Under-five mortality and its determinants in Nigeria: Evidence from 2013 Nigeria Demographic and Health Survey

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ABSTRACT

Background: Under-five mortality is a lingering problem in Nigeria. The rate of under-five mortality in Nigeria is 124.0 deaths per 1,000 live births. This research examined the effects of child related demographic factors, maternal factors, and access/health related factors on the risk of dying before age five in Nigeria.

Theory and methods: The Mosley and Chen analytical framework for the study of child survival in developing countries (1984) was applied in this research. The 2013 Nigeria Demographic and Health Survey cross-sectional dataset were used. The Kaplan Meier, micro life table, and the hazard proportional model were employed to estimate the effects of selected child and maternal characteristics on the risk of dying before age five in Nigeria.

Results: The mean age at death among the under-five children is 5.93 months. The hazard rate of under-five mortality is highest at age 0 month. A female child was discovered to have lower risk of dying before age five relative to a male child (HR 0.834, 95% C.I; 0.742 – 0.938). A child with a very small size at birth has higher risk of dying before fifth birthday compared with a child who has an average size at birth (HR 1.407, 95% C.I; 1.119 – 1.769). A child whose mother's age at birth fell in age group 20 to 24 years was found to have lower risk of under-five mortality relative to a child whose mother's age at birth was under 20 years (HR 0.694, 95% C.I; 0.561 – 0.859). A child who did receive a baby postnatal check-up has lower risk of under-five mortality compared with a child who did not receive a baby postnatal check-up (HR 0.692, 95% C.I; 0.587 – 0.815).

Conclusions: Majority of under-five deaths in Nigeria occur before the first birthday. Giving adequate care to the child from the first month of birth can drastically reduce the level of under-five mortality in Nigeria. Further studies among neonates and infants are suggested with a view to eliminating mortality among children in Nigeria.

Keywords: *Under-five mortality, mean age at death, hazard rate, child sex, maternal age at birth, baby postnatal check-up*

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AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal Care
CIA	Central Intelligence Agency
CMC	Century Month Code
CSPro	Census and Survey Processing System
FCT	Federal Capital Territory
HDSS	Health and Demographic Surveillance System
HIV	Human Immunodeficiency Virus
iERG	independent Expert Review Group
LML	Log minus Log Plot
MNH	Maternal and Neonatal Health
MSD	Mobility and Scholarship Desk
NDHS	Nigeria Demographic and Health Survey
NFP	Netherlands Fellowship Programme
NPC	National Population Commission
Nuffic	Netherlands organisation for international cooperation in higher education
PNC	Postnatal care
PRB	Population Reference Bureau
U5MR	Under-Five Mortality Rate
UNICEF	United Nations Children's Fund
WHO	World Health Organization

CHAPTER ONE: INTRODUCTION

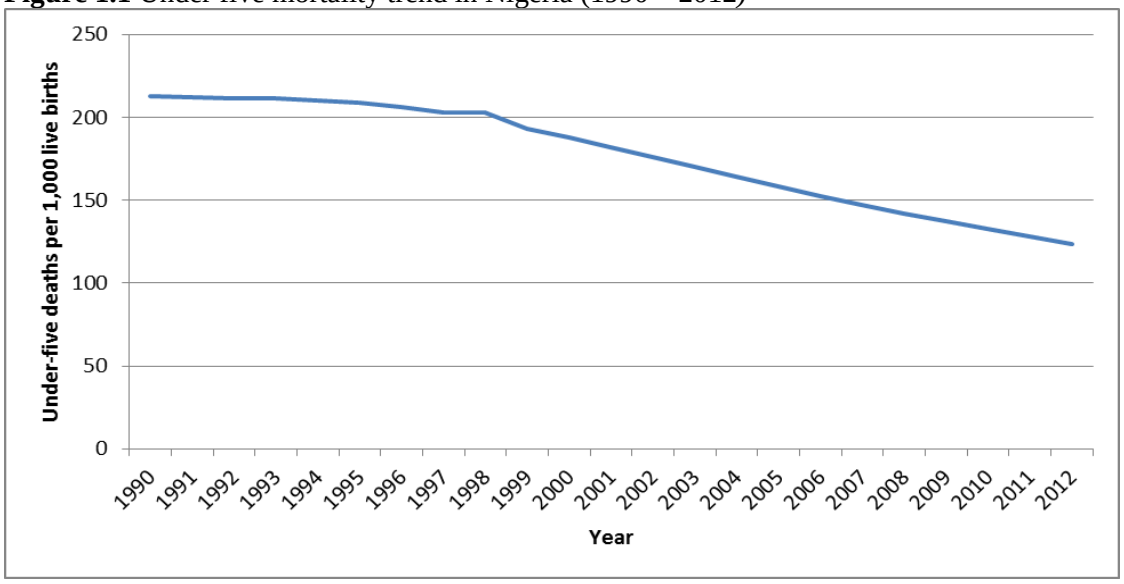
1.1 Background

Under-five mortality is one of the pressing events in the world today, especially in the developing countries. High death figures are being recorded among children aged less than five years including neonates and infants. In 2012, more than six and a half million children died before their fifth birthday, most of them occurred in sub-Saharan Africa and South Asia (WHO, 2013). Children in sub-Saharan Africa have more than 16.0% higher risk of dying before age five compared with children in developed countries (WHO, 2013).

Only five countries; India, Nigeria, Democratic Republic of Congo, Pakistan, and Ethiopia accounted for almost 50.0% of under-five mortality in the world (Child Survival Call to Action, 2012; WHO, 2013). Most of the deaths among children aged less than five years can be prevented if adequate and affordable interventions are provided. Nigeria was identified as one of the five countries that were responsible for nearly three and a half million under-five deaths in the world in 2012 (Child Survival Call to Action, 2012).

The current under-five mortality rate in Nigeria is 124.0 deaths per 1,000 live births (World Bank, 2013). The trend of under-five mortality rates in Nigeria from 1990 to 2012 is shown in figure 1.1. Although Figure 1.1 shows that the under-five mortality rate in Nigeria is steadily declining every year, but the declining rate is lower than the required 4.4% for achieving the Millennium Development Goal 4 in 2015 (iERG, 2012).

Figure 1.1 Under five mortality trend in Nigeria (1990 – 2012)



Source data: World Bank, 2013

The probability that Nigeria will achieve Goal 4 of the Millennium Development Goals - reducing child mortality rates by two-thirds in 2015 - is extremely low. This is due to the current high rate of under-five deaths recorded in the country.

Although few studies had been conducted on child survival in Nigeria, more studies are still needed on under-five mortality. The effects of some determinants such as ethnic group, access to mass media, number of antenatal visits during pregnancy, and postnatal check-up within two months after birth on the risk of dying before age five in Nigeria were not examined in the previous studies (to the best of my knowledge). Also, the nature of the

effects of some risk factors already determined, for instance, maternal age at birth, on under-five mortality risk is not clear yet.

Maternal age at birth, child spacing, birth order, child weight, use of contraception and residential area of the parents were identified as some of the risk factors that account for under-five deaths in Nigeria (Kayode et al., 2012). The impact of maternal age at birth on under-five mortality is controversial. Some researchers discovered that negative relationship exists between maternal age at birth and under-five mortality (Adetunji, 1995; Feyisetan et al., 1997). However, a positive relationship was revealed in some research. It was shown that under-five mortality began to increase from mothers' age group 26 – 30 years and the odds of under-five mortality increases as the mothers' age group increases (Kayode et al., 2012).

It was also revealed that survival of under-five children depends on the region where they live (Kayode et al., 2012). Children who live in the southwestern part of Nigeria had a higher probability to survive than those who live in other parts of the country due to the presence of better agricultural products in southwest than other five geo-political zones; North-west, North-east, North-central, South-east and South-south (Kayode et al., 2012).

The effect of proximity of parents to health facilities on child survival in low and middle-income countries, including Nigeria has also been examined (Okwaraji & Edmond, 2012). It was discovered that proximity to health facilities has statistically significant effect on child survival, especially in the neonatal period. Children whose parents reside within five kilometers or within 30 minutes travel time from a clinic have lower under-five mortality risk relative to children whose parents live further away from the clinic (Okwaraji & Edmond, 2012).

Therefore, in order to curtail or eradicate the under-five mortality in Nigeria, there is a need for more studies to determine major risk factors that are responsible for high deaths among children. Examining the effects of some factors such as child sex, size of the child at birth, maternal level of education, ethnic group, access to mass media, number of antenatal visits during pregnancy, place of delivery, postnatal check-up within two months of birth, and child breastfeeding status on the risk of dying before age five could provide additional information on determinants of under-five mortality in Nigeria.

It is hoped that this research will contribute to the existing knowledge on the determinants of under-five mortality in Nigeria by assessing the effects of the above stated explanatory variables on the risk of dying before fifth birthday. Also, this research is expected to facilitate timely and more focused policy interventions to solve the problem of under-five mortality and to promote preventive measures and foreign aids in Nigeria. Determining the most significant risk factors of under-five mortality in Nigeria will assist the country to focus on how to solve the problems emanating from those factors.

For instance, if access to radio was found to have a significant effect on the risk of dying before age five in Nigeria at the end of this study, distributing small transistor radio to the needy in rural and remote areas might provide opportunities to get information on how to prevent certain diseases that kill most of the children such as malaria, measles and diarrhoea. In addition, information on how and where to receive antenatal and postnatal cares (either free or out-of-pocket) can be received through radio. For those who have radio but do not listen to it always, they could be encouraged to listen to radio every day in order to get timely and useful information on child health care, which will consequently increase the chance of their children survival.

The critical realism paradigm informs this type of research. The critical realism advocates that all things that have observable effects in our lives should be deemed real (Hennink et al., 2011: Babbie, 2013). Therefore, throughout this project, the critical realism paradigm of social research was acknowledged. The effects of all explanatory factors included in this research on the risk of under-five mortality were reported as obtained and believed to be real.

1.2 Objective and research questions

The broad objective of this research is to examine the effects of child related demographic factors, maternal factors and access/health related factors on the risk of dying before age five in Nigeria. The research questions are as follows:

Main question

What are the effects of child related demographic factors, maternal factors and access/health related factors on the risk of dying before age five in Nigeria?

Sub-questions

- What are the effects of child related demographic factors such as child sex, size of the child at birth and birth order on the risk of dying before age five in Nigeria?
- What are the effects of maternal factors such as maternal age at birth, highest level of education and ethnic group on the risk of dying before age five in Nigeria?
- What are the effects of access/health related factors such as access to radio, number of antenatal visits during pregnancy, place of delivery, breastfeeding and baby postnatal check-up within two months after birth on the risk of dying before age five in Nigeria?

1.3 Scientific and societal relevance of the research

1.3.1 Scientific relevance of the research

This research is expected to add to the existing knowledge on the determinants of under-five mortality in Nigeria. Investigating the effects of child sex, size of the child at birth, maternal education, ethnic group, access to radio, number of antenatal visits during pregnancy, place of delivery, child breastfeeding status and postnatal check-up within two months after birth on the risk of dying before age five is hoped to provide a new dimension to research on child survival in Nigeria. This is because the above-stated explanatory variables received no or less attention from the previous studies conducted on child survival in Nigeria.

Furthermore, this research used the most recent DHS dataset for Nigeria; the 2013 Nigeria Demographic and Health Survey dataset. This dataset was released in June 2014. The use of the most recent information on child status and relevant maternal and child-related characteristics in Nigeria enabled the findings of this project to be apt, relevant, and timely.

Moreover, logistic regression model was used to investigate the effects of some determinants of under-five mortality in Nigeria by most of the previous researchers. Logistic regression does not take time dimension into account. Whereas this study employed survival analysis and Cox regression techniques to model the effects of the above-stated covariates on the risk of dying before age five in Nigeria. This is because survival analysis and Cox regression model takes time dimension into consideration. So, it is believed that Cox regression analysis is more appropriate for a research on under-five mortality within the stated periods (0-59 months) than logistic regression.

1.3.2 Societal relevance of the research

This research could provide many benefits to the society. This research has identified the effects of some additional risk factors of under-five mortality in Nigeria. It is part of the plan to publish the outcome of this master thesis. Publishing the outcome of this research in appropriate journal will make the society, especially the educated members of the society, be aware of the additional factors that affect child survival. The educated people can share the information with the less educated members of the community, especially their extended families. Nigeria is a country with well-connected extended family ties. Consequently, every family can take some personal illness controls in order to increase the chance of child survival.

In addition, making recent findings on under-five mortality in Nigeria available will enable Nigeria government to formulate policies that could reduce or eliminate the effects of the identified factors, which will consequently increase the child survival in the country. For instance, this research has identified that breastfeeding and a baby postnatal check-up with two months after birth can reduce under-five mortality in Nigeria. Identification of these factors can facilitate identification of groups or people that are less privileged in the society. Thus, the policy makers and health providers can plan a more focused and targeted interventions for such affected groups.

Similarly, more information on the benefits of the higher number of antenatal visits during pregnancy to children and their mothers could be provided to the public as this research investigates the effect of the number of antenatal visits during pregnancy on the risk of dying before age five. Furthermore, pointing out the ethnic group(s) whose children are most at risk of dying before age five can give a direction to the ethnic group that needs urgent attentions. For instance, children from the Yoruba major ethnic group were found to have a lower risk of dying before age five relative to Hausa/Fulani major ethnic group in Nigeria. Even though the effect of this variable is not statistically significant, adequate attention should be given to children from Hausa/Fulani major ethnic group.

1.4 Structure of the paper

In chapter one, the background information to the research, including statement of the research problem, the research objective and research questions as well as the information on the scientific and societal relevance of the research are provided. Chapter two contains information on relevant theory to the research, literature reviews, the conceptual framework, the research hypotheses, and definition of important concepts. In chapter three, the data and the methods employed in this research were described extensively. Chapter four consists of both descriptive and explanatory results of analysis. Chapter five includes conclusion and discussion as well as limitations of the research and recommendations for policy makers and for further research.

CHAPTER TWO: THEORETICAL FRAMEWORK

2.1 An analytical framework for the study of child survival in developing countries

This analytical framework for the study of child survival in development countries was used in this research. This framework incorporates both social and biological variables and combines the research methods employed by both social and medical scientists. This theoretical approach is based on the proposition that all socioeconomic determinants of child mortality operate through a common set of proximate determinants to have an effect on mortality (Mosley & Chen, 1984).

The proximate determinants approach to the study of child survival is developed based on five premises. First, it is assumed that in an optimal setting, over 97% of newborn infants can be expected to survive through the first five years. Second, the reduction in this survival probability in any society is premised to be as a result of social, economic, biological and environmental forces. Third, the socioeconomic determinants must operate through more basic proximate determinants that in turn influence the risk of disease and the outcome of disease processes (Mosley & Chen, 1984).

Fourth, it is assumed that specific diseases and nutrient deficiencies observed in a surviving population may be viewed as biological indicators of the operations of the proximate determinants. Fifth, the growth faltering and mortality in children are presumed to be the cumulative consequences of multiple disease processes (Mosley & Chen, 1984).

The most important aspect of this framework is the identification of a set of proximate determinants (intermediate variables) that directly affect child morbidity and mortality. All socioeconomic variables should operate through intermediate variables to influence child survival (Mosley & Chen, 1984).

Proximate determinants

The proximate determinants are in five groups, namely; maternal factors, nutrient deficiency, personal illness control, environmental contamination and injury.

- *Maternal factors*

The maternal factors consist of three main components, namely; age, parity and birth interval. These factors are measured directly from the interview. Questions relating to maternal age at birth, parity, and child spacing could be asked through an interview or questionnaire (Mosley & Chen, 1984).

- *Nutrient deficiency*

The availability of nutrient in child or in the mother during pregnancy and lactation periods can be measured directly by weighing all foods before consumption and by performing biochemical analysis of food samples. Levels of calories, protein and micronutrient intake are good measures of nutritional deficiency in child or mother. Also, the child breastfeeding status or duration can be used to measure the nutritional status of the child. In order to examine relative levels of nutrient intake indirectly, observation of the type of food eaten or the dietary history may be recorded. This method is indirect and cruder than the direct method (Mosley & Chen, 1984).

- *Personal illness control*

The personal illness control could be either preventive measures or curative medical treatment. The preventive measure can be examined by looking at the reported use of preventive services such as antenatal care, hospital delivery, postnatal care (for example, immunization) and the malaria prophylaxis. For curative medical treatment, the providers of care and the kind of therapies used for specific conditions are investigated. All sources of treatment; traditional practices, scientific medicine, etc.; should be included in the research. So, the type of therapies received and their providers must be scaled independently of, for instance, their efficacies (Mosley & Chen, 1984).

Socioeconomic determinants

The socioeconomic determinants of child faltering and survival are majorly classified into three groups, namely; individual-level variables, household-level variables and community-level variables.

- *Individual-level variables*

The productivity of the household is measured by three major factors. The first one is a skill which is scaled by educational level. The second factor is health and the third factor is time. The father's level of education operates indirectly through proximate determinants to influence the survival of the child. It has been discovered that the father's educational level is correlated with occupation and finally to income level (Mosley & Chen, 1984). Mothers' skills, health and time operate directly on the proximate determinants. Mothers' health and nutritional status affect child health and survival directly because of the biological links between mother and child during pregnancy and lactation (Mosley & Chen, 1984).

Mothers' educational level influences child survival through their health seeking behaviour and health care practices such as antenatal visits, nutrition, breastfeeding patterns and disease treatment. In order to have a healthy child, adequate time must be devoted to prenatal visits, breastfeeding and postnatal check-up. The Traditions/norms/attitudes of the household also affect child survival through proximate determinants. The culturally determined factors include power relationships within the household, value of children, belief about disease causation and the food preferences. All these factors shape and modify the economic choices and health-related practices of the household (Mosley & Chen, 1984).

- *Household-level variables*

Household income/wealth affects child health and survival through the quantity and quality of food, water, clothing/bedding, housing, means of transportation, hygiene and preventive care, sickness care, and access to information on proper nutrition, contraceptive methods and immunization (Mosley & Chen, 1984).

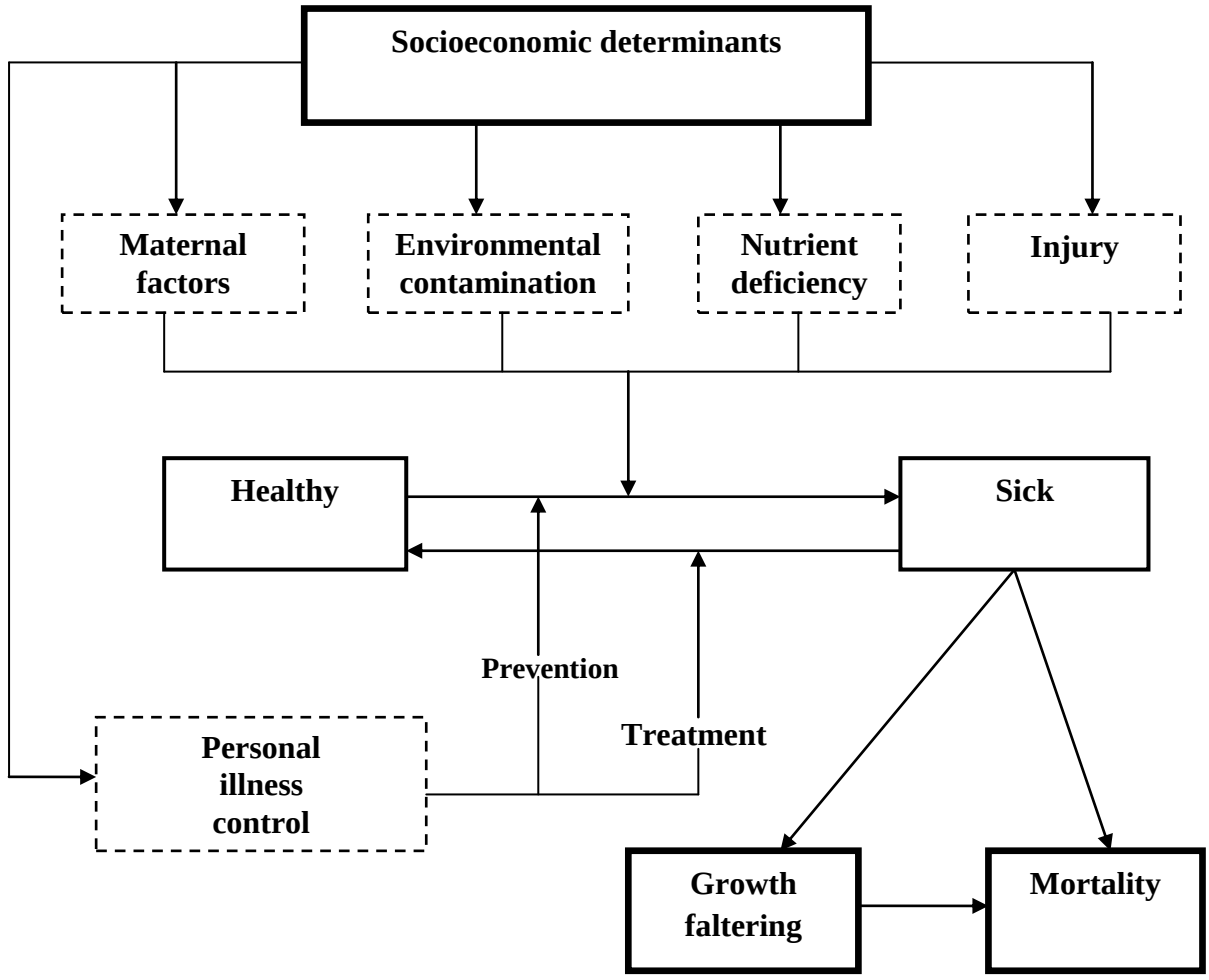
Dependent variable

The dependent variable in Mosley and Chen model is the combination of child growth faltering and mortality. This is done in order to correct the bias in medical research and to strengthen the social research. Medical researchers most often focus on the diseases and the nutritional status of the survivors and ignore the past deaths among the studied birth cohorts. They mostly carry out research among the living children. Social researchers focus majorly on mortality and little attention to differences in health status of the selected birth cohorts (Mosley & Chen, 1984). So, this model combines the level of growth faltering among the

survivors with the level of mortality among the birth cohort to form a single index (Mosley & Chen, 1984).

Note that only proximate and socioeconomic determinants that were included in this study were explained in detail. For detailed explanations of other proximate and socioeconomic determinants, check Mosley and Chen analytical framework for the study of child survival in developing countries (1984). However, Figure 2.1 presents the Mosley and Chen conceptual model for the study of child survival in developing countries including all proximate determinants. The factors inside the dotted rectangles are the proximate determinants.

Figure 2.1 Mosley & Chen conceptual framework for the study of child survival in developing countries



Source: Mosley & Chen (1984)

2.2 Literature review

The under-five mortality is of central concern to all countries of the world. Several researchers (Adetunji, 1995; Feyisetan et al., 1997; Padmadas, 2000; Nakamura et al., 2011; Schoeps et al., 2011; Kayode et al., 2012; Okwaraji & Edmond, 2012) throughout the world have published papers on some of the risk factors of under-five deaths. Identifying causes of under-five mortality will assist the world to know what problems to tackle and how to solve those problems. In addition to the literature provided in the introduction part, findings from

some of the previous studies on the risk factors of under-five mortality are discussed under the following sub-endings.

2.2.1 Child related factors and mortality among children

Some countries in Sub-Saharan Africa, especially Ghana, have recorded a tremendous reduction in child mortality (Nakamura et al. 2011). Recent research indicated an accelerated decrease in child mortality in Ghana since the year 2000. It was discovered that under-five mortality rate in Ghana has moderately declined over the past 40 years with improvement since the year 2000, and is forecasted to reach between 45 and 69 deaths per 1,000 live births in 2015 (Nakamura et al. 2011). The mean annual rate of reduction in child mortality was estimated to be 4.6% since 2000. This reduced rate is greater than the required 4.4% for achieving the Millennium Development Goal 4 in 2015. The study shows that increase in birth interval was one of the major contributors to the decline in child mortality in Ghana (Nakamura et al. 2011).

A female child had been discovered to have lower under-five mortality risk compared with a male child in Nigeria (Adedini & Odimegwu, 2013). A study conducted recently in Nigeria shows that the preceding birth interval, child birth order and birth weight have significant impacts on child survival in Nigeria (Kayode et al., 2012). It was discovered that when the preceding birth interval is at least 18 months, the odds of under-five mortality decline by more than 70.0% compared with when the preceding birth interval is less than 18 months. It was also revealed that the odds of under-five mortality for children whose birth order is between 2 and 4 increased by 93.0% relative to firth-born children. Children with low birth weight were found to have 31.0% higher odds of under-five deaths relative to children with normal birth weight (Kayode et al., 2012).

2.2.2 Maternal factors and mortality among children

Maternal age at birth and education level were found to be significant risk factors of under-five mortality in Ghana (Nakamura et al. 2011). It was discovered that for a child whose mother's age at birth is less than 18 years, the likelihood of dying before age five increased by 50.0% compared with a child whose mother's age at birth is greater than 18 years. It was also found that a child whose mother's level of education is primary has 70.0% higher risk of under-five mortality relative to a child whose mother's level of education is either secondary or higher education (Nakamura et al. 2011).

The effect of maternal age at first marriage on under-five mortality in Nigeria is very significant (Kayode et al., 2012). It has an inverse relationship with under-five deaths. This implies that the higher the maternal age at first marriage, the lower the under-five mortality in Nigeria and vice versa. This is because the younger mothers cannot take good care of the child themselves without assistance from either mothers-in-law or other relatives. But the maternal support is being faded out in Nigeria gradually due to civilisation and economic problems (Kayode et al., 2012).

2.2.3 Health related factors and mortality among children

A study on the effect of distance to healthcare facilities on childhood mortality in rural areas of Burkina Faso shows that distance to healthcare facilities is a major determinant of infant, child and under-five mortality in the Nouna HDSS in Burkina Faso (Schoeps et al., 2011). It was discovered that there is a significant and positive relationship between distance to health facilities and infant mortality. It was observed that the farther the distance to healthcare

facilities, the higher the risk of infant mortality and vice versa. Quantitatively, it was discovered that mortality risk for children is doubled for every walking distance of about six hours (Schoeps et al., 2011).

The residential area of the children plays a significant role on under-five mortality. The child mortality is lower in urban areas than in the rural areas of Burkina Faso (Schoeps et al., 2011). This is because the breeding sites of Anopheles mosquitoes, which are associated with a higher prevalence of malaria, are more common in the rural areas than in the urban areas (see Sankol et al., 2001; Ruthford et al., 2009; Van de Poel et al., 2009).

Furthermore, the outcome of a study conducted in Ghana shows that increased bed net use for children aged under-five and child breastfeeding status are major contributors to the decline in child mortality in Ghana (Nakamura et al. 2011). The likelihood of dying before fifth birthday decreased by 30.0% for children that slept under a mosquito net compared with children that did not sleep under a mosquito net. The under-five mortality increased by fivefold for never breastfed children compared with ever breastfed children (Nakamura et al. 2011).

In a research conducted in Nigeria, it was discovered that the use of contraception, sanitation and the health seeking behaviour of mothers have significant impacts on child survival in Nigeria (Kayode et al., 2012). It was revealed that children whose mothers adopt traditional method of contraception have 31.0% lower risk of under-five mortality compared with children whose mothers do not use any contraceptive method. Also, the likelihood of under-five mortality in homes with bad toilet facilities is 77.0% higher compared with homes with good toilet facilities. The research also revealed that children whose mothers have at least average health seeking behaviour have 94.0% lower risk of under-five mortality relative to children whose mothers have a very low health seeking behaviour (Kayode et al., 2012).

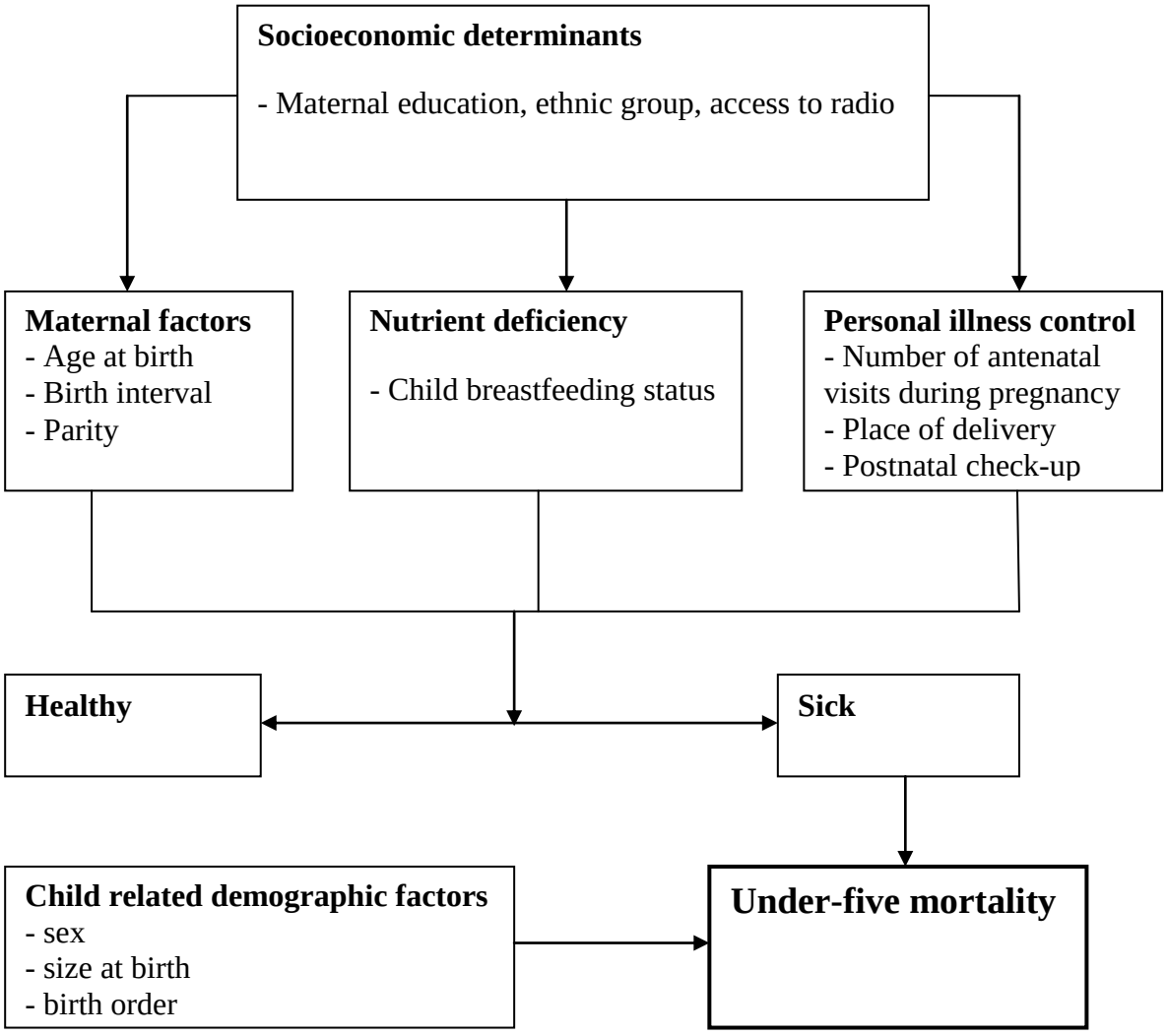
In conclusion, this project assessed the effects of child related demographic factors, maternal factors and access/health related factors on the risk of dying before age five in Nigeria. Considering Mosley and Chen theoretical framework and the previous studies, the variables included in this study are child sex, child size at birth, birth order, maternal age at birth, maternal education, ethnic group, access to radio, number of antenatal visits during pregnancy, place of delivery, child breastfeeding status and postnatal check-up within two months after birth. These variables were examined because of the following reasons.

First, maternal age at birth was included because the nature of its effect on the risk of under-five mortality in Nigeria is not clear yet. The outcome of the previous research on the effect of maternal age birth on under-five mortality risk in Nigeria is both positive and negative (see Adetunji, 1995; Feyisetan et al., 1997; Kayode et al., 2012). Therefore, including maternal age at birth in this research might provide a clearer direction of the effect of maternal age at birth on the risk of dying before age five in Nigeria.

Second, no previous research (to the best of knowledge) has ever studied the effects of mother's ethnicity, access to mass media, number of antenatal visits during pregnancy and baby postnatal check-up within two months after birth on the risk of dying before age five in Nigeria. Studying the effects of these variables on the risk of under-five mortality could add to the existing information on the risk factors of under-five mortality in Nigeria. In addition, it is expected that the outcome of this research could facilitate apt, timely, and relevant interventions and policy formulations. Some preventive measures on the examined variables could be taken in order to avert or eliminate under-five mortality in Nigeria.

2.3 The conceptual model

Figure 2.2 A Conceptual model to explain the determinants of under-five mortality in Nigeria



Source: derived from Mosley & Chen theoretical framework (1984).

Figure 2.2 reveals that all socioeconomic determinants operate through proximate determinants to affect under-five mortality. Maternal education, ethnic group, and access to radio affect under-five mortality indirectly through maternal age at birth, birth interval, parity, child breastfeeding status, number of antenatal visits during pregnancy, place of delivery and baby postnatal check-up within two months after birth. However, the child related demographic factors affect under-five mortality directly. This conceptual model was designed considering the previous studies and the Mosley and Chen analytical framework for the study of child survival in developing countries depicted in Figure 2.1.

2.4 Research hypotheses

- Female children are less likely to die before age five compared with male children in Nigeria.

- Children with a very small size at birth and higher birth order children have higher risk of dying before age five relative to children with an average size at birth and first born children in Nigeria.
- Children whose mothers' ages at birth are greater 20 years, those from the Yoruba ethnic group, those whose mothers have higher levels of education have lower risk of dying before age five relative to children whose mothers' ages at birth are less 20 years, those from the Hausa/Fulani ethnic group and those whose mothers have no education in Nigeria.
- Children whose mothers have access to radio and the ever breastfed children are less likely to die before age five compared with children whose mothers have no access to radio and the never breastfed children in Nigeria.
- Children whose mothers have no or less than four antenatal visits during pregnancy are more likely to die before age five relative to children whose mothers have more than four antenatal visits during pregnancy in Nigeria.
- Children who are delivered at the hospital and those who receive postnatal check-up within two months after birth have lower risk of dying before age five relative to children who are delivered at home and those who do not receive postnatal check-up within two months after birth in Nigeria.

2.5 Definition of concepts

Under-five mortality: It is the number of deaths occurring in a given population of under-five children during a specified time period (WHO, 2005). It is often abbreviated as U5MR. In other words, under-five mortality is the likelihood of dying before the fifth birthday (DHS, 2010).

Demographic factors: These are factors that relate to personal characteristics of an individual (DHS Guide to Statistics, 2006). For instance, child sex, size of the child at birth, birth order, and maternal age at birth are the demographic factors included in this research.

Socioeconomic factors: These are factors that measures economic and social status of an individual (DHS Guide to Statistics, 2006; DHS, 2010). Maternal education, ethnic group, and access to radio are the socioeconomic variables that were included in this research.

Utilization of healthcare services: Health care services are the services provided to people or societies by the health service providers in order to restore, promote, maintain, or monitor health (WHO, 2004). So, utilization of health services is the experience of people as to their receipt of health care services of different types (WHO, 2012). Number of antenatal visits during pregnancy, place of delivery, and baby postnatal check-up within two months after birth were used to measure the utilization of health care services in this study.

Maternal age at birth: This is the difference between date of birth of the child under study and the date of birth of mother (in CMC format) grouped into categories of age in years (DHS Guide to Statistics, 2006). In other words, it is the difference between the current age of the child under study and the current age of the mother.

Child size at birth: This is defined as the size of the child at birth as reported by the mother (DHS Recode Guide, 2012). It is used as a proxy for child weight at birth because most of the

children were not weighted after birth. It measures how small or large a child is after delivery.

Birth Order: This is defined as the chronological order of sibling births in a family (Encyclopedia of Children's Health, 2014). It can also be seen as a child's ordinal position among the children in a family (Medical Dictionary, 2012).

Maternal education: This is a standardized variable that measures the highest level of education of mother of the child under investigation as at the time of interview (DHS Recode Guide, 2012).

Ethnic group: This is the ethnic affiliation or distinctiveness. It defines a group of people whose members are identified with each other through one common heritage often consisting of one common language and an ideology which stresses a common ancestry or endogamy. In other words, it is a social group that has common cultural ties (Oxford Dictionaries Language Matters, 2014). The ethnic groups were categorized as Yoruba, Hausa/Fulani, Igbo, and other ethnic minorities.

Antenatal care: This is the care that a pregnant woman received before she delivered the baby. It is also known as the prenatal care. The World Health Organization recommends at least four antenatal visits during pregnancy (Opportunities for Africa's Newborns, 2006; UNICEF, 2009).

Postnatal care: Health care provided following childbirth to both mother and infant. It is also known as postpartum or puerperium care. The World Health Organization recommends at least three visits for baby postnatal check-up. The first contact should be within 24 hours after birth and the follow-up contacts should be between 2-3 days, 6-7 days and at most six weeks after birth (Opportunities for Africa's Newborns, 2006; WHO, 2013; UNICEF, 2009).

Duration of breastfeeding: It is the length of time (in months) that an infant is fed with breast milk. The World Health Organization recommends six months exclusive breastfeeding and at least twenty four months as the duration of breastfeeding for the child (Opportunities for Africa's Newborns, 2006)

CHAPTER THREE: DATA AND METHODS

3.1 Study design

This research is explanatory. This is because the research examined the effects of child sex, size of the child at birth, birth order, maternal age at birth, maternal education, ethnic group, access to radio, number of antenatal visits during pregnancy, child breastfeeding status, place of delivery and baby postnatal check-up on the risk of dying before age five in Nigeria. The time dimension of this research is cross-sectional and the time unit of analysis is months. A quantitative cross-sectional dataset was used for this project. The explanatory variables (covariates) are the above stated variables while the dependent variable is duration until occurrence of under-five death or censoring at the time of interview. The indicator variable was dichotomized (dead or alive). The risk of dying before the age of five was investigated using quantitative research method.

3.2 Description of study area

The study area for this research is Nigeria. The current size of Nigeria population is 177, 155, 754 (PRB, 2013; CIA World FactBook, 2014; World Bank, 2014). There are 36 states and a Federal Capital Territory (FCT) in Nigeria. Nigeria has more than 250 ethnic groups. There are three major ethnic groups, namely; the Hausa / Fulani, the Yoruba and the Igbo. The population of the Hausa / Fulani is 29.0%, that of the Yoruba is 21.0%, and the Igbo ethnic group accounts for 18.0% of the total population. Other ethnic minorities account for 32.0% of the Nigeria population size (CIA World FactBook, 2014).

The sex ratio at birth is 1.06 males per females. The Nigeria total fertility rate is 5.25 children per woman. The under-five mortality rate is estimated to be 124.0 under-five deaths per 1,000 live births (CIA World FactBook, 2014; World Bank, 2014). The average life expectancy at birth is 52.62 years. The male life expectancy at birth is 51.63 years and the female life expectancy at birth is 53.66 years. The HIV/AIDS adult prevalence rate in Nigeria is 3.1%. The per capita gross domestic product is 2,800 United States dollars (CIA World FactBook, 2014; World Bank, 2014).

3.3 Description of data

3.3.1 Method of data collection

This research used secondary data. So, the method of data collection for this research was secondary. The 2013 Nigeria Demographic and Health Survey dataset were used. The observation period was between 2008 and 2013 (NPC & ICF International, 2014). The data are retrospective and cover five years. Specifically, the information was extracted from women questionnaire administered to a nationally representative sample of women in Nigeria. So, information on both the dependent variable (duration until under-five mortality or censoring at interview) and all explanatory variables were extracted from already compiled data repository of Demographic and Health Survey. The 2013 Nigeria Demographic and Health Survey is the most recent available dataset for Nigeria. This dataset was released in June, 2014 (NPC & ICF International, 2014).

3.3.2 Study population and sampling

The study area is Nigeria. The sampling frame used for the selection of respondents was 2006 Nigeria population and housing census. A stratified three-stage cluster design (904 clusters; 372 in urban areas and 532 in rural areas) was used as the sampling technique (NPC & ICF

International, 2014). 40,680 households were selected for the interview with a target of at least 943 completed interviews per state. Within these selected households, 38,948 women were selected for interview based on the eligibility criteria. Only women within reproductive age (15 – 49 years) were selected for interview (NPC & ICF International, 2014).

Out of 38,948 women interviewed, only 31,482 women had at least a birth between 2008 and 2013 (NPC & ICF International, 2014). For this research, only last births (the most recent births) to the interview were selected. The sample of the most recent births selected was 20,192. The sample of the most recent births was taken because the most recent births have complete records of birth history, including information on maternal health care utilization during pregnancy, delivery, and after birth, which are very important in this research. The previous births do not have information about mothers' number of antenatal visits during pregnancy and the baby postnatal check-up within two months after birth (NPC & ICF International, 2014).

3.4 Operationalization of variables

Dependent variable

The dependent variable is the duration until under-five death (in months) or censoring at the time of interview. The observation period is between 2008 and 2013. The most recent births between 2008 and 2013 were studied from birth (age 0 month) to just before their fifth birthday (59 months). The child age at death and the child age at interview for those surviving until 59 months were used to form the duration variable. Whether or not the child was alive at the time of the interview was used to measure the under-five death indicator. Note that the time unit of analysis is months. Table 3.1 depicts how the dependent variable is operationalized.

Independent variables

How all explanatory variables were estimated is also shown in Table 3.1. It was assumed that all covariates included in the Cox regression models were constant throughout the observation period (2008 – 2013).

Table 3.1 Operationalization of variables used in Cox regression models

Variables	**Operational definition**	**The original coding categories**	**Research-adjusted Coding categories**
Dependent variable			
Duration until under-five death/censoring	Child age at death/ current age in months	-	-
Under-five death indicator	Is the child still alive?	No – 0 Yes – 1	(No) Dead – 1 (Yes) Censored - 0
Independent variables (Covariates)			
Sex of the child	Sex of the child	Male – 1 Female - 2	Male – 1 Female - 2

Size of the child at birth	Size of the child at birth	Very large – 1 Larger than average-2 Average – 3 Smaller than average-4 Very small – 5 Don't know - 8	Very large – 1 Larger than average-2 Average – 3 (3 & 8) Smaller than average-4 Very small – 5
Birth order	Birth order of the child	-	1, 2-3, 4-5, 6+
Maternal age at birth	Difference between mother's birth date and birth date of the child under study (in CMC)	-	< 20 years - 1 20-24 – 2 25-29 – 3 30-34 – 4 35-39 – 5 40+ - 6
Maternal education	Mother's highest level of education	No education – 0 Primary = 1 Secondary = 2 Higher = 3	No education – 0 Primary = 1 Secondary = 2 Higher = 3
Ethnic group	Mother's ethnic group	Fulani – 109 Hausa - 130 Igbo – 138 Yoruba - 298 Others – the remaining values from 1 to 398)	Hausa/Fulani– 1 (109 & 130) Igbo – 2 (138) Yoruba – 3 (298) Others– 4
Acess to mass media	Access to radio?	No – 0 Yes – 1 Not a de jure resident -7	No – 0 (0 & 7) Yes – 1
Breastfeeding	Child breastfeeding status?	Ever breastfed, not currently breastfeeding - 93 Never breastfed – 94 Still breastfeeding - 95	Ever breastfed – 93 (93&95) Never breastfed – 94
Place of delivery	Where did you give birth to your baby?	HOMES – 10 Respondents home – 11 Other home – 12 PUBLIC SECTOR – 20 Govt. hospital – 21 Govt. health centre – 22 Govt. health post – 23 Other public – 26 PRIVATE SECTOR-30 Private hospital/clinic - 31 Other private medical -	Homes – 10 (11&12) Public hospitals – 20 (21-26) Private hospitals – 30 (31&36) Other places - 96

		36 OTHERS - 96	
Antenatal care	How many times did you receive antenatal care during pregnancy?	- No antenatal visit – 0 Don't know - 98	No visit – 0 (0&98) 1–3 visits – 1 4+ visits - 2
Postnatal care	Baby postnatal check-up within two months?	No – 0 Yes – 1 Don't know - 8	No – 0 (0 & 8) Yes – 1

Table 3.1 shows how all variables were operationalized and how some coding categories were adjusted. There is need for explanation about why some original codes were adjusted in this research. Note that column three shows the original codes of the variables in the Demographic and Health Survey datasets. Column four indicates the adjusted coding scheme for this research. The size of the child at birth was used as a proxy for birth weight because 70.6% of the children were not weighted at birth (NPC & ICF International, 2014). Also, all children whose size at birth were claimed to be unknown by their mothers were assumed to have an average size at birth (don't know = 0.5%). The argument is that if the size of the child at birth was very large or very small, the mother would know.

Also, the maternal age at birth was categorized in order to identify the effect of each age group within childbearing ages (15 – 49 years) on the risk of under-five deaths. Moreover, the ethnic group variable was re-categorized into only four groups because the interest of this research is on the three major ethnic groups in Nigeria, namely; Hausa/Fulani, Yoruba and Igbo. Other ethnic minorities were coded as others. For access to radio variable, all respondents who claimed not to be a de jure resident were assumed to have no access to radio (Not a de jure resident = 0.9%). Either a de jure resident or not, as long as the respondent slept in the household a night before the interview, they were eligible and expected to provide adequate information (NPC & ICF International, 2014). Therefore, if they had access to radio, they would have said it.

For breastfeeding, the ever breastfed but not currently breastfeeding children and ever breastfed and still breastfeeding children were combined to form a single variable termed ''ever breastfed children''. The duration of breastfeeding would have been used instead of breastfeeding status, but there is no information about duration of breastfeeding for both ever breastfed not currently breastfeeding and never breastfed children. Only still breastfeeding children have duration information.

Lastly, the categorization of number of antenatal visits during pregnancy is subject to the WHO recommendation of at least four times antenatal visits during pregnancy. All mothers who reported that they did not know the number of antenatal visits during pregnancy were assumed to have no antenatal visit during pregnancy (Don't know = 2.1%). Similarly, all women who claimed that they did not know if the baby had a postnatal check within two months after birth were assumed to have no baby postnatal check-up (Don't know = 0.1%). This is because the children under study are the most recent births before interview. Mothers were expected to remember whether or not they did postnatal check-up for the babies under study.

3.5 Reflections on data quality

The quality of Demographic and Health Survey data is very good. Several steps were taken by the organization in order to ensure the quality of the data. First, all copies of the questionnaires were entered twice. This was done in order to avoid coding and data entry errors. The Census and Survey Processing System (CSPro) software designed by United States Census Bureau specifically for census and survey data entering, editing, tabulating and disseminating was used to enter the data into the systems (NPC & ICF International, 2014).

Second, the Demographic and Health Survey data has high coverage. The selected sample is nationally representative. At least 943 households were selected for interview per state. There are 36 states and the Federal Capital Territory in Nigeria. Specifically, 38,948 women were selected for interview. Therefore, every state is included in the study. Third, the response rate from the women questionnaire is 97.6% (NPC & ICF International, 2014). The data used for this research were compiled from the women questionnaire. The 97.6% response rate achieved is very high and strengthens the data quality.

Fourth, the percentage of missing cases is extremely low. Many variables have no missing cases at all. Some variables have less than 1% missing cases (NPC & ICF International, 2014). Considering the above-stated factors, we can conclude that the Nigeria Demographic and Health Survey data have good quality and that the results obtained from the data analysis could be trusted to a large extent as long as the appropriate technique of analysis is used.

3.6 Ethical considerations

Some ethical issues had been taken care of by the Demographic and Health Survey before, during, and after the survey. For instance, the respondents' participation in the survey was voluntary. The informed consent statement was provided in front of the Nigeria Demographic and Health Survey women questionnaire (Phase IV). Ethical approvals were collected for information on highly confidential events such as under-five deaths (NPC & ICF International, 2014). The trust and confidentiality was highly maintained throughout this study. In addition, there is a plan to publish the findings of this research without any harm to the respondents. It is hoped that the outcome of this research will be beneficial to the respondents and other residents in Nigeria through policies interventions and foreign aids towards reduction in under-five mortality. As requested by the director of Demographic and Health Survey, the reports of the findings will be sent to them.

3.7 Data analysis

3.7.1 Descriptive analysis

Frequency distribution was used to describe each variable considered in this research. The count and percentage of each category for each variable is shown using this descriptive statistical method. Also, the Kaplan Meier descriptive method was used to run the survival curves for both sexes (males and females). The survival curve depicts the proportion of children that survive from one month to the other over the observation period (Yamagushi, 1991; Blossfeld & Rohwer, 2001; Norusis, 2008 & 2010). The Kaplan Meier method was employed because it can handle smaller unit of analysis adequately.

For this project, the time unit of analysis is months. In addition, the micro life table was used to run the hazard functions (curves) for both males and females because Kaplan Meier cannot produce hazard of en event. Kaplan Meier can produce only cumulative hazard but not hazard itself (Yamagushi, 1991; Blossfeld & Rohwer, 2001; Norusis, 2008 & 2010).

3.7.2 Explanatory analysis

Karl Pearson product moment correlation coefficient was used to show the strength of relationship between the continuous variables such as number of children ever born and the birth order of the child. This was done in order to check whether or not there is collinearity between the two continuous variables. Also, the cross-tabulation with chi-square statistic and asymptotic significance (p-value) was employed to show whether or not there exit an association between under-five death and the covariates. This was done because it is better to know before a model is built whether or not there is any association between under-five mortality and all explanatory variables to be included in the model.

The log minus log (LML) curve was plotted to check for proportionality of the hazard. Since it was assumed that all explanatory variables were constant over the observation period, the effect of each covariate on the risk of dying before age five should be constant over the study period (0 - 59 months) as well. So, the log minus log plot was used to determine whether or not the proportionality assumption is violated.

Finally, the Cox regression model was used to show the effect of each covariate on the risk of dying before age five. The Cox regression model was employed because for under-five mortality study within a certain time period like this research, timing is very important. The Cox model gives consideration for the timing of occurrence of an event (Yamagushi, 1991; Blossfeld & Rohwer, 2001; Norusis, 2008 & 2010). In this research, the event is under-five death. So, both single-covariate (bivariate) and multivariate cox regression models were run. The bivariate model was run to determine the effect of each covariate on the risk of dying before age five without controlling for the effects of other explanatory variable(s) included in the study. However, the multivariate model was finally run to show the effect of each covariate on the likelihood of dying before age five having controlled for the effects of other independent variables that were included in this research.

CHAPTER FOUR: RESULTS

4.1 Descriptive analysis

4.1.1 Percentage distribution of child and mother's background characteristics

Table 4.1 shows the frequencies and the percentages of each category of all variables included in this research. Out of 20,192 most recent births in the five years preceding the survey, 1,195 children (5.9%) died before their fifth birthday while the remaining 18,997 children (94.1%) survived above age five. The mean age at death for the children that died before their fifth birthday is 5.93 months with 8.32 standard deviation. This implies that most of the deaths among under-five children occur approximately around six months of age. The percentage distribution of child by sex indicates that both males and females births were almost equal within the observation periods; 50.5% and 49.5% respectively. Approximately two out of every five births (40.8%) had average size at birth. 30.5% of the children had a size at birth that was larger than average. Children with a very small birth size have the least representation (4.3%).

It can also be observed from Table 4.1 that 31.0% of the children were second and third born. This is followed by those whose birth order was above six (27.2%). The representations of fourth and fifth birth and first birth were 27.2% and 17.9% respectively. Also, the percentage distribution of maternal age at birth shows that majority of women gave birth to the children under study between age 20 and 34 years. 13.3% of the mothers delivered at age less than 20 years and 12.7% of the mothers gave birth between 35 and 39 years. Women who claimed to be above 40 years when they gave birth to their children were 6.3% of the total women.

The percentage distribution of women by their highest level of education shows that close to average of the total women had no education during observation periods (45.4%). This is followed by mothers whose highest levels of education were secondary and primary; 27.6% and 20.4% respectively. Women with higher education had the least representation (6.7%). Moreover, the distribution of women by their ethnic groups indicates that 38.5% of the women under study are from Hausa/Fulani major ethnic group, 12.0% are from Yoruba major ethnic group and 10.5% are from Igbo major ethnic group. The remaining 247 ethnic minorities accounts for 38.9% of the total women.

More than three out of every five women (67.3%) said that they have access to radio. Less than two out of every five women (32.6%) claimed that they did not have access to radio within observation periods (2008-2013). The distribution of women by the number of antenatal visits during pregnancy reveals that more than half of the women (52.0%) claimed that their number of antenatal visits during pregnancy is more than four times which is the recommendation of the World Health Organization. However, more than one out of every three women (35.1%) did not attend any antenatal care at all during pregnancy. The percentage of women who claimed to have between one and three antenatal visits is 12.3%. Looking at the place of delivery statistics, it can be observed that more three out of every five women (61.4%) delivered their babies at home. 25.3% and 13.0% of the women delivered their babies at the public and private hospitals respectively. Only few women claimed to have delivered their babies at other places (0.2%).

The percentage distribution of women by baby postnatal check-up within two months after delivery shows that majority of the women did not do postnatal check-up for their babies within two months after birth. More than four out of every six women (71.0%) did not do postnatal check-up for their babies within two months after birth. Only 28.6% of women did

postnatal check-up for their children within two months after birth. Lastly, the distribution of women by child breastfeeding status reveals that majority of women claimed that they ever breastfed their children (97.8%). Only 1.9% of women had never breastfed their children at all.

Table 4.1 Percentage distribution of child and mother's background characteristics in the five years preceding the survey for the most recent births, Nigeria 2013

Background characteristic	(N)	%
Mean age at death (SD) = 5.93 months (8.32)		
Child survival status		
Survive	18997	94.1
Dead	1195	5.9
Total	**20192**	**100.0**
Sex of the child		
Male	10200	50.5
Female	9992	49.5
Total	**20192**	**100.0**
Size of the child at birth		
Average	8230	40.8
Very large	2806	13.9
Larger than average	6153	30.5
Smaller than average	2076	10.3
Very Small	871	4.3
Missing cases	56	0.3
Total	**20192**	**100.0**
Birth Order		
1	3624	17.9
2 - 3	6250	31.0
4 - 5	4821	23.9
6+	5497	27.2
Total	**20192**	**100.0**
Age at birth (years)		
< 20 years	2693	13.3
20 - 24	4684	23.2
25 - 29	5194	25.7
30 - 34	3782	18.7
35 - 39	2561	12.7
40+	1278	6.3
Total	**20192**	**100.0**
Highest level of education		
No education	9171	45.4
Primary	4113	20.4
Secondary	5565	27.6
Higher	1343	6.7
Total	**20192**	**100.0**

Table 4.1 continued

Background characteristic	(N)	%
Ethnic group		
Hausa/Fulani	7768	38.5
Igbo	2112	10.5
Yoruba	2430	12.0
Others	7852	38.9
Missing cases	30	0.1
Total	**20192**	**100.0**
Access to radio		
No	6574	32.6
Yes	13593	67.3
Missing cases	25	0.1
Total	**20192**	**100.0**
Number of antenatal visits during pregnancy		
No visit	7082	35.1
1 - 3	2483	12.3
4+	10507	52.0
Missing cases	120	0.6
Total	**20192**	**100.0**
Place of delivery		
Home	12398	61.4
Public hospitals	5100	25.3
Private hospitals	2620	13.0
Other places	31	0.2
Missing system	43	0.2
Total	**20192**	**100.0**
Postnatal check-up within two months		
No	14328	71.0
Yes	5782	28.6
Missing cases	82	0.4
Total	**20192**	**100.0**
Breastfeeding status		
Never breastfed	385	1.9
Ever breastfed	19744	97.8
Missing cases	63	0.3
Total	**20192**	**100.0**

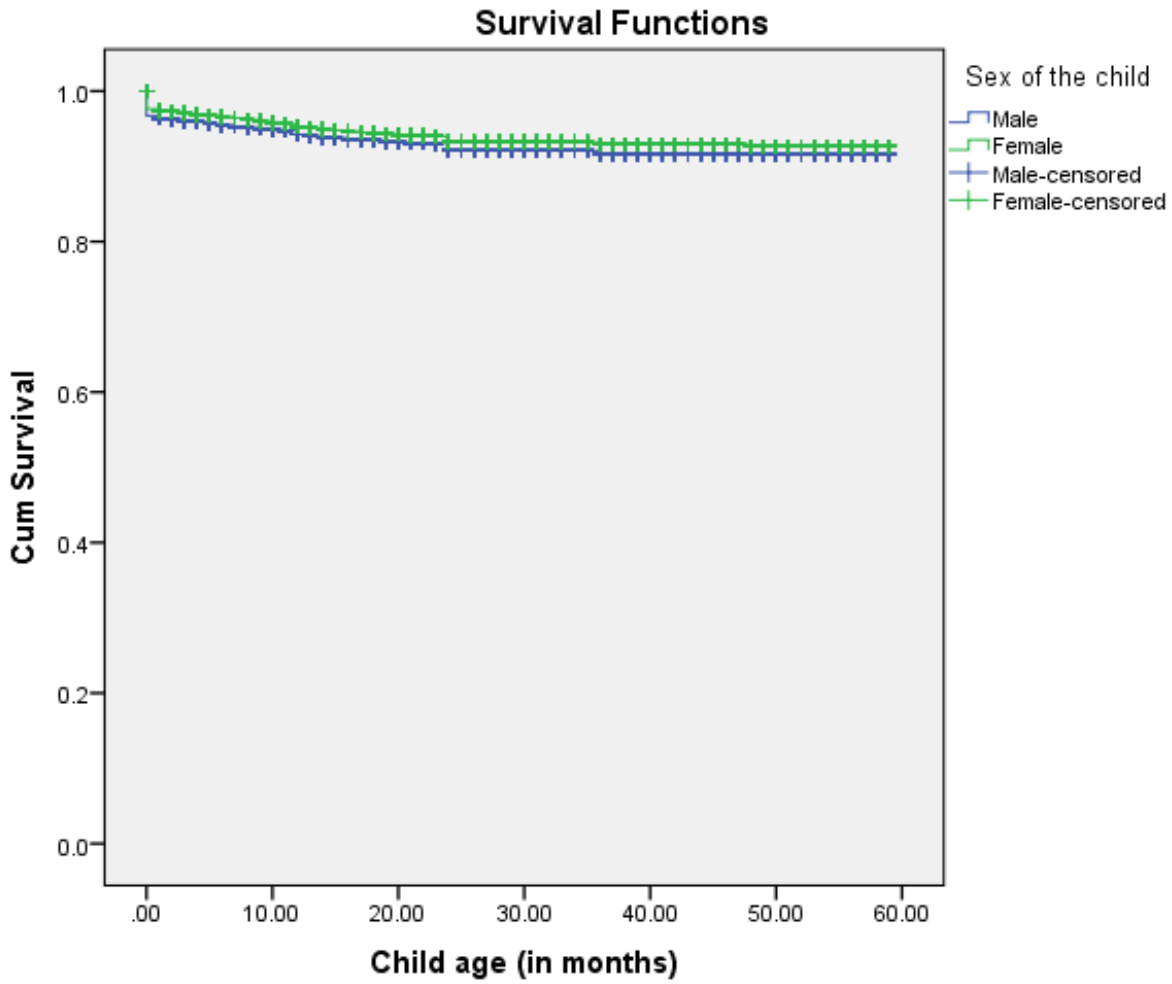
Source data: Nigeria Demographic and Health Survey, 2013.

4.1.2 Child sex and likelihood of surviving above age five

Figure 4.1 shows the survival curves for both male and female children in Nigeria. The male survival curve is below and relatively steeper than the female survival curve. This indicates that the under-five deaths occur relatively more among males than females. Female children have relatively higher likelihood to survive above age five than male children do. The Log Rank (Mantel-Cox) test of equality of survival distributions for male and female children

indicates that the difference between the two curves is statistically significant (p-value < 0.001). However, for both males and females, no death occurred after age 48 months.

Figure 4.1 A graph showing the survival functions for males and females children

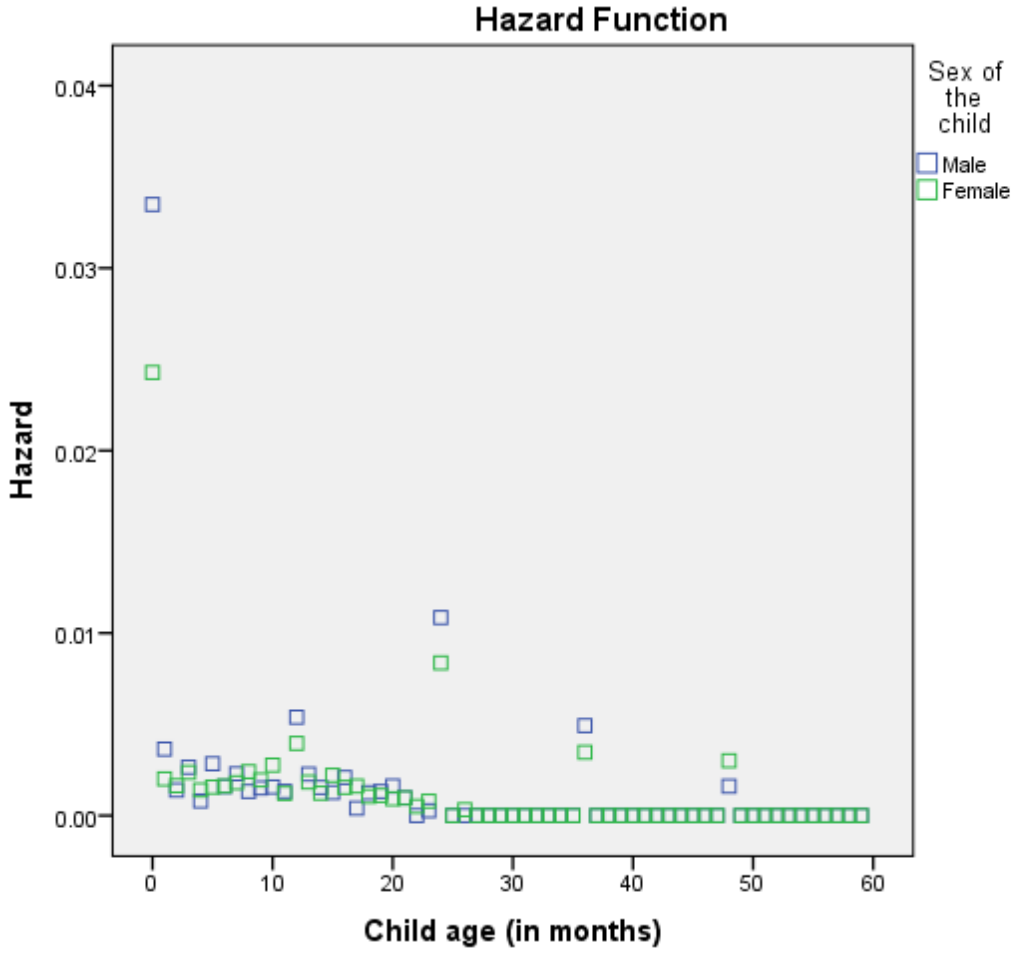


Source data: Nigeria Demographic and Health Survey, 2013.

4.1.3 Child sex and age at death

Figure 4.2 reveals that the hazard rate of under-five mortality is highest at age less than a month (at age 0) for both male and female children. Most of the under-five deaths occurred between age 0 and 24 months. Only few deaths occurred between age 24 and 48 months. After 48th month, no death was recorded among the under-five children. Also, figure 4.2 shows that the hazard of under-five death occurring is higher for male children in every month relative to female children. Female children have lower hazard rate of under-five mortality compared with male children. For both male and female under-five children, the hazard of dying is highest before first month birthday.

Figure 4.2 A graph showing the hazard functions for males and females children



Source data: Nigeria Demographic and Health Survey, 2013.

4.2 Cross-tabulation of child survival status and selected background characteristics

The cross-tabulation and chi-quare analysis was employed to examine whether or not there is significant association between child survival status and some selected background characteristics of children and their mothers. Table 4.2 shows that there is a statistically significant association between child survival status and all selected background characteristics except mother's access to radio. All p-values are less than 0.01 except access to radio whose p-value is 0.0503.

The cross-tabulation of child survival status and sex of the child indicates that 93.5% of the male children survived above age five and the remaining 6.5% of them died before age five. Whereas 94.6% of female children survived beyond their fifth birthday while the remaining 5.4% of them died before age five.

The cross-tabulation of child survival status and size of the child at birth indicates that children with very small size at birth have highest percentage of dead within the categories (10.3%). Whereas the percentages of larger than average and very large children at birth that died before age five are lowest compared with other categories (5.1% and 5.2% respectively). Higher survivors were recorded among children with large size at birth (either very large or larger than average). However, lower survivors were observed among children whose size at birth is smaller than average and very small.

Table 4.2 also reveals that children whose birth order category falls between 2 and 3 have largest percentage of survivors relative to other birth order categories (4.6%). However, higher percentage of children whose birth order is 6 and above died before their fifth birthday (7.8%). The cross-tabulation of maternal age at birth and child survival status indicates that mothers whose age at birth was between 25 and 29 years produced highest number of surviving children compared with other age groups. For mothers whose age at birth was 40 years and above, larger percentage of children died before age five (9.9%).

The association between maternal highest level of education and child survival status shows that mothers with no education gave birth to highest percentage of children that died before age five (6.9%). Only few children whose mothers have higher education level died before age five (3.6%). There is significant association between mothers education level and child survival status. The cross-tabulation of mothers ethnic group and child survival status reveals that 6.7% of children whose mothers's major ethnic group is Hausa/Fulani died before their fifth birthday. For igbo major ethnic group, 6.3% of the children died before age five. 4.0% of children from Yoruba major ethnic group died before their fifth birthday. 5.6% of children from other ethnic minorities died before age five. So, Hausa/Fulani major ethnic group have highest percentage of children that died before age five compared with other major and minor ethnic groups.

The cross-tabulation of mothers access to radio and child survival status shows that 6.4% of children whose mothers had no access to radio died before age five and 5.7% of children whose mothers had access to radio died before their fifth birthday. Although there is an association between mothers access to radio and child survival status but the association between the two variables is not statistically significant (p-value = 0.0503). Also, the number of antenatal visits during pregnancy is statistically associated with child survival status (p-value < 0.001). 7.4% of children whose mothers did not attend antenatal care at all died before age five. 5.8% of children whose mothers had between one and three antenatal visits during pregnancy died before age five and 4.9% of children whose mothers had four visits and above died before their fifth birthday.

The cross-tabulation of mothers place of delivery and child survival status reveals that 6.5% of children who were delivered at home died before age five. 4.6% of children whose mothers delivered at public hospitals died before age five and 4.9% of children whose mothers gave birth at private hospitals died before their fifth birthday. 6.5% of children whose mothers delivered at other places apart from home and hospitals died before age five. Moreover, the association between baby postnatal check-up within two months after birth and child survival status is statistically significant (p-value < 0.001). 6.6% of children who had no postnatal check-up within two months after birth died before age five. Whereas only 3.7% of children who had postnatal check-up within two months after birth died before their fifth birthday.

Lastly, the cross-tabulation of child breastfeeding status and child survival status indicates that 75.1% of children who had never received breast milk died before age five. However, 4.4% of children who had ever been breastfed died before their fifth birthday. The association between child breastfeeding status and child survival status is statistically significant (p-value < 0.001).

Table 4.2 Cross-tabulation of child survival status and selected background characteristics in the five years preceding the survey for the most recent births, Nigeria 2013

	Survival Status			
Variables	**Survive**	**Dead**	**Total**	**P value**
Sex of the child				**0.001**
Male	9542 (93.5%)	658 (6.5%)	10200 (100.0%)	
Female	9455 (94.6%)	537 (5.4%)	9992 (100.0%)	
Size of the child at birth				**0.000**
Average	7753 (94.2%)	477 (5.8%)	8230 (100.0%)	
Very large	2661 (94.8%)	145 (5.2%)	2806 (100.0%)	
Larger than average	5840 (94.9%)	313 (5.1%)	6153 (100.0%)	
Smaller than average	1933 (93.1%)	143 (6.9%)	2076 (100.0%)	
Very Small	781 (89.7%)	90 (10.3%)	871 (100.0%)	
Birth Order				**0.000**
1	3393 (93.6%)	231 (6.4%)	3624 (100.0%)	
2 - 3	5964 (95.4%)	286 (4.6%)	6250 (100.0%)	
4 - 5	4573 (94.9%)	248 (5.1%)	4821 (100.0%)	
6+	5067 (92.2%)	430 (7.8%)	5497 (100.0%)	
Age at birth (years)				**0.000**
< 20 years	2492 (92.5%)	201 (7.5%)	2693 (100.0%)	
20 - 24	4450 (95.0%)	234 (5.0%)	4684 (100.0%)	
25 - 29	4949 (95.3%)	245 (4.7%)	5194 (100.0%)	
30 - 34	3557 (94.1%)	225 (5.9%)	3782 (100.0%)	
35 - 39	2397 (93.6%)	164 (6.4%)	2561 (100.0%)	
40+	1152 (90.1%)	126 (9.9%)	1278 (100.0%)	
Highest level of education				**0.000**
No education	8542 (93.1%)	629 (6.9%)	9171 (100.0%)	
Primary	3846 (93.5%)	267 (6.5%)	4113 (100.0%)	
Secondary	5314 (95.5%)	251 (4.5%)	5565 (100.0%)	
Higher	1295 (96.4%)	48 (3.6%)	1343 (100.0%)	
Ethnic group				**0.000**
Hausa/Fulani	7244 (93.3%)	524 (6.7%)	7768 (100.0%)	
Igbo	1979 (93.7%)	133 (6.3%)	2112 (100.0%)	
Yoruba	2334 (96.0%)	96 (4.0%)	2430 (100.0%)	
Others	7413 (94.4%)	439 (5.6%)	7171 (100.0%)	
Access to radio				**0.050**
No	6154 (93.6%)	420 (6.4%)	6574 (100.0%)	
Yes	12819 (94.3%)	774 (5.7%)	13593 (100.0%)	

Table 4.2 continued

	Survival Status			
Variables	**Survive**	**Dead**	**Total**	**P value**
Number of antenatal visits during pregnancy				**0.000**
No visit	6559 (92.6%)	523 (7.4%)	7082 (100.0%)	
1 - 3	2338 (94.2%)	145 (5.8%)	2483 (100.0%)	
4+	9989 (95.1%)	518 (4.9%)	10507 (100.0%)	
Place of delivery				**0.000**
Home	11593 (93.5%)	805 (6.5%)	12398 (100.0%)	
Public hospitals	4865 (95.4%)	235 (4.6%)	5100 (100.0%)	
Private hospitals	2491 (95.1%)	129 (4.9%)	2620 (100.0%)	
Other places	29 (93.5%)	2 (6.5%)	31 (100.0%)	
Postnatal check-up within two months				**0.000**
No	13385 (93.4%)	943 (6.6%)	14328 (100.0%)	
Yes	5570 (96.3%)	212 (3.7%)	5782 (100.0%)	
Breastfeeding status				**0.000**
Never breastfed	96 (24.9%)	289 (75.1%)	385 (100.0%)	
Ever breastfed	18868 (95.6%)	876 (4.4%)	19744 (100.0%)	

Note: Missing cases were excluded from chi-square analysis

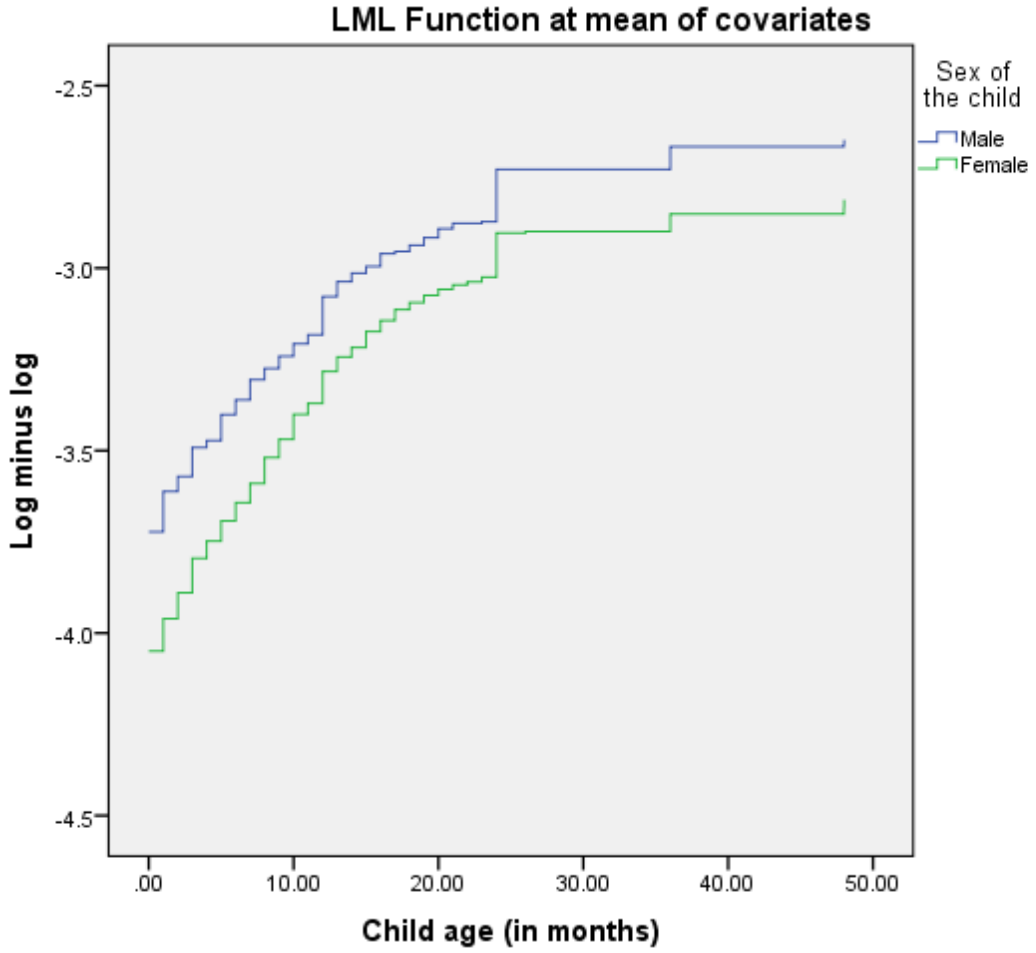
Source data: Nigeria Demographic and Health Survey, 2013

4.3. Test of proportionality of hazards

The hazard ratios obtained from the Cox regression model will be reliable if the proportionality assumption is not violated (Yamagushi, 1991; Blossfeld & Rohwer, 2001; Norusis, 2008 & 2010). This is the main requirement for the use of Cox proportional hazards model. In this research, it is assumed that the effects of all covariates on the risk of dying before age five are constant over time. One of the graphical methods to test if the hazards proportional model assumption is not violated is log minus log plot (Yamagushi, 1991; Blossfeld & Rohwer, 2001; Norusis, 2008 & 2010).

For the proportionality assumption to hold, the log minus log (LML) curves should be parallel. Figure 4.3 shows the LML plots for both male and female children. The two curves are almost parallel to each other. This indicates that the assumption of proportionality of hazards is not violated. The use of Cox regression model in this research is appropriate. Therefore, the hazard ratios obtained from the proportional hazards models are reliable to a large extent.

Figure 4.3 A graph showing the proportionality assumption of hazards



Source data: Nigeria Demographic and Health Surveys, 2013.

4.4. The effects of selected characteristics on the risk of dying before age five

The left-hand side of Table 4.3 shows the bivariate Cox regression outputs. The bivariate Cox regression models show the effect of each selected covariate on the risk of dying before age five without controlling for the effects of other covariates. So, in addition to the dependent variable (time until under-five death/censoring), only one covariate was included in the Cox regression model at a time in order to estimate the independent effect of each explanatory variable on the risk of dying before age five. However, the right-hand side of Table 4.3 contains the multivariate Cox regression results. In multivariate analysis, the effect of each covariate on the risk of dying before age five was modelled adjusting for the effects of all other covariates that were included in this research. So, the dependent variable and all covariates were jointly included in the multivariate Cox regression model simultaneously.

4.4.1. Without adjusting for the effects of other independent variables

Child related demographic factors and the risk of dying before age five

The left-hand side of Table 4.3 shows that the risk of dying before age five for a female child is 17.1% lower compared with a male child. A female child has a statistically significant lower likelihood of dying before age five relative to a male child (HR 0.829, 95% C.I; 0.740 – 0.929). Also, bivariate analysis of the effect of the size of the child at birth on the risk of dying before fifth birthday shows that a child with a very large size at birth has a statistically

insignificant 12.1% lower risk of dying before age five relative to a child with an average size at birth (HR 0.879, 95% C.I; 0.730 - 1.058).

Moreover, a child with a larger than average size at birth has a statistically insignificant 12.8% lower risk of dying before age five relative to a child with an average size at birth (HR 0.872, 95% C.I; 0.756 - 1.005). However, a child with a smaller than average size at birth has a statistically significant 22.2% higher risk of dying before age five relative to a child with an average size at birth (HR 1.222, 95% C.I; 1.014 - 1.473). Also, a child with a very small size at birth has a statistically significant 86.2% higher risk of dying before age five relative to a child with an average size at birth (HR 1.862, 95% C.I; 1.487 - 2.333). Overall, the effect of the size of the child at birth on the risk of dying before age five is statistically significant (p-value=0.000).

Table 4.3 also reveals that a child whose birth order falls between 2^{nd} and 3^{rd} has a statistically significant 30.0% lower risk of dying before age five compared with a firstborn child (HR 0.700, 95% C.I; 0.588 - 0.832). Also, a child whose birth order falls between 4^{th} and 5^{th} has a statistically significant 23.9% lower risk of dying before age five relative to a firstborn child (HR 0.761, 95% C.I; 0.636 - 0.911). In contrast, a child whose birth order is 6^{th} and above has a statistically significant 17.5% higher risk of dying before age five compared with a firstborn child (HR 1.175, 95% C.I; 1.001 – 1.379). The overall effect of birth order on the risk of dying before age five is statistically significant (p-value=0.000).

Maternal factors and the risk of dying before age five

On the one hand, the bivariate analysis of the effect of maternal age at birth on the risk of dying before fifth birthday indicates that a child whose mother's age at birth fell in age groups 20 to 34 years has a statistically significant lower risk of dying before age five relative to a child whose mother's age at birth was under 20 years. Similarly, a child whose mother's age at birth fell in age group 35-39 years has 18.3% lower risk of dying before age five relative to a child whose mother's age at birth was under 20 years but the effect is not statistically significant (HR 0.817, 95% C.I; 0.664 – 1.004). On the other hand, a child whose mother's age at birth was 40 years and above has a statistically significant 25.6% higher risk of dying before age five compared with a child whose mother's age at birth was under 20 years (HR 1.256, 95% C.I; 1.005 – 1.569). The overall effect of maternal age at birth on the risk of dying before age five is statistically significant (p-value=0.000).

Table 4.3 indicates that a child whose mother highest level of education was primary school has 6.9% lower risk of dying before age five relative to a child whose mother has no education but this effect is not statistically significant (HR 0.931, 95% C.I; 0.807 – 1.074). However, a child whose mother highest level of education was secondary school has a statistically significant 33.9% lower risk of dying before age five relative to a child whose mother has no education (HR 0.661, 95% C.I; 0.571 – 0.765). Also, a child whose mother highest level of education was higher education has a statistically significant 48.6% lower risk of dying before age five relative to a child whose mother has no education (HR 0.514, 95% C.I; 0.384 – 0.690). So, the higher the maternal highest level of education, the lower the likelihood that the child will die before age five. The overall effect of the maternal highest level of education on the risk of dying before age five is statistically significant (p-value=0.000).

It can also be observed from Table 4.3 that children from the Igbo major ethnic group, the Yoruba major ethnic group and other ethnic minorities have lower risk of dying before age five compared with children from the Hausa/Fulani major ethnic group. The effect of being

an Igbo child relative to being a Hausa/Fulani child on the risk of dying before fifth birthday is statistically insignificant (HR 0.935, 95% C.I; 0.773 – 1.131). But the effect of being a Yoruba child relative to being a Hausa/Fulani child on the risk of dying before age five is statistically significant (HR 0.555, 95% C.I; 0.447 – 0.690). Also, the effect of being a child from other ethnic minorities relative to being a Hausa/Fulani child on the risk of dying before age five is statistically significant (HR 0.809, 95% C.I; 0.713 – 0.918). The overall effect of ethnic group on the risk of dying before fifth birthday is statistically significant (p-value=0.000).

Access/health related factors and the risk of dying before age five

The bivariate analysis of the effect of mother's access to radio on the risk of dying before age five shows that children whose mothers had access to radio have statistically significant 11.6% lower risk of dying before age five relative to children whose mothers had no access to radio (HR 0.884, 95% C.I; 0.785 – 0.995). For the number of antenatal visits during pregnancy, a child whose mother had no antenatal visit during pregnancy has a statistically significant 51.0% higher risk of dying before age five relative to a child whose mother had at least four antenatal visits during pregnancy (HR 1.510, 95% C.I; 1.337 – 1.705). Also, a child whose mother had between 1 and 3 antenatal visits during pregnancy has a statistically significant 24.2% higher risk of dying before age five compared with a child whose mother had at least four antenatal visits during pregnancy (HR 1.242, 95% C.I; 1.033 – 1.493).

Table 4.3 also reveals that a child who was delivered at the public hospital has a statistically significant 30.0% lower risk of dying before age five relative to a child who was delivered at home (HR 0.700, 95% C.I; 0.605 – 0.810). Similarly, a child who was delivered at the private hospital has a statistically significant 25.4% lower risk of dying before age five compared with a child who was delivered at home (HR 0.746, 95% C.I; 0.620 – 0.899). However, a child who was delivered at other places has 3.7% higher risk of dying before fifth birthday relative to a child who was delivered at home but the effect of this category is not statistically significant (HR 1.037, 95% C.I; 0.259 – 4.152).

The bivariate analysis of effect of baby postnatal check-up within two months after birth on the risk of dying before age five shows that a child who did receive a postnatal check-up within two months after birth has a statistically significant 46.8% lower risk of dying before age five relative to a child who did not receive a postnatal check-up within two months after birth (HR 0.532, 95% C.I; 0.459 – 0.618). Table 4.3 also indicates that a child who had ever received breast milk has 96.3% lower risk of dying before age five relative to a child who had never received breast milk. Ever breastfed children have much more lower likelihood to die before age five compared with never breastfed children (HR 0.037, 95% C.I; 0.032 – 0.042).

4.4.2. Adjusting for the effects of other independent variables

Child related demographic factors and the risk of dying before age five

After controlling for the effects of all covariates included in this research, it can be observed from the right-hand side of Table 4.3 that the effect of sex of the child on the risk of dying before age five is still statistically significant. A female child has a statistically significant 16.6% lower risk of dying before age five compared with a male child (HR 0.834, 95% C.I; 0.742 – 0.938). Similarly, a child with a very small size at birth has a statistically significant 40.7% higher risk of dying before age five relative to a child with an average size at birth after the adjustment for the effects of other covariates in the model (HR 1.407, 95% C.I; 1.119 – 1.769). A child with a smaller than average size at birth has 17.1% higher risk of

dying before age five relative to a child with an average size at birth, but this effect is not statistically significant (HR 1.171, 95% C.I; 0.968 – 1.418).

However, a child with a very large size at birth has a statistically insignificant 2.5% lower risk of dying before age five relative to a child with an average size at birth (HR 0.975, 95% C.I; 0.806 – 1.178). Also, a child with a larger than average size at birth has a statistically insignificant 8.9% lower risk of dying before age five relative to a child with an average size at birth (HR 0.911, 95% C.I; 0.788 – 1.053). The overall effect of the size of the child at birth on the risk of dying before age five after controlling for the effects of other independent variables is still statistically significant (p-value=0.003).

After controlling for the effects of other explanatory variables in the model, a child whose birth order falls between 2^{nd} and 3^{rd} births has a statistically insignificant 15.4% lower risk of dying before age five compared with a firstborn child (HR 0.846, 95% C.I; 0.696 – 1.028). Also, a child whose birth order falls between 4^{th} and 5^{th} births has a statistically insignificant 9.8% lower risk of dying before age five relative to a firstborn child (HR 0.902, 95% C.I; 0.712 – 1.144). Although a child whose birth order is 6^{th} and above has 3.8% higher risk of dying before age five compared with a firstborn child but this effect is not statistically significant (HR 1.038, 95% C.I; 0.796 – 1.354). The overall effect of birth order on the risk of dying before age five is statistically insignificant after adjusting for the effects of other explanatory variables (p-value=0.110).

Maternal factors and the risk of dying before age five

Having adjusted for the effects of other predictors of under-five mortality in the multivariate model, a child whose mother's age at birth fell in age group 20 to 24 years has a statistically significant 30.6% lower risk of dying before age five relative to a child whose mother's age at birth was under 20 years (HR 0.694, 95% C.I; 0.561 – 0.859). Also, a child whose mother's age at birth fell in age group 25 to 29 years has a statistically significant 30.2% lower risk of dying before age five relative to a child whose mother's age at birth was under 20 years (HR 0.698, 95% C.I; 0.547 – 0.889). Although a child whose mother's age at birth fell in age group 30-34 years has 18.5% lower risk of dying before age five relative to a child whose mother's age at birth was under 20 years, but this effect is not statistically significant (HR 0.815, 95% C.I; 0.620 – 1.070).

Likewise, a child whose mother's age at birth fell in age group 35-39 years has a statistically insignificant 24.4% lower risk of dying before age five compared with a child whose mother's age at birth was under 20 years (HR 0.756, 95% C.I; 0.561 – 1.019). In contrast, a child whose mother's age at birth was 40 years and above has 2.7% higher risk of dying before age five compared with a child whose mother's age at birth was under 20 years, but the effect of this age group is not statistically significant (HR 1.027, 95% C.I; 0.745 – 1.415). The overall effect of maternal age at birth on the risk of dying before age five is still statistically significant (p-values=0.000).

After the adjustment for the effects of other covariates in the model, a child whose mother highest level of education was primary has 4.1% lower risk of dying before age five relative to a child whose mother has no education, but the effect of primary education compared with no education is not statistically significant (HR 0.959, 95% C.I; 0.810 – 1.136). However, a child whose mother highest level of education was secondary has a statistically significant 19.6% lower risk of dying before age five relative to a child whose mother has no education (HR 0.804, 95% C.I; 0.663 – 0.976). Similarly, a child whose mother highest level of education was higher education has a statistically significant 30.5% lower risk of dying

before age five relative to a child whose mother has no education (HR 0.695, 95% C.I; 0.492 – 0.983). The overall effect of maternal highest level of education on the risk of dying before age five is statistically insignificant due to increase in level of insignificance of the effect of primary education compared with no education in the multivariate model (p-value=0.064).

Furthermore, a child from the Igbo major ethnic group has a statistically insignificant 6.0% higher risk of dying before age five compared with children from Hausa/Fulani major ethnic group (HR 1.060, 95% C.I; 0.829 – 1.354). In contrast, a child from the Yoruba major ethnic group has a statistically insignificant 8.8% lower risk of dying before age five relative to a child from Hausa/Fulani major ethnic group (HR 0.912, 95% C.I; 0.700 – 1.188). Also, a child from other ethnic minorities has a statistically insignificant 8.1% lower risk of dying before age five relative to a child from Hausa/Fulani major ethnic group (HR 0.919, 95% C.I; 0.793 – 1.066). The overall effect of maternal ethnic group on the risk of dying before age five is statistically insignificant in the multivariate model (p-value=0.426).

Access/health related factors and the risk of dying before age five

After adjusting for the effects of other explanatory variables in the model, the direction of the effect of mother's access to radio on the risk of dying before age five changed and became statistically insignificant. A child whose mother had access to radio has 5.6% higher risk of dying before fifth birthday relative to a child whose mothers had no access to radio, but this effect is statistically insignificant (HR 1.056, 95% C.I; 0.931 – 1.198).

For the number of antenatal visits during pregnancy, a child whose mother had no antenatal visit during pregnancy has a statistically insignificant 3.5% higher risk of dying before age five relative to a child whose mother had at least four antenatal visits during pregnancy (HR 1.035, 95% C.I; 0.887 – 1.206). Also, a child whose mother had between 1 and 3 antenatal visits during pregnancy has a statistically insignificant 3.5% higher risk of dying before age five relative to a child whose mother had at least four antenatal visits during pregnancy (HR 1.035, 95% C.I; 0.852 – 1.257). The overall effect of number of antenatal visits during pregnancy on the risk of dying before age five is statistically insignificant in the adjusted model (p-value=0.896).

After the adjustment for the effects of other covariates included in the model, a child who was delivered at the public hospital has a statistically significant 16.8% lower risk of dying before age five relative to a child who was delivered at home (HR 0.832, 95% C.I; 0.697 – 0.993). Also, a child who was delivered at the private hospital has 6.3% lower risk of dying before age five relative to a child who was delivered at home, but the effect of private hospital delivery compared with home delivery is not statistically significant (HR 0.937, 95% C.I; 0.741 – 1.184). However, a child who was delivered at other places has a statistically insignificant 8.6% higher risk of dying before fifth birthday relative to a child who was delivered at home (HR 1.086, 95% C.I; 0.269 – 4.378). The overall effect of place of delivery on the risk of dying before age five is statistically insignificant (p-value=0.896).

Moreover, having controlled for the effects of other predictors in the model, a child who did receive a baby postnatal check-up within two months after birth has a statistically significant 30.8% lower risk of dying before age five compared with a child who did not receive a baby postnatal check-up within two months after birth (HR 0.692, 95% C.I; 0.587 – 0.815). Lastly, despite the adjustments for the effects of other independent variables in the model, an ever breastfed child has a statistically significant 96.2% much more lower risk of dying before age five relative to a never breastfed child (HR 0.038, 95% C.I; 0.033 – 0.043).

Table 4.3 Bivariate and multivariate results from Cox regression models showing the effects of selected child and maternal characteristics on the risk of dying before age five in the five years preceding the survey for the most recent births, Nigeria 2013

Variables	Bivariate (unadjusted model)			Multivariate (adjusted model)		
	Hazard ratio (HR)	95% C.I for HR	P-value	Hazard ratio (HR)	95% C.I for HR	P-value
Sex of the child						
Male (reference)						
Female	0.829	0.740 - 0.929	0.001	0.834	0.742 - 0.938	0.002
Size of the child at birth			**0.000**			**0.003**
Average (reference)						
Very large	0.879	0.730 - 1.058	0.172	0.975	0.806 - 1.178	0.790
Larger than average	0.872	0.756 - 1.005	0.059	0.911	0.788 - 1.053	0.206
Smaller than average	1.222	1.014 - 1.473	0.036	1.171	0.968 - 1.418	0.104
Very small	1.862	1.487 - 2.333	0.000	1.407	1.119 - 1.769	0.003
Birth Order			**0.000**			**0.110**
1 (reference)						
2 - 3	0.700	0.588 - 0.832	0.000	0.846	0.696 - 1.028	0.092
4 - 5	0.761	0.636 - 0.911	0.003	0.902	0.712 - 1.144	0.395
6+	1.175	1.001- 1.379	0.048	1.038	0.796 - 1.354	0.783
Maternal age at birth (years)			**0.000**			**0.000**
< 20 years (reference)						
20 - 24	0.669	0.554 - 0.808	0.000	0.694	0.561 - 0.859	0.001
25 - 29	0.634	0.526 - 0.764	0.000	0.698	0.547 - 0.889	0.004
30 - 34	0.781	0.646 - 0.945	0.011	0.815	0.620 - 1.070	0.141
35 - 39	0.817	0.664 - 1.004	0.054	0.756	0.561 - 1.019	0.066
40+	1.256	1.005 - 1.569	0.045	1.027	0.745 - 1.415	0.871
Highest level of education			**0.000**			**0.064**
No education (reference)						
Primary	0.931	0.807 - 1.074	0.328	0.959	0.810 - 1.136	0.631

Table 4.3 continued

Variables	Bivariate (unadjusted model)			Multivariate (adjusted model)		
	Hazard ratio (HR)	**95% C.I for HR**	**P-value**	**Hazard ratio (HR)**	**95% C.I for HR**	**P-value**
Secondary	0.661	0.571 - 0.765	0.000	0.804	0.663 - 0.976	0.028
Higher	0.514	0.384 - 0.690	0.000	0.695	0.492 - 0.983	0.040
Ethnic group			**0.000**			**0.426**
Hausa/Fulani (reference)						
Igbo	0.935	0.773 - 1.131	0.488	1.060	0.829 - 1.354	0.643
Yoruba	0.555	0.447 - 0.690	0.000	0.912	0.700 - 1.188	0.495
Others	0.809	0.713 - 0.918	0.001	0.919	0.793 - 1.066	0.264
Access to radio						
No (reference)						
Yes	0.884	0.785 - 0.995	**0.042**	1.056	0.931 - 1.198	**0.397**
Number of antenatal visits during pregnancy			**0.000**			**0.896**
4+ visits (reference)						
No visit	1.510	1.337 - 1.705	0.000	1.035	0.887 - 1.206	0.665
1 - 3 visits	1.242	1.033 - 1.493	0.021	1.035	0.852 - 1.257	0.730
Place of delivery			**0.000**			**0.230**
Home (reference)						
Public hospitals	0.700	0.605 - 0.810	0.000	0.832	0.697 - 0.993	0.042
Private hospitals	0.746	0.620 - 0.899	0.002	0.937	0.741 - 1.184	0.584
Other places	1.037	0.259 - 4.152	0.959	1.086	0.269 - 4.378	0.908
Postnatal check-up within two months						
No (reference)						
Yes	0.532	0.459 - 0.618	**0.000**	0.692	0.587 - 0.815	**0.000**
Breastfeeding status						
Never breastfed (reference)						
Ever breastfed	0.037	0.032 - 0.042	**0.000**	0.038	0.033 - 0.043	**0.000**

Note: Missing cases were excluded from analysis
Source data: Nigeria Demographic and Health Survey, 2013

CHAPTER FIVE: CONCLUSION AND DISCUSSION

5.1 Summary of the main findings and conclusions

This research examined the effects of child related demographic factors, maternal factors and access/health related factors on the risk of dying before age five in Nigeria. Out of 20,192 most recent births in the five years preceding the survey, 1,195 children (5.9%) died before their fifth birthday while 18,997 children (94.1%) survived above age five. The mean age at death among the under-five children is 5.93 months. The hazard rate of under-five mortality is highest at age 0 for both male and female children. Most of the under-five deaths in Nigeria occurred between age 0 and 24 months. Other findings were summarized and concluded under the following sub-research questions based on multivariate Cox regression results (the adjusted model).

What are the effects of child related demographic factors on the risk of dying before age five in Nigeria?

A female child was found to have a statistically significant lower risk of dying before age five relative to a male child in Nigeria (HR 0.834, 95% C.I; 0.742 – 0.938). Also, a child with a very small size at birth was discovered to have a statistically significant higher risk of dying before fifth birthday compared with a child who has an average size at birth (HR 1.407, 95% C.I; 1.119 – 1.769). Although a child with a very large size at birth was found to have a lower risk of dying before age five relative to a child who has an average size at birth, the effect of this category is not statistically significant. The overall effect of the size of the child at birth on the risk of dying before age five is statistically significant (p-value=0.003).

Moreover, 2^{nd} to 3rd, and 4^{th} to 5^{th} birth order children were discovered to have a statistically insignificant lower risk of dying before age five relative to first-born children. However, a 6^{th} and above birth order child has a higher risk of dying before fifth birthday compared with a first-born child, but this effect is not statistically significant. The overall effect of birth order on the risk of dying before age five is not statistically significant (p-value=0.110). Therefore, it can be concluded that sex of the child and the size of the child at birth have statistically significant effects on the risk of dying before age five in Nigeria. However, birth order of the child has statistically insignificant effect on the risk of dying before age five in Nigeria.

What are the effects of maternal factors on the risk of dying before age five in Nigeria?

A child whose mother's age at birth fell in the age group 20 to 24 years was found to have a statistically significant lower risk of dying before age five relative to a child whose mother's age at birth was under 20 years (HR 0.694, 95% C.I; 0.561 – 0.859). Also, a child whose mother's age at birth fell in the age group 25 to 29 years was discovered to have a statistically significant lower risk of dying before age five relative to a child whose mother's age at birth was under 20 years (HR 0.698, 95% C.I; 0.547 – 0.889). Although a child whose mother's age at birth fell in the age group 30-39 years was found to have a lower risk of dying before fifth birthday relative to a child whose mother's age at birth was under 20 years, this effect is not statistically significant. In contrast, a child whose mother's age at birth was 40 years and above was discovered to have a statistically insignificant higher risk of dying before age five compared with a child whose mother's age at birth was under 20 years. The overall effect of maternal age at birth on the risk of dying before age five is statistically significant (p-values=0.000).

Also, it was discovered that a child whose mother's highest level of education was secondary has a statistically significant lower risk of dying before age five relative to a child whose mother has no education (HR 0.804, 95% C.I; 0.663 – 0.976). Also, a child whose mother's highest level of education was higher education was found to have a statistically significant lower risk of dying before age five relative to a child whose mother has no education (HR 0.695, 95% C.I; 0.492 – 0.983). However, a child whose mother highest level of education was primary school has statistically insignificant lower risk of dying before age five compared with a child whose mother has no education. The overall effect of maternal highest level of education on the risk of dying before age five is statistically insignificant due to increase in level of insignificance of the effect of primary education compared with no education in the multivariate model (p-value=0.064).

Children from the Igbo major ethnic group were found to have a statistically insignificant higher risk of dying before age five compared with children from the Hausa/Fulani major ethnic group. Although children from the Yoruba major ethnic group and the other ethnic minorities were found to have a lower risk of dying before age five relative to children from the Hausa/Fulani major ethnic group, the effects of these ethnic groups are not statistically significant. The overall effect of ethnic group on the risk of dying before fifth birthday is not statistically significant (p-value=0.426). Hence, it can be concluded that maternal age at birth, secondary and higher levels of education have statistically significant effects on the risk of dying before age five in Nigeria. Whereas maternal primary level of education and ethnic group have statistically insignificant effects on the risk of dying before age five in Nigeria.

What are the effects of access/health related factors on the risk of dying before age five in Nigeria?

It was discovered that a child who was delivered at the public hospital has a statistically significant lower risk of dying before age five compared with a child who was delivered at home (HR 0.832, 95% C.I; 0.697 – 0.993). Although a child who was delivered at the private hospital has a lower risk of dying before age five relative to a child who was delivered at home, this effect is statistically insignificant. A child who was delivered at other places has a statistically insignificant higher risk of dying before fifth birthday relative to a child who was delivered at home. The overall effect of place of delivery on the risk of dying before age five is not statistically significant (p-value=0.230).

Furthermore, it was found that a child who did receive a baby postnatal check-up within two months after birth has a statistically significant lower risk of dying before age five relative to a child who did not receive a baby postnatal check-up within two months after birth (HR 0.692, 95% C.I; 0.587 – 0.815). It was also found that an ever breastfed child has a much more statistically significant lower risk of dying before age five compared with a never breastfed child (HR 0.038, 95% C.I; 0.033 – 0.043).

Moreover, it was discovered that a child whose mother had either no antenatal visit or between 1 and 3 antenatal visits during pregnancy has a statistically insignificant higher risk of dying before age five relative to a child whose mother had at least four antenatal visits during pregnancy. The overall effect of number of antenatal visits during pregnancy on the risk of dying before age five is not statistically significant (p-value=0.896). Also, it was discovered that children whose mothers had access to radio have statistically insignificant higher risk of dying before fifth birthday relative to children whose mothers had no access to radio.

Therefore, it can be concluded that public hospital delivery, baby postnatal check-up within two months after birth and child breastfeeding status have statistically significant effects on the risk of dying before age five in Nigeria. However, private hospital and other places of delivery, number of antenatal visits during pregnancy and access to radio have statistically insignificant effects on the risk of dying before age five in Nigeria.

5.2 Discussions

It was discovered that a female child has a statistically significant lower risk of dying before age five compared with a male child in Nigeria. This result is consistent with the results obtained by previous studies in Nigeria (Adedini, 2014). The reason for this result might be natural and biological. The result obtained is not surprising. Also, it was found that the size of the child at birth has a statistically significant effect on the risk of under-five mortality in Nigeria. This result is also in agreement with the findings of previous researchers in Nigeria (Kayode et al., 2012). A low birth weight might expose the child to several diseases like sepsis and other deadly diseases among children. A very low birth weight has been discovered to be one of the consequences of preterm birth (WHO, 2013). Nigeria is a developing country. It is not uncommon in such a developing country to have higher percentage of malnourished mothers. The level of nutrition of mothers during pregnancy might affect the size of the child at birth (weight).

Also, children whose mothers gave birth between 20 and 39 years were found to have lower risk of dying before age five relative to children whose mothers gave birth at the age under 20 years. This result is in line with previous findings (Ayotunde et al., 2009). One possible reason for this is that mothers who are less than 20 years might not mature enough psychologically to take good care of a newborn baby. In addition, for mothers who gave birth at age 40 years and above, their children have higher risk of under-five mortality probably because these people are very close to menopause. They are likely to give birth to a preterm baby. Medically, it is not advisable for a mother to give birth especially above age 45 or 49 years. Preterm birth is one of the leading causes of under-five mortality in developing countries (WHO, 2013).

Children whose mothers have secondary or higher education were discovered to have lower risk of dying before age five relative to children whose mothers have no education in Nigeria. This result coincides with the results from previous research (Nakamura et al., 2011). Women who have at least secondary education might adhere more carefully to child health related information than those without education. The health seeking behaviour of women with higher education is higher than that of those with no education. A child whose mother's health seeking behaviour is above average has lower risk of under-five mortality (Kayode et al., 2011). So, all these factors will have negative effects on the mothers during pregnancy and consequently on the child after birth.

Furthermore, it was discovered that doing postnatal check-up for the baby within two months after birth significantly reduce the risk of dying before age five in Nigeria. This result strengthens reasons for the compliance to WHO recommendations for the first baby postnatal check-up within first day of birth with follow-up contact at latest after three weeks. Although no previous research has ever looked at the effect of baby postnatal check-up within two months after birth on the risk of under-five mortality in Nigeria (to the best of my knowledge), women health seeking behaviour has been found to have a statistically significant effect on the risk of under-five mortality in Nigeria (Kayode et al., 2011).

Moreover, ever breastfed child has been found to have a statistically significant much more lower risk of dying before age five compared with never breastfed child. This result is not new. Several studies have confirmed this finding some years ago (Nakamura et al., 2011; Kayode et al., 2012). Duration of breastfeeding could have been looked at by this research but the 2013 DHS dataset does not contain information on duration of breastfeeding for all children. Only still breastfeeding children have duration information.

However, although the effect of birth order of the child on the risk of dying before age five is not statistically significant, the results obtained disagree with one of the previous findings (Kayode et al., 2012). Previous studies observed that the higher the birth order, the higher the under-five mortality. Whereas in this project, it was observed that from 2^{nd} to 5^{th} birth order the risk of dying before age five is lower compared to first birth order. But for 6^{th} and higher birth order, the risk of dying before age five is higher compared to first birth order. The difference in the direction of the effect of birth order on under-five mortality risk might be because of variable categorization. For example, one researcher categorized birth order as 1, (2, 3 & 4) and 5+. Whereas the categories of birth order in this study is 1, 2-3, 4-5, and 6+ to avoid clustering in one group.

Though the effect of ethnicity on the risk of under-five mortality is not statistically significant, possible reasons for the direction of the results obtained could be explained. Children from the Yoruba major ethnic group was found to have lower risk of dying before age five compared with the Hausa/Fulani major ethnic group. One of the reasons for this result might be because most of Hausa/Fulani women do not go to school. Most of Hausa/Fulani women have no or primary education. Whereas most of the Yoruba women have at least secondary education. As discussed above, women education is very important to child survival. No previous research has ever looked at the effect of ethnic group on under-five mortality in Nigeria (to the best of my knowledge). Nevertheless, the result is not surprising.

It was discovered that at least four antenatal visits during pregnancy reduces the risk of dying before age five in Nigeria. Although the effect of this variable is not statistically significant, but the result obtained strengthens reasons for the compliance to WHO recommendations for at least four antenatal visits during pregnancy. No previous research has ever looked at the effects of number of antenatal visits during pregnancy on the risk of under-five mortality in Nigeria.

Lastly, children whose mothers had access to radio were found to have higher risk of dying before age five compared with children whose mothers had no access to radio. Even though the effect of this determinant is not statistically significant, the result obtained was unexpected. The expectation was that mothers' access to radio would reduce under-five mortality risk through relevant and timely information gathering. But contrary result was found. No previous research has ever looked at the effect of access to radio on the risk of under-five mortality in Nigeria (to the best of my knowledge). This result needs further investigations.

5.3 Limitations of the research

This research used a cross-sectional dataset to estimate the effects of some selected characteristics, both time-constant and time-varying covariates, on the risk of dying before age five in Nigeria. The longitudinal dataset would have been used instead of cross-sectional dataset but the longitudinal data was not available. The use of longitudinal data will allow us to see how time-dependent variables, for instance, maternal level of education, vary over the

observation period. Therefore, the hazard proportional model (Cox regression) was used because the longitudinal dataset was not available. All time-varying independent variables were assumed constant throughout the study period. Whereas the use of discrete-time logistic regression model would have been better if longitudinal data were available. The discrete-time logistic regression model handles both time-constant and time-varying covariates appropriately without any assumption of proportionality over the observation period.

In addition, a single multivariate model was developed in this research due to limited time used to conduct the research. Whereas it would have been better if several multivariate models were developed with different adjustments in order to see how the effects of some covariates will change in different models. Moreover, because of the time, few literature were used to support the argument in the discussion part. More literature would have been reviewed if the time used to conduct the research was longer.

5.4 Recommendations

Considering the findings from this study, the following suggestions were raised for both policy makers and subsequent researchers in Nigeria.

Recommendations for policy makers

First, it is suggested that all women should be sensitized on the effects of giving birth at early and later ages, especially at age less than 20 years and above 40 years. Health talks can be included in the school curricular especially at primary and secondary levels. The health workers could also be instructed to pass the information to the mothers during hospital visits. Second, government should try to make antenatal and postnatal cares to be more accessible to an average resident in Nigeria. This could be done by making the hospital services free or highly subsidized. Third, it was observed that some mothers do not breastfeed their babies in Nigeria. It is possible that those mothers are HIV patients. The HIV/AIDS adult prevalence rate in Nigeria is 3.1%. They may not breastfeed their babies in order to avert mother-to-child transmission of HIV/AIDS. So, if that is the case, a targeted and more focused care should be given to those children that do not receive breast milk.

Recommendations for subsequent researchers

First, it is good to look at the effects of some risk factors that were discovered in this study for consistency checks. Such factors include mothers' ethnic group, access to radio, number of antenatal visits during pregnancy and baby postnatal check-up within two months after birth. Second, the effects of some variables like mothers' behavioural lifestyle during pregnancy and after birth on the risk of under-five mortality could be investigated. Information on mothers smoking habits and alcohol consumption during pregnancy and after birth could be found in 2013 DHS datasets. Third, it was observed from the hazard curves that most of the deaths among children occurred between age 0 and 24 months.

It is suggested that separate models be constructed for neonatal, infant, child and under-five mortality in Nigeria. This is expected to answer some research questions like which type of children is mostly affected by which risk factor(s) in Nigeria. Also, the use of survival and hazard analysis is recommended for under-five mortality study that is highly time-dependent. If longitudinal data are available, the discrete-time logistic regression is recommended. If not, Cox regression model is recommended for under-five mortality study instead of binary or multinomial logistic regression that do not account for timing of occurrence of the event.

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APPENDIX 1 Gantt chart for the execution of the master thesis