

**SCHOOL OF PUBLIC HEALTH  
COLLEGE OF HEALTH SCIENCES  
UNIVERSITY OF GHANA, LEGON.**

**DETERMINANTS OF OVERWEIGHT WITH CONCURRENT STUNTING  
AMONG GHANAIAIAN CHILDREN**



**THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA,  
LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE  
AWARD OF THE MASTER OF PUBLIC HEALTH DEGREE.**

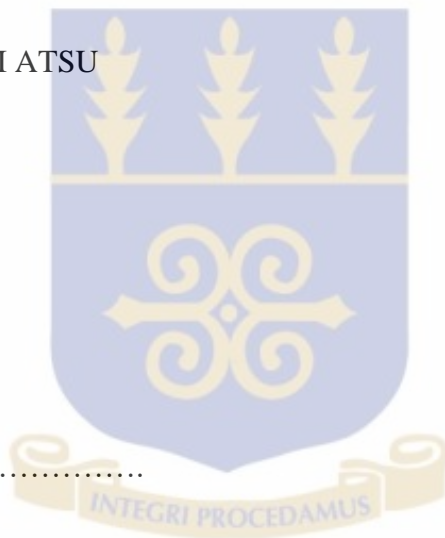
**JULY, 2015**

**DECLARATION**

I, Benedicta Kafui Atsu, hereby declare that with the exception of references to other people’s work which have been duly acknowledged, this analysis was performed with guidance from my supervisor. I further affirm, that this work has never been submitted to any other University, in part or whole for any Degree or other purpose.

.....  
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.....  
DATE



.....  
DR. AMOS LAAR  
(SUPERVISOR)

.....  
DATE

## **DEDICATION**

I dedicate this work to children under five living in Ghana, whose parents desire to have knowledge pertaining to their children's nutritional status. To public health experts who desire to know the current trend of children's nutritional status for the development of appropriate policies and interventions.

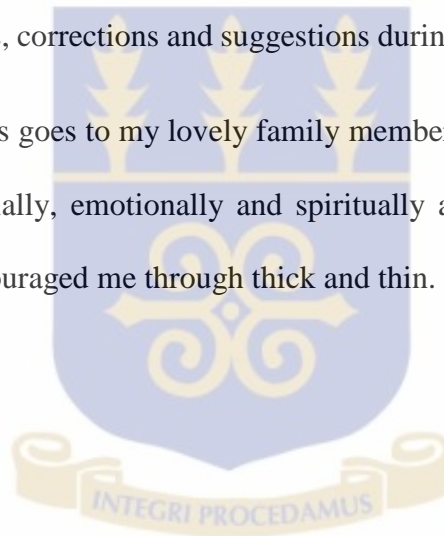


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## ABSTRACT

**Background** – Malnutrition is evident in the Ghanaian community. Stunting and overweight conditions occurring independently within individuals are of public health interest. Children under five are most susceptible to this condition. Studies concerning the dual burden of malnutrition in children have indicated the simultaneous occurrence of overweight and stunting within individuals (especially children).

**Objective** - This analysis was performed to assess the prevalence of overweight with concurrent stunting among Ghanaian under-fives. The individual and contextual determinants of stunting; overweight; and overweight with concurrent stunting were also determined.

**Methodology** – This study analyzed data sets of the fourth round of the Ghana Multiple Indicator Cluster Survey (MICS4). Eligible participants were under-fives whose mothers or caretakers provided complete interview responses. Univariate analyses were used to describe selected characteristics assessed from the Ghana MICS4 datasets. Chi-square and simple logistic regression analysis were used to compare the associations between the study outcomes (stunting, overweight and overweight with concurrent stunting) and several explanatory variables. Odds ratios with accompanying, 95% Confidence Intervals were used to assess the strength of association between the outcomes and each explanatory variable. The multiple logistic regression analysis was used to adjust for potential confounders.  $P < 0.05$  was used to denote statistical significance.

**Results** – Data was analyzed using 7550 children. The prevalence of stunting was 27.5%; underweight was 17.3%; wasting was 7.7%; overweight was 2.4% and double burden of malnutrition was 1.2%. Girls had a significantly higher odds than boys to be

stunted (aOR = 1.312; 95% CI, 1.111 - 1.549). Children who lived in the northern zones were 13 times as likely as coastal children to be overweight (aOR = 12.888; 95% CI, 1.738 – 95.543). Under-fives who belonged to the fourth quintile, were 4 times as likely as children within the poorest quintile to be overweight and concurrently stunted (aOR = 4.311; 95% CI, 1.219 – 15.241)

**Conclusion** - This analysis showed a 1.2% prevalence of the Double Burden of Malnutrition occurring among Ghanaian under-fives. Child's age, sex, malaria parasitemia and anemia were individual determinants of stunting. Contextual determinants of stunting were mother's age, religion of household head, wealth index quintile and mother registered with any health insurance. Individual determinant of overweight was the child's age, while contextual determinants were the religion of household head, wealth index quintile, marital status and geographic zones. Contextual determinants of DBM were maternal age, wealth index quintile, religion of household head and marital status of women.

**Keywords:** Stunting, overweight, double burden of malnutrition and children under-five, Ghana.

## TABLE OF CONTENTS

DECLARATION .....	i
DEDICATION .....	ii
ACKNOWLEDGEMENT .....	iii
ABSTRACT.....	iv
TABLE OF CONTENTS.....	vi
LIST OF TABLES .....	ix
LIST OF FIGURES .....	x
LIST OF ABBREVIATIONS.....	xi
CHAPTER ONE .....	1
1.0 INTRODUCTION .....	1
1.1 Background information .....	1
1.2 Statement of the problem .....	4
1.3 Justification for the study .....	4
1.4 Conceptual framework .....	5
1.5 Study objectives .....	7
1.5.1 General objective.....	7
1.5.2 Specific objectives.....	8
1.6 Research questions. ....	8
CHAPTER TWO .....	8
2.0 LITERATURE REVIEW .....	8
2.1 Introduction .....	8
2.2 Prevalence of stunting .....	9
2.3 Determinants of Stunting. ....	10
2.4 Children and effects of stunting .....	11
2.5 Prevalence of overweight .....	12
2.6 Determinants of overweight .....	13
2.7 Obesity and its implications .....	14
2.8 Stunting, overweight and geography.....	15
2.9 Overweight with concurrent stunting .....	16
2.10 Determinants of overweight with concurrent stunting and their effects on children.....	17

CHAPTER THREE .....	18
3.0 METHODOLOGY .....	18
3.1 Introduction .....	18
3.2 Study design .....	18
3.3 Study location.....	18
3.4 Study population .....	18
3.4.1 Inclusion criteria .....	19
3.4.2 Exclusion criteria.....	19
3.5 Sample and sampling method .....	20
3.5.1 Sample size .....	20
3.5.2 Sampling method.....	20
3.6 Variables.....	23
3.6.1 Outcome variable.....	23
3.6.2 Explanatory (independent) variables .....	23
3.7 Data processing and analysis.....	24
3.7.1 Examination of missing values.....	24
3.7.2 Data analysis.....	25
3.8 Quality assurance .....	30
3.9 Ethical considerations .....	30
CHAPTER FOUR.....	31
4.0 RESULTS .....	31
4.1 Introduction .....	31
4.2 Background and socio-demographic characteristics .....	31
4.3 Nutritional status of children.....	35
4.4 Associations between stunting and selected characteristics.....	39
4.5 Associations between overweight and selected characteristics.....	43
4.6 Associations between selected characteristics and overweight with concurrent stunting.....	46
4.7 Predictors of stunting among Ghanaian children. ....	49
4.8 Predictors of overweight among Ghanaian under-fives. ....	52
4.9 Predictors of overweight with concurrent stunting among Ghanaian children. .	53

CHAPTER FIVE .....	56
5.0 DISCUSSION .....	56
5.1 Introduction .....	56
5.2 Prevalence of overweight with concurrent stunting .....	56
5.3 Individual and contextual determinants of stunting. ....	58
5.3.1 Individual determinants .....	58
5.3.2 Contextual determinants .....	60
5.4 Individual and contextual determinants of overweight. ....	62
5.4.1 Individual determinants .....	63
5.4.2 Contextual determinants .....	64
5.5 Individual and contextual determinants of overweight with concurrent stunting. ....	66
5.5.1 Individual determinants .....	66
5.5.2 Contextual determinants .....	67
5.6 Study strength and weakness.....	69
5.6.1 Strengths .....	69
5.6.2 Limitations.....	69
CHAPTER SIX.....	70
6.0 CONCLUSIONS AND RECOMMENDATIONS .....	70
6.1 Introduction .....	70
6.2 Conclusions .....	70
6.3 Recommendations .....	71
References.....	72
APPENDICES .....	81
APPENDIX 1: Predictors of stunting among Ghanaian children under-five.....	81
APPENDIX 2: Predictors of overweight .....	84
APPENDIX 3: Predictors of overweight with concurrent stunting .....	87

**LIST OF TABLES**

Table 4.1a: Background and socio-demographic characteristics of children under 5 (n=7550 unless otherwise stated).....	32
Table 4.2: Sex-specific nutritional status of children under 5 according to four anthropometric indices, height for age, weight for age, weight for height and Body Mass Index .....	36
Table 4.3: Associations between stunting and selected characteristics .....	40
Table 4.4: Associations of overweight and selected characteristics .....	44
Table 4.5: Associations of the DBM and selected characteristics. ....	47
Table 4.6: Significant predictors of stunting among Ghanaian under-fives. ....	51
Table 4.7: Significant predictors of overweight among Ghanaian under-fives.....	53
Table 4.8: Significant predictors of overweight with concurrent stunting among children. ....	55

**LIST OF FIGURES**

Figure 1.1: Conceptual framework of overweight with conceptual framework .....	7
Figure 4.2: Distribution of the burden of malnutrition by region .....	37
Figure 4.3: Distribution of the Double Burden of Malnutrition by region. ....	38

**LIST OF ABBREVIATIONS**

BMI	Body Mass Index
BMIZ	Body Mass Index Z – scores
DBM	Double/ Dual Burden of Malnutrition
CI	Confidence Interval
GDHS	Ghana Demographic Health Survey
GHS	Ghana Health Service
GSS	Ghana Statistical Service
HAZ	Height for Age Z – score
JSS	Junior High School
LMIC's	Low and Middle Income Countries
MICS	Multiple Indicator Cluster Survey
MICS4	Fourth round of the Multiple Indicator Cluster Survey
NMIMR	Noguchi Memorial Institute for Medical Research
NCDs	Non-Communicable Diseases
NHIS	National Health Insurance Scheme
PPS	Probability Proportional Sample
PSUs	Primary Sampling Units
SES	Socioeconomic Status
SSUs	Secondary Sampling Units
USAID	United States Agency International Development
WAZ	Weight for Age Z – score
WI	Wealth Index
WHO	World Health Organization

## CHAPTER ONE

### 1.0 INTRODUCTION

#### 1.1 Background information

Child growth is an important public health indicator for monitoring nutritional status and health in populations (Onis & Blössner, 2003). Children at the start of their life have greater nutritional needs owing to the rapid pace of their growth (Cristina & Vieira, 2007). Early malnutrition begins in utero during the early embryonic and fetal development stages, where the developing fetus solely depends on its genotype and the materno–fetal environment (Langley-Evans, 2009). This period is characterised with increased energy demands to meet the metabolic demands of pregnancy. This ensures appropriate growth of the fetus, placenta and associated maternal tissues Brett, Ferraro, Yockell-Lelievre, Gruslin & Adamo, 2014; ).

Undernutrition is linked to chronic health problems in adulthood and is an important factor in the death of many young children (Svedberg, 2014).

Undernutrition in children is a non-monetary indicator, used to characterize poverty and food security conditions in developing countries (Weingärtner, 2000; Marx, 2005; Nube, 2005). Information on undernutrition prevalence in children is a proximate indicator of the overall nutritional and food security conditions in a country (Nube, 2005).

In Ghana, the prevalence of undernutrition has not totally reduced, yet the rate of overnutrition is increasing. Data from 2008 the World Health Organization (WHO) Global Database on Body Mass Index (BMI) shows prevalence of overnutrition in sub-Saharan Africa. The change in Ghanaian lifestyles and consumption patterns (consumption of inexpensive energy-dense nutrient-poor foods) are contributing factors to inadequate growth coupled with excess weight gain leading to an increased obesity

rate (Jehn & Brewis, 2009). The current change in diets of the Ghanaian population results from a shift from the traditional diet to a modern one, normally referred to as Western food (Agyei-Mensah, & de-Graft Aikins, 2010).

This change in other countries is determined by the interplay of economic, demographic, environmental and cultural changes in society which plays a role in the prediction and determination of the nutritional status of the overall population (Mamabolo, Alberts, Steyn, Delemarre-van de Waal, & Levitt, 2005). The rising prevalence of overweight where nutrition transition has been studied is attributed to changing behavioural practices such as reduced physical activity and poor dietary behaviours. Underweight is also associated with high levels of malnutrition, starvation, poverty and other multiple factors. Infections and social determinants are key determinants of undernutrition. (Frempong, 2013).

Overweight with concurrent stunting is of public health interest, particularly in countries where undernutrition and overweight coexist at individual, community and national levels (Kimani-murage et al., 2010; Provo, 2013). This condition occurs when overnutrition and undernutrition coexist at national and community levels, (Steyn et al., 1998; Bourne, Langenhoven, Steyn, Jooste, Laubscher, & Bourne, 1994; Florêncio, Ferreira, de França, Cavalcante, & Sawaya, 2001) and within households (Wibowo et al., 2015; Garrett & Ruel, 2005; Doak, Monteiro, Adair, Bentley & Popkin, 2000). This condition is often as a result of many related causes including: economic conditions related to changes in diet and physical activity patterns (Doak, Adair, Bentley, Monteiro, & Popkin, 2005). A key determinant is fetal undernutrition especially during the first thousand days of life. In addition to this, are poor environmental conditions and overpopulation, which can reduce food adequacy (Bain et al., 2013). The effect of the condition increases the risk of mortality, morbidity and poor cognitive development.

Poor health and development in early life can limit the educational, social and economic achievements of individuals across their life span and increase the risk of poor adult health (De Onis, Blössner, Borghi, Morris, & Frongillo, 2004; De Haas, 2008). Children under five are most susceptible to this condition (Steyn et al., 2005).

Undernutrition has burdened Ghanaians for decades. Stunting rates (short height for age due to malnutrition) among children have remained roughly the same over the past 25 years, with the most recent rates reported to be 28 percent (GSS, GHS and IFC Macro, 2009). Overweight, an indicator of overnutrition, reflects a high weight for height, which signifies an excessive energy intake and inefficient utilization between the supply of protein, other nutrients and energy and the body's demand for them to ensure optimal growth and function.

In Africa as a whole, and in Sub-Saharan Africa, 35% and 42% of children under-five are believed to be stunted (Mamabolo et al., 2005). Stunting is becoming already prevalent in low-income countries, (Agyei-Mensah & de- Graft Aikins 2010) where Ghana is inclusive. The 2011 MICS reported a 2.6% prevalence of overweight.

Ghana now suffers from both undernutrition and overnutrition, a condition known as the double burden of malnutrition. Ghanaian children under five suffer the same fate. Malnutrition is a leading contributor to the global burden of disease (Ezzati, Lopez, Rodgers, Vander Hoorn, & Murray, 2002). The simultaneous occurrence of undernutrition with overnutrition is commonly referred to as the double or dual burden of malnutrition – nutrition transition (Grijalva-Eternod, Wells, Cortina-Borja, Salse-Ubach, Tondeur, Dolan ... Seal, 2012; Jehn & Brewis, 2009) .

## **1.2 Statement of the problem**

Undernutrition and overnutrition are significant public health problems that originate from early childhood and leads to the onset of nutrition related illness or other complications later in life (Urke & Mittelmark, 2014). Childhood nutritional stunting is associated with impaired fat oxidation, a factor that predicts obesity in other at-risk populations (Paulo et al., 2000). In later years of life, stunting and overweight, directly or indirectly affects the child's growth, socially, emotionally, morally and academically (Paulo et al., 2000), and the nation as a whole (Atwood, 2003). Stunting trends in Ghana, decreased from 34% in 1988 to 28% in 2008 in under-five children with 5% of them overweight (GSS, GHS and IFC Macro, 2009). The highest proportion of overweight children lived in urban areas (7%) compared to rural areas (4%). GSS, (2011) also reported that 30% of the under-five children were stunted, 3% of the under-fives were overweight. This trend may have either increased or decreased owing to the fact that the surveys (GSS, GHS and IFC Macro, 2009) and GSS, 2011) were conducted six years and three years ago respectively. Literature shows that stunting and overweight coexist in children in developing countries (Adel et al., 1995; Popkin, Richards, & Montiero, 1996; Corvalán, Gregory, Ramirez-Zea, Martorell, & Stein, 2007; Fernald & Neufeld, 2007; & Urke & Mittelmark, 2014). Nationally representative surveys (DHS, MICS) report coexistence of the stunting and overweight in the Ghanaian community, but not within individuals.

This study seeks to find the coexistence of overweight with concurrent stunting among children under-five years in Ghana.

## **1.3 Justification for the study**

Overweight with concurrent stunting is a condition becoming more prevalent in low-income countries (Birks, 2012). Undernutrition and overnutrition which are significant

public health problems, have origins in early childhood that need interventions to improve the economic growth of the country (World Bank, 2006). Concurrency of overweight and stunting have been found to exist in children in rural Mexico, Peru, Russia, Brazil, South Africa and China (Fernald & Neufeld, 2007; Urke & Mittelmark, 2014; Popkin et al, 1996). This study would find out whether the double burden of malnutrition is prevalent among children under-five living in Ghana.

The need for a further study into such phenomenon (concurrency of overweight with stunting) would provide further information about the determinants of the DBM and give an idea about how to reduce the prevalence of the condition in children and also provide a basis for public health experts to design interventions to help curb the situation in Ghana.

#### **1.4 Conceptual framework**

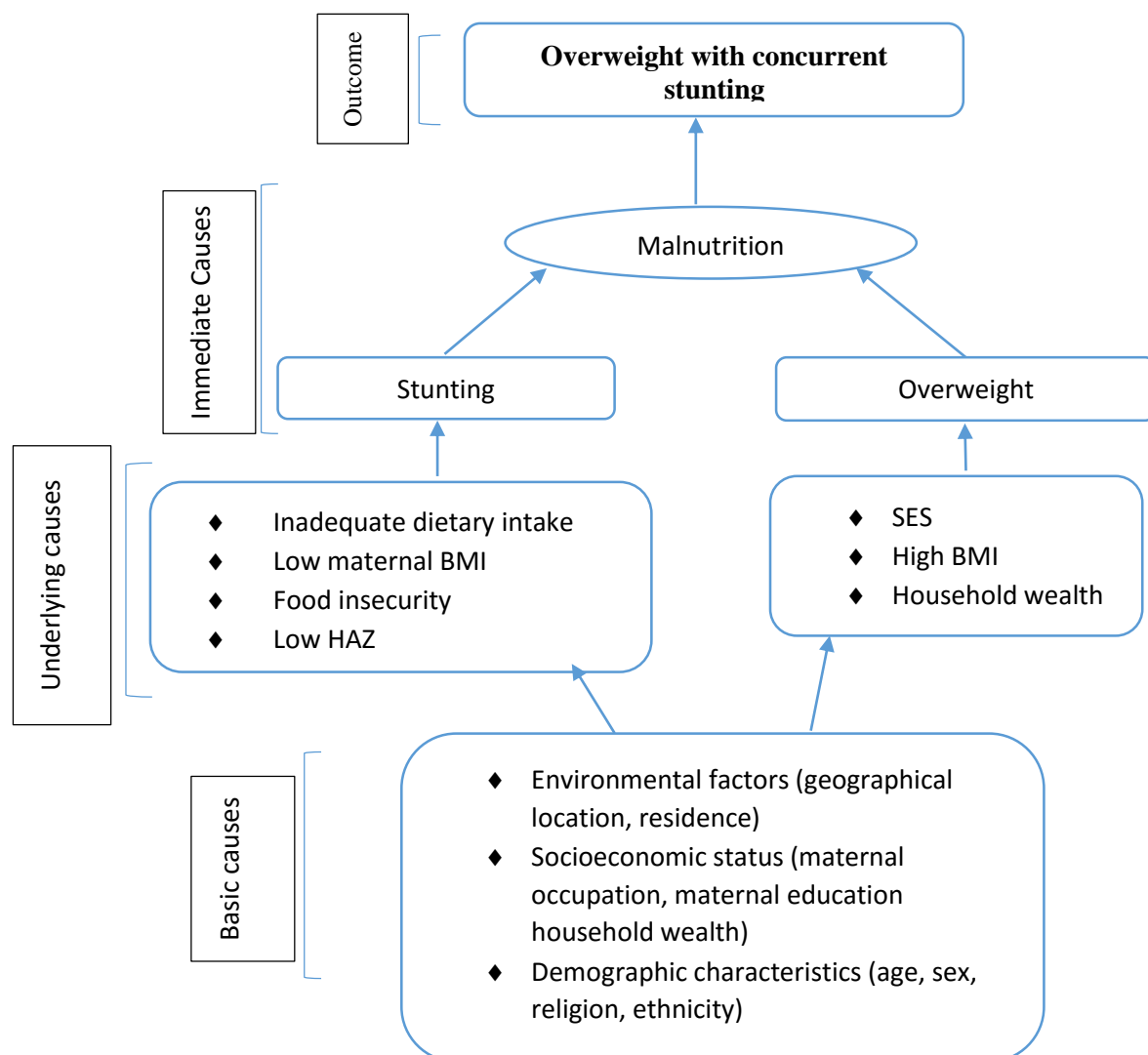
The framework illustrates the relationship between the outcome and independent variables associated with the concurrency of overweight and stunting. This relationship explains the various factors associated with overweight with concurrent stunting and the levels at which these factors interrelate. The outcome variable is overweight with concurrent stunting. The independent variables are grouped under demographic characteristics, environmental factors and socioeconomic status of mothers. The demographic characteristics include mothers' age, child's age, and sex. The Socio-Economic Status (SES) also includes household size, household wealth, mothers' education and occupation, while the environmental characteristic includes type of residence and sanitation.

Inadequate dietary intake, micronutrient deficiencies, low maternal Body Mass Index (BMI), child's age and low standard of living make up the immediate causes of stunting. The immediate causes of overweight are genetic (parental overweight, mothers BMI),

westernization, urbanisation, sedentary lifestyles (unhealthy lifestyles), reduced physical activity and energy imbalance. However, not all the above listed immediate causes, are variables measured in the MICS datasets.

The diagrammatic conceptual framework identifies stunting and overweight as influences of malnutrition, and malnutrition an immediate cause of overweight with concurrent stunting – double burden of malnutrition. This is because, it has direct impact on the child's nutritional status. The underlying causes of stunting operating at the household levels include: mothers' education, household wealth, maternal BMI and low Height-for-Age-Z score (HAZ). Underlying causes of overweight also include SES, household wealth, maternal BMI, and high BMIZ. The basic causes of overweight with concurrent stunting, which are the broad subset of factors that operate at the household, regional and national levels, range from economic, environments to other demographic factors . The environmental factors include geographical location; rural or urban residence. Socio-economic status looks at the occupation of mother, maternal education, and household wealth. The other demographic factors include age (6 months and older), sex of the child, religion and ethnicity.

Figure 1.1: Conceptual framework of overweight with concurrent stunting with conceptual framework



Source: Modified from the UNICEF conceptual framework for undernutrition

## 1.5 Study objectives

### 1.5.1 General objective

To assess the prevalence of overweight with concurrent stunting in Ghanaian children, and their individual and contextual determinants.

### **1.5.2 Specific objectives**

1. To assess the prevalence of overweight with concurrent stunting among Ghanaian children.
2. To determine the individual and contextual determinants of stunting among Ghanaian children.
3. To determine the individual and contextual determinants of overweight among Ghanaian children.
4. To determine the individual and contextual determinants of overweight with concurrent stunting among Ghanaian children.

### **1.6 Research questions.**

The following questions were asked. Answers of which answered the study's objectives.

1. Is overweight with concurrent stunting prevalent among children living in Ghana?
2. What are the determinants of stunting among Ghanaian children?
3. What are the determinants of overweight among Ghanaian children?
4. What are the determinants of concurrent overweight with stunting among Ghanaian children?
5. Where can the children with the concurrency of overweight and stunting be located?

## CHAPTER TWO

### 2.0 LITERATURE REVIEW

#### 2.1 Introduction

A country with the prevalence of underweight, stunting, and overweight, is assumed to be in its stages of nutrition transition with evident of double burden of malnutrition (Adel, Marie-Francoise, Mahmud Salaheddin, Najeeb, Ahmed, Ibrahim, & Gerard, 2008). Many developing countries suffer the dual burden of malnutrition within households. This is defined as the coexistence of an undernourished child (stunted child) and an overweight parent within the same household (Jinabhai, Taylor, & Sullivan, 2003). Countries undergoing the nutrition transition are facing the challenge of simultaneously dealing with nutritional deficiencies among children and obesity-related diseases among adults (Oddo et al., 2012).

It can be deduced from literature that, stunting and overweight are nutritional problems affecting developing countries in Sub-Saharan Africa. A study conducted to explore the determinants of stunting and overweight in Sub-Saharan Africa reported, a dramatic increase in overweight and obesity, gradually becoming a global epidemic. Sub-Saharan Africa equally recorded the world's highest rate of stunting (43%) among children (Keino, Plasqui, ETTYANG, & van den Borne, 2014).

Promoting exclusive breastfeeding for the first 6 months of infancy was reported to be important in preventing both stunting and overweight among children (Keino, et al, 2014; DHS 2008, MICS, 2011). Immediate attention should be targeted at children with nutritional morbidities to help maintain and improve child health within the early stages of life.

## 2.2 Prevalence of stunting

Africa is known as a continent with the highest prevalence of stunting in the world (Corvalán et al., 2007). High rates of stunting have been associated with many countries in Sub-Saharan Africa, South - Central Asia, and South - Eastern Asia (De Onis & Blössner, 2003). The result of a study conducted by de Onis, Blössner, & Borghi (2012) indicated increasing stunting levels in young children. It also confirmed, stunting increased in Eastern Africa, Northern Africa while the Caribbean showed modest improvements. Western Africa and Central America presented very little progress. Highest rates were found in Eastern (45%), Middle (39%) and Western (38%) Africa (Onis, Blo, & Borghi, 2011). The results underlined the importance of monitoring global levels and trends of stunting in young children (Onis et al., 2011).

Stunting occurs when a child is shorter than children of the same age compared to a reference population (Wondimagegn, 2014). The height-age index which reflects the linear growth achieved during the prenatal and postnatal periods, results from combination of insufficient ingestion of macro- and micronutrients; infections and hereditary factors (Cristina & Vieira, 2007).

Atwood (2003), also reported that 29% of children ages 0-59 months were stunted. The proportion of children who were stunted were 14 times the level expected in a healthy, well-nourished population. The Ghana Demographic and Health Survey, (2008) reported, 28% of Ghanaian children under five are stunted with 10% being severely stunted. This rate is an indication of chronic malnutrition. Children 18-23 months (40%) showed a higher prevalence of stunting while those less than 6 months showed a relatively lower prevalence of stunting (4%). Male children (30%) were more stunted compared to females (26%).

### **2.3 Determinants of Stunting.**

Stunting decreases as the birth interval, size at birth and mother's BMI increases. (Keino et al, (2008). Children of multiple births are more likely to be stunted than those of single births (Bhandari & Chhetri, 2011; Hong, Banta, & Betancourt, 2006).

In a study conducted in Mexico, it was reported that ethnicity was also a determinant of stunting. The notable difference among indigenous and non-indigenous children, was the significant difference in the living conditions of the two populations (Shamah-levy, Nasu, Moreno-macias, Monterrubio-flores, & Avila-arcos, 2008). According to Adekanmbi, Kayode, & Uthman, (2013), stunting was more prevalent among under-five children who resided in rural areas and communities with high poverty rate, unemployment rate and limited access to safe drinking water. The sex of a child was found to be a strong determinant of stunting in under-five children (Adekanmbi et al., 2013). According to Shamah-levy, Nasu, Moreno-macias, Monterrubio-flores, & Avila-arcos (2008), genetic factors were also important contributors to children's growth.

Stunting within households tends to increase with economic development in poorer and middle income countries (Said-Mohamed, Alliot, Sobgui & Pasquet 2009). In Keino et al, (2014), the risk factors linked to stunting were found to be socioeconomic status, such as mother's education, mother's occupation, and household income. The socioeconomic status factors including health expenditure influence stunting levels indirectly. On the other hand, micronutrient deficiencies, inadequate protein intake, intrauterine malnutrition, maternal stature and infections may be directly causative (Mamabolo, Alberts, Steyn, Delemarre-van de Waal, & Levitt, 2005). In a study conducted by Adekanmbi, Kayode, & Uthman, (2013) in Nigeria, it showed that childhood stunting was prevalent among under-five children who breastfed longer than

the usual time. Under-fives who did not complete their immunisation and born with low birth weights were also reported to be stunted. Similarly, stunting was highest in children with mothers having low BMI, and between the ages of 15 – 24 years and those without formal education.

#### **2.4 Children and effects of stunting**

Stunting in young children contributes significantly towards the global burden of disease (Caulfield, Onis, Blössner, & Black, 2004). Undernourished children were more likely to become short adults and to give birth to low birth weight babies. Evidence links stunting to cognitive development, school performance and educational achievement (Otoo, 2008). This impairs the accumulation of the human capital, crucial for economic growth and poverty alleviation (Onis et al., 2011). Mortality in childhood, low adult wages, and lost productivity, accompanied by excessive weight gain later in childhood were also reported to be significant effects of stunting (Onis, et al., 2011).

Stunting in childhood has been associated with an increased risk of elevated blood glucose concentrations, high blood pressure, higher susceptibility to gain central fat, and harmful lipid profiles, which are linked to Non-Communicable Diseases (NCDs) in adulthood (Sawaya, Martins, Baccin Martins, Florencio, Hoffman, do Carmo, Franco & das Neves, 2009; Prentice, 2006; Prentice, 2009). According to a study conducted by Sawaya & Roberts (2003), stunting causes long-lasting changes such as lower energy expenditure, higher susceptibility to the effects of high-fat diets, lower fat oxidation, and impaired regulation of food intake. Stunted children may have an impaired regulation of energy intake, which increases the risk for obesity later in life (Popkin, Richards & Montiero, 1996; Svedberg, 2014).

Children who suffer from growth retardation as a result of poor diets and/or recurrent infections tend to have more frequent episodes of severe diarrhoea and are more susceptible to several infectious diseases, such as malaria, meningitis, and pneumonia (Onis & Blössner, 2003).

## **2.5 Prevalence of overweight**

Overweight, a global public health problem is a result of positive energy imbalance, which occurs when an individual consumes more calories than expended in physical activity (Benkeser, Biritwum, & Hill, 2012). Previously, the overweight and obesity epidemic was only associated with industrialized countries (Appiah, Steiner-Asiedu, & Otoo, 2014). Although the prevalence of overweight in Ghana has not reached epidemic proportions as in developed countries, there is evidence of an alarming upward trend in overweight rates in many developing countries (Appiah, Steiner-Asiedu, & Otoo, 2014).

The mechanisms of the increasing trend in overweight rates in developing countries have been largely linked to nutrition transition accompanying westernization of diets, urbanization, food processing, food market globalization, and rising disposable income (Appiah et al., 2014; Agyei- Mensah & de- Graft Aikins 2010). The rising prevalence of obesity in Africa is attributed to changing behavioral practices such as sedentary lifestyles and consumption of food high in saturated fat, salt and sweetened food and beverages which have high energy value (WHO, 2011; Agyei-Mensah and de-Graft Aikins, 2010; Caballero, 2007; Prentice, 2006). The prevalence of obesity in West Africa, rapidly increased during the last two decades of the 20th century and continues to increase in the 21st century (Benkeser, Biritwum, & Hill, 2012).

Trends in overweight and obesity among children and adolescents have been reported for Europe and high- income Asian countries (Bellizzi, Horgan, Guillaume & Dietz 2002), as well as for developing countries (de Onis & Blossner 2000) in which income levels are rising, including China (Chen, 2002), Chile (Kain, Burrows, & Uauy, 2002) and Kuwait (Al-Moussa, Shaltout, Nkansa-Dwamena, Mourad, AlSheikh, Agha, & Galal 1999). The evidence suggests that as income levels rise, obesity and its co-morbidities become more prevalent among children in developing countries (Appiah, Steiner-asiedu, & Otoo, 2014).

This was estimated that overweight rates would increase by about 35% within a 10-year period (Amuna & Zotor, 2008). In 2003, the WHO estimated that about 115 million of the 300 million obese people live in low-income countries. The prevalence of overweight in urban sub-Saharan Africa was found to range between 23% in Malawi to 35% in Niger and Ghana, and 38% in Kenya (Appiah et al., 2014).

In accordance with 2010 data of WHO, more than 40 million under-fives were overweight. The global prevalence of childhood overweight is also on the increase, globally 22 million of children under five have been classified as overweight (Rocchin, 2002).

## **2.6 Determinants of overweight**

Parental overweight or obesity are the strongest determinants of childhood overweight (Strauss & Knight, 1999; Danielzik, Czerwinski-Mast, Langnäse, Dilba, & Müller, 2004). A study conducted by Fernald & Neufeld, (2007), reported that overweight was mostly associated with the child being a male, and having a young mother who was herself overweight. This implied that, a child with an obese mother had more than double the risk of being overweight than a child without an overweight mother; the risk

to the child for having an overweight mother was also very high. Other determinants of overweight among children include age, household composition, occupation of the mother, and the mother's BMI (Crepinsek & Burstein, 2004; Keino et al., 2014). Nutrition and lifestyle, were important risk factors (Swinburn, Caterson, Seidell, & James, 2007; Keino et al., 2014; Karageorgi, Alsmadi, & Behbehani, 2013). Prevalence of obesity varied with age, sex, socioeconomic class, and ethnic variables (Dwyer, Feldman & Mayer, 2014). A study conducted by Kruger, Kruger, & Macintyre (2006) also confirmed that sedentary environments, closer to fast-food outlets and other highly available energy-dense food products, where activity was discouraged by the availability of indoor recreation and travelling by vehicle were found to be determinants of obesity. Family size and income are important determinants of overweight (Gonzalez-Casanova et al., 2014; Kruger et al., 2006). According to a study conducted in South Africa, the highest level of overweight was found in smaller households with five or fewer family members, where parents in these smaller families mostly earned higher salaries. Children from the smaller families consumed the most energy as they had more food available per person and better access to food due to the higher income (Mo-suwan, Tongkumchum, & Puetpaiboon, 2000).

## **2.7 Obesity and its implications**

Childhood obesity is associated with a health problems such as diabetes, hypertension, sleep-disordered breathing, a range of orthopaedic complications and abnormal lipid profiles, and social problems namely stigmatization and bullying (Appiah et al., 2014). Obesity increases the risk for several types of cancer, and the most common include cancers of the esophagus (adenocarcinoma), colon, pancreas, breast (post-menopausal), endometrium and kidney (Key, Spencer, & Reeves, 2010). Diet an important determinant of obesity influences insulin resistance, and plays a role in the development

of type 2 diabetes. Excess energy intake promotes insulin resistance even before significant weight gain occurs (Musaiger, Hassan, & Obeid, 2011).

## **2.8 Stunting, overweight and geography**

In a study conducted by (Kosti, Panagiotakos, & Asia, 2006), it was reported that lower levels of overweight were found among children in the countries of central and eastern Europe whose economies suffered varying degrees of recession during the period of economic and political transition in the 1990. The prevalence of overweight was also higher among the southern countries of Europe, especially those outside of the former eastern bloc. The non-eastern bloc countries surrounding the Mediterranean showed prevalence rates for overweight children in the range 20–40%, while those in northern areas show rates in the range 10–20%.

In Ghana, stunting varies by region; it is highest in the Eastern and Upper East regions (38% and 36% respectively) and lowest in the Greater Accra region (14%) (GSS, 2008). According to the Demographic Health Survey in 2008, children in the northern areas of Ghana, appeared to be stunted while children in the southern areas appeared to be overweight. The level of stunting is higher in the rural areas (32%) than in the urban areas (21%). In MICS, (2011), 33% of households in urban areas and 44% of households in rural areas had at least one child less than five years. More children live in rural than urban areas (57% against 44%). About 23% of children under five live in poorest households while 17% live in richest households (MICS, 2011). This supports the fact that more children live in rural areas compared to the urban areas.

Undernutrition of which stunting is an indicator was more likely to be found in males, living in rural areas, and in underprivileged groups compared to female children (Adel, et al, 2008; Keino, et al, 2014). The outcome of a study revealed that the high prevalence

of overweight was associated to areas with a higher socioeconomic and sanitary conditions (Vitolo, Gama, Bortolini, Campagnolo, & Drachler, 2008). Overweight was more likely to be associated with children in urban, privileged groups

## **2.9 Overweight with concurrent stunting**

Stunting and obesity coexist in developing countries (Corvalán et al., 2007). The double burden of malnutrition- nutrition transition is becoming more prevalent in low-income countries (Agyei-Mensah & de- Graft Aikins 2010). Stunting co-occurring with overweight is more often reported for urban than for rural households (Gillespie and Haddad, 2003). The two conditions (stunting and overweight) are both among the top ten leading risk factors for the global burden of disease (WHO, 2002).

A study conducted in Mexico, indicated, the simultaneous increase in the occurrence of obesity and under nutrition (stunting) remained high (Fernald & Neufeld, 2007). The study provided evidence that stunting with concurrent overweight or obesity was an important public health problem, even among poor pre-school-aged children in rural Mexico. In particular, the Mexican study of the concurrent phenomenon showed a high prevalence of under- nutrition (low weigh-for-age and/or low height- for-age) in children (30%). Moreover, a high prevalence of obesity associated with stunting (indicative of chronic growth faltering during childhood and the main consequence of poor nutrition in developing countries) has been found in a number of protocols over the years, indicating that obesity could occur in an individual subsequent to growth faltering (Sawaya et al., 1995). Further studies conducted by Popkin et al., (1996), have replicated findings showing an association between stunting and overweight in other countries such as Russia, China, and South Africa, all of which are undergoing nutritional transition.

## **2.10 Determinants of overweight with concurrent stunting and their effects on children**

The factors associated with concurrent stunting and overweight were; maternal (maternal height, age, and education) and household factors (large household size, and lower socioeconomic status) (Fernald & Neufeld, 2007; Steyn et al., 2005; Urke & Mittelmark, 2014 & Mamabolo et al., 2005). Socio demographic variables (sex, age in months urban–rural residence, geographic region, maternal education and household wealth) as indicated and measured in a study conducted by (Corvalán et al., 2007), concluded the concurrency of stunting and overweight were influenced by the measured variables. Environmental factors, such as rural or urban setting and sanitation, influenced both stunting and overweight (Fernald & Neufeld, 2007). This implies that the concurrency of stunting and overweight were dependent on socioeconomic, demographic, and environmental factors (Keino, et al, 2014).

In addition, there is strong evidence that impaired growth is associated with delayed mental development, poor school performance, and reduced intellectual capacity. (Mendez & Adair, 1999; WHO, 1999& de Onis 2001).

## **CHAPTER THREE**

### **3.0 METHODOLOGY**

#### **3.1 Introduction**

This chapter presents the methods deployed in this study. It describes the study design, study location, study population with its inclusion and exclusion criteria. Also presented are the sample size and sampling method, variables, data consolidation techniques and analysis. Each section of the chapter summarizes the steps and processes detailed the Ghana MICS (Ghana Statistical Service, 2011).

#### **3.2 Study design**

This study made use of secondary data from a nationally representative survey (Ghana Statistical Service, 2011). The design used by fourth round of the Ghana Multiple Indicator Cluster Survey (MICS4) was a cross sectional design which collected data from the 15th September, 2011 and concluded on 14th December, 2011. MICS was designed to provide statistically reliable estimates for a large number of indicators on the situation of children and women at the national level, for urban and rural areas, and for the 10 regions of the country.

#### **3.3 Study location**

The Ghana MICS collected data from all 10 regions in Ghana. This included rural and urban settlements with randomly selected households. This study's secondary analysis makes use of the entire MICS4 data sets.

#### **3.4 Study population**

The target population for the MICS were all Ghanaians, especially children under 5, women and men in their respective reproductive age groups (Ghana Statistical Service, 2011).

This study made use of data collected from women (15–49years) and children (0-5 years). This current study's population is the MICS sample of selected households identified with children under five living with their mothers or primary caregivers.

#### **3.4.1 Inclusion criteria**

The Ghana MICS4 selected 12,150 households in 810 enumeration areas (EAs). In each of these EAs, 15 households were visited. Households with eligible women and men, were contacted for interviews. Consent and responses were obtained from mothers or caregivers within selected households where children under five years were identified (GSS, 2011).

This current analysis made use of data obtained from households where children under five were identified.

#### **3.4.2 Exclusion criteria**

In the Ghana MICS, households with ineligible men and women were not contacted for interviews. According to the Ghana MICS4 report, households with incomplete records of children's length or height, weight and ages were excluded from the anthropometric calculation.

In addition to the exclusion criteria by the Ghana MICS stated above, this current study excluded children whose HAZ was below -6 or above +6; WAZ was below -6 or above +5; WHZ was below -5 or above +5 and BMIZ below -5 or above +5 from certain aspects of the analysis (WHO, 2006). Mildly stunted, mildly underweight and, mildly wasted children were similarly excluded from certain aspects of the analysis. Details are given in the data analysis section.

### **3.5 Sample and sampling method**

#### **3.5.1 Sample size**

The sample size determination for the Ghana MICS is detailed in the MICS4 report (Ghana Statistical Service, 2011). In total 7626 children under-fives staying with their caregivers were sampled for survey.

This analysis however made use of 7550 children for whom complete interview responses were obtained from their mothers or caregivers. This also met the current study's inclusion criteria.

#### **3.5.2 Sampling method**

This section explains how the MICS4 households and individuals were selected for the survey. The MICS4 sample survey used a random two-stage sample survey, (multi-stage, stratified cluster sampling approach).

The first stage of the survey dealt with the selection of Primary Sampling Units (PSUs) from a sampling frame which was the list of the 2010 Ghana Population and Housing Census Enumeration areas (EAs). The 2010 Population and Housing census was used for the selection of clusters. Census EAs were defined as PSU. The second stage dealt with the selection of the Secondary Sampling Units (SSUs) which was the selection of households from each selected EA in first stage. PSUs were selected from each of the sampling strata using systematic Probability Proportional Sample (PPS) based on estimated sizes of the EA from the 2010 Population Census. Each region in Ghana, is made up of two strata: the urban and the rural areas. The total number of strata was therefore 20 for the whole country. Sample selection and estimation were conducted separately in each stratum. With the list of households from the 2010 Population Census, the total number of households in each selected cluster (Enumeration Area)

was sequentially numbered from 1 to n at the Ghana Statistical Service; and then the selection of 15 households in each cluster was carried out using random systematic selection procedures.

Households sample size calculation formula

$$n = \frac{4r(1-r)f(1+t)}{(0.12r)^2 hp} \quad n = 810$$

Where:

n = the minimum number of households to be interviewed (95% CI)

e = relative error = a percentage of the indicator value obtained

r<sup>2</sup> = 2006 MICS value for the indicator

r = expected rate for the indicator for 2011

f = design effect for the indicator in MICS 2006

t = non response rate for households in MICS 2006

h = average household size in 2006 MICS

p = proportion of children aged 12-23 months among the total population.

This result suggested that for each region taken as domain the household sub sample size was 810.

Central, Northern, Upper East and Upper West Regions were over sampled compared to their shares at the national level. The reasons are explained below.

### **Calculation of Sample Weights**

Sample weights for Central, Northern, Upper East and Upper West regions were calculated. The major component of the weight was the reciprocal of the sampling fraction employed in selecting the number of sample households in that particular sampling stratum (h) and PSU (i):

$$\text{Formula: } W_{hi} = \frac{1}{f_{hi}}$$

The term  $f_{hi}$ , the sampling fraction for the  $i$ -th sample PSU in the  $h$ -th stratum, is the product of the probabilities of selection at every stage in each sampling stratum, where  $p_{shi}$  is the probability of selection of the sampling unit at stage  $s$  for the  $i$ -th sample PSU in the  $h$ -th sampling stratum.

$$\text{Formula: } f_{hi} = P_{1hi} \times P_{2hi} \times P_{3hi}$$

Since the estimated number of households in each PSU in the sampling frame, used for the first stage selection and the updated number of households in the enumeration area from the listing were different, individual sampling fractions for households in each sample enumeration area were calculated.

The sampling fractions for households in each enumeration area, therefore, included the first stage probability of selection of the enumeration area in that particular sampling stratum and the second stage probability of selection of a household in the sample enumeration area (cluster).

A sample of 12,150 households were selected. 11,970 were contacted for interviews. 11,925 households were interviewed, giving a response rate of about 100%. In the households interviewed, 10,963 women aged 15–49 years were identified, 10,627 were interviewed, producing a response rate of 97%. Concerning children under the age of 5 years, 7,626 were identified, for whom responses were obtained from their mother or caregiver in 7,550 complete interviews gave a response rate of 99%. For the male survey, 3,511 men aged 15–59 years were identified, 3,321 successfully interviewed which yielded a response rate of 95%.

### 3.6 Variables

#### 3.6.1 Outcome variable

The primary outcomes of the study were; prevalence of stunting, prevalence of overweight and prevalence of overweight with concurrent stunting. In addition, individual and contextual determinants of stunting, overweight and overweight with concurrent stunting among the children under five years were determined.

#### 3.6.2 Explanatory (independent) variables

The MICS4 assessed nutritional status of children under age 5 according to three anthropometric indices: weight for age, height for age, and weight for height, breastfeeding and Infant and Young Child Feeding. It reported data on the concurrency of the overweight and stunting in Ghana but not within the individuals (children). With reference to studies conducted by, Adekanmbi, Kayode, & Uthman, 2013; Boyce, Walters, & Nyaku, 2014; Corvalán, Gregory, Ramirez-Zea, Martorell, & Stein, 2007; Fernald & Neufeld, 2007; Odelola & Adedini, 2013; Jesus et al., 2010 and Wondimagegn, 2014, variables that could further predict stunting, overweight and concurrency of overweight with stunting were identified and selected from the MICS datasets. The selected variables were grouped under, child's characteristic, maternal and household factors, environmental factors and other factors. The variables are listed below

##### *Child's characteristics*

- Child's age in months
- Sex of child
- Breastfeeding status
- Child health status
- Malaria rapid test outcome
- Mosquito net utilisation

##### *Household factors*

- Religion of household head
- Ethnicity of household head
- Marital status
- Sources of drinking water

***Maternal factors***

- Maternal age in years
- Maternal age at child birth
- Type of birth
- Size of child at childbirth
- Birth order
- Maternal education
- Wealth index quintile

***Environmental factors and others***

- Area of residence
- Geographic zones
- All but three northern regions

***Other Factors –NHIS status***

- Mother registered with any insurance scheme
- Mother holding a valid NHIS card

All selected characteristics were evaluated in the bivariate and regression analysis. At each stage of the analysis, relevant variables were assessed with each of the primary outcomes.

**3.7 Data processing and analysis****3.7.1 Examination of missing values**

The Ghana MICS data collected by the GSS, were edited on the field where, field editors and supervisors revisited households within the clusters where data was collected, to collect information which was either left out, uncompleted or responses which were not clear. In addition, data collected was office edited to ensure that field data collected conformed to the laid-down principles and procedures. Data was cleaned and imputed using SPSS and the model syntax and tabulation plans developed by UNICEF. Data processing personnel run further checks that ensured consistency. Where inconsistencies were huge, field monitors were sent back to the field for verification of the collected data. Individual data files were also checked for completeness and consistency. It was observed that most of the missing values in the MICS data were coded as 9 or a series of 9s that filled the length of the field (Ghana Statistical Service, 2011).

### 3.7.2 Data analysis

In the current study, statistical analysis of the MICS4 data sets were performed using IBM SPSS Statistics for Windows version 20.0. Preliminary assessments of normality of continuous variables of HAZ, WAZ, WHZ and BMIZ were performed. Key variables identified in the data sets for this study's analysis were transformed into either categorical or dichotomized variables. Variables that were categorized included religion and ethnicity of the household head, sources of drinking water, size of child at birth, the ten regions of Ghana and children's hemoglobin level.

Religion was categorized into Christian, Muslim, Traditionalist or Spiritualist and other religion with included no religion. Ethnicity was also categorized according to the main ethnic tribes in Ghana. These include; the Akan, Ga/Dangbe, Ewe and Northern tribes. Non-Ghanaian and others ethnic groups which were not part of the main tribes in Ghana were categorized as non-Ghanaian and others respectively. Sources of drinking water was categorized into pipe source, waterbody, bottle or sachet water and any other source apart from being a water body such as tube well or tanker. Size of child at birth was also categorized into child being large (above 4000g), normal (2,500g – 3999g) or small (below 2,500g) at birth. The regions of Ghana were also categorized according to the coastal, middle and northern zones. The regions were further dichotomized into all but three northern regions. This classification was based on the fact that over the years, national data always present worst nutrition indicators in the three northern regions (Northern, Upper East and Upper West regions). Using WHO (2011), children under five with hemoglobin levels 11gram per decilitre (g/dl) and above were classified as normal, hemoglobin levels of 10.0 - 10.9g/dl, 7.0 - 9.9g/dl and less than 7.0g/dl were categorized as mild, moderate and severe anemia. The children's anemia status were further dichotomized into child being anemic or normal. Other key variables such as

the child been sick with either cough, fever or diarrhea, or the malaria rapid test result were dichotomized into child being sick or healthy and test being positive or negative respectively.

The nutritional status of the children were measured using HAZ, WAZ, WHZ and BMIZ with consultation to the new cut-offs based on the 2006 WHO growth standards. Children whose appropriate height, weight were not recorded and with HAZ below -6 or above +6; WAZ below -6 or above +5; WHZ below -5 or above +5 and BMIZ below -5 or above +5 were excluded from the analysis (WHO, 2006). HAZ, WAZ, WHZ and BMIZ which were continuous variables were categorized into mildly, moderately, or severely stunted, underweight and wasted whereas BMIZ was categorized into overweight and obese.

A child was regarded as mildly stunted, underweight or wasted if HAZ, WAZ and WHZ were less than one standard deviation (1.00S.D - 1.99S.D) from the median reference population. Consequently, children were categorized as moderately or severely stunted, underweight or wasted if HAZ, WAZ and WHZ were two (2.00S.D - 2.99S.D) or above three (<3.00SD) standard deviations from the median of the reference population. Conversely, a child was considered as overweight and obese if BMIZ was greater than two (>2.00S.D) standard deviations from the median of the reference population. For the purpose of this study both obese and overweight children were referred to as overweight. From the above categorizations, three variables named any stunting, any underweight and any wasting were computed by adding up all children who were mildly, moderately or severely stunted, underweight and wasted. Beyond this children who were moderately and severely stunted, underweight and wasted (excluding mild) were computed into stunting (< 2.00S.D), underweight (< 2.00S.D) and wasting (< 2.00S.D) variables. A child who is simultaneously overweight and stunted was

considered as having  $BMIZ > 2.00$  S.D and HAZ below  $2.00$ S.D. This classification was computed into a variable named concurrency. Since this study's focus is overweight and concurrent stunting, children who were moderately and severely stunted, and had  $BMIZ > 2.00$ S.D were included in the analysis. The stunting, overweight and concurrency variables were dichotomized (further regrouped) into being stunted or normal; overweight or not-overweight and being overweight and concurrently stunted or not.

Univariate analysis was used to generate descriptive tabulations for key variables assessed from the MICS datasets. The background and socio-demographic variables were grouped under child's characteristics, household factors, maternal factors, environmental factors and NHIS insurance status. The sex specific prevalence nutritional status of children were computed and presented in Table 4.2.

Bivariate analysis were carried out to examine the associations between outcome variables and selected characteristics. The key outcome variables (stunting, overweight and overweight with concurrent stunting) were independently assessed with selected characteristics as listed section 3.6.2. Pearson chi-square statistics were used to determine explanatory variables that were statistically significant.  $P\text{-value} < 0.05$  was used to denote statistical significance. These bivariate analysis are presented in tables 4.3, 4.4 and 4.5.

Simple and multiple logistic regression modelling produced unadjusted and adjusted associations between each of the key outcome variables and selected characteristics. In the simple regression model, each of selected characteristics were assessed independently with the outcome variables. Odds ratios with accompanying 95% CI were used to assess the strength of the relationships. Significant relationships were

denoted with an asterisk (\*). \*\*\* denoted statistical significance at  $p < 0.001$ , while \* denoted statistical significance at  $p < 0.05$ .

A multiple logistic regression model was developed for selected characteristics that were significant at  $p < 0.25$ . Also, variables which were previously shown to predict any of the three outcomes from previous studies were added to each model. As in Laar, Taylor, & Akasoe, (2015), standard logistic regression modelling in SPSS (the “Enter” method) was employed in the analysis. Previously reported variables associated with each outcome variable or found to be associated during the bivariate analysis were entered and a full model generated in a single step.

Three multiple regression models were constructed. First model was to determine the predictors of stunting; second model was to determine the predictors of overweight and the third model to determine the predictors of overweight with concurrent stunting. The potential predictors included in the stunting model were; sex of the child, age of the child in months, child health status, vitamin A dose given over the last 6months, malaria rapid test results, child anemia status, type of birth, maternal education, religion of household head, wealth index quintile, area of residence, geographic zones, all but northern regions and mother registered with any health insurance. Mother’s age, maternal age at child birth, and marital status though not statistically significant at  $p < 0.25$ , predicted stunting in previous studies. They were added to the model. Child taken to a health facility during illness, persons slept under mosquito net, child’s size at birth, birth order, ethnicity, NHIS status, and mother holding a valid NHIS card covariates although significant at  $p < 0.25$  were excluded from the model.

$$Y_s = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \dots + \beta_{17} X_{17}$$

Where,  $Y_s$ , - stunting being predicted,  $\beta_0$  – Constant

$\beta_1 \dots \beta_{17}$  – Coefficient of each stunting predictor variable.

$X_1 \dots X_{17}$  – Potential predictor variables

Potential predictors included in the overweight model were; child's age, child's sex, child ever been breastfed, child health status, persons slept under mosquito net, marital status, maternal age in years, child's size at birth, maternal education, religion of household head, wealth index quintile, geographic zones and all but northern regions. Area of residence ( $p > 0.25$ ) was included in the model because it was a significant predictor of overweight in previous studies.

$$Y_o = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \dots + \beta_{13} X_{13}$$

Where,  $Y_o$ , - overweight being predicted,

$\beta_0$  – Constant

$\beta_1 \dots \beta_{13}$  – Coefficient of each overweight predictor variable.

$X_1 \dots X_{13}$  – Potential predictor variables.

Potential predictors included in the overweight with concurrent stunting model were; child's age, child's sex, child health status, marital status, religion of household head, type of birth, maternal education, and wealth index quintile. Maternal age in years, sources of drinking water, geographic zones and all but northern regions which were significant predictors of the outcome in other studies, were included in the model.

$$Y_{os} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \dots + \beta_{13} X_{13}$$

Where,  $Y_{os}$ , - overweight with concurrent stunting being predicted,

$\beta_0$  – Constant

$\beta_1 \dots \beta_{13}$  – Coefficient of each overweight with concurrent stunting predictor variable.

$X_1 \dots X_{13}$  – Potential predictor variables.

Child's age, sex, health status, maternal age, religion of household head, wealth index quintile, marital status, geographical location and maternal education remained

constant in any of the three multiple regression models. Regression analysis are presented in tables 4.6, 4.7 and 4.8.  $P < 0.05$  was used to denote statistical significance.

### **3.8 Quality assurance**

Data sets collected from GSS were copied into a folder, renamed and locked with a password. Household data and mother's data were merged with that of the children's. Original data sets were kept as reference. Data was available to only the researcher and the supervisor.

### **3.9 Ethical considerations**

The owners of the data set outlined that data sets obtained from GSS was strictly for statistical and scientific research purposes. In addition, individuals who have been granted access to the datasets were not to produce links among datasets that could identify individuals or organizations.

In addition to the ethical considerations employed by the Ghana MICS, permission in accordance to the required procedures was sought from UNICEF for access to the Ghana MICS 2011 data sets. The data was used for academic purposes, and only made accessible to the researcher and the supervisor. Further permission was granted to carry out other forms of studies with the data sets.

## CHAPTER FOUR

### 4.0 RESULTS

#### 4.1 Introduction

The findings of the double burden of malnutrition (overweight with concurrent stunting) among children under five living in Ghana are presented in this chapter. The results are presented under the following thematic areas; background and socio-demographic characteristics, nutritional status of the children, associations of each the study outcomes with selected characteristics and predictors of each study outcome.

#### 4.2 Background and socio-demographic characteristics

Table 1 presents the background and socio-demographic characteristics of the children under 5 years. These characteristics were assembled under; child's characteristics and other factors (4.1a); household head or environmental factors (4.1b) and maternal factors (4.1c). Most of the children were males (51.1 %) and were between 36 – 47 months of age (21.2%). About 56.5% of the children were sick. The household characteristics of children showed that most of their household heads were males (68.2%). Christian household heads constituted about 48%, followed by Muslims, (31.5%), Traditionalists (14.2%) and other religions (6.4%). Also, most of the household heads were from Ghanaian northern tribes (60.6%). Considering the maternal factors, about 63.5% of the women were married. Mothers with no form of education constituted, 54.1% with the least being 7.2% having a secondary education and or higher. Most of the under-fives and their household heads lived in rural areas (72%) especially in the northern geographical zone (54.6%). Mothers who had registered with any health insurance were about 54.1%. Majority of the mothers (73.2%) had either no valid card, or missing cards. Other details are given in table 4.1a, 4.1b and 4.1c.

Table 4.1a: Background and socio-demographic characteristics of children under 5 (n=7550 unless otherwise stated).

Characteristics	Frequency (n=7550)	Percentage (100%)
<b>Demographic characteristics</b>		
<b>Child's age (months)</b>		
0-5	792	10.5
6-11	720	9.5
12-23	1451	19.2
24-35	1518	20.1
36-47	1599	21.2
48-59	1470	19.5
<b>Sex of the child</b>		
Male	3859	51.1
Female	3691	48.9
<b>Breastfeeding status</b>		
Child ever been breastfed	7484	99.1
Total	7484	
<b>Child health status</b>		
Child healthy	3280	43.5
Child sick	4263	56.5
Total	7543	
Child given Vitamin A dose within last 6 months	5134	69.4
Total	7403	
Child taken to a health facility during illness	893	78.1
Total	1144	
Child ever received any vaccinations	1211	86.9
<b>Mosquito net utilisation</b>		
Mother and child slept under mosquito net last night	3268	43.3
<b>Malaria rapid test result</b>		
Positives	2668	59.2
Negative	1835	40.8
Total	4503	
<b>Registered with any health insurance scheme</b>		
Yes, registered	4083	54.1
Not registered	3466	45.9
<b>Mother holds a valid NHIS card</b>		
No valid card/Valid card not seen/Missing	5529	73.2
Valid card seen	2021	26.8

Sick child – child suffered from either diarrhoea, cough or fever over the past two weeks

Table 4.1b: Background and socio-demographic characteristics of children under 5 continued.

<b>Household or environmental factors</b>	Frequency (n=7550)	Percentage (100%)
<i>Household factors</i>		
<i>Sex of household head</i>		
Male	5012	67.8
Female	2376	32.2
Total	7388	
<b>Religion of household head</b>		
Christian	3623	48
Muslim	2376	31.5
Traditional/ Spiritualist	1070	14.2
Other religion/ No Religion	481	6.4
<b>Ethnicity of household head</b>		
Akan	1889	25.0
Ga/Dangme	281	3.7
Ewe	587	7.8
Northern tribes	4572	60.6
Non-Ghanaian/ others	221	2.9
<b>Marital status/ union status</b>		
Currently married	4654	63.5
Formerly married	587	8.0
Never married	2087	28.5
<b>Total</b>	<b>7328</b>	
<b>Sources of drinking water</b>		
Pipe water	2538	34.4
Tube Well, Borehole, Tanker	2308	31.2
River, Spring and other water bodies	946	12.8
Bottled Water, Sachet Water	1596	21.6
Total	7388	
<i>Environmental factors</i>		
<b>Area of residence</b>		
Urban	2117	28.0
Rural	5433	72.0
<b>Geographic zones</b>		
Coastal/ southern Zone	1806	23.9
Middle zone	1624	21.5
Northern zone	4120	54.6
<b>Three northern and non-northern regions</b>		
All but three northern regions	2551	33.8
Three northern regions	4999	66.2

Christian comprise; Catholic, Pentecost, Deeper life, Jehovah witness, SDA and other Christian religions; Northern tribes - Comprise Guan, Gruma, Mole Dagbaani, Grusi and Mande

Table 4.1c: Background and socio-demographic characteristics of children under 5 continued. Maternal, characteristics of children's caregivers

<i>Maternal characteristics</i>	<b>Frequency (n =7550)</b>	<b>Percentage (%)</b>
<b>Maternal factors</b>		
<b>Maternal age (years)</b>		
15-19	1345	18.4
20-24	1122	15.3
25-29	1198	16.3
30-34	1094	14.9
35-39	1013	13.8
40-44	826	11.3
45-49	730	10.0
Total	7328	
<b>Maternal age at child birth</b>		
Less than 20	1400	18.5
20 - 34	5226	69.2
35 - 49	924	12.2
<b>Type of birth</b>		
Single	7254	96.1
Twin	296	3.9
<b>Size of child at birth</b>		
Large	825	43.1
Average	870	45.5
Small	218	11.4
<b>Total</b>	<b>1913</b>	
<b>Birth order</b>		
1	2127	28.2
2 - 3	2973	39.4
4 - 6	1919	25.4
7 +	531	7.0
<b>Maternal education</b>		
None	4081	54.1
Primary	1363	18.1
Middle/JSS	1565	20.7
Secondary +	541	7.2
<b>Wealth index quintile/ Household wealth</b>		
Poorest	3528	46.7
Second	1499	19.9
Middle	1045	13.8
Fourth	836	11.1
Richest	642	8.5

### **4.3 Nutritional status of children**

Out of the total number of children (7550), who took part in the study, 97.2% were included in the stunting analysis. Similarly, 97.9%, 97.8%, 97.1% and 96.6% included in the underweight, wasting, BMI calculation and overweight with concurrency stunting analysis.

About 30% of the Ghanaian children were malnourished. The most prevalent form of malnutrition was stunting (27.5%) followed by underweight, (17.3%) wasting (7.7%) and overweight and obese (2.4%) and the double burden of malnutrition (1.2%). Most of the children under five were mildly stunted, mildly underweight and mildly wasted compared with being moderately or severely stunted, underweight or wasted. The proportions of males mildly stunted was the same as that of females. Comparatively more males were more stunted, underweight, wasted, overweight and anemic compared to females. Details are presented in table 4.2.

Table 4.2: Sex-specific nutritional status of children under 5 according to four anthropometric indices, height for age, weight for age, weight for height and Body Mass Index

Characteristics	Overall n (%)	Male n (%)	Female n (%)
<b>Stunting</b>			
Mildly stunted	2287 (31.1)	1144 (15.6)	1143 (15.6)
Moderately stunted	1355 (18.5)	740 (10.1)	615 (8.4)
Severely stunted	667 (9.1)	380 (5.2)	287 (3.9)
<b>Stunting (below -2 SD)</b>	<b>2022 (27.5)</b>	<b>1120 (15.3)</b>	<b>902 (12.3)</b>
Total	<b>7342</b>		
<b>Underweight</b>			
Mildly underweight	2348 (31.8)	1197 (16.2)	1151 (15.6)
Moderately underweight	973 (13.2)	528 (7.1)	445 (6.0)
Severely underweight	306 (4.1)	186 (2.5)	120 (1.6)
<b>Underweight (below -2SD)</b>	<b>1279 (17.3)</b>	<b>714 (9.7)</b>	<b>565 (7.6)</b>
Total	<b>7395</b>		
<b>Wasting</b>			
Mildly wasted	1547 (21.0)	787 (10.7)	760 (10.3)
Moderately wasted	448 (6.1)	270 (3.7)	178 (2.4)
Severely wasted	118 (1.6)	75 (1.0)	43 (0.6)
High weight for height	144 (2.0)	86 (1.2)	58 (0.8)
<b>Wasting (below -2SD)</b>	<b>566 (7.7)</b>	<b>345 (4.7)</b>	<b>221 (3.0)</b>
Total	<b>7381</b>		
<b>Body Mass Index</b>			
<b>Overweight/obese (&gt; +2SD)</b>	<b>178 (2.4)</b>	<b>103 (1.4)</b>	<b>75 (1.0)</b>
Overweight	130 (1.8)	80 (1.1)	50 (0.7)
Obese	48 (0.7)	23 (0.3)	25 (0.3)
Total	<b>7328</b>		
<b>Concurrency</b>	<b>88 (1.2)</b>	<b>51 (0.7)</b>	<b>37 (0.5)</b>
Total	<b>7293</b>		
<b>Anemia status</b>			
Normal	1535 (34.0)	710 (15.7)	825 (18.3)
Mild anemic	1036 (22.9)	526 (11.6)	510 (11.3)
Moderate anemic	1756 (38.9)	888 (19.7)	868 (19.2)
Severe anemic	190 (4.2)	127 (2.8)	63 (1.4)
<b>Total</b>	<b>4517</b>		

Mildly: z-score -1.00SD to -1.99SD; moderately: z-scores -2.00SD to -2.99SD; severely: z-score less than 3.00SD; overweight: z-score +2.00SD to 2.99SD and obese -z-score greater than 3.00SD. Normal- 11g/dl and above; mild anemia-10g/dl – 10.9g/dl; moderate anemia-7g/dl – 9.9g/dl; severe anemia- less than 7g/dl.

The graph shows the malnutrition burden among under-fives by region. Stunting (black box) was prevalent in the northern regions of Ghana compared to the other regions. Greater Accra recorded highest prevalence of overweight (purple pentagon) being 12.6%. Figure presents other details.

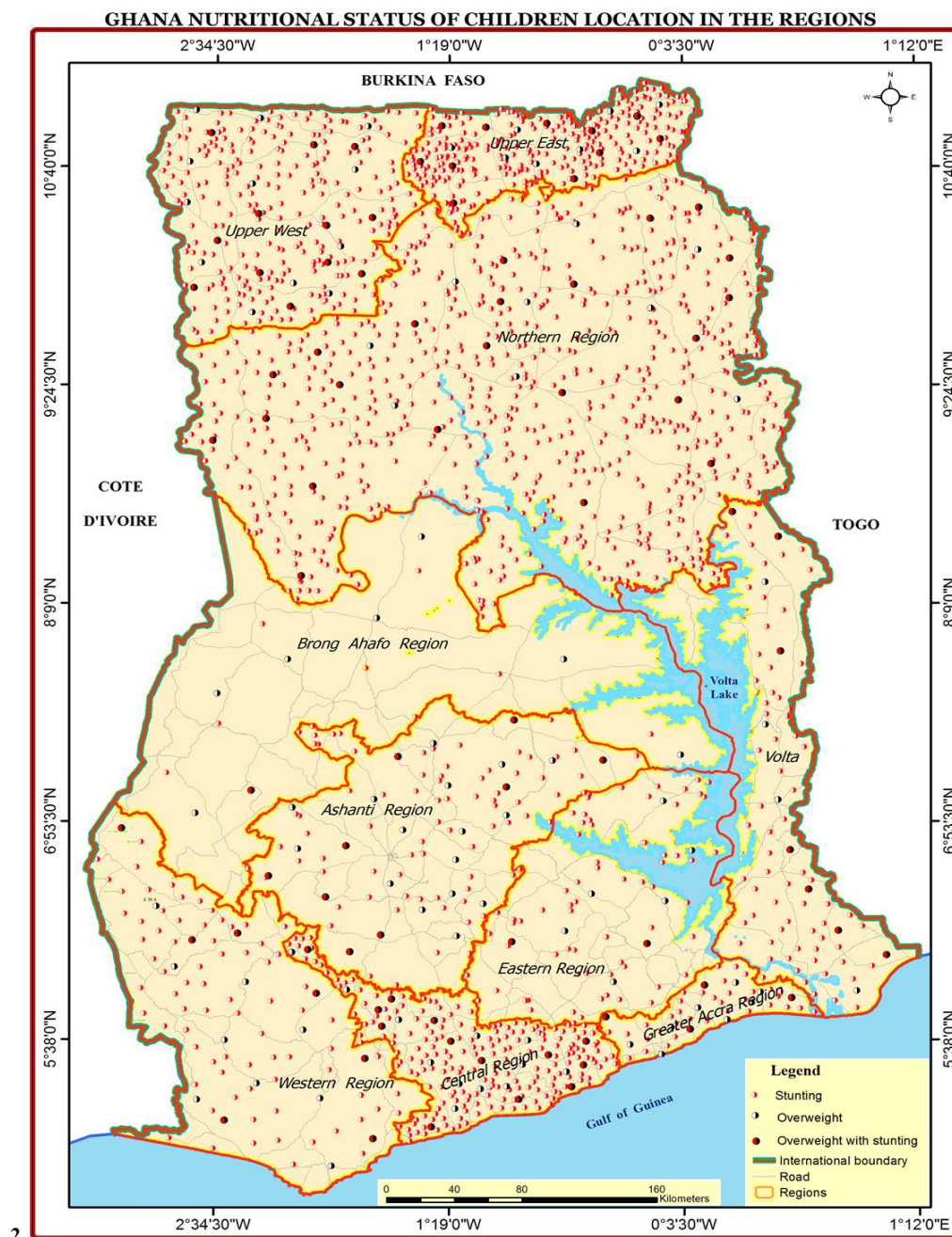
Figure 4.2: Distribution of the burden of malnutrition by region



<sup>1</sup> Percentages for malnutrition distribution cover the entire region. Each region records 5 nutritional statuses. Malnutrition indicators were stunting, wasting, underweight, overweight and overweight with concurrent stunting.

The figure shows the double burden of malnutrition among under-five by region. Each dot represents a malnourished child sampled by region during the Ghana MICS4. The double burden of malnutrition (red and black circles) was prevalent in the three northern regions. Figure 4.2 graphically presents other details

Figure 4.3: Distribution of the Double Burden of Malnutrition by region.



<sup>2</sup> Each dot represents a malnourished child who was sampled for the survey.

#### **4.4 Associations between stunting and selected characteristics.**

There was a statistically significant association between certain child characteristics such as child's ages in months, child's sex, malaria status and anemia status at  $p < 0.001$ . Similarly, religion and ethnicity of the household head, maternal education, wealth index quintile, area of residence, geographical zones, NHIS status among other characteristics were similarly statistically significant ( $p < 0.001$ ).

However, there was no association between child's breastfeeding and vaccination status, maternal age, maternal age at child birth among others ( $P > 0.05$ ), although such explanatory variables were seen to be statistically significant in previous studies. Children who belonged to mothers with no education (25.6%); belonged to the poorest wealth index quintile (22.4%); lived in rural areas (31.4%) and dominantly in the northern zone (25.9%) were relatively stunted. Children whose household heads were predominantly males recorded higher prevalence of stunting (26.9%) compared to they being females (13.2%). Details are shown in Table 4.3a, 4.3b and 4.3c.

Table 4.3a: Associations between stunting and selected characteristics

Characteristics	Outcome n (%)		Chi square	P - value
	Stunted n (%)	Normal n (%)		
<b>Child's characteristics</b>				
<b>Child's age (months)</b>				
0-5	86 (1.7)	551 (10.9)	389.108	< <b>0.001</b>
6-11	100 (2.0)	441 (8.7)		
12-23	442 (8.7)	531 (10.5)		
24-35	492 (9.7)	472 (9.3)		
36-47	496 (9.8)	528 (10.4)		
48-59	406 (8.0)	510 (10.1)		
<b>Sex of the child</b>				
Male	1120 (22.2)	1479 (29.3)	21.330	< <b>0.001</b>
Female	902 (17.8)	1554 (30.7)		
<b>Breastfeeding status</b>				
Child ever been breastfed	2006 (39.7)	3010 (59.5)	3.072	0.215
<b>Child health status</b>				
Child sick	948 (18.8)	1237 (21.3)	18.244	< <b>0.001</b>
Child healthy	1074 (24.5)	1794 (35.5)		
Child given Vitamin A dose	1455 (28.8)	1943 (38.4)	2.122	0.145
Child taken to a health facility during illness	208 (27.8)	374 (49.9)		
<b>Total</b>	278	471		
Child ever received any vaccinations	368 (40.0)	439 (47.8)	2.047	0.359
<b>Total</b>	419	500		
<b>Malaria status</b>				
Persons slept under mosquito net last night	843 (16.7)	1359 (26.9)	4.790	< <b>0.05</b>
<b>Malaria rapid test result</b>				
Positives	860 (28.8)	877 (29.3)	138.531	< <b>0.001</b>
Negative	352 (11.8)	901 (30.1)		
<b>Total</b>	1212	1778		
<b>Anemia status</b>				
Normal	304 (10.1)	731 (24.4)	81.344	< <b>0.001</b>
Anemic	910 (30.4)	1052 (35.1)		
<b>Total</b>	1214 (40.5)	1783 (59.5)		
<b>Sex of household head</b>				
Male	1327 (26.9)	1991 (40.3)	0.001	0.497
Female	650 (13.2)	973 (19.7)		
<b>Religion of household head</b>				
Christian	780 (15.4)	1644 (32.5)	135.998	< <b>0.001</b>
Muslim	726 (14.4)	869 (17.2)		
Traditional/ Spiritualist	379 (7.5)	330 (6.5)		
Other religion/ No Religion	137 (2.7)	190 (3.8)		
<b>Ethnicity of household head</b>				
Akan	410 (8.1)	872 (17.3)	155.747	< <b>0.001</b>
Ga/Dangme	54 (1.1)	154 (3.0)		
Ewe	102 (2.0)	312 (6.2)		
Northern tribes	1409 (27.9)	1595 (31.6)		
Non-Ghanaian/ others	47 (0.9)	100 (2.0)		

Bolded p- value statistical significant at  $p < 0.05$ . Anemia below 10g/dl; normal-11g/dl and above.

Table 4.3b: Associations between stunting and selected characteristics continued.

Characteristics	Outcome n (%)		Chi-square	P - value
	stunted	Normal		
<b>Household factors</b>				
<b>Marital status/ union status</b>				
Currently married	1253 (25.5)	1885 (38.4)	0.280	0.869
Formerly married	146 (3.0)	227 (4.6)		
Never married	569 (11.6)	835 (17.0)		
<b>Sources of drinking water</b>				
Pipe water	667 (13.5)	1010 (20.4)	3.165	0.367
Tube Well, Borehole, Tanker	634 (12.8)	935 (18.9)		
River, Spring and other water bodies	271 (5.5)	366 (7.4)		
Bottled Water, Sachet Water	405 (8.2)	653 (13.2)		
<b>Maternal factors</b>				
<b>Maternal age (years)</b>				
15-19	363 (7.4)	542 (11.0)	4.486	0.611
20-24	319 (6.5)	437 (8.9)		
25-29	323 (6.6)	487 (9.9)		
30-34	289 (5.9)	445 (9.1)		
35-39	252 (5.1)	407 (8.3)		
40-44	230 (4.7)	315 (6.4)		
45-49	192 (3.9)	314 (6.4)		
<b>Maternal age at child birth</b>				
Less than 20	369 (7.3)	558 (11.0)	0.018	0.991
20 – 34	1395 (27.6)	2088 (41.3)		
35 – 49	258 (5.1)	387 (7.7)		
<b>Type of birth</b>				
Single birth	1933 (38.2)	2924 (57.8)	2.103	0.085
Twin	89 (1.8)	109 (2.2)		
<b>Maternal factors</b>				
<b>Size of child at birth</b>				
Large	227 (17.3)	328 (25.0)	1.429	0.489
Average	240 (18.3)	362 (27.6)		
Small	70 (5.3)	85 (6.5)		
<b>Birth order</b>				
1	563 (11.1)	830 (16.4)	2.112	0.550
2 – 3	806 (15.9)	1184 (23.4)		
4 – 6	516 (10.2)	782 (15.5)		
7+	137 (2.70)	237 (4.7)		
<b>Maternal education</b>				
None	1294 (25.6)	1406 (27.8)	184.401	< <b>0.001</b>
Primary	323 (6.4)	564 (11.2)		
Middle/JSS	328 (6.5)	745 (14.7)		
Secondary +	77 (1.5)	318 (6.3)		

Bolded p –value statistical significant at  $p < 0.05$ .

Table 4.3c: Associations between stunting and selected characteristics continued

Characteristics	Outcome n (%)		Chi square	P - value
	Stunted	Normal		
<b>Maternal factors</b>	Stunted	Normal		
<b>Wealth index quintile</b>				
Poorest	1134 (22.4)	1142 (22.6)	284.049	< <b>0.001</b>
Second	425 (8.4)	605 (12.0)		
Middle	261 (5.2)	453 (9.0)		
Fourth	131 (2.6)	431 (8.5)		
Richest	71 (1.4)	402 (8.0)		
<b>Area of residence</b>				
Urban	435 (8.6)	1033(20.4)	92.658	< <b>0.001</b>
Rural	1587 (31.4)	2000 (39.6)		
<b>Geographic zones</b>				
Coastal/southern zone	379 (7.5)	869 (17.2)	190.784	< <b>0.001</b>
Middle zone	333 (6.6)	799 (15.8)		
Northern zone	1310 (25.9)	1365 (27.0)		
<b>Three and non-northern regions</b>				
All but northern regions	535 (10.6)	1251 (24.7)	116.107	< <b>0.001</b>
Northern regions	1487 (29.4)	1782 (35.3)		
<b>Insurance status</b>				
<b>Registered with any health insurance</b>				
Yes registered	1031 (20.4)	1630 (32.2)	3.688	0.055
Not registered	991 (19.6)	1403 (27.8)		
<b>NHIS status</b>				
Insurance card not valid or not seen or missing	1549 (30.6)	2179 (43.1)	14.224	< <b>0.001</b>
Valid card seen	473 (9.4)	854 (16.9)		
<b>Do you hold a valid NHIS card</b>				
Yes, card seen	473 (17.9)	854 (32.3)	28.436	< <b>0.001</b>
Yes card not seen	166 (6.3)	311 (11.8)		
No	389 (14.7)	452 (17.1)		
Total	1028 (38.9)	1617 (61.1)		

Bolded p –value statistical significant at  $p < 0.05$ . NHIS- National Health Insurance Scheme.

#### **4.5 Associations between overweight and selected characteristics**

Children's BMIZ were used for this analysis. Overweight and obese variables were put together and further dichotomised as overweight (0) or not overweight. Data was excluded for children with BMIZ below -5 or above +5. In all, 7328 children were included in the BMI calculation for overweight and obesity. Children diagnosed to be overweight were 178 (2.4%) while, 7150 (97.6%) were not overweight.

Considering the child's characteristics, prevalence of overweight was high for children between 12 – 23 months (0.7%). Sick children had a lower prevalence of overweight compared to healthy children (2.7%). Similarly, the occurrence of overweight among children whose household head's belonged to the northern tribes (1.2%), had mothers between the ages of 25 – 29 years (0.5%) and had primary education (0.6%) were higher compared to the least occurrence in Ga/Adangbe and other tribes (0.1%), mother's between 45 – 49 years (9.7%), and had secondary education (0.2%). Prevalence of overweight was high in Christian (1.3%) households while traditional or spiritualist households showed relatively low prevalence (0.2%). Children who were not overweight were seen to be living in rural areas (70.1%). were mostly not overweight. Details are presented in table 4.4a, 4.4b and 4.4c.

Table 4.4a: Associations of overweight and selected characteristics

	Outcome n (%)		Chi square	P – value
	Overweight	Not -overweight		
<b><i>Child's characteristics</i></b>				
<b>Child's age (months)</b>				
0-5	31 (0.4)	735 (10.0)	25.025	< <b>0.001</b>
6-11	14 (0.2)	687 (9.4)		
12-23	50 (0.7)	1359 (18.5)		
24-35	35 (0.5)	1445 (19.7)		
36-47	27 (0.4)	1521 (20.8)		
48-59	21 (0.3)	1403 (19.1)		
<b>Sex of the child</b>				
Male	103 (1.4)	3635 (49.6)	3.431	0.064
Female	75 (1.0)	3515 (48.0)		
<b>Breastfeeding status</b>				
Child ever been breastfed	174 (2.4)	7092 (96.8)	4.632	0.099
<b>Child health status</b>				
Child sick	67 (0.9)	3140 (42.9)	2.806	0.094
Child healthy	111 (2.7)	4005 (54.1)		
Child given Vitamin A dose	108 (1.5)	4883 (66.6)	4.648	0.098
Child taken to a health facility during illness	13	858	0.085	0.770
Total	16 (1.4)	1097 (98.6)		
Child ever received any vaccinations	27 (2.1)	1107 (85.8)	4.934	0.085
Total	33	1257 (97.4)		
<b>Malaria status</b>				
Persons slept under mosquito net last night	86 (1.2)	3090	1.838	0.175
<b>Malaria rapid test result</b>				
All Positives	57 (1.3)	2562 (57.9)	0.480	0.489
Negative	45 (1.0)	1759 (39.8)		
Total	102 (2.3)	4321 (97.7)		
<b>Anemia status</b>				
Normal	38 (0.9)	1471 (33.2)	0.490	0.484
Anemic	64 (1.4)	2864 (64.5)		
Total	102 (2.3)	4335 (97.7)		
<b><i>Household and maternal factors</i></b>				
<b>Sex of household head</b>				
Male	111 (1.5)	4745 (66.2)	0.826	0.203
Female	61 (0.9)	2252 (31.4)		
<b>Religion of household head</b>				
Christian	94 (1.3)	3420 (46.7)	16.597	< <b>0.05</b>
Muslim	45 (0.6)	2257 (30.8)		
Traditional/ Spiritualist	17 (0.2)	1033 (14.1)		
Other religion/ No Religion	22 (0.3)	440 (6.0)		
<b>Ethnicity of household head</b>				
Akan	59 (0.8)	1775 (24.2)	10.390	< <b>0.05</b>
Ga/Dangme	9 (0.1)	256 (3.5)		
Ewe	17 (0.2)	555 (7.6)		
Northern tribes	88 (1.2)	4362 (59.5)		
Non-Ghanaian/ others	5 (0.1)	202 (2.8)		

Bolded p – value statistical significant at  $p < 0.05$ ; Anemia below 10g/dl; normal-11g/dl and above

Table 4.4b: Associations of overweight and selected characteristics continued.

	Outcome n (%)		Chi square	P – value
	Overweight	Not-overweight		
<b><i>Household and maternal factors</i></b>				
<b>Sex of household head</b>				
Male	111 (1.5)	4745 (66.2)	0.826	0.203
Female	61 (0.9)	2252 (31.4)		
<b>Marital status</b>				
Currently married	102 (1.4)	4418 (62.1)	2.590	0.274
Formerly married	13 (0.2)	554 (7.8)		
Never married	59 (0.8)	1966 (27.6)		
<b>Sources of drinking water</b>				
Pipe water	60 (0.8)	2403 (33.5)	0.205	0.977
Tube Well, Borehole, Tanker	51 (0.7)	2185 (30.5)		
River, Spring and other water bodies	23 (0.3)	898 (12.5)		
Bottled Water, Sachet Water	38 (0.5)	1511 (21.1)		
<b><i>Maternal factors</i></b>				
<b>Maternal age (years)</b>				
15-19	29 (0.4)	1285 (18.1)	6.250	0.396
20-24	27 (0.4)	1063 (14.9)		
25-29	36 (0.5)	1130 (15.9)		
30-34	31 (0.4)	1030 (14.5)		
35-39	24 (0.3)	950 (13.4)		
40-44	13 (0.2)	789 (11.1)		
45-49	14 (0.2)	691 (9.7)		
<b>Maternal age at child birth</b>				
Less than 20	34 (0.5)	1308 (17.8)	0.096	0.953
20 – 34	123 (1.7)	4965 (67.8)		
35 – 49	21 (0.3)	877 (12.0)		
<b>Type of birth</b>				
Single	172 (2.3)	6865 (93.7)	0.172	0.678
Twins	6 (0.1)	285 (3.9)		
<b>Child size at birth</b>				
Large	13 (0.7)	792 (42.3)	4.437	0.109
Average	8 (0.4)	844 (45.1)		
Small	6 (0.3)	209 (11.2)		
<b>Birth order</b>				
1	54 (0.7)	2015 (27.5)	2.512	0.473
2 – 3	74 (1.0)	2808 (38.3)		
4 – 6	36 (0.5)	1818 (24.8)		
7+	14 (0.2)	509 (6.9)		
<b>Maternal education</b>				
None	83 (1.1)	3868 (52.8)	7.009	0.072
Primary	45 (0.6)	1289 (17.6)		
Middle/JSS	36 (0.5)	1489 (20.3)		
Secondary +	14 (0.2)	504 (6.9)		
<b>Wealth index quintile</b>				
Poorest	83 (1.1)	3336 (45.5)	5.968	0.202
Second	38 (0.5)	1430 (19.5)		
Middle	24 (0.3)	992 (13.5)		
Fourth	12 (0.2)	803 (11.0)		
Richest	21 (0.3)	589 (8.0)		

Statistical significance was set at  $p < 0.05$ .

Table 4.4c: Associations of overweight and selected characteristics continued.

	Outcome n (%)		Chi square	P – value
	Overweight	Not-overweight		
<b><i>Environmental factors</i></b>				
<b>Area of residence</b>				
Urban	45 (0.6)	2010 (27.4)	0.690	0.406
Rural	133 (1.8)	5140 (70.1)		
<b>Geographic zones</b>				
Coastal/southern zone	53 (0.7)	1690 (23.1)	12.746	<b>&lt;0.05</b>
Middle zone	51 (0.7)	1528 (20.9)		
Northern zone	74 (1.0)	3932 (53.7)		
<b>Three northern and non-northern regions</b>				
All but northern regions	71 (1.0)	2397 (32.7)	3.148	0.076
Northern regions	107 (1.4)	4753 (64.9)		
<b><i>Insurance status</i></b>				
<b>Registered with any insurance</b>				
Yes, registered	90 (1.2)	3883(53.0)	1.011	0.603
Not registered	88 (1.2)	3266 (44.6)		
<b>NHIS status</b>				
Insurance card not valid or not seen or missing	131 (1.8)	5230 (71.4)	0.018	0.894
Valid card seen	47 (0.6)	1920 (26.2)		
<b>Do you hold a valid NHIS card</b>				
Yes, card seen	47 (1.2)	1920 (48.7)	0.327	0.849
Yes card not seen	16 (0.4)	718 (18.2)		
No	26 (0.7)	1216 (30.8)		
Total	89 (2.3)	3854 (97.7)		

Bolded p –value statistical significant at  $p < 0.05$ . NHIS – National Health Insurance Scheme

#### **4.6 Associations between selected characteristics and overweight with concurrent stunting.**

Children diagnosed to be overweight and concurrently were 88 (1.2%). A chi-square analysis to test the associations between the double burden of malnutrition and selected characteristics showed a statistical significance for breastfeeding status ( $p < 0.05$ ). All other selected variables did not show statistical significance  $p > 0.05$ . The prevalence of the Double Burden of Malnutrition (DBM) was high within children between the ages of 12 – 23 months and 24 – 35 months compared to the other age categories with differences of 0.1%. Children with mothers who were Christians (0.5%) from the northern tribes of Ghana (0.7%), had no maternal education (0.6%) and belonged to the poorest wealth quintile (0.6%), characterised by rural residence (0.9%) showed higher prevalence of this condition. Details are presented in Table 5.5a, 5.5b and 5.5c.

Table 4.5a: Associations of the Double Burden of Malnutrition and selected characteristics.

Child's characteristics	Outcome n (%)		Chi square	P – value
	88 (1.2%)	7205 (98.8%)		
	Concurrent	Non – concurrent		
<b>Child's age (months)</b>				
0-5	8 (0.1)	749 (10.3)		0.128†
6-11	4 (0.1)	689 (9.4)		
12-23	25 (0.3)	1373 (18.8)		
24-35	21 (0.3)	1457 (20.0)		
36-47	18 (0.2)	1528 (21.0)		
48-59	12 (0.2)	1409 (19.3)		
<b>Sex of the child</b>				
Male	51 (0.7)	3667 (50.3)	1.734	0.188
Female	37 (0.5)	3538 (48.5)		
<b>Breastfeeding status</b>				
Child ever been breastfed	85 (1.2)	7147 (98.8)	7.528	0.023
<b>Child health status</b>				
Child sick	36 (0.5)	3158 (43.3)	0.308	0.519
Child healthy	52 (0.7)	4042 (55.5)		
Child given Vitamin A dose	59 (0.8)	4913 (67.4)	0.391	0.822
Child taken to a health facility during illness	6 (0.5)	864 (77.7)	0.231	0.631
Total	7 (0.6)	1105 (99.4)		
Child ever received any vaccinations	16 (1.2)	1118 (86.7)	1.894	0.388
Total	19 (1.5)	1270 (98.5)		
<b>Malaria status</b>				
Persons slept under mosquito net last night	43 (0.6)	3118 (42.8)	1.106	0.293
<b>Malaria rapid test result</b>				
All Positives	31 (0.7)	2578 (58.5)	0.169	0.681
Negative	19 (1.4)	1782 (40.4)		
Total	50 (1.1)	4360 (98.9)		
<b>Anemia status</b>				
Normal	18 (0.4)	1490 (33.7)	0.082	0.774
Anemia	32 (0.7)	2884 (65.2)		
<b>Total</b>	50 (1.1)	4374 (98.9)		

† - P - value from fishers exact test. Normal status of anemia - 11g/dl and above Anemia – below 11g/dl

Table 4.5b: Associations of the DBM and selected characteristics continued

	Outcome n (%)		Chi square	P – value
	88 (1.2%)	7205 (98.8%)		
<i>Household factors</i>	Concurrency	Non – concurrency		
<b>Sex of household head</b>				
Male	57 (0.8)	4775 (66.9)	0.034	0.085
Female	26 (0.4)	2276 (31.9)		
<b>Religion of household head</b>			4.209	0.240
Christian	38 (0.5)	3462 (47.5)		
Muslim	27 (0.4)	2267(31.1)		
Traditional/ Spiritualist	13 (0.2)	1031 (14.1)		
Other religion/ No Religion	10 (0.1)	445 (6.1)		
<b>Ethnicity of household head</b>				0.568†
Akan	27 (0.4)	1800 (24.7)		
Ga/Dangme	3 (0)	262 (3.6)		
Ewe	5 (0.1)	566 (7.8)		
Northern tribes	49 (0.7)	4374 (60.0)		
Non-Ghanaian/ others	4 (0.1)	203 (2.8)		
<b>Marital status</b>			2.007	0.367
Currently married	51 (0.4)	4447 (62.8)		
Formerly married	5 (0.1)	559 (7.9)		
Never married	30 (0.7)	1986 (28.1)		
<b>Sources of drinking water</b>			2.868	0.412
Pipe water	30 (0.4)	2413 (33.8)		
Tube Well, Borehole, Tanker	24 (0.3)	2206 (30.9)		
River, Spring and other water bodies	15 (0.2)	904 (12.7)		
Bottled Water, Sachet Water	14 (0.2)	1528 (21.4)		
<b>Maternal factors</b>				
<b>Maternal age (years)</b>			4.614	0.594
15-19	15 (0.2)	1293 (18.3)		
20-24	10 (0.1)	1075 (15.2)		
25-29	19 (0.3)	1140 (16.1)		
30-34	15 (0.2)	1041 (14.7)		
35-39	13 (0.2)	954 (13.5)		
40-44	9 (0.1)	791 (11.2)		
45-49	5 (0.1)	698 (9.9)		
<b>Maternal age at child birth</b>			0.289	0.865
Less than 20	18 (0.2)	1321 (18.1)		
20 - 34	60 (0.8)	5000 (68.6)		
35 - 49	10 (0.1)	884 (12.1)		
<b>Type of birth</b>			1.860	0.173
Single	82 (1.1)	6920 (94.9)		
Twins	6 (0.1)	285 (3.9)		
<b>Child size at birth</b>				0.412†
Large	5 (0.3)	795 (42.8)		
Average	2 (0.1)	844 (45.4)		
Small	1 (0.2)	1528 (21.4)		
<b>Birth order</b>			1.232	0.743
1	26 (0.4)	2034 (27.9)		
2 - 3	38 (0.5)	2830 (38.8)		
4 - 6	18 (0.2)	1828 (25.1)		
7+	6 (0.1)	513 (7.0)		
<b>Maternal education</b>				0.466†
None	46 (0.6)	3887 (53.3)		
Primary	21 (0.3)	1303 (17.9)		
Middle/JSS	17 (0.2)	1503 (20.6)		
Secondary +	4 (0.1)	512 (7.0)		

† - P –values from fishers exact test.

Table 4.5c: Associations of the dual burden of malnutrition and selected characteristics continued

	Outcome n (%)		Chi square	P – value
	88 (1.2%) Concurrency	7205 (98.8%) Non – concurrency		
<b>Maternal factors</b>				
<b>Wealth index quintile</b>				
Poorest	46 (0.6)	3349 (45.9)		0.377†
Second	17 (0.2)	1446 (19.8)		
Middle	13 (0.2)	1002 (13.7)		
Fourth	4 (0.1)	807 (11.1)		
Richest	8 (0.1)	601 (8.2)		
<b>Environmental factors</b>				
<b>Area of residence</b>				
Urban	20 (0.3)	2030 (27.8)	1.277	0.259
Rural	68 (0.9)	5175 (71.0)		
<b>Region</b>				
<b>Geographic zones</b>				
Coastal/southern zone	24 (0.3)	1711 (23.5)	0.653	0.721
Middle zone	19 (0.3)	1555 (21.3)		
Northern zone	45 (0.6)	3939 (54.0)		
<b>Three northern and non-northern regions</b>				
All but northern regions	33 (0.5)	2427 (33.3)	0.566	0.452
Northern regions	55 (0.8)	4778 (65.5)		
<b>Insurance status</b>				
Registered with any health insurance				
Yes, registered.	47 (1.2)	3913 (53.7)	0.0419	0.980
Not registered	41 (1.2)	3291 (45.1)		
<b>NHIS status</b>				
Insurance card not valid or not seen or missing				
	63 (0.9)	5269 (72.2)	0.105	0.746
Valid card seen				
	25 (0.3)	1936 (26.5)		
<b>Do you hold a valid NHIS card</b>				
Yes, card seen	25 (0.6)	1936 (49.3)	1.072	0.585
Yes card not seen	6 (0.2)	725 (18.4)		
No	16 (0.4)	1222 (31.1)		
Total	47 (1.2)	3883 (98.8)		

† - P – values from fishers exact test

#### 4.7 Predictors of stunting among Ghanaian children.

Outcomes from the simple logistic regression and multiple logistic regression modelling are presented together with their unadjusted and adjusted measures of association. Simple logistic regression was performed for all selected characteristics, while the multiple logistic regression analysis was done for variables that showed significance at  $p < 0.25$ . Few variables though not significant at  $p < 0.25$  were added based on previous models. Details of the variables used in the model are explained section 3.6.2.

At the simple logistic level, female children had a higher odds of being stunted compared to males (OR = 1.305; 95% CI, = 1.165 - 1.461); children with malaria parasitemia were almost 3 times as likely as malaria negatives to be stunted (OR = 2.510; 95% CI, 2.150 – 2.931). However, the prevalence of stunting in children living in the coastal zone is lower than those in the northern zone. Overall children who lived in all but northern regions were protected against stunting (OR = 0.454; 95% CI, 0.394 -0.524).

After adjusting for a number of covariates, girls (aOR) = 1.312; 95% CI, 1.111 – 1.549), aged of 6 – 11 months (aOR = 0.218; 95% CI, 0.150 – 0.316) and 12 -23 months (aOR = 0.153; 95% CI, 0.105 – 0.223) were significantly associated with the odds of stunting. Similarly, mother registered with any health insurance (OR = 1.117; 95% CI, 0.998 – 1.250), was found to be statistically significant with a reduced strength of association (aOR = 0.711; 95% CI, 0.595 – 0.849). From the multiple logistic regression model specified, the age of a child, sex, positive malaria test, anemia status, religion and wealth index quintile, are significant predictors of stunting. Details are presented in Table 4.6. Child health status, area of residence, geographic zones, maternal education among others were not significant predictors of stunting. Detailed model is presented in Appendix 1. The multiple logistic regression was able to explain about 20% of the variability in stunting.

Table 4.6: Significant predictors of stunting among Ghanaian under-fives.

<i>Characteristics</i>	Unadjusted		Adjusted	
	OR	95% CI	aOR	95% CI
<b>Sex of child</b>				
Male	Ref			
Female	1.305***	(1.165 - 1.461)	1.312*	(1.111- 1.549)
<b>Age of child (in months)</b>				
0-5	Ref			
6-11	0.688*	(0.503 - 0.942)		
12-23	0.188***	(0.145 - 0.243)	0.218***	(0.150 - 0.316)
24-35	0.150***	(0.115 - 0.194)	0.153***	(0.105 - 0.223)
36-47	0.166***	(0.128 - 0.215)	0.160***	(0.110 - 0.232)
48-59	0.196***	(0.151 - 0.255)	0.214***	(0.146 - 0.314)
<b>Malaria rapid test result</b>				
All Positives	2.510***	(2.150 - 2.931)	1.314*	(1.069 - 1.614)
Negative	Ref			
<b>Anemia status</b>				
Normal	Ref			
Anemic	0.481***	(0.409 - 0.564)	0.703***	(0.576 - 0.857)
<b>Household characteristics</b>				
<b>Religion of household head</b>				
Christian	Ref			
Muslim	0.568***	0.499 - 0.647	0.883	(0.705 - 1.106)
Traditional/ Spiritualist	0.413***	0.348 - 0.490	0.623*	(0.469 - .827)
Other religion/ No Religion	0.658***	0.520 - 0.833	0.942	(0.676 - 1.313)
<b>Wealth index</b>				
Poorest	Ref			
Second	1.414***	1.218 - 1.640	1.024	(0.804 - 1.304)
Middle	1.723***	1.450 - 2.049	1.163	(0.852 - 1.587)
Fourth	3.267***	2.643 - 4.039	1.902*	(1.320 - 2.742)
Richest	5.622***	4.312 - 7.331	2.244*	(1.413 - 3.565)
<b>Insurance status</b>				
<b>Registered with any health insurance</b>				
Yes, registered	1.117	(0.998 - 1.250)	0.711***	(0.595 - 0.849)
Not registered	Ref			

Statistical significance was set at  $p < 0.05$ . \*\*\* denotes  $p < 0.001$ ; \* denotes  $p < 0.05$ . Ref – reference  
-2 Log likelihood -3290.866a, Cox & Snell R Square - 0.147, Nagelkerke R Square - 0.199. OR mean odds ratio; aOR means adjusted odds ratio.

#### 4.8 Predictors of overweight among Ghanaian under-fives.

Table 4.7 describes regression analysis between overweight and selected characteristics. Outcomes from the two analytic procedures (simple and multiple logistic regression modelling) are presented together with their unadjusted and adjusted measures of association. As done with stunting, a simple logistic regression was performed for all selected characteristics, while the multiple logistic regression analysis was done for variables that showed significance at  $p < 0.25$ . Child's gender, age, maternal educational level, wealth index quintile and geographic zones (refer to details in section 3.6.2), were generated in a single step.

At the simple logistic level, girls had a higher odds to boys of being stunted (OR = 1.328; 95% CI, 0.983 - 1.795). The odds of overweight children living in urban areas was almost 1.2 times higher than living in rural areas. Rural living showed a protective association to overweight (OR = 0.865; 95% CI, 0.615 - 1.218). Children living within the northern zone were 1.6 times more likely to be overweight compared to living in the coastal or middle zones (OR = 1.666; 95% CI, 1.166 - 2.382). The multiple logistic regression model examined the predictors of overweight after adjusting for a number of covariates. Children aged of 36 - 47 months were significantly associated with increased odds of overweight (aOR = 4.093; 95% CI, 0.995 – 16.839). Additionally, children given vitamin A dose over the last 6 months showed a non-significant increased odds of overweight (aOR = 1.838; 95% CI, 0.595 – 2.675). All but northern regions, maternal education level among other factors showed no significant associations during the analysis. Details are presented in Appendix 2. The outcome of the analysis show that child's age, geographic zones, marital status of the mother, and wealth index quintile were significant predictors of overweight. Details are shown in Table 4.7. The model explained only about 17% of the variability of overweight.

Table 4.7: Significant predictors of overweight among Ghanaian under-fives

Characteristics	Unadjusted		Adjusted	
	OR	95% CI	aOR	95% CI
<b>Age of child (in months)</b>				
0-5		Ref		
6-11	2.070*	(1.092 - 3.924)	5.944	(0.680 - 51.989)
12-23	1.146	(0.726 - 1.810)	2.037	(0.625 - 6.633)
24-35	1.741*	(1.065 - 2.847)	1.595	(0.509 - 4.996)
36-47	2.376*	(1.408 - 4.010)	4.093*	(0.995 - 16.839)
48-59	2.818***	(1.608 - 4.938)	3.995	(0.957 - 16.688)
<b>Region</b>				
<b>Geographic zones</b>				
Coastal/southern zone		Ref		
Middle zone	0.940	(0.636 - 1.389)	2.483	(0.595 - 10.356)
Northern zone	1.666*	(1.166 - 2.382)	12.888*	(1.738 - 95.543)
<b>Household factors</b>				
<b>Marital status</b>				
Currently married		Ref		
Formerly married	0.984	(0.549 - 1.764)	0.242*	(0.062 - 0.951)
Never married	0.769	(0.556 - 1.065)	1.877	(0.215 - 16.395)
<b>Wealth index</b>				
Poorest		Ref		
Second	0.936	(0.635 - 1.381)	3.619*	(1.022 - 12.814)
Middle	1.028	(0.649 - 1.629)	4.844*	(1.158 - 20.272)
Fourth	1.665	(0.904 - 3.065)	3.144	(0.740 - 13.367)
Richest	0.698	(0.429 - 1.135)	2.257	(0.419 - 12.165)

Significance,  $p < 0.05$ ; \*\*\* denotes  $p < 0.001$ ; \* denotes  $p < 0.05$ . Ref – reference; -2 Log likelihood - 237.042a, Cox & Snell R Square - 0.024; Nagelkerke R Square - 0.171; OR mean odds ratio; aOR means adjusted odds ratio.

#### 4.9 Predictors of overweight with concurrent stunting among Ghanaian children.

The associations between the double burden of malnutrition and selected characteristics are presented in Table 4.8. As done with stunting and overweight, outcomes from the two analytic procedures (simple and multiple logistic regression modelling) are presented together with their unadjusted and adjusted measures of association.

Simple logistic regression analysis was used to assess the association between the outcome (overweight with concurrent stunting) and selected characteristics. Variables significant at  $p < 0.25$  were modelled and generated in a single step. Covariates included sex of child, age and maternal education (refer to details in data analysis section 3.7.2).

The results of the regression model showed that the odds of concurrent stunting with overweight generally decreases with increasing age of a child. At the simple logistic

level, female children had higher odds than males to be overweight and concurrently stunted (OR = 1.330; 95% CI, 0.869 - 2.036). The odds of this dual burden of malnutrition in rural areas was 0.7 times as likely as urban areas (OR = 0.750; 95% CI, 0.454 - 1.238). Children whose household heads did not belong to any religion had lower odds of the Double Burden of Malnutrition (DBM) compared to Christian, Muslim and Traditionalist or Spiritualist household heads (OR = 0.488; 95% CI, 0.242 - 0.987)

After adjusting for the potential predictors of overweight with concurrent stunting, data showed that females had higher odds of DBM than males (aOR = 1.436; 95% CI, 0.917 – 2.249). Compared to the poorest quintile, children belonging to the fourth index quintile had a significantly increased odds of overweight with concurrent stunting (aOR = 4.311; 95% CI, 1.2.9 – 15.241). Children with mothers aged of 20 -24 years and 25-29 years had a reduced odds of association although there was no significant relationship at the unadjusted level (aOR = 0.385; 95% CI, 0.167 – 0.887 and aOR = 0.379; 95% CI, 0.146 – 0.979). Detailed model is presented in Appendix 3. Significant predictors of overweight with concurrent stunting are maternal age, marital status, religion of household head and wealth index quintile. Details are shown in Table 4.8. The multiple regression table was able to explain only 6% of the degree of variability of the double burden of malnutrition.

Table 4.8: Significant predictors of overweight with concurrent stunting among children.

	OR	Unadjusted CI	aOR	Adjusted CI
<b>Household factors</b>				
<b>Marital status</b>				
Currently married	Ref			
Formerly married	1.282	(0.510 - 3.226)	1.092	(0.430 - 2.777)
Never married	0.759	(0.482 - 1.196)	0.497*	(0.253 - 0.974)
<b>Religion of household head</b>				
Christian		Ref		
Muslim	0.922	(0.561 - 1.514)	0.802	(0.438 - 1.470)
Traditional/ Spiritualist	0.871	(0.462 - 1.640)	0.832	(0.408 - 1.697)
Other religion/ No Religion	0.488*	(0.242 - 0.987)	0.472*	(0.227 - 0.982)
<b>Wealth index</b>				
Poorest		Ref		
Second	1.168	(0.668 - 2.045)	1.602	(0.824 - 3.113)
Middle	1.059	(0.570 - 1.967)	1.393	(0.643 - 3.014)
Fourth	2.771*	(0.995 - 7.720)	4.311*	(1.219 - 15.241)
Richest	1.032	(0.485 - 2.197)	1.275	(0.447 - 3.638)
<b>Maternal factors</b>				
<b>Maternal age (years)</b>				
15-19	Ref			
20-24	1.247	(0.558 - 2.787)	0.878	(0.373 - 2.067)
25-29	0.696	(0.352 - 1.376)	0.385*	(0.167 - 0.887)
30-34	0.805	(0.392 - 1.655)	0.379*	(0.146 - 0.979)
35-39	0.851	(0.403 - 1.798)	0.427	(0.158 - 1.156)
40-44	1.020	(0.444 - 2.341)	0.535	(0.181 - 1.580)
45-49	1.619	(0.586 - 4.475)	0.897	(0.245 - 3.276)

Statistical significance set at  $p < 0.05$ ; \* denotes  $p < 0.05$ . Ref – reference; -2 Log likelihood - 843.604a, Cox & Snell R Square - 0.005; Nagelkerke R Square - 0.046; OR mean odds ratio; aOR means adjusted odds ratio.

## CHAPTER FIVE

### 5.0 DISCUSSION

#### 5.1 Introduction

This chapter discusses the findings of the study under the following key areas; prevalence of overweight with concurrent stunting, individual and contextual determinants of stunting, individual and contextual determinants of overweight and individual and contextual determinants of overweight with concurrent stunting.

#### 5.2 Prevalence of overweight with concurrent stunting

The main objective of the study was to assess the prevalence of overweight with concurrent stunting among children under-five living in Ghana. It must be noted upfront that, the new cut-offs based on the 2006 WHO growth standards, where children with HAZ below -6 or above +6; WAZ below -6 or above +5; WHZ below -5 or above +5 and BMIZ below -5 or above +5 were excluded from certain parts of the analysis (WHO, 2006). This criteria was used in assessing the malnutrition burden among the under-fives. Concurrent stunting and overweight is a manifestation of the Double Burden of Malnutrition (DBM) in individuals. Previous analysis of the Ghana MICS4 data sets and other studies indicated the coexistence of overweight and stunting occurring at the national level (GSS, 2011; Adel et al., 1995). Similarly previous studies had showed DBM coexisted household and individual levels (Rivera, Pedraza, Martorell, Gil, & Double, 2014; Provo, 2013; Urke & Mittelmark, 2014; Said-Mohamed, Alliro, Sobgui, & Pasquet, 2009; Fernald & Neufeld, 2007 and Garrett & Ruel, 2005). Overall, 1.2% of Ghanaian children under five were concurrently overweight and stunted. This value was expected in reference to the number of under-fives who were overweight. This prevalence favorably compares with previous studies, where authors reported the prevalence of overweight with concurrent stunting in

children under five, living in developing countries (Adel et al., 1995; Popkin, Richards, & Montiero, 1996; Corvalán et al., 2007; Fernald & Neufeld, 2007; Birks, 2012 & Urke & Mittelmark, 2014). Current study showed that prevalence of the DBM was relatively higher in children aged 12 - 23 months and 24 – 35 months than the others. Similar, patterns have been observed in Peru, (Urke & Mittelmark, 2014) among Peruvian preschoolers under five using the Peru DHS from 1991–2011; Cameroon, (Said-Mohamed et al., 2009) among preschool children using 169 preschool children of both sexes and Mexico, (Fernald & Neufeld, 2007) among children 24–72 months who lived in impoverished areas.

Popkin et al, 1996, found an association between stunting and overweight in children aged 3 to 9 years in four countries (Russia, Brazil, the Republic of South Africa and China) undergoing, nutrition transitions. According to Kimani-murage et al., (2010), the DBM is evident in societies undergoing nutrition transition especially in LMICs. This compares with Ghana since its declaration of being a middle income country (Duffour, 2011).

From the study, prevalence of overweight with concurrent stunting though not significant was slightly higher in the male children (0.7%), as compared to females (0.5%). Findings disagrees with Masibo & Makoka (2012) in Provo, (2013) that females were most affected by the DBM. In this current study, female children recorded higher odds of the DBM compared to males (aOR = 1.312; 95% CI- 1.111 - 1.549). This lends itself to the assertion that, male children tend to have better health status than females in certain communities (Bain et al., 2013). The prevalence of the DBM could be associated to lower educational levels and socioeconomic status of women, which are determinants of poor nutrition practices in developing countries where children under five are mostly affected (Bain et. al, 2013).

Thus, the DBM can be seen as both a consequence of early-life undernutrition and a cause of later-life non-communicable diseases (NCDs) within populations. Shrimpton & Rokx (2012). Early-life nutrition sets the trajectory for growth and long-term health (Barker, 2004).

### **5.3 Individual and contextual determinants of stunting.**

This study further sought to identify the individual and contextual determinants of stunting among under 5 children in Ghana. The findings of the study suggest that certain individual and contextual factors were significantly associated with stunting among under five children. The factors are discussed.

#### **5.3.1 Individual determinants**

Contributing factors significant at the child level were termed individual determinants. These are child's age, sex, malaria test result, and child's anemia status. In this study, males exhibited higher prevalence of mild, moderate and severe stunting. Stunting was common among males (22.2%) than females (17.8%). This compared with Kofuor, Darteh, Acquah, & Kumi-kyereme, (2014); Adel et al., (1995) and Adair & Guilkey, (1997). A meta-analysis of DHS from 16 sub-Saharan countries conducted by Wamani, Astrøm, Peterson, Tumwine, & Tylleskär, (2007) found that male children were more likely to be stunted in most of the countries studied (10 out of 16). A similar finding was reported in a systematic review conducted by Elena & Luminit, (2007); Olagunju (2011). And Adekanmbi, Kayode, & Uthman, (2013) Walingo & Ekesa, (2013) and Teller & Yimar, (2000), in Wondimagegn, (2014) have reported that biologically, female subjects have an advantage for better health and longer survival because of the role of female sex hormones in modulating lipid levels and increasing immune response. This could be that most of the girls who were sampled for this current study had characteristic which acted as confounders and increased their odds of stunting.

Child's age was likewise found to be a significant determinant. Children aged 6 - 11 months (aOR = 0.218; 95% CI, 0.150 – 0.316)) and 48 – 59 months (aOR = 0.214; 95% CI, 0.146 – 0.314) had the highest strengthened odds of association compared to the other age categories. Afework. et al., in Wondimagegn, (2014) confirmed that the rate of stunting becomes more apparent as children grow older. In contrast, findings of two previous studies conducted by Kabubo-Mariara, Ndenge, & Mwabu, (2009) and Shrimpton et al. (2001), revealed a rapid fall in children's height from birth to 24 months; although stunting processes after 24 months still continue, but at a much slower rate. In the same way, Kofuor et al., (2014) who used the GDHS 2008, reported that children aged 36–47 months had the highest odd of stunting. This could link itself to the assertion that the Ghana MICS4 data was collected three years after the DHS. It has also been shown that children below 3 years are the most vulnerable group to stunting, which may increase risks of being overweight later in life (Mamabolo, et al., 2004; Steyn, et, 2005; Popkin, et al., 1996 and Dietz, 1994).

In addition, child's malaria parasitemia and anemia were reliable determinants of stunting. Malaria positive children recorded attenuated odds ratio while anemic children recorded an increased strength of association after adjusting for a number of covariates. In this current study, prevalence of any anemia (total of mildly, moderately and severely anemia) at the national level was 72.1%. Males were more mildly, moderately and severely anemic compared to the females. This finding compare with GSS, 2011; Ayoya et al., 2013) The Ghana MICS4 reported the prevalence of anemia in children as 57.0%. The difference in the prevalence rates could be as a result of the different data exclusion criteria employed in both analysis. A study conducted by Ayoya et al., (2013) in Fond des Blancs and Villa, Haiti, to assess the prevalence of childhood anemia and its risk factors among children 6–59 months old showed child

anemia was positively associated with stunting. A similar study conducted by Mohamed & Hussein (2015) showed similar results. This previous findings from literature in relation to this current study postulates that anemic children are exposed to stunting compared to the normal (non-anemic) children. Malaria positive children could become anemic owing to the occurrence of frequent infections. Verhoef, West, Veenemans, Beguin, & Kok, (2002), in a study to determine the severity of malaria-associated anemia in African children concluded that nutritional inadequacies causing stunting impair immunity. Increased intake of micronutrients may reduce stunting, nutritional anemia, and malaria-associated anemia.

However, child's breastfeeding status, a significant predictor of stunting was not found to be significant in this study. About 40% of under-fives who had ever been breastfed were stunted. Adair & Guilkey, (1997), reported that breastfed infants had a reduced likelihood of stunting. This contrasts with the findings of this current study. This is because in this study, breastfeeding was not defined as being exclusively breastfed but rather ever been breastfed. A community based cross-sectional survey by Beka et al, showed the importance of appropriate feeding during infancy and childhood. As in Adekanmbi et al., (2013), the findings in this study could be attributed to inadequate breastfeeding or competition for nutritional intake among multiple birth children.

### **5.3.2 Contextual determinants**

The contributing factors significant beyond the child level (child characteristics) are termed as contextual determinants. They are; maternal factors, household factors and community characteristics. Religion of household head and wealth index quintile were found to be significantly associated with stunting. Mothers between 15 -19 years had children recording the highest prevalence of stunting (7.4%). This contrasts with the findings of Kofuor et al., (2014), who used the 2008 GDHS that, children whose

mothers were aged 35–44 years were more likely to be stunted. This contrast could be attributed to the changing Ghanaian population.

Mothers with no education had children recording 25.6% of stunting, while secondary educated mothers recorded (1.5%). Generally, primary education (aOR = 0.969; 95% CI, 0.761 – 1.235), had lower odds to stunting than JSS education (aOR = 1.045; 95% CI, 0.811 – 1.347 and secondary education and above (aOR = 1.364; 95% CI, 0.904 – 2.059). Children with secondary or higher educated mothers had higher odds of stunting compared to the other categories. The findings of this study contrast those of other studies, which indicated that maternal education had positive effect on childhood stunting (Hong et al. 2006; Odunayo & Oyewole 2006; Pongou et al. 2006; Wamani et al. 2006; Ijarotimi & Ijadunola 2007; VandePoel et al. 2007; Semba et al. 2008; El Taguri et al. 2009; Kabubo-Mariara et al. 2009; Monteiro et al. 2009). This means, educated mothers who may find themselves in poor households due to no fault of theirs could increase the likelihood of stunting.

Similarly, children belonging to the poorest wealth index quintile, had 22.4% prevalence of stunting. Children within the richest wealth index quintile had higher odds of stunting compared to the poorest quintile (aOR = 2.244; 95% CI, 1.413 – 3.655). This does not assert that, under-fives from less wealthy households have greater odds of being stunted compared to under-fives from wealthy households. (Hong et al. 2006; Odunayo & Oyewole 2006; Pongou et al. 2006; Van de Poel et al. 2007; Hien & Kam 2008; Semba et al. 2008; Kabubo-Mariara et al. 2009 in Masibo, 2013; Monteiro et al. 2009; Ramli et al. 2009; Tiwari, Ausman, & Agho, 2014; Kofuor et al., 2014). This implies that, although most wealthy households can afford all types of foods, most households are unable to feed their children with adequate and quality complementary foods due to the limited time caregivers give to their children. Socioeconomic status of

a household accompanying nutrition education are important determinant regarding the availability and consumption of appropriate meals, for the growth and development of children.

Area of residence, although not statistically significant in this study, revealed that 31.4% of children living in rural areas were stunted against children living in the urban areas (8.6%). The odds of living in a rural to an urban area almost showed no association (aOR = 1.033; 95% CI, 0.513 – 1.312) with a slightly higher odds of association. The Ghana Demographic and Health Survey conducted in 2008 slightly concurs that the level of stunting was higher in the rural areas (32%) than in the urban areas (21%). This further asserts that, in communities where short stature is the norm of the day, stunting is likely to go unrecognized. (Onis, Blo, & Borghi, 2011). Similarly, stunted children who lived in the northern regions (29.4%) were more than those living in the all but northern regions (10.6%). Children in the northern regions had an increased strength of association to stunting (aOR = 0.996; 95% CI, 0.722 – 1.345). There was no association between stunting and living in all other regions. This finding contrast the Demographic Health Survey in 2008 which reported that children in the northern areas of Ghana, appeared to be stunted while children in the southern areas appeared to be overweight. Multiple births in this current study were protective to stunting. This contradicts the findings of Bhandari & Chhetri, (2011), Hong et al. (2006) and Kabubo-Mariara et al. (2009), which found that children of multiple births are more likely to be stunted than those of single births.

#### **5.4 Individual and contextual determinants of overweight.**

The third objective of the study was to determine the individual and contextual determinants associated with overweight. Characteristics associated at the child level

and beyond were similarly assessed to achieve the objective. Determinants are hereby discussed under individual determinants and contextual determinants.

#### **5.4.1 Individual determinants**

Prevalence rate of overweight in Ghanaian under-fives was 2.4%. Prevalence rate in males was 1.4% and that of females 1.0%. Females are were almost 2 times as likely as males to be overweight. Similar finding was reported in Gonzalez-Casanova et al., (2014). Females have a lower prevalence compared to males but have higher odds of stunting than males. This finding relates with studies conducted by Müller et al., (2014), among urban Brazil under-fives and Muhihi et al., (2013), among primary school children in Tanzania. The latter reported girls had a prevalent overweight of 6.3% while boys was 3.8%. Girls had a higher odds of overweight than boys (aOR = 2.6; 95% CI, 1.4 – 4.9). Similar findings were reported by Guedes, Rocha, Silva, Carvalhal, & Coelho, (2011) where study was conducted among Brazilian children from a developing region; Jesus et al., (2010) among children under 4 years in Brazil and Kruger, Kruger, & Macintyre, (2006) among 10- 15year-old schoolchildren in South Africa. Despite the similar findings, by Müller et al., (2014), it was conducted among the urban children while this study made use of rural and urban children. Similarly, all studies mentioned above were conducted using primary data collected from children but this current study used secondary data from a nationally representative data of under-fives.

Rate of overweight peaked among children 12 - 23 months (0.7%). After adjusting for confounders, children aged 36 – 47 months were significantly associated. The highest odds of overweight children were between 6 – 11 months (OR = 5.94). Findings of overweight were in contrast with study by Irigoyen, Glassman, Chen, & Findley, (2008), among low-income 1- 5-year olds in New York City, which associated

increasing age increases with rate of overweight. The different settings employed for the different studies could also be a factor.

At the bivariate level, children who had ever been breastfed and were overweight were universal (2.4%). Child's breastfeeding status which was only significant at the simple logistic level was excluded from the analysis by the statistical software. Breastfed infants were 3 times as likely as non-breastfed infants to be overweight. The findings are contrary to Moschonis, Grammatikaki, & Manios, (2008), where exclusively breastfed children at 6 months and at 12 months were 0.5 times less likely to be overweight. Unlike Al-Qaoud & Prakash, (2009), no significant association was reported between overweight and breastfeeding. Given that all children who were ever breastfed were equally overweight, this could be attributed to the definition of breastfeeding as used in the analysis. Breastfeeding was defined as children who were ever breastfed but not exclusively breastfed.

#### **5.4.2 Contextual determinants**

Multiple regression model with all potential predictors put together in a model showed geographic zones, marital status and wealth index quintile to be significantly associated. Religion, ethnicity, maternal age and maternal education maternal age and area of residence were not statistically significant. Overall urban children recorded 0.6% prevalence of overweight while rural children recorded 1.8%. Rural children were protected against overweight (OR = 0.865; 95% CI, 0.615 – 1.218). This finding contrasted with the assertion that, most overweight children resided in urban areas (Muhihi et al., 2013). The current study compared with that same study, conducted among school age children in Tanzania, urban children reported a significant higher odds of overweight to rural children (OR = 2.5; 95% CI, 1.2 – 5.3). Findings from Müller et al., (2014) and Kruger et al., (2006) also contrasted with the current study's

findings. Rural children were protective to overweight, because they are perceived not to be exposed to obesogenic environments but rather adhere to traditional and cultural food and other habits.

Children living in the northern zones were 13 times as likely as living in the coastal zones to be overweight. After controlling for confounders, with coastal zones as reference, northern zones reported an increased strength of association. This supports the GDHS, 2008 which reported malnutrition to be associated to the northern areas. This could be due to the fact that, although children living in these northern areas may not be exposed to rapidly developing areas, sociocultural barriers could be major hindrances to their healthy nutritional status.

The results of this study also indicate that children whose mothers had no form of education recorded (1.1%), following up was primary educated mothers (0.6%), then middle or JSS educated mothers (0.5%) with the least being secondary educated and beyond mothers (0.2%). Although not statistically significant, children with secondary or higher educated mothers had higher odds of overweight to the primary, middle or JSS and uneducated mothers. The high frequency of uneducated mothers confirms with Bain et al., (2013) which reported that inadequate or poorly educated mothers tend to have disadvantaged children, especially when healthy practices like breastfeeding and child healthy foods are concerned. The study further reported that low levels of education especially in women are key perpetuators of poor nutrition practices.

From the results, almost half (46.7%) of the sampled children were living in the poorest wealth quintile with their mothers or primary care givers. The highest prevalence of overweight was found among those who lived in the poorest wealth quintile (1.1%). Children belonging to women living in the second quintile (aOR = 3.619; 95% CI, 1.022

– 12.814) and middle quintile (aOR = 4.844; 95% CI, 1.158 – 20.272) showed significant increased strengths of association. This finding concedes with a study which found that wealth index was positively associated with BMI (Neuman, Kawachi, Gortmaker, & Subramanian, 2013).

### **5.5 Individual and contextual determinants of overweight with concurrent stunting.**

The co-existence of overweight and stunting at the country level is what determines the presence of double burden at the household and individual levels. (Rivera et al., 2014). Although the determinants of the double burden of malnutrition have been reported in Ghana (at the national level). There is no exact establishment if the factors are consistent over time, considering the rapidly changing economic and socio-demographic characteristics of Ghanaian children, which are being influenced by technological advances and rural-urban migration, among other factors (Masibo, 2013). None of the variables assessed from the Ghana MICS4 data sets were significantly associated with the double burden of malnutrition. Owing this this, a multiple logistic regression model developed for variables significant at  $p < 0.25$  showed a significant relationship with maternal age, never married women and women belonging to either no religion or other religions (as explained in 3.6.2 in the results section).

#### **5.5.1 Individual determinants**

Child's age and sex although not significant in this study but in literature were hereby discussed. Previous studies have reported that the sex of a child is a significant determinant of DBM. This study revealed that female children were 1.4 times as likely as males to be overweight and concurrently stunted (aOR = 1.44; 95% CI, 0.917 – 2.249). This supports the statement by the Food and Agricultural Organization (FAO), that women and girls are more vulnerable and likely to die of malnutrition than men

and boys. Social and economic inequalities between men and women often stand in the way of good nutrition (FAO, 2013).

Children between 12 – 23 months and 24 – 35 months recorded the highest prevalence of DBM with children below one year recording the least (0.1%). In general, there was a non-significant reduction in the odds as ages in months increased. Children aged 6 – 11 months had higher odds of the DBM compared to those above one year. This slightly concedes with Kroker-lobos, Pedroza-tob, Pedraza, & Rivera, (2014), whose study reported the prevalence of the DBM between 5 – 11 year olds.

### **5.5.2 Contextual determinants**

The significantly associated factors are maternal age, wealth index quintile, never married women and women belonging to either no religion or other religions. Key determinants associated with previous studies are; area of residence and geographic zones.

Generally maternal ages were protective to the DBM. Children belonging to mothers between 25 – 29 and 30 – 34 years were 0.3 times as likely as 15 – 19 years to be overweight and concurrently stunted. With the exception of mothers between 20 – 24 years (aOR = 0.878; 95% CI, 0.373 – 2.067), odds of DBM increased as maternal age increased. Therefore increasing maternal age exposes under-fives to the double burden of malnutrition. Similarly, Said-Mohamed et al., (2009), study among Cameroon preschool children, indicated stunted and overweight children lived with both parents and had an older mother. In contrast to above mentioned studies, Fernald & Neufeld, (2007), indicated that a lower maternal age showed an association to the DBM. This confirms the study's findings that children with mothers between 20 – 24 years were 0.8 times as likely as having 15 – 19 year olds mothers to be overweight and

concurrently stunted. This could imply that nutrients needed by adolescent mothers, for optimum growth and development are been competed for especially during pregnancy and lactation. This competition for nutrients especially iron could predispose the adolescent mother to micronutrient deficiency. This micronutrient deficiency affects uterine development and further result in the birth of a low weight baby who may be predisposed to chronic illness and may eventually lead to the onset of DBM. Additionally, Adair et al, (2013) indicated that, “LBW infants tend to have greater adult lean mass and human capital when they experience rapid weight gains still in the first one thousand days of life.” The same study associated weight gains in later life to adverse cardiovascular consequences.

There was an increased strength of associations after controlling for confounders. With a child living within the poorest WI as reference, children second, middle, fourth and richest WI showed an exposed odds to DBM. Overweight with concurrent stunting was significantly associated with the fourth index quintile (aOR = 4.311; 95% CI, 1.219 – 15.241). This study agreed with Fernald & Neufeld, (2007)’s conclusion that children living in lower SES were more exposed to the occurrence of DBM but disagreed that overweight with concurrent stunting occurs more frequently among children from poorer households and/or poorer communities (Fotso & kuatedefo, 2005). Differences in previous studies could attributed to their study populations and how representative their sample was.

Rural children (0.3%) were more concurrently stunted and overweight compared to urban children (0.9%). Rural living showed a protective association (OR = 0.750; 95% CI, 0.454 – 1.238) to DBM. The study findings agrees with Oddo et al., (2012) who conducted a study in rural Indonesia and Bangladesh which concluded that DBM is

not exclusive to urban areas, therefore future policies and interventions should address DBM in both rural and urban developing country settings.

## **5.6 Study strength and weakness**

### **5.6.1 Strengths**

The major strength of this analysis is the analytic method used. The Ghana MICS stopped at the univariate level but this study went beyond that and conducted bivariate and logistic regression analysis to determine associations and predictors.

Another strength is the ability to generalize findings to the Ghanaian children under five population. .

The use of a high quality nationally representative data (MICS) to investigate the relationships between the variables assessed (child characteristics, maternal factors, household factors, environmental factors and insurance status) and the study outcomes (stunting, overweight and the double burden of malnutrition) also gives merit and value to the study.

### **5.6.2 Limitations**

An important limitation of this study is that strong conclusions could not be cannot be drawn with respect to the causes of stunting, overweight and DBM. This is because the nationally representative survey MICS4 (GSS, 2011) did not assess certain key variables that could assess the specific and detailed nutritional status of the under-five children.

The data sets could not give details of household sanitation, specific infant and young feeding practices. These unmeasured factors undoubtedly influence children health

## CHAPTER SIX

### 6.0 CONCLUSIONS AND RECOMMENDATIONS

#### 6.1 Introduction

This chapter summarizes and concludes on the study findings. In addition, it gives recommendations to health care providers, and primary care givers. The conclusions and recommendations are presented in conjunction with the study's key findings.

#### 6.2 Conclusions

This study found the prevalence of DBM to be occurring at 1.2% within the under-fives. Children aged 6 – 11 months had higher odds of the DBM (aOR = 1.325; 0.917 – 2.249) of this condition. Girls were more likely than boys to be overweight and concurrently stunted.

This study concludes that, a child's age, sex, malaria status, anemia status are the individual determinants of stunting. The contextual determinants are; maternal religion, ethnicity, wealth index quintile and having a mother registered with any health insurance.

Similarly this study also concludes that, child's age is the individual determinant while geographic zones, marital status, and wealth index quintile are the contextual determinants of overweight.

Four variables were significantly associated after controlling for confounders. This study therefore concludes that, only contextual factors as marital status, religion, maternal age and wealth index quintile can determine the DBM among children under five.

In general, this study revealed that both individual and contextual level factors are significant determinants of childhood DBM in Ghana.

### **6.3 Recommendations**

Given that both spectrums of malnutrition (undernutrition and overnutrition) have been shown by this analysis to be problems among Ghanaian children, nutrition policy and programming recognizing childhood overnutrition as an important public health problem is warranted.

It would be useful to both policy makers and practitioners if the two nutrition-relevant nationally representative surveys (the DHS and the MICS) report the prevalence stunting with concurrent overweight among Ghanaian children. At present, these surveys report only the double burden of malnutrition at the national and regional levels but not within individuals.

This study further recommends that health workers who come into contact with caregivers of Ghanaian children should educate mothers and primary care givers on the portion sizes of foods, frequency and timing of meals given to children. Also pre-school authorities should focus on giving these children, balanced diets during their lunch breaks. Foods should be incorporated from the three major foods groups (energy-giving, body-building and protective foods).

Community based qualitative research may be required to appreciate what accounts for the high prevalence of stunting and the dual burden of malnutrition in worst affected regions such as the three northern regions (for stunting), and the Ashanti region (for concurrent stunting and overweight).

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## APPENDICES

## APPENDIX 1: Predictors of stunting among Ghanaian children under-five

Table 4.6a: Predictors of stunting among Ghanaian under-fives

<i>Characteristics</i>	Unadjusted		Adjusted	
	OR <sub>1</sub>	95% CI	OR <sub>2</sub>	95% CI
<b>Sex of child</b>				
Male	Ref			
Female	1.305***	(1.165 - 1.461)	1.312*	(1.111 - 1.549)
<b>Age of child (in months)</b>				
0-5	Ref			
6-11	0.688*	(0.503 - 0.942)		
12-23	0.188***	(0.145 - 0.243)	0.218***	(0.150 - 0.316)
24-35	0.150***	(0.115 - 0.194)	0.153***	(0.105 - 0.223)
36-47	0.166***	(0.128 - 0.215)	0.160***	(0.110 - 0.232)
48-59	0.196***	(0.151 - 0.255)	0.214***	(0.146 - 0.314)
<b>Breastfeeding status</b>				
Child ever been breastfed	0.913	(0.469 - 1.779)		
No	Ref			
<b>Child health status</b>				
Child healthy	1.280***	(1.143 - 1.434)	1.070	(0.903 - 1.268)
Child unhealthy	Ref			
Child given Vitamin A dose given	0.682***	(0.602 - 0.773)	0.888	(0.730 - 1.080)
No	Ref			
Child taken to a health facility during illness	1.298	(0.913 - 1.843)		
No	Ref			
Child ever received any vaccinations	0.845	(0.533 - 1.339)		
No	Ref			
<b>Malaria status</b>				
Persons slept under mosquito net last night	0.881*	(0.786 - 0.987)		
No	Ref			
<b>Malaria rapid test result</b>				
All Positives	2.510***	(2.150 - 2.931)	1.314*	(1.069 - 1.614)
Negative	Ref			
<b>Anemia status</b>				
Normal	Ref			
Anemic	0.481***	(0.409 - 0.564)	0.703***	(0.576 - 0.857)
<b>Household factors</b>				
<b>Sex of household head</b>				
Male	Ref			
Female	0.998	(0.884 - 1.126)		
<b>Marital status</b>				
Currently married	Ref			
Formerly married	1.034	(0.830 - 1.288)	1.124	(0.811 - 1.558)
Never married	0.975	(0.858 - 1.109)	0.960	(0.721 - 1.277)
<b>Ethnicity of household head</b>				
Akan		Ref		
Ga/Dangme	1.341	0.963 - 1.868		
Ewe	1.438*	1.117 - 1.851		
Northern tribes	0.532***	0.464 - 0.611		
Non-Ghanaian/ others	1.000	0.694 - 1.442		

- Shaded portions were excluded from the analysis. Significance at  $p < 0.05$ ; \*\*\* denotes  $P < 0.001$ ; \* denotes  $P < 0.05$ . Ref means reference; -2 Log likelihood -3290.866a - Cox & Snell R Square - 0.147, Nagelkerke R Square - 0.199. OR means odds ratio; aOR means adjusted odds ratio.

Table 4.6b: Predictors of stunting among Ghanaian under-fives continued.

Characteristics	Unadjusted		Adjusted	
	OR	95% CI	aOR	95% CI
<b>Religion of household head</b>				
Christian		Ref		
Muslim	0.568***	0.499 - 0.647	0.883	(0.705 - 1.106)
Traditional/ Spiritualist	0.413***	0.348 - 0.490	0.623*	(0.469 - .827)
Other religion/ No Religion	0.658***	0.520 - 0.833	0.942	(0.676 - 1.313)
<b>Wealth index</b>				
Poorest		Ref		
Second	1.414***	1.218 - 1.640	1.024	(0.804 - 1.304)
Middle	1.723***	1.450 - 2.049	1.163	(0.852 - 1.587)
Fourth	3.267***	2.643 - 4.039	1.902*	(1.320 - 2.742)
Richest	5.622***	4.312 - 7.331	2.244*	(1.413 - 3.565)
<b>Sources of drinking water</b>				
Pipe water		Ref		
Tube Well - Borehole - Tanker	0.974	(0.846 - 1.121)	0.988	(0.801 - 1.219)
River - Spring and other water bodies	0.892	(0.741 - 1.073)	0.941	(0.716 - 1.237)
Bottled Water - Sachet Water	1.065	(0.909 - 1.247)	0.940	(0.747 - 1.183)
<b>Maternal factors</b>				
<b>Maternal age (years)</b>				
15-19		Ref		
(20-24	0.917	(0.754 - 1.116)	1.022	(0.750 - 1.392)
25-29	1.010	(0.832 - 1.225)	1.191	(0.838 - 1.692)
30-34	1.031	(0.845 - 1.258)	1.071	(0.730 - 1.570)
35-39	1.082	(0.880 - 1.329)	1.342	(0.908 - 1.984)
40-44	0.917	(0.739 - 1.138)	1.119	(0.747 - 1.675)
45-49	1.095	(0.876 - 1.369)	0.953	(0.628 - 1.446)
<b>Maternal age at child birth</b>				
Less than 20		Ref		
20 - 34	0.990	(0.854 - 1.148)	0.935	(0.754 - 1.160)
35 - 49	0.992	(0.808 - 1.218)	0.955	(0.707 - 1.291)
<b>Type of birth</b>				
Single	1.235	(0.928 - 1.644)	1.013	(0.654 - 1.570)
Twins		Ref		
<b>Child size at birth</b>				
Large	1.190	(0.831 - 1.703)		
Average	1.242	(0.870 - 1.773)		
Small		Ref		
<b>Birth order</b>				
1	0.852	(0.673 - 1.079)		
2 - 3	0.849	(0.676 - 1.067)		
4 - 6	0.876	(0.691 - 1.111)		
7+		Ref		
<b>Maternal education</b>				
None		Ref		
Primary	1.607***	(1.375 - 1.879)	0.969	(0.761 - 1.235)
Middle/JSS	2.090***	(1.799 - 2.429)	1.045	(0.811 - 1.347)
Secondary +	3.801***	(2.930 - 4.930)	1.364	(0.904 - 2.059)

■ - Shaded portions were excluded from the analysis. Significance at  $p < 0.05$ ; \*\*\* denotes  $P < 0.001$ ; \* denotes  $P < 0.05$ . Ref means reference; -2 Log likelihood -3290.866a - Cox & Snell R Square - 0.147, Nagelkerke R Square - 0.199. OR means odds ratio; aOR means adjusted odds ratio. CI means confidence interval

Table 4.6c: Predictors of stunting among Ghanaian under-fives continued.

	Unadjusted OR	95% CI	Adjusted aOR	95% CI
<b>Community characteristic</b>				
Area of residence				
Urban		Ref		
Rural	0.531***	0.466 - 0.604	1.033	(0.813 - 1.312)
<b>Geographic zones</b>				
Coastal/southern zone				
Middle zone	1.046	0.878 - 1.248	1.096	(0.824 - 1.459)
Northern zone	0.454***	0.394 - 0.524	0.741	(0.483 - 1.136)
<b>Three northern and non-northern regions</b>				
All but northern regions				
Northern regions	0.512***	0.453 - 0.579	0.996	(0.722 - 1.375)
<b>Insurance status</b>				
<b>Registered with any health insurance</b>				
Yes - registered	1.117	(0.998 - 1.250)	0.711***	(0.595 - 0.849)
Not registered	Ref			
<b>NHIS status</b>				
Card not valid or not seen or missing	Ref			
Valid card seen	1.283***	(1.127 - 1.461)		
<b>Do you hold a valid NHIS card</b>				
Yes - card seen	1.554***	1.303 - 1.853		
Yes card not seen	1.612***	1.278 - 2.034		
No	Ref			

Shaded portions were excluded from the analysis. Significance at  $p < 0.05$ ; \*\*\* denotes  $P < 0.001$ ; \* denotes  $P < 0.05$ . Ref means reference; -2 Log likelihood - 3290.866a - Cox & Snell R Square - 0.147, Nagelkerke R Square - 0.199. OR means odds ratio; aOR means adjusted odds ratio. CI means confidence interval

**APPENDIX 2: Predictors of overweight**

Table 4.7a: Predictors of overweight among Ghanaian under-fives.

Characteristics	Unadjusted		Adjusted	
	OR	95% CI	aOR	95% CI
<b>Sex of child</b>				
Male		Ref		
Female	1.328	(0.983 - 1.795)	1.825	(0.784 - 4.250)
<b>Age of child (in months)</b>				
0-5		Ref		
6-11	2.070*	(1.092 - 3.924)	5.944	(0.680 - 51.989)
12-23	1.146	(0.726 - 1.810)	2.037	(0.625 - 6.633)
24-35	1.741*	(1.065 - 2.847)	1.595	(0.509 - 4.996)
36-47	2.376*	(1.408 - 4.010)	4.093*	(0.995 - 16.839)
48-59	2.818***	(1.608 - 4.938)	3.995	(0.957 - 16.688)
<b>Breastfeeding status</b>				
Child ever been breastfed	2.911*	(1.044 - 8.118)		
No	Ref			
<b>Child health status</b>				
Child healthy	0.770	(0.566 - 1.046)	1.245	(0.545 - 2.848)
Child unhealthy	Ref			
Child given Vitamin A dose	1.399*	(1.026 - 1.908)	1.838	(0.595 - 5.675)
No	Ref			
Child taken to a health facility during illness	0.828	(0.234 - 2.931)		
No	Ref			
Child ever received any vaccinations	2.343	(0.946 - 5.803)		
No	Ref			
<b>Malaria status</b>				
Person slept under mosquito net last night	1.228	(0.912 - 1.654)	1.607	(0.679 - 3.802)
No	Ref			
<b>Malaria rapid test result</b>				
Positives	0.870	(0.586 - 1.292)		
Negative	Ref			
<b>Anemia status</b>				
Normal	Ref			
Anemia	1.156	(0.770 - 1.735)		
<b>Household factors</b>				
<b>Sex of household head</b>				
Male	Ref			
Female	0.864	(0.629 - 1.185)		
<b>Marital status</b>				
Currently married	Ref			
Formerly married	0.984	(0.549 - 1.764)	0.242*	(0.062 - 0.951)
Never married	0.769	(0.556 - 1.065)	1.877	(0.215 - 16.395)
<b>Religion of household head</b>				
Christian		Ref		
Muslim	1.379	(0.963 - 1.974)	2.085	(0.641 - 6.784)
Traditional/ Spiritualist	1.670*	(0.992 - 2.813)	2.896	(0.601 - 13.952)
Other religion/ No Religion	0.550*	(0.342 - 0.884)	2.941	(0.371 - 23.325)

Shaded portions were excluded from the analysis. Significance -  $p < 0.05$ ; -2 Log likelihood - 237.042a, Cox & Snell R Square - 0.024; Nagelkerke R Square - 0.171. \*\*\* denotes  $P < 0.001$ ; \* denotes  $P < 0.05$ ; OR means odds ratio; aOR means adjusted odds ratio. CI means confidence interval

Table 4.7b: Predictors of overweight among Ghanaian under-fives continued.

	Unadjusted		Adjusted	
	OR	95% CI	aOR	95% CI
<b>Ethnicity of household head</b>				
Akan		Ref		
Ga/Dangme	0.945	(0.463 - 1.930)		
Ewe	1.085	(0.627 - 1.877)		
Northern tribes	1.648**	(1.179 - 2.302)		
Non-Ghanaian/ others	1.343	(0.533 - 3.385)		
<b>Wealth index</b>				
Poorest		Ref		
Second	0.936	(0.635 - 1.381)	3.619*	(1.022 - 12.814)
Middle	1.028	(0.649 - 1.629)	4.844*	(1.158 - 20.272)
Fourth	1.665	(0.904 - 3.065)	3.144	(0.740 - 13.367)
Richest	0.698	(0.429 - 1.135)	2.257	(0.419 - 12.165)
<b>Sources of drinking water</b>				
Pipe water		Ref		
Tube Well, Borehole, Tanker	1.070	(0.733 - 1.561)		
River, Spring and other water bodies	0.975	(0.599 - 1.586)		
Bottled Water, Sachet Water	0.993	(0.658 - 1.498)		
<b>Maternal factors</b>				
<b>Maternal age (years)</b>				
15-19		Ref		
20-24	0.889	(0.523 - 1.510)	1.337	(0.224 - 7.985)
25-29	0.708	(0.432 - 1.163)	1.325	(0.238 - 7.380)
30-34	0.750	(0.449 - 1.252)	1.293	(0.219 - 7.627)
35-39	0.893	(0.517 - 1.544)	2.229	(0.318 - 15.620)
40-44	1.370	(0.708 - 2.651)	4.362	(0.322 - 59.080)
45-49	1.114	(0.585 - 2.122)	1.257	(0.094 - 16.895)
<b>Maternal age at child birth</b>				
Less than 20		Ref		
20 - 34	1.049	(0.714 - 1.541)		
35 - 49	1.086	(0.625 - 1.883)		
<b>Type of birth</b>				
Single	0.840	(0.369 - 1.913)		
Twins		Ref		
<b>Child size at birth</b>				
Large	1.749	(0.657 - 4.657)	1.964	(0.778 - 4.955)
Average	3.029*	(1.040 - 8.823)	0.569	(0.203 - 1.590)
Small		Ref		
<b>Birth order</b>				
1	1.026	(0.566 - 1.862)		
2 - 3	1.044	(0.585 - 1.862)		
4 - 6	1.389	(0.743 - 2.595)		
7+		Ref		
<b>Maternal education</b>				
None		Ref		
Primary	0.615**	(0.425 - 0.888)	0.571	(0.213 - 1.527)
Middle/JSS	0.888	(0.598 - 1.318)	2.356	(0.652 - 8.516)
Secondary +	0.772	(0.435 - 1.371)	3.477	(0.339 - 35.645)

Shaded portions were excluded from the analysis. Significance -  $p < 0.05$ ; -2 Log likelihood - 237.042a, Cox & Snell R Square - 0.024; Nagelkerke R Square - 0.171. \*\*\* denotes  $P < 0.001$ ; \* denotes  $P < 0.05$ ; OR means odds ratio; aOR means adjusted odds ratio. CI means confidence interval

Table 4.7c: Predictors of overweight among Ghanaian under-fives continued.

Characteristics	Unadjusted		Adjusted	
	OR	95% CI	aOR	95% CI
<b>Community characteristic</b>				
Area of residence				
Urban		Ref		
Rural	0.865	(0.615 - 1.218)		
<b>Region</b>				
<b>Geographic zones</b>				
Coastal/southern zone		Ref		
Middle zone	0.940	(0.636 - 1.389)	2.483	(0.595 - 10.356)
Northern zone	1.666**	(1.166 - 2.382)	12.888*	(1.738 - 95.543)
<b>Three northern and non-northern regions</b>				
All but northern regions		Ref		
Northern regions	1.316	(0.971 - 1.783)	0.560	(0.118 - 2.648)
<b>Registered with any health insurance</b>				
Yes, registered	1.162	(0.863 - 1.565)		
Not registered		Ref		
<b>NHIS status</b>				
Card not valid or not seen or missing		Ref		
Valid card seen	1.023	(0.730 - 1.434)		
<b>Do you hold a valid NHIS card</b>				
Yes, card seen	0.873	(0.538 - 1.418)		
Yes card not seen	0.959	(0.511 - 1.801)		
No		Ref		

Shaded portions were excluded from the analysis. Significance -  $p < 0.05$ ; -2 Log likelihood - 237.042a, Cox & Snell R Square - 0.024; Nagelkerke R Square - 0.171. \*\*\* denotes  $P < 0.001$ ; \* denotes  $P < 0.05$ ; OR means odds ratio; aOR means adjusted odds ratio. CI means confidence interval

**APPENDIX 3: Predictors of overweight with concurrent stunting**

Table 4.8a: Predictors of overweight with concurrent stunting among under-fives

Child characteristics	OR	Unadjusted		Adjusted	
		CI	aOR	CI	
<b>Sex</b>					
Male	Ref				
Female	1.330	(0.869 - 2.036)	1.436	(0.917 - 2.249)	
<b>Age of child</b>					
0-5	Ref				
6-11	1.840	(0.552 - 6.137)	1.325	(0.369 - 4.750)	
12-23	0.587	(0.263 - 1.307)	0.462	(0.186 - 1.152)	
24-35	0.741	(0.327 - 1.681)	0.599	(0.236 - 1.518)	
36-47	0.907	(0.392 - 2.095)	0.693	(0.270 - 1.778)	
48-59	1.254	(0.510 - 3.081)	0.938	(0.349 - 2.524)	
<b>Breastfeeding status</b>					
Child ever been breastfed	4.504*	(1.383 - 14.674)			
No	Ref				
Child still being breastfed	1.041	(0.971 - 1.614)			
No	Ref				
<b>Child health status</b>					
Child healthy	0.886	(0.770 - 1.359)	0.892	(0.567 - 1.405)	
Child unhealthy	Ref				
Child given Vitamin A dose	1.082	(0.688 - 1.701)			
No	Ref				
Child taken to a health facility during illness	0.598	(0.072 - 4.987)			
No	Ref				
Child ever received any vaccinations	1.959	(0.562 - 6.831)			
No	Ref				
<b>Malaria status</b>					
Person slept under mosquito net last night	1.253	(0.822 - 1.907)			
No	Ref				
<b>Malaria rapid test result</b>					
All Positives	1.128	(0.635 - 2.003)			
Negative	Ref				
<b>Anemia status</b>					
Normal	Ref				
Anemic	1.089	(0.609 - 1.946)			
<b>Household factors</b>					
<b>Sex of household head</b>					
Male	1.045	(0.655 - 1.666)			
Female	Ref				
<b>Marital status</b>					
Currently married	Ref				
Formerly married	1.282	(0.510 - 3.226)	1.092	(0.430 - 2.777)	
Never married	0.759	(0.482 - 1.196)	0.497*	(0.253 - .974)	
<b>Ethnicity of household head</b>					
Akan		Ref			
Ga/Dangme	1.310	(0.395 - 4.349)			
Ewe	1.698	(0.651 - 4.430)			
Northern tribes	1.339	(0.834 - 2.149)			
Non-Ghanaian/ others	0.761	(0.264 - 2.197)			
<b>Religion of household head</b>					
Christian		Ref			
Muslim	0.922	(0.561 - 1.514)	0.802	(0.438 - 1.470)	
Traditional/ Spiritualist	0.871	(0.462 - 1.640)	0.832	(0.408 - 1.697)	
Other religion/ No Religion	0.488*	(0.242 - 0.987)	0.472*	(0.227 - .982)	

Shaded portions excluded from the analysis. Significance  $p < 0.05$ ; -2 Log likelihood -843.604a, Cox & Snell R Square - 0.005; Nagelkerke R Square - 0.046; \* denotes  $P < 0.05$ ; aOR-adjusted odds ratio

Table 4.8b: Predictors of overweight with concurrent stunting among Ghanaian under-fives continued

Characteristics	OR	Unadjusted	Adjusted	
		95% CI	aOR	95% CI
<b>Sources of drinking water</b>				
Pipe water	Ref			
Tube Well, Borehole, Tanker	1.143	(0.666 - 1.961)	1.058	(0.610 - 1.833)
River - Spring and other water bodies	0.749	(0.401 - 1.399)	0.747	(0.390 - 1.433)
Bottled Water - Sachet Water	1.357	(0.717 - 2.567)	1.256	(0.648 - 2.434)
<b>Maternal factors</b>				
<b>Maternal age (years)</b>				
15-19	Ref			
20-24	1.247	(0.558 - 2.787)	0.878	(0.373 - 2.067)
25-29	0.696	(0.352 - 1.376)	0.385*	(0.167 - 0.887)
30-34	0.805	(0.392 - 1.655)	0.379*	(0.146 - 0.979)
35-39	0.851	(0.403 - 1.798)	0.427	(0.158 - 1.156)
40-44	1.020	(0.444 - 2.341)	0.535	(0.181 - 1.580)
45-49	1.619	(0.586 - 4.475)	0.897	(0.245 - 3.276)
<b>Maternal age at child birth</b>				
Less than 20	Ref			
20 - 34	1.136	(0.668 - 1.930)		
35 - 49	1.205	(0.553 - 2.622)		
<b>Type of birth</b>				
Single	1.777	(0.769 - 4.104)	1.294	(0.465 - 3.600)
Twins	Ref			
<b>Child size at birth</b>				
Large	0.750	(0.087 - 6.454)		
Average	1.991	(0.180 - 22.056)		
Small	Ref			
<b>Birth order</b>				
1	0.915	(0.375 - 2.235)		
2 - 3	0.871	(0.366 - 2.071)		
4 - 6	1.188	(0.469 - 3.008)		
7+	Ref			
<b>Maternal education</b>				
None		Ref		
Primary	0.734	(0.437 - 1.235)	0.873	(0.469 - 1.625)
Middle/JSS	1.046	(0.598 - 1.831)	1.011	(0.489 - 2.088)
Secondary +	1.515	(0.543 - 4.225)	1.684	(0.433 - 6.555)
<b>Wealth index</b>				
Poorest		Ref		
Second	1.168	(0.668 - 2.045)	1.602	(0.824 - 3.113)
Middle	1.059	(0.570 - 1.967)	1.393	(0.643 - 3.014)
Fourth	2.771*	(0.995 - 7.720)	4.311*	(1.219 - 15.241)
Richest	1.032	(0.485 - 2.197)	1.275	(0.447 - 3.638)
<b>Insurance status</b>				
<b>Registered with any health insurance</b>				
Yes - registered	1.037	(0.681 - 1.581)		
Not registered	Ref			
<b>NHIS status</b>				
Card not valid or not seen or missing	Ref			
Valid card seen	0.926	(0.581 - 1.476)		
<b>Do you hold a valid NHIS card</b>				
Yes - card seen	1.014	(0.539 - 1.907)		
Yes card not seen	1.582	(0.616 - 4.061)		
No	Ref			

Shaded portions were excluded from the analysis. Significance  $p < 0.05$ ; -2 Log likelihood - 843.604a, Cox & Snell R Square - 0.005; Nagelkerke R Square - 0.046. \* denotes  $P < 0.05$ ; OR means odds ratio; aOR means adjusted odds ratio. CI - confidence interval

Table 4.8c: Predictors of overweight with concurrent stunting among Ghanaian under-fives continued.

Characteristics	OR	Unadjusted	Adjusted	
		95% CI	aOR	95% CI
<b>Community characteristic</b>				
Area of residence				
Urban		Ref		
Rural	0.750	(0.454 - 1.238)		
<b>Region</b>				
<b>Geographic zones</b>				
Coastal/southern zone		Ref		
Middle zone	1.148	(0.626 - 2.104)	1.228	(0.546 - 2.764)
Northern zone	1.228	(0.746 - 2.022)	1.650	(0.475 - 5.734)
<b>Three northern and non-northern regions</b>				
All but northern regions		Ref		
Northern regions	1.181	(0.765 - 1.824)	1.143	(0.423 - 3.089)

Shaded portions were excluded from the analysis. Significance  $p < 0.05$ ; -2 Log likelihood - 843.604a, Cox & Snell R Square - 0.005; Nagelkerke R Square - 0.046; OR means odds ratio; aOR means adjusted odds ratio; CI means confidence interval