet facility (T_i)

T_i = 1: if the toilet facility in the household where the child lives is a non-improved sanitation

0: if otherwise

Where "Improved Sanitation" is the reference category.

Type of Cooking Fuel (J_i)

J_i = 1: if the type of cooking fuel used in the household is i

0: if otherwise

Where i = 1, 2 representing Wood/Charcoal/Coal and Animal dung/Agricultural substance. The reference category is "Kerosene/ Electricity/Gas".

Maternal Health Seeking Behaviour

Place of Delivery (D_i)

D_i = 1: if the mothers' place of delivery is a non-health care facility

0: if otherwise

Where "Health care facility" is the reference category.

3.10 Model Specification

The implicit function of the model can be specified thus:

$$y = f(U, P) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.3)$$

Where y is the outcome variable representing under-five mortality

U: represent the selected underlying factors used in the study

P: represent the proximate determinants used in the study

The underlying factors are further classified as; socio-economic, demographic and cultural factors and are presented below as:

U: {*MOE, MOC, REG, REL, POR, WEI, MOA, MAR*} … … (3.4)

Where,

MOE: Mother's Educational Attainment

MOC: Mother's Occupation

REG: Region

REL: Religion

POR: Place of Residence

MOA: Mother's Age

WEI: Wealth Index

MAR: Marital Status

The proximate determinants are further classified as; biological/maternal factors, nutritional factors, environmental factors and maternal health-seeking behavior factors.

P: {*BIO, BIP, BRF, SDW, TOF, COF, POD*} … (3.5)

Where,

BIO: Birth Order

BIP: Births in past five years

BRF: Breastfeeding

SDW: Source of drinking water

TOF: Toilet Facility

COF: Type of cooking fuel

POD: Place of Delivery

Hence,

$y = f(MOE, MOC, REG, REL, POR, WEI, MOA, MAR,$ BIO, *BIP*, *BRF*, *SDW*, *TOF*, *COF*, *POD*) … … … … … … … … … … … … … … (3.6)

The following regression models were developed to examine the pathways through which the underlying factors operate to influence under-five mortality in Nigeria.

3.10.1 Statistical Models for Testing Relationships

Three statistical models (models 1, 2 and 3) were set up to test the hypotheses stated in chapter one, section 1.5 of this study. The following hypotheses which were stated in the null form was tested:

1. Underlying factors do not have significant indirect effects on under-five mortality in Nigeria.
2. Underlying factors do not have a significant relationship with the proximate determinants; hence, the later cannot help to explain the relationship of the former with under-five mortality.
3. There is no significant reduction in the indirect effects of the underlying factors on under-five mortality, after taking into consideration (i.e., adjusting for) the effects of the proximate determinants on under-five mortality.

Model 1 (Reduced Model)

The first model was set up to test the significant effects of the underlying factors on the outcome variable.That is, to test those underlying factors that indirectly influence under-five mortality.

The Implicit function of the relationship is denoted as:

$$y = f(U) \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3.7)$$

The Explicit function is denoted as:

$$y = \beta_0 + \beta_1 E_1 + \beta_2 E_2 + \beta_3 E_3 + \beta_4 O_1 + \beta_5 O_2 + \beta_6 O_3 + \beta_7 O_4 + +\beta_8 R_1 + \beta_9 R_2 + \beta_{10} R_3 + \beta_{11} R_4 + \beta_{12} R_5 + \beta_{13} W_1 + \beta_{14} W_2 + \beta_{15} L_1 + \beta_{16} A_1 + \beta_{17} A_2 + \beta_{18} A_3 + \beta_{19} H_1 + \beta_{20} G_1 + \beta_{21} G_2 + \mu \quad (3.8)$$

In model 1 above, y is the outcome variable and it referred to the logistic transformation of the probability of under-five mortality occurring. β_0 is the intercept representing the probability of occurrence of the under-five mortality in the absence of all the underlying factors. $\beta_1 \ldots \beta_{21}$ were the odds ratios of under-five mortality occurring, while each letter in the model represent the dummy variables derived from the underlying factors. The "μ" is the error term.

If the estimated odd ratio of any of the dummy variables is greater than 1, it signifies that the probability of occurrence of the outcome event (i.e. under-five mortality) given that category of the variable is higher than the probability of the event occurring in the presence of the reference category of that variable. However, if the estimated odd ratio is less than 1, then the probability of the event occurring given that variable category, is less than the event occurring given the reference category for that variable. The test statistic for this model as well as for other similar logistic models in this study was the Chi-square statistic. The degree of freedom was the number of parameters estimated. The significant level was set at 5% (i.e., $P < 0.05$).

Model 2

This model was set up to test the significant direct effects of the underlying factors on each of the proximate determinants. This was achieved by first identifying significant bivariate relationship between the underlying factors and each of the proximate determinants using the chi-square statistic, after which a multivariate analysis through the use of the binary logistic regression was carried out. The essence of the multivariate analysis was to test the independent effects of the underlying factors on the proximate determinants. The result from this model was used to establish the condition 2 that was previously mentioned and which is thus, restated as, "for a variable (Y) to serve as a proximate through which an underlying factor (X) transmits its effects on under-five mortality (Z), there must be a significant relationship between the underlying and the proximate variables". The level of significance was set at 5 percent.

$$P_i = \gamma_0 + \gamma_1 E_1 + \gamma_2 E_2 + \gamma_3 E_3 + \gamma_4 O_1 + \gamma_5 O_2 + \gamma_6 O_3 + \gamma_7 O_4 + \gamma_8 F_1 + \gamma_9 F_2 + \gamma_{10} F_3 + \gamma_{11} R_1 + \gamma_{12} R_2 + \gamma_{13} R_3 + \gamma_{14} R_4 + \gamma_{15} R_5 + \gamma_{16} W_1 + \gamma_{17} W_2 + \gamma_{18} L_1 + \gamma_{19} A_1 + \gamma_{20} A_2 + \gamma_{21} A_3 + \gamma_{22} H_1 + \gamma_{23} G_1 + \gamma_{24} G_2 + \mu \quad (3.9)$$

Where,

P_i : represent each of the proximate determinants

γ: is the odds ratio, indicating the probability of the event occurring

μ: error term

Each letter in the equation represent the underlying factors.

Model 3 (Full Model)

This model was set up to test or determine the extent to which the proximate determinants account for the indirect effects of the underlying factors on under-five mortality. Model 3 is an expanded model for Model 1. All the proximate variables were added to all the underlying variables in Model 1. Variables in Model 1 are therefore subsets of Model 3 variables. Model 1 is therefore referred to as a **reduced** model of Model 3 and the latter is referred to as the **"full"** model. The reduced model was specified to test for the indirect adjusted effects of the underlying factors on under-five mortality, while the full model was specified to test the extent to which the added proximate determinants help to account for the initial indirect effects which the underlying factors initially had on under-five mortality. The model is specified below as:

Implicit function:

$$y = f(U, P) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.10)$$

Explicit function:

$$
\begin{aligned}
& y \\
& = \vartheta_0 + \vartheta_1 E_1 + \vartheta_2 E_2 + \vartheta_3 E_3 + \vartheta_4 O_1 + \vartheta_5 O_2 + \vartheta_6 O_3 + \vartheta_7 O_4 + + \vartheta_8 R_1 + \vartheta_9 R_2 + \vartheta_{10} R_3 \\
& + \vartheta_{11} R_4 + \vartheta_{12} R_5 + \vartheta_{13} W_1 + \vartheta_{14} W_2 + \vartheta_{15} L_1 + \vartheta_{16} A_1 + \vartheta_{17} A_2 + \vartheta_{18} A_3 + \vartheta_{19} H_1 \\
& + \vartheta_{20} G_1 + \vartheta_{21} G_2 + \vartheta_{22} Y_1 + \vartheta_{23} Y_2 + \vartheta_{24} Y_3 + \vartheta_{25} B_1 + \vartheta_{26} B_2 + \vartheta_{27} B_3 + \vartheta_{28} N_1 + \vartheta_{29} K_1 \\
& + \vartheta_{30} T_1 + \vartheta_{30} J_1 + \vartheta_{31} J_2 + \vartheta_{32} D_1 + \vartheta_{33} D_2 \\
& + \mu \qquad (3.11)
\end{aligned}
$$

3.11 Test of Significance of the Proximate Determinants – Likelihood Ratio Test

In Logistic Regression Analysis, when one model is a special case (i.e., a subset) of another model such as in a full model and a reduced model, statisticians have shown that the difference between the log-likelihood statistics for the two models has an approximate chi-square distribution in a large sample. The degrees of freedom (df) for the chi-square are the difference between the number of parameters in the two models. The test statistic is called **Likelihood Ratio or LR** statistic. The test of hypothesis about the parameters in the model is called **likelihood ratio test** (Kleinbaum and Klein, 2010). In this study, the difference between the **log- likelihood statistics** of model 3 and model 1 was used to test the extent to which the proximate determinants account for the indirect relationships between the underlying factors and under-five mortality. The number of additional parameters due to the proximate determinants in the full model (Model 3) gives the degree of freedom for the test statistic. The level of significance determines the extent to which the proximate variables had helped to account for or explain the indirect effects of the underlying factors on the outcome variable (i.e., under-five mortality).

3.12 Model of Fit Statistic

The Hosmer-Lemeshow goodness-of –fit statistic is used in the binary logistic regression model to determine if the model sufficiently explains the data. The statistic shows a good fit when the significance value is above 0.05 and vice-versa (Pallant, 2011).

3.13 Ethical Consideration

Secondary data was used for analyses in this study and access to the data was obtained from Opinion Research Corporation Macro International, Incorporated (ORC Macro Inc.). The National Ethics Committee under the auspices of the Federal Ministry of Health, Nigeria and the Ethics Committee of the Opinion Research Corporation Macro International, Incorporated (ORC Macro Inc.), Calverton, USA gave the approval for the research to be conducted (NPC and ICF, 2014).

CHAPTER FOUR

RESULTS

4.1 Preface

This chapter presents the data analyses in line with the specific objectives and the research questions raised in chapter one. The data analyses was presented in three stages; the univariate analyses, which focused on the unit description of each of the variables of interest to this study. The second stage was the bivariate analyses and this centered on the association between each of the underlying variable and under-five mortality without examining the adjusted effects. The third and the final stage was the multivariate (logistic regression) analyses. This was used to determine the independent effect of each of the underlying factor on under-five mortality (i.e., effect after adjusting for the presence of the other factors).

4.2. Correlation Matrix

The correlation matrix result was used to check for multicollinearity among the independent variables (the underlying factors). The correlation coefficients are presented in table 4.2.1 and the result shows that there was no collinearity between the independent variables. That is, none of the coefficients was up to or greater than 0.85 (Pallant, 2011; Oni, 1988). Therefore, there was no need to drop any of the variables from the analyses.

Table 4.2.1: Pairwise Correlation Matrix

Variables	Region	Residence	Mother's Education	Father's Education	Wealth status	Religion	Mother's Age	Marital Status	Occupation
Region	**1.000**								
Residence	-0.248	**1.000**							
Mother's Education	0.331	-0.399	**1.000**						
Father's Education	0.199	-0.352	0.688	**1.000**					
Wealth Status	0.322	-0.566	0.636	0.610	**1.000**				
Religion	-0.372	0.175	-0.593	-0.457	-0.378	**1.000**			
Mother's Age	0.069	-0.066	-0.012	-0.006	0.047	-0.056	**1.000**		
Marital Status	0.075	-0.025	0.111	0.032	0.034	-0.152	-0.077	**1.000**	
Mother's occupation	0.141	-0.091	0.245	0.214	0.159	-0.303	0.176	0.013	**1.000**

Source: Author's Computation, 2016

4.3 Findings

4.3.1 Percent Distribution of Respondents by selected Underlying Factors

Table 4.3.1 shows the percent distribution of respondents by selected underlying factors used in this study. The total for each variable differs due to missing values and no response. The result shows that 46.9 percent of the mothers had no education, while 20.4 percent, 26.6 percent, and 6.1 percent reported that they had primary, secondary and higher education respectively. Further, 29.1 percent reported that they were not working as at the time of the survey, 11.7 percent reported that they were in manual labor, while 38.2 percent, 12.3 percent, and 8.7 percent were engaged in sales, agriculture/household and professional related jobs respectively.

About 14.7 percent of the children were from the North Central region of Nigeria, 20.7 percent were from North East, 31.5 percent from the North West, 8.5 percent were from the South East and 11.9 percent and 12.3 percent were from the South South and South Western part of Nigeria respectively. Forty-six percent of the children were from poor households, while 19.9 percent and 34.1 percent were from middle- class and rich households respectively.

A larger proportion of the under-five mothers were within ages 20-29 years (47.2 percent) and 30-39 years (37.7 percent). Ninety-five percent were currently married and 4.7 percent were not married. Only 32.9 percent of the mothers lived in the urban centers, while 67.1 percent lived in rural areas. About 40 percent of the mothers were Christians, 58.6 percent were Muslims and 1.0 percent practiced other religions.

Table 4.3.1: Percent Distribution of Respondents by selected Underlying factors

Variables	Freq.	Percent	Variables	Freq.	Percent
Mother's Education			**Mother's Age**		
No Education	14762	46.9	Below age 20 years	1531	4.9
Primary	6432	20.4	20-29 years	14845	47.2
Secondary	8365	26.6	30-39 years	11859	37.7
Tertiary	1923	6.1	40+ years	3247	10.3
Total	**31482**	**100**	**Total**	**31482**	**100**
Mother's Occupation			**Marital Status**		
Not working	9099	29.1	Currently married	29990	95.3
Manual	3651	11.7	Not currently married	1492	4.7
Sales	11964	38.2	**Total**	**31482**	**100**
Agric./Household	3839	12.3	**Religion**		
Professional	2734	8.7	Christianity	12654	40.4
Total	**31287**	**100**	Islam	18354	58.6
Region			Other	314	1.0
North Central	4614	14.7	**Total**	**31482**	**100**
North East	6517	20.7	**Place of Residence**		
North West	9906	31.5	Urban	10351	32.9
South East	2816	8.9	Rural	21131	67.1
South South	3747	11.9	**Total**	**31482**	**100**
South West	3882	12.3			
Total	**31482**	**100**			
Wealth Status					
Poor	14462	45.9			
Middle	6272	19.9			
Rich	10748	34.1			
Total	**31482**	**100**			

Source: Author's Computation 2016

4.3.2 Percent Distribution of Respondents by Proximate Determinants and the Outcome variable

Table 4.3.2 shows the percent distribution of respondents by selected proximate determinants and the outcome variable used in this study. The total for each variable differs, due to missing values and no response. Ninety-seven percent of the children were reported to have ever been breastfed, while about 3 percent had never been breastfed. Out of this total, 55.6 percent drank water from improved source (e.g. pipe water, borehole, covered well, etc.) and 44.4 percent from non-improved source (e.g. uncovered well, stream/pond, etc.).

Further, 17.3 percent of the children reside in households where kerosene/electricity/ gas was used as a source of cooking fuel. While about 80.1 percent were from households where wood/ coal/ charcoal was used as a source of cooking fuel. Among the under-five children, 19.4 percent were of birth order 1, while 32 percent, 31.7 percent, and 16.9 percent were of birth order 2-3, 4-6 and 7+ respectively. Sixty-three percent of them were delivered at home, while only 37 percent were delivered at the hospital.

About 33 percent of the mothers reported that they had only 1 birth during the previous five years before the survey, while 52.8 percent, 12.9 percent, and 1.1 percent reported that they had 2 births, 3 births and 4+ births respectively. Forty-nine percent of the under-five children were born in homes where improved toilet facility (i.e., flush to piped sewer system, pit latrine with slab, flush to septic tank, ventilated improved pit latrine, etc.) was used, while 51 percent were from households where non-improved facility (i.e. pit latrine without slab, bucket, hanging toilet, no facility/ bush/ field, etc.) was used.

Finally, the table shows that 90.8 percent (28,596) out of the total number of under-five children sampled in the survey were reported alive as at the time the information was collected, while 9.2 percent (2,886) were reported to have died. In total, information was elicited on 31,482 under-five children in the survey.

Table 4.3.2: Percent Distribution of Respondents by selected Proximate Determinants and the Outcome Variable

Variables	Freq.	Percent	Variables	Freq.	Percent
Breastfeeding			**Place of Delivery**		
Breastfed	30086	97.4	Non-health care facility	19619	63.0
Never breastfed	818	2.6	Health care facility	11512	37.0
Total	**30904**	**100**	**Total**	**31131**	**100**
			Number of births in the		
Drinking Water			**last five years**		
Improved Source	17320	55.6	1 birth	10435	33.1
Non-improved Source	13817	44.4	2 births	16638	52.8
Total	**31137**	**100**	3 births	4059	12.9
Cooking fuel			4 births	350	1.1
Kerosene/Electric/Gas	5397	17.3	**Total**	**31482**	**100**
Wood/ Charcoal/Coal	24986	80.1	**Outcome Variable**		
Animal dug/Agric.	800	2.6	**Under-five Mortality**		
Total	**31183**	**100**	Alive	28596	90.8
Toilet facility			Dead	2886	9.2
Improved sanitation	15170	48.7	**Total**	**31482**	**100**
Non-improved sanitation	16002	51.3			
Total	**31172**	**100**			
Birth Order					
Birth order 1	6109	19.4			
Birth order 2-3	10074	32.0			
Birth order 4-6	9971	31.7			
Birth order 7+	5328	16.9			
Total	**31482**	**100**			

Source: Author's Computation, 2016

Model 1

The model was set up to test the significant effects of the underlying factors on the outcome variable. This was achieved by first identifying those underlying factors that have a significant relationship with under-five mortality at the bivariate level and after which the binary logistic regression was used to examine their adjusted indirect effects on the outcome variable.

4.3.3 Bivariate Relationship between the Underlying Factors and Under-five Mortality

Table 4.3.3 shows the cross-tabulation analysis between the selected underlying factors and under-five mortality. The result showed a strong bivariate relationship between each of the underlying factors and under-five mortality (i.e. $P<0.01$). Under-five mortality declines as mother's level of education improve, ranging from 11.2 percent for mothers who have no education to 4.5 percent for those who have higher education (Chi-square = 195.4 on 3 d.f; $P < 0.01$). The association between mother's occupation and under-five deaths showed that only mothers who were engaged in professional occupation reported a lower percentage of deaths of their children (6.3 percent) when compared with those in other categories. Therefore, mother's occupation was significantly related to under-five mortality ($P < 0.01$).

Under-five deaths were high in the North-East, North-West and South-South region of Nigeria with the following percentages of 10.1, 11.6 and 9.3 respectively. Further, 10.5 percent of children from the rural areas were reported dead before the research was conducted, compared to 6.4 percent reported in the urban centers. Also, 11.9 percent of children from poor households were reported dead, unlike 6.2 percent who were from rich households. Women who were not currently married during the period the data was collected reported higher percent (10.7 percent) of deaths of their children than mothers who were currently married (9.1 percent). About 10.3 percent of children whose mothers practiced Islam were reported dead compared 7.6 percent whose mothers were Christians. Hence there is a significant relationship between the faith of the mother and her experience of under-five mortality ($P<0.001$).

Table 4.3.3: Bivariate Relationship between the Underlying Factors and Under-five Mortality

Variables	If Child is Alive?			
Mother's Education	**Alive**	**Dead**	**Chi-square**	**P-value**
No education	13105 (88.8%)	1657 (11.2%)	195.42	0.000
Primary	5836 (90.7%)	596 (9.3%)		
Secondary	7818 (93.5%)	547 (6.5%)		
Higher	1837 (95.5%)	86 (4.5%)		
Mother's Occupation				
Not working	8262 (90.8%)	837 (9.2%)	31.24	0.000
Manual	3295 (90.2%)	356 (9.8%)		
Sales	10817 (90.4%)	1147 (9.6%)		
Agric./ Household	3483 (90.7%)	356 (9.3%)		
Professional	2562 (93.7%)	172 (6.3%)		
Region				
North Central	4286 (92.9%)	328 (7.1%)	170.51	0.000
North East	5856 (89.9%)	661 (10.1%)		
North West	8760 (88.4%)	1146 (11.6%)		
South East	2553 (90.7%)	263 (9.3%)		
South South	3498 (93.4%)	249 (6.6%)		
South West	3643 (93.8%)	239 (6.2%)		
Place of Residence				
Urban	9685 (93.6%)	666 (6.4%)	138.33	0.000
Rural	18911 (89.5%)	2220 (10.5%)		
Wealth Status				
Poor	12740 (88.1%)	1722 (11.9%)	257.36	0.000
Middle	5770 (92.0%)	502 (8.0%)		
Rich	10086 (93.8%)	662 (6.2%)		
Mother's Age				
Below age 20 years	1349 (88.1%)	182 (11.9%)	34.60	0.000
20-29 years	13549 (91.3%)	1296 (8.7%)		
30-39 years	10814 (91.2%)	1045 (8.8%)		
40+ years	2884 (88.8%)	363 (11.2%)		
Marital Status				
Currently married	27264 (90.9%)	2726 (9.1%)	4.56	0.033
Not currently married	1332 (89.3%)	160 (10.7%)		
Religion				
Christianity	11697 (92.4%)	957 (7.6%)	66.47	0.000
Islam	16467 (89.7%)	1887 (10.3%)		
Other	284 (90.4%)	30 (9.6%)		

Source: Author's Computation, 2016

Binary Logistic Regression (Reduced Model)

4.3.4 Binary Logistic Regression showing the effects of the Underlying factors on Under-five Mortality

This model shows the independent (or adjusted) effects of the selected underlying factors on under-five mortality. The results are shown in table 4.3.4. Only two of the eight underlying factors did not indicate significant indirect effects on under-five mortality. They are the religion of the mother and her occupation. All the other six had significant indirect effects on under-five mortality ($P < 0.05$ for each of the variables). The results showed that mothers with little (i.e., primary education) or no education, were at a higher risk of experiencing under-five deaths compared to their counterparts who had secondary education and above. The odds ratio showed that children of illiterate mothers were 1.64 times more likely to die before age five than children of educated mothers ($P<0.05$).

Similarly, the likelihood of under-five deaths was higher among children from financially deprived households than those from rich homes (OR= 1.36, $P< 0.01$). Under-five deaths were less likely to occur among mothers aged 20-29 and 30 -39 years when compared with mothers who were below age 20 years (OR=0.81, $P<0.01$; OR= 0.83, $P<0.05$ respectively). Hence, mother's age was a significant predictor of under-five mortality. Further, currently, married mothers were 0.74 times less likely to experience under-five mortality, unlike mothers who were not currently married. Marital status was a significant predictor of under-five mortality ($P<0.01$). Also, under-five children residing in the rural areas were 1.30 times more likely to die when compared with their counterparts who lived in the urban centers. Therefore, place of residence was also a significant predictor of child's death ($P<0.01$). Similarly, children who were from the northeastern, northwestern and southeastern zones were 1.22 times, 1.35 times and 1.60 times respectively more likely to die before reaching the age of five years, than their counterparts from the north central zone ($P < 0.01$). The religion and occupation of the mother do not have significantly adjusted effects on under-five mortality. The overall effect of the underlying factors on under-five mortality was given by the log-likelihood value of 18701.166 with a chi-square value of 384.372 on a degree of freedom of 21 ($P<0.01$).

Table 4.3.4: Binary Logistic Regression showing the effects of the Underlying factors on Under-five Mortality

Variables	Odds Ratio	Prob. Value	95% of C.I. for EXP(B)	
Mother's Education			**Lower**	**Upper**
No education	1.636***	0.000	1.252	2.137
Primary	1.586***	0.000	1.226	2.052
Secondary	1.251	0.075	0.978	1.600
Higher	**RC**			
Wealth Status				
Poor	1.357***	0.000	1.179	1.562
Middle	1.035	0.629	0.902	1.187
Rich	**RC**			
Mother's Age				
Below age 20 years	**RC**			
20-29 years	0.806*	0.013	0.680	0.955
30-39 years	0.833*	0.040	0.699	0.992
40+ years	0.986	0.888	0.810	1.200
Marital Status				
Currently married	0.738**	0.001	0.619	0.880
Not currently married	**RC**			
Religion				
Christianity	**RC**			
Islam	0.992	0.906	0.863	1.140
Other	0.896	0.582	0.606	1.324
Place of Residence				
Urban	**RC**			
Rural	1.304***	0.000	1.165	1.461
Mother's Occupation				
Not working	0.950	0.588	0.789	1.144
Manual	1.044	0.680	0.851	1.280
Sales	1.078	0.412	0.901	1.290
Agric./Household	1.012	0.913	0.820	1.248
Professional	**RC**			
Region				
North Central	**RC**			
North East	1.223*	0.010	1.050	1.424
North West	1.353***	0.000	1.164	1.572
South East	1.598***	0.000	1.323	1.930
South South	1.024	0.803	0.851	1.232
South West	1.078	0.417	0.899	1.294
Constant	0.060	0.000		
-2 Log likelihood = 18701.166			**Chi-Square value = 384.372**	
Hosmer and Lemeshow test (Chi-square= 18.479; P-value= 0.018)			**P-value = 0.000**	
****** significant at p<0.001; **significant at p<0.01 and *significant at p<0.05***			**df. = 21**	

Model 2

This model was set up to identify the intervening (proximate) variables through which each of the underlying factors may be operating to influence the outcome variable. This was done by testing for the significant relationships between each of the underlying factors and the proximate determinants. The bivariate analyses was used to test for these relationships using chi-square as the test statistic and the level of significance was set at 5% (i.e. $P < 0.05$). The binary logistic regression analysis was carried out to test for the independent effects of the underlying factors on each of the proximate determinants.

Maternal and Biological Factors

4.3.5 Bivariate relationship between the Underlying factors and Birth Order

Table 4.3.5 shows the bivariate relationship between the underlying factors and the birth order of the child. The results showed that all the underlying factors had a significant relationship with the birth order of the child ($P < 0.01$ in all cases). This implies that birth order is an intervening variable through which each of the underlying variables could be influencing under-five mortality. In the three Southern regions and the North Central region, majority of the children born in the previous five years before the survey (more than 55 percent) were of birth order 1 to 3, whereas, most of the children born during the same period in the North East and North West regions (greater than 55 percent) were of birth order 4 and above. This indicates higher fertility rates in the latter two regions than in the former four regions.

Similarly, a greater percentage of children born in the urban areas (58 percent) belong to lower birth order 1-3 compared to 48 percent of children that were born in the rural areas. This also implies a higher fertility rate in rural areas than in the urban areas. Further, 29.5 percent and 33.2 percent of children who were of the first birth order, have mothers who had secondary and higher educational qualifications respectively unlike 13.9 percent and 14.4 percent delivered by mothers who had primary and no education. Hence, the lower the level of education, the higher the level of fertility of a woman.

Regarding wealth status, the result shows that 24 percent and 37.9 percent of children in the first birth order and within 2-3 were from wealthy homes, while 33 percent and 23 percent of children who were of birth order 4-6 and 7+ were from poor homes. This also suggests higher fertility in poor homes than wealthy homes. In reference to mother's age, as expected, the older a woman is, the higher her birth order. For example, 80 percent of the recent births reported by women under 20 years of age were of birth order 1, whereas about 65 percent of recent births reported by mothers who were 40 years and older were of birth order seven and above.

As expected, marital status was also significantly associated with the birth order of the child (i.e. fertility level). About 44.7 percent of recent births reported by the currently unmarried mothers were only of birth order 1 when compared to 18 percent reported by currently married mothers. Further, about 9 percent of recent births of currently unmarried mothers were of birth order seven or greater compared to 17 percent reported by currently married mothers. Religion also influences the level of fertility with Christian mothers having lower fertility than mothers of other faiths. For example, only 11 percent of recent births by Christian mothers were of birth order 7 or more, compared to 21 percent and 33 percent that were reported by Muslim mothers and mothers of other religions respectively. Finally, professional and non-working mothers tend to have lower fertility compared to mothers engaged in manual, petty traders and agricultural jobs.

Table 4.3.5: Bivariate Relationship between the Underlying Factors and Birth Order

Underlying Factors	Birth Order					
	1st Birth	2-3 order	4-6 order	7+ order	Chi-sq.	P-value
Region					1294.12	0.000
North Central	1018 (22.1%)	1658 (35.9%)	1523 (33.0%)	415 (9.0%)		
North East	1085 (16.6%)	1907 (29.3%)	2129 (32.7%)	1396 (21.4%)		
North West	1567 (15.8%)	2728 (27.5%)	3203 (32.3%)	2408 (24.3%)		
South East	640 (22.7%)	970 (34.4%)	814 (28.9%)	392 (13.9%)		
South South	878 (23.4%)	1233 (32.9%)	1161 (31.0%)	475 (12.7%)		
South West	921 (23.7%)	1578 (40.6%)	1141 (29.4%)	242 (6.2%)		
Place of Residence					376.23	0.000
Urban	2311 (22.3%)	3671 (35.5%)	3152 (30.5%)	1217 (11.8%)		
Rural	3798 (18.0%)	6403 (30.3%)	6819 (32.3%)	4111 (19.5%)		
Mother's Education						
No education	2103 (14.2%)	4063 (27.5%)	5023 (34.0%)	3573 (24.2%)	2827.47	0.000
Primary	901 (14.0%)	1897 (29.5%)	2420 (37.6%)	1214 (18.9%)		
Secondary	2466 (29.5%)	3285 (39.3%)	2134 (25.5%)	480 (5.7%)		
Higher	639 (33.2%)	829 (43.1%)	394 (20.5%)	61 (3.2%)		
Wealth Status						
Poor	2293 (15.9%)	4070 (28.1%)	4779 (33.0%)	3320 (23.0%)	1148.18	0.000
Middle	1232 (19.6%)	1929 (30.8%)	2068 (33.0%)	1043 (16.6%)		
Rich	2584 (24.0%)	4075 (37.9%)	3124 (29.1%)	965 (9.0%)		
Mother's age						
Below 20 years	1226 (80.1%)	300 (19.6%)	5 (0.3%)	0 (0.0%)	16672.95	0.000
20-29 years	4223 (28.4%)	7037 (47.4%)	3402 (22.9%)	183 (1.2%)		
30-39 years	630 (5.3%)	2562 (21.6%)	5616 (47.4%)	3051 (25.7%)		
40+ years	30 (0.9%)	175 (5.4%)	948 (29.2%)	2094 (64.5%)		
Marital Status						
Currently married	5442 (18.1%)	9696 (32.3%)	9665 (32.2%)	5187 (17.3%)	651.70	0.000
Not currently married	667 (44.7%)	378 (25.3%)	306 (20.5%)	141 (9.5%)		
Religion					757.16	0.000
Christianity	2958 (23.4%)	4524 (35.8%)	3769 (29.8%)	1403 (11.1%)		
Islam	3082 (16.8%)	5410 (29.5%)	6059 (33.0%)	3803 (20.7%)		
Other	35 (11.1%)	79 (25.2%)	97 (30.9%)	103 (32.8%)		
Mother's Occupation						
Not working	2486 (27.3%)	3111 (34.2%)	2315 (25.4%)	1187 (13.0%)	1459.83	0.000
Manual	650 (17.8%)	1211 (33.2%)	1174 (32.2%)	616 (16.9%)		
Sales	1632 (13.6%)	3518 (29.4%)	4378 (36.6%)	2436 (20.4%)		
Agric./Household	534 (13.9%)	1073 (27.9%)	1377 (35.9%)	855 (22.3%)		
Professional	775 (28.3%)	1108 (40.5%)	659 (24.1%)	192 (7.0%)		

Source: Author's Computation, 2016

4.3.6 Binary Logistic Regression showing the effects of the Underlying factors on the Birth order of the child (Parity)

Table 4.3.6 presents the logistic regression analysis showing the adjusted effects of all the underlying factors on the birth order of the child. The birth order of the child was dichotomized as; Birth order 1-3= 0, Birth order 4+ =1. All the underlying factors except the place of residence of the mother were significant predictors of the child's birth order (parity). The results showed that mothers who have secondary education and below were more likely to have higher parity when compared with mothers who had more than secondary education. Hence, the lower the level of mother's education, the higher her parity ($P<0.001$).

The wealth status of the mother was also a significant predictor of her parity. Mothers who were in the poor and middle socioeconomic classes were 1.17 and 1.28 times more likely to have more children (4+ children) respectively when compared with mothers who were rich ($P<0.01$). Parity also differs by mother's occupation, as mothers in agricultural or household and sales employments were 1.80 and 1.59 times more likely to have higher parity when compared with mothers who are in professional employments ($P<0.01$). With the exception of the south western region, mothers from the remaining four other regions in Nigeria were more likely to have more children ever born when compared with mothers from the north central region ($P<0.01$).

Table 4.3.6: Binary Logistic Regression showing the effects of the Underlying factors on the Birth order of the child (Parity)

Variables	Odds Ratio	Prob. value	95% of C.I. for EXP(B)	
Mother's Education			**Lower**	**Upper**
No education	6.017***	0.000	5.107	7.089
Primary	5.707***	0.000	4.886	6.666
Secondary	2.604***	0.000	2.256	3.005
Higher	**RC**			
Wealth Status				
Poor	1.173**	0.002	1.058	1.301
Middle	1.282***	0.000	1.164	1.412
Rich	**RC**			
Mother's Age				
29 years and below	**RC**			
30-39 years	14.538***	0.000	13.606	15.534
40+ years	71.981***	0.000	61.455	84.310
Marital Status				
Currently married	1.691***	0.000	1.446	1.977
Not currently married	**RC**			
Religion				
Christianity	**RC**			
Islam	1.349***	0.000	1.223	1.487
Other	1.284	0.119	0.938	1.757
Place of Residence				
Urban	**RC**			
Rural	1.053	0.208	0.972	1.140
Mother's Occupation				
Not working	0.832**	0.004	0.734	0.944
Manual	1.084	0.260	0.942	1.247
Sales	1.590***	0.000	1.411	1.791
Agric./Household	1.800***	0.000	1.554	2.083
Professional	**RC**			
Region				
North Central	**RC**			
North East	1.931***	0.000	1.732	2.153
North West	1.794***	0.000	1.612	1.997
South East	1.205**	0.007	1.051	1.382
South South	1.342***	0.000	1.182	1.522
South West	0.707***	0.000	0.626	0.797
Constant	0.014	0.000		
-2 Log likelihood = 28440.107			**Chi-Square value = 14686.252**	
****** significant at p<0.001; **significant at p<0.01 and *significant at p<0.05***			**P-value = 0.000**	
			df. = 20	

Source: Author's Computation, 2016

4.3.7 Bivariate Relationship between the Underlying factors and Number of Births a woman had during the last five years before the survey

Table 4.3.7 shows that all the underlying factors had a significant relationship with number of births a woman had in the last five years before the survey ($P < 0.01$ in all cases). This implies that each of the underlying variables could be influencing under-five mortality through the number of births a woman had during the previous five years. For the purpose of this study, women who had 2 or more births within the five years period were considered to have multiple births.

By regional variation, the frequency of births (during the last five years) was more common in the North East (71.8 percent), North West (70 percent) and South East (69.7 percent) than in the North Central (62.2 percent), South-South (61.7 percent) and South West (59.8 percent). With respect to the place of residence, multiple births within a period of five years was more common among rural mothers (68.3 percent) than among the urban mothers (63.9 percent).

Also, multiple births declined with mother's education ranging from 70.7 percent among illiterate mothers to 57 percent among mothers with post-secondary education. Similarly, for wealth status, multiple births within the last five years declined with the wealth status of the women, ranging from 70.6 percent among the poor to 62.4 percent among the rich. About 71 percent of poor women had more than one birth within the last five years period. In regards to mother's age, multiple births during the previous five years was more common among mothers aged between 20 and 39 years (about 71 percent) compared to 32.7 percent and 51 percent of mothers under 20 years and mothers 40 years and above respectively. Currently, married mothers significantly had a greater number of births in the last five years (68.3 percent) than the unmarried mothers (38.1 percent). Lastly, Muslim mothers had more multiple births (69.6 percent) than Christian mothers (62.9 percent) or mothers of other religions (59.4 percent).

Table 4.3.7: Bivariate Relationship between the Underlying Factors and number of births a woman had in the last five years before the survey

Variables	Number of births in the last five years					
	1 birth	**2 births**	**3 births**	**4+ births**	**Chi-sq.**	**P-value**
Region					561.16	0.000
North Central	1745 (37.8%)	2372 (51.4%)	483 (10.5%)	14 (0.3%)		
North East	1837 (28.2%)	3664 (56.2%)	939 (14.4%)	77 (1.2%)		
North West	2968 (30.0%)	5616 (56.7%)	1206 (12.2%)	116 (1.2%)		
South East	854 (30.3%)	1334 (47.4%)	561 (19.9%)	67 (2.4%)		
South South	1436 (38.3%)	1780 (47.5%)	495 (13.2%)	36 (1.0%)		
South West	1595 (41.1%)	1872 (48.2%)	375 (9.7%)	40 (1.0%)		
Place of Residence					69.50	0.000
Urban	3736 (36.1%)	5164 (49.9%)	1320 (12.8%)	131 (1.3%)		
Rural	6699 (31.7%)	11474 (54.3%)	2739 (13.0%)	219 (1.0%)		
Mother's Education						
No education	4321 (29.3%)	8306 (56.3%)	1971 (13.4%)	164 (1.1%)	300.14	0.000
Primary	2118 (32.9%)	3392 (52.7%)	834 (13.0%)	88 (1.4%)		
Secondary	3170 (37.9%)	4032 (48.2%)	1065 (12.7%)	98 (1.2%)		
Higher	826 (43.0%)	908 (47.2%)	189 (9.8%)	0 (0.0%)		
Wealth Status						
Poor	4254 (29.4%)	8048 (55.6%)	1986 (13.7%)	174 (1.2%)	212.92	0.000
Middle	2145 (34.2%)	3336 (53.2%)	705 (11.2%)	86 (1.4%)		
Rich	4036 (37.6%)	5254 (48.9%)	1368 (12.7%)	90 (0.8%)		
Mother's age						
Below 20 years	1030 (67.3%)	430 (28.1%)	63 (4.1%)	8 (0.5%)	1387.14	0.000
20-29 years	4307 (29.0%)	8294 (55.9%)	2088 (14.1%)	156 (1.1%)		
30-39 years	3503 (29.5%)	6556 (55.3%)	1647 (13.9%)	153 (1.3%)		
40+ years	1595 (49.1%)	1358 (41.8%)	261 (8.0%)	33 (1.0%)		
Marital Status						
Currently married	9512 (31.7%)	16158 (53.9%)	3978 (13.3%)	342 (1.1%)	588.74	0.000
Not currently married	923 (61.9%)	480 (32.2%)	81 (5.4%)	8 (0.5%)		
Religion					206.25	0.000
Christianity	4693 (37.1%)	6112 (48.3%)	1704 (13.5%)	145 (1.1%)		
Islam	5578 (30.4%)	10284 (56.0%)	2295 (12.5%)	197 (1.1%)		
Other	127 (40.4%)	146 (46.5%)	33 (10.5%)	8 (2.5%)		
Mother's Occupation						
Not working	3093 (34.0%)	4732 (52.0%)	1197 (13.2%)	77 (0.8%)	94.54	0.000
Manual	1062 (29.1%)	2056 (56.3%)	492 (13.5%)	41 (1.1%)		
Sales	3880 (32.4%)	6392 (53.4%)	1551 (13.0%)	141 (1.2%)		
Agric./Household	1279 (33.3%)	1988 (51.8%)	516 (13.4%)	56 (1.5%)		
Professional	1066 (39.0%)	1362 (49.8%)	279 (10.2%)	27 (1.0%)		

Source: Author's Computation, 2016

4.3.8 Binary Logistic Regression showing the effects of the Underlying factors on the number of births mothers had in the last five years preceding survey

Table 4.3.8 shows the adjusted effects of the underlying factors on the frequency of births of mothers during the preceding five years before the study was conducted. The variable indicating the total number of children born within the five years period was dichotomized as; 1 birth=0; 2 or more births=1. That is, to compare mothers who had just 1 birth during the previous five years with those who had 2 or more births (multiple births) during the same period. All the underlying factors, with the exception of where the mother resides and her type of occupation, were significant predictors of the number of births she had within the five years period before the survey. The lower the educational attainment of a mother the higher her chances of having 2 or more births within the five years period before the survey ($P<0.01$).

Further, the number of births mothers had within the period varied by their age. The results showed that mothers who were 20 years and above were 5.40 times more likely to have 2 or more children during the five years period than their counterparts who were below age 20 years ($P < 0.001$). The marital status of a mother was significantly related to the number of births she had within that period. The result showed that currently, married mothers were 3.11 times more likely to have 2 or more children within the five years period when compared to mothers who were not currently married ($P<0.001$).

With the exception of mothers from the South-Western region, mothers from the remaining regions were more likely to have 2 or more births within the five years period than mothers who were from the North Central region ($P<0.001$). South- West, and North-Central are similar in this respect ($P= 0.942$).

Table 4.3.8: Binary Logistic Regression showing the effects of the Underlying factors on the number of births mothers had in the last five years preceding survey

Variables	Odds Ratio	Prob. value	95% of C.I. for EXP(B)	
Mother's Education			**Lower**	**Upper**
No education	1.512***	0.000	1.328	1.722
Primary	1.460***	0.000	1.292	1.650
Secondary	1.201**	0.001	1.075	1.342
Higher	**RC**			
Wealth Status				
Poor	1.172***	0.000	1.076	1.278
Middle	1.073	0.079	0.992	1.161
Rich	**RC**			
Mother's Age				
Below age 20 years	**RC**			
20-29 years	5.401***	0.000	4.801	6.076
30-39 years	5.183***	0.000	4.594	5.848
40+ years	2.056***	0.000	1.799	2.349
Marital Status				
Currently married	3.111***	0.000	2.775	3.487
Not currently married	**RC**			
Religion				
Christianity	**RC**			
Islam	1.118**	0.006	1.032	1.211
Other	0.708**	0.005	0.556	0.902
Place of Residence				
Urban	**RC**			
Rural	1.040	0.240	0.974	1.112
Mother's Occupation				
Not working	0.950	0.314	0.859	1.050
Manual	1.135*	0.033	1.010	1.276
Sales	1.063	0.219	0.965	1.171
Agric./Household	1.112	0.081	0.987	1.253
Professional	**RC**			
Region				
North Central	**RC**			
North East	1.472***	0.000	1.343	1.613
North West	1.281***	0.000	1.171	1.400
South East	1.818***	0.000	1.624	2.035
South South	1.273***	0.000	1.151	1.408
South West	0.996	0.942	0.906	1.096
Constant	0.074	0.000		
-2 Log likelihood = 37251.325			**Chi-Square value = 2328.788**	
****** significant at p<0.001; **significant at p<0.01 and *significant at p<0.05***			**P-value = 0.000**	
			df. = 21	

Source: Author's Computation, 2016

Nutritional Factors

4.3.9 Bivariate Relationship between the Underlying factors and Ever Breastfed

Table 4.3.9 shows the bivariate relationship between all the underlying factors and breastfeeding status of the child (i.e., whether or not the child was ever breastfed). In this analysis, not all the underlying factors had a significant relationship with the breastfeeding status of the child. However, variables such as mother's education ($P<0.05$), region ($P<0.01$), marital status ($P<0.05$) and religion ($P<0.01$) were significantly associated with ever breastfed variable. Variables that failed to show significant bivariate relationships include; mother's occupation, place of residence, wealth status and mother's age.

Table 4.3.9: Bivariate Relationship between the Underlying Factors and Breastfeeding Status of the Child

	Breastfeeding Status			
Variables	**Ever breastfed**	**Never breastfed**	**Chi-square**	**P-value**
Mother's Education				
No education	14121 (97.6%)	344 (2.4%)	8.193	0.042
Primary	6152 (97.2%)	175 (2.8%)		
Secondary	7978 (97.0%)	244 (3.0%)		
Higher	1835 (97.1%)	55 (2.9%)		
Mother's Occupation				
Not working	8700 (97.2%)	249 (2.8%)	6.87	0.143
Manual	3514 (97.6%)	88 (2.4%)		
Sales	11423 (97.6%)	282 (2.4%)		
Agric./Household	3650 (96.9%)	115 (3.1%)		
Professional	2615 (97.1%)	78 (2.9%)		
Region				
North Central	4377 (96.9%)	138 (3.1%)	55.39	0.000
North East	6250 (97.0%)	190 (3.0%)		
North West	9522 (98.3%)	164 (1.7%)		
South East	2646 (96.3%)	102 (3.7%)		
South South	3560 (96.9%)	115 (3.1%)		
South West	3731 (97.2%)	109 (2.8%)		
Place of Residence				
Urban	9918 (97.4%)	262 (2.6%)	0.32	0.574
Rural	20168 (97.3%)	556 (2.7%)		
Wealth Status				
Poor	13829 (97.6%)	345 (2.4%)	4.85	0.088
Middle	5976 (97.1%)	179 (2.9%)		
Rich	10281 (97.2%)	294 (2.8%)		
Mother's Age				
Below age 20 years	1459 (96.6%)	52 (3.4%)	5.53	0.137
20-29 years	14225 (97.5%)	365 (2.5%)		
30-39 years	11302 (97.2%)	320 (2.8%)		
40+ years	3100 (97.5%)	81 (2.5%)		
Marital Status				
Currently married	28667 (97.4%)	765 (2.6%)	5.46	0.020
Not currently married	1419 (96.4%)	53 (3.6%)		
Religion				
Christianity	12040 (96.8%)	398 (3.2%)	27.96	0.000
Islam	17603 (97.8%)	404 (2.2%)		
Other	297 (96.1%)	12 (3.9%)		

Source: Author's Computation, 2016

4.3.10 Binary Logistic Regression showing the effects of the Underlying factors on the Breastfeeding Status of the child

Table 4.3.10 presents the binary logistic regression showing the adjusted effects of the underlying factors on the breastfeeding status of the child, (i.e., whether or not the child was ever breastfed). The dependent variable was coded as; breastfed = 0 and Never breastfed =1. Similar to the bivariate analysis result, most of the underlying factors with the exemption of the age of the mother and region failed to act as significant predictors of the breastfeeding status of the child. This means that the breastfeeding status of the child can help to transmit the effects of those two significant underlying factors on under-five mortality. Hence, breastfeeding status is a significant proximate determinant for the age of mother and her region in exerting their effects on under-five mortality.

The result showed that mothers who were within ages 20-29 years were 0.71 times less likely never to have breastfed their children when compared with mothers who were below age 20 years ($P < 0.05$). Further, mothers from the North Western region were less likely never to have breastfed their children when compared with their counterparts who were from the North Central region (OR= 0.53; $P<0.001$).

Table 4.3.10: Binary Logistic Regression showing the effects of the Underlying factors on the Breastfeeding Status of the child

Variables	Odds Ratio	Prob. Value	95% of C.I. for EXP(B)	
Mother's Education			**Lower**	**Upper**
No education	1.129	0.528	0.775	1.643
Primary	1.004	0.981	0.706	1.428
Secondary	1.019	0.908	0.739	1.405
Higher	**RC**			
Wealth Status				
Poor	0.960	0.738	0.755	1.220
Middle	1.005	0.968	0.807	1.250
Rich	**RC**			
Mother's Age				
Below age 20 years	**RC**			
20-29 years	0.710*	0.027	0.523	0.962
30-39 years	0.781	0.122	0.571	1.068
40+ years	0.743	0.113	0.515	1.073
Marital Status				
Currently married	0.837	0.238	0.623	1.125
Not currently married	**RC**			
Religion				
Christianity	**RC**			
Islam	0.876	0.253	0.697	1.100
Other	1.349	0.327	0.741	2.458
Place of Residence				
Urban	**RC**			
Rural	1.199	0.056	0.996	1.444
Mother's Occupation				
Not working	1.068	0.649	0.805	1.418
Manual	1.006	0.972	0.722	1.401
Sales	0.947	0.695	0.719	1.246
Agric./Household	0.909	0.568	0.654	1.263
Professional	**RC**			
Region				
North Central	**RC**			
North East	0.930	0.570	0.725	1.194
North West	0.531***	0.000	0.407	0.694
South East	1.209	0.198	0.905	1.615
South South	0.961	0.778	0.730	1.266
South West	0.975	0.857	0.743	1.280
Constant	0.046	0.000		
-2 Log likelihood = 7388.701			**Chi-Square value = 76.702**	
Hosmer and Lemeshow test (Chi-square= 6.927; P-value=0.544)			**P-value = 0.000**	
****** significant at p<0.001; **significant at p<0.01 and *significant at p<0.05***			**df. = 21**	

Source: Author's Computation, 2016

Environmental Factors

4.3.11 Bivariate Relationship between the Underlying factors and Source of Drinking Water

Table 4.3.11 shows the bivariate relationship between the underlying factors and source of drinking water in the household where the child resides. All the factors except the current marital status of the mother are significantly related to the source of drinking water (P<0.01). About 77.8 percent of the under-five children whose mothers had higher education drank water from improved source compared to 46.5 percent of children born to illiterate mothers.

Children whose mothers were in the professional jobs (73.9 percent) had more access to improved source of drinking water when compared with those who have mothers in the agricultural/ household jobs (40.1 percent). A larger proportion of under-five children from the southwestern region (67.6 percent) of the country drank water from a safer source relative to all other regions, most especially children from the northeastern region (43.7 percent). Further, children who lived in the urban centers had more access to improved source of drinking water than their counterparts who lived in the rural areas (76 percent against 46 percent, chi-square = 2522 on 1 d.f.; P< 0.001). Children who were raised in rich homes had access to improved water source than children who were raised in poor homes (77 percent as against 39 percent; chi-square = 3560 on 2 d.f.; P< 0.001).

Table 4.3.11: Bivariate Relationship between the Underlying Factors and Source of Drinking water

	Source of Drinking Water			
Variables	**Improved Source**	**Non-improved Source**	**Chi-square**	**P-value**
Mother's Education				
No education	6832 (46.5%)	7862 (53.5%)	1363.40	0.000
Primary	3447 (54.5%)	2881 (45.5%)		
Secondary	5581 (67.7%)	2657 (32.3%)		
Higher	1460 (77.8%)	417 (22.2%)		
Mother's Occupation				
Not working	4805 (53.3%)	4211 (46.7%)	778.36	0.000
Manual	2120 (58.6%)	1498 (41.4%)		
Sales	6794 (57.4%)	5048 (42.6%)		
Agric./Household	1516 (40.1%)	2263 (59.9%)		
Professional	1987 (73.9%)	703 (26.1%)		
Region				
North Central	2621 (57.7%)	1923 (42.3%)	710.01	0.000
North East	2826 (43.7%)	3641 (56.3%)		
North West	5407 (54.8%)	4467 (45.2%)		
South East	1805 (65.1%)	966 (34.9%)		
South South	2070 (56.7%)	1579 (43.3%)		
South West	2591 (67.6%)	1241 (32.4%)		
Place of Residence				
Urban	7759 (75.8%)	2472 (24.2%)	2522.19	0.000
Rural	9561 (45.7%)	11345 (54.3%)		
Wealth Status				
Poor	5593 (38.9%)	8777 (61.1%)	3560.04	0.000
Middle	3590 (58.2%)	2577 (41.8%)		
Rich	8137 (76.8%)	2463 (23.2%)		
Mother's Age				
Below age 20 years	699 (46.2%)	815 (53.8%)	96.57	0.000
20-29 years	7994 (54.5%)	6685 (45.5%)		
30-39 years	6830 (58.3%)	4888 (41.7%)		
40+ years	1797 (55.7%)	1429 (44.3%)		
Marital Status				
Currently married	16489 (55.6%)	13183 (44.4%)	0.751	0.386
Not currently married	831 (56.7%)	634 (43.3%)		
Religion				
Christianity	7174 (57.8%)	5248 (42.2%)	92.85	0.000
Islam	9957 (54.6%)	8290 (45.4%)		
Other	105 (33.5%)	208 (66.5%)		

Source: Author's Computation, 2016

4.3.12 Binary Logistic Regression showing the effects of the Underlying factors on Source of Drinking Water in the household where the child lives

Table 4.3.12 shows the adjusted effects of the underlying factors on the source of drinking water in the household where the child resides. Sources of drinking water in the household was dichotomized into improved source = 0 (example; pipe water, covered well, borehole, etc.) and non-improved = 1 (example; uncovered well, ponds and river, tanker truck etc.). All the underlying factors, except the marital status of the mother, had significant effects on the source of drinking water ($P<0.05$). This implies that the source of drinking water used in the household as a proximate determinant can help to transmit the effects of all those significant underlying factors on under-five mortality.

The result showed that access to improved source of drinking water was lower among children whose mothers had little or no education when compared with mothers who had secondary education and above. Likewise, children whose mothers were not economically buoyant (i.e., poor and middle-class mothers) were more likely to drink water from the non-improved source than children whose mothers were economically buoyant (OR = 4.17 and 1.85 respectively; $P < 0.001$).

Further, children of matured mothers (i.e., mothers who are above age 20 years) were less likely to drink water from non-improved sources compared to children of very young mothers (i.e., below age 20 years). Children whose place of residence are in the rural areas were 1.88 times more likely to drink water from non-improved source compared to their counterparts who reside in the urban centers ($P<0.001$).

Table 4.3.12: Binary Logistic Regression showing the effects of the Underlying factors on the Source of Drinking Water in the household where the child lives

Variables	Odds Ratio	Prob. value	95% of C.I. for EXP(B)	
Mother's Education			**Lower**	**Upper**
No education	1.380***	0.000	1.192	1.598
Primary	1.171*	0.027	1.019	1.347
Secondary	0.972	0.674	0.853	1.108
Higher	**RC**			
Wealth Status				
Poor	4.173***	0.000	3.825	4.553
Middle	1.852***	0.000	1.709	2.007
Rich	**RC**			
Mother's Age				
Below age 20 years	**RC**			
20-29 years	0.884*	0.037	0.788	0.993
30-39 years	0.776***	0.000	0.689	0.874
40+ years	0.720***	0.000	0.629	0.824
Marital Status				
Currently married	1.111	0.080	0.987	1.250
Not currently married	**RC**			
Religion				
Christianity	**RC**			
Islam	0.646***	0.000	0.593	0.704
Other	1.302*	0.042	1.010	1.679
Place of Residence				
Urban	**RC**			
Rural	1.878***	0.000	1.756	2.008
Mother's Occupation				
Not working	1.241***	0.000	1.113	1.384
Manual	1.122	0.066	0.992	1.269
Sales	1.331***	0.000	1.197	1.480
Agric./Household	1.518***	0.000	1.339	1.720
Professional	**RC**			
Region				
North Central	**RC**			
North East	1.236***	0.000	1.126	1.357
North West	0.740***	0.000	0.675	0.812
South East	1.032	0.589	0.919	1.159
South South	1.351***	0.000	1.217	1.500
South West	1.367***	0.000	1.230	1.518
Constant	0.205	0.000		
-2 Log likelihood = 37402.109			**Chi-Square value = 4886.367**	
Hosmer and Lemeshow test (Chi-square= 47.117; P-value= 0.000)			**P-value = 0.000**	
****** significant at p<0.001; **significant at p<0.01 and *significant at p<0.05***			**df. = 21**	

Source: Author's Computation, 2016

4.3.13 Bivariate Relationship between the Underlying factors and Type of Toilet Facility

Table 4.3.13 shows the bivariate relationship between the underlying factors and type of toilet facility. All the underlying factors showed a significant bivariate relationship with the type of toilet facility used in the household where the child resides. Most of the children of highly educated mothers (83.6 percent) lived in homes where improved toilet facilities were used unlike children of illiterate mothers (42.1 percent). Hence, there is a significant statistical association between mother's educational attainment and the type of toilet facility used in the household (Chi-square value= 1636.44, $P<0.001$).

Since mothers who are in professional jobs were more likely to live in the cities, most of their children had access to improved toilet facility for sanitation than children of mothers in other occupations. Fifty-nine percent and 57.9 percent of children of mothers who had primary and no education used non-improved sanitation and this constituted the highest percent among children who used non-improved sanitation.

Further, only 22.0 percent of children whose mothers were engaged in agricultural related or household jobs used improved toilet facility, while 78.0 percent used non-improved toilet facility. About 32.3 percent of children of mothers who engaged in professional occupation had the lowest percentage among those who used non-improved toilet facility when compared with 78.0 percent, 50.1 percent, 45.5 percent and 50.0 percent, whose mothers are into Agric. /household jobs, Sales, Services oriented jobs and are currently not working respectively. Seventy-two percent of the children who lived in the urban centers used improved toilet facility, while 28.0 percent used non-improved toilet facilities.

Further, only 37.2 percent of those who lived in the rural areas used improved toilet facility for sanitation, while 62.8 percent used non-improved toilet facility. Approximately, 75.0 percent of children from rich households used improved toilet facility, while 25.5 percent used non-improved toilet facility.

Children from rich homes were better-off than their colleagues who lived in poor and middle-class households. This was because about 68.3 percent and 56.1 percent of children who lived in poor and middle-class households used non-improved sanitations. With respect to religion, 81.1 percent of children who lived in households where other religious affiliations different from Christianity and Islam were practiced used non-improved sanitation, which makes these group of children worse-off than the others.

Table 4.3.13: Bivariate Relationship between the Underlying Factors and Toilet Facility

	Toilet Facility			
Variables	**Improved Toilet facility**	**Non-improved Toilet facility**	**Chi-square**	**P-value**
Mother's Education				
No education	6193 (42.1%)	8513 (57.9%)	1636.44	0.000
Primary	2590 (40.9%)	3745 (59.1%)		
Secondary	4814 (58.4%)	3436 (41.6%)		
Higher	1573 (83.6%)	308 (16.4%)		
Mother's Occupation				
Not working	4502 (49.9%)	4521 (50.1%)	1535.32	0.000
Manual	1974 (54.5%)	1647 (45.5%)		
Sales	5923 (50.0%)	5930 (50.0%)		
Agric./Household	832 (22.0%)	2957 (78.0%)		
Professional	1823 (67.7%)	870 (32.3%)		
Region				
North Central	1799 (39.5%)	2752 (60.5%)	443.39	0.000
North East	2940 (45.4%)	3535 (54.6%)		
North West	5215 (52.8%)	4662 (47.2%)		
South East	1487 (53.5%)	1293 (46.5%)		
South South	1540 (42.1%)	2114 (57.9%)		
South West	2189 (57.1%)	1646 (42.9%)		
Place of Residence				
Urban	7373 (72.0%)	2866 (28.0%)	3325.77	0.000
Rural	7797 (37.2%)	13136 (62.8%)		
Wealth Status				
Poor	4557 (31.7%)	9833 (68.3%)	4559.40	0.000
Middle	2711 (43.9%)	3468 (56.1%)		
Rich	7902 (74.5%)	2701 (25.5%)		
Mother's Age				
Below age 20 years	630 (41.6%)	883 (58.4%)	83.96	0.000
20-29 years	6986 (47.5%)	7711 (52.5%)		
30-39 years	6056 (51.6%)	5682 (48.4%)		
40+ years	1498 (46.5%)	1726 (53.5%)		
Marital Status				
Currently married	14523 (48.9%)	15182 (51.1%)	12.82	0.000
Not currently married	647 (44.1%)	820 (55.9%)		
Religion				
Christianity	5746 (46.2%)	6697 (53.8%)	177.72	0.000
Islam	9294 (50.9%)	8967 (49.1%)		
Other	59 (18.9%)	253 (81.1%)		

Source: Author's Computation, 2016

4.3.14 Binary Logistic Regression showing the effects of the Underlying factors on the type of toilet facility used in the household where the child resides

Table 4.3.14 shows the binary logistic regression showing the adjusted effects of the underlying factors on the type of toilet facility used in the household where the child resides. The type of toilet facility used in the household was dichotomized into improved toilet facility = 0 (example; flush to piped sewer system, flush to septic tank, Ventilated improved pit latrine, etc.) and non-improved toilet facility =1 (example; bucket, hanging toilet, bush, pit latrine without slab, etc.). With the exemption of the marital status of the mother, all the underlying factors had significant effects on the type of toilet facility used in the household where the child resides ($P<0.05$). This implies that type of toilet facility, as a proximate determinant can help to transmit/ explain the effects of all those significant underlying factors on under-five mortality.

Children whose mothers had secondary education and below were more likely to be raised in homes where non- improved toilets are used for sanitation than children whose mothers had post-secondary or tertiary educational attainments ($P<0.001$). Similarly, children whose mothers were not economically buoyant (poor and middle class), were 13 times and 4 times more likely to be raised in homes with non-improved toilets facilities compared to children of rich mothers ($P<0.001$). Further, children whose mothers lived in the rural areas were 2.15 times more likely to use non-improved toilet facility for their sanitation compared to children who lived in the urban centers ($P<0.001$).

Table 4.3.14: Binary Logistic Regression showing the effects of the Underlying factors on the type of toilet facility used in the household where the child resides

Variables	Odds Ratio	Prob. value	95% of C.I. for EXP(B)	
Mother's Education			**Lower**	**Upper**
No education	2.732***	0.000	2.321	3.218
Primary	2.813***	0.000	2.410	3.283
Secondary	2.093***	0.000	1.811	2.418
Higher	**RC**			
Wealth Status				
Poor	12.571***	0.000	11.345	13.930
Middle	3.878***	0.000	3.556	4.228
Rich	**RC**			
Mother's Age				
Below age 20 years	**RC**			
20-29 years	0.972	0.652	0.860	1.099
30-39 years	0.828**	0.003	0.730	0.940
40+ years	0.815**	0.005	0.706	0.940
Marital Status				
Currently married	1.039	0.563	0.914	1.180
Not currently married	**RC**			
Religion				
Christianity	**RC**			
Islam	0.690***	0.000	0.630	0.756
Other	1.673**	0.002	1.216	2.304
Place of Residence				
Urban	**RC**			
Rural	2.154***	0.000	2.008	2.311
Mother's Occupation				
Not working	0.999	0.987	0.894	1.117
Manual	0.919	0.182	0.811	1.041
Sales	1.164**	0.005	1.046	1.295
Agric./Household	1.515***	0.000	1.325	1.734
Professional	**RC**			
Region				
North Central	**RC**			
North East	0.290***	0.000	0.260	0.323
North West	0.194***	0.000	0.174	0.216
South East	0.801**	0.001	0.705	0.910
South South	1.307***	0.000	1.162	1.470
South West	1.422***	0.000	1.268	1.594
Constant	0.151	0.000		
-2 Log likelihood = 33985.449			**Chi-Square value = 8720.471**	
Hosmer and Lemeshow test (Chi-square= 56.649; P-value= 0.000)			**P-value = 0.000**	
****** significant at p<0.001; **significant at p<0.01 and *significant at p<0.05***			**df. = 21**	

Source: Author's Computation, 2016

4.3.15 Bivariate Relationship between the Underlying factors and Type of Cooking Fuel

Table 4.3.15 shows the bivariate relationship between the underlying factors and type of cooking fuel used in the household where the child resides. All the underlying factors showed a significant bivariate relationship with the source of cooking fuel used in the household where the child resides. Among the regions, 56.8 percent, 37.8 percent and 23.9 percent of children from South West, South South, and South East respectively were from households where Kerosene/ Electricity/ Gas was used as cooking fuel. None of the children from South West and South South lived in households where animal dug/ agricultural substance was used as cooking fuel. Ninety-six percent, 89.9 percent, 84.3 percent and 76.0 percent of children from North East, North West, North Central and South East respectively lived in households where wood/coal/charcoal was used as cooking fuel. There was a significant relationship between region and type of cooking fuel ($P< 0.001$).

Further, 41.2 percent of children who lived in the urban centers reside in households where Kerosene/ Electricity/ Gas was used as cooking fuel, while 58.5 percent and 0.3 percent lived in households where wood/coal/charcoal and animal dug/agricultural substance are used for cooking respectively. Among those who reside in the rural areas, 5.6 percent lived in households where Kerosene/ Electricity/Gas was used as cooking fuel, while 90.7 percent and 3.7 percent lived in homes where wood/coal/charcoal and animal dug/agricultural substance were used for cooking respectively.

Sixty-seven percent of mothers with higher education reported that they used Kerosene/Electricity/Gas for cooking unlike 1.5 percent of their counterparts who had no education. None of the mothers with higher education reported that they used animal dung/ agricultural substance for cooking. About 49.0 percent and 50.9 percent of the under-five children were from rich homes where kerosene/electricity/gas and wood/coal/charcoal are used as a source of cooking fuel respectively. In total, 96.5 percent and 94.7 percent of children from the middle-class and poor households used wood/coal/charcoal as a source of cooking fuel.

Table 4.3.15: Bivariate Relationship between the Underlying Factors and Cooking Fuel

	Cooking Fuel				
Variables	**Kerosene/Electric/Gas**	**Wood/Charcoal/ Coal**	**Animal dug/Agric.**	**Chi-sq.**	**P-value**
Region				8548.40	0.000
North Central	708 (15.6%)	3838 (84.3%)	7 (0.2%)		
North East	131 (2.0%)	6207 (96.0%)	127 (2.0%)		
North West	337 (3.4%)	8896 (89.9%)	663 (6.7%)		
South East	665 (23.9%)	2111 (76.0%)	3 (0.1%)		
South South	1381 (37.8%)	2277 (62.2%)	0 (0.0%)		
South West	2175 (56.8%)	1657 (43.2%)	0 (0.0%)		
Place of Residence				6210.72	0.000
Urban	4218 (41.2%)	5988 (58.5%)	35 (0.3%)		
Rural	1179 (5.6%)	18998 (90.7%)	765 (3.7%)		
Mother's Education					
No education	215 (1.5%)	13775 (93.6%)	731 (5.0%)	8722.25	0.000
Primary	823 (13.0%)	5451 (86.1%)	60 (0.9%)		
Secondary	3090 (37.5%)	5146 (62.4%)	9 (0.1%)		
Higher	1269 (67.4%)	614 (32.6%)	0 (0.0%)		
Wealth Status					
Poor	10 (0.1%)	13627 (94.7%)	756 (5.3%)	11821.61	0.000
Middle	189 (3.1%)	5960 (96.5%)	30 (0.5%)		
Rich	5198 (49.0%)	5399 (50.9%)	14 (0.1%)		
Mother's age					
Below 20 years	109 (7.2%)	1339 (88.6%)	64 (4.2%)	311.50	0.000
20-29 years	2502 (17.0%)	11841 (80.6%)	351 (2.4%)		
30-39 years	2430 (20.7%)	9042 (77.0%)	274 (2.3%)		
40+ years	356 (11.0%)	2764 (85.5%)	111 (3.4%)		
Marital Status					
Currently married	5145 (17.3%)	23782 (80.0%)	792 (2.7%)	25.27	0.000
Not currently married	252 (17.2%)	1204 (82.2%)	8 (0.5%)		
Religion				3421.53	0.000
Christianity	3967 (31.9%)	8460 (68.0%)	18 (0.1%)		
Islam	1391 (7.6%)	16100 (88.1%)	777 (4.3%)		
Other	13 (4.2%)	297 (94.9%)	3 (1.0%)		
Mother's Occupation					
Not working	1178 (13.1%)	7532 (83.5%)	315 (3.5%)	2594.57	0.000
Manual	499 (13.8%)	2979 (82.2%)	145 (4.0%)		
Sales	2282 (19.2%)	9281 (78.3%)	295 (2.5%)		
Agric./Household	134 (3.5%)	3640 (96.1%)	14 (0.4%)		
Professional	1291 (47.9%)	1384 (51.3%)	21 (0.8%)		

Source: Author's Computation, 2016

4.3.16 Binary Logistic Regression showing the effects of the Underlying factors on the Source of Cooking Fuel used in the household where the child resides

In table 4.3.16 all the underlying factors significantly predicted the source of cooking fuel used in the household where the child reside (P<0.05). Source of cooking fuel used in the household was dichotomized into biomass fuel=1 (example; wood, charcoal, coal, agric. substance and animal dung) and non-biomass fuel =0 (example; kerosene, electricity and gas). The underlying factors that showed significant effects on the source of cooking fuel are those variables that the latter helps to transmit their effects on under-five mortality.

Mothers whose educational attainments are secondary education and below were more likely to use biomass fuel (i.e., wood, charcoal, coal, agric. substance and animal dung) for cooking when compared to their counterparts who had higher education (P<0.001). Poor and middle-class mothers were 137.22 times and 13.20 times more likely to use biomass fuel for cooking fuel than rich mothers (P<0.001).

Further, mothers who were currently married as at the time of the survey were about 31 percent less likely to use biomass fuel for cooking, unlike mothers who were not currently married (P<0.001). Similarly, mothers who reside in the rural areas were 3.45 times more likely to use biomass fuel for cooking than their counterparts who lives in the urban centers (P<0.001). Mothers from the North-Western, North-Eastern and South-Eastern regions were more likely to use biomass fuel than mothers who were from the North-Central region. But mothers who were from the South-South and South-Western regions were about 70 percent less likely to use biomass fuel when compared with mothers from North Central region (P<0.001).

Table 4.3.16: Binary Logistic Regression showing the effects of the Underlying factors on the Source of Cooking fuel used in the household where the child resides

Variables	Odds Ratio	Prob. value	95% of C.I. for EXP(B)	
Mother's Education			**Lower**	**Upper**
No education	7.008***	0.000	5.689	8.634
Primary	3.937***	0.000	3.343	4.636
Secondary	2.049***	0.000	1.782	2.357
Higher	**RC**			
Wealth Status				
Poor	137.220***	0.000	73.268	256.994
Middle	13.198***	0.000	11.229	15.513
Rich	**RC**			
Mother's Age				
Below age 20 years	**RC**			
20-29 years	0.808	0.135	0.611	1.068
30-39 years	0.903	0.484	0.680	1.201
40+ years	1.425*	0.029	1.037	1.957
Marital Status				
Currently married	0.685***	0.000	0.563	0.835
Not currently married	**RC**			
Religion				
Christianity	**RC**			
Islam	1.422***	0.000	1.255	1.611
Other	1.407	0.398	0.638	3.106
Place of Residence				
Urban	**RC**			
Rural	3.448***	0.000	3.111	3.821
Mother's Occupation				
Not working	0.843*	0.019	0.731	0.973
Manual	1.189	0.056	0.996	1.419
Sales	1.060	0.373	0.932	1.206
Agric./Household	3.522***	0.000	2.787	4.450
Professional	**RC**			
Region				
North Central	**RC**			
North East	5.118***	0.000	4.094	6.400
North West	1.879***	0.000	1.580	2.233
South East	1.264**	0.006	1.071	1.492
South South	0.303***	0.000	0.258	0.356
South West	0.301***	0.000	0.261	0.346
Constant	0.559	0.001		
-2 Log likelihood= 12625.645			**Chi-Square value = 15853.041**	
Hosmer and Lemeshow test: (Chi-square= 10.670; sig.= 0.221)			**P-value = 0.000**	
****** significant at p<0.001; **significant at p<0.01 and *significant at p<0.05***			**df. = 21**	

Source: Author's Computation, 2016

4.3.17 Bivariate Relationship between the Underlying factors and Place of Delivery

Table 4.3.17 shows the bivariate analysis between all the underlying factors and place of delivery. All the underlying factors showed a significant bivariate relationship with the place of delivery (i.e., P<0.001).The result shows that 92.2 percent of children whose mothers had higher education were born in the modern health care facility unlike 12.1 percent born in a health care facility by non-educated mothers. Only 7.8 percent of children of mothers with higher education were born in non-health care facilities, compared to 87.9 percent of children of mothers who had no education.

Seventy-two percent of children of mothers who engaged in professional occupation were delivered at the health care facilities, while 27.9 percent were born at non-health care facilities. Seventy-two percent of children of mothers who were not currently working were delivered at non-health care facilities, while only 28.1 percent were delivered at the health care facilities. Among all the regions, South East (79.3 percent), South West (74.7 percent) and North Central (53.0 percent) had the highest percentage of children delivered at the health care facilities when compared with 44.8 percent, 20.9 percent and 10.4 percent from the South South, North East and North West respectively that were delivered at the health care facilities. North West (89.6 percent) and North East (79.1 percent) had the highest percentage of children who were delivered at the non-health care facilities.

Only 36 percent of children in the urban centers were delivered at the non-health care facilities, while 64.3 percent were delivered at the health care facilities. For those living in the rural areas, 76.4 percent of such children were delivered at the non-health care facilities, while only 23.6 percent were delivered in the health care facilities.

Approximately 88 percent of the children from poor households were delivered at non-health care facilities, unlike 31.1 percent children from rich homes who were delivered at non-health care facilities. About 68.7 percent of the children from rich households were delivered at the health care facilities when compared to 38.9 percent and 12.5

percent delivered at the health care facilities who were from the middle-class and poor households. With respect to religion, Christian mothers reported the highest number of births (59.8 percent) in the health care facilities unlike 21.6 percent and 21.4 percent reported by Muslim and mothers who practiced other religions.

Table 4.3.17: Bivariate Relationship between the Underlying Factors and Place of Delivery

	Place of Delivery			
Variables	**Non-health care facility**	**Health care facility**	**Chi-square**	**P-value**
Mother's Education				
No education	12830 (87.9%)	1766 (12.1%)	9258.19	0.000
Primary	3770 (59.3%)	2587 (40.7%)		
Secondary	2871 (34.7%)	5399 (65.3%)		
Higher	148 (7.8%)	1760 (92.2%)		
Mother's Occupation				
Not working	6491 (71.9%)	2532 (28.1%)	1801.14	0.000
Manual	2491 (68.8%)	1131 (31.2%)		
Sales	7337 (62.2%)	4466 (37.8%)		
Agric./Household	2404 (63.6%)	1374 (36.4%)		
Professional	756 (27.9%)	1957 (72.1%)		
Region				
North Central	2143 (47.0%)	2416 (53.0%)	8780.52	0.000
North East	5101 (79.1%)	1344 (20.9%)		
North West	8784 (89.6%)	1017 (10.4%)		
South East	574 (20.7%)	2197 (79.3%)		
South South	2044 (55.2%)	1658 (44.8%)		
South West	973 (25.3%)	2880 (74.7%)		
Place of Residence				
Urban	3664 (35.7%)	6596 (64.3%)	4897.52	0.000
Rural	15955 (76.4%)	4916 (23.6%)		
Wealth Status				
Poor	12501 (87.5%)	1790 (12.5%)	8268.01	0.000
Middle	3781 (61.1%)	2407 (38.9%)		
Rich	3337 (31.3%)	7315 (68.7%)		
Mother's Age				
Below age 20 years	1133 (74.5%)	387 (25.5%)	182.81	0.000
20-29 years	9430 (64.3%)	5241 (35.7%)		
30-39 years	6947 (59.2%)	4794 (40.8%)		
40+ years	2109 (65.9%)	1090 (34.1%)		
Marital Status				
Currently married	18803 (63.4%)	10856 (36.6%)	38.15	0.000
Not currently married	816 (55.4%)	656 (44.6%)		
Religion				
Christianity	5030 (40.2%)	7473 (59.8%)	4664.16	0.000
Islam	14244 (78.4%)	3922 (21.6%)		
Other	243 (78.6%)	66 (21.4%)		

Source: Author's Computation, 2016

4.3.18 Binary Logistic Regression showing the effects of the Underlying Factors on the Place of Delivery of the Child

Table 4.3.18 presents the logistic regression showing the adjusted effects of the underlying factors on the place of delivery of the child. The dependent variable was coded as, place of delivery: Non-health care facility =1 and health care facility = 0. The results showed that mothers with secondary or lower education were more likely to deliver at a non-health care facility than their counterparts who have higher education and delivered in a health care facility ($P<0.001$).

Further, matured mothers (20-29 years) were 1.17 times more likely to deliver at a non-health care facility than very young mothers who delivered at a health care facility (below 20 years). Also, poor and middle-class mothers were more likely to deliver at a non-health care facility compared to their counterparts who are rich ($P<0.001$). Mothers who practiced other faith (Islam and Traditional worshippers) apart from Christianity were 1.36 and 1.90 times more likely to deliver at a non-health care facility than Christian mothers ($P<0.001$). Mothers who reside in the rural areas were 1.81 times more likely to deliver their children at a non-health care facility than mothers who lived in the urban areas ($P<0.001$).

Mothers who were not working and those engaged in agricultural or household employments were 1.25 times and 1.32 times more likely to deliver at a non-health care facility than their counterparts who were in professional employments ($P<0.01$). With the exception of South West and South Eastern regions, mothers who were from the Northern regions and those from the South-South were more likely to deliver their children at a non-health care facility than mothers who were from the North Central region ($P<0.05$).

Table 4.3.18: Binary Logistic Regression showing the effects of the Underlying factors on the place of delivery of the child

Variables	Odds Ratio	Prob. value	95% of C.I. for EXP(B)	
Mother's Education			**Lower**	**Upper**
No education	13.178***	0.000	10.797	16.085
Primary	6.989***	0.000	5.761	8.480
Secondary	3.956***	0.000	3.280	4.772
Higher	**RC**			
Wealth Status				
Poor	3.242***	0.000	2.949	3.563
Middle	1.607***	0.000	1.478	1.748
Rich	**RC**			
Mother's Age				
Below age 20 years	**RC**			
20-29 years	1.173*	0.039	1.008	1.364
30-39 years	1.114	0.173	0.954	1.300
40+ years	1.000	0.997	0.839	1.192
Marital Status				
Currently married	0.842*	0.011	0.739	0.961
Not currently married	**RC**			
Religion				
Christianity	**RC**			
Islam	1.362***	0.000	1.242	1.493
Other	1.902***	0.000	1.380	2.621
Place of Residence				
Urban	**RC**			
Rural	1.812***	0.000	1.683	1.951
Mother's Occupation				
Not working	1.253**	0.001	1.102	1.424
Manual	1.087	0.265	0.939	1.257
Sales	1.076	0.243	0.952	1.216
Agric./Household	1.321***	0.000	1.148	1.521
Professional	**RC**			
Region				
North Central	**RC**			
North East	2.361***	0.000	2.131	2.615
North West	5.191***	0.000	4.665	5.776
South East	0.620***	0.000	0.543	0.707
South South	3.161***	0.000	2.833	3.528
South West	0.951	0.379	0.851	1.063
Constant	0.038	0.000		
-2 Log likelihood = 26056.261			**Chi-Square value = 14536.264**	
****** significant at p<0.001; **significant at p<0.01 and *significant at p<0.05***			**P-value = 0.000**	
			df. = 21	

Model 3

This model was set up to test the extent to which the proximate determinants accounted for some of the indirect effects the underlying factors had on under-five mortality (see model results). This was achieved by first identifying those proximate determinants that have a bivariate significant association with under-five mortality based on the condition stated in section 3.3.1 and which was re-stated below as:

If an underlying variable X is known to have a relationship with an outcome variable Z, in order for a variable Y to be called a proximate variable for the effect of X on Z, two conditions must be satisfied.

1. First, variable X must have a relationship with variable Y and
2. Secondly, variable Y must be associated with variable Z.

4.3.19 Bivariate Relationship between the Proximate Determinants and Under-five Mortality

Table 4.3.19 presents the bivariate relationship between the selected proximate determinants in this study and under-five mortality. There was a significant relationship between all the selected proximate determinants and under-five death (i.e., $P< 0.01$). The result shows that about 12.4 percent of children who were of birth order 7+ were reported dead as at the time of the survey. Similar to this are children who were of first birth order, with 9.5 percent of such births been reported dead.

Mothers who had 4 or more births within the five years period preceding the survey experienced about 32.9 percent deaths among those children when compared to 5.9 percent deaths of children of those who had only 1 birth during the period. Next to this were those who had 3 births within the five years period, unlike mothers who had only 1 or 2 births who reported 5.9 percent and 8.9 percent respectively. This implies that the more the frequency of births by a woman within a five years period, the more the chances that the mother will lose a child.

Another, interesting proximate determinant was breastfeeding. The result shows that 61.9 percent of children who were never breastfed were reported dead when compared with just 7.4 percent who were ever breastfed that died. Further, 10.1 percent of children who lived in households where non-improved toilet facilities were used died, when compared to 8.1 percent who died in households where improved sanitation was used. This experience was similar to that of the source of drinking water. As about 10.1 percent of children who lived in households where their source of drinking water was classified as non-improved died when compared with 8.4 percent who died in households with improved source of drinking water.

Approximately 12 percent and 10 percent of the under-five children who lived in households where animal dug/agricultural substance and wood/coal/charcoal are used for cooking were reported dead respectively. Only 5.6 percent of children who lived in houses were Kerosene/ Electricity/ Gas was used as cooking fuel were reported dead. Ten percent of the children who were delivered at a non-health care facility were reported dead as at the time of the survey when compared to 6.8 percent who died and were delivered in the health care facility.

Table 4.3.19: Bivariate Relationship between the Proximate Determinants and Under-five death

	If Child is Alive?			
Variables	**Alive**	**Dead**	**Chi-square**	**P-value**
Birth Order				
Birth order 1	5528 (90.5%)	581 (9.5%)	94.34	0.000
Birth order 2-3	9283 (92.1%)	791 (7.9%)		
Birth order 4-6	9119 (91.5%)	852 (8.5%)		
Birth order 7+	4666 (87.6%)	662 (12.4%)		
Births in five years				
1 birth	9820 (94.1%)	615 (5.9%)	641. 21	0.000
2 births	15156 (91.1%)	1482 (8.9%)		
3 births	3385 (83.4%)	674 (16.6%)		
4+ births	235 (67.1%)	115 (32.9%)		
Ever Breastfed				
Ever Breastfed	27870 (92.6%)	2216 (7.4%)	2944.07	0.000
Never breastfed	312 (38.1%)	506 (61.9%)		
Drinking water				
Improved source	15869 (91.6%)	1451 (8.4%)	27.34	0.000
Non-improved source	12422 (89.9%)	1395 (10.1%)		
Toilet facility				
Improved sanitation	13938 (91.9%)	1232 (8.1%)	36.90	0.000
Non-improved sanitation	14385 (89.9%)	1617 (10.1%)		
Cooking fuel				
Kerosene/Electric/ Gas	5095 (94.4%)	302 (5.6%)	102.13	0.000
Wood/Charcoal/Coal	22528 (90.2%)	2458 (9.8%)		
Animal dug/Agric.	707 (88.4%)	93 (11.6%)		
Place of Delivery				
Non-health care facility	17649 (90.0%)	1970 (10.0%)	97.17	0.000
Health care facility	10734 (93.2%)	778 (6.8%)		

Source: Author's Computation, 2016

4.3.20 Binary Logistic Regression showing the effects of the Proximate Determinants on Under-five Mortality

Table 4.3.20 shows the independent effects of each of the proximate determinant of under-five mortality after adjusting for the presence of the other proximate determinants in the model. All the proximate determinants except for the source of drinking water in the household maintained significant effects on under-five mortality. This showed that these proximate variables can independently help to channel the effects of the underlying factors on under-five mortality in Nigeria. Those that are not, might be working in synergy with other proximate determinants to influence under-five mortality.

Children who were of birth orders 2 and 3 or 4 - 6 were less likely to die before reaching age five years than children who were the first born of their mothers (OR = 0.63, 0.68 respectively; P<0.001). Children who were seventh or higher birth order die equally as children who were birth order 1 before reaching age five years. Hence, the pattern of the effects of birth order on under-five mortality in Nigeria took the form of a U –shape. Mothers who had more than 1 birth within the five years period preceding the survey were more likely to experience child's death when compared with mothers who had just one birth within the same period (P<0.001). The risk increased from about 2 times for mothers who had two births to about 7 times for mothers who had four or more births during the five years period.

Further, children who were never breastfed were 20 times more likely to die before age of five years than children who were ever breastfed (P<0.001). Children living in households where non-improved toilet facilities are used for sanitation were 1.12 times more likely to die when compared with children who lived in households with improved toilet facilities (P<0.05). Likewise, children living in homes where biomass fuel (wood, charcoal, coal, agricultural or animal dung) was used as a source of cooking fuel were 1.51 times and 1.77 times more likely to die than children who are living in homes where non-biomass fuel was used as cooking fuel (P<0.001). Children who were delivered at the health care facilities were 27 percent less likely to die when compared with children who were born outside health care facility (P<0.001).

Table 4.3.20: Binary Logistic Regression showing the effects of the Proximate Determinants on Under-five Mortality

Variables	Odds Ratio	Prob. value	95% of C.I. for EXP(B)	
			Lower	Upper
Birth Order				
Birth order 1	**RC**			
Birth order 2-3	0.634***	0.000	0.554	0.727
Birth order 4-6	0.675***	0.000	0.590	0.771
Birth order 7+	0.988	0.867	0.857	1.138
Births in five years				
1 birth	**RC**			
2 births	1.554***	0.000	1.387	1.740
3 births	3.156***	0.000	2.756	3.613
4+ births	6.739***	0.000	5.053	8.988
Breastfeeding				
Breastfed	**RC**			
Never breastfed	20.358***	0.000	17.326	23.922
Drinking water				
Improved source	**RC**			
Non-improved source	1.062	0.199	0.969	1.164
Toilet facility				
Improved sanitation	**RC**			
Non-improved sanitation	1.118*	0.018	1.019	1.227
Cooking fuel				
Kerosene/Electric/ Gas	**RC**			
Wood/Charcoal/Coal	1.506***	0.000	1.289	1.760
Animal dug/Agric.	1.769***	0.000	1.333	2.346
Place of Delivery				
Non-health care facility	**RC**			
Health care facility	0.731***	0.000	0.655	0.815
Constant	0.039	0.000		
-2 Log likelihood = 14997.146			**P-value = 0.000**	
Chi-Square value =1973.434			**df. = 13**	

****** significant at p<0.001; **significant at p<0.01 and *significant at p<0.05***

Source: Author's Computation, 2016

Binary Logistic Regression (Full Model)

4.3.21 Effects of the Underlying Factors and Proximate Determinants on Under-five Mortality

Table 4.3.21 show the effects of the underlying factors on under-five mortality, in the presence of the proximate determinants in the model. (i.e., after adjusting for the direct effects of the proximate determinants of under-five mortality). The results showed that the six underlying factors that indicated significant indirect effects on under-five mortality in model 1, maintained their significance even after adjusting for the proximate variables. The two other variables (i.e., religion and occupation of the mother) that were not significant under model 1 were also not significant in model 3.

Mothers' education still maintained its significant effect on under-five mortality. Children of mothers with primary education and those who had no education were about 1.6 times more likely to die before age five than were children of mothers who had tertiary education ($P < 0.01$). Further, children from poor households were about 1.3 times more likely to die before reaching age five than were children from rich homes ($OR = 1.30$; $P<0.01$). Also, children whose mothers were between ages 20-29 years were less likely to die in childhood than were children of mothers who were less than 20 years old ($OR = 0.77$; $P < 0.01$).

Similarly, under-five children from North West were 1.52 times more likely to die than children from the North Central region ($P< 0.001$). Further, under-five children in rural areas were 1.28 times more likely to die unlike those living in urban centers ($P<0.001$). Children within birth order 2-3 and 4-6 were 0.67 times and 0.66 times less likely to die compared to children who were birth order 1 ($P<0.01$).

Under-five children who were second births within the five years period before the survey were 1.64 times more likely to die than children who were the only birth within the period, while those who were the third and fourth births and above were 3.35 times and 7.60 times respectively more likely to die compared to children who were the only birth within the same period ($P< 0.001$).

Children who were never breastfed were 22.49 times more likely to die compared to their counterparts who were ever breastfed (P<0.001). Hence, whether or not a child was breastfed had a significant effect on under-five mortality. The implication for those variables that still maintained significant indirect relationship with under-five mortality after adjustments had been made for the proximate determinants was that, although they depended on those intermediate variables to affect under-five mortality, but they may also, in addition, be operating through some other proximate determinants that were not included in the current model. The log-likelihood ratio [LLR] for this model was 15478.743, Chi-square= 2318.634 on 33 degrees of freedom, P-value = 0.000. This indicated a very good fit.

4.4 Test of Significance of the Proximate Determinants

The significance of all the selected proximate determinants that helped to explain the effects of the underlying factors on under-five mortality was determined by using the Likelihood Ratio (LR) test (see section 3.11). This was the difference between the Log Likelihood Statistic (LLS) for model 3 (full model) and LLS for model 1 (reduced model). Model 1 was called the reduced model for model 3 because all the variables in the former were all included in the latter, which also contains all the proximate variables. Hence, model 1 was a subset of model 3. The LLS for model 1 was 18701.166 on 21 degrees of freedom (refer to Table 4.3.4), while the LLS for model 3 was 15478.743 on 33 degrees of freedom (refer to Table 4.3.21). The extra 12 degrees of freedom in the full model 3 came from the 12 parameters of the seven proximate determinants used in the study. The difference between the two log-likelihood statistics (LLS) was 3222.423 on 12 degrees of freedom is highly significant ($P<0.001$). This result indicates that the proximate determinants used in this study significantly helped to account for and explain the indirect effects of the underlying factors on under-five mortality in this study.

Table 4.3.21.: Binary Logistic Regression showing the effects of the Underlying and Proximate Determinants on Under-five Mortality

Variables	Odds Ratio	Prob. value	95% of C.I. for EXP(B)	
Mother's Education			**Lower**	**Upper**
No education	1.580**	0.004	1.155	2.160
Primary	1.558**	0.004	1.151	2.108
Secondary	1.205	0.198	0.907	1.600
Higher	**RC**			
Wealth Status				
Poor	1.301***	0.003	1.096	1.543
Middle	1.018	0.827	0.864	1.200
Rich	**RC**			
Mother's Age				
Below age 20 years	**RC**			
20-29 years	0.770*	0.011	0.629	0.941
30-39 years	0.796	0.050	0.633	1.000
40+ years	1.053	0.700	0.809	1.372
Marital Status				
Currently married	0.619***	0.000	0.507	0.755
Not currently married	**RC**			
Religion				
Christianity	**RC**			
Islam	1.016	0.839	0.868	1.190
Other	0.751	0.216	0.477	1.183
Place of Residence				
Urban	**RC**			
Rural	1.279***	0.000	1.124	1.456
Mother's Occupation				
Not working	0.943	0.577	0.766	1.161
Manual	1.051	0.668	0.837	1.320
Sales	1.090	0.406	0.890	1.334
Agric./Household	1.020	0.871	0.804	1.294
Professional	**RC**			
Region				
North Central	**RC**			
North East	1.199*	0.041	1.007	1.428
North West	1.529***	0.000	1.283	1.821
South East	1.356**	0.006	1.091	1.685
South South	0.893	0.304	0.720	1.108
South West	1.059	0.593	0.858	1.307
Birth in the last five years				
1 birth	**RC**			
2 births	1.643***	0.000	1.467	1.840
3 births	3.352***	0.000	2.923	3.845
4+ births	7.604***	0.000	5.683	10.174
Birth Order				
1 birth	**RC**			
2-3 births	0.667***	0.000	0.580	0.767
4-6 births	0.657***	0.000	0.562	0.768
7+ births	0.826	0.052	0.681	1.002
Place of Delivery				
Non-health care facility	1.084	0.203	0.957	1.227
Health care facility	**RC**			
Toilet facility				
Improved sanitation	0.929	0.146	0.842	1.026
Non-improved sanitation	**RC**			

Table 4.3.21.: Binary Logistic Regression showing the effects of the Underlying and Proximate Determinants on Under-five Mortality

Variables	Odds Ratio	Prob. value	95% of C.I. for EXP(B)	
			Lower	Upper
Cooking fuel				
Kerosene/Electric/Gas	1.129	0.442	0.829	1.537
Wood/ charcoal/coal	1.088	0.499	0.852	1.388
Animal dung/Agric. substance	**RC**			
Drinking Water				
Improved source	0.991	0.846	0.903	1.087
Non-improved source	**RC**			
Ever Breastfeeding				
Breastfed	**RC**			
Never breastfed	22.489***	0.000	19.165	26.391
Constant	0.043	0.000		
-2 Log likelihood = 15478.743			**Chi-Square value = 2318.634**	
Hosmer and Lemeshow test (Chi-square= 17.638; P-value= 0.024)			**P-value = 0.000**	
****** significant at p<0.001; **significant at p<0.01 and *significant at p<0.05***			**df. = 33**	

CHAPTER FIVE
DISCUSSION

5.1 Preface

This chapter provides an extensive discussion on the findings of this study. Results that followed apriori expectations were presented, while those that failed to follow apriori expectations were discussed and backed up with possible explanations.

5.2 Results Discussions

This study examined how socioeconomic, demographic and cultural factors (i.e., the underlying factors) influence under-five mortality by identifying some more direct factors (i.e., proximate determinants) through which they operate in order to influence under-five mortality in Nigeria. Some of the findings of this study established the results from some of the other previous studies. For example, the indirect adjusted effect of mother's education on under-five mortality was confirmed by the findings of this study. Hence, the result established the findings of Caldwell, 1979, Mosley and Chen, 1984, Fayehun and Omololu, 2009, Antai 2010 and Adedini, 2013, on the importance of mother's education on childhood survival.

Further, the place of residence of the mother and her wealth status also maintained their significance after controlling for other underlying factors in this study. This result established the findings of Mosley and Chen, 1984, Uddin *et al*., 2009, Antai, 2010, Fayehun, 2010 and Bello and Joseph, 2014. Those underlying factors that were not significant in the final and third model, showed that those proximate determinants included in the model had absorbed most of their effects on under-five mortality. Hence, number of births in the previous five years before the survey, birth order and whether or not the child was breastfed had helped to channel the effects of the underlying factors such as the religion of the mother and her occupation on under-five mortality in Nigeria. For those underlying factors that maintained their significant effects on under-five mortality in the presence of the proximate determinants in the full model (model 3), indicated that there were other proximate determinants which they might be operating

through which this study had not considered. Some of such variables may include child immunization and nutrition status as well as other environmental exposure factors. Hence, this could be area for further studies.

In this study, the number of children a woman delivered within the five years period before the survey was used as a proxy for her birth-spacing practice. Mothers who practiced short birth spacing would have more births within a five years period (e.g. 3, 4 or more births) than mothers who practiced longer birth spacing (e.g., 1 or 2 births within 5 years). Studies that have examined the relationship between birth spacing and child survival had found that short birth interval was detrimental to the survival of a child (Bongaarts, Cleland, Townsend & Das-Gupta, 2012; Kayode *et al.*, 2012; Rafalimanana and Westoff, 2001; NPC and ICF, 2014). Other studies have recommended a waiting period of at least 2-3 years between births (Adegbola, 2008; Federal Ministry of Health, Nigeria, 1988; Odimegwu, 1999; Pathfinder International, 2012; Rutstein, 2002). However, the United States Agency for International Development (USAID) recommended that a birth spacing period of 3-5 years might be more advantageous (USAID, 2014).

The findings of the study confirmed 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. Hence, it will, therefore, be much quicker, and less expensive to channel policies and programs towards ensuring that mothers practice adequate birth spacing by promoting extensive and prolonged breastfeeding and contraceptive use (proximate variables) than devoting resources to training all women to achieve at least a secondary education (underlying variable). Before knowledge acquired would have an impact on the woman's fertility behaviour, it would take at least 12 years for her to attain and complete secondary education. However, women's education could be a long-term strategy to achieve a modified favorable fertility behaviour as well as achieving other socioeconomic advantages for the country. It is, therefore, important to know that

reducing frequency and number of births by mothers is advantageous to the health of both the mothers and their children.

Another proximate determinant that was significant in this study was birth order (i.e., the parity of the woman). The result showed that children who were of birth order 1 and birth order 7 and above, were at higher risk of dying than children who were of birth order 2 to 6. Children who were of birth order 1, in most cases were at higher risk of dying, probably because their mothers were too young and/ or inexperienced in child care. Further, children of birth order 7 and above were also at higher risk of dying mainly because children within this birth order usually suffer from low birth weight which is an associated risk of under-five mortality (Stover and Ross, 2013; Uddin *et al.*, 2009). Lastly, breastfeeding acted as a pathway for exerting the effects of background factors on under-five mortality in this study. This was due to the fact that breastfeeding is healthier, safer and inexpensive than bottle-feeding. It is said to confer invulnerability on infants against childhood infections and ensures well-spaced birth interval (Amosu Atulomah, Thomas, Olarenwaju, and Degun, 2011).

The intensity and duration of breastfeeding would have been most appropriate to use in this study, but unfortunately, this information was only available on children who survived and not those who had died before the survey. Information on "Ever breastfed" was obtained for all the children (dead or alive). Nigerian women are generally known to breastfeed their children and because of this, only 2.6 percent of the mothers were reported not to have breastfed their children in this study. However, mortality among such unbreastfed children was extremely high, more than twenty times greater than that of children who were ever breastfed (OR = 22.5; P <0.001). Although, the reasons why some of the children were not breastfed were unknown (i.e., whether they are too sick to be breastfed or their mothers were too sick to breastfeed them, etc.), nevertheless, a child that was never breastfed stands a very high chance of dying in childhood.

In this study, all the proximate determinants selected indicated significant bivariate (unadjusted) direct effects on childhood mortality. However, some of them did not show

significant independent effects in the presence of other proximate variables (Model 3). The explanation could be that they transmit their effects on under-five mortality in "synergy" with other proximate determinants in the model. Such variables include; type of cooking fuel, type of toilet facility, source of drinking water and place of delivery. Other studies that had found similar results gave some explanations. For example, in the study by Shaheed, Orgill, Ratana, Montgomery, Jeuland and Brown (2014), they explained that households' drinking water supervision was difficult because various sources were used at intervals due to their availability and accessibility at that particularly period. It has been found that households combine various water sources in storage containers, including 'improved' with 'non-improved' sources. Hence, storing water from taps deteriorate when mixed with rain water.

Similarly, for cooking fuel, Mestl, Aunan, Seip, Wang, Zhao and Zhang (2007), found that most households were using mixture of two or three cooking fuels, such as use of gas and coal, stove, and firewood, (i.e., using biomass and non-biomass together) etc. As a result of these mixtures, source of drinking water and cooking fuels, could not help to explain the indirect effects of these background factors on under-five mortality.

The 2013 NDHS data on duration of breastfeeding and vaccination status of the under-five children were inadequate. Unfortunately, information on vaccination was only obtained on children who were alive. For the variable on breastfeeding, the question on "if the child was ever breastfed with a yes or no" answer was eventually used since this had information for both the dead and alive under-five children. Place of delivery failed to indicate significant independent (direct effects) the effects of the underlying factors on under-five mortality at the multivariate level. This might be due to the fact that, the variable relates more to neonatal and infant mortality than it does to under-five mortality (Awunyo, 2010). Research revealed that about 40 percent of the childhood deaths occurred at the neonatal stage (UNICEF, 2014) and mothers' utilization of health care facility for delivery is very crucial at that stage of life.

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

6.1 Preface

This chapter focuses on the summary of the study, policy implications, conclusions and recommendations based on the findings of this study.

6.2 Summary of the Study

The study examined how socioeconomic, demographic and cultural factors (i.e., underlying factors), influence under-five mortality by identifying those direct factors (i.e., proximate determinants) through which they influence under-five mortality in Nigeria. The data used was the Nigeria Demographic and Health Survey (NDHS) of 2013. It was a nationally representative sample. Mothers of the 31,482 children who were born during the previous five years of the survey were interviewed on the survival status of their children and also on their own characteristics and child healthcare practices.

The Mosley and Chen framework (1984) was adopted to explore the pathways of influence of the underlying factors on under-five mortality. The statistical analyses used were the univariate, bivariate and the multivariate analyses. Due to the binary nature of the dependent variable, the multivariate analysis technique adopted was the "binary logistic regression". The level of significance was set at 5 percent. Findings showed that all the nine underlying factors considered in the study had a significant indirect bivariate relationship with the outcome variable.

The underlying factors were mother's age, marital status, mother's education, her occupation, her geographical region, her urban/rural residence, her wealth status and religious affiliation. At the multivariate analysis level, all the underlying factors except religion and occupation maintained their significant indirect effects on under-five mortality. The seven proximate determinants examined in the study were, the child's birth order, number of births the mother had within the previous five years of the survey, whether or not the child was ever breastfed, the household source of drinking water,

type of toilet facility, type of cooking fuel, and the place where the child was delivered. Findings showed that all the eight underlying factors indicated significant direct bivariate relationship with six of the seven proximate determinants, implying that the underlying factors may be influencing under-five mortality through those proximate variables. The only proximate determinant that many of the underlying factors did not indicate significant bivariate relationship with was the "ever breastfed" variable. At the multivariate analysis level, we found that children who were never breastfed were twenty-two times more likely to die before five years of age than children who were breastfed (Chi-square value = 22.49; $P<0.001$).

The Log-likelihood Ratio test (LR) used to test the overall level of importance of the proximate determinants as pathways of influence for the underlying factors on under-five mortality found them to be highly significant (Chi-square = 3222. 423 on 12 degrees of freedom, P = 0.000). However, several of the underlying factors still maintained their significant relationship with under-five mortality even with adjustments for the seven proximate variables. The result implies that, in addition to the seven proximate determinants used in the study, there could be other proximate variables not included in the study through which the underlying factors may also be influencing under-five mortality.

Policies and programmes to reduce under-five mortality which are targeted to influence proximate determinants (e.g., birth spacing), will be effective given the short period the country have to reduce under-five mortality to 25 per 1000 in 2030. Programmes that create awareness about some of the causes of childhood mortality and also encourage the use of contraceptives and extensive breastfeeding to prevent frequent births within short intervals of time will go a long way in helping to reduce the high under-five mortality in Nigeria.

6.3 Policy Implications

Policies and programmes to reduce under-five mortality, which are targeted at influencing proximate determinants (e.g., birth spacing), are often much easier, less expensive and much quicker to produce the desired results than policies and programs that are aimed at changing the underlying factors, such as increasing the levels of women's education or wealth status. The reason for this was because the impact of proximate determinants such as birth spacing, parity, and breastfeeding practices may be achievable within short period of time when compared with policies designed to improve women's education, wealth status, and jobs creation, which are more or less long term goals. If governments at all levels are to focus on influencing underlying factors such as increasing women's education the basis for policy formulation and programs implementation, the actualization of SDG 3, target 3.2 which states that "Deaths of newborns and children under-5 years of age should have declined to 25 per 1,000 by 2030" (13 years from now), may not be a reality. It is known that a woman's educational attainment may have meaningful effect on her reproductive behavior only at achieving a secondary or higher level of education, which may take up to 12 years or more of schooling.

That is why this study was conducted to examine those proximate variables through which socioeconomic, demographic and cultural characteristics operate through to influence under-five mortality in Nigeria.

6.4 Conclusion and Recommendations

One major recommendation from the findings of this study was that in order to quickly reduce childhood mortality in Nigeria, policies and programmes should be targeted towards ensuring proper birth spacing by Nigerian mothers. Therefore, this study recommends that policies be tailored towards creating more awareness on having fewer children (i.e. low parity), through effective birth spacing. This can be achieved through the use of contraceptives and exclusive and prolonged breastfeeding which will help to reduce frequent births (Amosu *et al.*, 2011; Ross and Stover, 2005; Singh, Pandey and Gautam, 2007; Stover and Ross, 2013). There is need for stakeholders in the area of

child health to intensify efforts in ensuring that women space their births according to recommended standards of the Safe Motherhood Initiative, that is, for 3 years, (Davanzo, Razzaque, Rahman, Hale, Ahmed, Khan, Mustafa and Gausia, 2004; Starrs, 2006).

Programmes to reduce frequent births must target those groups of mothers identified to be giving births to multiple children within short period of time (e.g., five years). This study identified such mothers to include mothers aged 20-39 years, mothers with little or no education, rural mothers and mothers in the North East and North West regions of the country.

Although only 2.6 percent of mothers never breastfed their babies, however, childhood mortality was about twenty-two times greater among their children compared to those children who were ever breastfed. This study, therefore, recommends programmes that will encourage mothers to breastfeed their babies. Also extensive or prolonged breastfeeding can help to prevent frequent births within short intervals of time through its effect on delaying return of ovulation following a child's birth, which then extends inter-birth intervals or birth spacing (Agho, Dibley, Odiase, Ogbonmwan, 2011; Agunbiade and Ogunleye, 2012). Reduction in the frequency of births will reduce the high under-five mortality in Nigeria. It is important, therefore, to note that achieving the SDG 3, target 3.2 is a big task which requires an urgent and more rapid direct policy approach.

Hence, it will be much more meaningful, quicker and cheaper to direct policies and programmes that will encourage women to space their births than to keep investing in women's education, which can only have an impact on under-five mortality on a long term basis. However, women's education is important for other socio-economic and developmental considerations.

6.5 Contributions to knowledge

This study used the proximate determinants approach to examine the effects of underlying factors on under-five mortality in Nigeria. The study was able to identify those proximate determinants that helped to channel the effects of selected underlying factors such as mother's educational attainments, place of residence, mother's age, her current marital status, her religion, occupation, wealth status and region on under-five mortality.

The method used in the study is one of the latest and most effective methods found in the literature for assessing the determinants of child survival in the developing countries. The comprehensive use of the method in this study to explain how socioeconomic, cultural and environmental conditions affect under-five mortality in Nigeria was unprecedented. It has been able to disentangle the pathways through which the underlying factors operate to influence under-five mortality and therefore could aid policies and programmes to ensure reduction of childhood mortality in Nigeria. Hence, the main contribution of this study is the methodological approach used to identify the pathways of influence through the underlying factors operate to affect under-five mortality.

This study was able to identify those group of mothers contributing largely to under-five mortality in Nigeria. As a result findings from this study can enhance policies that focus on quick reduction of childhood mortality in Nigeria. Therefore, to rapidly achieve the SDG 3, target 3.2, policies must be channeled toward those group of mothers that were reported to be having multiple births within short period of five years, married mothers aged 20-39 years, mothers with little or no education, rural mothers and mothers from the North East and North West regions of the country.

It is important, therefore, to note that achieving the SDG 3, target 3.2 is a big task which requires an urgent and more rapid direct policy approach. Hence, it will be easier for policy makers to invest more in interventions that are achievable within a short-term period given the nearness of the target year- 2030 (i.e., encourage more women to space

their births and elongate breastfeeding) than to keep investing in education, and expecting a quicker effect on under-five mortality.

6.6 Area for further study and Limitations of the study

The findings from this study showed that some of the underlying factors still maintained significant indirect effects on under-five mortality despite their significant direct relationship with some or all of the proximate determinants used in the study. This meant that there are some other proximate factors that may have helped to explain the effects of the underlying factors, which this study did not consider. Therefore, there is the need for more research using other proximate variables not used in this study. Further research can also focus on other behavioral and environmental factors influencing under-five mortality in Nigeria. For example, behavioral factor such as the vaccination and nutrition status or feeding practice of the children and a woman's decision-making autonomy particularly on her own health and the health of her child among others.

Although, the analytical framework of this study included some environmental factors, but some inconsistency was experienced in the NDHS 2013 dataset. It was also discovered that information on vaccination was only obtained on children who were alive as at the time of the survey, but none on those who were dead, which limited the use of this variable in this study. Hence, there is the need for a more reliable and complete dataset.

Similarly, there was also inconsistency in the variable on duration of breastfeeding of the child in the NDHS dataset for 2013. Information on duration of breastfeeding was only available for 9,782 children out of a total of 31, 482 children sampled in 2013. Further, there was no information on breastfeeding duration of children who died. This is essential particularly with respect to the kind of nutritional care mothers give to their children. This was supposed to be part of the focus of this study but was eventually dropped, because of the limited information in the Nigeria Demographic and Health Survey dataset. Finally, the variable on who makes decision on the child's health was

also inadequate. The variable could not be used because the question was only asked from currently married mothers, while the response to the question on decision making was limited to either husband or wife or both. Information on involvement of a third party in making such decision was missing, particularly for mothers who were currently not married as at the time of the survey.

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APPENDIX I

Summary of Empirical Review				
S/N	**Author(s) & year**	**Data Source**	**Method**	**Findings**
1.	Antai D., (2010)	Nigeria Demographic and Health Survey (NDHS), 2003 dataset	Cox regression; Multilevel logistic Regression	Religion, ethnicity, residence are major determinants of under-five mortality in Nigeria
2.	Gayawan E. & Turra C.M., (2012)	Demographic and Health Survey (DHS), for Nigeria (2008) and Columbia (2010)	Geoaddictive Regression Model	Child mortality was influenced by both socio-economic and healthcare related factors.
3.	Kayode G.A., Adekanmbi V.T. & Uthman O.A., (2012)	Nigeria Demographic and Health Survey (NDHS), 2008 dataset	Likelihood Ratio Test, Hosmer-Lemeshow Goodness-of-fit and Variance Inflation Factor (VIF)	Major determinants of under-five mortality were mother's age at first marriage, her health seeking behavior, breastfeeding, small family size, low birth order, normal birth weight, use of contraception, living in urban centers and good sanitation.
4.	Adepoju A.O., Akanni O. & Falusi A.O. (2012)	Nigeria Demographic and Health Survey (NDHS), 2008 dataset	Descriptive Statistics and Logit Regression Model	Maternal education, access to health care and breastfeeding are major factors of child mortality
5.	Hill K., (2003)	A review of 1984 paper by Mosley and Chen	A review paper	The background variables go through the proximate determinants to influence under-five mortality.

6.	Antai (2011)	Nigeria Demographic & Health Survey (NDHS), 2003 dataset	Cox proportional hazards model	Individual and community levels factors are significant predictors of under-5 mortality.
7.	Buwembo (2010)	October Household Survey (OHS), 1997; General Household Survey (GHS), 2002	Logistic Regression	Type of dwelling and place of delivery influences under-five mortality.
8.	Bello and Joseph (2014)	Primary data collected from Atiba Local Government Area in Oyo State through questionnaire.	Logistic Regression	Poverty, Postnatal care, and Breastfeeding are the major determinants of Child mortality in Oyo state
9.	Titaley *et al*, 2008	Indonesia Demography & Health Survey (IDHS), 2002-2003 dataset	Multilevel Logistic Regression	Community, household and individual factors significantly influence neonatal mortality
10.	Adedini (2010)	Nigeria Demography & Health Survey (NDHS), 2003 and 2008 dataset	Cox Proportional Hazard Regression; Generalized linear latent and mixed models (GLLAMM); Multilevel Survival Analysis	Individual, Household and community- levels factors are determinants of under-five mortality.

12.	Deribew, Tessema, and Girma, (1999)	A Case-Control Study (from December 12 to 27, 2005)	Logistic Regression	Health practices of mothers and perceived benefits of the modern treatment are identified as the key predictors of child survival
13.	Kuate-Defo, (1993)	Cameroon Fertility Survey (1978)	Piecewise logit regression	Inverse education-mortality relationship in the first year of life and direct in the next four years. Ethnicity and utilization of health care services are predictors of childhood mortality.