# BIRTH SPACING AND CHILD HEALTH IN CORE NORTHERN NIGERIA

BY

AKINWALE OMOLARA LATEEFAT
B.Sc. DEMOGRAPHY AND SOCIAL STATISTICS (OAU)
MATRIC NUMBER: 196479

A DISSERTATION SUBMITTED TO
THE DEPARTMENT OF EPIDEMIOLOGY AND MEDICAL STATISTICS,
FACULTY OF PUBLIC HEALTH, COLLEGE OF MEDICINE,
UNIVERSITY OF IBADAN.

IN PARTIAL FULFILMENT OF
THE REQUIREMENT FOR THE AWARD OF
MASTERS OF PUBLIC HEALTH DEGREE IN MEDICAL DEMOGRAPHY
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## CERTIFICATION

I certify that this project was carried out under my supervision by AKINWALE Omolara Lateefat, in the Department of Epidemiology and Medical Statistics (Medical Demography), College of Medicine, University of Ibadan, Ibadan.

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# DEDICATION

To Almighty Allah; the most Gracious, Merciful and ever dependable.

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# ACKNOWLEDGEMENTS

I give all thanks and glory to Almighty Allah for His mercies bestowed on me in the course of this programme. It is not by my ability or power but to the glory of God the provider, the giver and the sufficient.

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## ABSTRACT

Short birth interval is known to adversely affect infant and childhood mortality, and also can impede childhood nutrition repletion in low-income settings like Nigeria. The effects of the length of time between pregnancies on subsequent childhood morbidity and childhood mortality require careful assessment. Short birth spacing has been shown to be related to poor child health. The Northern region in Nigeria is characterized with the highest; childhood mortality, high fertility and undernourished children. Unfortunately, immunization is lowest in the core North among all regions in Nigeria. This study was designed to access birth spacing pattern and relationship between birth spacing and child health in core north Nigeria.

The Nigeria Demographic and Health Survey (NDHS) 2013 data was utilized in this study. Data were extracted from the complete child dataset and with focus on 17,353 women resident in core north Nigeria. The key independent variable is the length of the preceding birth interval measured as the number of months between the most recent birth and the immediately preceding birth to the mother. The birth spacing pattern was assessed among the women who have had at least a child. The dataset was weighted and analyzed using descriptive statistics and Chi-square. Further analyses were carried out using binary logistic regression, cox regression and brass model. The level of significance was set at 5%.

The mean age of the women was 28.79±7.29 and median birth interval was 31.0 months. Prevalence of short birth interval (less than 24 months) was highest among the Muslim women. The percentage of women who left about 36-59 months interval before the birth of index child was highest among the women with higher education. About 24.4% of the women in core north left between 36-59 months interval before their last birth. The prevalence of complete childhood immunization was 20.4% and it was highest among those who left 36-59 months interval before their most recent birth. About 40% of the children in the core north were stunted and underweight and the prevalence were highest among the children who had preceding birth interval of less than 24 month (42.4% and 31.4% respectively). The percentage of women who had lost at least a child was highest among respondents who left less 24 months interval before their most recent birth (16.1%). The likelihood of stunting and underweight were 0.20 (CI=0.73-0.89; P<0.001) and 0.13 (CI=0.79-0.96; P<0.001) times lesser among children who had preceding birth interval of 36-59 months than those who had less than 24 months.

Short birth spacing was common among women in NE and NW Nigeria and the level of childhood mortality was high. In addition, the immunization coverage was low. The identified predictors of birth spacing were; contraceptive use, education, duration of breast-feeding, wealth index residence and age of mothers. Government should intensify more efforts in programmes and frameworks aim at reducing childhood mortality and improving immunization coverage in core North Nigeria. Poor nutritional status of the children in the core north region needs urgent attention.

**Keywords:** Birth interval, Immunization, Stunting, Underweight, Childhood Mortality.

**Word count:** 494

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# CHAPTER ONE

## 1.0 INTRODUCTION

### 1.1 Background of the Study

Birth interval is the length of time between two successive live births (EDHS, 2006). Optimal spacing between pregnancies has greater health advantages for both mother and child, which can give an opportunity for the mother to recover from pregnancy, labor and lactation. Longer birth intervals are healthier for mothers and their children, enable parents to devote more of their time to each child in the early years, give parents more time for activities other than child-rearing, and often ease pressure on family finances (Julie, 2004). Birth interval, as the number of months between the birth of the child under study and the immediately preceding birth to the mother, has a critical effect on the population size and the health status of the mother and her child. Evidence showed that a relationship prevails between shorter birth intervals and high infant and child mortality (Desta Hailu, 2016). It was also indicated that short inter birth intervals have been linked to increased risk for preterm birth, low birth weight, being small for gestational age (SGA), labor dystocia, and maternal morbidity and childhood mortality (John, 2014). Short birth intervals are also associated with high rates of premature rupture of membranes, third-trimester bleeding, anemia, and puerperal endometritis which place women at greater risk of hemorrhage, the primary cause of maternal death (WHO, 2005).

Under-five mortality remains a major public health concern in low income countries. In 2015, the under-five mortality rate in low-income countries was 76 deaths per 1000 live births, about 11 times the average rate in high-income countries -7 deaths per 1000 live birth (WHO, 2015).

In sub-Saharan African, the level is high as 129 per 1000 live births in 2009 compared to 37per 1000 live birth as observed in Asia and 13 per 1000 live birth Europe. Nigeria is one of the Africa countries that has the highest levels of and slow decline in mortality rates. Childhood mortality has declined by 31 percent over the last 15 years in Nigeria and stood at 128 deaths per 1,000 live births in 2013 (NDHS, 2013). Timing and spacing of pregnancy is important for the health and survival of the child and the mother, unintended pregnancy and short birth interval are still among the contributing factors of the high maternal and child mortality in developing countries like Nigeria. Information about birth intervals is important in understanding the health status of young children as researches have shown that short birth intervals less than 24 months are associated with poor health outcomes, especially during infancy. Children born too soon after a previous birth, especially if the interval between the births is less than two years, have an increased risk of sickness and death at an early age. Longer birth intervals more than two years, on the other hand, contribute to improved health status for both mother and child (NDHS, 2013).

Data on birth intervals are important because short intervals are associated with higher childhood mortality. Short birth intervals, especially intervals of less than two years, substantially reduce children's chances of survival. Children born less than two years after the preceding birth are more than 2.5 times as likely to die within the first year of life and more than twice as likely to die within the first five years of life as children born three years after the preceding birth (NDHS, 2013). A study on the relationship between pregnancy intervals and Perinatal Mortality showed that children born 3 to 5 years after a previous birth are about 2.5 times more likely to survive than children born before 2 years. Similarly evidence has consistently shown that a birth interval of 2 years improves the chance of infants and childhood survival compared with an interval <2 years (Boerma and Bicego, 1999). Also, a study conducted on Implication for Under-Five

Mortality in Ekiti Communities, Southwestern Nigeria shows that births occurring after an interval of less than 24 months have higher relative risk for under-five mortality compared with an interval of 36-60 months. (Adebowale, 2008)

Malnutrition is estimated to contribute to more than one third of all child deaths, contributing to more than half of deaths in children worldwide; child malnutrition was associated with 54% of deaths in children in developing countries in 2001 (Bain, 2013). Approximately 35.8 percent of all children under five were stunted in South Asia in 2016, decreasing from 61 percent in 1990. Even though the prevalence of child stunting in Sub-Saharan Africa fell from 49 percent in 1990 to 34 percent in 2016, the total number of stunted children in Africa increased by 11.6 million during the same period as a result of high fertility rates and lower rates of decline in stunting. According to a recent study published in *Maternal and Child Nutrition*, birth spacing plays an important role in nutritional status among children under 5 years of age, with shorter birth intervals increasing the risk of both stunting and underweight (El Salvador, 2008). Under nutrition increases with age due to premature weaning of breastfeeding and inadequate alternative feeding practices, often as a result of a younger sibling's birth in a short period of time. Findings from a study shows that short birth intervals significantly increase the risk of stunting.

Large percentage of children in developing countries suffer from under nutrition. Under nutrition contributes to high rates of child morbidity, affects long-term childhood morbidity and mortality, affects long term childhood growth and increase susceptibility to disease later in adulthood. (Calvin, 2009). A child born after an interval of less than 24 months is 1.52 time more likely to be stunted compared with an interval of 36 to 59 month. (James, 2008). Also, study conducted by Rutsein (2008) shows that short preceding birth interval have negative effect of nutrition status of the index child.

Approximately 3 million children die each year of Vaccine-Preventable diseases with a disproportionate number of these children residing in developing countries (Kane, 2002). Vaccines remain one of the most cost-effective public health initiatives, yet the cover against VPDs remains far from complete; recent estimates suggest that approximately 34 million children are not completely immunized with almost 98 percent of them residing in developing countries (Frenkel, 2003). The significant program effect on fertility and birth intervals can be explained in terms of reduction in child mortality due to the immunization program. Kumar (2009) finds that Immunization has a significant and negative effect on infant and under-five mortality. The results of a study conducted by Santosh (2010) also indicated that, exposure of the first-born child to the immunization program reduces the likelihood of subsequent and cumulative fertility of women and increases the birth intervals between first and second births. Several studies on infant and under-five mortality in less developed countries indicate that most of the under five deaths are from avoidable causes such as diarrhoea, pneumonia, measles, malaria, complete vaccination and underlying malnutrition. They proposed that significant reduction in childhood mortality could be achieved by improved coverage of a small number of effective child survival interventions (Bryce et al., 2005; Fotso et al., 2007; Jones et al., 2003; Mohan, 2005). While preventive interventions such as immunization, safe water and sanitation, micronutrient supplement, nutrition counselling, have been widely promoted in the public health sector (World Bank, 2010). World health organization (WHO) have suggested that, after a live birth, the recommended interval before attempting to have the next child is 2-3 years in order to reduce infant and child mortality and improve maternal health. (WHO 2005). Recent studies on birth spacing supported by the United

States Agency for International Development (USAID) have suggested that longer birth spacing, 3-5years, might be more advantageous.

## 1.2 Problem Statement

Short birth intervals, especially intervals of less than two years, substantially reduce children's chances of survival. Children born less than two years after the preceding birth are more than 2.5 times as likely to die within the first year of life and more than twice as likely to die within the first five years of life as children born three years after the preceding birth. (NDHS 2013). It was reported in the Nigeria Demographic and Health Survey 2013 that, thirty-seven percent of Nigeria under age five are stunted. The North West has the highest proportion of children who are stunted (55 percent), followed by the North East (42 percent). Stunting is higher among children with a preceding birth interval of less than 24 months (41 percent) than among children who were first births and children with a preceding birth interval of 24-47 months or 48 months or more.

One in four Nigerian children age 12–23 months have received all recommended vaccines—one dose each of BCG and measles and three doses each of DPT and polio (25%). One in five children did not receive any of the recommended vaccines. About 14% and 10% of children in North-East and North West Zone respectively to 52% in South East and South South have been fully vaccinated. Less than 20% of children received the DPT1 vaccine, a measure of access to child immunization in the North East and North West. The same indicator is over 80% in the South.

Findings from a national study of regional distribution of high-risk births by fertility and by the level of TFR, shows that the proportion of births associated with avoidable risk is higher in the North West (72%) and North East (69%) regions compared with the South South (57%) and South West (45%) regions. The two core Northern Nigeria, North East and North West have 15% of

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Contraception is a major way to optimize birth spacing and contraceptive use in Nigeria is low. Use of modern contraceptives among married women in 2003 was much higher in the South West region than in any other part of the country 21%, compared with 12% in the South Central and South East regions, 9% in the North Central region and about 2% in the North East and North West regions. In 2013, use of modern contraceptives among married increases in south-west (38%) compared to North-East and North-west which have a slight increase of 3% and 4% respectively (NDHS 2008, 2013).

Spacing children at least 36 months reduces the risk of infant and childhood death. In Nigeria, the median birth interval is 31.7 months. The median birth interval varies by zone, 35.1 months among women in the South West compared to 30.2 and 31.6 months among women in North-East and North West respectively.

## 1.3 Research Justification

Researchers have attempted to identify factors driving poorly birth spacing, which consequently lead to high level of childhood mortality in Nigeria; there is dearth of information on research that examined the relationship between birth spacing and child health in the core north Nigeria using childhood immunization, nutrition and childhood mortality as child health indicators. This study will be of great benefit to Nigeria which remains the country with largest population in Africa and one of the fifteen countries with the highest maternal mortality rate in Sub-Saharan Africa (UNAIDS, 2008). This study aims to address the gap and findings from this research will be useful to guide policies and programmes aimed at increasing birth spacing consequently increases nutritional status of children, increases the immunization coverage, reducing childhood mortality and reducing high level of fertility in the core Northern of the country. This will help proffer suggestions to reduce fertility and population growth rate in Nigeria.

Most available evidence of studies on birth spacing in Nigeria were hospital based and the few population based studies that exist in the country were conducted at national level. (e.g Omietimi, 2015; Fayehun, 2011; and Gbolahan 2015). This study will employ a technical demography approaches in the study of birth spacing in Nigeria. The approaches (technical demography) will be an eye opener to researchers who will find the need of modelling birth spacing with the use of DHS data necessary.

This study will provide information that can assist the health planners to develop a framework that will reduce persistent increase in childhood mortality in the regions. In addition, the outcome of this study will provide insights into the mechanisms influencing birth spacing in the core Northern part of Nigeria.

## 1.4 Research Question

What is the relationship between birth spacing and child health in the core Northern Nigeria?

## 1.5 Objectives

The general objective of this study is to examine how birth spacing and child health indicators (Childhood mortality, Child Nutrition and Child Immunization) are interrelated in core Northern Nigeria.

**The specific objectives of this study are to:**

1. Examine the patterns of birth spacing in core Northern Nigeria.
2. Determine the relationship between birth spacing and childhood nutritional status in the core Northern Nigeria.
3. Determine the relationship between birth spacing and childhood immunization status in the core Northern Nigeria.
4. Determine the relationship between birth spacing and childhood mortality in the core Northern Nigeria.

## CHAPTER TWO

## 2.0 LITERATURE REVIEW

### 2.1 Global Perspective on Birth spacing and child health

The interval between births has been shown in numerous studies to substantially affect the mortality, birth size and weight, and nutritional status of children, and the risk of pregnancy complications for mothers (Gribble et al., 2008; Rutstein, 2008). Children born after intervals of less than 24 months are considered at a higher risk for child mortality and under nutrition, and mothers with those intervals are at a higher risk of birth complications. Globally, almost one in four births occurred after an interval of less than 24 months. Children born after intervals of less than 36 months are also considered to have an elevated risk of mortality and malnutrition. More than half (57 percent) of children are born after such intervals (USAID, 2011). According to the report from a study, preceding interpregnancy intervals shorter than 36 months are significantly associated with a greater risk of child and under-five-years mortality, and intervals shorter than 24 months significantly increase risk of early neonatal, neonatal, and infant mortality (Rutstein 2008). It was reported from a study in Bangladesh that birth intervals of less than 21 months were associated with a greater than two-fold increased risk of adverse pregnancy, as well as increased risk of perinatal mortality, stillbirth and under five mortality (Hendrick, 2014).

Globally, under-5 child mortality, low birth weight and infant or child malnutrition are significantly increased with birth-to-pregnancy intervals of less than six months, while an interval of at least two years, but no more than five years, between pregnancies has been linked to improved neonatal morbidity and mortality and associated with the healthiest pregnancies (Conde-Aguedo, 2007). Investigators in Matlab, Bangladesh, also found, controlling for other etiologies of infant and child mortality, that shorter intervals were associated with higher mortality, with a larger effect if the preceding pregnancy resulted in a live birth (DaVanzo, 2008). Evidence from systematic reviews and meta-analyses indicates that short and long intervals between pregnancies are independently associated with increased risk of adverse maternal, perinatal, infant, and child outcomes (CondeAgudelo, Rosas-Bermudez, and Kafury-Goeta 2006, 2007; Rutstein 2008). Finding from a research shows that among multiple factors that influence malnutrition include: maternal education; maternal employment status; close birth spacing; poor health seeking behavior; inadequate water; hygiene and sanitation (NFNSP, 2011).

Evidenced from the survey conducted in Russian and United State, preceding birth intervals < 24 months were associated with increased risk of all mortalities ranging from Neonatal, postneonatal, to child mortality. A study done in Spain reported that, preceding birth intervals < 17 months were associated with increased risk of infant mortality (Blanco, 2009). Based on the research carried out in Bangladesh, they observed that increased child mortality associated with intervals of 19-23 months and 24-35 months relative to the birth intervals of three years. In Bangladesh it was found that the relationship between birth intervals and childhood mortality, demonstrate significant but very distinctive effects of the previous and subsequent birth intervals on mortality, with the former concentrated in the neonatal period and the latter during early childhood. A study revealed that the impact of short birth intervals on mortality, however, is substantially less than that found in many previous studies of this issue, particularly for the previous birth interval. (Michael 1990).

## 2.2 Birth interval and child health in Africa

Women in the developing world who have many children in quick succession place themselves and their children at enormous risk. Maternal age, birth order, and the interval between births have an important influence upon the probability that a child will survive infancy and early childhood. Birth or child spacing has a particular significance for child survival. Studies show that when the length of time between two births in a family is less than two years, the new-born, on average, is twice as likely to die in infancy as might a child born after a longer birth-interval (UNICEF, 1990).

Recent world fertility surveys have contributed an impressive amount of comparative data from developing countries which reconfirm the significance of these relationships, particularly birth spacing, as key factors contributing to child survival. Studies have also shown that the length of time between two births in a family (the "birth interval") greatly influences survival of both children. When there is a short birth interval, both have a much greater chance of dying than do children with a longer birth interval. A study on in India reported that there is a strong positive effect of immunization program exposure of the first-born on the length of birth-interval between first birth and second birth. The immunization program increases the expected length of birth-intervals between first two children by about 2.5 percent. (Kumar, 2009). The length of the preceding birth interval is a major determinant of infant and early childhood mortality. In infancy, a preceding birth interval of less than 18 months is associated with a two-fold increase in mortality risks (compared with lengthened intervals of 36 months or longer), while an interval of 18–23 months is associated with an increase of 18%. During the early childhood period, children born within 18 months of an elder sibling are more than twice as likely to die as those born after an interval of 36 months or more (Jean 2013).

Among the causes of infant and child deaths in developing nations are, children born as a result of pregnancies categorized as 'too young, too old, too frequent, or too many" constitute high risks for deaths. And for every child who dies, there are many more who are weakened or handicapped. When the birth interval is less than two years, the pregnancy outcome is more hazardous (UNICEF, 1990). Short birth intervals are associated with higher rates. Impact of foetal, infant and child mortality, particularly high if the inter-birth period is shorter than a year. In developing countries, children who are born after a birth interval of less than two years are, on average, twice as likely to die in infancy as are children born after a longer interval (Conde-Agudelo, 2012). Too short interval between births not only raises an infant's chance of dying during the first year, it adversely affects the child's survival for at least the first four years of life. Such children have a 50 per cent greater risk of dying between the ages of one and four than do children born after a longer birth interval (UNICEF, 1990).

The report from National Family Health Survey shows that short birth interval is significantly increases the risk of stunting. A child born after an interval of less than 24 months is 1.52 times more likely to be stunted, compared with an interval of 36-59 months. Similarly a child born after an interval of 24-35 months is 1.30 times more likely to be stunted than a child born after an inter of 36-59 month. As the birth interval length increases, the risk of stunting decreases (El Salvador, 2008). In Nairobi, the adjusted results on the study on birth spacing and child mortality implied that children born within 24 months of an elder sibling experienced a 60% increased risk of death in infancy while those born within two to three years faced a 10% increase compared with those born after intervals of four to five years (Jean, 2013). This result is broadly consistent with earlier cross-national studies using similar data sources (Rutstein *et al.*, 2005). With regard to early child

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Other African countries are not ruled out as regards birth spacing and child health. The report of the study in Afghanistan on the effect of birth interval on child mortality shows that of all deaths among children under age 5 that took place in the eight years before the survey, a higher proportion of children who died had a short birth interval of 0-23 months, at 42% compared with 33% among all children. (Mohammad, 2013). Findings from Senegal on birth spacing and child survival shows that odds of dying in the neonatal and post-neonatal period is 2.27 and 2.12 times higher respectively for children born after preceding birth intervals of one year or less compared to children born after longer intervals.

A study done by Rutstein using 17 developing countries shows that on average, children born after short intervals, under 18 months between births and 18 to 23 months between births, are respectively 3.0 and 1.9 times as likely to die before their fifth birthday as are children born after 36 to 59 months. In addition, those children born after intervals of 24 to 29 months and 30 to 35 months have a 60% and 30% greater chance of dying, respectively, than those children born after 36 to 59 months. It has also been noted that for those developing countries studied, the increases in the risk of dying range from 124% to 381% for births occurring less than 18 months. This study also show a relationship between birth interval and nutritional status, the unweighted averages show an almost linear decline in stunting as birth interval increases. (Rutstein, 2005). It has been reported from a study that for both postneonatal and childhood mortality, there was a consistent negative relationship between length of interval and mortality rate, with rates declining as intervals increased to more than three years (Beverly, 2015).

Report from study on developing countries shows that shorter birth intervals increases the risk of child malnutrition. (*Christina, 2014)*. Study done by Agustin 2007 discovered that short intervals between pregnancies are associated with an increased risk of several adverse pregnancy outcomes such as low birthweight, preterm delivery, maternal death, and anemia and child mortality. Another study show that longer intervals are even better for infant survival and health and for maternal survival and health as well compare to shorter intervals. Children born 3 to 5 years after a previous birth are about 2.5 times more likely to survive than children born before 2 years. (DHS, 2002). Children born within two years of a subsequent birth are at 4.09 times higher risk of dying in the second year of life than children whose mother gave birth more than 2 years after the index birth. (Ronsmans, 1996).

More recently, there has been a renewed interest in the effects of spacing and the optimal duration between births because new evidence suggests that three to five years may offer greater health benefits. Study on a large data sets from a number of different settings indicate that there could be additional gains to child health by increasing the spacing between births to a minimum of three years (DaVanzo, 2004; Rutstein, 2002;Conde-Agudelo and Belizan, 2000). Furthermore, this is the first instance of empirical evidence to indicate that there are benefits to mothers as well. Previous research from Matlab, Bangladesh had suggested that there is little empirical evidence for an association between birth interval length and the risk of maternal death (Ronsmans and Campbell, 1998). However, another study indicates that women with short or very long inter-pregnancy intervals are at a significantly higher risk of childhood mortality and maternal complications (DaVanzo *et al.*, 2004). A period of 3-5 years is the optimum birth interval and saves lives. The new evidence for the benefits of spacing births 3 to 5 years apart argues for renewed emphasis on helping couples space births, especially young women who want to postpone their next pregnancy longer. Expanded access to good quality family planning services through a variety of avenues will help women achieve their preferred intervals. (Rasheed and AlDabal, 2007).

**2.3 Birth interval and child health in Nigeria**

In Nigeria, The median birth interval is 31.7 months, roughly the same as the median interval in the 2008 NDHS (31.4 months). Furthermore, awareness of the use of contraceptive to space births and reduce the number of children is high, but Nigeria Demographic and Health Survey reports showed that the level of contraceptives uses among currently married women is still low; 6 percent in 1990 and 13 percent in 2003 to 15 percent in 2013; infant and maternal mortality rates are still high and substantial proportion of children are stunted (39%) while about 20% of mothers are malnourished. Irrespective of the contraceptive method used in Nigeria, the intervals between births are still relatively short; hence its harmful consequences on maternal and child health.

Childhood mortality has persisted in Nigeria as evidenced by several studies and one of the cause is short birth interval. This high childhood mortality like in other African countries is attributed to high level of illiteracy and some other socio-demographics factors, especially in the northern part of the country where men dominate in the issues of reproductive health. (Feyisetan & Bankole, 2002). A study of antenatal patients of the University of Nigeria Teaching Hospital, Enugu, Nigeria, shows that cultural pattern has been disrupted by Westernization, urbanization and consumerism. The patients studied had an average of four pregnancies in five years. Roughly half of those conceived did not survive: 41% of the patients reported having lost at least one child. (Ebigbo and Chukudebelu (1980).

Nigeria has the highest reported number of under-5 deaths in Africa with about one million of them dying annually. A number of factors are contributory to this high prevalence of under-five mortality in Nigeria. High childhood mortality has persisted in Nigeria coupled by low immunization coverage as evidenced by several studies. The result of NDHS surveys 2013 has shown that there are 128 childhood death per 1000 live birth and also only 25 percent of the children in Nigeria received the recommended vaccines. This high fertility like in other African countries is attributed to many factors like illiteracy, short birth spacing especially in the northern part of the country, where men dominate the issues of reproductive, health, fertility and contraception.

David (2017) provides empirical evidence on how birth spacing influence maternal and child health using logistic regression technique. He found that the six factors (Health Histories, Family Background, Utilization of reproductive health services, Family backgrounds, Contraceptive use, Socio-economic status) of birth spacing significantly influenced maternal and child health in Nigeria. Adebowale (2008) used Cox-proportional hazard model to study the relationship between under-five mortality and birth intervals; the result revealed that, increased under-five mortality risks were found to be associated with birth intervals of less than 24 months and above 60 months. Akinyemi (2013) has concluded on the study done on the new trends in under-five mortality determinants and their effects on child survival in Nigeria that, Nigeria has recorded very minimal improvements in birth spacing and antenatal/delivery care. Poor access to potable drinking water and sewage disposal, and short birth intervals, are among the factors fuelling childhood mortality risks. Child health tends to become better as birth spacing increases.

### 2.4 Determinant of short birth spacing

Women continue to fall victim of short birth spacing, not because they deliberately want to, but because a large percent of them are ignorant of what risky short birth spacing entails because they hardly find the conducive platform to discuss about sexual issues freely, either with their spouses or sexual issues professionals. Studies supported by the United States Agency for International Development in 2002 have suggested that optimal birth spacing of three to five years might be more advantageous. These studies confirm that in less developed countries, if no births occur within thirty-six (36) months of a preceding birth, infant mortality and under five mortality rates would drop by 2% and 35 % respectively (USAID, 2002).

Birth spacing is affected by a complex range of factors. Some of which are rooted in social and cultural norms, others in the reproductive histories and behaviors of individual women, utilization of reproductive health services and other personal factors (David, 2016). Moreover, there are information on a number of socioeconomic and demographic variables that may affect birth spacing and/or mortality, e.g., age and education of the mother, household space (a proxy for the household's economic status), and religion. Furthermore, data are available on additional explanatory variables that will be considered in this work, including maternal age, contraceptive use, breastfeeding, abortion, and the immunization status of children under the age of five. These may affect birth spacing and they may also pregnancy and birth outcomes; such a relationship could contribute to associations between birth spacing and these outcome measures.

Maternal age, parity, and socioeconomic status also vary with interval. Maternal age and parity both have independent effects on child health and tend to vary both together and with interval. Older women tend to have longer intervals between births than younger women, and they have different patterns of reproductive loss. Higher parity is associated with shorter average birth intervals, and, therefore, effects attributed to short intervals may be, in fact, reflections of the biological risks of high parity or the social detriments of large families. (Beverly, 2015). Another ground for scepticism concerns common causes that might give rise to both short intervals and increased risk of death in infancy or childhood is breast-feeding. Early weaning is associated with short intervals and poses a threat to the survival of the index child, and may thus give rise to a spurious relationship between spacing and mortality (Jean, 2012). The desire to have a particular sex, marital status, ageing pressure, religion, education, place of residence, fetal loss and the desire to have a new child were also some of the factors which influenced the decision of mothers on birth spacing.

### 2.4.1 Maternal age and Birth Interval

According to health facility based cross-sectional study done among multiparous women in Babol, Northern Iran, age of the mother was a major determinant of birth interval. It indicated that as age increases birth interval decreases. Among the study participants, half (50%) of the women aged <20 years old and 0.9% of women ≥35 years old had a birth interval of <2 years, while 42.9% of the mothers aged ≥35 years old had a birth interval of ≥6 years, which increased with increasing maternal age, while the birth interval of <2 years decreased with increasing maternal age (Hajian-Tilaki, 2009) Other cross-sectional studies from Saudi Arabia, Denmark, Jordan, Nepal, and Pakistan showed similar findings.

A study in Mozambique shows that, the shortest median interval does occur among younger mothers than older but there is not a sizeable difference between those under 19 and those in their 20s; 15-19 year old mothers have the shortest interval of 28.9 months while those 20-29 have slightly longer intervals of 32.7 months. Only those who are thirty and older have intervals longer than three years—36.3 months among 30-39 year olds and 41.7 months among those forty and over. (Population council, 2010). In line with the above findings, report from Nigeria DHS 2013 showed that young maternal age had significant association with birth interval. The median birth interval increases with age, ranging from 26.3 months for births to women aged 15–19 to 37.7 months for births to women aged 40–49 months.

### 2.4.2 Occupation

Regarding the occupation of respondents, study from Nepal, indicated that occupation of mothers found to be significant predictor of birth interval. Working mothers were more likely to have longer birth intervals than house wife mothers. Study from Iran and Tanzania showed similar findings. Another study from Saudi indicated that Employment status was significantly related to birth interval. The optimum birth interval of 3–5 years was more frequently observed among women who were employed 171 (39.2%) than among home-makers 143 (32.7%).

According to the study done in Nepal, occupations of husbands were significantly associated with birth intervals. Women whose husbands were engaged in agriculture had longer birth intervals as compared to those working in business and cottage industry. Another study done in Southern Ethiopia showed that women whose husbands were students were found to be significant predictors of short birth interval.

### 2.4.3 Wealth index

Wealth index of the mother was also a strong predictor of short inter birth interval. The odds of having short inter birth interval were higher for mothers who belong to the poorest wealth index than the richest ones. (Yohannes, 2011). Evidence from study done in Saudi Arabia revealed the odds of having short inter birth interval were higher for mothers who belonged to the poorest wealth index than the richest group of mothers. In contrast, study conducted in Lemo District, Ethiopia, showed that the length of inter birth interval increased with increasing wealth index. This can be partly explained by the fact that wealthy women are more likely to access health care information and afford health care services and materials and thus can easily apply scientifically recommended inter birth spacing.

### 2.4.4 Place of residence

It has been found that the place where a woman resides influences the length of intervals between their births. Study in Nepal and Tanzania indicated that women residing in urban areas had longer birth intervals than their rural counterparts. Another study from Tanzania revealed that short birth spacing was higher among women that resided in rural areas than their urban counterparts (50% versus 45%), and the difference was statistically significant. NDHS 2013 also showed similar conclusion.

### 2.4.5 Mother's education

Mother's education level has also been correlated with birth spacing although the mechanisms by which these background variable influence birth spacing is less clear. In some settings, maternal education is associated with shorter spacing; in Korea, for example, one study reported that better educated women had shorter second birth intervals than those less educated (Bumpass, Rindfuss & Palmore, 1986). However, in 38 of 51 countries with DHS data, women with no education were more likely than educated women to have shorter intervals (Setty-Venugopal & Upadhyay, 2002). It can be speculated that better educated women wish to compress childbearing into fewer years and participate in non-childbearing activities and hence have shorter spacing. The pathways through which these happen can been explained through an array of mechanisms including late age at marriage, greater knowledge and access to contraception, high labor force participation and alternative values regarding family size (Martin, 1995; Ware 1984). For example, in Ghana birth interval has been found a positive linear effect of education on the intervals between successive births (Gyimah, 2001).

### 2.4.6 Age at first marriage and Birth Interval

Age at marriage is considered to be an important variable in the fertility process. If couples marry at a very young age, decisions on number of children, use of contraceptives and the like may be formed at a less mature age, consequently affecting the birth interval (Bumpass 1978). Furthermore, since the effect of age at marriage possibly operates through biological and maturational factors rather than with respect to coital frequency (Kallan & Udry, 1986), age at marriage may have a varied effect on different birth intervals. For young women, West (1987) found that the first birth is an important determinant at the transition from parity one to parity two. For older women, he found its importance at the transition from parity two to parity three. Interestingly, his findings also showed that the younger a woman is at first birth, the higher the transition probability. In another study, Abdel-Aziz (1983) concluded that the later a Jordanian girl marries, the swifter she will bear her first child. A similar result was found in Nepal. The women of Tamang ethnicity, who married at age 19 or older, had higher chances of childbirth than those marrying at younger age (Fricke & Teachman, 1993).

### 2.4.7 REPRODUCTIVE HISTORIES

Previous studies have consistently observed that the survival status of the index child significant associated to length of birth spacing (Montgomery & Cohen, 1998). Survival status of index of a child refers about information for a child either survived or not up to his/her second birth date. In Ghana, it has been demonstrated that intervals following the death of the index child tend to be significantly shorter than intervals where the child survived, a result of biological and behavioral processes (Gyimah, 2001). We thus expect the death of the index child to be associated with shorter intervals.

Sex composition of a family can also influence the age gap between successive children. "Gender" refers to the different role that men and women play in society and also the rights and responsibilities that come with these roles (Centre for Development and Population Activities (CEDPA), 1996). Sex of the preceding child revealed a significant association with inter birth interval. Mothers whose preceding birth was female were about 7 times more likely to experience short birth interval than those whose child was male. (Desta & Hailu 2016).

According to the classical demographic transition theory, child mortality affects fertility in two ways: physiological/biological changes and behavioral/replacement effects. The physiological effect can be explained by the fact that breastfeeding is interrupted with a child death, and consequently, the postpartum infecundable period is shortened (Van Ginneken 1974). As a result, under ineffective use or non-use of contraception, the mother is able to conceive the next child sooner, leading to a shorter birth interval and, possibly, higher fertility. The association between the death of a child and birth intervals or fertility decisions has been attributed to two strategies of reproductive behavior: replacement and hoarding (Ben-Porath 1976 & Wolpin 1998). Hoarding refers to the fertility response to expected mortality of offspring, while replacement is the response to an actual child death. Both are closely related to the total number of surviving children that parents ultimately wish to have. On the other hand, many studies found an association between a short birth interval and neonatal or infant death of the next child, particularly when the preceding sibling survived (Zenger 1993; Koenig et al. 1990; Alam & David 1998). An explanation for this is that the mother has not recuperated physiologically from the previous birth (DaVanzo and Pebley 1993; Scrimshaw 1996). Hence vulnerable families can be caught in a death-trap that leads to clustering of child deaths within families: the death of a child reduces the interval to the next birth and thus increases in the risk of death of the subsequent sibling in the family (Arulampalam & Bhalotra 2006).

Yohannes (2011) characterized the relationship between inter-birth interval and breast-feeding as a direct linkage. Mothers who breast-fed the preceding child for less than 24 months were more likely to have short inter birth interval than their counterparts of mothers who breast-fed for 24 months or more.

### 2.5 Problems associated to poorly birth spacing

There are various reasons why time is needed between births. Having children too close together has long been associated with increased risk of various adverse health outcomes, including poor health and mortality for mothers and children. Enough planned time between births increases the chances of a good outcome for the mother and each of her babies. It reduces abortions and unwanted pregnancies and improves children's health, nutrition and development. Mothers with short intervals between their births do not have enough time to recover from the nutritional burden of pregnancy before getting pregnant again while larger intervals allows for repletion or improvement in the nutritional status of mothers before the next conception. Birth spacing also allows the mother to recover physically and emotionally before she becomes pregnant again to face the demands of another pregnancy, birth, breastfeeding and child care. Birth spacing enables the proper planning of family resources for each child by the parents. Closely spaced and frequent births often lead to poverty and overburdened family environments and contribute to poor school performance through malnutrition and the inability of parent to provide attention to each child's needs. New research suggests a period of 3-5 years is the optimum birth interval and saves lives (Rasheed, 2007).

According to the summer 2000 population Report, children born three to five years after the last birth were about 2.5 times more likely to survive than children born two years or less after the last delivery. Mothers with 27 to 32 month birth intervals were found to be 2.5 times more likely to survive childbirth compared to women with 9 to 14-month birth intervals. Women with optimal birth intervals were more likely to avoid anaemia, fetal growth retardation and premature delivery, which results in low birth weight neonates. Realizing these consequences, promoting family planning programs has long been a central goal around the world to help women achieve their desire birth intervals.

Published studies have shown short birth intervals increase maternal risk for toxemia, anemia, malnutrition, third trimester bleeding and maternal mortality (Conde-Agudelo & Belizan, 2000; Smith *et al*, 2003) and it has several serious adverse outcomes for neonates as well, such as prematurity, low birth weight, still birth, neonatal mortality and adverse effects on intellectual ability, physical growth and development (Greenspan,1993; Zhu *et al*, 1999; Bella *et al*, 2005; Hsieh & Chen, 2005). However, a birth interval longer than 70 months is associated with increased risk for maternal death, third trimester bleeding, eclampsia and postpartum hemorrhage (Conde-Agudelo & Belizan, 2000).

According to the Ghana Maternal Health Survey, childhood and maternal mortality is strongly associated with variations in birth intervals. Unfortunately, many women in developing countries are only not able to achieve their own reproductive goals but are also falling far short of the three to five years intervals that new evidence suggest for healthiest.

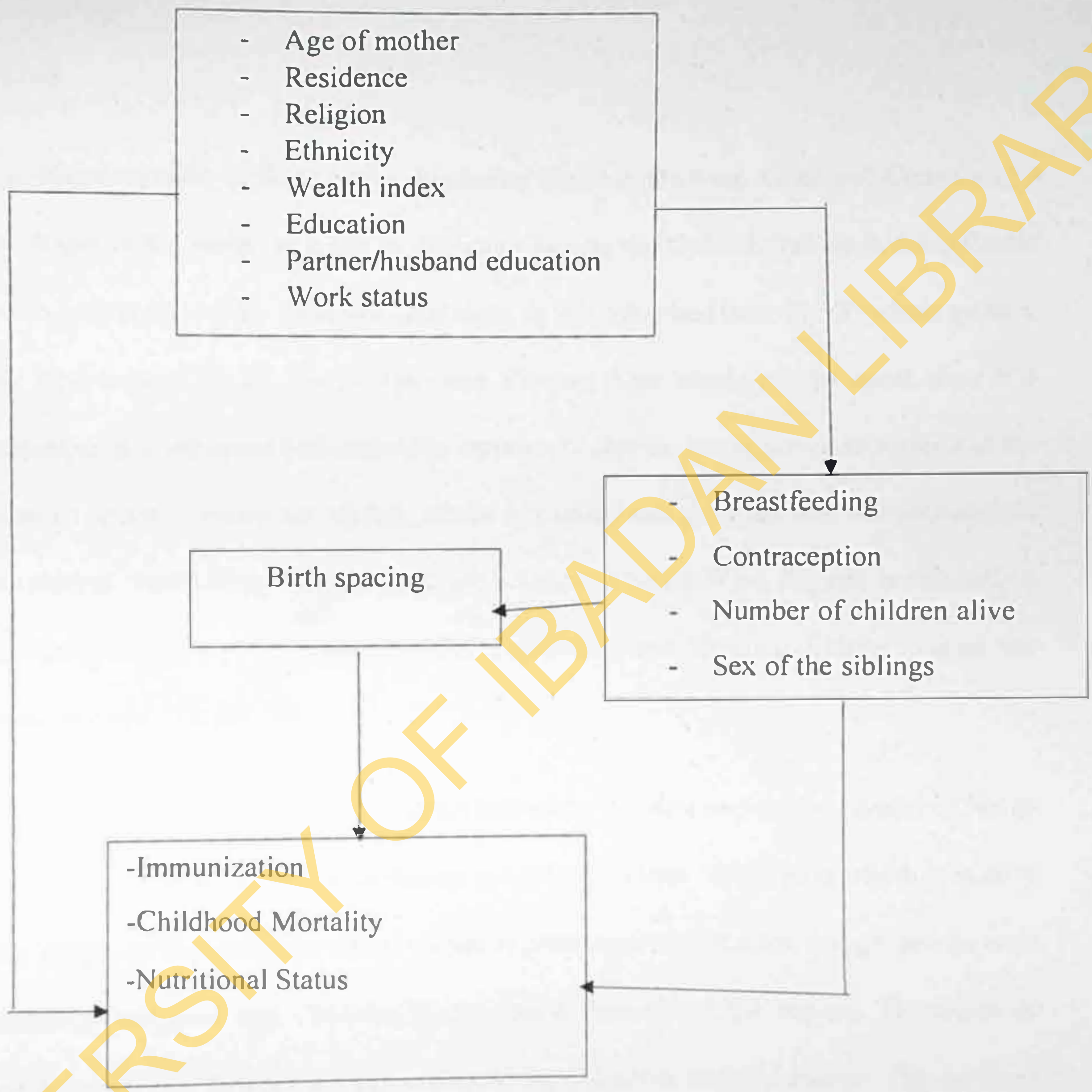
A United Nations Development programme report drawn from studies in the least developed and developing countries in Africa reveals that the practice of family planning is very low and in most of these countries, one out of every four women expresses the desire to avoid pregnancies and use birth spacing methods but they are not able to do so. Among the findings: Compared with women who give birth at 9- to 14-month intervals, women who have their babies at 27- to 32-month birth intervals are: 1.3 times more likely to avoid anemia, 1.7 times more likely to avoid third-trimester bleeding; and 2.5 times more likely to survive childbirth. (DHS 2002).

Some studies showed that infant delivered with birth interval less than 15 months face approximately 50% increase risk of fetal death and early neonatal death. There is also 80/100% increase risk of very low birth weight, low birth weight, very preterm and small for gestational age. Therefore, birth spacing could significantly reduce adverse perinatal outcome. (Geidam, 2015).

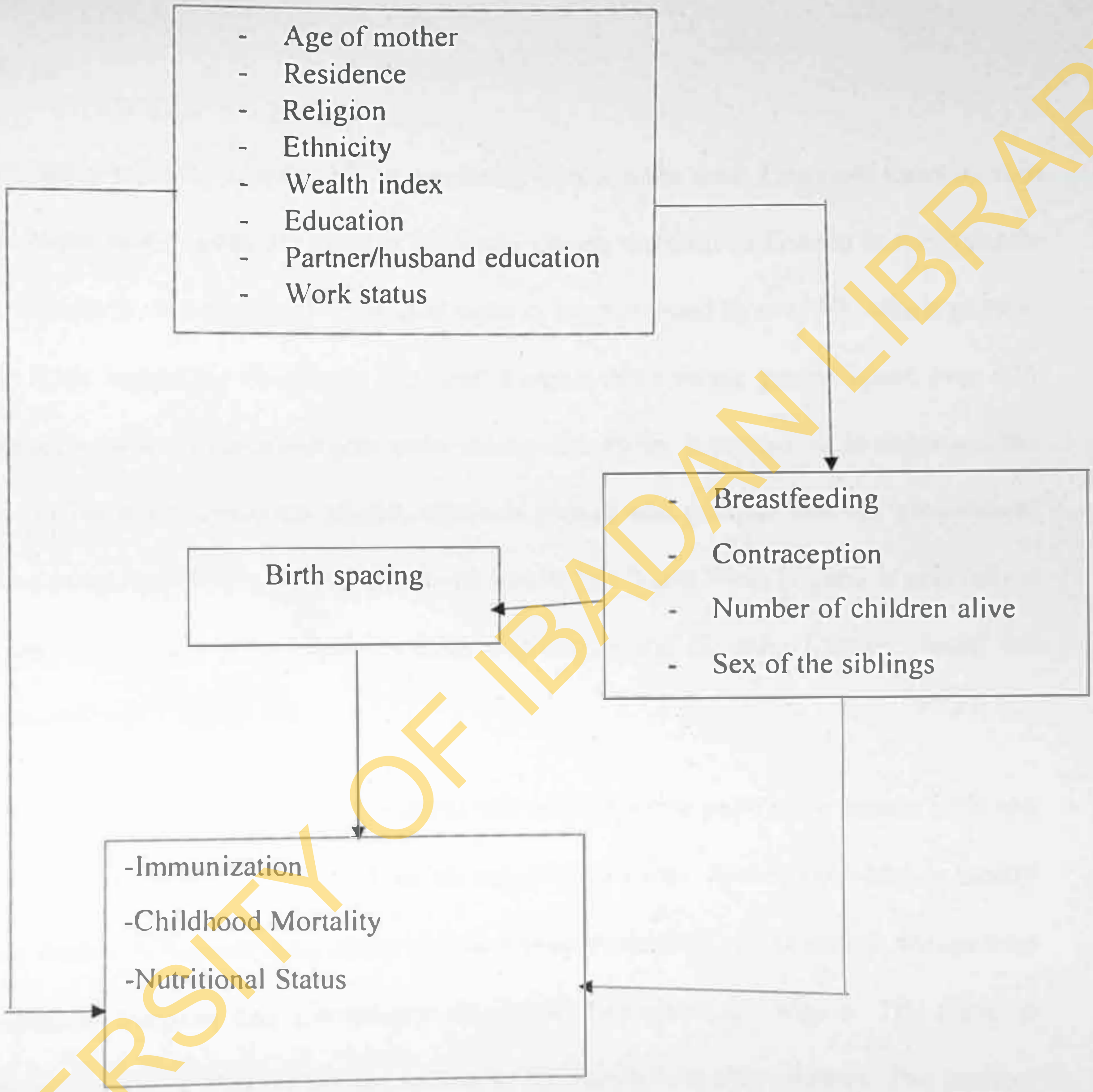
## 2.6 Conceptual Framework

The framework shows that socio-economic, cultural and demographic factors influence birth spacing through proximate determinants. The framework also shows that childhood immunization, nutrition and childhood mortality may be affected by birth spacing

### 2.6 Conceptual framework for analyzing birth interval dynamics



## 2.6 Conceptual framework for analyzing birth interval dynamics



# CHAPTER THREE

## 3.0 METHODOLOGY

### 3.1 Study Area

Nigeria, is a federal republic in West Africa, bordering Benin in the west, Chad and Cameroon in the east, and Niger in the north. Its coast in the south lies on the Gulf of Guinea in the Atlantic Ocean. The country is viewed as a multinational state, as it is inhabited by over 500 ethnic groups, of which the three largest are the Hausa, Igbo and Yoruba; these ethnic groups speak over 500 different languages, and are identified with wide variety of cultures. It comprises 36 states and the Federal Capital Territory, where the capital, Abuja is located and grouped into six geopolitical zones: North central, North East, South East, South South, and South West. Nigeria is officially a democratic secular country. The country's 2006 Population and Housing Census placed the country's population at 140,431,790.

The Core Northern Nigeria, which contains about half of the Nigeria population consist of North East and North-West, encompasses two of the six geopolitical zones The region which is mostly dominated by people of Hausa/Fulani ethnic groups is predominantly Muslim though groups who practice traditional religions and Christianity are found throughout the region. The north is characterized by both less demand for and access to reproductive health services. The level of women's literacy is exceedingly low in North East and North West. About 90% of women have at least primary education in the southern region, but the level for women in the core-North was between 25% and 30%. Women's exposure to mass media and social activities are also lower in the core North part of Nigeria.

## 3.2 Study Design

Secondary data from Nigerian Demographic and Health Survey (DHS) implemented by the National Population Commission during 2013 will be used for this study. This was the fifth comprehensive survey designed to provide estimates for the health and demographic variables of interest in Nigeria as a whole, urban and rural areas of Nigeria and all geographic areas.

This survey collected from a nationally representative sample of women and men in the reproductive age groups of 15-49 and 15-59, respectively. The survey was conducted in selected rural and urban areas throughout the country. The sample survey was based on a three-stage stratified cluster sample of households. The survey used as a sampling frame the list of enumeration areas (EAs) prepared for the 2006 Population Census of the Federal Republic of Nigeria, provided by the National Population Commission.

The sample for 2013 NDHS were nationally representative and covered the entire population residing in non-institutional dwelling units in the country. The sample was designed to provide data and monitor the population and health indicator estimates at the national, zonal, and state levels. The sample design allowed for specific indicators to be calculated for each of the six zones, 36 states and Federal Capital Territory in Abuja.

## 3.3 Data Collection procedure

The Nigeria Demographic and Health survey are implemented by the National Population Commission. The 2013 NDHS sample was selected using a stratified three stage cluster design consisting of 904 clusters, 372 in urban areas and in rural areas. A representative sample of 40,680 households was selected for the survey, with a minimum target of 943 completed interviews per state. (NDHS 2013). Each state of the federation is subdivided into government areas (LGAs), and each LGA was divided into localities. During 2006 population census, localities were subdivided into census enumeration areas. The primary sampling unit (PSU), referred to as a cluster in the 2013 NDHS, is defined on the basis of EAs from the 2006 EA census frame. (NDHS).

The survey were based on national representative sample of women aged 15-49 who were either permanent residents of the households or visitors present in the households on the night before the survey. Information on background characteristics and reproduction history of women were collected from all the women 15-49 years using women questionnaire.

### 3.4 Variable Description

The outcome variable of interest (dependent variable) in this study is the child health which was measured by child immunization, child nutritional status and child mortality. The independent variable is birth spacing, other variables are socio-demographic and health related variable. All these variables are available in the original datasets of Nigeria Demographic and Health Survey.

#### Outcome variable

The outcome variable 'child health' which was measured by child immunization, child nutritional status and childhood mortality:

- Child immunization- complete vaccination was measured by children who received the following; BCG, DPT1, DPT 2, DPT 3, Polio 1, Polio 2, Polio 3, Polio 0 and Measles vaccines.
- Childhood Mortality- children who died before their fifth birthday.
- Child Nutritional Status- Height-for-age and Weight-for- age of the child

**-Height-for-age:** is a measure of the linear growth of a child. A child that is less than minus two standard deviation (-2 SD) from the median of the WHO reference population in terms of height-for-age is considered short for his/her age or STUNTED

**-Weight-for-age:** is a composite index of weight-for-height and height-for-age. It does not distinguish between wasting and stunting but it is a good overall indicator of a population's nutritional health as a child can be underweight for his/her age as a result of being stunted or wasted or both. A child that is less than minus two standard deviation (-2 SD) from the median of the WHO reference population in terms of weight-for-age is considered to be UNDERWEIGHT

Stunting and underweight variables was self-generated from the information on Height/Age standard deviation and Weight/Age standard deviation respectively. At the time of survey, information was sought on the age, weight and height of the children. A child whose height/age standard deviation is less than minus two was regarded as being stunted while a child whose weight/age standard deviation is less than minus two was regarded as being underweight.

**Independent variable**

'Birth spacing' was captured as birth interval between the most recent and immediate previous birth 'preceding birth interval'.

Socio-demographic and health related variables

- Age of women; classified in five year age groups, 15-19, 20-24......44-49
- Age of child; grouped as thus, 0-11, 12-23, 24-35, 36-47, and 48-59 months
- Level of education; classified based on no education, primary, secondary and higher secondary

- Partners' level of education; classified based on no education, primary, secondary higher education.
- Respondents currently working; classified based on yes and no
- Wealth index; captured using household assets and each household is categorized into poorest, poorer, middle, richer, richest.
- Religion; categorized based on catholic, Islam Traditionalists, and other Christians
- Marital status; categorized into never married, married, living together, divorced, separated and widowed categories.
- Number of surviving children; grouped as thus 1-2, 3-4 and 5+ children
- Place of residence; classified into rural and urban.
- Contraception: this variable was captured based on knowledge of contraceptive methods, 'current use of any method and future use of contraception'
- Duration of breast feeding; classified into none, less than 12 months and 12 months and above.
- Working status of the respondents; captured by currently working: no and yes
- Gender of the preceding child.

### 3.5 Method of Analysis

Analysis for the quantitative data was done using the SPSS statistical software version 20. The Chi-Square model was used to derive the patterns of birth spacing. Chi-square and Logistic regression models were employed to determine the relationship between birth spacing and childhood nutritional status. In addition, Chi-square and Logistic regression models were used to determine the relationship between birth spacing and childhood immunization status. Chi-square, Cox regression and Brass logit models were used to determine the relationship between birth spacing and childhood mortality in the core Northern Nigeria.

### 3.5.1 Logistic regression

Logistic regression analysis is conducted to find a relationship between a categorical response variable and one or more explanatory variables. The analysis helps to determine the predictor variables significantly associated with the dependent variable with exact significance level. Here the conditional probability $Yi = 1$ given:

$X_i = x_i$ is expressed as $P_i = \Pr(Y_i = 1 \mid X_i = x_i) = \exp(x_i^T\beta)/(1+\exp(x_i^T\beta))$ and that of $Y_i = 0$ as $1 - P_i = \Pr(Y_i = 0 \mid X_i = x_i) = 1/(1+\exp(x_i^T\beta))$ where

$Yi$ is the dichotomous variable having values 1 for success (say a child received complete childhood immunization/child not stunted) and 0 for failure (child not completely immunized/child stunted), $xi$ is a vector of independent variables and β is a vector of unknown parameters. Then the odds and the log of odds being success are respectively

$$\frac{pi}{1-pi} = e(x_i^T\beta) \text{ and } \ln\left(\frac{pi}{1-pi}\right) = x_i^T\beta \qquad (1)$$

For a binary explanatory variable, odds ratio (OR) can be easily calculated by taking the exponential of the corresponding regression coefficient ($e^{\beta}$) which helps to interpret the probability of being success for a target group compared to a reference group. It is noted that an OR greater than 1.0 suggests more possibility to occur, while an OR less than 1.00 indicates a decreased likelihood compared to the reference category.

### 3.5.2 Cox Regression

The Cox regression procedure (i.e. survival analysis) is a useful technique for analysis of survival data. It is appropriate in analyzing time-to-event as an outcome variable where it can be assumed that the explanatory variables have a multiplying effect on the hazard rates. This means that, using Cox proportional hazards model, both the occurrence of under-five mortality and the time when the child died were combined to generate the outcome variable. The outcome variable in this study was treated as the time between birth and death of a child under age 59 months (in the case of under-five mortality); or until the observation is censored. In addition, Cox regression analysis handles the censoring problem and permits the inclusion of censored observation. In medical and social science research, an observation is said to be censored when the outcome of interest has not occurred. Using Cox proportional hazards model, the probability of under-five mortality was regarded as the hazard.

The hazard was modeled using the following equations:

$$H(t) = H_0(t) \times \exp(b_1x_1+b_2x_2+\ldots+b_kx_k) \qquad (1)$$

Where $x_1 \ldots x_k$ are explanatory variables and $H_0(t)$ is the baseline of hazard at time t, representing the hazard for a person with the value 0 for all the explanatory variables. Dividing through the both side of equation 1 by $H_0(t)$ and taking a logarithm, then equation one becomes:

$$\ln\left[H(t)/H_0(t)\right] = b_1x_1+b_2x_2+\ldots+b_kx_k \qquad (2)$$

Where $H(t)/H_0(t)$ is the hazard ratio. The coefficient $b_1 \ldots b_k$ are estimates of Cox regression (*Cox 1972*).

### 3.5.3 CHILDHOOD MORTALITY ESTIMATION

The estimate of under-five mortality was derived by indirect method. The procedure in Manual X was adopted (UN, 1983).

The rationale of the Brass's method: the proportion dead for a given age group of mother depends on the lengths of time since the children were born

Step 1: Tabulate the mean children born per woman, and proportion of children dead for given age of mother.

Step 2: Identify adjustment factors by which the proportions of children dead had to be multiplied to give life table function $q(r)$ (probability of dying). Note: This adjustment factor was developed by Trussel in 1979. The adjustment factor $K_1$ is given as:

$$K_1 = a_i + b_i \times P_1/P_2 + c_i \times P_2/P_3$$

Where $a_1$, $b_1$ and $c_1$ are coefficients given by Trussel;

$(P_1/P_2)$ is the ratio of mean children ever born per women in the 15-19 and 20-24 years age group;

$(P_2/P_3)$ is the ratio of mean children ever born per women in the 20-24 and 25-29 years age group

Step 3: Multiply the proportion of children dead by identified adjustment factors to give life table function probability of dying.

That is: $q(r) = D_i \times K_i$

Where $q(r)$ is probability of dying, $D_i$ is proportion of children dead, and $K_i$ is adjustment factors

### 3.6 Ethical Consideration

This study used a secondary analysis and hence there are no serious ethical issues. All the personal identifiers have been removed from the data. As a result, the confidentiality and anonymity of respondents are guaranteed. Also, permission to download and utilize the 2013 NDHS data was obtained from the ICF International before the utilization of the data. See appendix 1.

# CHAPTER FOUR

## 4.0 Data Presentation and Analysis

This chapter presents the results on characteristics of women, patterns of birth spacing and the relationship between preceding birth interval and child health. The assessment involves univariate, bivariate and multivariate analysis of factors related to poor child health in the North-east and North-west Nigeria.

## 4.1 Summary of respondent's background characteristics

Table 4.1 shows the description of respondents interviewed in the core North (North East, NE and North West, NW) Nigeria. The result reveals that, across the age group of mothers, majority of the respondents were between the ages of 25–29 and the least percentage of the respondents interviewed falls within the age group 45-49. According to ages of the children, the percentages were close across all the age groups. Age group 0-11 months has the highest percentage (19.2) while the least percentage (15.9) falls among 24-35 months. Majority (75.2%) of the respondents have no formal education while tertiary education has the lowest percentage (1.6%). Also majority of the respondents were Muslims (91.6%), while percentage of Christian and other religions were 7.7% and 0.7% respectively.

Furthermore, rural residents constituted higher percentage (76.9%) of the respondents, while 23.1% of the respondents resides in urban. More than half (50.4%) of the respondents reported that their children were male while 49.6% reported female children. However, majority of the children were not fully immunized (79.6%). Almost all the respondents were married (99.7%) while 0.3% were not married; very few of the respondents (3.7%) were using contraceptive. About

35.2% of the respondents have more than five surviving children while percentage of women who have no child, 1-2 children and 3-4 children respectively were (1.2%), (31.1%), and (32.5%).

**Table 4.1: Frequency Distribution of Respondents by Background Characteristics**

| Background Characteristic | Frequency | Percentage |
|---|---|---|
| **Age of Mothers (in years)** | | |
| 15-19 | 1144 | 6.6 |
| 20-24 | 3824 | 22.0 |
| 25-29 | 4654 | 26.8 |
| 30-34 | 3366 | 19.4 |
| 35-39 | 2556 | 14.7 |
| 40-44 | 1237 | 7.1 |
| 45-49 | 572 | 3.3 |
| **Age of Children (in Months)** | | |
| 0-11 | 3340 | 19.2 |
| 12-23 | 3078 | 17.7 |
| 24-35 | 2765 | 15.9 |
| 36-47 | 3015 | 17.4 |
| 48-59 | 2855 | 16.5 |
| **Education** | | |
| No Education | 13048 | 75.2 |
| Primary | 2213 | 12.8 |
| Secondary | 1811 | 10.4 |
| Higher | 281 | 1.6 |
| **Religion** | | |
| Christian | 1325 | 7.7 |
| Islam | 15831 | 91.6 |
| Others | 120 | 0.7 |
| **Wealth Index** | | |
| Poorest | 6694 | 38.6 |
| Poorer | 5310 | 30.6 |
| Middle | 2570 | 14.8 |
| Richer | 1790 | 10.3 |
| Richest | 898 | 5.7 |
| **Residence** | | |
| Urban | 4015 | 23.1 |
| Rural | 13338 | 76.9 |
| **Sex of child** | | |
| Male | 8748 | 50.4 |
| Female | 8605 | 49.6 |
| **Sex of sibling** | | |
| Male | 8760 | 52.3 |
| Female | 7971 | 47.6 |
| **Marital Status** | | |
| Never Married | 60 | 0.3 |
| Ever Married | 17292 | 99.7 |
| **Contraception** | | |
| No | 16707 | 96.3 |
| Yes | 646 | 3.7 |
| **Complete Vaccination** | | |
| No | 6902 | 79.6 |
| Yes | 1773 | 20.4 |
| **No of surviving Children** | | |
| 0 | 209 | 1.2 |
| 1-2 | 5404 | 31.1 |
| 3-4 | 5635 | 32.5 |
| 5+ | 6106 | 35.2 |

The figures below describe the age distribution of women of reproductive age (15-49 years) and distribution of birth interval in the Northeast and Northwest regions of Nigeria. According to figure 1, the mean age of women from the core North (n=17353) was 28.79±7.27. This is also affirmed by the age distribution on Table 4.1 in which majority of the respondents falls within the age category of 20-24 years and 25-29 years, making up 22.0% and 26.8% respectively of the population. Figure 2 shows that majority (40.1%) of respondents left interval of 24-35 months before their recent birth while 29.3% of the respondents left interval of 36-59 months. The median birth interval is 31.0 months

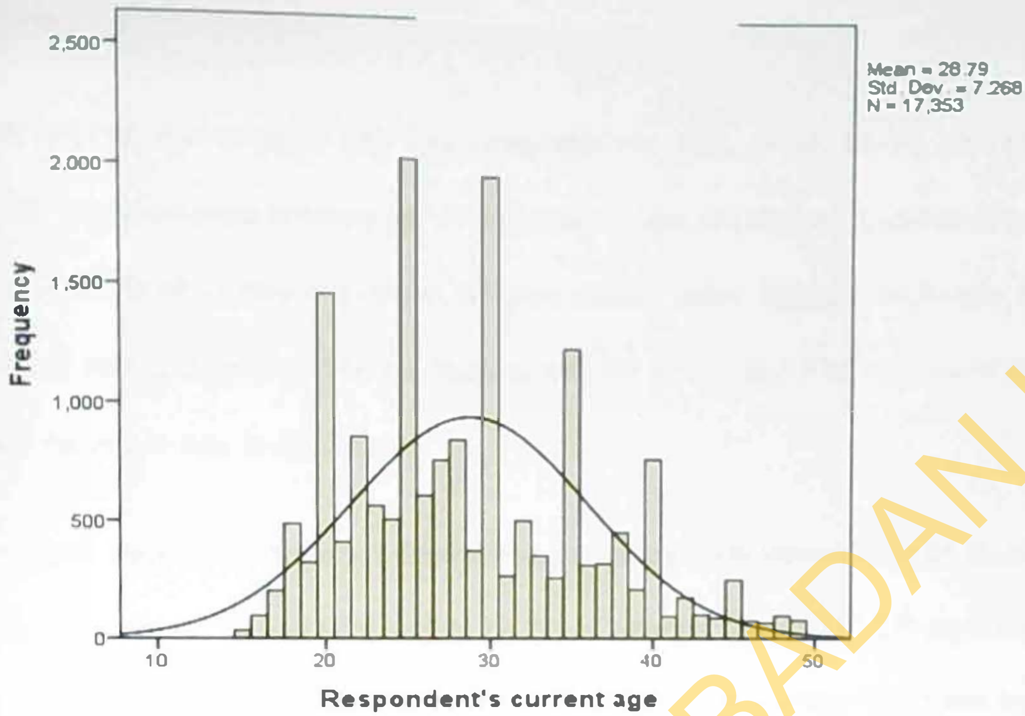
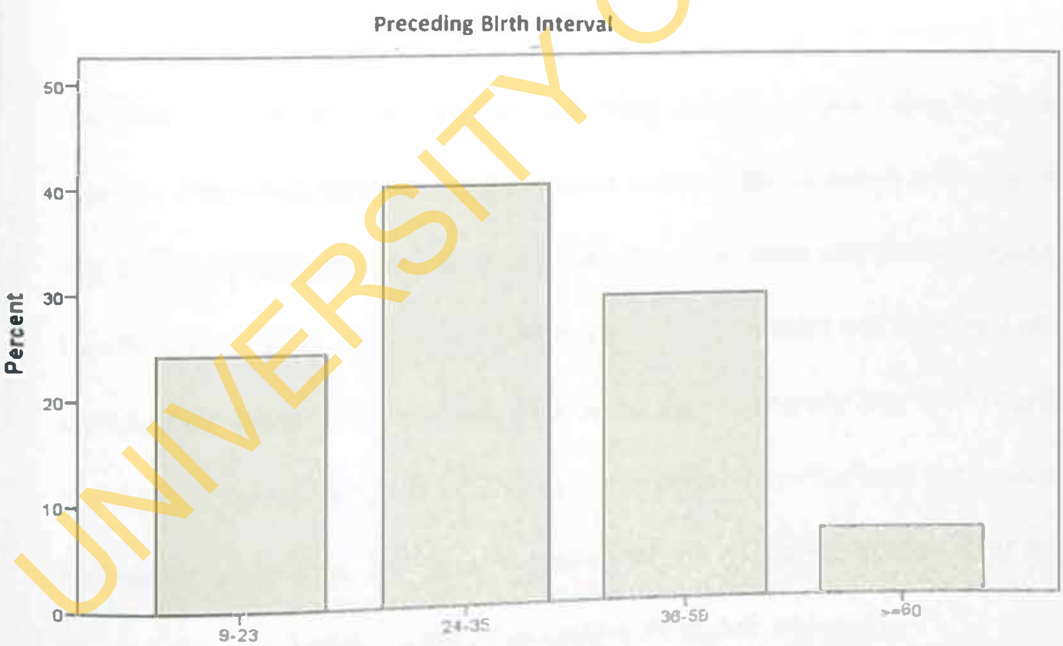



Figure 1: Age distribution of respondents from NE and NW regions Nigeria




Median BI =31.0

Figure 2: Birth Interval of the Study population

**Table 4.2 describes birth spacing (BS) according to background characteristics of respondents and Chi- Square value to examine the patterns of Birth Spacing in Core North Nigeria.**

Birth Interval was grouped into four categories viz: <24, 24-35, 36-59, 60+ months. There is a significant association between age of respondents, age of children, Number of surviving children, educational level, contraceptive use, religion, wealth index, literacy, husbands' educational level, working status, duration of breast-feeding and BS in NE and NW regions of Nigeria at (0.001) while residence was insignificant.

The result shows that there is a decrease in preceding birth interval of <24 months with increase in age of mothers. The data depict that 29.5% of younger women (15-24) reported that the interval between the preceding and succeeding child is less than 24 months while this age group have the lowest percentage of 1.6% among women who spaced index birth for 60 and above. Also, as children age increases, there is a decline in preceding birth interval of 60 months and above. Children ages 0-11 months have the highest preceding birth interval of 60+. About 24.5% of respondents who have at least one surviving child have preceding birth interval of less than 24 months. Preceding birth interval between respondents of urban and rural was very close, 24.7% and 24.1% of respondents reside in urban and rural areas respectively spaced their index birth for less than 24 months. About 24.4 percentage of respondents who reported non-use of contraceptive spaced their index child less than 24 months; approximately 24.7% of Muslim respondents spaced less than 24 months while the Christian respondents have the least percentage of 18.7%. According to level of education, 24.3% of women with no education spaced their index birth less than 24 months compared with 16.3% of women with higher education.

Considering the wealth index of respondents, women in the middle wealth category has the lowest percentage (22.5%) of those who spaced their index birth less than 24 months and 6.6% of them had spaced their index birth for 60 months and above. Respondents who did not breastfeed their children constituted the highest percentage (44.0) among those left less than 24 month before the birth of another child while respondents who breastfeed their children for 12 month and above have the least percentage (33.3). However, among women who had preceding birth interval of less than 24 months, 24.3 % of their husbands had no education compared with those who have higher education (21.8%). Across the working status of respondents, higher number of respondents who spaced their index child less than 24 months was observed among respondents who are currently not working (26.8%) than those who are working (22.8%).

**Table 4.2: Percentage Distribution of Respondents' Background Characteristics by Birth Spacing**

| Background Characteristics | Birth interval | | | | Total | $\chi^2$ valve | P-valve |
|---|---|---|---|---|---|---|---|
| | <24months | 24-35 | 36-59 | 60+ months | | | |
| **Age of Mothers** | | | | | | 454.928 | <0.001 |
| 15-24 | 29.5 | 33.1 | 20.8 | 1.6 | 2612 | | |
| 25-34 | 24.4 | 40.2 | 30.0 | 5.5 | 7509 | | |
| 35+ | 20.8 | 35.1 | 33.1 | 11.0 | 4342 | | |
| **Child's Age** | | | | | | 321.466 | <0.01 |
| 0-11 | 13.6 | 39.1 | 38.6 | 8.7 | 2793 | | |
| 12-23 | 19.0 | 39.9 | 32.5 | 8.5 | 2594 | | |
| 24-35 | 25.1 | 41.3 | 27.7 | 5.9 | 2295 | | |
| 36-47 | 28.2 | 38.5 | 28.0 | 5.2 | 2517 | | |
| 48-59 | 27.2 | 41.4 | 26.7 | 4.7 | 2433 | | |
| **Number of Surviving Children** | | | | | | 40.247 | <0.001 |
| 0 | 38.6 | 54.5 | 6.8 | 0.0 | 44 | | |
| 1-2 | 24.6 | 42.4 | 25.8 | 7.2 | 2776 | | |
| 3-4 | 24.0 | 39.5 | 30.0 | 6.4 | 5540 | | |
| 5+ | 24.2 | 40.1 | 29.3 | 6.4 | 6104 | | |
| **Residence** | | | | | | 1.798 | <0.615 |
| Urban | 24.7 | 39.1 | 29.6 | 6.6 | 3320 | | |
| Rural | 24.1 | 40.4 | 29.1 | 6.4 | 11142 | | |
| **Contraception use** | | | | | | 28.385 | <0.001 |
| No | 24.4 | 40.3 | 29.1 | 6.2 | 13911 | | |
| Yes | 21.1 | 34.8 | 33.0 | 11.1 | 551 | | |
| **Religion** | | | | | | 64.519 | <0.001 |
| Christian | 18.7 | 36.2 | 35.2 | 10.0 | 1045 | | |
| Islam | 24.7 | 40.3 | 28.9 | 6.1 | 13253 | | |
| Other | 22.1 | 50.0 | 17.3 | 10.6 | 104 | | |
| **Education** | | | | | | 33.40 | <0.001 |
| No Education | 24.3 | 40.2 | 29.2 | 6.3 | 11100 | | |
| Primary | 23.5 | 40.9 | 29.1 | 6.5 | 1843 | | |
| Secondary | 25.9 | 38.7 | 29.6 | 5.7 | 1311 | | |
| Higher | 16.3 | 38.0 | 30.8 | 14.9 | 208 | | |
| **Duration of Ever breastfeeding** | | | | | | 29.675 | <0.001 |
| None | 44.0 | 38.4 | 12.0 | 5.6 | 125 | | |
| <12months | 38.1 | 39.4 | 13.4 | 9.1 | 2492 | | |
| 12+ | 33.3 | 39.6 | 18.2 | 8.9 | 2284 | | |
| **Wealth Index** | | | | | | 25.776 | <0.05 |
| Poorest | 23.0 | 41.1 | 29.6 | 6.3 | 5711 | | |
| Poorer | 26.3 | 39.3 | 28.2 | 6.2 | 4408 | | |
| Middle | 22.5 | 40.3 | 30.6 | 6.6 | 2094 | | |
| Richer | 25.7 | 39.2 | 28.4 | 6.7 | 1455 | | |
| Richest | 23.7 | 37.8 | 31.0 | 7.6 | 794 | | |
| **Partner's education** | | | | | | 31.902 | <0.01 |
| No Education | 24.3 | 39.9 | 29.4 | 6.4 | 8978 | | |
| Primary | 23.5 | 41.1 | 29.9 | 5.5 | 2130 | | |
| Secondary | 25.4 | 39.6 | 28.8 | 6.2 | 2066 | | |
| Tertiary | 21.8 | 42.3 | 27.6 | 8.3 | 1114 | | |
| **Currently working** | | | | | | 46.682 | <0.001 |
| No | 26.8 | 40.2 | 27.2 | 5.8 | 5441 | | |
| Yes | 22.8 | 40.0 | 30.4 | 6.8 | 8940 | | |

Table 4.3.1 gives an account of immunization status of the children in the NE and NW regions of Nigeria across some selected socio-demographic characteristics and preceding birth interval. The chi square statistics (p value) shows the statistical significance between maternal age, residence, education, wealth index, preceding birth interval and immunization. Table 4.3.1 shows that all demographic characteristics but not preceding birth interval were significant at 0.001. The result depicts that 42.5% and 28.6% of respondents in age group 15-19 and 45-49, respectively reported that their children were not fully immunized. Among women, who reside in urban and rural areas, about 69.2% and 64.7%, respectively reported that their children are fully immunized.

Furthermore, respondents who had higher education (83.5%) and no education (60.9%) constituted the highest and the least percentage of who reported that their children are fully immunized. Table 4.3.1 shows that 42.5%, 43.1%, 41.0% and 41.8% of women who had preceding birth interval of < 24, 25-35, 36-59 and 60+ months respectively did not fully immunized their children. Across the wealth index, 41.3% of the women whose children were not fully immunized were the poorest while 17.6% were the richest.

**Table 4.3.1: Distribution of immunization experience by selected background characteristics of respondents**

| Background Characteristics | Immunization No | Yes | Total | $\chi^2$ valve | P-value |
|---|---|---|---|---|---|
| **Maternal Age** | | | | 45.46 | P<0.001 |
| 15-19 | 42.5 | 57.5 | 968 | | |
| 20-24 | 35.6 | 64.4 | 3303 | | |
| 25-29 | 33.6 | 66.4 | 4058 | | |
| 30-34 | 33.9 | 66.1 | 2871 | | |
| 35-39 | 32.3 | 67.7 | 2168 | | |
| 40-44 | 32.0 | 68.0 | 1050 | | |
| 45-49 | 28.6 | 71.4 | 469 | | |
| **Residence** | | | | 25.39 | P<0.001 |
| Urban | 30.8 | 69.2 | 3645 | | |
| Rural | 35.3 | 64.7 | 11237 | | |
| **Education** | | | | 471.81 | P<0.001 |
| No education | 39.1 | 60.9 | 11022 | | |
| Primary | 24.0 | 76.0 | 1944 | | |
| Secondary | 16.6 | 83.4 | 1656 | | |
| Higher | 16.5 | 83.5 | 261 | | |
| **Birth Interval** | | | | 4.16 | P>0.05 |
| <24 | 42.5 | 57.5 | 2790 | | |
| 24-35 | 43.1 | 56.9 | 4979 | | |
| 36-59 | 41.0 | 59.0 | 3845 | | |
| 60+ | 41.8 | 58.2 | 850 | | |
| **Wealth Index** | | | | | |
| Poorest | 41.3 | 58.7 | 5650 | 298.06 | P<0.001 |
| Poorer | 32.3 | 67.7 | 4436 | | |
| Middle | 33.1 | 66.9 | 2251 | | |
| Richer | 25.7 | 74.3 | 1633 | | |
| Richest | 17.6 | 82.4 | 914 | | |

Table 4.3.1: Distribution of immunization experience by selected background characteristics of respondents

| Background Characteristics | Immunization No | Yes | Total | $\chi^2$ valve | P-value |
|---|---|---|---|---|---|
| **Maternal Age** | | | | 45.46 | P<0.001 |
| 15-19 | 42.5 | 57.5 | 968 | | |
| 20-24 | 35.6 | 64.4 | 3303 | | |
| 25-29 | 33.6 | 66.4 | 4058 | | |
| 30-34 | 33.9 | 66.1 | 2871 | | |
| 35-39 | 32.3 | 67.7 | 2168 | | |
| 40-44 | 32.0 | 68.0 | 1050 | | |
| 45-49 | 28.6 | 71.4 | 469 | | |
| **Residence** | | | | 25.39 | P<0.001 |
| Urban | 30.8 | 69.2 | 3645 | | |
| Rural | 35.3 | 64.7 | 11237 | | |
| **Education** | | | | 471.81 | P<0.001 |
| No education | 39.1 | 60.9 | 11022 | | |
| Primary | 24.0 | 76.0 | 1944 | | |
| Secondary | 16.6 | 83.4 | 1656 | | |
| Higher | 16.5 | 83.5 | 261 | | |
| **Birth Interval** | | | | 4.16 | P>0.05 |
| <24 | 42.5 | 57.5 | 2790 | | |
| 24-35 | 43.1 | 56.9 | 4979 | | |
| 36-59 | 41.0 | 59.0 | 3845 | | |
| 60+ | 41.8 | 58.2 | 850 | | |
| **Wealth Index** | | | | | |
| Poorest | 41.3 | 58.7 | 5650 | 298.06 | P<0.001 |
| Poorer | 32.3 | 67.7 | 4436 | | |
| Middle | 33.1 | 66.9 | 2251 | | |
| Richer | 25.7 | 74.3 | 1633 | | |
| Richest | 17.6 | 82.4 | 914 | | |

Table 4.3.2 explains the factors responsible for differences in Immunization among children in core North Nigeria using logistic regression model. The table consists of three models; first model describes the interaction of immunization and birth spacing, second model describe the influence of preceding birth interval on Immunization after controlling for demographic factors (age of mothers and age at first birth) while the third model explains the influence of preceding birth interval when age of mothers, religion, residence, wealth index, education, working status, age at first birth, marital status and partner's education have been controlled for. The first model shows that there is no relationship between complete immunization status of children and birth spacing in core North Nigeria ($p>0.05$). Second model shows that the age of mothers and age at first birth were related to immunization status of the children. In addition, respondents in the age group 45-49 are 2.01 times more likely to complete immunization for their children than their counterparts in age-group 15-19. Also, the odds of women who had first birth before age 18 was lower compared to women who had first birth at age 18 and above to complete immunization for their children.

Furthermore, third model shows the insignificant association between preceding birth interval, marital status, partner's education and immunization. Age of mothers, religion, residence wealth index, education level and working status of respondents are significantly associated with immunization status of the children. Respondents who are in age group 45-49 remain statistically significant, and were 2.20 times more likely than those in age group of 15-19 to complete immunization for their children. Muslims were 0.12 less likely to complete immunization for their children than Christian with wider CI (OR=0.88, CI = 1.79-4.61). Respondents who live in rural area were 0.32 less likely to complete immunization for their children compared with their urban counterparts, the odd is statistically significant. The richest women have a higher odds of completing immunization for their children which is also statistically significant. And, as expected; the results reveals that the level of education has significant odds and women who have higher education are 3.22 times more likely to complete immunization for their children compared with women with no education. However, women who are currently working were 0.65 less likely to complete immunization for their children compared with those who are not working currently. This has a significant odd with a wider C.I (OR=0.35, CI = 0.12-0.96). Respondent's husband/partner education does not have a significant odds.

**Table 4.3.2 Logistic regression of factors responsible for differences in Immunization among children in core North Nigeria**

| Background Characteristics | Model 1 UOR(95% C.I) | Model 2 AOR(95% C.I) | Model 3 AOR(95% C.I) |
|---|---|---|---|
| **Preceding Birth Interval** | | | |
| <24 months(*Ref cat)* | | | |
| 24-35 | 1.03(0.94-1.14) | 1.01(0.92-1.13) | 1.02(0.92-1.12) |
| 36-59 | 0.99(0.90-1.10) | 0.93(0.84-1.03) | 0.93(0.84-1.03) |
| 60+ | 1.08(0.92-1.27) | 0.94(0.79-1.10) | 0.95(0.80-1.12) |
| **Age of mothers** | | | |
| 15-19(ref cat) | | | |
| 20-24 | | 1.27(0.93-1.71) | 1.29(0.96-1.73) |
| 25-29 | | 1.53(1.14-2.04)* | 1.54(1.15-2.06)* |
| 30-34 | | 1.49(1.11-2.01)* | 1.52(1.13-2.04)* |
| 35-39 | | 1.63(1.21-2.20)* | 1.65(1.22-2.22)* |
| 40-44 | | 1.71(1.25-2.37)* | 1.73(1.27-2.78)** |
| 45-49 | | 2.01(1.41-2.85)** | 2.02(1.43-2.87)** |
| **Age at first birth** | | | |
| <18(ref) | | | |
| 18+ | | 0.91(0.85-0.97)*** | 0.85(0.76-0.96)*** |
| **Residence** | | | |
| Urban(ref) | | | |
| Rural | | | 0.68(0.57-0.80)** |
| **Wealth Index** | | | |
| Poorest(ref) | | | |
| Poorer | | | 0.43(0.30-0.61)** |
| Middle | | | 0.57(0.40-0.81)** |
| Richer | | | 0.53(0.38-0.74)** |
| Richest | | | 0.65(0.47-0.89)* |
| **Education** | | | |
| No education(ref) | | | |
| Primary | | | 2.04(1.82-2.28)** |
| Secondary | | | 3.22(2.82-3.69)** |
| Higher | | | 3.22(2.32-4.47)** |
| **Currently working** | | | |
| No(ref) | | | |
| Yes | | | 0.35(0.12-0.96)* |
| **Religion** | | | |
| Christian (ref) | | | |
| Islam | | | 0.88(1.79-4.65)** |
| Others | | | 0.81(0.52-1.27) |
| **Current marital status** | | | |
| Never married (ref) | | | |
| Ever married | | | 0.54(0.82-3.53) |
| **Partner's Education** | | | |
| No Education(ref) | | | |
| Primary | | | 0.80(0.44-1.47) |
| Secondary | | | 1.36(0.73-2.52) |
| Higher | | | 1.28(0.68-2.38) |

***p<0.001; *p<0.01; ***p<0.05; UOR: Unadjusted Odds ratio; AOR: Adjusted Odds ratio; Ref. Cat.: Reference category*

Table 4.4.1 describes the relationship between nutrition status (stunting) of the children in the NE and NW regions of Nigeria with some selected socio-demographic characteristics and preceding birth interval. The chi square statistics (p value) shows the statistical significance between age, residence, education, wealth index, birth interval and stunting. The data depict that birth interval and all the selected demographic characteristics were significant. This result reveals that 37.8% of women in age group 15-19, reported stunted children compared with 45-49 age group (45.4%); and also of women who live in urban whose children were stunted are 31.5% compared with 41.8% of their rural counterparts

Among women whose children are stunted, women with no education constituted the highest percentage (41.3%), while the least was those who have higher education (23.6%). In addition, table 4.4.1 shows that women who left less than 24 month before the birth of index child reported highest percentage of stunted children (42.3%) while women who had preceding birth interval of 60 months and above reported 33.1% of stunted children. Regarding the wealth index, 43.4% of the women whose children were stunted are the poorest while 29.3 percent of the richer respondents reported stunted children.

**Table 4.4.1 Distribution of Nutrition experience by selected background characteristics of respondents**

| Background Characteristics | Stunting | | | | |
|---|---|---|---|---|---|
| | No | Yes | Total | $\chi^2$ valve | P-value |
| **Age** | | | | 15.24 | P<0.01 |
| 15-19 | 62.2 | 37.8 | 966 | | |
| 20-24 | 61.7 | 38.3 | 3294 | | |
| 25-29 | 61.1 | 38.9 | 4089 | | |
| 30-34 | 61.4 | 38.6 | 2925 | | |
| 35-39 | 59.6 | 40.4 | 2245 | | |
| 40-44 | 57.9 | 42.1 | 1069 | | |
| 45-49 | 60.7 | 45.4 | 467 | | |
| **Residence** | | | | 124.58 | P<0.001 |
| Urban | 68.5 | 31.5 | 3681 | | |
| Rural | 58.2 | 41.8 | 11374 | | |
| **Education** | | | | 121.894 | P<0.001 |
| No education | 58.7 | 41.3 | 11195 | | |
| Primary | 61.2 | 38.8 | 1948 | | |
| Secondary | 71.2 | 28.8 | 1653 | | |
| Higher | 76.4 | 23.6 | 258 | | |
| **Birth Interval** | | | | 35.850 | P<0.001 |
| <24 | 57.7 | 42.3 | 2823 | | |
| 24-35 | 59.5 | 40.5 | 5051 | | |
| 36-59 | 63.0 | 37.0 | 3912 | | |
| 60+ | 66.9 | 33.1 | 847 | | |
| **Wealth Index** | 56.6 | | | 180.024 | P<0.001 |
| Poorest | 59.0 | 43.4 | 5716 | | |
| Poorer | 70.7 | 41.0 | 4492 | | |
| Middle | 73.7 | 38.1 | 2286 | | |
| Richer | 60.7 | 29.3 | 1646 | | |
| Richest | | 39.3 | 915 | | |

Table 4.4.2 shows the unadjusted odds for age of mothers, education, residence, birth interval, wealth index and nutritional status (stunting) of the children in core north Nigeria. This table describes the single influence of birth spacing and selected socio demographic variables on nutritional status (stunting) of the children in the core north Nigeria. According to Table 4.4.2, there is a significant association between preceding birth interval and nutritional status. Children who have a preceding birth interval of 24-35 months were 0.7 times less likely to be stunted compared with the children who have preceding birth interval of less than 24 months. Also, women in the age group of 45-49 have a wider C.I (OR=1.37, CI = 1.09-1.71), and they were 1.37 more likely to have stunted children compared to women in age group 15-19 and the odd is statistically significant.

Based on the ages of the children, children in the age group of 24-35 months were 3.22 times more likely to be stunted compared to children of ages 0-11 months while children of 12-23 months were 2.83 times more likely to be stunted compared with those in ages 0-11 months. The odd of child's age is statistically significant. Furthermore, children of women who have primary education have higher relative risk of stunting (0.90), when compared with higher education (0.44) and the odds is statistically significant. Children of women in the richest category of wealth index were 0.53 less likely to be stunted compared with poorest women category. Also, women who practiced other religion has higher odd of 1.81 compared to Muslim women (1.28). In addition, respondents who have more than 5 living children were 1.09 times more likely to have stunted children compared with those women who have 1-2 children.

Concerning the education status of respondents' partners, the odd is statistically significant and respondents who have partners with higher education were 0.45 times less likely to have stunted children compared with those partners that have no education. Respondents who reside in rural area were 0.64 times more likely to have their children to be stunted compared with those who reside in urban; and women who are currently working has the higher odd of 1.12 compared with those who are not working and the odd is significant.

**Table 4.4.2 Logistic regression of factors responsible for differences in Stunting among children in core North Nigeria**

| Independent variables | Unadjusted Odd ratio (95% CI) | p-valve |
|---|---|---|
| **Preceding Birth Interval** | | |
| <24 months*(Ref)* | | |
| 24-35 | 0.93(0.85-1.02) | 0.12 |
| 36-59 | 0.80(0.73-0.89) | 0.00 |
| 60+ | 0.67(0.57-0.79) | 0.00 |
| **Age of mothers** | | |
| 15-24 *(ref)* | | |
| 20-24 | 1.02(0.88-1.19) | 0.76 |
| 24-29 | 1.05(0.90-1.21) | 0.50 |
| 30-34 | 1.04(0.89-1.20) | 0.64 |
| 35-39 | 1.12(0.96-1.31) | 0.15 |
| 40-44 | 0.20(1.00-1.43) | 0.05 |
| 45-49 | 1.37(1.09-1.71) | 0.01 |
| **Child's age in months** | | |
| 0-11*(ref)* | | |
| 12-23 | 2.83(2.55-3.18) | 0.00 |
| 24-35 | 3.22(2.88-3.60) | 0.00 |
| 36-47 | 3.03(2.71-3.38) | 0.00 |
| 48-59 | 2.80(2.50-3.12) | 0.00 |
| **Education** | | |
| No education(ref) | | |
| Primary | 0.90(0.82-0.99) | 0.04 |
| Secondary | 0.58(0.51-0.64) | 0.00 |
| Higher | 0.44(0.33-0.59) | 0.00 |
| **Wealth Index** | | |
| Poorest(ref) | | |
| Poorer | 0.91(0.84-0.98) | 0.01 |
| Middle | 0.80(0.73-0.88) | 0.00 |
| Richer | 0.54(0.48-0.61) | 0.00 |
| Richest | 0.47(0.40-0.54) | 0.00 |
| **Religion** | | |
| Christian(ref) | | |
| Islam | 1.28(1.13-1.46) | 0.00 |
| Others | 1.81(1.21-2.71) | 0.00 |
| **Number of surviving children** | | |
| 1-2(ref) | | |
| 3-4 | 1.07(0.99-1.16) | 0.09 |
| 5+ | 1.09(1.00-1.18) | 0.04 |
| **Sex of child** | | |
| Male(ref) | | |
| Female | 0.93(0.87-0.99) | 0.04 |
| **Husband/Partner educational level** | | |
| No Education(ref) | | |
| Primary | 1.09(0.99-1.19) | 0.09 |
| Secondary | 0.75(0.69-0.83) | 0.00 |
| Higher | 0.55(0.48-0.63) | 0.00 |
| **Residence** | | |
| Urban(ref) | | |
| Rural | 0.64(0.59-0.69) | 0.00 |
| **Respondent Currently working** | | |
| No(ref) | | |
| Yes | 1.12(1.04-1.19) | 0.00 |

Table 4.5.1 describes the relationship between nutrition status (underweight) of the children in the NE and NW regions of Nigeria with some selected socio-demographic characteristics and preceding birth interval. The chi square statistics (p value) shows the statistical significance between residence, education status, wealth index, birth interval and underweight but not with age of mothers. The data depicts that birth interval and all the selected demographic characteristics were significant at 0.05 except for age of mothers. This result reveals that 37.7% of women in age group 15-19 children were underweight compared with 45-49 age group (40.1%); and also of women who live in urban whose children were underweight are 37.0 percent compared with their rural counterparts (39.0%).

Furthermore, among women whose children were underweight, 40.3% have no education while 20.7% have higher education. It has been revealed that 41.4 %, 40.0%, 35.7% and 34.2% of children of women with preceding birth interval of < 24, 25-35, 36-59 and 60+, respectively were underweight. Regarding the wealth index, 41.2% of the women whose children are stunted are the poorest while 38.6% were the richest.

**Table 4.5.1 Distribution of nutrition experience by selected background characteristics of respondents**

| Background Characteristics | Underweight | | | | |
|---|---|---|---|---|---|
| | No | Yes | Total | $\chi^2$ value | P-value |
| **Age** | | | | 6.69 | P=0.35 |
| 15-19 | 62.3 | 37.7 | 872 | | |
| 20-24 | 62.1 | 37.9 | 3067 | | |
| 25-29 | 61.6 | 38.4 | 3869 | | |
| 30-34 | 61.8 | 38.2 | 2766 | | |
| 35-39 | 59.2 | 40.8 | 2102 | | |
| 40-44 | 62.7 | 37.3 | 1015 | | |
| 45-49 | 59.9 | 40.1 | 441 | | |
| **Residence** | | | | 4.08 | P<0.05 |
| Urban | 63.0 | 37.0 | 3006 | | |
| Rural | 61.0 | 39.0 | 11126 | | |
| **Education** | | | | 75.24 | P<0.001 |
| No education | 59.7 | 40.3 | 10447 | | |
| Primary | 63.9 | 36.1 | 1941 | | |
| Secondary | 67.7 | 32.3 | 1503 | | |
| Higher | 79.3 | 20.7 | 241 | | |
| **Birth Interval** | | | | 31.98 | P<0.001 |
| <24 | 58.6 | 41.4 | 2658 | | |
| 24-35 | 60.0 | 40.0 | 4793 | | |
| 36-59 | 64.3 | 35.7 | 3674 | | |
| 60+ | 65.8 | 34.2 | 800 | | |
| **Wealth Index** | | | | 35.35 | P<0.001 |
| Poorest | 58.8 | 41.2 | 5411 | | |
| Poorer | 61.6 | 38.4 | 4404 | | |
| Middle | 64.7 | 35.3 | 2152 | | |
| Richer | 65.4 | 34.6 | 1423 | | |
| Richest | 61.4 | 38.6 | 742 | | |

Table 4.5.2 describe the single influence of birth spacing and selected socio-demographic factors on nutritional status of children (underweight). Birth interval and the socio-demographic factors have significant odds except for sex of the child which is not significant. The result shows that children who have preceding birth interval of 35-59 months were 0.13 times less likely to be underweight compared with those who have preceding birth interval of less than 24 months. Also, children of women of age group 45-49 were 0.03 less likely to be underweight compared to the youngest age group. The odd of children of age group 24-35 month to be underweight was 3.19 times than those in age group 0-11 month; and it has been observed that children of women with higher education were 0.84 times less likely to be underweight compared with those with no education.

It has been shown from table 4.5.2 that the odd of richest children to be underweight was the lowest compared to the poorest respondents (0.26); and children of respondents who practiced other religion were 1.52 times more likely to be underweight compared with the Christian. However, respondents with 5 children and above are 1.22 times more likely to have underweight children than those with two children. The children of respondents whose partner have higher education were 0.67 less likely to be underweight compared with those with no education. Children of Women who live in rural areas were 1.65 more likely to be underweight than the urban; and respondents who are currently working were 0.25 times less likely than those who are not working to have stunted children.

**Table 4.5.2 Logistic regression of factors responsible for differences in underweight among children in core North Nigeria**

| Independent variable | Unadjusted Odd ratio (95% CI) | p-valve |
|---|---|---|
| **Preceding Birth Interval** | | |
| <24 months (*Ref*) | | |
| 24-35 | 0.98(0.90-1.08) | 0.77 |
| 36-59 | 0.87(0.79-0.96) | 0.01 |
| 60+ | 0.83(0.71-0.97) | 0.02 |
| **Age of mothers** | | |
| 15-24 *(ref)* | | |
| 20-24 | 0.90(0.79-1.03) | 0.13 |
| 24-29 | 0.79(0.69-0.90) | 0.00 |
| 30-34 | 0.74(0.65-0.84) | 0.00 |
| 35-39 | 0.80(0.70-0.92) | 0.00 |
| 40-44 | 0.78(0.67-0.91) | 0.00 |
| 45-49 | 0.96(0.79-1.17) | 0.00 |
| **Child's age in months** | | |
| 0-11*(ref)* | | |
| 12-23 | 3.04(2.72-3.40) | 0.00 |
| 24-35 | 3.19(2.85-3.57) | 0.00 |
| 36-47 | 2.28(2.04-2.55) | 0.00 |
| 48-59 | 2.14(1.91-2.40) | 0.00 |
| **Education** | | |
| No education(ref) | | |
| Primary | 0.55(0.52-0.59) | 0.00 |
| Secondary | 0.36(0.33-0.38) | 0.00 |
| Higher | 0.16(0.14-0.19) | 0.00 |
| **Wealth Index** | | |
| Poorest(Ref) | | |
| Poorer | 0.16(0.14-0.19) | 0.00 |
| Middle | 0.76(0.71-0.82) | 0.00 |
| Richer | 0.52(0.48-0.56) | 0.00 |
| Richest | 0.40(0.37-0.43) | 0.00 |
| **Religion** | 0.26(0.23-0.28) | 0.00 |
| Christian(ref) | | |
| Islam | 0.52(0.40-0.69) | 0.00 |
| Others | 1.45(1.11-1.90) | 0.00 |
| **Number of surviving children** | | |
| 1-2(ref) | | |
| 3-4 | 1.07(1.00-1.14) | 0.04 |
| 5+ | 1.22(1.13-1.30) | 0.00 |
| **Sex of child** | | |
| Male(ref) | | |
| Female | 0.16(0.96-1.01) | 0.16 |
| **Partner educational level** | | |
| No Education(ref) | | |
| Primary | 0.63(0.58-0.68) | 0.00 |
| Secondary | 0.43(0.40-0.46) | 0.00 |
| Higher | 0.33(0.30-0.37) | 0.00 |
| **Residence** | | |
| Urban(ref) | | |
| Rural | 1.65(1.56-1.75) | 0.00 |
| **Currently working** | | |
| No(ref) | | |
| Yes | 0.85(0.81-0.90) | 0.00 |

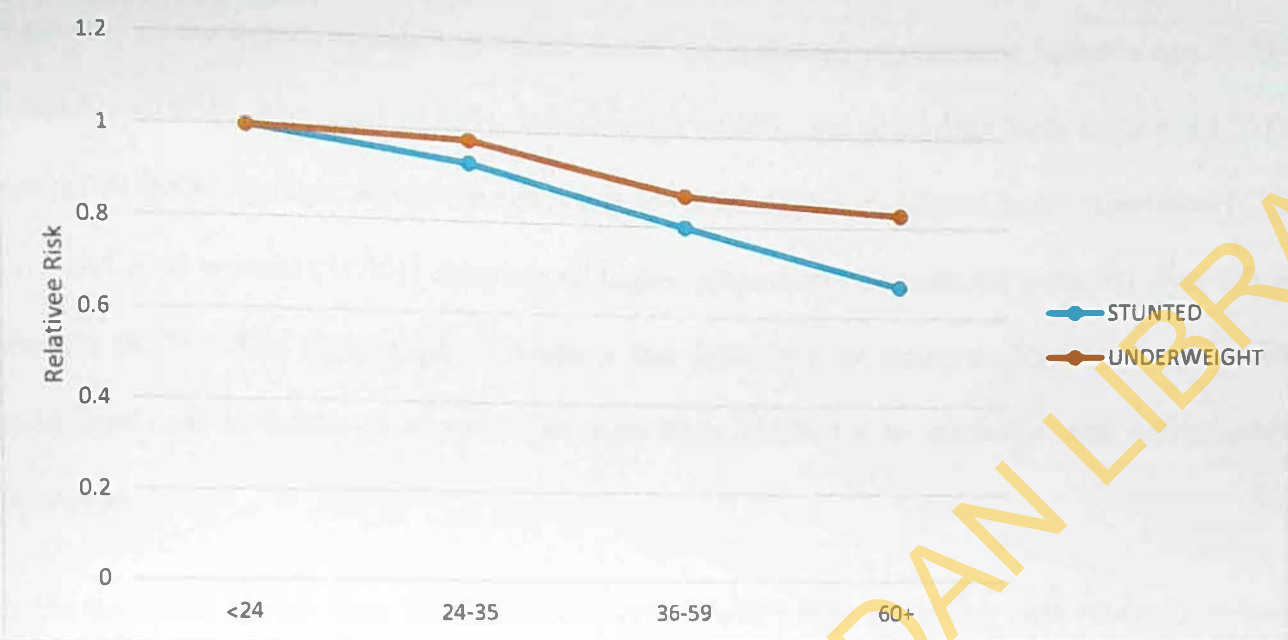



**Figure 3: Childhood Nutritional status by birth interval.**

The odds ratios based on the results of the relationship between birth spacing and childhood nutritional status in NE and NW are shown in Fig. 3 for both stunting and underweight. It is clear that undernutrition declines substantially with longer intervals. Indeed, children born after an interval of 35-59 months were 20% less likely to be stunted and 13% less likely to be underweight than children born after an interval of less than 24 months.

Table 4.6.1 shows the percentage distribution of children according to child survival status by preceding birth interval and selected background characteristics of mothers in the core Northern Nigeria. The chi square statistics (p value) shows the statistical significance between age (0.01), residence (0.001), education (0.001), wealth index (0.001) and preceding birth interval (0.001). Across all the age groups, women in age group 45-49 has higher childhood death experience (15.1 %); and rural women (11.9%) experienced higher proportion of childhood mortality than urban women (6.3%). The percentage of mothers that have lost, at least, a child in the past fell consistently as the levels of education increase from 11.6% for no education and 4.6% higher education.

It has also been shown from the Table 4.6.1 that women whose preceding birth interval are less than 24 months experience childhood mortality the most (16.1%). Across the wealth index, poorer women has the highest percent of childhood mortality (12.1%) compared to the richest women (6.2%).

**Table 4.6.1 Distribution of Childhood Mortality experience by selected background characteristics of respondents**

| Background Characteristics | Childhood Mortality No | (Child Alive) Yes | Total | χ2 value | P-value |
|---|---|---|---|---|---|
| **Age** | | | | 24.092 | P<0.01 |
| 15-19 | 13.0 | 87.0 | 1143 | | |
| 20-24 | 10.3 | 89.7 | 3823 | | |
| 25-29 | 9.7 | 90.3 | 4654 | | |
| 30-34 | 10.5 | 89.5 | 3367 | | |
| 35-39 | 10.4 | 89.6 | 2555 | | |
| 40-44 | 10.8 | 84.9 | 1237 | | |
| 45-49 | 15.1 | 89.4 | 571 | | |
| **Residence** | | | | 103.006 | P<0.001 |
| Urban | 6.3 | 93.7 | 4015 | | |
| Rural | 11.9 | 88.1 | 13338 | | |
| **Education** | | | | 72.323 | P<0.001 |
| No education | 11.6 | 88.4 | 13048 | | |
| Primary | 8.9 | 91.1 | 2214 | | |
| Secondary | 6.0 | 94.0 | 1811 | | |
| Higher | 4.6 | 95.4 | 281 | | |
| **Birth Interval** | | | | 251.401 | P<0.001 |
| <24 | 16.1 | 83.9 | 3507 | | |
| 24-35 | 10.6 | 89.4 | 5797 | | |
| 36-59 | 5.6 | 94.4 | 4230 | | |
| 60+ | 6.0 | 94.0 | 928 | | |
| **Wealth Index** | | | | 133.202 | P<0.001 |
| Poorest | 12.1 | 87.9 | 6694 | | |
| Poorer | 12.6 | 87.4 | 5310 | | |
| Middle | 7.7 | 92.3 | 2570 | | |
| Richer | 5.4 | 94.6 | 1790 | | |
| Richest | 6.2 | 93.8 | 989 | | |

**Table 4.6.2 Unadjusted and Adjusted Cox Regression of Relationship between Childhood Mortality Experience and Selected Background Characteristics of Respondents**

| Background Characteristics | Unadjusted Exp(β) (95% C.I) | Adjusted Exp(β) (95% C.I) |
|---|---|---|
| **Preceding Birth Interval** | | |
| <24 months*(Ref cat)* | | |
| 24-35 | 0.92(0.82-1.03) | 0.92(0.82-1.04) |
| 36-59 | 1.04(0.89-1.21) | 1.06(0.91-1.23) |
| 60+ | 0.90(0.69-1.17) | 0.92(0.70-1.21) |
| **Age of mothers** | | |
| 15-19(ref cat) | | |
| 20-24 | | 0.68(0.45-1.03) |
| 25-29 | | 0.65(0.43-0.96)* |
| 30-34 | | 0.65(0.44-0.98)* |
| 35-39 | | 0.68(0.45-1.02) |
| 40-44 | | 0.73(0.48-1.11) |
| 45-49 | | 0.51(0.33-0.80)** |
| **Religion** | | |
| Christian(ref) | | |
| Islam | | 0.70(0.58-0.86)* |
| Others | | 0.68(0.37-1.27) |
| **Residence** | | |
| Urban(ref) | | |
| Rural | | 0.86(0.73-1.02) |
| **Wealth Index** | | |
| Poorest | | 0.99(0.89-1.11) |
| Poorer | | 1.29(1.08-1.54)* |
| Middle | | 1.36(1.05-1.75)* |
| Richer | | 1.66(1.19-2.32)* |
| Richest(ref) | | |
| **Education** | | |
| No education | | 1.15 (0.98-1.34) |
| Primary | | 1.49(1.18-1.88)* |
| Secondary | | 1.48(0.71-3.13) |
| Higher(ref) | | |
| **Ever Breastfeeding** | | |
| Yes(ref) | | |
| No | | 2.13(1.80-2.51)** |

***p<0.001; *p<0.01; UOR: Unadjusted Odds ratio; AOR: Adjusted Odds ratio; Ref. Cat.: Reference category***

Table 4.6.2 shows the Cox-proportional hazard models for under-five mortality and birth interval and selected socio-demographic factors. From the table, birth interval does not have a significant odds on childhood mortality and even when adjusting for confounding variables. The table shows that mothers in the age group 45-49 were 0.49 less likely to experience childhood mortality than their counterparts. Women who belong to other religion affiliation were 0.32 less likely to experienced childhood mortality than their Christian counterparts. Resident do not have a significant odds; and children of the poorer women were 1.29 times more likely to die compared with the richest women. More so, children of women with primary education were 1.49 more likely to die than the higher educated women. Children who are not breastfed were 2.13 time more likely to die than those who are breastfed.

Table 4.7.1 and 4.7.2 show the derivation of probability of dying, mortality level and smoothed probability level in NE and NW Nigeria. The probability of dying reduces with age ranging from ages 1 to 3 (0.3132256, 0.200833 and 0.185678) and then pick increment from age 5 till age 20. The smoothening of mortality probabilities either reduces or increases the unadjusted mortality probability in the regions. Across ages 1, 2, 3, 5, 10, 15 and 20 of the children, smoothed probabilities of dying were consistently higher ranging from 0.143233 for infants to 0.261293 for children under age 20. The reference period was also estimated to know when in the past can the mortality experienced be referred. From table 4.7.2 it reveals that mortality had been experienced about 7 years before the survey.

Figure 4 depicts the results of unadjusted and adjusted childhood mortality probabilities in the core Northern Nigeria. The data show that clear differences existed between the unadjusted and adjusted childhood probabilities of dying in the regions. The unadjusted probabilities of dying at all childhood ages were consistently higher among women. Also, the unadjusted probabilities of dying increase steadily with the age of the child.

Table 4.7.1 Derivation of Probability of Dying in core North Nigeria (North East and North West)

| Age | CEB | CD | FPi | Pi | di | Ki | Qx | lx |
|---|---|---|---|---|---|---|---|---|
| 15-19 | 457 | 138 | 3618 | 0.11 | 0.30197 | 1.037375 | 0.313256 | 0.686744 |
| 20-24 | 4424 | 858 | 3110 | 0.63 | 0.19394 | 1.035528 | 0.200833 | 0.799167 |
| 25-29 | 10640 | 1985 | 3211 | 1.31 | 0.18656 | 0.995274 | 0.185678 | 0.814322 |
| 25-30 | 11708 | 2274 | 2409 | 2.05 | 0.19423 | 1.007427 | 0.195669 | 0.804331 |
| 25-31 | 13463 | 2909 | 2079 | 2.67 | 0.21607 | 1.026174 | 0.221729 | 0.778271 |
| 25-32 | 10882 | 2656 | 1569 | 3.02 | 0.24407 | 1.014272 | 0.247556 | 0.752444 |
| 25-33 | 12906 | 3796 | 1646 | 3.49 | 0.29413 | 1.006312 | 0.295983 | 0.704017 |

FP(i): Female population; CEB(i): Children ever born; CD(i): Children dead; P(i): Average parity; D(i): Proportion of children dead; K(i): Multiplier; qx(i): Probability of dying; lx(i): Probability of surviving.

Table 4.7.2 Derivation of Smoothed Probability of dying and Smoothed Mortality Levels for core Northern Nigeria.

| X | Level 12 | Level 13 | Level 12.57 | logit(lx) | logit(ls) | lx(ref) | q(x)ref | $t_{(x)}$ |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.85617 | 0.87087 | 0.868101 | 0.39247 | 0.94214 | 0.856767 | 0.143233 | 1.108567 |
| 2 | 0.81963 | 0.839 | 0.835352 | 0.69055 | 0.81202 | 0.821781 | 0.178219 | 2.420785 |
| 3 | 0.80345 | 0.82489 | 0.820852 | 0.73917 | 0.76107 | 0.806364 | 0.193636 | 4.330888 |
| 5 | 0.78503 | 0.80881 | 0.804331 | 0.70679 | 0.70679 | 0.78885 | 0.21115 | 6.590584 |
| 10 | 0.76632 | 0.79185 | 0.787042 | 0.62781 | 0.65359 | 0.770583 | 0.229417 | 9.075995 |
| 15 | 0.75255 | 0.77939 | 0.774335 | 0.55584 | 0.61648 | 0.757197 | 0.242803 | 11.74845 |
| 20 | 0.73385 | 0.76204 | 0.756731 | 0.43325 | 0.56742 | 0.738707 | 0.261293 | 14.67072 |

lx(ref): Smoothed Probability of Surviving; qx(ref): Smoothed Probability of Dying; tx: reference period

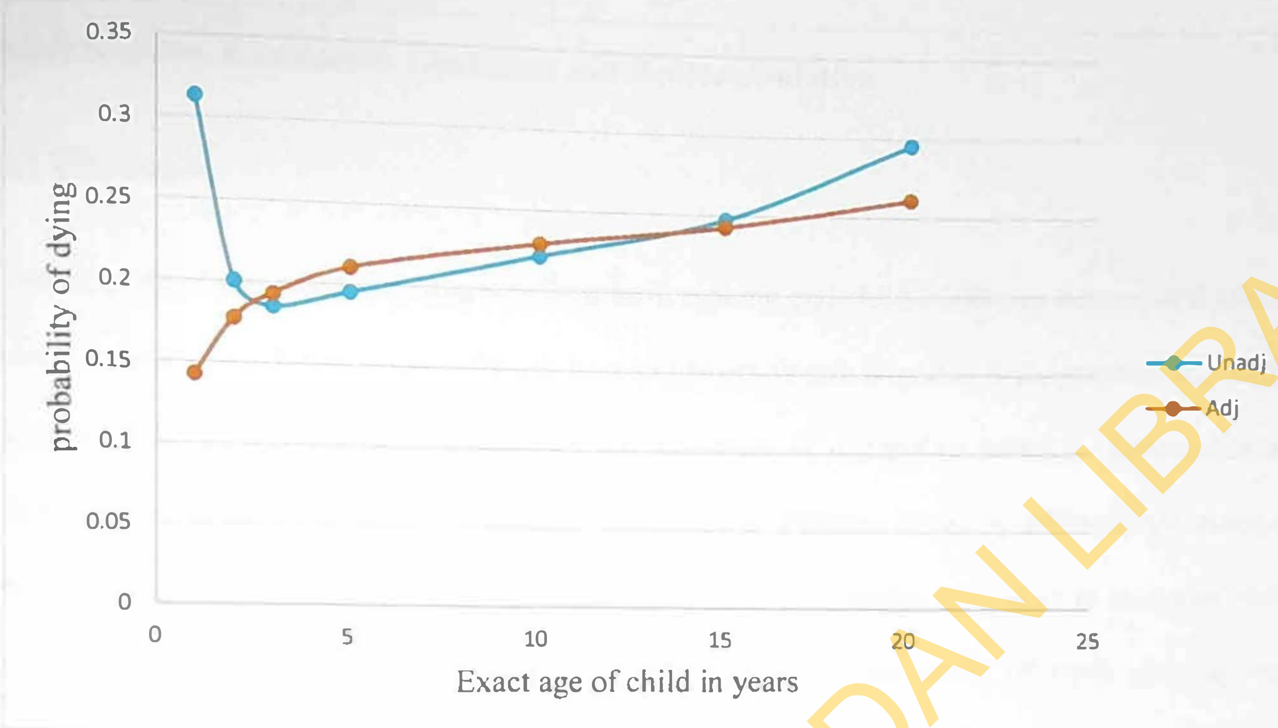



**Figure 4: Unadjusted and Adjusted Estimate of Childhood Probabilities of Dying in the core Northern Nigeria**

# CHAPTER FIVE

## 5.0 Discussion, Conclusion, Limitation and Recommendation

### 5.1 Discussion

The purpose of this study is to examine how birth spacing and child health are interrelated among children in the core North Nigeria (North East and North West). Nigerian demographic and health Survey have been re-analyzed to explore the dynamics of under-five survival. Researches on factors influencing child health have been conducted at different times in different locations in Nigeria, but no studies have been conducted combining three major indicators to measure child health (Immunization, Nutrition and Childhood mortality) in the study of birth spacing and, especially, at regional levels. Most of the studies found in the reviewed literature used childhood mortality alone and for individual states (Adebowale, 2008 and David, 2017).

The findings of this study on birth spacing pattern in core Northern Nigeria reveals that across the birth interval categories, preceding birth interval decreases as age increases. The younger age group was the highest among their counterparts who left less than 24 months before the birth of their index child. This result is similar to the previous studies such as (NDHS 2013 and Hajian-Tilaki 2009). This study also shows that the use of contraceptives increases the length of preceding birth interval. Women who are not on contraceptives have short birth interval than their counterparts who are on contraceptives. The effect of contraceptive on birth spacing as evident in this study is similar to studies done in Kwara state Nigeria. (Gbolahan& James 2015). Birth spacing pattern in both rural and urban was very close which could be due to higher geographical distribution of proportion of rural–urban areas in Northern Nigeria. This result is also similar to that of NDHS 2013. Muslim mothers have the highest percent of short birth interval among their counterparts and we should also note that Muslims are more than the other religions in core Northern Nigeria.

It has been revealed in this study that education is a fundamental factor to consider in term of birth spacing. Women with no education were more likely than educated women to have shorter intervals and this finding is consistent with that reported by (Gyimah 2001, Settu-Venugopal & Upadhyay 2001& NDHS 2013). Wealth index was found to have significant relationship with birth spacing as seen from the findings of this study. The poor has the lowest percent of those women who have spaced their index birth and very close to the rich. This can be partly explained by the fact that wealthy women are more likely to access health care information and afford health care services and thus can easily apply scientifically recommended inter birth spacing. This finding is contrary to some studies but consistent with the study carried out in Ethiopia and NDHS 2013. Occupation is found to be significant predictor of birth interval in this study. Working women have longer birth intervals than those who are not working. This result is similar to study done in Iran and Tanzania. Finding from this study shows a significant relationship between inter-birth interval and breast-feeding. Women who breast-fed for more than 12 months and above are more likely to have longer inter birth interval than their counterparts who did not breast-fed and those who breast-fed for less than 12 months. This result is similar to literature reviewed (e.g. see Yohannes 2011).

However, the finding of the study evidenced that there is no significance association between birth spacing and immunization. This is in contrary to the study done by Santosh 2009. This might be due to the fact that Santosh's study was based on the interval between first and second births and that two regions have been considered whereby the existing studies used the entire nation's data. In addition, Northern Nigeria are embedded with much distraction such as insurgency, which may hinder the effective functioning of immunization program apart from birth interval. It has been discovered from this study that there is a significance association between age of mothers, education, residence, wealth index and immunization status of the children. As age of mothers increases, the immunization status of their children also increase; and also urban women get their children fully immunized than rural women. This might due to more accessibility to health facilities in urban areas. The proportion of children immunized in the past increases consistently as level of education of mother increases. Also, richest women were likely to get their children fully immunized than other wealth category as this might due to high literacy level, access to health information, accessibility and affordability which are common among the rich women. All this result are similar to some literature reviewed (NDHS 2013 and Santosh 2011).

Furthermore, the study evidenced significance association existed between nutrition status of child (stunting and underweight) and birth spacing. Also other variable such as Age of mothers, residence education and wealth index have significant association with nutrition status of child. In this study, it has been revealed that children who have a short preceding birth interval are more likely to be stunted and underweight than those whose preceding birth are 2 years and above. This result is in agreement with the recent study on Maternal and Child Nurition and (James (2008 & Rutstein 2008). Children of youngest women are more likely to be stunted and underweight compared with their counterparts. Striking difference between children who live in urban and rural areas, rural children were more stunted and underweight than their urban counterparts; and children of women with no education were more likely to be stunted and underweight also. It has been seen from this study that children whose mothers are of poorest category of wealth index were more likely to be stunted and underweight than their counterparts. These results are in agreement with previous the previous study (Mosfequr, 2015).

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Furthermore, the study evidenced significance association existed between nutrition status of child (stunting and underweight) and birth spacing. Also other variable such as Age of mothers, residence education and wealth index have significant association with nutrition status of child. In this study, it has been revealed that children who have a short preceding birth interval are more likely to be stunted and underweight than those whose preceding birth are 2 years and above. This result is in agreement with the recent study on Maternal and Child Nurition and (James (2008 & Rutstein 2008). Children of youngest women are more likely to be stunted and underweight compared with their counterparts. Striking difference between children who live in urban and rural areas, rural children were more stunted and underweight than their urban counterparts; and children of women with no education were more likely to be stunted and underweight also. It has been seen from this study that children whose mothers are of poorest category of wealth index were more likely to be stunted and underweight than their counterparts These results are in agreement with previous the previous study (Mosfequr, 2015).

In addition, the finding of this study shows that preceding short birth interval, age of mothers, residence, education and wealth index are associated with under-five mortality. The oldest age group has the highest percent of childhood mortality; and rural women lost more of their under-five children than their urban counterparts. As shown in this study, the higher the level of education and wealth index of the mother, the lower the risks of under-five mortality. This might due to reason that higher educated and richest women have better behavioral attitudes and are more knowledgeable of underlying mechanisms that can improve health of their children and hence, their survival chances. The study revealed that across the births categories, prevalence of under-five mortality was least among women who spaced their index birth for an interval between 36 and 59 months, whereas, it was highest among their counterparts who left less than 24 months before the birth of their index child. These results are the results due to bivariate analysis of the study and it is in agreement with previous studies (Adebowale 2008, Yohannes 2011, NDHS 2013). This study shows in the multivariate analysis that there is no significant relationship between birth spacing and childhood mortality and this is in contrary with other studies and this might due to the reason that only North East and North West data have been reanalyzed but not the whole country's data as considered in the earlier studies like Rutsein 2008.

The smoothed probability of dying increase with age of the children and the reference period was also estimated to know when in the past can the mortality experienced be referred. From the study, it reveals that mortality had been experienced about 7 years before the survey. Childhood mortality had been experienced in year 2006.

### 5.2 Conclusion

Preceding birth intervals is significantly influenced by maternal characteristics (such as her level of education, Ever-breastfeeding, her religion, her marital status, whether she resides in urban or rural areas, and number of living children. In addition, preceding birth interval is a determinant of child health. Furthermore, short birth interval was found to be associated with the nutritional status of the index child. However, there is no relationship between preceding birth interval and immunization status of children in the core Northern Nigeria and therefore it is not considered a factor enough to predict immunization status of a child; and lastly Childhood mortality has a significant association with birth interval in the core Northern Nigeria.

### 5.3 Limitations

There are two major limitations of this study which are recall bias and response error. The first limitation is the recall bias; it is logical to assume that biases are likely in reported birth interval due to memory lapses, and because women who had lost at least a child before the index birth might count the duration of interval they have for their children as part of the interval they left before the index child was born. The second limitation is the response error; inability of some women who had experienced death of one or more children to report the truth about their experience which may affect the level of childhood mortality and this may bias the number of women who had experienced childhood mortality in core Northern Nigeria.

## 5.4 Recommendations

In view of the above findings, the following recommendations are arrived at:

- Women in Nigeria should be more sensitized about the benefit of waiting period of 36-59 months between successive birth, as well as the health consequences of short birth intervals. There should be emphasizes on the role of breast-feeding and contraceptives as strategies for birth spacing and child health.
- Mothers should be sensitized on the benefit of complete vaccination for the children. Policies and programs should put up which integrate child programme that will increase the immunization coverage in Nigeria especially the Northern region.
- Preventive interventions such as micronutrient supplement, nutrition counselling, safe water and sanitation should be widely promoted in the public health sector.
- Health interventions programmes on mortality reduction should be intensified in Nigeria with particular attention to Northern region.

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# APPENDIX

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It is essential that you consult the questionnaire for a country, when using the data files. Questionnaires are in the appendices of each survey's final report: http://dhsprogram.com/publications/publications-by-type.cfm. We also recommend that you make use of the Data Tools and Manuals at: http://www.dhsprogram.com/accesssurveys/technical_assistance.cfm.

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