CORRELATES OF INFANT AND CHILD STUNTING IN NIGERIA: A MULTILEVEL ANALYSIS

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DECLARATION

I, Ibukunoluwa Feyikemi Odelola, declare that this research report is my original work. This research work is being submitted for the degree of Masters in Demography and Population Studies at the University of the Witwatersrand, Johannesburg. To the best of my knowledge, this work has not been submitted for any degree or examination or to any other university.

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ABSTRACT

Background

Stunting, linear growth retardation is the outcome of not meeting nutritional requirement for growth over a long timeframe starting from conception (Bloem, et al., 2013). It is considered as the most reliable indicator of child's nutritional status, best predictor of human capital and best measure of child health inequalities especially long term malnourishment (Arif, et al., 2012; UNICEF, et al., 2012; Adekanmbi, et al., 2013; Agee, 2010; Victora, et al., 2008; Fotso, 2007). This malnutrition indicator has bi-directional cause of frequent infections and malnutrition (Victora, et al., 2008). This makes children who are stunted to be at increased risk of severe chronic illnesses and ultimately death (de Onis, et al., 2012). Despite its numerous negative effects, it remains a public health menace in Nigeria with alarming rate of 41% (NPC & ICF Macro, 2013). Although, contributing factors to stunting among under-five children have been greatly flogged by different researchers (Arif, et al., 2012; Akorede & Abiola, 2013; Bolajoko & Ogundahunsi, 2012;Agee, 2010), less attention has been focused on the investigation of childhood stunting during the two distinct periods of infancy (0-11months) and early childhood (12-59 months). In addition, few studies have examined under-five stunting taking into consideration moderate; children with height-for-age Z-score below minus two standard deviations (-2SD) from the mean and severe stunting; children with height-for-age Z-score below minus three standard deviations (-3SD) from the mean. To this end, this study examines the factors associated with infant (age 0-11 months) and early childhood (12-59 months) stunting in Nigeria.

Theoretical focus

The study has its theoretical underpinning in Mosley & Chen theoretical model, (Mosley & Chen, 1984), Sastry's framework on childhood stunting (Sastry 1997) and WHO Conceptual Framework (Stewart et al., 2013).

Data and Methodology

To address the study objective, multinomial logistic regression analysis were performed on a nationally representative sample of 20,192 women of childbearing age who had a total of 28,596 children during the five years preceding the 2013 Nigeria Demographic and Health Survey (NDHS). The outcome variables for this study are infant stunting and child stunting. Stunting was categorized into three, not stunted (coded as 0), severely stunted (coded as 1) and moderately stunted (coded as 2). Severe stunting is defined as height for age *z*-score less than -3 standard deviations from the mean (HAZ < -3 SD) and moderate stunting is defined as height for age *z*-score less than -2 standard deviations from the mean (HAZ < -2 SD).

Key Findings

Results from the study indicate that 20 % of Infants in Nigeria were stunted and 41% of children in early childhood phase were stunted. It is observed that child stunting was higher than infant stunting. Stunting increased significantly across age group to peak at age 24-36 months before a gradual decline. Being a male child, born small at birth and with incomplete immunization predisposes children to be stunted both at infancy and during early childhood. For instance, children with low birth weight were more than twice more likely to be stunted during infancy (aOR: 2.31; P-Value<0.05). Results from 2013 NDHS data also showed significant variation across all regions. However, vast variations were observed South West and North West (aOR: 4.07; P-Value<0.05). Both micro and macro-level characteristics accounted for the observed regional variation. For instance a child with complete immunization status is less likely to be stunted during infancy (aOR: 0.23; P-value<0.05). Community maternal education was an important macro-level factor influencing stunting. Therefore a child whose mother resides in a community with high concentration of mothers with secondary school and higher level of education had reduced odds of being stunted (aOR: 0.59; P-value<0.05). Surprising place of residence was not an important factor associated with stunting during infancy phase (aOR: 1.06; P-Value>0.05) but was associated with stunting during childhood phase (aOR: 1.42; P-Value <0.05).

Conclusion

Findings of this study emphasize amongst others the need for interventions aimed at improving maternal health if efforts to reduce chronic forms of malnutrition among children will yield the desired results in Nigeria. Policies and programs should also be directed towards mitigating vast regional variations observed with regards infant and child stunting.

CHAPTER 1:

1.0 INTRODUCTION

1.1. Background

Adequate nutrition remains essential for healthy growth, and the proper functioning of all systems in a child.

"Childhood malnutrition has been defined as a pathological state resulting from inadequate nutrition, including under-nutrition due to insufficient intake of energy and other nutrients, over-nutrition due to excessive consumption of energy and other nutrients, and deficiency diseases due to insufficient intake of one or more specific nutrients such as vitamins or minerals" (Ge & Chang, 2001: p.284).

Child malnutrition is observed to be an important cause of illness and death across the world. It contributes negatively to physical and mental development, and has significant impact on educational attainment (Arif, et al., 2012). Therefore child malnutrition has a negative impact not only on the early development of a child, but also in later stages of life. Such malnutrition exhibits synergistic association with infections and diseases and has a significant impact on child deaths. Caulfield et al. (2004) estimated that more than half of the deaths of children under five are attributable to pneumonia, diarrhea, malaria, measles, and HIV/AIDS. Malnutrition is associated and contributes to almost 60 percent of these and could be exemplified by the fact that a malnourished child is less able to fight infections, thus making them more susceptible to disease deaths (Liu et al., 2012; Black et al., 2008; Wagstaff, et al., 2004).

Linear growth retardation, known also as stunting is the outcome of a lack of nutritional requirements for growth over a long timeframe starting from conception (Bloem, et al., 2013).

There is a two-way directional causative relationship between stunting, frequent infections and malnutrition and evidence shows that repeated episodes of diarrhea can increase the incidence of stunting (Branca & Ferrari, 2002; de Onis et al, 2012; Victora, et al., 2008).

Many scholars have identified stunting as the greatest malnutrition indicator with the highest prevalence across the world. (de Onis & Blössner, 2003). Furthermore, literature considers stunting as the most reliable indicator of a child's nutritional status, the best predictor of human capital and the best measure of child health inequalities (especially long-term malnourishment) (Arif, et al., 2012; de Onis, et al., 2012; Adekanmbi, et al., 2011; Agee, 2010; Victora, et al., 2008; Fotso, 2007). This is because it reflects long-term inadequacies of nutrition and experiences of recurrent and chronic diseases (NPC & ICF Macro, 2013). Stunting is also identified as the most difficult of the three malnutrition indicators to treat (Adekanmbi, et al., 2013)

It is worthy to note that the prevalence of stunting among children worldwide under-five years of age decreased worldwide for the periods of 1990-2011 (a decrease of 35%); therefore it is clear that overall progress remains unsatisfactory and millions of children remain at risk. Globally, stunting remains a public health challenge with an estimated 165 million stunted children (under-five) in 2011 (de Onis, et al, 2012). This is because the Africa and Asia regions contributes significantly as they have more than 90 percent of the world's stunted children. Even though Asia has experienced a gradual decrease since the 1990s, Africa remains the only major world region with an increased number of stunted children over the last decade, and which can be attributed to the enormous population increase in the regions (Black, et al., 2013).

Moreover, significant variation is observed between developed and developing countries. The prevalence of stunting in under-fives in developed countries is 5.1 million compared to 159.7 in developing countries (de Onis, et al, 2012). The high prevalence of stunting in sub-Saharan Africa signifies that it largely contributes to the malnutrition burden experienced across the globe. Sadly, 56.3 million under-fives are affected by stunting in sub-Saharan Africa with East Africa having the highest prevalence level with 25.8 million (de Onis, et al, 2012).

Furthermore, stunting has remained a public health menace in Nigeria (Agee, 2010). A decrease of 1 percent between 2003 and 2008 and 4 percent between 2008 and 2013 with an overall decline of 5 percent observed for stunting over a ten-year period (NPC & ICF Macro, 2013). Using the WHO child growth standards adopted by Demographic and Health Survey improvement with regards stunting can be described as minimal over this time period (2003-2013) (NPC & ICF Macro, 2009; de Onis & Blössner, 2003). It is evident that Nigeria is facing one of the largest burdens of malnutrition with the fact that the country has 11 million chronically malnourished children, which is over six percent of the world's chronically malnourished children (SUN, 2013).

It is worthy noting that within the country, there are vast geopolitical variations with regards to stunting (NPC & ICF Macro, 2013). Nevertheless, other factors such as type of birth, breastfeeding duration, number of children in a household, economic inequalities and poverty serve as major contributors to stunting (Arif, et al., 2012; Adekanmbi, Kayode & Uthman, 2011; Akorede & Abiola, 2013; Omobuwa, et al., 2013; Bolajoko & Ogundahunsi, 2012; Uthman, 2008; Murphy, 2012; Agee, 2010).

Many initiatives have focused on malnutrition and how to combat the short and long-term impact. For instance, the Zero hunger challenge by the United Nations that has the aim of reducing the level of stunting and monitors the first 1,000 days of a child's life reflects the importance of combating this issue (UN, 2010). In addition, the Zero hunger initiative, West Africa's adaptation of the global initiative (zero hunger challenge), also recognizes malnutrition as a regional tragedy that requires urgent collective efforts to be able to protect the future and growth of the region (ECOWAS, 2013). In addition, the Scale Up Nutrition (SUN) movement was launched in 2010 to collectively unite people from all spheres of life, including researchers and national governments, with the United Nations and other donors in an effort to improve nutrition (SUN, 2013). This called for serious and additional efforts to be made in order to be able to meet the MDGs in 2015, this call seems to have gone unheard in Nigeria as there are still a large number of malnourished children remain even as the 2015, deadline has passed. (SUN, 2013). In summary, despite all efforts malnutrition has not reached zero level that is desired by all and is evidenced with the high stunting rates in Nigeria (37%).

Furthermore, for 10 years the countries were saddled with the responsibilities of achieving Millennium Development Goal (MDG) of the United Nations (2000). Having identified the importance of nutrition, the first goal was to eradicate extreme poverty and hunger and the fourth goal was to reduce the under-five mortality rates of the year 1990 by two-thirds by the year 2015. It's already the MDG target year and Nigeria is far from achieving goal one and goal four with the high rates of stunting and under-five still observed in the country. Also, as the world is now focused and more concerned about sustainable developmental goals (SDG), Nigeria is lacking behind as it is, because goals achieved are what will be sustained. However, with SDGs, the stakes are higher, more defined and specific with similar targets under each goal. For instance, target 1b states that: “End hunger and achieve food security, appropriate nutrition, and zero child stunting” (UNSDSN, 2014). Therefore, urgent actions needs to be taken toprotect the future of the nation, to keep at par with other countries with positive improvement and to even rise above equals and lead the campaign against malnourishment with successes to show**.**

Bearing in mind that infant and child malnourishment remains a major public health challenge in Nigeria and other developing countries, scholars had made it a point of duty to study different aspects of malnutrition. The contributing factors to malnutrition have been greatly flogged by different researchers. According to Arif et al (2012) child nutrition remains one of the most significant social problems faced by many developing countries. Also, many studies have shown that stunting of under-five children vary by socio-economic and bio-demographic characteristicsat individual and community levels (Arif, et al., 2012; Adekanmbi, Kayode & Uthman, 2011; Akorede & Abiola, 2013; Omobuwa, et al., 2013; Bolajoko & Ogundahunsi, 2012; Uthman, 2008; Murphy, 2012; Agee, 2010). Furthermore, the interaction of individual, household and community factorshave been observed to be significant determinants of early childhood stunting.

In addition, findings of previous studies have established the influence of various predictors of under-five stunting in Nigeria and other developing countries. For example, sex of a child, type of birth (single or multiple), birth interval to mention a few has been established by several authors that are strong determinants of stunting in under-five children (Akorede & Abiola, 2013; Arif, et al., 2012). Some community variables have also been identified to be strong determinants of stunting in under-five children. For instance, Adekanmbi et al, (2013) observed that children living in communities with high illiteracy rate negatively influence stunting. Although, previous studies have examinedunder-five stunting during the overall period under the age five (i.e. 0-59 months), less attention has been focused on the investigation of early childhood stunting during the two distinct periods of infancy(0-11 months) and early childhood (12-59 months) in Nigeria.

Furthermore, while many studies have established a number of micro-level (individual and household) determinants of stunting in under-five children in Nigeria, similar researches on the influence of macro-level factors on infant and child stunting have been few (Adekanmbi , et al., 2013; Uthman, 2008). Besides, earlier attempts at investigating macro-level determinants of early childhood stunting in Nigeria did not comprehensively examine how various dimensions of community-level structures influence stunting in the country. Hence, this study contributed to body of literature with the focus of examining the influences of different dimensions of macro-level characteristics (net of micro-level factors) on infant and early childhood stunting in Nigeria and understanding the extent to these characteristics determined the regional variations observed in the country.

1.2 Problem statement

Malnutrition is a health challenge with both short and long term consequences. The outcome of insufficient nutrition especially during pregnancy and the critical developmental phase of a child are stunting (Bloem, et al., 2013). Stunting specifically has 1000-days window of opportunity period of exposure after which repair is slow and difficult (Bloem, et al., 2013). The above mentioned impairment affects not just the stunted child stunted but might also affect future generations (Victora, et al., 2008). For instance, a woman with a history of stunted growth evidenced with short stature and poor maternal nutrition is likely to have a child with low birth weight and stunted growth (Victora, et al., 2008). Also, reversing the developmental consequences of early childhood stunting later in childhood is quite difficult because it is impossible for this phase to reoccur later in life (Bloem, et al., 2013). The many impacts of stunting are shorter adult height, weakened immune system, reduced cognitive abilities that influences schooling, economic productivity and lower human capital to mention a few (Chirwa & Ngalawa, 2008; Victora, et al., 2008; Caufield et al, 2004). For example, stunting can influence schooling in the sense that having inhibited cognitive abilities development; direct structural damage to the brain and infant motor development impairment had been caused (Victora, et al., 2008). Also, it is possible that with weakened immune system, a child is easily exposed to sicknesses and diseases which on the long runaffect the attendance in school. Therefore the single effect of stunting brings about a long chain of other negative effect on child's health and human capital.

Stunting has been indicated to be the most prevalent of the three malnourishment indicators in Nigeria evidenced with stunting rate for under-fives at 37%, underweight at 29% and wasting at 18% (NPC & ICF Macro, 2013; Agee, 2010). Over the period of 10 years the varying rates of malnutrition indicators vary. With Stunting at 42% in 2003, 41% in 2008, 37% in 2013, wasting are 11% in 2003, 14% in 2008, 18% in 2013, underweight 24% in 2003, 23% in 2008 and 29% in 2013 for under-fives in Nigeria. These rates show that stunting remains the highest malnutrition indicator. Studies have also shown that stunting is the greatest of malnutrition problem (Agee, 2010; Chirwa & Ngalawa, 2008). Stunting is also observed to be related with micronutrient deficiencies, obesity, chronic diseases and this makes it an important health menace (Adekanmbi, et al., 2013).

Moreover, despite international and national policies, under-five stunting still remains a serious public health issue that is important for research and policy making in Nigeria especially as

2015, the target year for meeting MDG goals is here and there is a paradigm shift to sustainable developmental goals, with stunting still being target 1b to achieve goal 1 which is to end extreme poverty including hunger.Besides, human and economic burden of diseases experienced by the country will be minimal if malnutrition is taken care of knowing fully well that stunting is associated with acute and chronic diseases such as malaria and HIV/AIDS (Kang, et al., 2013; McGrath, et al., 2012; Victora, et al., 2008; Caulfield, et al., 2004). For instance, it is estimated that 300,000 under-five children yearly are infected and affected with malaria in Nigeria (NPC & ICF Macro, 2013). Also, the prevalence of this infection varies by age, with infants aged 0-11 months having lower rates compared to those in their early childhood phases (DHS PROGRAM, 2012). There is therefore an urgent need to provide new and more reliable scientific evidence that can suggest interventions on infant and child stunting separately in the country.It is equally known that stunting is associated with under-five mortality. This is evidenced with under-five mortality rate in Nigeria which is at 128 per 1000 live births, and still unacceptably high (NPC & ICF Macro, 2013). Marked reduction of under-five mortality can be experienced in Nigeria if this health challenge is combated.

In addition, demographic dividend is experienced when fertility and child mortality rates are declining and a demographic shift from high dependent ratio to low dependent ratio is observed (Lee R & Mason A., 2006). Demographic dividend is the accelerated economic growth experienced during the change in the resulting age structure (Gribble & Bremner, 2012). Bongaarts (2009) acknowledged that with changing age distribution, age-dependency ratio reduces and this creates demographic dividend that can boost economic growth because of the accompanying potential increased size of labour force. Bloom et al. (2007) also recognized that it is necessary for adequate policies and solid institutional settings to be in place before the expected economic growth is observed. Although fertility rates are slightly falling and under-5 mortality rates are decreasing and a shift in age structure is feasible in nearest future, Nigeria has a country has a window of opportunity for economic growth. However, the demographic dividend of Nigeria is threatened if majority of her children have reduced physical and mental development. What then will be the future of Nigeria if stunting increases or the rate of reduction is minimal?

Furthermore, it is worthy to note that regionally variations are observed with regards stunting in Nigeria. According to Nigerian Demographic and Health Survey (2013) North West had the highest prevalence of stunting (55% of Under-five children are stunted in the North West)and South East had the lowest prevalence (15% of Under-five children are stunted in South East). These indicate that the region a child is found influences stunting. It is therefore of great importance to tackle this health menace.

This study however, will attempt to build on the findings of the previous studies by advancing the existing body of knowledge beyond the understanding of factors influencing infant and child stunting at the individual level. This is necessary because literatures have shown that contextual characteristics of a community and household where children are raised tend to modify and influence individual-level factors (Adedini, et al., 2014; Adekanmbi, et al., 2013; Antai, 2011; Uthman, 2008; Sastry, 1997). Variations should be expected at the two distinct periods of infanthood and early childhood because the effects of factors associated with mortality among children vary by age (Omariba, et al., 2007). Hence, this study seeksto identify community level factors influencing infant and early childhood stunting in Nigeria.

1.3 Research Questions

1.3.1 General question

What are the correlates of infant (0-11 months) and early childhood (12-59 months) stunting in Nigeria?

1.3.2 Specific research question

- What is the level of infant and child stunting in Nigeria?
- What is the micro- and macro- level correlates of infant and child stunting in Nigeria?
- What is the extent to which contextual factors account for regional variations in infant and child stunting in Nigeria?

1.4 Research Objectives

1.4.1 General Objective

To identify the micro- and macro-level correlates of infant and early childhood stunting in Nigeria

1.4.2 Specific Objectives

- To measure the level of infant and child stunting in Nigeria
- To determine the micro and macro-level correlates of infant and early childhood stunting in Nigeria
- To examine the extent to which contextual factors account for regional variations in infant and child stunting in Nigeria

1.5 Justification/significance of study

Infant and child stunting remains an overwhelming health issue as it remains the most prevalent malnutrition indicator in Nigeria (Agee, 2010). Although, the overall Nigeria population will benefit if there is an observed decrease in the prevalence of stunting in the country, under-five children seem to be first beneficiary of this improvement.

Firstly, chronic and acute malnutrition rate in under-five children in the country is a cause for concern with future implications if not well addressed. Considering that child malnutrition is an important cause for illness and death globally, evidence shows that this phenomenon accounts for 60% of under-five death (Wagstaff, et al., 2004). Surprisingly, between the period of ten years (2003 – 2013) when demographic and health surveys were conducted, it is observed that the changes experienced for stunting is minimal (a reduction of 1%, dropped from 42% in 2003 to 41% in 2008 and to 37% in 2013) (NPC & ICF Macro, 2013). This statistics are not impressive as more would have been expected for the period of ten years.

In addition, for Nigeria to achieve part of the SDGs, the nutritional status of infant and child has to be treated with urgent attention. This is because the nutrition status of infant and child are associated with SDG 1 and SDG 5 directly and SDG3 indirectly. Judging from the statistics, it is obvious that Nigeria needs to double effort to be able to make appreciable progress towards achieving these goals.

Many initiatives have recognised stunting as a pressing health need that requires urgent attention because of its health, educational and economic benefits. The likes of Zero hunger challenge by United Nations, zero hunger initiative by ECOWAS, SUN initiative and 1000 days among others are examples of international and regional efforts. All these initiatives have the common goal of reducing stunting to zero percent globally, regionally and in every individual country. This is a synergistic action to achieve SDG 1, target 1b specifically. Global, regional and national efforts in regards stunting will be abortive if research about stunting is not of high priority. To be able to achieve the target of zero stunted children in Nigeria, the target of these organizations, and the world at large, it is therefore imperative to embark on this study.

The health implications of stunting remain an important reason to focus research efforts on infants and child stunting. Having established the bi-directional synergistic causational relationship between stunting, diseases and mortality, stunting becomes an important underlying factor in reducing high under-five mortality rate observed in Nigeria. Statistics with regards under-five mortality shows that rate in the country had only marginally decreased from 201 per 1000 birth for the 1999-2003 period to 157 per 1000 live births during the 2004-2008 period and 128 per 1000 live births during 2009-2013 despite the interventions that have been put in place such as provision of primary health care that incorporates both maternal and child health care (NPC & ICF Macro, 2013). Other interventions include initiation of Subsidy Reinvestment and Empowerment Program, maternal and Child Health (SURE-P-MCH), full childhood immunization and HIV/AIDS prevention (NPC & ICF Macro, 2013). It will be of great value in generating new empirical evidence on how to tackle stunting, one important underlying factor of infant and under-five mortality, thereby tackling under-five mortality indirectly. Empirical evidence provided can help in suggesting policy and designing programs to reduce stunting directly and under-five mortality indirectly. In addition, by reducing the under-5 mortality rate in Nigeria, child survival, which is the target of SDG 5, target 5b which is to;

"End preventable deaths by reducing child mortality to [20] or fewer deaths per 1000 births, maternal mortality to [40] or fewer deaths per 100,000 live births, and mortality under 70 years of age from non-communicable diseases by at least 30 percent compared with the level in 2015" (UNSDSN, 2014: p12).

Also, stunting is evident to have negative influence on early development of a child (Arif et al., 2012). Focusing effort on this research will have impact on SDGs related to universal effective learning for all children and youth for life and livelihood (UNSDSN, 2014). For instance, target 3a of SDG 3 is to

"Ensure that all children under the age 5 reach their developmental potential through access to quality early childhood development programs and policies" (UNSDSN, 2014: p.10).

This affects the ability to complete the full course of primary schooling in so doing affects SDG target 3c. Completing primary schooling is measured using primary school net attendance ratio. The primary school net attendance ratio in Nigeria in 2013 is 59.1% (NPC & ICF Macro, 2013). This reflects that Nigeria is still lacking behind and urgent attention is needed in sustaining the developmental goals.

Moreover, Nigeria is the most populous country in Africa, with a large proportion of young dependents and a huge percentage of them as under-five. With a growth rate at 3.2% (NPC &ICF Macro, 2013), Nigeria's 2006 population and housing census shows that 22,609,518 out of 140,431,790 Nigeria's population are under-five children. (NPC & ICF Macro, 2009). Therefore it is important studying the micro and macro-level determinants of infant and early childhood stunting in such a country with high proportion of under-five children, many of whom suffer from chronic malnutrition.

Although several studies have been conducted to identify factors associated, suggest strategies and policies for policy makers and interventions to combat this menace, nevertheless, evidence suggests that stunting is still high in Nigeria (Adekanmbi, et al., 2013; Akorede & Abiola, 2013; Omobuwa, et al., 2013; NPC & ICF Macro, 2013; Bolajoko & Ogundahunsi, 2012; Murphy, 2012; Agee, 2010). Despite the international and national efforts to reduce the level of malnutrition in the country, stunting continued to be a pressing health challenge in Nigeria.

Also, stunting has been identified as the best indicator of human capital. It negatively affects economic productivity and lower human capital. It is equally vital to embark on this research on infant and child stunting because combating this challenge will improve an individual's educational attainment and earning potentials that influences economic growth. This study will help in identifying individual and community factors that can guide in policy making, program design and implementation. It will further increase Nigeria's gross domestic product that has minimally increasedover a long period of time (1980-2006) by at least 2-3 percent (Bloom, et al., 2010).

Stunting will therefore inhibit the actualisation of this goal. Furthermore, according to Devlin (2012) the bodies of these children have limited energy and it targets the essential functions like important organ function, growth and social interaction and learning which are all necessary for effective schooling

In addition, it is also important to embark on this research to be able to provide new and more reliable scientific evidence that can suggest better interventions on infant and child stunting in the country. Although several researchers have studied determinants of stunting, it is rare that they distinctly examine correlates of stunting at micro and macro-level, particularly during the two distinct periods 0-11 months & 12-59 months (Adekanmbi, et al., 2013; Akorede & Abiola, 2013; Omobuwa, et al., 2013; Bolajoko & Ogundahunsi, 2012; Murphy, 2012; Adekanmbi, et al., 2011; Agee, 2010). Therefore a study that distinctly examine the determinants of stunting at micro-(individual/household) and macro-level (community), particularly during the two distinct periods 0-11 months (infant) & 12-59 months (early childhood) will be greatly useful in guiding policy makers and in program designing.

Also, with observed varying rates of stunting in different regions in Nigeria (North West with 55%, North East with 42%, North Central with 29%, South West with 22%. South South with 18%, and South East with 15%, it is of great importance to examine the extent to which community factors bring about regional variations (NPC & ICF Macro, 2009).

Furthermore, few studies have established the influence of community-level factors on stunting among under-five children in Nigeria. Adekanmbi et al, (2013), examined community-level factors like poverty rate, illiteracy rate, unemployment rate, proper sanitation, safe water, residence and region. The authors confirmed the key role played by these factors in regards to stunting. Nevertheless, the influence of ethnic diversity, community maternal education, community access to health facility were not examined. Although Uthman(2008) examined maternal health-seeking behaviour index and maternal socioeconomic disadvantage index among others, he did not examine ethnic diversity, community maternal education, community access to health facility. Therefore, having identified these gaps, it is imperative to examine the un-observed factors in regards infant and early childhood stunting in Nigeria.

Hence, this study seeks to add to the existing body of knowledge and suggest programs, interventions and policies to policy makers by identifying the micro- and macro-level correlates of infant and early childhood stunting in Nigeria.

1.6 Definition of Terms and Delimitation

1.6.1 Stunting

The term stunting in this study is an anthropometric measure that indicates linear retardation and cumulative growth deficits and is measured by height for age Z-score. Children with height-for-age Z-score below minus two standard deviations (-2 SD) from the mean are considered as stunted and those who their standard deviations are below minus three (-3 SD) from the mean are considered severely stunted(UNICEF, 2013).

1.6.2 Infancy

Infancy in this study means the first year of life (i.e. ages 0 to 11 months) (Canniffe et al., 2013)

1.6.3 Early Childhood

The term early childhood in this study means the period between ages 1 and 5 years

1.6.4 Micro-level characteristics

Micro-level characteristics in this study include individual characteristics and household characteristics.

1.6.5 Individual characteristics

Individual characteristics in this study are defined as attributes or features of an infant (0-11 months) or a child (12-59 months or 1-5 years)

1.6.6 Household characteristics

"Household characteristics are defined as attributes or features of a domestic unit which consists of the members of a family (especially the mother) who live together under the same roof and have common cooking and eating arrangementand who are under the control of one domestic head" (Adedini, 2014: p12).

1.6.7 Macro-level characteristics

Macro-level characteristics are contextual or community characteristics

1.6.8 Community characteristics

These are the characteristics attributed to a community or cluster. A community comprises of people living in a particular area or in a common location. In the 2003 and 2008 Demographic and health survey programmes, the primary sampling units (PSU) are considered as communities or clusters and are defined on the basis of enumeration areas (EAs) from the 2006 enumeration areas census frame (NPC & ICF Macro, 2013).

1.6.9 Single-level model

A single-level model in this study concerns the analysis of the relationship between variables that are measured without taking into consideration hierarchical levels in the data.

1.6.10 Multi-level model

A multilevel model in this study concerns the analysis of the relationship between variables that are measured at different hierarchical levels

1.6.11 Intra-class correlation coefficient

The intra-class correlation coefficient (ICC) is an important measure of the relatedness of clustered data within community or household units. ICC explains the proportion of total variance in the outcome that is attributable to the area level (Merlo, 2006).

1.6.12 Primary sampling units (PSU)

These are small and well-defined administrative areas having population with homogeneous background characteristics. PSUs are used as proxies for communities. A PSU contains one or more enumeration areas (NPC & ICF Macro, 2013).

1.6.13 Cluster

A cluster consists of a minimum of 80 households (NPC & ICF Macro, 2013).

1.6.14 Enumeration area

An enumeration area is a geographic area that is assigned to a set of enumerators during the census exercise for enumeration.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1. Review of relevant literature

This section represents a critical review of the literature, and theoretical and conceptual framework. A number of relevant literatures on various indicators of health outcomes were identified and reviewed. Several studies in regards correlates of under-five stunting has produced diverse findings. Scholars have identified different factors associated with under-five stunting. Backed up with empirical facts, it is established that sub-Saharan African countries and South Asia countries have the highest burden of stunting. This makes these sub-regions the highest contributors to global statistics on chronic malnutrition.In the same vein, evidence shows that Nigeria being a West African country has the highest prevalence of stunting in the sub-region.It is therefore of great importance to identify and review relevant prior studies to identify deficiencies, andcontribute to body of literature. Literature review section of this chapter is divided into threesub sections: global overview of infant and child stunting, overview of infant and child stunting in sub-Saharan Africa, and overview of infant and child stunting in Nigeria in Nigeria.

2.1.1 Overview of infant and child stunting globally

Globally, an estimated 165 million under-five children are affected by stunting (Black, et al., 2013). Extremely high rates of stunting have been established in many countries of sub-Saharan Africa, South-Central Asia, and South-Eastern Asia (de Onis & Blössner, 2003). Previously Asia was leading in child malnutrition (Frongillo, et al., 1997) but of recent Africa and specifically sub-Sahara Africa is being faced with the greatest challenge of malnutrition (de Onis , et al., 2012).

Over the years, infant and child stunting vary significantly among the regions of the world. Prevalence of stunting among under-five children in developed countries is 5.1 million compared to 159.7 million who are stunted in developing countries (de Onis et al, 2012). For instance, the variation in early childhood stunting between the developing and developed nations in mean z scores is -2.58 in Niger compared to Montenegro with 0.70 mean z score which is the lowest globally (Victora, et al., 2010).

Considering determinants of stunting, a complex interplay is observed between demographic, social, and economic determinants of stunting and these results in substantial variations between population subgroups (Black, et al., 2013). This interplay occurs on hierarchy basis, at the individual, household and community level. Individual characteristics like age, sex, birth weight, type of birth among others are important factors associated with stunting. For instance, according to the study conducted by Arif, et al., (2012) in Pakistan, stunting is the only malnutrition indicator with a significant and positive association with age.

Growing bodies of literature have also established that the education of the mother influences child-care practices which include feeding practices that is likely to reduce the chances of stunting. Several studies had associated late initiation, deprivation from colostrum and suboptimum breastfeeding to stunting, its influence on a child's IQ and death (Harron , et al., 2013; Horta & Victora, 2013; Black, et al., 2008; Kumar, et al., 2003). Kumar et al, (2003) went further to establish that appropriate complementary feeding practices are equally important (Kumar, et al., 2003) This complementary diet significantly influence stunting. In addition to maternal education, a cross sectional study in India argues that paternal education also increases the odds of stunting (Subramanyam, et al., 2011)

Scholars have identified that economic inequalities across various household is a strong indicator for stunting. Subramanyam et al, (2011) and Black et al, (2013) had also observed that children from poor households are more likely to be affected by stunting. Furthermore, Black and his colleagues provided evidence that severe infectious diseases in early childhood, for instance, measles, diarrhea, pneumonia, meningitis, and malaria have lasting effects on stunting. Studies have consistently shown that diarrhea is the most imperative disease determinant of stunting (Black, et al., 2013; Checkley, et al., 2008) because repeated episodes of diarrhea raise the incidence of stunting among children (de Onis et al., 2012).

In addition, apart from the individual and household characteristics of the child, the community characteristics also play great roles in influencing the health outcome of a child. Sanitation of the environment a child lives in plays a huge role in the rates of both symptomatic and asymptomatic infections that a child is exposed to (Humphery, 2009).

Hence, global discourse on infant and child stunting remains inconclusive in spite of several studies that have been conducted on infant and child stunting around the world. Stunting remains a public health menace for further research and policy in the developing world. In order to add to the global discourse on infant and child stunting, this study attempts to build on the insights provided in the reviewed literature. Besides, this study seeks to add to the existing body of knowledge by examining the effect of both individual and community level factors on incidence of stunting during two distinct periods of infancy (0-11 months) and early childhood (12-54 months).

2.1.2 Overview of infant and child stunting in Africa

Relevant literatures show that under-five stunting remains a daunting challenge in the African continent and specifically in sub-Saharan African countries (de Onis & Blössner, 2003). Evidence shows that there are varying rates of under-five stunting is observed across the region (UNICEF, et al., 2012; de Onis, et al., 2011). Sub-Saharan African context seems to increase the odds of stunting due to the fact that there are many geographic, socio-economic and health challenges faced by the region.

Literatures have established the importance of appropriate complementary feeding practices (Mamiro, et al., 2005; Kumar, et al., 2003). For instance, in rural Tanzania, Mamiro, et al, (2005) obsevered that complementary food commonly given lacks adequate energy density, sufficient amount of fat, and macro and micronutrients but are only basically rich in cabohydrate. Therefore the type of complementary diet with the standard minimun dietary energy is important.

A study by Mamiro, et al., (2005) in Tanzania, shows that low household income, low birth weight of child, malaria infection and low body mass index of the mother were strong predictors of stunting. Mamiro stressed that low body mass index of mother and birth weight of the child were the strongest indicators of stunting in Tanzania.

Using a cross sectional survey in Mbale district of Eastern Uganda 2003, Engebretsen, et al., (2008) established that having siblings were protective against stunting. However, Ukwuani &Suchindran, (2003) observed that a child with higher parity has increased odds of stunting. Kravdal & Kodzi, (2011) also confirms the “sibling effect” line of thought. The authors further stressed that each additional sibling increases the risk of been stunted by 2%. Therefore these studies suggest that both the presence of siblings and higher parity are important determinants of stunting.

Furthermore,Van de Poel, et al., (2007) recognised urban-rural disparity as a strong predictor of child health outcomes including stunting. Amist 47 developing countries used as case studies, 26 were countries from sub-Saharan Africa (SSA). In all SSA countries studied, stunting remained higher in rural than urban. the authors explained that the results observed were reflections of advantageous household level characteristis like wealth (Van de Poel, et al., 2007). Fotso (2005) also examined the urban-rural differencials in child malnutrition in sub-Saharan Africa. He found that although urban–rural differentials are considerable in all 15 sub-Saharan african countries, gap between urban and rural areas had narrowed due to the increase in urban manutrition. Specifically in six countries, the differentials observed based on place of resisdence substantially narrowed. In four countries insignificant change was observed and in three countries urban-rural differential gap had widened. Findings from both studies indicates that urban-rural disparity in stunting cannot be over-emphasied.

Focusing on gender, Wamani, et al., (2007) observed that boys are more likely to be stunted than girls. The authors noted that in ten out of sixteen sub-Saharan African countries studied, females were significantly less likely to be stunted than males. The authors realised that socio-economic inequalities also play an important role in establishing the gender differences observed. Collaborating the gender influence, El Taguri, et al., (2008) noted that being a boy increases the odds of stunting in Libya. All these findings point to the issue of gender inequalities in sub-Saharan Africa and the significance of child’s sex in child’s health and survival.

Thus, the reviewed literature laid emphasis on a number of factors like low household income, presence of siblings, sibling effect, age of mother and gender are associated with under-five stunting in Africa. However, this study was based on the premise established by these studies by improving on the gaps recognized in the reviewed literatures. Which means that this study went beyond identifying individual-level and household-level determinants of under-five stunting already established by the previous studies.

2.1.3 Overview of infant and child stunting in Nigeria

Nigeria contributes immensely to global statistics on child and infant stunting. Despite being a middle-income country, Nigeria has the highest level of stunting in sub-Saharan Africa, and the third highest in the world, with 37% of all children under five classified as stunted (NPC & ICF Macro, 2013). Many studies have identified the determinants of under-five stunting in Nigeria (Akorede & Abiola, 2013; Awoyemi, et al., 2012; Adekanmbi, et al., 2011; Agee, 2010). The identified determinants range from bio-demographic to socio-economic.

There has been endless debate on what constitutes the determinants of stunting among under-five children in Nigeria. Stunting has been observed to vary by region in the country. According to Adelekan, (2003), stunting varied across South West, South East, North West and North East regions, with North East having the highest prevalence of 51.2% and South West with the lowest with 36.6%.After a decade, in all regions of Northern Nigeria, on the average, stunting of under-five still exceeds 50% which indicates no improvement (Longhurst & Cornelius, 2013). The outrageous rate of stunting observed in Northern Nigeria is a function of many factors. For instance, 1 in 10 children receive all recommended doses of immunization (Longhurst & Cornelius, 2013). Furthermore, low health care facility utilization is unacceptably high. Three quarter of all women had never sought health advice and 10% of deliveries are carried out in health facilities (Longhurst & Cornelius, 2013). Adekanmbi, et al., (2013) also confirms the strong influence of region with regards stunting. Their findings suggest that the region parent of the child lives either increases or decreases the odds of being stunted (Adekanmbi , et al., 2013).

According to Esimai, et al., (2001), in their study on sociocultural practices influencing under-five nutritional status in an urban community in Osun state of Nigeria, gender plays a huge role in stunting. These authors found that female children were not adequately nourished compared to their male counterparts. This finding is in contrast to the findings of Adekanmbi et al (2013) in their study on individual and contextual factors associated with early childhood stunting in Nigeria. They identified that a male child is more likely to be stunted than a female child. Their findings suggested that biological advantage and cultural importance ascribed to female child in some cultures could be responsible. This indicates that there is no consensus in literature on association between gender and stunting.

Further, Adewara & Visser (2011) used 2008 Nigeria DHS to analyze how sources of water and sanitation affect children's health in Nigeria. These authors found that children who are of multiple births are likely to be more stunted than those of single birth (Adewara & Visser, 2011). They further observed that the type of birth plays a significant role in child stunting. Adekanmbi et al, (2011) supported the finding of Adewara and Visser by establishing that a child born as a twin has higher odds of being stunted.Kravdal & Kodzi, (2011)also corroborated the fact that twins had more than twice as high a chance of being stunted than singletons. These findings are similar to Fenske, et al, (2013) in India that observed that twins are potentially overlooked risk group.

Contributing to the debate, Agee (2010) found that household wealth contributes immensely to stunting. He went further to indicate that this factor influences the ability to access more and better quality food, funds to improve their hygiene standards, funds to ensure geographical mobility and access to media. Also emphasizing on the influence of household wealth, Ukwuani & Suchindran, (2003) found in their study on the implication of women's work for child nutritional status in sub-Saharan Africa using Nigeria as a case study, that household wealth has negative association with stunting. Akorede & Abiola (2013) found contrasting results by establishing that there was positive correlation between stunting and household income. Therefore different views have been identified by literatures in regards the association between household wealth and stunting.

In addition, geographical location of the household residence has been found to impart significant influence on child stunting. Agee (2010) found that there was negative association between stunting and family living in a large city or a sparsely populated rural area but reverse is the case when family is residence in urban deprived or slum area. Corroborating this finding, Fotso (2006) found that intra-urban differences in child stunting are larger than overall urban-rural differentials in child stunting in Nigeria. He went further to observe that intra rural differential is also observed but was lesser than intra-urban differentials.

Furthermore, maternal health seeking behavior index which takes into consideration at least one vaccination for the child, prenatal attendance of the mother, any medical assistance at delivery, use of oral rehydration syrup for the child and collecting tetanus injection by the mother before the birth of the child is shown to be an important predictor of stunting. According to Uthman (2008), in his study that focused on individual and community effect of chronic malnutrition in rural Nigeria, poor maternal health seeking behavior index increases the odds of being stunted.

According to a comparative study of the nutritional status of under-five children of indigenous and non-indigenous parentage in a South-West town in Nigeria, it is remarkable to note that being an indigene of a place influences chances of stunting. It was found by Omobuwa et al, (2013) that the children of a non-indigene are more likely to be stunted compared to the children of an indigene. The issue of poor sanitation in the area of residence of non-indigenous people contributed to stunting. This shows how importantly the community characteristics influence a child's nutritional status. Another study in a peri-urban town in South West Nigeria, precisely by Awoyemi, et al., (2012) confirms that poor sanitation increases the likelihood of stunting.

Although, a few studies have established the community-level effects of malnutrition in under-five children in Nigeria, as important as their findings are, gaps in evidence regarding the macro-level effects on infant and early childhood stunting in Nigeria still remains. Hence, this study builds on the reviewed literature to explore the correlates of infant and early childhood stunting in Nigeria.

2.2 Theoretical framework

There are a number of theories that may be used as a guide for the study of child mortality; however, few of them deal specifically with child morbidity and/or nutritional status as a proxy for child's health. Thus, this study had its theoretical foundation built on Mosley and Chen theoretical model, Sastry framework and WHO Conceptual framework on early childhood stunting (Stewart, et al., 2013).

As such, Mosley and Chen theoretical framework that has been chosen was specifically formulated to investigate child mortality and survival trends and patterns (Mosley & Chen., 1984). However, this framework can be used in the study of child health and nutritional status as well. Mosley and Chen model is a model for the study of the determinants of child survival in developing countries. The model incorporated both social and biological variables. The framework is based on the premise that all social and economic determinants of mortality and morbidity operates through a common set of proximate determinants to exert an impact on child health outcome (Mosley & Chen., 1984).The Mosley and Chen framework allows an understanding of how these variables may interact with one another to produce growth faltering or malnutrition. And also in investigating how the socio-economic and biological determinants interact and how they are then interlinked with the proximate determinants may provide a pathway in order to understand how malnutrition may occur.

Sastry's model built on the foundation Moseley and Chen model had. Sastry's argument from a methodological view was based on the fact that data collected in most demographic surveys in developing countries are clustered at both family and community level therefore organizing frailty effects into individual, family and community components/levels will be useful (Sastry, 1997)

He noted that there are three forms of effect; genetic, behavioral and environmental and they operate in the 3 levels of operation (Sastry, 1997). These genetic, behavioural and environmental factors influence child health and survival through each of the sets of intervening variables provided by Mosley and Chen. This framework therefore provides a basis of organizing underlying factors into the three levels of operation; individual, family and community levels.

WHO conceptual framework on early childhood stunting: context, causes and consequences takes into consideration inadequate complementary feeding and breastfeeding as important intervening variables of stunted growth and development. This framework is based on the

UNICEF framework on the causes of malnutrition (Stewart, et al., 2013). This framework particularly concentrates on the need to strengthen the complementary feeding aspect of infant and child feeding (Stewart, et al., 2013). It also took into consideration breastfeeding practices which include initiation of breastfeeding. Therefore, in this study, these frameworks were of great importance.

2.3 Conceptual framework

This study was guided by reviewed literature, Mosley and Chen framework (1984), Sastry (1997) and WHO conceptual framework on early childhood stunting (Stewart et al, 2013).The conceptual framework to be used in this study was adapted from these frameworks. The framework below took into consideration determinants at two levels of operations, micro and macro level of operations. This framework provided links between the underlying individual and community levels factors, intervening factors associated with child survival.

As shown in the framework, the individual- level includes both child and mother in level one. The mother and child are nested in the household unit. Also the household unit is nested within the community. There are therefore interactions between these levels of operation.

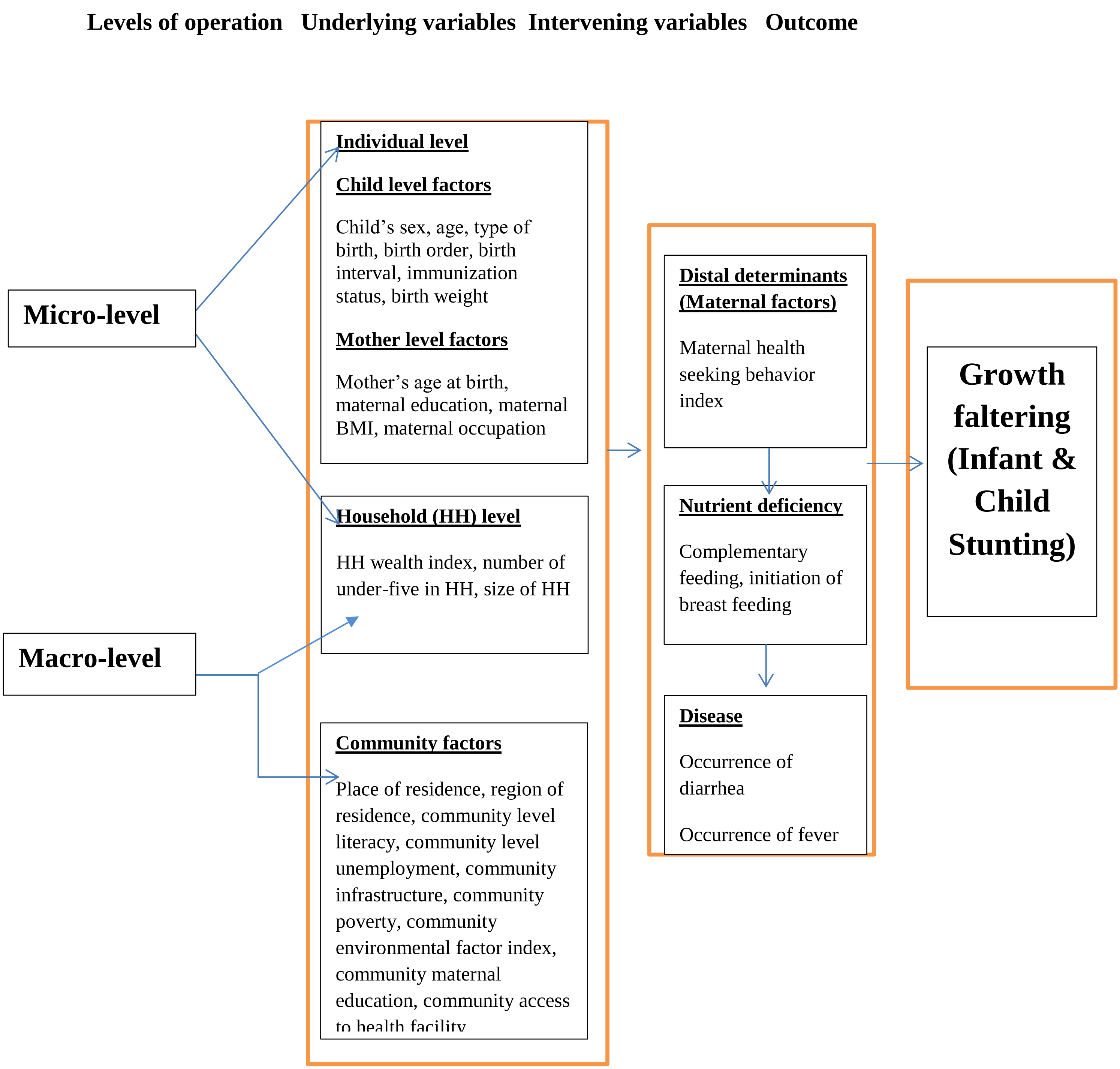

Figure 2.3: Conceptual framework on the relationship between stunting and micro and macro determinants (adapted from Mosley and Chen, 1984, Sastry, 1997, WHO framework- (Stewart, et al., 2013)

2.4 Hypotheses

The hypotheses tested in this study were as follows:

H_0= There is no relationship between immunization status and infant and child stunting

H_1= Fully immunized children have reduced risk of infant and child stunting

H_0 = There is no negative association between residence in rich households and infant and child stunting

H_2 = Residence in rich household is negatively associated with the risk of infant and child stunting

H_0 = Community poverty is not a significant predictor of infant and child stunting

H_3 = Community poverty is a significant predictor of infant and child stunting

H_0 = Community maternal education is not a significant predictor of infant and child stunting

H_4 = Community maternal education is a significant predictor of infant and child stunting

2.4.1 Rationale for hypotheses

The hypotheses for this study were drawn from the reviewed literature and the conceptual frame work. The determinants selected were observed to be important in the literature. Literature provided background and justification for hypotheses 1 and 2. For instance, hypothesis 1 posits that fully immunized children have reduced risk of infant and child stunting. Studies show that non-immunized children were more likely to be stunted compared to their counterparts who were immunized (Chowdhury, et al., 2006; Ukwuani & Suchindran, 2003).

Also, it is established in the literature that household wealth influences stunting, although the direction is debateable (Akorede & Abiola, 2013; Agee, 2010; Ukwuani & Suchindran, 2003). However, it is important to test if this hypothesis stands true for both infant and child stunting or just one group. Theories used also provided background and justification for hypothesis 4. Mosley and Chen model and Sastry's framework, which provided the theoretical foundation for the conceptual framework shows that community attributes greatly influence health outcomes. It is however important to test if these determinants will influence the infancy and early childhood individually or both groups.

CHAPTER 3

3.0 METHODOLOGY

3.1 Introduction

This chapter presents the description of the study setting, survey design, study population, study sample, instrument used, selected variables, steps in data analysis, proposed statistical analysis, ethical issues, study limitations and strengths.

3.2 Study setting

Nigeria, the selected study location, accounts for 6.7% chronically malnourished children globally (de Onis et al, 2012). The country is a sub-Saharan African country located in the West African sub-region, a sub- region with one of the highest prevalence of stunting and highest prevalence of wasting (de Onis, et al., 2012). Nigeria is divided into six zones and 37states including the Federal Capital Territory.

Figure 3.1: Geographical distribution of the population

Source: (NPC & ICF Macro, 2008)

3.3 Data Source

This study made use of the 2013 Nigerian Demographic Health Survey (NDHS) datasets. The 2013 NDHS provided information on demographic and health indicators at all levels.The survey was designed using the sampling frame provided by the National Population Commission (NPC). A cluster was defined as the primary sampling unit (PSU) based on enumeration areas (EAs) prepared for the 2006 Population and Housing Census of the Federal Republic of Nigeria. Selection of samples was through stratified two-stage cluster design. In the whole country, 904 clusters were selected with 372 in urban and 532 in rural areas. A representative sample of 40,680 households was selected for the 2013 NDHS survey. In each state, the number of households was distributed proportionately among its urban and rural areas(NPC & ICF Macro, 2013).

3.4 Study design

This study drew from 2013 Nigeria Demographic Health Survey (NDHS) data. The data from 2013 NDHS was used in this study to identify the micro and macro-level determinants of infant and child stunting. This study also made use of population-based cross-sectional study using 2013 Nigerian Demographic and Health survey(NPC & ICF Macro, 2013).

3.5 Study population and sample size

The sample for the 2013 NDHS is nationally representative and sample covering the entire population. The sample was designed and selected to provide population and health indicator estimates at the national, zonal, and state levels.This study was based on analysis of 28,596live births, born to 20,192 womenduring the five years preceding the 2013 Nigeria Demographic and Health Survey (NDHS). Analysis was focused on 28,596 children encompassing 6,235 between the ages 0-11months and 22,361 between the ages of 12-59 months because valid and complete information was only obtained on them .The unit of analysis was the child born in the five years before the survey.Birth recode of 2013 NDHS dataset was utilized in the analysis(NPC & ICF Macro, 2013).

3.6 Instruments

Questionnaires were the data collection instrument used for the 2013 NDHS. There were three types of questionnaires: the Household Questionnaire, the Woman's Questionnaire, and the Man's Questionnaire. Most of the variables for this study were predominately from the Woman's Questionnaire. The contents of the questionnaires were based on model questionnaires developed by DHS program. The questionnaires reflected relevant issues within the population, including family planning, domestic violence, HIV/AIDS, malaria, and maternal and child health issues.

3.7 Variable Identification

3.7.1 Dependent Variables

The dependent variables for this study were infant stunting and child stunting. Stunting was categorized into three – not stunted (coded as 0), moderately stunted (coded as 1) and severely stunted (coded as 2). Stunting was defined as height for age *z*-score less than -2 standard deviations (HAZ < -2 SD) from the median of the reference population of World Health Organization (WHO, 2006; de Onis *et al*. 2009). Mean z-scores describe the nutritional status of the entire population without the use of a cut off. A mean Z-score of less than 0 (i.e., a negative mean value for stunting) suggests that the distribution of an index has shifted downward and that most, if not all, children in the population suffer from stunting relative to the reference population (NPC & ICF Macro, 2013). A child who is below minus two standard deviations (-2 SD) from the median of the WHO reference population in terms of height-for-age is considered moderately stunted, If the child is below minus three standard deviations (-3 SD) from the reference median, then the child is considered to be severely stunted. A child between -2 SD and-3 SD is considered to be moderately stunted.

Table 3.1: Definition of the dependent variables

Dependent Variables	**Variable definition**	**Description**
Infant stunting (single-level)	height for age *z*-score less than -2 standard deviations (HAZ < -2 SD) for infants categorized into (1) 0-6 (2) 7-11months	0 = HAZ >-2 (not stunted) 1 = HAZ < -2 SD (moderately stunted) 2 = HAZ < -3 SD (severely stunted)
Infant stunting (multi-level)	height for age *z*-score less than -2 standard deviations (HAZ < -2 SD) for infants categorized into (1) 0-6 (2) 7-11months	0 = HAZ >-2 (not stunted) 1 = HAZ < -2 SD (stunted)
Child stunting (single-level)	height for age *z*-score less than -2 standard deviations (HAZ < -2 SD) for child categorized into (1) 12-23 (2) 24-35 (3) 36-47 (4) 48-59	0 = HAZ >-2 (not stunted) 1 = HAZ < -2 SD (moderately stunted) 2 = HAZ < -3 SD (severely stunted)
Child stunting (multi-level)	height for age *z*-score less than -2 standard deviations (HAZ < -2 SD) for child categorized into (1) 12-23 (2) 24-35 (3) 36-47 (4) 48-59	0 = HAZ >-2 (not stunted) 1 = HAZ < -2 SD (stunted)

3.7.2Independent variables

The independent variables included in this study were variables at the individual-, household-and community-levels. The variables selection was guided by the reviewed literature and the theoretical foundationearlier established for this study. These variables are said to have influence on child health outcome. These variables were divided into 2 levels- micro and macro level factors.

The micro level predictors used were divided into two; child/mother-level factors and household-level factors. The selected child-level factors were age, sex, birth interval, birthorder, type of birth, immunization status, birth weight, and breast-feeding duration. The maternal factors at the micro level were mother’s age at birth, mother’s body mass index (BMI), mother’s occupation and mother’s education. The household factors were household wealth index, household sanitation index, and number of under-five in household. The micro-level factors were nested within the macro-level factors.

The macro level factors were region of residence, place of residence, community level of poverty, poor community feeding practice, community environmental index, ethnic diversity, and community maternal education. The term community was used to describe clustering within the same geographical living environment. Using STATA package, individual and household variables of interest were aggregated at the level of primary sampling unit, all categories of such variables were generated and then collapsed, afterwards an average is gotten and then divided into 3 quintiles which enables division into 3 categories e.g. low medium, high; poor, fairly good, good etc**.**

Table 3.1: Definition of individual level-factors (micro-level)

Variables	Definition	Coding
Individual-level factors		
Child factors		
Age of child	Infant age (month) Child age (month)	(1) 0-6 (2) 7-11 (1) 12-23 (2) 24-35 (3) 36-47 (4) 28-59
Child's sex	Sex of the child	(1) Female (2) Male
Birth type	Type of birth of child	(1) Single birth (2) Multiple birth
Birth order	Order of birth	(1) First order (2) 2-4 order (3) 5+ order
Birth interval	Interval between birth	(1) Less than 24 months (2) 24 months or higher
Birth weight	Weight description of size at birth by mother	(1) Large (Very large and larger than average) (2) Normal (Average) (3) Small (Smaller than average/very small)
Immunization status	Full immunization status is receiving all the required immunization vaccines	(1) Complete (0) Incomplete
Mother factors		
Mother's age at birth	Mother's age atbirth of the child	(1) <15years (2) 15-24 years (3) 25-34 years (4) 35+ years
Maternal BMI	Body mass index of mother	(1) <18.5 (underweight) (2) 18.5-24.9 (normal) (3) >=25.0 (overweight or obese)
Maternal education	Highest educational attainment of mother	(1) No education (2) Primary (3) Secondary (4) Tertiary
Maternal occupation	Occupational status of mother	(1) Not working (2) Formal employment (professional/technical/managerial/clerical/sales services/skilled manual labour) (3) Informal employment (agricultural/unskilled manual workers)

Table 3.3: Definition of household level factors (micro-level)

Variable	**Definition**	**Coding**
Household wealth index		(1) Poorest (2) Poorer (3) Middle (4) Rich (5) Richest
Number of under-five children in household	Number of under-five children in household	(1) One (2) two (3) three (4) Four and more
Household size	Number of household members	(1) One - four (2) Five-six (3) Seven +

Table 3.4: Definition of community-levelfactors (macro-level)

Variable	Definition	Coding
Community environmental index	The index wasgenerated from the variables below • Safe water source • Proper sanitation • Cooking fuel • Electricity	(1) Poor (2) Fairly good (3) Good
Place of residence	Rural or urban residence	(1) Urban (2) Rural
Region of residence	Geopolitical zones where respondent resides	(1) South-west (2) North-east (3) North-west (4) North-central (5) South-east (6) South-south
Community level of poverty	Rate of households in the community living below proportion of poor households in the community	(1) Low (2) Medium (3) High
Ethnic diversity	The extent of diversity in the community where respondents live in terms of ethnic composition.	(1) Homogenous (2) Mixed (3) Heterogeneous
Community maternal education	The proportion of mothers who had at least	(1) Low (2) Medium

	secondary level of education in the community	(3) High
Poor Community feeding Practice	The proportion of children in the community who had minimum dietary diversity	(1) Low (2) Medium (3) High

3.7.3 Intervening variables

Intervening variables to be used in this study include maternal factors, nutrient deficiency and disease. To measure the maternal factors, health seeking behaviour index of mother was created. Nutrient deficiency will be measured by child feeding practices, this include initiation of breast feeding and complementary feeding.

Table 3.5: Definition Intervening Variables

Variable	Definition	Coding
Maternal factors		
Maternal health seeking behaviour index	Child received at least one vaccination, pre-natal attendance, medical assistance at delivery, use of oral rehydration syrup, tetanus injection before birth	(1) low (2) Medium (3) High
Nutrient deficiency		
Initiation of breastfeeding	When child was put to breast	(1) Immediately (2) 1-23 hours (3) 1 day and more
Complementary feeding	Quality of complementary food given to childmeasured by minimum dietary diversity (consuming at least one animal-source food, one fruit or vegetable, and a staple food)	(1) Low dietary quality (2) Medium dietary quality (3) High dietary quality
Disease		
Diarrhoea	Occurrences of diarrhoea (Child had diarrhoea within the last 2weeks before the survey)	(1) Yes (2) No
Fever	Occurrence of fever (Child had fever within the last	(1) Yes (2) No

	2weeks before the survey)	

3.8 Steps in data analysis

First objective: to measure the level of stunting in Nigeria. This objective was addressed using appropriate descriptive statistics e.g. percentage distribution to examine the levels of infant and child stunting in Nigeria.

Second objective: to identify the micro and macro-level correlates of infant and early childhood stunting in Nigeria. This objective was addressed using appropriate inferential statistics e.g. single level multinomial logistic regression, multilevel binary logistic regression. Firstly, bivariate analysis using cross tabulations was performed. Furthermore, chi-square test was performed to examine the association between infant and child stunting and selected individual, household and community–level variables. Secondly, multivariate analysis was performed using single-level multinomial logistic regression and multilevel binary logistic regression. Single-level multinomial logistic regression wasemployed to identify determinants associated with infant and child stunting at child and mother level. The outcome variable “stunting” had three categories of responses at the single-level phase, which were ‘not stunted’ ‘moderately stunted’ or ‘severely stunted’. Multilevel binary logistic regressionwasemployed to identify micro and macro-level determinants of infant and child stunting in Nigeria, to remove the effect of clustering and to examine the variation of effect across the levels. The outcome variable for the multilevel binary logistic regression at this phase had 2 responses, whichwill be ‘stunted’ or ‘not stunted’ response. The two-level model for dichotomous outcome includes standard logistic regression as first model and second model accounted for contextual influence.

Third objective: To examine the extent to which contextual factors account for regional variations in infant and child stunting in Nigeria. Multilevel binary logistic regression analysis was performed to achieve this objective.

3.9 Statistical analysis

The statistical analysis on the data was carried outwith the use of Stata statistical package (version 11.1). To analyze the datasets, three levels of analyses were carried out. The first is univariate, while the second and third are bivariate and multivariate analysis, respectively. At the univariate level,percentage distributions of the respondents according to the characteristics of interest were tabulated. At the bivariate level, cross tabulations of some important determinants were carried out. Chi-square wasemployed to test for the association between infant and child stunting and selected individual, household and community –level variables.

$$\chi^2 = \sum(o-e)^2 / e$$

Where χ^2 is chi-square, $\sum$ is summation, o is observed and e is expected

At the multivariate level, firstly, single level multinomial logistic regression was employed to examine the relationship between identified determinants of infant and child stunting. Two multinomial logistic regression models were fitted separately for infant and child population in order to identify determinants of stunting in children and infant populations. Secondly, multilevel binary logistic regression was employed to identify the micro and macro-level determinants of infant and child stunting in Nigeria. Two multilevel binary logistic regression models were fitted separately for infant and child population in order to identify determinants of stunting in children and infant populations at micro and macro levels of operation.

The single-level multinomial logistic regression is the combination of the binary logistic regression with the multinomial logistic link.

In mathematical terms, the multinomial logistic regression model is of the form:

logPr(Y=moderately stunted)= $\alpha+\beta_1 X_1 \beta_1 X_2+...\beta_k X_k$……………….. ..1

Pr(Y=not stunted)

(Adapted from Moutinho & Hutcheson, 2011)

Interpreted as predictors of moderate stunting relative to no stunting(in Nigerian children and infants-separate models)

logPr (Y= severely stunted) = $\alpha+\beta_1 X_1 \beta_1 X_2+...\beta_k X_k$……………….. …2

Pr(Y=not stunted)

(Adapted from Moutinho& Hutcheson, 2011)

Interpreted as predictors of severe stunting relative to no stunting

Where z indicates the dependent variable, $\alpha$the intercept,β the coefficient, $X$the independent variable.

The multilevel binary logistic regression is of the form:

Level-1 equation (micro-level)

$Yij = \beta_0 + \beta_1 xij + Rij$ ……………………………………………………..3(Snijders & Bosker, 2012)

Level-2 equation (macro-level)

$Yij = \beta_0 j + \beta_1 j\ xij + eij$……………………………………4 (Snijders & Bosker, 2012)

$Yij = \beta 0 + \beta_1 x_{ij} + u_j + e_{ij}$…………………….………......6(Goldstein, 2007)

i indicates level-one unit (i.e. micro-level), j level-two unit (i.e. macro-level), *eij*level-one residual, $u_j$level-2 residual, *Yij* dependent variable, and *Xij* indicates the explanatory variable at level one.

In addition, for the outcome variable, analyses were done for infant and child stunting separately at the bivariate and multivariate levels. This is because according to Omariba (2007), different factors influence infancy and early childhood phases. In addition, different factors influence different specific indicators of under-five mortality. Therefore, five models were constructedfor each outcome variablein this study. The first model was an empty model which contains no variable. Its purpose was mainly to decompose the total variance into the micro and macro-level components. The second model incorporated the micro-level variables. The third model had only the region of residence so as to measure the effect of region to further ascertain regional variations. The Fourth model contained other macro-level variables including region to be able to examine the extent to which contextual characteristics accounted for regional variation observed. The fifth model was the full model which contained both the micro- and macro-level variables and this model shown the extent to which both micro- and macro-level characteristics accounted for regional variations. In every model, stepwise logistic analysis was done to identify the key variables significantly associated with infant and child stunting. In totality, eight models were fitted for both infant and child stunting.

3.10 Ethical issues

This study used secondary data from the 2013 NDHS with all personal identifiers of respondents already removed. Hence, confidentiality and anonymity issues of the respondents were guaranteed.

3.11 Study limitation and strengths

3.11.1 Limitations

An important limitation that can be observed in this study is temporality i.e. the fact that Demography and Health Survey is a cross sectional survey, causation cannot be established. It can only suggest correlates and associated factors. Therefore whatever conclusions are drawn from this study cannot be drawn in regards the cause or origin of infant and early childhood stunting. Secondly, despite the fact that multilevel analysis can be performed at more finite levels e.g. child- level 1, household- level 2, and community- level 3, this study decomposes child-level and household level into one (micro-level) because DHS is not designed for such stratifications. Thirdly, recall bias is another limitation because the data on immunization and weight at birth were collected on both vaccination cards and mother's recall if cards are not available. Despitethe limitations identified, microscopic impact is expected on the study because data quality was well monitored so the data used is that of high quality (NPC & ICF Macro, 2013) and decomposing the analysis into two-levels did not distort DHS hierarchical levels.

3.11.2 Strengths

Despite the limitations of this study, it also has its strengths. Firstly, the study was able to disentangle the effect of micro and macro-level factors in infancy and early childhood. Secondly, the study made use of the most recent NDHS dataset and this gave credibility to the study.The third identified strength is the representativeness of the sample which therefore made generalization of result possible. These strengths will help make relevant suggestions for policy and programs to combat the menace of stunting in Nigeria.

CHAPTER 4

4.0 RESULTS

4.1 Introduction

This chapter dwells on the all the results, which answers the research questions. The chapter is divided into three sections. First section describes the selected socio-economic and demographic variables. This section shows the levels of infant and child stunting in Nigeria, percentage distribution of selected socio-economic and demographic factors and also bivariate relationship between infant/child stunting, micro and macro level characteristics. The second section dealt with identifying micro- and macro-level correlates of infants and child stunting using single level multinomial logistic regression. The third section of this chapter answered the remaining part of research two and three by employing multilevel binary logistic regression. This section further examined the micro- and macro-level correlates of infant and child stunting in Nigeria. In addition, it examined the extent to which contextual factors accounted for regional variations in infant and child stunting in Nigeria. Having observed variations with regards infant and child stunting across the six geopolitical regions of Nigeria in the previous sections using aforementioned statistics, the extent to which contextual factors account for regional variation in infant and child stunting in Nigeria was examined. Finally the summaries of results from each section of the chapter are discussed.

4.2 DESCRIPTIVE RESULTS

4.2.1 Percentage distribution of selected socio-economic and demographic variables

This section shows percentage distribution of selected predictor variables. A total number of 23,075 children whose height for age measure was collected were included in the sample. Theseinclude 5,270 aged 0-11months and 17,805 between the ages of 12-59 months. Percentage distribution of the children by child characteristics in micro-level is shown in table 4.1.

Table 4.1: Percentage distribution of sampled children by child characteristics in micro-level

Predictor variables	Percentage	Absolute Number
Sex		
• Female	49.99	13,813
• Male	50.01	14,014
Infant age		
• 0-6 months	63.12	4,529
• 7-11 months	36.88	2,644
Child age		
• 12-23 months	22.79	4,221
• 24-35 months	25.74	4,748
• 36-47 months	26.24	4,856
• 48-59 months	25.22	4,596
Birth type		
• Single	96.49	26,838
• Multiple	3.51	989
Birth order		
• 1st order	19.46	5,402
• 2nd to 4th order	45.5	12,545
• 5+ order	35.05	9,880
Birth Weight		
• Large	43.85	12,134
• Normal	41.26	11,352
• Small	14.89	4,033
Birth interval		
• Less than 2 years	18.61	5,143
• 2 years & higher	81.39	22,684
Immunization status		
• Incomplete	83.36	20,046
• Complete	16.64	4,178

The child characteristics of the children are as follows. At child level, about 63% of infant were in the age group 0 to 6 months and about 37% of them were in age group 7 to 11 months. Children aged 12-23 months were of about 23%, those of 24 to 35 months were of 26%, children of 36-47 months were approximately 26% and those of 48-59 months were of 25%. About 50% of them were male and about 50% were females. From the sample, children who are product of single birth were the majority with about 96% while the minority group was children who are product of multiple births with approximately 4%. Children born in the first order were about 20%, 2^{nd} to 4^{th} order were about 46% and those in the 5th and more than 5^{th} order were approximately 35%. Birth weight of the children according to the description of the mother indicated that 46% of the children were large at birth, 41% were of normal weight at birth and 15% were small at birth. Children that their birth interval was less than 2 years were approximately 19% and those that their birth interval were two years and higher were more in the sample with approximately 81%. The immunization status was grouped into incomplete and complete and children with incomplete immunization status were the majority of the sample with approximately 83% and those with complete immunization status were about 17%.

At mother level, characteristics of interest were maternal age at birth, maternal education level, mother's body mass index, and occupation type of mother. Percentage distribution of the children by mother and household characteristics in micro-level are shown in table 4.2 Percentage distribution of maternal age at birth indicates that in Nigeria, majority of children were from mothers aged 18 years to 34 years evidenced with approximately 75% while the minority came from children from mothers aged below 18years with approximately 7% and women aged 35 years and above with about 18%. Distribution of children from mothers with no education were approximately 47%, children from mothers with primary education were approximately 20%, children from mothers with secondary education were approximately 27% and those from mothers with tertiary education were the lowest with about 6%. Children from overweight mothers were the majority with 76%, children from underweight mothers were about 24%, and minority of children were from mothers with normal body mass index with 0.21%. With regards mother's occupation type, more than half of children were from mothers with informal education with 56%, children from mothers who had no form of occupation were about 24%, children from mothers who were involved in agriculture were about 11% and those who mothers had formal occupation were the lowest with approximately 4%.

Table 4.2: Percentage distribution of sampled children by mother and household characteristics in micro-level

Predictor variables	Percentage	Absolute number
Maternal age at birth		
• Below 18	6.85	1,828
• 18-34	74.77	20,767
• 35+	18.37	5,232
Maternal Education		
• No education	47.47	12,624
• Primary education	20.12	5,879
• Secondary education	26.56	7,593
• Tertiary education	5.85	1,731
Mother's Body Mass Index		
• Underweight	24.24	2,345
• Normal	0.21	21
• Overweight	75.55	7,200
Mother's occupation type		
• Not working	28.34	7,783
• Formal	3.74	1,123
• Informal	56.43	15,232
• Agricultural	11.49	3,496
Family size		
• Less than 5	29.55	6,759
• 5-6	16	3,777
• More than 6	54.45	12,965
Household wealth		
• Poor	45.54	12,488
• Middle	18.95	5,594
• Rich	35.51	9,745
Household under-five		

• One • Two • Three • Four or more	26.91 39.97 19.92 13.2	7,218 10,747 5,390 3,505

Furthermore, at household level, characteristics of interest were family size, household wealth index, and number of under-five children in the household. With respect to family size, more than half of the children were from household with more than six individuals (54.45%), children from household with less than five family members were approximately 30% and those from household with family size between five and six individuals were approximately 19%. Considering household wealth, largest fraction of children was from poor household (45.54%), 36% of children from rich households and smallest fraction of children were from middle households (19%). With regards number of under-five children in the household, table 4.2 shows that 27% of children were from household with one under-five child, 40% of children were from household with two under-five children, 20% of children were from household with three under-five children and 13% of children were from household with four and more than four under-five children.

At macro level, characteristics of interest are place of residence, region, poor community environmental index, maternal community educational level, community poverty, ethnic diversity and poor community feeding practice. Percentage distribution of the sampled children by macro-level characteristics are shown in table 4.3 Considering place of residence, majority of children were from mothers residing in rural community (64.34%) while minority of children were from mothers residing in urban community (35.66%). With regards region, approximately 47% of the children were children from mothers residing in North East region, approximately 36% of the children were children from mothers residing in North West region, approximately

15% of the children were children from mothers residing in South West region, approximately 14% of the children were children from mothers residing in North Central region, approximately 9% of the children were children from mothers residing in South East region, and approximately 9% of the children were children from mothers residing in North East region.

Table 4.3: Percentage distribution of sampled children by macro-level characteristics

Predictor variables	Percentage	Absolute Number
Place of Residence		
• Urban	35.66	9,301
• Rural	64.34	18,526
Region		
• South West	14.76	3,653
• North East	46.89	5,660
• North West	35.65	8,375
• North Central	14.02	4,171
• South East	9.22	2,582
• South South	9.46	3,386
Poor Community environmental Index		
• Low	19.22	5,514
• Middle	28.02	8,342
• High	52.76	13,971
Community educational level		
• Low	43.41	11,258
• Middle	24.84	7,463
• High	31.75	9,106
Community poverty		
• Low	24.99	7,023
• Middle	33.74	9,360
• High	41.26	11,444
Ethnic Diversity		
• Low	26.22	6,906
• Middle	39.58	10,037
• High	34.20	10,884
Poor Community feeding practice		
• low	21.14	5,740
• Medium	31.25	8,539
• High	47.60	13,548

Considering poor community environmental index, more than half of the children were children from mothers residing in communities with high concentration of poor environmental index (52.76%), 28% of the children were children from mothers residing in communities with medium concentration of poor environmental index and 19% of the children were children from mothers residing in communities with low concentration of poor environmental index. Taking maternal community educational level into consideration, table 4.3 shows that largest fraction of the children were from mothers residing in communities with low concentration of mothers who had secondary or higher level of education (43.41%), approximately 32% of the children were from mothers residing in communities with high concentration of mothers who had secondary or higher level of education and approximately 25% of the children were from mothers residing in communities with medium concentration of mothers who had secondary or higher level of education. With respect to community poverty, approximately 41% of the children were children from mothers residing in communities with high concentration of poor households, approximately 34% of the children were children from mothers residing in communities with medium concentration of poor household and approximately 25% of the children were children from mothers residing in communities with low concentration of poor households. In consideration of ethnic diversity, about 40% of the study samples were children from mothers residing in fairly heterogeneous, about 34% of the study sample were children from mothers residing in highly heterogeneous and about 26% of the children were from mothers residing in homogeneous communities. With regards to poor community feeding practice, largest fraction of the children were children from mothers residing in communities with high concentration of poor feeding practice (47.6%), about 31% of the sampled children were children from mothers residing in communities with medium concentration of poor feeding practice and approximately 21% of the samples children were children from mothers residing in communities with low concentration of poor feeding practice.

4.2.2 Levels of infant stunting in infancy and early childhood phase in Nigeria

This subsection presents the levels of infant and child stunting in Nigeria. The section further indicates the specific form of stunting experienced by children in infancy and early childhood phase.

Figure 4.1 presents the percentage distribution of infant and child stunting in Nigeria. From figure 4.1 approximately 80% of infant aged 0-11 months were not stunted and approximately 20% of the sampled infants were stunted. Figure 4.2 equally shows that approximately 59% of children in the early childhood phase were not stunted while about 41% of children in the early childhood phase were stunted.

Figure 4.1 levels of infant stunting in Nigeria

Figure 4.2 levels of child stunting in Nigeria

Figure 4.3 presents the percentage distribution of infant and child stunting in Nigeria in two categories of stunting. This figure further shows the specific stunting status of infant and children in the early childhood phase in Nigeria. From figure 4.3 approximately 80% of infant aged 0-11 months were not stunted, approximately 10% of the sampled infants was severely stunted and approximately 10% of the sampled infants were moderately stunted. According to figure 4.4 approximately 59% of children in the early childhood phase were not stunted while approximately 24% of the sampled children in early childhood phase were severely stunted and approximately 17% of the sampled children in the early childhood phase were moderately stunted.

Figure 4.3: Levels of infant stunting in three categories of stunting

Figure 4.4: Levels of child stunting in three categories of stunting

4.2.3 Levels of stunting across age in Nigeria

This subsection reports results with regards levels of stunting across age in Nigeria. Figure 4.5 shows the level of stunting status across age in from 2013 NDHS data. Taking into consideration the categories of stunting, the results indicates that 7.9% and 8.6% of children aged 0-6months were severely and moderately stunted, 12.6% and 11.1% of children aged 7-11 months were severely and moderately stunted, 20.9% and 16.2% of children aged 12-23 months were severely and moderately stunted, 27.2% and 17.7% of children aged 24-36 months were severely and moderately stunted, 24% and 18.4% of children aged 37-47 months were severely and moderately stunted, 20.1% and 18.5% of children aged 48-59 months were severely and moderately stunted respectively

Figure 4.5 Categories of stunting status across age

4.4.4 Bivariate relationship between infant and child Stunting and Selected Micro-and Macro- Level Characteristics

This subsection presents the bivariate relationship between infant and child stunting and all selected characteristics. Firstly, bivariate relationship between infant and child stunting and micro-level characteristics were presented. Secondly, bivariate relationship between infant and child stunting and macro-level characteristics were presented. Thirdly, bivariate relationship between infant and child stunting and intervening characteristics were presented. In each subsection, the results from the Pearson chi-square analysis were reported.

4.4.4.1 Bivariate relationship between infant and child stunting and micro level characteristics

The results from chi-square analysis which shows bivariate relationship between infant/child stunting and selected micro-level, macro-level and intervening characteristics are presented in table 4.5 to table 4.11. With regards relationship between infant age and infant stunting as shown in table 4.5, the results indicated that as the age increases the percentage stunted increases significantly ($p<0.05$). Similarly, from table 4.6, considering the relationship between child age and child stunting, as the age increases the percentage stunted also increases significantly with the exception of children aged 48-59 months with approximately 3% lower than the previous age group.

Birth type showed statistical significant bivariate relationship for infant stunting and no statistical significance for child stunting ($p<0.05$). Table 4.5 and 4.6 showed that majority of infant/child experiencing infant\child stunting were those who were products of single birth, although slightly higher proportions of stunting occurred during early childhood (96.86%) than in infancy (95.75%). Birth order showed a statistical significant association for both infant and child stunting (p<0.05). Tables 4.5 and 4.6 shows that similar results were observed during infancy and early childhood. For instance, proportion of infants who were stunted and born in first order were 16.32% while those in their early childhood phase and are stunted were 16.68%, born in their second to fourth order in infancy phase were 41.35% while those in early childhood phase were 43.67% and those born in the fifth and more order were 39.32% in infancy phase and 39.65% in the early childhood phase.

Birth weight showed a statistical significant association for both infant and child stunting (p<0.05). Proportion of infants who were stunted and were described as large at birth by their mothers were 36.93% while those in their early childhood phase and are stunted were 41.60%, normal birth weight in infancy phase was 42.41% while those in early childhood phase were 40.4% and those of small birth weight were 23.03% in infancy phase and 15.99% in the early childhood phase. Similarly, Birth interval showed a statistical significant association for infant and child stunting (p<0.05). Higher proportion of infant\child stunting occurred in two years and greater birth interval (88.02% for infants and 78.87% for child) compared to less than two years birth interval (11.98% of infants and 21.13% of child).

Table 4.5 Bivariate relationship between infant stunting and micro level characteristics

Infant stunting			
Independent variables	Not Stunted (%)	Stunted (%)	p-value
Micro-level factors			
Infant Age • 0-6 months • 7-11 months	 57.95 42.05	 46.67 53.33	 0.000
Birth type • Single • Multiple	 97.62 2.38	 95.75 4.25	 0.001
Birth order • First order • 2-4 order • 5+ order	 19.95 46.61 33.44	 19.32 41.35 39.32	 0.001
Birth weight			

• Large • Normal • Small	45.53 40.36 14.11	36.93 40.04 23.03	0.000
Birth Interval • Less 2 years • 2years & greater	12.82 87.18	11.98 88.02	0.466
Immunization status • Not complete • Complete	94.85 5.15	97.73 2.27	0.000
Sex • Female • Male	51.74 48.26	46.09 53.91	0.001
Mother factors			
Mother's Education • No Education • Primary Education • Secondary Education • Tertiary Education	37.95 19.65 34.66 7.74	61.45 19.52 16.23 2.80	0.000
Maternal body mass index • Underweight • Normal • Overweight	24.75 0.43 74.82	39.86 1.03 59.11	0.000
Mother's Age at birth • Below 18 years • 18-34 years • 35+ years	4.09 76.22 19.69	6.86 70.72 22.42	0.000
Mother's Occupation • Not working • Formal • Informal • Agricultural	32.51 4.78 50.61 12.10	36.05 2.04 55.69 6.22	0.000
Family size • Less than four • 5-6 • 7+	32.98 14.86 52.16	24.38 13.26 62.36	0.000
Household Under-five • One • Two • Three • Four/more	25.81 38.56 21.84 13.80	21.09 34.21 25.66 19.05	0.000
Household wealth • Poor • Middle • Rich	38.89 21.25 39.86	60.10 19.81 20.10	0.000

Tables 4.5 and 4.6 presents that immunization status of a child showed a statistical significant association for both infant and child stunting ($p<0.05$). Similar results were observed during infancy and early childhood. For instance, higher proportion of infant & child who were stunted

had incomplete immunization status (97.73% of infant and 87.81% of child) and lower proportion of stunted children had complete immunization status (2.27% of infant and 12.19% of child). Similarly sex of a child showed a statistical significant relationship with infant\child stunting ($p < 0.05$). Higher proportions of males were stunted than females in both infancy and early childhood phases (53.91% of infants who were male and 52.23% of children who were female while 46.09% of infants who were female 47.77% of female children).

Taking into consideration mother characteristics, maternal education showed a statistical significant relationship with both infant\child stunting ($p<0.05$). As the education level of the mother increases the proportion of infant & and child stunting decreases. For instance, tertiary education had the lowest proportion of children of mothers who were stunted for infancy and early childhood phases with 2.8% and 2.22% respectively. With regards maternal body mass index, a statistical significant relation was observed ($p<0.05$). Children of mothers who were overweight had the highest proportion of being stunted in both infancy and early childhood phase with 59.11% and 63.3% respectively, then children of mothers who were underweight with 39.86% and 36.44% respectively and the lowest proportion was observed for children of mothers who had normal body mass index with 1.03% and 0.26% respectively.

Table 4.6 Bivariate relationship between child stunting and micro level characteristics

Child stunting			
Independent variables	Not Stunted	Stunted	p-value
Child variables			
Child Age • 12-23 months • 24-35 months • 36-47 months • 48-59 months	23.02 23.78 26.28 26.92	20.82 27.58 27.54 24.06	0.000
Birth type • Single • Multiple	97.23 2.77	96.86 3.14	0.141
Birth order			

• First order • 2-4 order • 5+ order	19.81 47.28 32.91	16.68 43.67 39.65	0.000
Birth weight • Large • Normal • Small	 47.34 41.11 11.55	 41.60 42.41 15.99	0.000
Birth Interval • Less than 2 years • 2 years & greater	 17.18 82.82	 21.13 78.87	0.000
Immunization status • Not complete • Complete	 72.94 27.06	 87.81 12.19	0.000
Sex • Female • Male	 51.17 48.83	 47.77 52.23	0.000
Mother factors			
Mother's Education • No Education • Primary Education • Secondary Education • Tertiary Education	 33.23 23.09 34.21 9.48	 61.37 19.46 16.96 2.22	0.000
Maternal body mass index • Underweight • Normal • Overweight	 16.63 0.11 83.26	 36.44 0.26 63.30	0.000
Mother's Age at birth • Below 18 years • 18-34 years • 35+ years	 4.75 76.18 19.07	 8.26 74.09 17.65	0.000
Mother's Occupation • Not working • Formal • Informal • Agricultural	 23.74 6.05 56.35 13.86	 30.86 1.71 55.37 12.06	0.000
Family size • Less than four • 5-6 • 7+	 27.88 18.93 53.18	 22.92 14.96 62.12	0.000
Household Under-five One Two Three Four/more	 26.67 43.19 19.52 10.62	 21.48 40.86 21.01 16.65	0.000
Household wealth • Poor • Middle • Rich	 32.44 20.40 47.16	 59.29 19.58 21.13	0.000

Mother's age at birth showed a statistical significant result with infant\child stunting ($p<0.05$). Children from mothers who were aged between 18years and 34years had the highest proportion of infant and child stunting with 70.72% and 74.09% respectively, then children of mothers aged 35 years and above with 22.42% and 17.65% respectively and children from mother aged 18years and below had 6.86% and 8.26% respectively. Occupation type of mother shows statistical significant association with infant\child stunting ($p<0.05$). The highest proportion of children who experienced stunting were children of mothers who had informal type of occupation with 55.69% and 55.37% respectively, the proportion of children from mothers who were not working were 36.05% and 30.86% respectively, proportion of children from mothers who were involved in agriculture were 6.22% and 12.06 respectively and the lowest proportion was from children from mothers who had formal occupation with 2.04% and 1.71% respectively.

The relationship between family size and infant\child stunting was statistically significant ($p<0.05$). Highest proportion of children that experienced stunting were from households with 7 and more than 7 household member with 62.36% and 62.12% respectively, the proportion of children from household with family size less than 4 were 24.38% and 22.92% respectively and proportion of children from household with family size between 5 and 6 members were the lowest with 13.26% and 14.96% respectively. Household wealth in which a child is found shows statistical significance with infant\child stunting ($p<0.05$). Similar results were observed between children in the infancy phase and early childhood phase. Infants and children from poor households had the highest percentage with 60.10% and 59.29% respectively, those from rich households had 20.1% and 21.13% respectively and those from middle household had 19.81% and 19.58% respectively

4.4.4.2 Bivariate relationship between infant and child stunting and macro level characteristics

In considering macro-level characteristics, table 4.7 and table 4.8 shows that place of residence has a statistical significant association with infant and child stunting ($p<0.05$). Children whose mothers resided in rural areas experienced higher proportion of stunting (75.17% for infant and 75.9% for child) compared to children whose mothers resided in urban areas (24.83% for infant and 24.1%for child stunting). In the same vein, region shows statistical significant relationship with infant and child stunting. children whose mothers resided in North West region had the highest proportion of infant and child stunting with 52.95% and 43.57% respectively, followed by North East region with 20% and 24.82% respectively, North Central with 8.89% and 12.71% respectively, South South with 8.89% and 6.66% respectively, South West with 6.38% and 8.30% respectively and South East with 2.9% and 3.94% respectively.

Table 4.7 Bivariate relationship between infant stunting and macro-level characteristics

Infant stunting			
Independent variables	Not Stunted	Stunted	P-values
Macro-level factors			
Place of residence			
• Urban	37.02	24.83	
• Rural	62.98	75.17	0.000
Region			
• South West	15.94	6.38	
• North East	20.71	20.00	
• North West	23.09	52.95	0.000
• North Central	16.29	8.89	
• South East	11.24	2.90	
• South South	12.73	8.89	
Ethnic diversity			
• Low	24.11	26.86	
• Medium	34.95	41.93	0.000
• High	40.94	31.21	
Poor Community feeding practice			
• Low	20.76	11.11	
• Medium	32.21	22.71	0.000
• High	47.04	66.18	

Community maternal education • Low • Medium • High	34.14 28.97 36.88	56.81 21.26 21.93	0.000
Community Poverty • **Low** • **Medium** • **High**	**24.94** **33.20** **41.87**	**23.67** **35.85** **40.48**	**0.266**
Poor Community environmental index • Low • Middle • High	22.13 31.43 46.45	10.14 26.18 63.67	0.000

With regards ethnic diversity, results from the chi-square analysis shows statistical significant association with infant and child stunting (p<0.05). Proportion of stunted children whose mothers reside in fairly heterogeneous communities is the highest with 41.93% and 38.45% respectively, those from mothers residing in highly heterogeneous communities with 31.21% and 37.98% respectively and children from mothers who reside in homogenous communities with 26.86% and 23.57%respectively. Considering poor community feeding practice, a statistical significant association is observed with infant and child stunting (p<0.05). Highest Proportion of children were from mothers residing in communities with high poor feeding practice (47.04% for infant and 60.05% for child stunting), 22.71% and 26.32% of infant and child phases stunted children were those that their mothers reside in communities with medium poor feeding and stunted children whose mothers reside in communities with low poor feeding practice were the lowest with 11.11% and 13.63% of infant and child stunted children respectively.

In respect to community maternal education, results from the chi-square analysis shows statistical significance with infant and child stunting (p<0.05). Largest fraction of stunted children was children from mothers residing in communities with low concentration of mothers who had secondary school or higher level of education (56.81% for infant stunting and 55.15%

for child stunted). 21.26% and 22.72% of children stunted at infancy and early childhood phases were children from mothers residing in communities who had medium concentration of mothers who had secondary school or higher level of education. 21.93% and 22.13% of children stunted at infancy and early childhood phases were children from mothers residing in communities with high concentration of mothers who had secondary or higher level of education.

Table 4.8 Bivariate relationship between child stunting and macro-level characteristics

Child stunting			
Independent variables	Not Stunted	Stunted	p-values
Macro-level factors			
Place of Residence			
• Urban	42.15	24.10	
• Rural	57.85	75.90	0.000
Region			
• South West	17.02	8.30	
• North East	16.37	24.82	
• North West	19.44	43.57	
• North Central	17.65	12.71	0.000
• South East	12.95	3.94	
• South South	16.56	6.66	
Ethnic diversity			
• Low	26.26	23.57	
• Medium	33.66	38.45	0.000
• High	40.08	37.98	
Poor Community feeding practice			
• Low	27.56	13.63	0.000
• Medium	34.52	26.32	
• High	37.92	60.05	
Community maternal education			
• Low	29.01	55.15	
• Medium	30.04	22.72	0.000
• High	40.95	22.13	
Community Poverty			
• Low	24.92	26.13	
• Medium	33.12	33.68	0.038
• High	41.96	40.19	
Community environmental index			
• Low	25.55	13.80	0.000
• Middle	34.20	24.37	
• High	40.25	61.82	

Considering poor community environmental index, results from the chi-square analysis shows statistical significance ($p<0.05$). Highest proportion of stunted children were children from mothers residing in communities with high concentration of poor environmental index (63.67% for infant and 61.82% for child stunting), 26.18% and % 24.37% of children stunted at infancy and early childhood phases were children from mothers residing in communities with medium concentration of poor environmental index and 10.14% and 13.80% of children stunted at infancy and early childhood phases were children from mothers residing in communities with low concentration of poor environmental index. Considering poor community environmental index, 63.67% and61.82% of children stunted at infancy and early childhood phases were children from mothers residing in communities with high concentration of poor environmental index, 26.18% and 24.37% of children stunted at infancy and early childhood phases were children from mothers residing in communities with medium concentration of poor environmental index and 10.14% and 13.8% of children stunted at infancy and early childhood phases were children from mothers residing in communities with low concentration of poor environmental index.

4.4.4.3 Bivariate relationship between infant and child stunting and intervening characteristics

The intervening characteristic of interest is poor maternal health seeking behavior. Other intervening characteristics are diarrhea, initiation of breast feeding, complementary feeding and fever. The result for bivariate relationship between each of these variables and infant &child stunting is shown in table 4.9. In consideration of poor maternal health seeking behavior and infant stunting, a statistical significant association is observed.

Table 4.9 Bivariate relationship between infant stunting and intervening characteristics

Infant stunting			
Intervening Factors	Not Stunted	Stunted	p-values
Poor maternal health seeking • Low • Medium • High	9.87 11.37 78.76	24.46 16.55 58.99	0.000
Disease- Diarrhea • No • Yes	88.87 11.13	86.36 13.64	0.024
Initiation of breastfeeding • Immediately • 1-23hours • <=1day	36.64 39.89 23.47	29.39 43.49 27.12	0.000
Complementary feeding • **Low dietary quality** • **Medium dietary quality** • **High dietary quality**	**92.51** **6.76** **0.73**	**93.39** **5.83** **0.78**	**0.558**
Disease- Fever • No • Yes	87.43 12.57	84.95 15.05	0.034

Highest proportion of stunted infants and children were from mothers who had high poor maternal health seeking behavior (58.99% in infancy phase and in early childhood phase). 24.46% of stunted infant and of Children were children from mother who had low poor maternal health seeking behavior. The lowest proportion of stunting experienced by children in infancy and early childhood were those from mother that had medium poor maternal health seeking behavior. In respect to diarrhea, results from the chi-square analysis shows statistical significance with infant and child stunting ($p<0.05$). Majority of stunted children were children who didn't experience diarrhea two weeks before the survey (86.36% in infancy phase and 87.78% in early childhood phase). Minority of stunted infant and children in early childhood phase, 13.64% and 12.22% respectively were those had experienced diarrhea two weeks before the survey.

Table 4.10 Bivariate relationship between child stunting and intervening characteristics

Child stunting

Intervening factors	Not Stunted	Stunted	p-values
Maternal health seeking • Low • Medium • High	 10.33 13.32 76.36	 19.49 22.36 58.16	 0.000
Disease- Diarhorea • No • Yes	 91.45 8.55	 87.78 12.22	 0.000
Initiation of breastfeeding • Immediately • 1-23hours • <=1day	 39.61 40.94 19.45	 32.41 41.34 26.25	 0.000
Complementary feeding • Low • Medium • High	 80.63 16.95 2.42	 84.51 13.56 1.93	 0.000
Disease- Fever • No • Yes	 87.39 12.61	 85.91 14.09	 0.003

In considering initiation of breastfeeding, statistical significant relationship was observed with infant and child stunting ($p<0.05$). largest fraction of stunted infant and children in their early childhood phase were children that their mothers started breastfeeding within the first day of birth (43.49% of stunted infant and   of stunted children), proportion of stunted infants and children that were breastfed immediately were 29.39% of stunted infant and of children and those breastfed after the first day were 27.12% of stunted infant and of stunted children. In the same vein, with regards complementary feeding, a statistical significant association was observed with child stunting but not with infant stunting ($p<0.05$). Proportion of children was low minimum dietary fiber in their complementary feeding were 84.51%, those with medium minimum dietary fiber were 13.56% and the lowest fraction were children with high minimum dietary fiber in their complementary feeding with 1.93%. In respect to occurrence of fever, results from the chi-square analysis shows statistical significance with infant and child stunting ($p<0.05$). Majority of stunted children were children who didn’t experience fever two weeks before the survey (84.95% in infancy phase and 85.91% in early childhood phase). Minority of stunted infant and children in early childhood phase, 15.05% and 14.09% respectively were those had experienced fever two weeks before the survey.

4.3 Micro- and Macro-level correlates of infants and child stunting in Nigeria

4.3.1 Single level multinomial logistic regression

This subsection presented the results from unadjusted and adjusted models of multinomial logistic regression. The subsection further had 5 sub-subsections and each sub-subsections reported results for each model taking into consideration effect of different characteristics on infant/child stunting. The Tables 4.11 to 4.15 showed results from the unadjusted and adjusted models of multinomial logistic regression.

4.3.1.1 Unadjusted Multinomial logistic regression

This sub-subsection reported results from the un-adjusted model for multinomial logistic regression. This model checked for association and size of effect of each characteristic on infant/child stunting without taking into consideration other selected characteristics. The results are presented on table 4.11.

From the unadjusted model shown in table 4.11, in comparison to infant that did not experience infant stunting, infant aged 7 to 11 months had 1.74 higher odds to be severely stunted than infant aged 0-6 months. This relationship is statistically significant. In comparison to infant that didn’t experience stunting, infant aged 7 to 11 months had significantly 1.42 higher odds to be moderately stunted than infant aged 0-6 months. Table 4.11 showed that all age group had significant relationship with child stunting. From unadjusted model, in comparison with children that didn’t experience stunting, children aged 24-35 months had significantly 1.36 higher odds of being severely stunted compared with children aged 12-23 months. With regards children that didn’t experience stunting, children aged 24-35 months had significantly 1.18 higher odds of being moderately stunted compared with children aged 12-23 months. Similar results were observed for children aged 36-47 months. With regards children that didn’t experience stunting, although significant results were observed with children aged 48-59 months in comparison to severe stunting, but considering children that didn’t experience stunting, children aged 48-59 months had insignificantly 1.1 higher odds of being moderately stunted compared with children aged 12-23 months.

Taking infant that didn’t experience stunting into consideration, table 4.11 showed that infant from second to fourth birth order had insignificantly 0.9 lesser odds to be severely stunted than infant in the first birth order. In contrast to infant that didn’t experience stunting, infant from second to fourth birth order had insignificantly 0.93 lesser odds to be moderately stunted than infant in the first birth order. In comparison to children who didn’t experience stunting, children from second to the fourth birth order were shown to significantly have 1.12 higher odds of being severely stunted compared to their counterparts from the first birth order. In comparison to children who didn’t experience stunting, children from second to the fourth birth order showed insignificant 1.07 higher odds of being moderately stunted compared to their counterparts from the first birth order. In contrast to infant that didn’t experience stunting, infant from fifth and more birth order had insignificantly 1.27 higher odds to be severely stunted than infant in the first birth order. In contrast to infant that didn’t experience stunting, infant from fifth and more birth order had insignificantly 0.16 lesser odds to be moderately stunted than infant in the first birth order. With regards children who didn’t experience stunting, children from fifth and above birth order were shown to significantly have 1.53 higher odds of being severely stunted compared to their counterparts from the first birth order. In the same vein, in comparison to children who didn't experience stunting, children from fifth and above birth order were shown to significantly have 1.31 higher odds of being severely stunted compared to their counterparts from the first birth order.

Relative to infant that didn't experience stunting, table 4.11 revealed that infant who were described to have normal weight at birth by their mothers had significantly 1.3 higher odds to be severely stunted than infant who were large at birth. In relative to infant that didn't experience stunting, infant who were described to have normal weight at birth by their mothers had insignificantly 1.15 higher odds to be moderately stunted than infant who were large at birth. In comparison to children who were not stunted, children who were described to have normal weight at birth by their mothers had significantly 1.19 higher odds to be severely stunted than children who were large at birth. In considering children that didn't experience stunting, children who were described to have normal weight at birth by their mothers had significantly 1.16 higher odds to be moderately stunted compared to children who were large at birth. Relative to infant that didn't experience stunting, infant who were described by their mothers to be small at birth by their mothers had significantly 2 folds higher odds to be severely stunted than infant who were large at birth. In relation to infant that didn't experience stunting, infant who were described by their mothers to be small at birth had significantly 2.02 higher odds to be moderately stunted than infant who were large at birth. Similarly, compared to children that didn't experience stunting, children who were described by their mothers to be small at birth by their mothers had significantly 1.78 higher odds to be severely stunted than children who were large at birth. Compared to children that didn't experience stunting, children who were described by their mothers to be small at birth had significantly 1.33 higher odds to be moderately stunted than children who were large at birth.

In contrast to infants that didn't experience stunting, table 4.11 showed that infant that are product of multiple births had significantly 1.62 higher odds of being severely stunted than infants that are products of single birth. In contrast to infants that didn't experience stunting, infant that are product of multiple births had significantly 2.01 higher odds of being moderately stunted than infants that are products of single birth. Differences were observed between child and infant stunting with regards birth type. In comparison to children who didn't experience stunting, children that are product of multiple births had insignificantly 1.14 higher odds of being severely stunted than their counterparts who were products of single birth. In contrast to un-stunting children, children that are product of multiple births had insignificantly 1.12 higher odds of being moderately stunted than children that are products of single birth.

Table 4.11 revealed that in contrast to infants that didn't experience stunting, male infants had significantly 1.41 higher odds of being severely stunted than female infants. In contrast to infants that didn't experience stunting, male infants had insignificantly 1.11 higher odds of being moderately stunted than female infants. In the same vein, in comparison to children that didn't experience stunting, male children in early childhood phase had significantly 1.20 higher odds of being severely stunted than female children. With regards children that didn't experience stunting, male children had significantly 1.08 higher odds of being moderately stunted than female children.

In comparison to infants that didn't experience stunting, table 4.11 showed that infants with complete immunization status had significantly 0.44 lesser odds of being severely stunted than infant that had incomplete immunization status. In comparison to infants that didn't experience stunting, infants with complete immunization status had significantly 0.41 lesser odds of being moderately stunted than infant that had incomplete immunization status. With regards children that didn't experience stunting in early childhood phase, children with complete immunization status had significantly 0.26 lesser odds of being severely stunted than children that had incomplete immunization status. In comparison to children that didn't experience stunting in early childhood phase, those with complete immunization status had significantly 0.52 lesser odds of being moderately stunted compared to their counterpart that had incomplete immunization status.

In relation to infants that didn't experience stunting, table 4.11 revealed that infant with birth interval of two years or greater than had insignificantly 1.05 higher odds of being severely stunted than infant with less than two years birth interval. In relation to infants that didn't experience stunting, infant with birth interval of two years or greater than had insignificantly 1.11 higher odds of being moderately stunted than infant with less than two years birth interval. In comparison to children that didn't experience stunting in early childhood phase, children with birth interval of two years or greater than had significantly 0.74 lesser odds of being severely stunted compared to children with less than two years birth interval.With regards children that didn't experience stunting, children with birth interval of two years or greater had significantly lower (0.82) odds of being moderately stunted than children with shorter birth interval.

Table 4.11 Results from unadjusted multinomial logistic regression of infant and child stunting showing relative risk ratio

Unadjusted Model	Infant Stunting		Child Stunting	
	Severe stunting	Moderate Stunting	Severe stunting	Moderate Stunting
Micro-level factors	RRR	RRR	RRR	RRR
Age				
• 0-6 months	1.00	1.00		
• 7-11 months	1.74*	1.42*		
• 12-23 months			1.00	1.00
• 24-35 months			1.36*	1.18*
• 36-47 months			1.14*	1.18*

• 48-59 months			0.90*	1.10
Birth order				
• First order	1.00	1.00	1.00	1.00
• 2-4 order	0.90	0.93	1.12*	1.07
• 5+ order	1.27	0.16	1.53*	1.31*
Birth weight				
• Large	1.00	1.00	1.00	1.00
• Normal	1.30*	1.15	1.19*	1.16*
• Small	2.00*	2.02*	1.78*	1.33*
Birth type				
• Single	1.00	1.00	1.00	1.00
• Multiple	1.62*	2.01*	1.14	1.12
Sex				
• Female	1.00	1.00	1.00	1.00
• Male	1.41*	1.11	1.20*	1.08*
Immunization status				
• Not complete	1.00	1.00	1.00	1.00
• Complete	0.44*	0.41*	0.26*	0.53*
Birth Interval				
• Less 2 years	1.00	1.00	1.00	1.00
• 2years & greater	1.06	1.11	0.74*	0.82*
Mother & Household factors				
Household Wealth				
• Poor	1.00	1.00	1.00	1.00
• Middle	0.51*	0.71*	0.46*	0.63*
• Rich	0.29*	0.37*	0.17*	0.37*
Mother's Education				
• No Education	1.00	1.00	1.00	1.00
• Primary	0.52*	0.73*	0.37*	0.60*
• Secondary	0.22*	0.37*	0.18*	0.41*
• Tertiary	0.18*	0.27*	0.09*	0.19*
Family size				
• </= four	1.00	1.00	1.00	1.00
• 5-6	1.20	1.21	1.96	0.96
• 7+	1.76*	1.48*	1.54*	1.28*
Mother's Age at birth				
• Below 18 years	1.00	1.00	1.00	1.00
• 18-34 years	0.55*	0.56*	0.49*	0.67*
• 35+ years	0.69	0.66*	0.45*	0.67*
Maternal body mass index				
• Underweight	1.00	1.00	1.00	1.00
• Normal	1.78	1.10	1.42	0.45
• Overweight	0.44*	0.55*	0.29*	0.43*
Household Under-five				
• One	1.00	1.00	1.00	1.00
• Two	1.08	1.09	1.18*	1.16*
• Three	1.38*	1.50*	1.42*	1.23*
• Four/more	1.64*	1.75*	2.18*	1.66*
Mother's Occupation				
• Not working	1.00	1.00	1.00	1.00
• Formal	0.24*	0.54*	0.16*	0.30*

• Informal • Agricultural	0.96 0.43*	1.03 0.50*	0.69* 0.56*	0.86* 0.84*
Intervening factors				
Maternal health seeking • Low • Medium • High	 1.00 0.66 0.26*	 1.00 0.51 0.35*	 1.00 0.99 0.36*	 1.00 0.69 0.48*
Initiation of breastfeeding • Immediately • 1-23hours • <=1day	 1.00 1.33* 1.30*	 1.00 1.39* 1.59*	 1.00 1.23* 1.77*	 1.00 1.23 1.50*
Complementary feeding • Low • Medium • High	 1.00 0.82 1.29	 1.00 0.90 0.80	 1.00 0.70* 0.67**	 1.00 0.84* 0.88
Fever	 1.00 1.17	 1.00 1.29*	 1.00 1.18*	 1.00 1.08
Diarrhea	 1.00 1.15	 1.00 0.37*	 1.00 1.72*	 1.00 1.19*

* indicates p-value<0.05

Taking mother factors into consideration, relative to infant that didn't experience stunting, infants that were from mothers that reside in middle wealth index households were significantly 0.51 less likely to be severely stunted compared to their counterparts in the poor households. Considering infant that didn't experience stunting, infant from mothers residing in middle wealth index households were significantly 0.71 less likely to experience moderate stunting compared to their counterparts in poor households. Similarly, compared to children that didn't experience stunting, children that were from mothers that resided in middle wealth index households were significantly 0.46 less likely to be severely stunted compared to their counterparts in the poor households. Considering children that didn't experience stunting, children from mothers residing in middle wealth index households were significantly 0.63 less likely to experience moderate stunting compared to their counterparts in poor households. With regards not stunted infants, infants from mothers residing in rich households were significantly 0.29 less likely to experience severe stunting compared to their counterparts in poor households. In relation to infants that didn't experience stunting similar results were observed with infants that were from living in rich households with significantly 0.37 lesser holds of being moderately stunted compared to their counterparts from poor households. In the same vein, taking into considerations children not stunted in early childhood phase, children from mothers residing in rich households were significantly 0.17 less likely to experience severe stunting compared to their counterparts in poor households. In relation to children that didn't experience stunting, table 4.11 showed that with regards children that were from mothers living in rich households, they had significantly 0.37 lesser holds of being moderately stunted compared to their counterparts from poor households.

Table 4.11 revealed that in consideration with un-stunted infants, infants from mothers with primary education had significantly 0.52 lesser odds of being severely stunted compared to their counterparts from uneducated mothers. In the same vein, in comparison with un-stunted infants, infants from mothers with primary education had significantly 0.73 lesser odds of being moderately stunted compared to their counterparts from uneducated mothers. With regards un-stunted children, children from mothers with primary education had significantly 0.37 lesser odds of being severely stunted compared to their counterparts from uneducated mothers. Similarly, in comparison with un-stunted children, children from mothers with primary education had significantly 0.60 lesser odds of being moderately stunted compared to their counterparts from uneducated mothers. In consideration of un-stunted infants, infants from mothers with secondary education had significantly 0.22 lesser odds of being severely stunted compared to their counterparts from uneducated mothers. Similarly, in comparison with un-stunted infants, infants from mothers with primary education had significantly 0.37 lesser odds of being moderately stunted compared to their counterparts from uneducated mothers. In consideration of un-stunted children, children from mothers with secondary education had significantly 0.18

lesser odds of being severely stunted compared to their counterparts from uneducated mothers. Similar results were observed with regards moderate stunting. With regards un-stunted infants, infants from mothers with tertiary education had significantly 0.18 lesser odds of being severely stunted compared to their counterparts from uneducated mothers. In the same vein, in comparison with un-stunted infants, infants from mothers with tertiary education had significantly 0.27 lesser odds of being moderately stunted compared to their counterparts from uneducated mothers. Taking into consideration unstinted children, children from mothers with tertiary education had significantly 0.09 lesser odds of being severely stunted compared to their counterparts from uneducated mothers. In the same vein, in comparison with un-stunted children, children from mothers with tertiary education had significantly 0.19 lesser odds of being moderately stunted compared to their counterparts from uneducated mothers.

In comparison with infant that are not stunted, table 4.11 indicated that infant from households with family size between five and six had significantly 1.2 lesser odds of experiencing severe stunting than infants from household with family size less than or equal to four. Similarly, in comparison to un-stunted children, children from households with family size between five and six members had insignificantly 1.96 higher odds of being severely stunted compared to their counterparts from household with less than four or four members. Relative to un-stunted infants, infants from households with family size between five and six had insignificantly 1.21 higher odds of being moderately stunted in comparison to infants from household with family size less than or equal to four. With reference to un-stunted children, children from households with five to six members are insignificantly 0.96 less likely to be moderately stunted than their peers who lived in household with four or less than four members. Relative to infant that are not stunted, infant from households with family size with seven members and above had significantly 1.76

higher odds of been severely stunted than infants from household with family size less than or equal to four. Similarly, with reference to un-stunted children, children from households with family size with seven members and above had significantly 1.54 higher odds of been severely stunted than children from household with family size less than or equal to four. In contrast to infant that are not stunted, infants that are from households with seven or more than seven family members had significantly 1.48 higher odds of being moderately stunted than their counterparts from households with four or less than family members. Similarly, with reference to un-stunted children, children from households with family size with seven members and above had significantly 1.28 higher odds of been moderately stunted than children from household with family size less than or equal to four.

Table 4.11 revealed that relative to un-stunted infants and children, infants and children born to mothers aged between 18years and 34years had significantly 0.55 and 0.49 lesser odds of being severely stunted compared to their counterparts from mothers below 18years old respectively. In comparison to infant and children that didn't experience stunting, infant and children in early childhood phase born to mothers aged between the ages of 18-34years had significantly 0.56 and 0.67 lesser odds of being moderately stunted compared to their peers born to mothers that are below 18years respectively. Relative to infant that had not experience stunting, those from mothers that are 35 years and above had insignificantly 0.69 lesser odds of being stunted compared to infants from mothers below age 18. In contrast to children that had not experience stunting, children from mothers that are 35 years and above had significantly 0.67 lesser odds of being stunted compared to infants from mothers below age 18. In comparison to infants and children that are not stunted, infant and children born to mothers that are 35 years and above had significantly 0.66 and 0.67 lesser odds of being moderately stunted than infants born to mothers aged below 18years respectively.

As indicated from table 4.11, in contrast to un-stunted infants and children, infants and children from mothers with normal body mass index had insignificantly 1.78 and 1.42 higher odds of being severely stunted than those from underweight mother respectively. In comparison to un-stunted infants and children, infants and children from mothers with normal body mass index had insignificantly 1.1 higher odds and 0.45 lower odds of being moderately stunted than infants from underweight mothers respectively. Relative to un-stunted infants and children, infants and children from mothers with overweight body mass index had significantly 0.44 and 0.29 lesser odds of being severely stunted than infants from underweight mothers. In comparison to un-stunted infants and children, those from overweight mothers had significantly 0.55 and 0.43 lesser odds of being moderately stunted than infants from underweight mothers respectively.

In comparison to infant that did not experience stunting, infant that are from household with two under-five children had insignificantly 1.08 increased odds of being severely stunted when compared to their counterparts in households with one under-five child. In the same vein, with regards infant that didn’t experience stunting, infant that are from household with two under-five children had insignificantly 1.09 increased odds of being moderately stunted when compared to their counterparts in households with one under-five child. Table 4.11 revealed that in comparison to children that didn’t experience stunting, those from household with two under-five children had significantly 1.18 and 1.16 increased odds of being severely and moderately stunted respectively when compared to their counterparts in households with one under-five child. In comparison to infants and children that didn’t experience stunting, those from household with three under-five children have significantly 1.38 and 1.42 increased odds of being severely stunted when compared to their counterparts in households with one under-five child. In comparison to infant and children that didn't experience stunting, those from household with three under-five children had significantly 1.5 and 1.23 respectively increased odds of being moderately stunted when compared to their counterparts in households with one under-five child. In contrast to children in both infancy and early childhood phases that didn't experience stunting, those from household with four or more under-five children had significantly 1.64 and 1.66 respectively increased odds of being severely stunted when compared to their counterparts in households with one under-five child. In contrast to children in both infancy and early childhood phases that didn't experience stunting, those from household with four or more under-five children had significantly 1.75 and 1.66 increased odds of being moderately stunted when compared to their counterparts in households with one under-five child respectively.

As indicated in table 4.11, relative to infant and children that didn't experience stunting as at the time of survey, those born to mothers who had formal type of occupation had significantly 0.24 and 0.16 reduced odds of being severely stunted than their counterparts born by mothers who were not employed respectively. In comparison to infant and children that didn't experience stunting as at the time of survey, those born to mothers who had formal type of occupation had significantly 0.54 and 0.3 reduced odds of being moderately stunted than their counterparts born to mothers who were not employed respectively. In relation to infant that didn't experience stunting as at the time of survey, infant born to mothers who had informal type of occupation had insignificantly 0.96 lesser odds of being severely stunted than their counterparts born to mothers who were not working. In contrast to children that didn't experience stunting as at the time of survey, those born to mothers who had informal type of occupation had significantly 0.69 and 0.86 lesser odds of being severely and moderately stunted than their counterparts born to mothers who were not working respectively. With regards infant that didn't experience stunting as at the time of survey, infant born to mothers who had informal type of occupation had insignificantly 1.03 higher odds of being moderately stunted than their counterparts born by mothers who were not working. Compared to children in both infancy and early childhood phases that didn't experience stunting as at the time of survey, those born to mothers who were involved in agriculture had 0.43 and 0.56 lesser odds of being severely stunted compared to their counterparts born to mothers who were not working respectively. Considering children in both phases that didn't experience stunting as at the time of survey, those born by mothers who are involved in agriculture had significantly 0.5 and 0.84 reduced odds of being moderately stunted compared their counterparts born to mothers who were not working respectively.

In comparison with children in both infancy and early childhood phases that were not stunted, table 4.11 shows that those from mothers with medium maternal health seeking behavior had insignificantly 0.66 and 0.99 lesser odds to be severely stunted compared to their peers from mothers with low maternal health seeking behavior respectively. In the same vein, relative to children in both infancy and early childhood phases that didn't experience stunting, those from mothers with medium maternal health seeking behavior were insignificantly 0.51 and 0.69 less likely to be moderately stunted than infant from mothers with low maternal health seeking behavior respectively. In comparison to children in both infancy and early childhood phases that didn't experience stunting, those from mothers with high maternal health seeking behavior were significantly 0.26 and 0.36 less likely to be severely stunted than their counterparts from mothers who had low maternal health seeking behavior respectively. With regards children in both infancy and early childhood phases that were not stunted, those from mothers with high maternal health seeking behavior had significantly 0.35 and 0.48 less likelihood to be moderately stunted compared to their counterparts born by mothers with low maternal health seeking behavior respectively.

Furthermore, with regards initiation of breastfeeding, table 4.11 reveals that in comparison with children in both infancy and early childhood phases that were not stunted, those who were breastfed between the first hour of birth and 23 hours were significantly 1.33 and 1.23 more likely to be severely stunted than infants who were fed immediately after birth respectively. Taking into consideration the probability of being moderately stunted, in comparison with infant that didn't experience stunting in infancy, infants that were breast fed after the first day of birth had significantly 1.39 higher odds to be moderately stunted compared to those who were breastfed immediately. However, taking into consideration the probability of being moderately stunted, in comparison with children that didn't experience stunting in infancy, those that were breast fed after the first day of birth had insignificantly 1.23 higher odds to be moderately stunted compared to those who were breastfed immediately. In contrast to children in both infancy and early childhood phases that were not stunted, those who were breastfed after a day had passed had significantly 1.3 and 1.77 higher odds of being severely stunted compared to their peers who were breastfed immediately respectively. In comparison to children in both infancy and early childhood phases that were not stunted, those who were breastfed after a day had passed had significantly 1.59 and 1.5 higher odds of being moderately stunted compared to their peers who were breastfed immediately respectively.

Taking occurrence of fever into consideration, the only significant relationship with regards infant stunting revealed from table 4.11 shows that with reference to un-stunted infants, infants who had fever were significantly 1.29 more likely of being moderately stunted compared to their peers who didn’t have fever. Besides, in comparison to un-stunted children in early childhood phase, those who had fever had significantly 1.18 higher odds of being severely stunted compared to their counterparts who did not have fever.

With regards the occurrence of diarrhea, in comparison to un-stunted children in early childhood phase, those who had diarrhea were significantly 1.72 more likely to be severely stunted compared to their peers who didn’t experience diarrhea. In relation children in both infancy and early childhood phases that were not stunted, those with no diarrhea occurrence had significantly 0.37 lesser odds and 1.19 higher odds to be moderately stunted than those who didn’t have diarrhea respectively.

With regards complementary feeding no significant association was observed with infant moderate or severe stunting whereas significant relationship were observed with child stunting. For instance, in contrast to children who were not stunted, those who had medium complementary feeding had 1.7 and 0.84 lesser odds of being severely and moderately stunted respectively compared to their counterparts who had low complementary feeding. In addition, in comparison with un-stunted children, those who had high complementary feeding were significantly 0.67 more likely to be severely stunted and insignificantly 0.88 more likely to be moderately stunted compared to the peers who had low complementary feeding.

4.3.1.2 Multinomial logistic regression between infant & child stunting and micro level factors.

This sub-section reported results from multinomial regression between infant and child stunting and selected micro level factors. As earlier mentioned, micro level factors included child factors and mother/household-level factors. Micro-level factors included in this adjusted model were selected using stepwise logistic regression. Results from this regression analysis are shown below in table 4.12.

After adjusting for all the factors in the model, many significant results in the previous model became insignificant. This trend was equally observed with age of children. With regards age of children in infancy, in comparison to infants that didn't experience stunting, those aged 7 to 11 months had significantly 1.77 higher odds to be severely stunted than infant aged 0-6 months. In comparison to children in early childhood phase that didn't experience stunting, children aged 24-35 months had significantly 1.59 higher odds to be severely stunted compared to their counterparts aged 12-23 months.

As indicated by results shown in table 4.12, no significant relationship was observed between birth order and any form of infant and child stunting. For instance, although the lesser odds of being severely or moderately stunted by infants from fifth and more order were observed, no significant relationship was shown. In contrast to infant that didn't experience infant stunting, infant from fifth and more birth order had 0.59 lesser odds to be moderately stunted than infant in the first birth order

With regards relationship between stunting and birth weight of child at birth, only infants described as small by their mothers were statistically significant at p value 0.05. Therefore, relative to infant that didn’t experience stunting, infant who were described by their mothers to be small at birth had significantly 1.75 and 2.31 higher odds to be severely and moderately stunted respectively than infant who were large at birth.

Taking type of birth of a child into consideration, in contrast to infants that didn’t experience stunting; infants that were product of multiple births had significantly 3.05 higher odds of being severely stunted than infants that are products of single birth. This was the only form of stunting statistically significant at p value less than 0.05 as indicated by table 5.3.

With regards sex of child, in contrast to children in infancy and early childhood that didn’t experience stunting, male infants had significantly 1.52 and 1.26 higher odds of being severely stunted respectively compared to their female counterparts.

With regards child factors, analysis of 2013 NDHS data showed that only children severely stunted in early childhood phase had statistically significant relationship with immunization status. Therefore, in comparison to children in early childhood phase that didn’t experience stunting, those with complete immunization status had 0.57 lesser odds of being severely stunted than their counterparts that had incomplete immunization status

Analysis of 2013 NDHS data showed that no significant association was observed between all forms of stunting and birth interval. For instance, relative to infants that didn’t experience stunting, infant with birth interval of two years or greater than had insignificantly 0.73 lesser odds of being severely stunted than infant with less than two years birth interval.

Table 4.12 Results from multinomial logistic regression of infant & child stunting with micro-level characteristics showing their relative risk ratio

	Infant Stunting		Child Stunting	
	Severely stunted	Moderately stunted	Severely stunted	Moderately stunted
	Relative Risk Ratio	Relative Risk Ratio	Relative Risk Ratio	Relative Risk Ratio
Micro-level factors				
Infant Age				
• 0-6 months	1.00	1.00		
• 7-11 months	1.77*	1.22		
• 12-23 months			1.00	1.00
• 24-35 months			1.59*	1.08
• 36-47 months			0.98	1.00
• 48-59 months			0.87	1.04
Birth order				
• First order	1.00	1.00	1.00	1.00
• 2-4 order	1.07	1.01	0.97	0.97
• 5+ order	0.67	0.59	0.87	0.99
Birth weight				
• Large	1.00	1.00	1.00	1.00
• Normal	1.49	1.13	1.12	1.13
• Small	1.75*	2.31*	1.23	0.99
Birth type				
• Single	1.00	1.00	1.00	1.00
• Multiple	3.05*	2.04	1.03	1.45
Sex				
• Female	1.00	1.00	1.00	1.00
• Male	1.52*	0.98	1.26*	1.05
Immunization status				
• Not complete	1.00	1.00	1.00	1.00
• Complete	0.53	1.22	0.57*	0.83
Birth Interval				
• Less 2 years	1.00	1.00	1.00	1.00
• 2years & greater	0.73	1.05	1.07	0.82
Mother & Household factors				
Household Wealth				
• Poor	1.00	1.00	1.00	1.00
• Middle	0.733	1.05	0.63*	0.74*
• Rich	0.53*	0.80	0.40*	0.58*
Mother's Education				
• No Education	1.00	1.00	1.00	1.00
• Primary	0.74	0.89	0.59*	0.74*
• Secondary	0.30*	0.38*	0.43*	0.70*
• Tertiary	0.21*	0.25*	0.23*	0.29
Family size				
• </= four	1.00	1.00	1.00	1.00
• 5-6	0.76	1.47	0.85	0.89
• 7+	1.75	1.43	1.18	0.95
Mother's Age at birth				

• Below 18 years	1.00	1.00	1.00	1.00
• 18-34 years	1.02	0.62	0.84	1.07
• 35+ years	1.05	0.84	0.69	1.07
Maternal body mass index				
• Underweight	1.00	1.00	1.00	1.00
• Normal	1.89	1.02	2.14	1.48
• Overweight	0.71	0.99	0.67*	0.65*
Household Under-five				
• One	1.00	1.00	1.00	1.00
• Two	0.70	0.87	1.07	1.13
• Three	0.97	0.96	1.05	1.17
• Four/more	0.79	1.16	1.21	1.12
Mother's Occupation				
• Not working	1.00	1.00	1.00	1.00
• Formal	1.88	2.39	0.82	1.09
• Informal	1.17	1.17	0.89	0.94
• Agricultural	1.30	0.53	0.59*	0.76

* Indicates p-value<0.05

With regards mother/household factors, significant relationships were observed between severely/moderately stunted children in early childhood phase and all categories of household wealth whereas the only significant associated observed between infancy stunting and household wealth was with rich category. Relative to children not stunted in early childhood phase, those from mothers living in households with middle wealth index had significantly 0.63 and 0.74 reduced odds of being severely and moderately stunted respectively compared to children from mothers living in poor households. In comparison to children not stunted in early childhood phase, those born to mothers residing in rich households had 0.4 and 0.58 reduced odds of being severely and moderately stunted respectively in comparison with counterparts from mothers living in poor household. In the case of children not stunted in infancy, in contrast to un-stunted infants, infants from mothers living in rich households had significantly 0.53 lesser odds of being severely stunted compared to infants from mothers living in poor households.

Taking into consideration level of education of the mother, table 4.12 showed that the odds of being severely or moderately stunted by children in early childhood phase tend to reduce significantly except in the tertiary category of moderate stunting where insignificant relationship was observed. In comparison to children in children in early childhood phase that are not stunted, those from mothers who had primary education had insignificantly 0.59 and 0.74 lesser odds of experiencing severe and moderate stunting respectively compared to their counterparts from mothers with no education. In the same vein, relative to children in children in early childhood phase that didn't experience stunting, those from mothers with secondary school education had significantly 0.43 and 0.7 reduced odds of experiencing severe and moderate stunting respectively in comparison to children from mothers with no education. Also, in comparison with to children in early childhood phase that are not stunted, those from mothers that have tertiary education had significantly 0.23 and insignificantly 0.29 lesser odds of being severely and moderately stunted compared to those from mothers with no education. In addition, taking infant stunting into consideration, in comparison to infants that didn't experience stunting, infant from mothers with secondary education had significantly 0.3 and 0.38 reduced odds of experiencing severe and moderate stunting respectively compared to infant from mothers with no education. In the same vein, in comparison with to infant that were not stunted, those from mothers that have tertiary education had significantly 0.21 and 0.25 lesser odds of being severely and moderately stunted respectively compared to their counterparts from mother with no form of education.

Table 4.12 revealed that no statistical association was observed between family sizes and child/infant stunting from analysis of 2013 NDHS data. For instance, in comparison with infant that are not stunted, infant from households with family size between five and six had insignificantly 0.76 reduced odds of experiencing severe stunting than infants from household with family size less than or equal to four.

With regards mother's age at birth, no statistical association was observed with child/infant stunting from analysis of 2013 NDHS data. For instance relative to un-stunted infants, infants born by mothers between 18years and 34years had insignificantly 1.02 higher odds of experiencing severe stunting compared to infant born by mothers that are less than 18years. In comparison to children in early childhood phase that were not stunted, those born by mothers that are 35 years and above had insignificantly 0.69 less odds of being severely stunted than those born by mothers aged below 18.

Taking into consideration maternal body mass index, the only significant relationship shown by table 4.12 is that with overweight mothers and both forms of stunting. In comparison to un-stunted children in early childhood phase, those from overweight mothers had significantly 0.67 and 0.65 lesser odds of being severely and moderately stunted compared to their counterparts from underweight mothers. No significant relationships were observed with maternal body mass index and infant stunting. For instance, relative to un-stunted infants, those from overweight mothers had insignificantly 0.71 and 0.99 lesser odds of being severely and moderately stunted compared to their counterparts from underweight mothers.

Table 4.12 revealed that no statistical association was observed between number of household under-five and child/infant stunting from analysis of 2013 NDHS data. For instance, in comparison to infant that didn't experience stunting, infant that are from household with two under-five children had insignificantly 0.7 and 0.87 reduced odds of being severely and moderately stunted respectively when compared to their counterparts in households with one under-five child. In contrast to children in early childhood phase that didn't experience stunting, those that were from household with four or more under-five children had insignificantly 1.21

and 1.12 higher odds of being severely and moderately stunted when compared to their counterparts in households with one under-five child.

Taking into consideration relationship between occupation of mother and infant/child stunting, the only significant relationship observed from analysis of 2013 NDHS data was from mothers in agricultural occupation. Table 4.12 revealed that, compared to children in early childhood phase that didn't experience stunting as at the time of survey, those born by mothers who are involved in agriculture had significantly 0.56 reduced odds of being severely stunted compared to their counterparts born by mothers who were not working.

4.3.1.3 Multinomial logistic regression between infant and child stunting and intervening variables

This sub-subsection presented results from the multinomial logistic regression that models the association between infant/child stunting and the selected intervening variables peculiar to infant and child stunting. The factors in the model were selected using stepwise logistic regression. For infant stunting, stepwise selected factors were maternal health seeking behavior, initiation of breast feeding and occurrence of fever while for child stunting, stepwise selected factors were maternal health seeking behavior, complementary feeding and occurrence of fever. These factors were chosen based on theoretical background, previous work indicating peculiarities for these early childhood phases. These regression results were shown on table 4.13.

Table 4.13 Result from adjusted multinomial logistic regression of infant & child stunting with intervening characteristics showing their adjusted relative risk ratio

Infant Stunting	Severely stunted	Moderately stunted	Severely stunted	Moderately stunted

	aRRR	aRRR	aRRR	aRRR
Intervening factors				
Maternal health seeking • Low • Medium • High	1.00 0.62 0.23*	1.00 0.61 0.40*	1.00 1.05 0.38*	1.00 0.66 0.43*
Initiation of breastfeeding • Immediately • 1-23hours • <=1day	1.00 0.81 0.58	1.00 1.24 1.82		
Complementary feeding • Low • Medium • High			1.00 1.43 0.67	1.00 1.09 2.30
Fever	1.00 1.37	1.00 0.98	1.00 1.08	1.00 0.83

* indicates p-value<0.05

Taking maternal health seeking behavior into consideration, table 4.13 showed that the only significant relations observed were with infant/child stunting and high maternal health seeking behavior. In comparison with children in infancy and early childhood phases that were not stunted, those from mothers with high maternal health seeking behavior were 0.23 and 0.38 respectively less likely to be severely stunted compared to their peers from mothers with low maternal health seeking behavior. Also, relative to children in infancy and early childhood phases that didn’t experience stunting, those from mothers with high maternal health seeking behavior were 0.4 and 0.43 less likely respectively to be moderately stunted than those from mothers with low maternal health seeking behavior.

Furthermore, with regards initiation of breastfeeding, complementary feeding and occurrence of fever, no significant relationships were observed. For instance, in comparison with infants that didn’t experience stunting in infancy, infants who were breastfed between the first hour of birth and 23 hours were insignificantly 0.81 less likely to be severely stunted than infants who were fed immediately after birth. Taking into consideration the probability of being moderately stunted, in comparison with children in early childhood that didn’t experience stunting, those that had high complementary feeding were insignificantly 0.67 more likely to be severely stunted compared to those who had low complementary feeding. In comparison to infant that are not stunted, infants who didn’t experience fever were insignificantly 0.98 less likely to be moderately stunted than infant that had fever.

4.3.1.4 Multinomial logistic regression between infant &child stunting and selected micro-level and intervening characteristics

This sub-section reported results from multinomial regression between infant/child stunting and selected micro level, and intervening factors. Micro-level and intervening factors included in this adjusted model were selected using stepwise logistic regression. This model is the full model that incorporated micro-level and intervening characteristics. Results from this regression analysis are shown below in table 4.14. After adjusting for all the factors in this model, many significant results in the previous models became insignificant, some that were insignificant became insignificant and some remained significant with increase size of effect.

With regards age of children in infancy, in comparison to infants that didn’t experience stunting, those aged 7 to 11 months had significantly 2.69 higher odds to be severely stunted than infant aged 0-6 months. In comparison to children in early childhood phase that didn’t experience stunting, children aged 24-35 months had significantly 1.93 higher odds to be severely stunted compared to their counterparts aged 12-23 months.

As indicated by results shown in table 4.14, no significant relationship was observed between birth order and any form of infant and child stunting. For instance, although the higher odds of being severely or moderately stunted by children in early childhood phase from fifth and more order were observed, no significant relationship was shown. In contrast to children in early childhood phase that didn't experience stunting, those from fifth and more birth order had 1.05 and 1.14 higher odds to be severely and moderately stunted respectively than those in the first birth order

With regards relationship between stunting and birth weight of child at birth, only infants described as small by their mothers were statistically significant at p value 0.05. Therefore, relative to infant that didn't experience stunting, infant who were described by their mothers to be small at birth had significantly 2.39 higher odds to be moderately stunted respectively than infant who were large at birth.

Taking type of birth of a child into consideration, no statistically significant relationship was observed at p value less than 0.05 as indicated by table 4.14. For instance, in contrast to children in early childhood phase that didn't experience stunting; those that were product of multiple births had insignificantly 2.32 and 2.53 higher odds of being severely and moderately stunted compared to their counterparts that were products of single birth.

With regards sex of child, in contrast to children in infancy that didn't experience stunting, male infants had significantly 2 folds higher odds of being moderately stunted respectively compared to their female counterparts. Whereas with regards early childhood stunting, in contrast to children in early childhood phase that didn't experience stunting, male infants had significantly 1.54 folds higher odds of being severely stunted respectively compared to their female counterparts.

With regards child factors, analysis of 2013 NDHS data showed that only children severely stunted in early childhood phase had statistically significant relationship with immunization status as observed in model 3. Therefore, in comparison to children in early childhood phase that didn't experience stunting, those with complete immunization status had 0.52 lesser odds of being severely stunted than their counterparts that had incomplete immunization status

Analysis of 2013 NDHS data showed that only one significant association was observed between stunting and birth interval. Relative to children in early childhood phases that did not experience stunting, those with birth interval of two years or greater than had significantly 0.66 lesser odds of being severely stunted than those with less than two years birth interval.

Table 4.14 Results from multinomial logistic regression of infant and child stunting with micro-level and intervening characteristics

	Infant		Child	
	Severely stunted	Moderately stunted	Severely stunted	Moderately stunted
	aRRR	aRRR	aRRR	aRRR
Micro-level factors				
Infant Age				
• 0-6 months	1.00	1.00		
• 7-11 months	2.69*	1.51		
• 12-23 months			1.00	1.00
• 24-35 months			1.93*	1.13
• 36-47 months			1.61	0.87
• 48-59 months			0.78	0.76
Birth order				
• First order	1.00		1.00	1.00
• 2-4 order	0.86	0.50	0.82	1.09
• 5+ order	1.20	0.57	1.05	1.14
Birth weight				
• Large	1.00	1.00	1.00	1.00
• Normal	1.65	1.28	1.26	1.30
• Small	2.11	2.39*	1.26	0.93
Birth type				
• Single			1.00	1.00
• Multiple			2.32	2.53
Sex				
• Female	1.00		1.00	1.00
• Male	0.84	2.00*	1.54*	1.40
Immunization status				
• Not complete	1.00		1.00	1.00
• Complete	0.84	0.30	0.52*	0.60
Birth Interval				
• Less 2 years	1.00	1.00	1.00	1.00
• 2years &greater	1.57	1.50	0.66*	0.65

Mother & Household factors				
Household Wealth				
• Poor	1.00	1.00	1.00	1.00
• Middle	0.80	1.06	0.65*	0.81
• Rich	0.30	0.41	0.54*	0.61
Mother's Education				
• No Education	1.00	1.00	1.00	1.00
• Primary	0.55	1.25	0.57*	0.44*
• Secondary	0.63	0.65	0.55*	0.64
• Tertiary	8.64	0.65	0.39	0.19*
Family size				
• </= four	1.00	1.00	1.00	1.00
• 5-6	0.97	1.06	0.68	0.72
• 7+	0.95	1.36	0.99	0.80
Mother's Age at birth				
• Below 18 years	1.00	1.00	1.00	1.00
• 18-34 years	0.67	0.77	0.63	0.55
• 35+ years	0.41	1.02	0.35*	0.53
Household Under-five				
• One	1.00	1.00	1.00	1.00
• Two	1.94	1.03	0.88	0.63
• Three	2.48	1.10	1.13	0.65
• Four/more	1.81	0.70	1.90*	1.63
Mother's Occupation				
• Not working	1.00	1.00	1.00	1.00
• Formal	6.25	1.62	0.30	3.27
• Informal	2.11*	1.73	0.82	1.41
• Agricultural	0.78	0.12*	0.77	1.17
Maternal health seeking				
• Low	1.00	1.00	1.00	1.00
• Medium	0.56	0.52	1.56	0.73
• High	0.37*	0.46	1.00	0.90

* indicates p-value<0.05

With regards mother/household factors, significant relationships were only observed between severely stunted children in early childhood phase and all categories of household wealth. Relative to children not stunted in early childhood phase, those from mothers living in households with middle wealth index had significantly 0.65 reduced odds of being severely stunted compared to children from mothers living in poor households. In comparison to children not stunted in early childhood phase, those born to mothers residing in rich households had 0.54 reduced odds of being severely stunted in comparison with counterparts from mothers living in poor household.

Taking into consideration level of education of the mother, table 4.14 showed that the odds of being severely stunted by children in early childhood phase tend to reduce significantly. In comparison to children in early childhood phase that were not stunted, those from mothers who had primary education had significantly 0.57 and 0.44 lesser odds of experiencing severe and moderate stunting respectively compared to their counterparts from mothers with no education. In the same vein, relative to children in early childhood phase that didn't experience stunting, those from mothers with secondary school education had significantly 0.55 and insignificantly 0.64 reduced odds of experiencing severe and moderate stunting respectively in comparison to children from mothers with no education. Also, in comparison to children in early childhood phase that were not stunted, those from mothers that had tertiary education had insignificantly 0.39 and significantly 0.19 lesser odds of being severely and moderately stunted compared to those from mothers with no education. With regards infant stunting, no statistically significant relationships were observed. For instance, in contrast to infant that were not stunted, those from mothers that had tertiary education had insignificantly 8.64 higher odds of being severely stunted compared to those from mothers with no education.

Table 4.14 revealed that no statistical association was observed between family sizes and child/infant stunting from analysis of 2013 NDHS data. For instance, in comparison with infant that were not stunted, infant from households with seven or more members had insignificantly 0.95 reduced odds of experiencing severe stunting than infants from household with family size less than or equal to four.

With regards mother's age at birth, the only statistical association observed with child/infant stunting from analysis of 2013 NDHS data was for mothers aged 35 and above and severe stunting. In comparison to children in early childhood phase that were not stunted, those born by mothers that are 35 years and above had significantly 0.35 lesser odds of being severely stunted than those born by mothers aged below 18.

Table 4.14 revealed that no statistical association was observed between number of household under-five and infant stunting from analysis of 2013 NDHS data but was only observed for children from households with four or more under-five children. In contrast to children in early childhood phase that didn’t experience stunting, those that were from household with four or more under-five children had significantly 1.9 higher odds of being severely stunted when compared to their counterparts in households with one under-five child.

Taking into consideration relationship between occupation of mother and infant stunting, the significant relationships observed from analysis of 2013 NDHS data were from mothers in informal and agricultural occupations. Relative to infants that didn’t experience stunting as at the time of survey, those born by mothers who are involved in informal occupation had significantly 2.11 higher odds of being severely stunted compared to their counterparts born by mothers who were not working. Table 4.14 revealed that, compared to infants that didn’t experience stunting as at the time of survey, those born by mothers who are involved in agriculture had significantly 0.12 reduced odds of being moderately stunted compared to their counterparts born by mothers who were not working.

Taking maternal health seeking behavior into consideration, table 4.14 showed that the only significant relationship observed was with infant stunting and high maternal health seeking behavior. In comparison with children in infancy phase that were not stunted, those from mothers with high maternal health seeking behavior were 0.37 less likely to be severely stunted compared to their peers from mothers with low maternal health seeking behavior.

4.4 Multi-level binary logistic regression

This subsection further presents the micro-and macro-level correlates of infants and child stunting in Nigeria. Five models were fitted for the 2 outcome variables (infant and child stunting). These models were presented in five sub-subsections. Model one which took into consideration micro-level characteristics. This model presented adjusted odd ratios examining the effect of micro-level characteristics on infant and child stunting. Model two presented adjusted odd ratios examining effect of region on infant and child stunting. After observing interesting variations across the six geopolitical zones in Nigeria in earlier chapters and also from 2013 NDHS report, the extent to which macro-level factors accounted for regional variations in infant and child stunting in Nigeria was examined and presented in the next model. Model three then incorporated other contextual factors to address the third objective of this study. Model four is the full model and it incorporated both micro- and macro-level characteristic to also examine their effects on infant and child stunting. Objectives two and particularly three were achieved using multi-level binary logistic regression. Table 4.15 and 4.16 shows the results of multilevel binary logistic regression models for both micro- and macro–level factors for infant and child stunting respectively.

In reporting and interpreting the results of the multilevel binary logistic regression, fixed and random effects are peculiar concepts. Fixed effects are important in establishing associations and size of effect of the association while random effects are used to model variations (Adedini et al, 2014). As earlier measured, relative risk ratio, a measure of association provided size of effect of relationship between selected independent characteristics and stunting but variations within and between communities cannot be measured. Therefore in measuring within and between communities variations, measures like intra-class correlations (or variance partition coefficient) and proportional change in variance helps provide importance of context on individual's characteristics(Merlo, et al., 2005).

Furthermore, in this study, fixed effects were expressed in odds ratio and p-value determines the statistical significance while random effects were expressed in intra-class correlation (or variance partition coefficient) and proportional change in variance (PCV). Standard error was employed to determine the precision of the random effects.

The results from tables 4.15 and 4.16 show the empty model and four other models. The empty model contained no predictor variable, with the sole aim of decomposing the total variance into the two level components, micro and macro-level components. The empty model equally had the purpose of identifying if there is need for examining the contextual effects of stunting in Nigeria (Merlo, et al., 2005).

Model one incorporated micro level variables and model two contained only region to be able to examine the effect of region alone before accounting for the extent of regional variations attributed to the contextual factors. Model three incorporated other contextual characteristics alongside region. Model four is the full model; it incorporated micro-level variables to model three and it examines to what extent both micro- and macro-level characteristics accounts for regional variations. The factors in these models were selected by forward stepwise selection at 1% significance level.

4.4.1 Empty Model

Estimation of the empty model was done first and the results shown in this model which contained no factor, shows only the random intercept from which the intra-class correlation which measured the between communities variations were calculated. The between communities variation estimated for child stunting differed substantially to that of infant stunting indicated by 57% for child stunting compared to 34% for infant stunting in the empty models. This suggests that 57% of variation observed in stunting during early childhood phase can be explained by contextual characteristics in the null model while 34% of variation observed in stunting during the first year of birth can be explained by contextual characteristics. With the addition of micro level factors, ICC changed for both. Proportional change in variance (PCV) cannot be calculated for the empty model because it is the reference.

4.4.2 Model One

The results from analysis of 2013 NDHS data indicated that the between communities variance (intra-class correlation coefficient – ICC) in child stunting was larger than the between communities variance estimated for infant stunting. This result suggests that intra-community variations associated with risk of being stunted during the first year of life (i.e. 39%) was smaller than the observed variations associated with risk of being stunted between ages 1 and 5 (i.e. 42%). Likely reasons for this were provided in the discussion section in chapter 5. Also, intra-community variation (i.e. the community variance in the empty model attributed to the micro factors considered during infancy) was estimated at 60.2% while intra-community variation between ages 1 and 5 was estimated at 74.1%.

With regards to infant stunting, table 4.15 shows that infant aged 7-11 months were 55% more likely to be stunted compared to those aged 0-6 months. This association was statistically significant. With regards child stunting, table 4.16 revealed that children aged 24-35 months had 1.42 higher odds of being stunted compared to those aged 12-23 months. This relationship was statistically significant. In addition, children aged 36-47 months and 48-59 months had 0.97 and lesser 0.89 odds of being stunted compared to those aged 12-23 months. These relationships were statistically insignificant.

Taking into consideration birth order in relation to infant stunting, table 4.15 revealed that infants from 2nd to 4th birth type were insignificantly 0.91 less likely to be stunted compared to their counterparts from the first order.

With regards type of birth, infants that were products of multiple births had 3.11 increased odds to be stunted compared to those of single birth. This relationship was statistically significant. Infant who are in the 5th or greater order of birth were statistically significantly 56% less likely to be stunted compared to infant who were first born.

Considering the relationship between infant stunting and birth weight, although not statistically significant, infants who were presumed to be of normal birth weight were 29% more likely to be stunted compared to their counterparts who were presumed large at birth. Infants with small birth weight had more than 2-folds probabilities to be stunted than infants that were presumed to be large.

Complete immunization status reduced the chances of being stunted at both infancy and early childhood phases although in different magnitude. Infant with complete immunization status are 44% less likely to be stunted than infant with incomplete immunization status while children in early childhood phase with complete immunization status are 67% less likely to be stunted compare to their counterparts with incomplete immunization status.

Sex of the child was an important factor at early childhood phase. Male children at early childhood phase had 1.18 higher odds of being stunted compared to their female counterparts.

The relationship between educational level of the mother and infant/child stunting shown on table 4.15 and 4.16 respectively indicated a negative relationship, that is, as educational level increases chances of being stunted decreases. For instance, infant from mothers with tertiary education were 28% less likely to be stunted compared to infant from mothers with no education. Also, children in early childhood phases born by mothers with tertiary education were 21% less likely to be stunted compared to their counterparts from mothers with no education.

Taking into consideration maternal body mass index, no statistical significance was observed for all categories in relation to infant stunting while statistical significance was observed with a category in the case of child stunting. Infant from overweight mothers were 0.77 less likely to be stunted compared to their counterparts born by underweight mothers. Children in early childhood phase born by overweight mothers had 0.6 lesser odds of being stunted compared to their counterparts born by underweight mothers. This relationship is statistically significant.

Considering mother's age at birth, table 4.16 revealed that children in early childhood phase that were born by mothers that are 35 years and above had 0.74 lesser odds of being stunted compared to those born by mothers aged below 18. Children in early childhood phase that were born by mothers that were between 18-34 years and above had 0.89 lesser odds of being stunted compared to those born by mothers aged below 18. Both relationships were statistically insignificant.

With regards mother's occupation type, table 4.16 revealed that the only statistically significant relationship was observed with those from agricultural occupation. Children in early childhood phase from mothers who were involved in agriculture were 0.64 less likely to be stunted compared with their counterparts who were born by mothers that were not working.

Although no statistical significance was observed for the relationship between family size and child stunting, no pattern was observed within the categories of family size. Table 4.16 indicated that children in early childhood phase from households with family size between five and six had significantly 0.87 lesser odds of experiencing stunting compared to counterparts from household with family size less than or equal to four. Also, children from households with family size greater than 6 had insignificantly 1.12 higher odds of being stunted compared to their counterparts from household with less than four or four members.

With regards household wealth, negative relationship was observed with infant/child stunting. Table 4.15 and 4.16 revealed that children in infancy and early childhood phases from mothers residing in households with middle wealth index had insignificantly 0.87 and 0.58 respectively reduced odds of being stunted compared to children from mothers living in poor households. Children in infancy and early childhood phases born to mothers residing in rich households had significantly 0.6 and 0.38 respectively reduced odds of being stunted in comparison with their counterparts from mothers living in poor household.

4.4.3 Model Two

The results from analysis of 2013 NDHS data indicated that the between communities variance (intra-class correlation coefficient – ICC) in child stunting was larger than the between communities variance estimated for infant stunting. This result suggests that intra-community variations associated with risk of being stunted during the first year of life (i.e. 16%) was smaller than the observed variations associated with risk of being stunted between ages 1 and 5 (i.e. 59%). Likely reasons for this were provided in the discussion section in chapter 5. Also, intra-community variation (i.e. the community variance in the empty model attributed to the micro factors considered during infancy) was estimated at 57% while intra-community variation between ages 1 and 5 was estimated at 63.6%.

Results from model 2 which examines the effect of region on stunting were shown on table 4.15 and 4.16 In comparison to South West Nigeria, all other regions except South East region for infant stunting and South South for child stunting showed increased odds of stunting in different magnitudes. Children born by mothers residing in North West region of Nigeria had more than 27 and 7 folds increased chances of being stunted in infancy and early childhood respectively compared to their peers whose mothers resided in South West region of the country. This relationship was statistically significant. Similarly but of less magnitude, children born by mothers residing in North East region of Nigeria had almost 5-folds increased probabilities of being stunted in infancy and early childhood compared to their counterparts whose mothers resided in South West Nigeria. This relationship was also statistically significant. Same goes to infants from mothers residing in South South region, with 2.58 increased odds of being stunted compared to their counterparts born by mothers residing in South Western Nigeria. While in early childhood phase, children born by mothers residing in South South had 0.78 reduced odds of being stunted compared to their counterparts from mothers residing in South West. This relationship was statistically significant. Children from mothers residing in North Central had 1.64 and 1.53 increased odds of being stunted in infancy and early childhood respectively compared to their counterparts from mothers residing in South West Region. This association was statically insignificant in infancy and significant in early childhood. Children from mothers residing in South East region of Nigeria had 0.52 and 0.56 reduced odds of being stunted in infancy and early childhood respectively compared to their counterparts from South West region. This relationship was statistically insignificant at infancy and significant at early childhood.

4.4.4 Model Three

The results from analysis of 2013 NDHS data indicated that the between communities variance (intra-class correlation coefficient – ICC) in child stunting was larger than the between communities variance estimated for infant stunting. This result suggests that intra-community variations associated with risk of being stunted during the first year of life (i.e. 14%) was smaller than the observed variations associated with risk of being stunted between ages 1 and 5 (i.e. 59%). Likely reasons for this were provided in the discussion section in chapter 5. Also, intra-community variation (i.e. the community variance in the empty model attributed to the micro factors considered during infancy) was estimated at 62% while intra-community variation between ages 1 and 5 was estimated at 75.9%.

Taking place of residence into consideration, results shown from model 3 in table 4.15 and 4.16 indicated that children whose mothers resided in rural areas had 1.06 and 1.42 higher odds of being stunted in infancy and early childhood compared to their counterparts from mothers residing in urban areas. This association was statistically insignificant in infancy and significant for early childhood.

Furthermore, results from model 3 with regards region of residence shows that compared to model 2 the magnitude of effect reduced remarkably. For instance, children born by mothers residing in North West region of Nigeria had more than 15-folds and 4-folds increased chances of being stunted compared to their peers whose mothers resided in South West region. Also in this model, children from mothers residing in North Central had 0.99 reduced odds of being stunted compared to their counterparts from mothers residing in South West Region, although not statically significant as opposed to model 2.

Children from mothers residing in communities with high maternal education were 37% and 50% less likely to be stunted in infancy and early childhood respectively compared to children from mothers residing in communities with low maternal education. Similarly but of reduced magnitude, infant from mothers residing in communities with high maternal education were 61% less likely to be stunted compared to children from mothers residing in communities with low maternal education. Relationships at infancy were statistically significant while at early childhood were statistically insignificant.

As the level of poor community feeding practice increases the odds of being stunted also increased. For instance, children from mothers residing in communities with high poor complementary feeding practices were 51% and 29% more likely to be stunted at infancy and early childhood respectively compared to their counterparts from mothers residing in community with low poor complementary feeding practices. These associations were statistically insignificant at p-value 0.05

Furthermore, results from model 3 shown on table 4.16 and 4.16 indicated that as the pattern of relationship could not be ascertained. For example, children from mothers residing in communities with high poverty level were 28% more likely to be stunted during infancy and 92% less likely to be stunted at early childhood phase compared to their counterparts from mothers residing in community with low poverty level. These relationships were statistically insignificant at p-value 0.05.

Results from model 3 in table 4.15 and 4.16 shows that children from mothers residing in communities with medium poor community environmental index were 82% and 4% more likely to be stunted during infancy and early childhood phases compared to their counterparts from mothers residing in communities with low poor community environmental index. This relationship was statistically insignificant.

Moreover, table 4.15 and 4.16 shows that from model 3 in consideration of ethnic diversity, children from mothers residing in highly heterogeneous communities had 1.24 and 1.66 higher odds of being stunted during infancy and early childhood compared to their counterparts born to mothers residing in highly homogenous communities. Children from mothers residing in mixed ethnic diversified communities had 1.16 and 1.33 higher odds of being stunted during infancy and early childhood compared to their peers from mothers residing in highly homogenous communities. Both relationships were statistically insignificant.

4.4.5 Model Four

The results from analysis of 2013 NDHS data indicated that the between communities variance (intra-class correlation coefficient – ICC) in child stunting was larger than the between communities variance estimated for infant stunting. This result suggests that intra-community variations associated with risk of being stunted during the first year of life (i.e. 13%) was smaller than the observed variations associated with risk of being stunted between ages 1 and 5 (i.e. 22%). Likely reasons for this were provided in the discussion section in chapter 5. Also, intra-community variation (i.e. the community variance in the empty model attributed to the micro factors considered during infancy) was estimated at 70.1% while intra-community variation between ages 1 and 5 was estimated at 79.6%.

Table 4.15 and 4.16 shows full models which include the stepwise selected micro-, macro-level and intervening correlates of infant and child stunting respectively. The micro-level factors selected for infant stunting were infant age, birth type, birth order, birth weight, immunization status, mother's education, family size and household wealth index. The micro-level factors for child stunting were child age, birth weight, sex, and immunization at the child level, mother's education, maternal body mass index, and household wealth index at mother/household level. The macro-factors selected for infant stunting was region of residence, while for child stunting, community maternal education, community feeding practice and ethnic diversity were equally included. The intervening factor selected for infant stunting was maternal health seeking behavior while none was selected for child stunting. Surprisingly, all relationships between each factor and infant stunting were statistically insignificant at p-value 0.05.

With regards child stunting, table 4.15 revealed that the relationship observed in model 1 was similar to that observed in model 4. For instance, children aged 24-35 months had 1.41 higher odds of being stunted compared to those aged 12-23 months. This relationship was statistically significant.

In consideration of the relationships between child stunting and different categories of birth weight, all were statistically significant. Children in early childhood phase presumed to be of normal birth weight had 1.19 higher odds of being stunted compared to their counterparts described to be large at birth. In addition, children in early childhood phase presumed to be small at birth had 1.32 higher odds of being stunted compared to their counterparts described to be large at birth.

Also similar to that observed in model 1, male children at early childhood phase had 1.27 higher odds of being stunted compared to their female counterparts.

Complete immunization status reduced the chances of being stunted during both infancy and early childhood phases. Children with complete immunization status are 0.24 and 0.71 less likely to be stunted during infancy and early childhood respectively compared to children with incomplete immunization status.

The direction of relationship between educational level of the mother and infant/child stunting shown on table 4.15 and 4.16 did not change much in model 1 and 3 except for infants born by mothers with primary education with 1.02 increased odds of being stunted compared to their counterparts from mothers with no education. For instance, children born in early childhood phase from mothers with secondary education had 0.8 reduced odds to be stunted in comparison to their counterparts from mothers with no education.

Furthermore, similarly to model 1, children in early childhood phase born by overweight mothers had 0.65 lesser odds of being stunted compared to their counterparts born by underweight mothers. This relationship is statistically significant.

With regards household wealth, negative relationship remained with infant/child stunting. For instance, table 4.15 revealed that children in early childhood phases born to mothers residing in rich households had significantly 0.56 reduced odds of being stunted in comparison with their counterparts from mothers living in poor household. This relationship was statistically significant.

Likewise results from model 3 with regards region of residence, model 4 showed similar direction but reduced size of effect. For instance, children born by mothers residing in North West region of Nigeria had almost 3-folds increased chances of being stunted compared to their peers whose mothers resided in South West region. This relationship was statistically significant.

Children from mothers residing in communities with high maternal education were 59% less likely to be stunted during early childhood compared to children from mothers residing in communities with low maternal education. This relationship is statistically significant.

Furthermore, the direction of relationship between level of poor community feeding practice and child stunting remained. For instance, children from mothers residing in communities with high poor complementary feeding practices were 59% more likely to be stunted at early childhood compared to children from mothers residing in community with low poor complementary feeding practices. This relationship was statistically significant.

Moreover, table 4.16 shows that from model 4 in consideration of ethnic diversity, children from mothers residing in highly heterogeneous communities had 1.44 higher odds of being stunted during early childhood compared to their counterparts born to mothers residing in highly homogenous communities. This relationship was statistically significant.

Table 4.15 Results from Muti-level binary logistic regression of infant stunting

	Empty Model	Model 1 (Micro)	Model 2 (region alone)	Model 3 (Macro alone)	Model 4 (Full Model)
	OR	aOR	aOR	aOR	aOR
Micro-level					
Child level					
Infant age					
• 0-6 months		1.00			1.00
• 7-11 months		1.55*			2.88
Birth type					
• Single		1.00			1.00
• Multiple		3.11*			30.02
Birth order					
• First order		1.00			1.00
• 2-4 order		0.91			0.32
• 5+ order		0.56*			0.38
Birth weight					
• Large		1.00			1.00

• Normal • Small		1.29 2.31*			2.64 4.49
Immunization status • Not complete • Complete		1.00 0.23*			1.00 0.24
Mother factors					
Mother's Education • No Education • Primary • Secondary • Tertiary		1.00 0.88 0.33* 0.28*			1.00 1.02 0.56 0.29
Maternal body mass index • Underweight • Normal • Overweight		1.00 1.05 0.77			
Family size • Less than four • 5-6 • 7+		1.00 1.12 1.77*			1.00 1.46 1.71
Household Wealth • Poor • Middle • Rich		1.00 0.87 0.60*			1.00 0.91 0.25
Place of residence • Urban • Rural				1.00 1.06	
Region of residence • South West • North east • North west • North central • South east • South south			1.00 4.94* 27.20* 1.64 0.52 2.58*	1.00 2.78* 15.52* 1.20 0.62 2.44*	1.00 0.94 4.13 0.08 0.67 1.55
Community maternal education • Low • Medium • High				1.00 0.61* 0.37*	
Poor Community feeding practice • Low • Medium • High				1.00 1.01 1.51	
Community poverty • Low • Medium • High				1.00 1.17 1.28	
Poor Community environmental index • Low • Medium				1.00 1.82*	

• High				1.10	
Ethnic diversity • Homogenous • Mixed • Heterogeneous				 1.00 1.16 1.24	
Maternal Health seeking behavior • Low • Medium • High					 1.00 0.44 0.33
Random effects	**Empty**	**Micro**	**Region**	**Macro**	**Full model**
Macro level Variance (SE) ICC Explained variation (PCV %)	 2.84 (0.95) 0.34 Reference	 1.13 (0.42) 0.39 60.2	 1.22 (0.4) 0.16 57.0	 1.08 (0.36) 0.14 62.0	 0.85 (1.39) 0.13 70.1
Micro level Variance (SE) ICC Explained variation (PCV)	 5.58 (2.63) Reference	 1.79 (0.0) 67.9	 6.45 (2.62) *****	 6.68 (2.62) *****	 5.50 (7.7) 1.4****

OR indicates odd ratio; aOR indicates adjusted odd ratio; SE indicates standard error; ICC indicates intra-cluster correlation; Model 1 is the empty model; Model 2 is adjusted for micro-level factors; Model 3 is adjusted for region only; Model 4 is adjusted for macro-level factors; Model 5 is final model adjusted for both micro and macro-level factors* indicates p-value<0.05.

Table 4.16 Results from Multilevel binary logistic regression of child stunting

CHILD STUNTING	Model 1	Model 2	Model 3	Model 4	Model 5
	aOR	aOR	aOR	aOR	aOR
Micro-level					
Child level					
Child age • 12-23 months • 24-35 months • 36-47 months • 48-59 months		 1.00 1.42* 0.97 0.89			 1.00 1.41* 0.97 0.89
Birth weight • Large • Normal • Small					 1.00 1.19* 1.32*
Sex • Female • Male		 1.00 1.18*			 1.00 1.27*
Immunization status • Not complete • Complete		 1.00 0.67*			 1.00 0.71*
Mother factors					
Mother’s Education					

• No Education • Primary • Secondary • Tertiary		1.00 0.62* 0.51* 0.21*			1.00 0.90 0.80* 0.39
Maternal body mass index • Underweight • Normal • Overweight		1.00 1.41 0.60*			1.00 0.92 0.65*
Mother’s Age at birth • Below 18 years • 18-34 years • 35+ years		1.00 0.89 0.74			
Mother’s Occupation • Not working • Formal • Informal • Agricultural		1.00 1.00 0.90 0.64*			
Family size • Less than four • 5-6 • 7+		1.00 0.87 1.12			
Household Wealth • Poor • Middle • Rich		1.00 0.58* 0.38*			1.00 0.80 0.56*
Place of residence • Urban • Rural				1.00 1.42*	
Region of residence • South West • North east • North west • North central • South east • South south			1.00 4.19* 7.71* 1.53* 0.56* 0.78*	1.00 1.98* 4.07* 0.99 0.65* 0.62*	1.00 1.40 2.97* 1.08 0.68* 0.68*
Community maternal education • Low • Medium • High				1.00 0.76 0.50	1.00 0.83 0.59*
Poor Community Feeding Practice • Low • Medium • High				1.00 1.29 1.59	1.00 1.09 1.42*
Community poverty • Low • Medium • High				1.00 0.98 0.92	
Poor Community environmental index • Low				1.00 1.04	

• Medium				0.09	
• High					
Ethnic diversity					
• Homogenous				1.00	1.00
• Mixed				1.33	1.17
• Heterogeneous				1.66	1.44*
Random effects	**Empty**	**Micro**	**Region**	**Macro**	**Full model**
Macro level					
Variance (SE)	1.62 (0.13)	0.42 (0.1)	0.59 (0.06)	0.39 (0.04)	0.33 (0.08)
ICC	0.57	0.32	0.33	0.24	0.22
Explained variation (PCV %)	Reference	74.1	63.6	75.9	79.6
Micro level					
Variance (SE)	1.20 (0.16)	0.90 (0.3)	1.21 (0.15)	1.23 (0.16)	1.20 (0.31)
ICC					
Explained variation (PCV)	Reference	25	*****	*****	*****

OR indicates odd ratio; aOR indicates adjusted odd ratio; SE indicates standard error; ICC indicates intra-cluster correlation; Model 1 is the empty model; Model 2 is adjusted for micro-level factors; Model 3 is adjusted for region only; Model 4 is adjusted for macro-level factors; Model 5 is final model adjusted for both micro and macro-level factors, * indicates p-value<0.05

4.5 Summary of Chapter

This chapter reports all results; it addressed level of infant and child stunting, the micro- and macro-level correlates of infant and child stunting and contextual factors that accounted for regional variations in Nigeria. On a general note, there was more account of children stunted in their early childhood phase compared to those stunted in infancy in Nigeria. The findings of this study also show that different factors influenced stunting at infancy and childhood phases. It is equally worthy to note that differences were observed when hierarchical nature of the 2013 NDHS data was taken into consideration. Using multinomial logistic regression, the micro-level factors that influenced infant stunting were age, sex, birth weight, mother's occupation and maternal health seeking behavior then after further analysis using multilevel binary regression, micro-level factors that influenced infant stunting were age, birth type, birth order, immunization status, mother's education and family size. The macro level factors influencing stunting at infancy were region, community maternal education and poor community environmental index.

With regards stunting during early childhood, when the different forms of stunting were taken into consideration, the micro-level factors that influenced child stunting were age, sex, birth interval, household wealth, maternal education, mother's age at birth, and number of household under-five then after further analysis micro-level factors that influenced child stunting were age, birth weight, sex, immunization status, mother's education, mother's BMI and household wealth. The macro level factors influencing stunting during childhood were region, community maternal education, poor community feeding practice and ethnic diversity.

In summary, children aged 24-35 months, with normal or perceived small birth-weight, born by mothers residing in North West region, from mothers residing in communities with high poor community feeding practice and born by mothers residing in highly heterogeneous communities had increased risk of experiencing stunting during early childhood phase. Also children with complete immunization status, from mothers with secondary school education, born by overweight mothers, born by mothers residing in rich households, from mothers residing in South East/South South region and from mothers living in communities with high maternal education have reduced risk of experiencing stunting during early childhood phase.

CHAPTER 5

5.0 DISCUSSION, RECOMMENDATION AND CONCLUSION

5.1Introduction

This chapter presents three sections, which are hypotheses testing as the first section, discussion as section two and conclusion and recommendation stands as the third section. Hypothesis testing is used to understand whether any results discovered in the study exist in the overall population. Relationship between stunting and four factors were tested. The factors selected were based on literature and also had theoretical background. The four research hypotheses tested were:

1) Fully immunized children have reduced risk of infant and child stunting;
2) Residence in rich household is negatively associated with the risk of infant and child stunting;
3) Community poverty is a significant predictor of infant and child stunting;
4) Community maternal education is a significant predictor of infant and child stunting

The four hypotheses were tested using inferential statistics (i.e. logistic regression). This section was divided into four subsections. Each subsection was centered upon the testing of each hypothesis.

The second section presents the discussion of findings of the research. This section was guided by the three objectives addressed by this study. The first objective was to measure the level of infant and child stunting in Nigeria. Second objective was to determine the micro and macro-level correlates of infant and early childhood stunting in Nigeria. Third objective was to determine the extent to which contextual factors accounted for regional variations in infant and child stunting. Interesting results were discussed with the aid of existing literatures.

The section was divided into three subsections. The subsections of this section therefore discussed each objective. The first subsection presents discussion on the levels of infant and child stunting in Nigeria. The second section presents discussion on the micro- and macro-level correlates of infant and child stunting in Nigeria. The third subsection presents discussion on the extent to which contextual factors accounted for regional variations in infant and child stunting.

The third section provided conclusion for the entire study and recommendations for future policy and programs.

5.2 Hypothesis testing

5.2.1 Hypothesis one and two: selected micro-level correlates and risk of infant and child stunting

H_o: Fully immunized children do not have reduced risk of infant and child stunting

H_1: Fully immunized children have reduced risk of infant and child stunting

H_o: Residence in rich household is not negatively associated with the risk of infant and child stunting

H_2: Residence in rich household is negatively associated with the risk of infant and child stunting

Hypothesis 1 and 2 stated above focused on micro-level correlates that influence the risk of infant and child stunting. To test these hypotheses, multilevel binary logistic regression analysis was utilized and to test the significance of the relationship, the p-value was set at 95% significant level (α=0.05) and the p-value corresponding to the odd ratios were noted. Multilevel binary logistic regression models were fitted to determine the micro-and macro-level correlates of infant and child stunting in Nigeria. To achieve this, micro level variables were independently considered and then included at the two levels of operation micro-and macro-level. With regards influence of immunization status, results from analysis of 2013 NDHS data shown in table 4.15 and 4.16 indicated that fully immunization status was not significantly associated with stunting in the first year of life, while during early childhood phase, fully immunized status was statistically associated with the risk of stunting. This therefore leads to the acceptance of the null hypothesis. This means results from the analysis of 2013 NDHS data provided insufficient evidence in accepting the research hypothesis.

With regards wealth, results from analysis of 2013 NDHS data shown in table 4.15-4.16 indicated that the relationship between stunting in infancy and residing in rich households was statistically insignificant while early childhood stunting and residing in rich household was statistically significant. This thereby leads to the acceptance of the null hypothesis and it also means results from the analysis of 2013 NDHS data provided insufficient evidence in accepting the research hypothesis which states that residence in rich household is negatively associated with the risk of infant and child stunting.

5.2.2 Hypothesis three and four: Selected macro-level correlates and risk of infant and child stunting

H_o: Community poverty is not a significant predictor of infant and child stunting

H_3: Community poverty is a significant predictor of infant and child stunting

H_o: Community maternal education is not a significant predictor of infant and child stunting

H_4: Community maternal education is a significant predictor of infant and child stunting

Hypothesis 3 and 4 focused on the relationship between macro-level correlates and the risk of infant and child stunting

With regards poverty and the risk of infant and child stunting. In testing this hypothesis multilevel binary logistic regression was made use of. The p-value was set at 95% significant level (α=0.05) and corresponding p-values to the odd ratios were examined. Multilevel binary logistic regression models were fitted to determine the micro-and macro-level correlates of infant and child stunting and also to examine the extent to which contextual factors accounted for regional variations in infant and child stunting in Nigeria. Results from analysis of 2013 NDHS data indicated that community poverty is a statistically significant predictor of infant and child stunting. Therefore, this leads to the acceptance of the null hypothesis (which states that community poverty is not a significant predictor of infant and child stunting) and results from analysis of 2013 NDHS did not provide sufficient evidence that would enable the acceptance of research hypothesis – that states that community poverty is a significant predictor of infant and child stunting.

Hypothesis 4 examined the relationship between community maternal education and the risk of infant and child stunting. Results from analysis of 2013 NDHS data indicated that community maternal education is a statistically significant predictor of infant and child stunting. This means results from the analysis of 2013 NDHS data provided sufficient evidence in accepting that community maternal education is a significant predictor of infant and child stunting.

5.3 Discussion

5.3.1 Discussion on levels of infant and child stunting in Nigeria

The first objective of this study as earlier mentioned was to measure the level of infant and child stunting in Nigeria. Results of this study established that the levels of stunting at childhood were higher than levels of stunting at infancy. This means that children between the ages 1 and 5 are more susceptible to stunting compared to children in the first year of life. This is evident with low percentages observed for stunting during infancy compared to that of childhood.

Analysis on the level of stunting at infancy and childhood phases in this study also shows a gradual increase in stunting across the age group, peaks between age 2 and 3, then slightly decline. Although, earlier studies, for instance, Adekanmbi et al, (2013) explained that children between age 12-24 months are prone to childhood stunting because of lower breast milk intake and weaning, this study shows that 24-35months children had the highest odds of being stunted before slightly declining.

Furthermore, the period between age 2 and 3 years can be described as when a child is adjusting to solid complementary feeding as opposed to breast milk. This study earlier showed that complementary feeding with low dietary quality is widely practiced in Nigeria and a significant positive relationship was also observed between poor community feeding practice and childhood stunting. The findings from this study therefore establishes that improper weaning practice such as poor quality complementary feeding is an important factor that contributes to stunting as observed byKumar et al, (2006). This suggests that the complementary foods given to wean these children are limited in quality and variety and against the recommendation of UNICEF.

In addition, this study established that stunting increases with age peaks at 24 months (2 years) before the observed slight decline (Victora et al, 2010). This suggests that much repair becomes difficult after already being stunted. Therefore, intervention and programs should be targeted between age 2 and 4 to be able to curtail this health challenge.

5.3.2 Discussion on micro- and macro-level correlates of infant and childhood stunting in Nigeria

The second objective of this study was to determine the micro- & macro-level correlates of infant and child stunting in Nigeria. To achieve this objective, multinomial logistic regression was first employed and this took into consideration the different forms of stunting. Furthermore, multilevel binary logistic regression was also employed to incorporate the hierarchical nature of the 2013 NDHS data. These analyses were able to do justice to achieving the second objective. The first analysis helped to determine the factors at micro level that determined the types of stunting, having identified that, the multi-level analyses incorporated the macro-level factors and then further aided the determining of the micro- and macro-level characteristics that determined stunting generally in Nigeria.

The findings of this study showed that age and sex were important micro-level correlates influencing stunting in both infancy and early childhood phases in Nigeria. One of the striking results was the observed stunting at infancy infant. This suggests that these children were born stunted. This is in line with results from a study in Malawi by Espo et al, (2007), which observed increasing stunting rates at three, six and nine months of age. Berngard et al, (2013) also observed similar results, their study demonstrated that stunting rates increased from newborn to six months and this made these scholars to conclude that impaired fetal linear growth is the major predictor of the stunting process during infancy. This suggests that stunting process had started from the womb (intrauterine growth retardation). Amidst many factors that could have influenced intrauterine growth retardation, Visram et al, (2014) suggested that these infants were exposed to chronic nutrient deprivation in the womb (Visram , et al., 2014). This discovery implies that the health state of the mother during pregnancy influences the pregnancy outcome (Hovdenak & Haram, 2012).

Taking child's sex into consideration, the study's findings established increased risk of stunting for male children. This result tends to lend credence to the findings of previous studies (Adekanmbi et al, 2013; Wamani et al, 2007; Espo et al, 2007; Svedberg, 1990). For instance, preferential treatment of females due to their usefulness for domestic purposes in some cultures could be responsible for higher likelihood of stunting found among male children compared to females. (Adekanmbi et al, 2013). An alternative explanation for preferential treatment of female could be the exorbitant bride wealth often payable by the would-be husbands to the bride's family during wedding ceremonies.

Furthermore, birth weight of a child during both phases influenced stunting. The result of this finding is in support with that of Mamiro et al, (2005). These authors found that babies born with low birth rate were at very high risk of being stunted compared to their contemporaries born with normal weight. A plausible explanation could be that given by Black and colleagues, (2013), explaining the relationship between the birth outcome of a child and the mother's health. Suggesting that faltering maternal health due to low maternal body mass index negatively influences low weight at birth. Espo et al, (2007) also noted in their study that small birth weight was the strongest predictor of stunting.

With regards occupation of mother, it was interesting to note that infants from mothers involved in agricultural related work had reduced chances of being moderately stunted. A plausible reason for this could be in accordance to Agbo and colleagues (2011) that noticed that 16.4% of infants in Nigeria are exclusively breastfeed, therefore complementary food becomes the alternative and probably because the mothers are into agricultural occupations, there is high possibility of being exposed to fresh farm produce which in actual sense has large amount of nutrients. Also infants from mothers engaging in informal occupation had more than two-fold odds of experiencing severe stunting. A plausible reason for this is that, most informal work only brings meagre income and this influencing the availability of proper diet, rich in nutrients for the mother, then this can affect the quality of breast milk that is given to the child and even the type of complementary food given to the child is affected.

In addition, the findings from this study showed that poor community feeding practice was significantly associated with stunting at the childhood phase. Children from mothers living in communities with high poor feeding practices had increased chances of being stunted. Feeding practices were based on the standard minimum dietary energy. Possible reason for this could be that there are norms and culture that uphold each community and this influence the type of food commonly eaten, commonly acceptable as children's diet. It is also important to note that different factors will influence the community's diet, the likes of weather, soil type etc.

Moreover, results from both multinomial and multilevel binary logistic regression showed that household wealth was significantly associated with experiencing stunting during the childhood phase. Particularly, children from rich household had reduced chances of been stunted. This establishes findings from many study, for instance, a study in Ghana showed that children from rich households were less likely to experience stunting (Darteh, et al., 2014). This is also in line with findings of a study in Nepal that indicated a negative relationship between household wealth and stunting (Tiwari, et al., 2014). A Plausible reason for this could be due to ability to access more and better quality food, funds to improve their hygiene standards, funds to ensure geographical mobility, funds to afford preventive health care services and access to media and health facilities (Visram, 2014; Agee, 2010).

5.3.3 Discussion on the extent to which contextual factors accounts for regional variations in infants and child stunting in Nigeria

The third objective of this study was to examine the extent to which contextual factors account for regional variations in infant and child stunting in Nigeria. Having established that reasonable variations exists between the regions in Nigeria, this objective tend tried to examine to what extent macro-level characteristics contributed to the variations.

The findings from this study showed that there are important macro-level factors that influenced the noticed variations observed at infancy and childhood phases. The results further established that both micro and macro-level factors influenced the regional variations observed in stunting. Also this study shows that between communities variations were large and this signifies that to experience a remarkable progress in reducing stunting in infancy and childhood, the context is very important.

Furthermore, results indicated that between communities variance linked with stunting during childhood phase was more than that observed during infancy. This means that macro-level factors are more importantly influencing stunting during childhood phase compared to infancy. This could be explained by the fact that children tend to have limited exposure to the community in the first year of life compared to the older years in childhood (Adedini et al, 2014)

Additionally, it was observed in the third model that region of residence, the only variable, had significant and large influence on infant and child stunting. This was evident with the large odd ratios noticed both during infancy and childhood. For instance, higher risks of stunting was observed in North West, North East, South South and North Central during infancy and elevated risks of childhood stunting in North West, North East, and North Central compared to South West region. This means that residing in a particular region in the country greatly determined the occurrence of infant and child stunting. This finding might be due to spatial inequalities in social development observed in regions, different rates of maternal educational levels, varying regional immunization coverage, and climatic disadvantage in the northern regions (Adedini, et al, 2014; Antai, 2011; Uthman, 2009; Wastaff et al, 2004).

Moreover, it is worthy to note that although elevated risks of stunting was observed during infancy in South South region of Nigeria, reverse is the case during childhood phase. The plausible explanation for this could be the presence of low immunization uptake during infancy observed in the region (Antai, 2010). The scholar further presented the association between low immunization uptakes with elevated infant mortality. An alternative reason might be that the region is highly heterogeneous in ethnicity (Adedini et al, 2014).

Furthermore, findings from this study show that in the full model, both micro- and macro-level characteristics had influence in determining the observed regional variation in childhood phase. Age, birth weight, birth type, sex, immunization status, maternal education, mother’s body mass index, and household wealth were the important micro-level factors influencing regional variation with regards childhood stunting. The important macro-level characteristics determining regional variations in childhood stunting in Nigeria were community maternal education, poor community feeding practice, and ethnic diversity.

With regards household wealth in influencing regional variations in childhood stunting in the country of study, findings from this study shows that reduced risks of experiencing stunting in childhood phase is associated with children from mothers residing in rich households. This established findings from previous studies, for instance, child malnutrition tends to be more common among the poor (Wagstaff, 2004). This author further explained that a socioeconomically deprived child is more susceptible to death and malnutrition. In addition, according to Fagbamigbe et al, (2015), the northern regions of the nation have the lowest rates of rich household. Residing in a rich community translates to presences of social amenities, good roads which increase access and utilization of health facilities and services, electricity which might influence access to media which suggests awareness about stunting, etc. This suggests that wealth and region are associated and this influences child's health outcome.

5.4 Conclusions and recommendations

This study had the focus of answering three specific research questions: (1) what are the level of infant and child stunting in Nigeria? (2) What are the micro- and macro- level correlates of infant and child stunting in Nigeria? (3) What are the extent to which contextual factors account for regional variations in infant and child stunting in Nigeria? These questions were answered using appropriate statistical analysis. Research question one was answered using univariate (percentage distribution) and bivariate (chi-square and cross-tabulations) analysis. Research question two was answered using multinomial logistic regression and multilevel binomial logistic regression. Research question three was answered using multi-level logistic regression.

The findings of the study shown interesting results due to the various techniques used and this contributed to the body of knowledge. Stunting was observed at infancy but child stunting was higher than infant stunting. Also, stunting increased significantly across age group to peak at age 24-36 months, after which gradual decline was observed. Similar results were observed with the categories of stunting. The important micro- and macro-level correlates associated with infant stunting were age, sex, birth weight, mother's occupation and maternal health seeking behavior. Correlates associated with child stunting were age, birth weight, sex, immunization status, birth interval, household wealth, maternal educational attainment, number of household under-five, mother's BMI, region, community maternal education, poor community feeding practice and ethnic diversity.

Furthermore, the contextual characteristics that accounted for infant stunting were community maternal education level and poor community environmental index while those for child stunting was place of residence. It is worthy to note that not only contextual factors accounted for the regional variations observed in child stunting in Nigeria, both micro and macro-level characteristics accounted for this observed variation. Factors like age, birth weight sex, immunization status, birth interval, household wealth, maternal educational attainment, number of household under-five, mother's BMI, region, community maternal education, poor community feeding practice and ethnic diversity accounted for this variation.

The findings from this study identified important factors that have implication for policy and program. Policies and programs can be directed targeting stunting even before birth of the child. This can be achieved by raising awareness for proper nutrition for mothers to prevent intrauterine growth retardation. This will also aid creating an intervention in improving the birth weight of the child. This is important because of the identified relationship between maternal health and child outcome. It is equally paramount to involve community leaders in creating awareness. This is because Nigeria is a very cultural nation where her citizens still uphold cultural norms and hold their community leaders in high esteem; therefore they listen and obey them. Penetrating through the help of community leaders will likely ensure maximum results.

Policies should also be targeted towards creating interventions that will improve community feeding practices. Great awareness should be given to proper and adequate feeding practices. This will help improve knowledge of minimum dietary diversity and minimum meal frequency which are WHO acceptable standards. The practice of such feeding practices can also be aided with the help of media such as radio and television. Information education and communication (IEC) materials should be available at both orthodox and traditional health facilities. Community leaders can also be used to cascade such informations.

Policies and programs should also be directed towards regional variations with regards infant and child stunting. For instance designing policies and programs directed towards achieving full immunization status for every child in every region but particularly in the Northern regions in the country. This can include incorporating traditional birth attendants so as to combat proximity and easy availability challenges. These traditional birth attendants can be trained in administering and the administration of these vaccines can also be done in individual homes. In addition, community leaders should not be left out especially in creating awareness.

Further studies are needed in the area of infant and early childhood feeding practices such as minimum meal frequency and minimum acceptable diet which were not treated in this study.

Further studies are needed using qualitative data on other contextual factors such as socio-cultural factors influencing infant and early childhood stunting in Nigeria

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