

**SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
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**DETERMINANTS OF ANAEMIA IN CHILDREN UNDER FIVE
YEARS IN GHANA**

BY

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DECLARATION

I, Henry Ofori Duah, declare that this thesis presented for the degree of Masters in Public Health is my original work and contributions of other authors have been duly acknowledged.

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DEDICATION

First and foremost, this work is dedicated to the Almighty God for his love and protection during my study period. This work is also dedicated to my parents, Mr. John Kofi Duah and Madam Mary Yeboah and my siblings, Gladys Asante Waa, Patricia Duah, Prudence Duah and Godwin Gyamfi Duah, for their support and encouragement throughout my study period.



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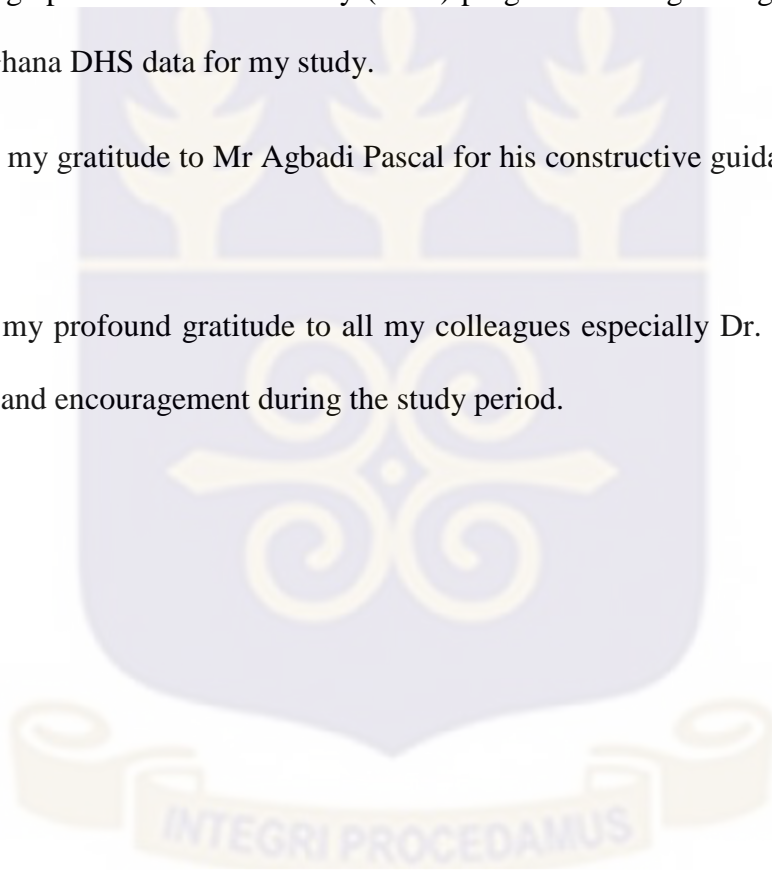
I wish to extend my profound gratitude to my supervisor, Dr. Anthony Danso-Appiah for his instructive guidance and encouragement during the research and study period.

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ABSTRACT

Background: Anaemia in children under five years remains an important public health concern. It affects the physical and cognitive development of the child and increases morbidity and mortality among children under five years old. Knowledge of the determinants of anaemia is integral for effective policy decisions and interventions.

Objectives: This study sought to investigate the determinants of anaemia in children under five years in Ghana.

Methods: The study employed a secondary data analysis of a nationally representative 2014 Ghana Demographic and Health Survey (DHS) data. A total of 2343 children under 5 years were included in the analysis. Ordered logistic regression analysis was performed to assess the determinants of anaemia using four models.

Results: The findings of the study revealed that the overall prevalence of anaemia in children under 5 years in Ghana was 69.61% with 27.19% being mildly anaemic, 39.56% moderately anaemic and 2.86% severely anaemic. The highest prevalence was found in the Northern Region (84.84%) while Ashanti Region recorded the lowest prevalence of 52.89%. The determinants of anaemia were found to exist at the child, maternal and household levels. Factors independently associated with increased odds of anaemia in children under five years were child's age below 2 years (OR=2.14, 95%CI 1.79-2.56), being a male child (OR=1.26 95% CI 1.07-1.49), increasing birth order (OR=1.07, 95% CI 1.01-1.14), history of fever (OR=1.96, 95% CI 1.55-2.48), children of severely anaemic mothers (OR=9.14, 95% CI 1.37-61.11), moderately anaemic mothers (OR=1.77, 95%CI 1.33-2.35), and mildly anaemic mothers (OR=1.51, 95%CI 1.26-1.81), children living in households with 2 children under five years (OR=1.24, 95%CI 1.03-

1.49), children living in household with three and more children under 5 years (OR=1.32, 95%CI 1.02-1.70) and children from poorer households (OR=1.36, 95%CI=1.03-1.70). Moreover, factors independently associated with reduced odds of anaemia in children under five years in Ghana were increasing maternal age ($p<0.05$), secondary education of mother (OR=0.71, 95%CI 0.55-0.90), higher education of mother (OR=0.48, 95%CI 0.26-0.89), children from richest households (OR=0.48 95%CI 0.33-0.70), residing in Ashanti Region (OR=0.65, 95% CI 0.43-0.98) and Brong Ahafo Region (OR=0.62, 95% CI 0.41-0.94). However, history of diarrhoea, vitamin A supplementation, fathers' educational level, household size, source of drinking water, main floor material and locality were not independent determinants of anaemia in children under five years in Ghana in this study.

Conclusion: The study reports high prevalence of anaemia in children under five years in Ghana. Determinants of anaemia in children under five years were child's age, gender of child, birth order, history of fever, mothers' age, mothers' educational level, mothers' anaemia status, number of children under 5 years in household, household wealth status and region of residence. The findings imply the need for holistic policy interventions to address the problem of anaemia in children under five years in Ghana.

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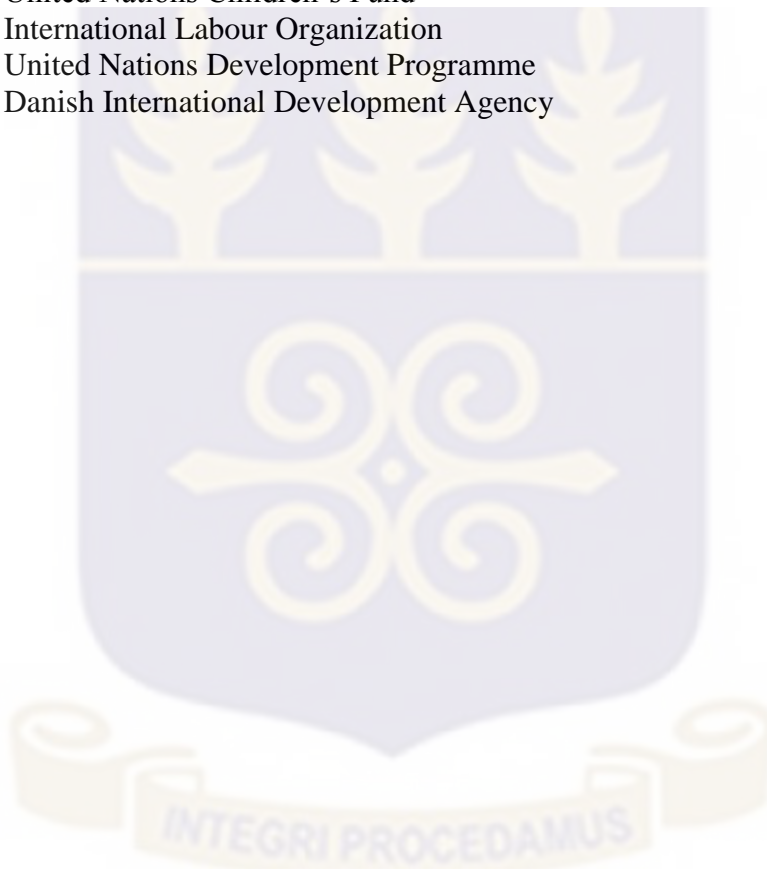
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LIST OF ABBREVIATION

WHO	—	World Health Organization
DHS	—	Demographic and Health Survey
GHS	—	Ghana Health Service
GSS	—	Ghana Statistical Service
MICS	—	Multiple Indicator Cluster Survey
Hb	—	Haemoglobin
OR	—	Odds Ratio
CI	—	Confidence Interval
USAID	—	U.S. Agency for International Development
UNFPA	—	United Nations Population Fund
UNICEF	—	United Nations Children’s Fund
ILO	—	International Labour Organization
UNDP	—	United Nations Development Programme
DANIDA	—	Danish International Development Agency



CHAPTER ONE

INTRODUCTION

1.0 Background

Anaemia is a condition in which the red blood cells are insufficient to meet the physiologic needs of the human body (WHO & Chan, 2011). Although anaemia affects people of all ages, its burden is heavy on children and pregnant women. The World Health Organization (WHO) estimated that about 800 million women and children suffered anaemia in 2011 (WHO, 2015).

Global prevalence and trends of Anaemia in children under 5years

The World Health Organization (2015) estimated that the 2011 global prevalence of anaemia in children under five years was 42.6% with an average prevalence of 53.8% among children from South East Asia and Africa. However, the prevalence of anaemia in children under 5years was about 62% among WHO African Countries (World Health Organization, 2015).

These notwithstanding, the period between 1995 and 2011 saw an average global decline in the trends in prevalence of anaemia in children under five years. The global prevalence reduced from 47% in 1995 to about 43% in 2011, although significant regional variations were observed (Stevens et al., 2013). In high income regions, for example, prevalence of anaemia in children under five years was averagely maintained at 11% during the period from 1995 to 2011, whereas in Central and Eastern Europe, the prevalence reduced from 29% to 26% within the same period. South Asia, saw a reduction in the prevalence of anaemia among children under five years from 70% to 58% during the same period, and in Latin America and the Caribbean, prevalence of anaemia averagely reduced from 33% to 28% during the same period. Likewise, within the same period (1995-2011) there was a decline in the prevalence of anaemia among children under five

years from 43% to 38% in Central Asia, Middle East and North Africa (Stevens et al., 2013; World Health Organization, 2015).

In contrast, Southern Africa saw a rise in the prevalence of anaemia among children under five years from 30% in 1995 to 46% in 2011. However, East Africa saw a decline in the prevalence of anaemia in children under five years from 74% to 55% within the same period although the prevalence remains relatively high as compared to other regions. Central and West Africa recorded 71% prevalence of anaemia in children under five years in 2011, a slight reduction from 80% in 1995 (Stevens et al., 2013; World Health Organization, 2015). Despite the slight decline in prevalence, the burden of anaemia in children under five years appears to be consistently greater in Central and West African Regions.

Prevalence in Ghana

In Ghana, recent national surveys using the 2008 Demographic and Health Survey (DHS) data have estimated the prevalence of anaemia in children under five years to be about 78% (Ewusie, Ahiadeke, Beyene, & Hamid, 2014; Nikoi & Anthamatten, 2014). Ewusie et al. (2014), for example, reported that 7.8%, 48.0% and 22.6% of children under five years in Ghana were severely, moderately and mildly anaemic, respectively. However, Fosu, Frimpong, & Arthur (2014) reported a 64.7% prevalence using data from the 2011 Multiple Indicator Cluster Survey (MICS).

Risk factors of Anaemia in Children under Five

Worldwide, the leading cause of anaemia among children under five is iron deficiency (WHO & Chan, 2011). Nevertheless, the risk factors for anaemia in children are multifactorial. This may include nutritional status, socioeconomic status, duration of lactation, iron and calcium intake

(Kenya Ngesa & Mwambi , 2014 Villalpando et al., 2003), child's gender (Ewusie et al., 2014; Fosu et al., 2014; Nikoi & Anthamatten, 2014), birth weight, and the presence of malaria and infections (Ewusie, 2014; Ewusie et al., 2014; Santos, 2011; Simbauranga et al., 2015).

Effects of Anaemia on Child

Anaemia in children under five years can have detrimental effects on the overall wellbeing of the child. At the individual level, anaemia can affect the physical , cognitive and intellectual development of the young child (Igbal et al., 2015), impairs language development (Santos, Rates, & Lemos, 2009), and accounts for hospitalization and death among children in Ghana (Commey & Dekyem, 1994). Other studies have documented deaths from anaemia secondary to malaria (Menendez, Fleming, & Alonso, 2000).

Presentation of Anaemia

Although the symptoms of anaemia may be overt and dependent on the underlying cause, symptoms such as fatigue, headache weakness, shortness of breath, pale or yellowish skin, irregular heartbeats, dizziness or lightheadedness, and chest pain amongst others have been reported (Mayo Clinic, 2016).

Diagnosis of Anaemia

A diagnosis of anaemia in children is made empirically by checking blood haemoglobin (Hb) level through blood test. Anaemia is diagnosed when blood Hb levels is below 11.0g/dl (WHO, 2011). A child is diagnosed as mildly anaemic when Hb level is between 10.0-10.9g/dl, moderately anaemic when Hb is between 7.0-9.9 g/dl, and severely anaemic when Hb is less

than 7.0 g/dl (Ghana & Statistical Service (GSS), Ghana Health Service (GHS), 2015; WHO, 2011).

Management of anaemia

The management of anaemia is dependent on its severity, underlying cause, symptoms and comorbidities. For mild anaemia, dietary changes and haematinics are often prescribed. However, in children with moderate to severe anaemia in the presence of clinical symptoms management may include the treatment of underlying cause, haematinics and blood transfusions where necessary (Janus & Moerschel, 2010). However, Schellenberg et al.(2003) observed that anaemia is usually asymptomatic and when symptoms arose they are often nonspecific and are rarely identified as a serious illness by health care providers.

In all, an important aspect in the prevention and management of anaemia in children is the identification of risk factors and planning of appropriate interventions to mitigate these risk factors.

1.1 Problem statement

Although the 2011 global prevalence of anaemia in children under 5years was estimated to be 42.6%, recent national studies based on data from the 2008 DHS have estimated about 78% prevalence of anaemia in children under five years in Ghana (Ewusie et al., 2014; Nikoi & Anthamatten, 2014). This reported prevalence is almost twice the global average in 2011 (World Health Organization, 2015). Anaemia in children under five years occurs at a critical milestone in the growth and development of the child.

According to Piaget's theory of cognitive development, children learn sensory motor skills and foundations of language during the first 24 months of their life (Wood, Smith, & Grossniklaus,

2001). Moreover, the period from 2yrs -5yrs forms a major portion of the pre-operational period (2-7yrs) during which children begin to use language, memory and imagination (Wood et al., 2001). Anaemia in children under five years impairs cognitive (Igbal et al., 2015) and language development (Santos et al., 2009) which are critical for intellectual and social functions in adulthood.

Aside the aforementioned impacts, anaemia accounts for morbidity and mortality in children under 5years (Scott, Chen-Edinboro, Caulfield, & Murray-Kolb, 2014 ; Menendez et al., 2000). Scott et al.(2014) , for example, suggested that about 1.8 million deaths in children aged 28 days to five years could be avoided each year by increasing Hb in these children by 1g/dL. However, this can only be achieved when the risk factors for anaemia are identified and properly addressed.

Literature has revealed that factors at the child level, parental level and household/community level all contribute to the development of anaemia in children under five years (Borbor et al., 2014; Chandyo et al., 2016; Dangour, Hill, & Ismail, 2002; El Hioui et al., 2008; Ewusie et al., 2014; Semedo, Santos, Baião, Luiz, & da Veiga, 2014; Simbauranga et al., 2015; Wang et al., 2015; World Health Organization, 2015; Yang et al., 2012; Zanin et al., 2015; Zuffo et al., 2016).

Four (4) recent nationwide studies about anaemia in children under 5years in Ghana were published in 2014. Three of these used the 2008 DHS data (Borbor et al., 2014; Ewusie et al., 2014; Nikoi & Anthamatten, 2014) while Fosu et al. (2014) used the 2011 Multiple Indicator Cluster Survey (MICS).

This present study employs an ordered logistic regression to examine the determinants of anaemia in children under 5years Ghana using the 2014 DHS data. This study therefore provides

a more recent estimate of the national burden of anaemia and identifies the determinants of anaemia in children under five years in Ghana. Therefore, the findings of this study will help to develop specific interventions to prevent and control anaemia in children under five years in Ghana.

1.2 Justification of the Study

Besides increasing the morbidity mortality, anaemia also impairs physical and cognitive development of children under five years. Moreover, given that there are diverse determinants of anaemia, identifying these determinants is essential in policy decisions and interventions. In addition, it is important to examine the extent of the problem to help determine the resources needed in solving the problem. Therefore, this study explores the determinants of anaemia in children under five years in Ghana. The findings of the study will help to estimate of the burden of anaemia in children under five years in Ghana and identify the determinants of anaemia in children under five years. Therefore, the results of the study can serve as guide to policy makers in planning targeted interventions to reduce the burden of anaemia among children under 5years in Ghana.



1.3 Conceptual Framework

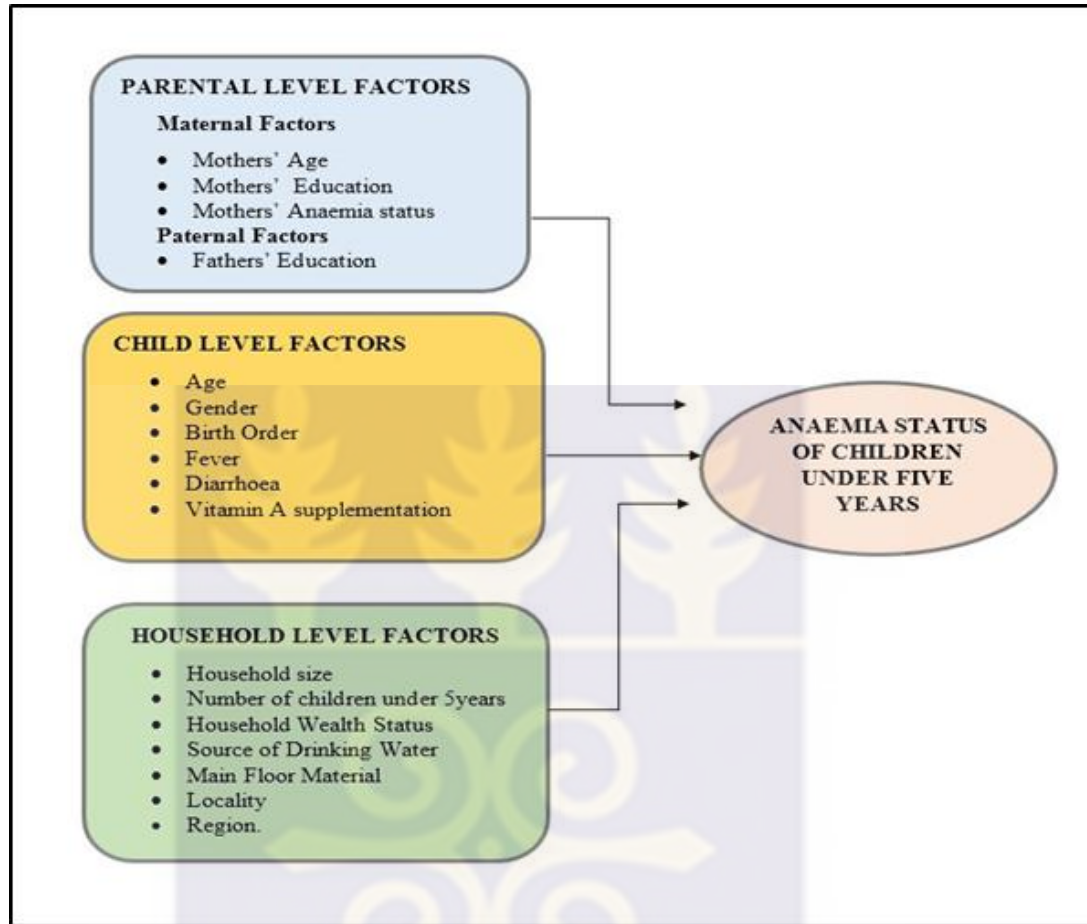


Figure 1.1 Conceptual Framework of the Determinants of Anaemia in children under five years old in Ghana

Narrative of conceptual frame work

Literature has revealed that determinants of anaemia are multifactorial and occurs at different levels which all lead to the development of anaemia in children under five. These factors were therefore grouped under the child level, parental and household/community level factors.

Child level factors are biologic and social factors at the level of the child which predispose them to anaemia. They include the age, gender, nutrition, infection, vaccination status. Age of child determine the type of food the child consumes which in turn can lead to under-nutrition and

results in anaemia. Acute and chronic infection in the child also modulates anaemia. Chronic infections may result in low levels serum iron and a decrease in the total iron binding capacity which eventually leads to anaemia. However, acute infections, for example malaria, cause the destruction of Red Blood Cells (RBC) which lead to anaemia. Likewise, vaccination status of a child determines the level of immunity against childhood infections which in turn affects the development of anaemia.

Parental level factors include the biological and social-demographic characteristics at the maternal/paternal level that determines the development of anaemia. Maternal factors identified in literature as determinants of anaemia include age of mother, level of education, and the anaemia status of the mother, occupation and Body Mass Index (BMI) of the mother. Paternal factors such as fathers' education and occupation are known to determine anaemia in children under five years.

Household level factors are mainly social, economic and cultural factors at the household or community level which determines anaemia in children under five years old. They include household wealth quintile, household size, number of children under five years in household, source of drinking water, main floor material and place of residence, locality and region of residence.

1.4 General Objective

The general objective of the study was to assess the determinants of anaemia among children under five in Ghana. The specific objectives have been outlined below.

1.5 Specific objectives

1. To assess the prevalence of anaemia in children under five years in Ghana.
2. To identify child level factors that determine anaemia in children under five years.
3. To identify parental level factors that determine anaemia in children under five years.
4. To identify household level factors that determine anaemia in children under five years.

1.6 Outline of the Dissertation

The dissertation is presented in six (6) chapters. Chapter One (1) introduces the background of the study, problem statement, justification, general and specific objectives and research questions. Chapter Two (2) presents the review of empirical literature and the presentation of conceptual framework. Chapter three (3) presents the methods employed in data collection and analysis. Chapter four (4) presents the results of the study following data analysis. Chapter five (5) presents the discussion of results in relation to empirical literature. Chapter Six (6) presents the summary of the study, conclusions and recommendations. Limitations and suggestions for future studies are also provided in chapter 6.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents empirical literature on the determinants of anaemia in children under five years. The objective of the chapter is to present the existing findings in literature on the trends and determinants of anemia on anaemia in children under five years. It also discusses the different methodological approaches employed by various authors to investigate the topic under study. It begins with an overview of the prevalence of anaemia and then proceeds to present the determinants of anaemia in children under 5years old under three thematic areas: child, parental and household level factors. Finally, the main gaps identified in literature are also presented.

2.1 Prevalence of Anaemia in Children under five years

Anaemia in children under five year has been much investigated worldwide given its impact on child health and survival. The prevalence varies over time across the different regions of the world but generally, developed regions of the world tend to have low prevalence of anaemia as compared to under-developed nations (Stevens et al., 2013; World Health Organization, 2015). While the global prevalence of anaemia in children under five years was 42.6% in 2011, the prevalence was 62.3% among WHO African Countries (World Health Organization, 2015). Several studies across developing countries have documented prevalence above the global average (Chandyo et al., 2016; Khan et al., 2016; Pinlap, 2015; Semedo et al., 2014; Siegel et al., 2006). Simbouranga et al., (2015) reported anaemia prevalence of 77.2% in Tanzania, Pinlap(2015) reported 60% prevalence in Cameron, and Semedo et al., (2014) reported 51.8% prevalence in Cape Verde.

In Ghana, three recent national studies have estimated 78% prevalence of anaemia in children under 5 years using the 2008 DHS data (Borbor et al., 2014; Ewusie et al., 2014; Nikoi & Anthamatten, 2014) whiles Fosu et al. (2014) also reported about 65% prevalence of anaemia in children under five years in Ghana using the 2011 Multiple Indicator Cluster Survey (MICS). Therefore, the prevalence of anaemia in children under five years in Ghana remains higher than the global average.

2.2 Child Level Factors

This part of the literature review presents child level factors that determine anaemia status of children under five years. Child level factors under consideration here include age, gender, history of fever, diarrhoea and vitamin A supplementation.

2.2.1 Age of Child

The age of the child is known to determine the presence of anaemia. Children under 2 years old have increased risk of developing anaemia as compared to children between ages 24 -59 months (Ewusie et al., 2014 ; Souganidis et al.,2012; Villalpando et al., 2003). Children under 24 months include breastfeeding infants and those who are adjusting with complementary feeding after exclusive breastfeeding.

Although breast feeding is able to provide the low iron requirements in the first 6 months of life, the body's demand for iron exceeds the supply in breast milk during 6-12 months period (FAO & WHO, 2001 pp. 195-196). Therefore, anaemia is likely to occur when complementary feeding does not contain adequate nutrients especially in children under 2 years old.

In Kazakhstan , for example, Tazhibayev et al.(2014) found that anaemia prevalence of 59.8% for children under 2years old compared to 35.8% in those older than 2 years ($p < 0.001$). Ayoya et al., (2013) reported similar findings in Haiti.

Likewise in Cameroon, Pinlap (2015) revealed that the risk of anaemia was 2.6 times greater for children under 2years than those older than two years old living in cities.

In Ghana , Borbor et. al., (2014) also reported that children less than 2years were twice likely to be anaemic as compared to those aged over 2years (OR 2.10, $p < 0.000$) . In a separate study in Ghana , Ewusie et al., (2014) reported 85.1% prevalence for children under 2 years as compared to 74.8% prevalence in children over 2 years ($p < 0.05$).

Children under two years include children adapting to complementary feeding following weaning from breast milk. Onyango (2003) explains that complementary feeding in contemporary African societies is very monotonous consisting of mainly cereals which lacks the required minerals and nutrients required for growth immunity. In addition, high phytate content in cereal foods is associated with decreased bioavailability of iron (Al Hasan et al., 2016; Hurrell & Egli, 2010), and this may explain the high rate of anaemia in children under 2years.

2.2.2 Gender of Child

Some literature attempt to suggest that anaemia status in children under 5years is mediated by the gender of the child. Nevertheless, opinion about which gender category is at higher risk seems to be divided in literature. In Nepal , Chandyo et al., (2016) found high level of Haemoglobin and Ferritin among female children above 6-months as compared to male counterparts ($p < 0.05$), although no significant gender differences was found in children under 6months old. In contrast, Ngesa & Mwambi (2014) reported that a male child in Kenya is 21%

more likely of developing anaemia as compared to female child (OR: 1.21 95% CI 1.08-1.36). Similarly, Fosu et al., (2014) reported a 52% prevalence of anaemia in male children as compared to 48% in female children under five years living in Ghana ($p < 0.05$). However, some studies among Ghanaian children found no significant differences in the prevalence of anaemia between males and females (Borbor et al. 2014, ; Ewusie et al., 2014). Despite the contrasting findings in literature, this study will further assess the relationship between gender and anaemia status of children under five years in Ghana.

2.2.3 Presence of Fever/Infection of the child

The presence of fever in the child is also known to be associated with anaemia. Some chronic febrile illness may result in low levels serum iron, a decrease in the total iron binding capacity and percentage reduction in plasma transferrin saturation (Viana, 2011) which eventually leads to anaemia. However, acute infections, for example malaria, causes the destruction of Red Blood Cells (RBC) which lead to anaemia (Viana, 2011). Magalhaes Soares & Clements (2011) reported that malaria and worm infestations accounts for about 2.5 million cases of anaemia in Burkina Faso, Ghana, and Mali. In a study in Brazil, Santos, et al., (2011) evaluated relationship between fever and anemia using poisson regression and found that anemia significantly correlated with the presence of acute lower respiratory disease (PR = 1.57, 95% CI 1.27-1.96). In Kenya, Ngesa & Mwambi (2014) noted that children with malaria were 4 times likely to be anaemic as compared to those without malaria (OR:4.02, 95%CI 3.44-7.59). Likewise, Simbouranga et al.(2015) found that Tanzanian children with malaria had 4 times greater risk of developing anaemia as compared to those without malaria (OR; 4.0 95% CI 2.1–7.8). In Ghana, Fosu et al.(2014) also found a highly significantly association between anaemia among children and malaria prevalence (p -value=0.000). In another study in Brazil, Zanin et

al. (2015) found that children who suffer parasitic infections had 90% increased risk of developing anaemia as compared to children had no parasitic infections (OR = 1.9, 95% CI 1.2–2.8).

2.2.4 Vitamin and Mineral Deficiency

Deficiency of micro nutrients such as Vitamin A and Vitamin B is also known to contribute to the presence of anaemia in Children. Vitamin A deficiency can modulate anaemia through three main modulation mechanism: modulation of erythropoiesis, immunity to infectious diseases and the anemia of infection and iron metabolism (Semba & Bloem, 2002). Some epidemiological surveys in developing countries reveals high prevalence of anemia in people with vitamin A deficiency (Semba & Bloem, 2002; Souganidis et al., 2012). Souganidis et al., (2012), for example, reported that intake of vitamin A in the last six months is protective against anaemia in children under 5years living in rural areas. In China Wang et al. (2015) found that children with iron and vitamin B12 deficiency had 5 times greater risk of developing anaemia (OR = 5.3; 95% CI: 1.9–14.5). From the above literature, it is evident that the intake of vitamin A is an important determinant of the anaemia status of the child.

2.2.5 Birth Order

Ray, Chandra, Bhattacharjee, Sharma & Agarwala (2016) found that increasing birth order is significantly associated with decreasing hemoglobin levels among children under 5years. Similarly, Goswami & Das (2015) reported that higher birth order in children increases the risks of all types of anaemia ($p < 0.05$). Maternal iron reserves decreases with increasing parity of mother (Miller, 2014). Therefore, this may explain why increasing birth order is associated with high risk of anaemia. However, some studies have reported no significant associating between

the risk of developing anaemia and birth order (Baranwal, Baranwal, & Roy, 2014; Singh & Patra, 2014).

2.3 Parental level Factors

Parental factors include maternal and paternal factors which determine anaemia in children under five years.

2.3.1.0 Maternal Factors

This part of the literature review presents factors at the maternal factors which determine anaemia in children under five years. The maternal factors considered here include age of mother, educational level of mother and anaemia status of mother.

2.3.1.1 Mothers' Educational Status

The educational status of the mother has also been reported as a determinant of child anaemia (Ngesa & Mwambi, 2014; Pinlap, 2015; El Hioui et al., 2008). At least secondary education of mothers have been reported to reduce the risk of anaemia in their children (Ngesa & Mwambi, 2014; Pinlap, 2015). Ngesa & Mwambi (2014) , for example, reported that the risk of anaemia is 1.5 times greater for children whose mothers had no education as compared to those whose mothers had higher than secondary education (OR: 1.57, 95% CI 1.09-2.26). Likewise, Pinlap (2015) reported that children in rural areas whose mothers had at least secondary education had 22% reduced risk of developing anaemia as compared to those of less educated mothers. Similarly , Borbor et al. (2014) noted that children whose mothers had only primary education had 2.12 times greater risk of being anaemic as compared to those whose mother had higher levels of education after controlling for age (OR 2.12, $p < 0.02$). Furthermore, a study in Brazil revealed that children in urban areas whose mothers had less than 9years of education were 40%

more likely to be anaemic as compared to children whose mothers had at least 9yrs of education (OR:1.4, 95% CI 1.05-1.76) after controlling for maternal age, maternal anaemia, age of child, number of children in household and treatment for drinking water (Leal, Batista Filho, Lira, Figueiroa, & Osório, 2011). Evidently, mothers with higher level of education have a protective effect on the risk of anaemia on their children. Besides having adequate knowledge about child feeding practices and nutrition, highly educated mothers are also capable of affording balanced meal for their children and are more likely to be living in relatively sanitary conditions. This may explain why children of highly educated mothers have low risk of child anaemia.

2.3.1.2 Maternal Age

Like maternal education, some studies have reported significant relationship between the age of a mother and the anaemia status of the child (Borbor et al., 2014; Leal et al., 2011; Souganidis et al., 2012; Zuffo et al., 2016). In Ghana, Borbor et al. (2014), for example, revealed that children whose mothers were at least 20 years old were less likely to be anaemic as compared to those whose mothers were less than 20 years. Similarly in Brazil, Leal et al. (2011) also found that children whose mothers are below 20yrs are 50% more likely of to suffer episodes of anaemia as compared to children whose mothers were above 20yrs after controlling for family income, housing conditions and type of sewage system (PR: 1.5, 95% CI: 1.12-1.4, p=0.005). Zuffo et al. (2016) found that children whose mothers were below 28yrs of age were 80% more likely to develop anaemia as compared to children whose mothers were above 28yrs old, after controlling for age of child, gender and nutritional status of the children (OR: 1.80, 95% CI: 1.14-2.84, p=0.01). Unlike older mothers, relatively younger mothers seem to lack knowledge and experience about child care and nutrition which makes their children more prone to suffer anaemia. On the contrary, Souganidis et al., (2012) found that older maternal age (above 35)

was associated with higher odds of anaemia clustering as compared to younger maternal age in rural Indonesia (OR: 1.18 95% CI: 1.05–1.33, $p < 0.05$) after adjusting for sex of child, maternal education, maternal BMI, wealth quintile and age of child.

2.3.1.3 Anaemia Status of Mother

Some studies have revealed a significant relationship between the anaemia status of the mother and the presence of anaemia in the children (Pinlap, 2015; Sandip et al., 2016; Wang et al., 2015). Wang et al. (2015), for example, found that the odds of having anaemia is 2.6 times greater for children whose mothers are anaemic as compared to children of non-anaemic mothers (OR= 2.6; 95% CI: 1.2–5.4, $P < 0.05$). Likewise, Pinlap (2015) revealed that the risk of developing anaemia is 1.63 times greater for children of anaemic mothers than children of non-anaemic mothers living in rural areas. Leal et al. (2011) also found that children of anaemic mothers are 50% more likely of to suffer anaemia as compared to their counterparts of non-anaemic mothers (PR: 1.5, 95% CI: 1.18-1.9, $p = 0.001$). Similarly, Ayoya et al., (2013) reported that children of anaemic mothers were 80% more likely to be anaemic as compared to children of non-anaemic mothers (OR = 1.8; $P = 0.011$). It is evident from literature that mother's anaemia status is a significant determinant of anaemia in children under 5 years.

2.3.2 Paternal Factors

2.3.2.1 Fathers' Educational Status

Like maternal education, Malkanthi, Silva & Jayasinghe-mudalige (2010) reported that children whose fathers had more education have lower risk of anaemia than those whose fathers had low education. Similarly, Khan et al., (2016) also reported that children whose fathers had attained

secondary education and below are associated with higher odds of anaemia as compared to children whose fathers had higher education.

2.4 Household Level Factors

This section of the literature review presents household level factors that determine anaemia in children under five years. The review include household wealth, household size, number of children under five years, source of drinking water, main floor material, place of residence.

2.4.1 Household Wealth Status

Some studies have documented on the relationship between household wealth and child survival (Chalasani, 2010) . Generally, adequate wealth in the family implies that there will be adequate money for better nutrition, water, clothing, shelter and medication amongst others. Unsurprisingly, there is a growing evidence to suggest that children from family within higher wealth quintiles have a reduced risk of developing anaemia as compared to children of lower wealth quintile (Fosu et al., 2014; Ngesa & Mwambi, 2014). Specifically, Ngesa & Mwambi (2014) reported that the risk of presenting with anaemia was highest for children from poorest households in Kenya (OR:1.615, CI: 1.284, 2.031, p-value,0.001). In another study in Cape Verde, Semedo et al. (2014) reported that the risk of developing anaemia is 1.99 times greater for children from poor household conditions as compared to those from wealthy household environment (OR 1.99; 95% CI 1.06-3.71). In Ghana, Fosu et al. (2014) also found a significant relationship between household wealth status and anaemia status of children ($p < 0.01$).

2.4.2 Household Size

Borbor et al. (2014) reported the risk of developing anaemia is increased by 22% for children living in households with 6-10 members as compared to households with less than six members.

The reason may be that large family size means that children do not get enough nutrition and the care they would have had if there were in smaller households hence making them at risk of diseases and malnutrition which can all result in anaemia.

2.4.3 Number of children under five years in household

Like household size, the number of children under five per household also has an impact on anaemia status of the child. Souganidis et al. (2012), for example, reported that households with more than three children under 5 years had higher odds of anaemia clustering in rural Indonesia (OR: 1.60 95% CI: 1.10–2.34, $p=0.02$). Likewise, Leal et al. (2011) found a significant relationship between anaemia and number of children under five years ($p=0.045$).

2.4.4 Place of Residence

Several studies have also reported that the place of residence is related to anaemia in children with children living in rural settings having significantly high prevalence of anaemia compared to urban households (Borbor et al., 2014; Ewusie et al., 2014; Fosu et al., 2014; Magalhaes Soares, R.J, Clements, 2011). Borbor et al. (2014), for example, reported that the risk of anaemia is decreased by 44% among children living in urban areas as compared to those living in rural areas (OR : 0.56, $p<0.004$). These notwithstanding, some studies have found no significant relationship between place of residence and anaemia (Tazhibayev et al., 2014; Villalpando et al., 2003). Given the contradictory findings about the role of place of residence in literature, this study will attempt to contribute to the discourse by assessing the relationship between place of residence and anaemia in children.

2.4.5 Source of Drinking Water

Like other socio-economic conditions at the household level, source of drinking water has also been associated with anaemia in children (Khan et al., 2016; Leal et al., 2011). The reason may be that children who drink untreated water are more likely suffer infections and diarrheal illnesses which can modulate anaemia in children (Viana, 2011). In Northeastern Brazil, Leal et al. (2011) found that children who drink untreated water are 30% more likely to suffer anaemia as compared to children who drink treated water (OR: 1.30 95% CI: 1.03-1.65, $p=0.028$). Likewise in Bangladesh, Khan et al. (2016) found a higher weighted prevalence (74.3%) of anaemia in children who take non-improved water as compared to 51.1% prevalence in children who take improved water ($p=0.01$).

2.4.6 Main Floor Material

Some literature suggest that the type of floor material also determines the anaemia in children under five years. Like drinking water, if the floor is not cemented, children are likely to play with dirt in the household and hence at a greater risk of having infections and diarrhea which can increase the risk of anaemia. Borbor et al., (2014) , for example, showed that children from cemented households in Ghana are 21% less likely to be anaemic (OR: 0.79, $p<0.041$) as compared to children from mud households.

1.6 Gaps in Evidence

Most of the reviewed literature employed a logistic regressions analysis to evaluate the determinants of anaemia in children under five years and a few employed a generalized logit models. Moreover, none of the three recent studies which used the 2008 Ghana DHS data to study anaemia in children under five years (Borbor, 2014; Ewusie et al., 2014; Nikoi &

Anthamatten, 2014) employed an ordered logit model to study the risk factors of anaemia in children under five years in Ghana. Given that anaemia status was measured as an ordinal variable in the 2008 Ghana DHS data, an ordered logit model would be more appropriate for assessing the risk factors of anaemia. Therefore, this present study employs an ordered logistic regression analysis to assess the determinants of anaemia in children under five years old in Ghana using the 2014 DHS Data.



CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter presents the methods employed in data collection and analysis. The chapter covers areas such as study design, overview of DHS, sampling frame, Data extraction, measurement and recoding of variables, methods of data analysis and ethical considerations.

3.1 Study Design

The study employed a secondary data analysis of a nationally representative 2014 Ghana Demographic and Health Survey (DHS). Details of the design employed in the primary data collection for the 2014 DHS have been described below (page 22-25).

3.2.0 Overview of the Demographic and Health Survey (DHS)

The Demographic and Health Surveys (DHS) is a prospective Cross Country Multi-Round Survey that provide essential data related to general health with emphasis on reproductive health, population and nutrition. The DHS Survey is one of the several surveys conducted by the DHS Programme. The DHS Survey can be further divided into two types and includes the Standard DHS Surveys and the Interim DHS Surveys. The standard DHS surveys employ large samples and are usually undertaken at five yearly intervals whereas the Interim DHS Surveys employ relatively small samples and are conducted between the standard DHS surveys.

The 2014 Ghana DHS was the sixth (6th) standard DHS Surveys conducted in Ghana as part of the Global DHS Program since 1988. Previous standard DHS surveys were conducted in 1988, 1993, 1998, 2003, and 2008. The 2014 Ghana DHS Survey was undertaken by the Ghana Statistical Service (GSS) in partnership with the National Reference Laboratory and the Ghana

Health Service (GHS). The 2014 Ghana DHS was funded by international agencies including the U.S. Agency for International Development (USAID), the United Nations Population Fund (UNFPA), the Global Fund, the United Nations Children’s Fund (UNICEF), the International Labour Organization (ILO), the United Nations Development Programme (UNDP), the Danish International Development Agency (DANIDA) and the government of Ghana (GSS, GHS, 2015). Technical support for the survey was provided by the ICF international.

3.2.1 Sampling Design employed in the 2014 Ghana DHS

The 2014 Ghana DHS survey employed a stratified two-stage sample design. The first stage involved selecting clusters consisting of enumeration areas (EAs) that were demarcated for the 2010 Population and Housing Census (PHC) of Ghana. A total of 427 clusters were selected, 216 from urban areas and 211 from rural areas. Subsequently, about 30 households were randomly selected from each selected cluster. A total sample of 12,831 households were included in the 2014 Ghana DHS. Details of the sampling procedure can be found in the 2014 Ghana DHS report.

3.2.2.0 Questionnaires Used in the 2014 DHS survey

Three main questionnaires were used for the 2014 Ghana DHS: The Household Questionnaire, the Woman’s Questionnaire, and the Man’s Questionnaire.

3.2.2.1 Household Questionnaire

The “Household Questionnaire” gathers data on usual members of the household and visitors, their age, sex, relationship to the head of the household, education, parental survivorship and residence, and birth registration. It also collects data on other household characteristics such as

source of drinking water, toilet facilities, materials used for the floor of the dwelling unit, and ownership of various durable goods, cooking fuel, assets of the household, and exposure to second-hand smoke (“DHS Methodology,” n.d.)

3.2.2.2 The Woman’s Questionnaire

The "Woman's Questionnaire" contains information on nine (9) broad topics: Background characteristics, Reproductive behavior and intentions, contraception, antenatal, delivery, and postnatal care, Breastfeeding and nutrition, Children's health, Status of women, HIV and other sexually transmitted infections and Husband's background amongst others. Other topics such as behavior related to environmental health, the use of tobacco, and health insurance (“DHS Methodology,” n.d.). In addition, it collects data on child health including immunization coverage, vitamin A supplementation, recent occurrences of diarrhea, fever, cough for young children and treatment of childhood diseases amongst others. Details of the other components of the woman’s questionnaire can be found on the DHS programmes website at <http://dhsprogram.com>.

3.2.2.3 The Man’s Questionnaire

The "Man’s Questionnaire" is similar to but relatively shorter than the Woman’s Questionnaire. It gathers information on the following topics: Background characteristics, Reproduction. Knowledge and use of contraception, Employment and gender roles, HIV and other sexually transmitted infections. Other health issues included various health issues such as circumcision, injections, use of tobacco, health insurance, and health and care for their children.(“DHS Methodology,” n.d.)

3.2.2.4 Other Questionnaires

Aside these three main questionnaires, a "Biomarker Questionnaire" was used to collect data on Anthropometry, Anemia and HIV. Blood specimens for anaemia testing were collected in half of the selected households from women age 15-49 who voluntarily consented to be tested and from all children age 6-59 months for whom consent was obtained from their parents or the adult responsible for them ("DHS Methodology," n.d.)

3.2.3.0 Types of DHS Data Sets

Data obtained from DHS surveys are stored in eight (8) main data sets namely: Household file (HR), Household members, or persons file (PR), Women's file (IR), All Births file (BR), Children born in the 5 years prior to the interview, or kids file (KR), Men's file (MR), Couple's file (CR) and HIV file (AR) ("DHS Methodology," n.d.)

3.2.3.1 Children born in the 5 years prior to the interview, or kids file (KR)

This dataset detailed information for every child of eligible women, born within the last five years of the survey. It contains the information related to the child's pregnancy and postnatal care and immunization and health. It also has the information of the mother of each child. It is therefore the appropriate file for investigating child health indicators such as immunization coverage and recent episodes of childhood illnesses. Given that unit of analysis in this file is the children of women born in the last 5 years, it is most appropriate data for the present study. The details of the description of the other datasets can be found on the DHS program website at <http://dhsprogram.com>.

3.3 Data Extraction

Child recode data was downloaded from DHS webpage. Data was then opened in Statistical Package of Social Sciences (SPSS) software version 21. Original data had 5884 cases and 1158 variables. Cases were selected based on the availability of data on anaemia status of children under five years. Out of the 5884 cases, only 2388 had data on results on anaemia testing. Therefore, a subset with 2388 cases was opened in a new data set. In addition, 45 children who were not usual residents in their households were excluded from the analysis. Therefore, the total study sample used subsequently in the analysis was 2343. This represents almost half of the total sample of children and very consistent with expectation given that only half of the total number of children in the survey had their blood samples taken for anaemia testing. Variables which were relevant to the study were then identified in the sub data. Data was subsequently imported into Stata 14 analysis. The summary of the stages in the data extraction is shown in a data flow chart below (Figure 3.1)

Figure 3.1

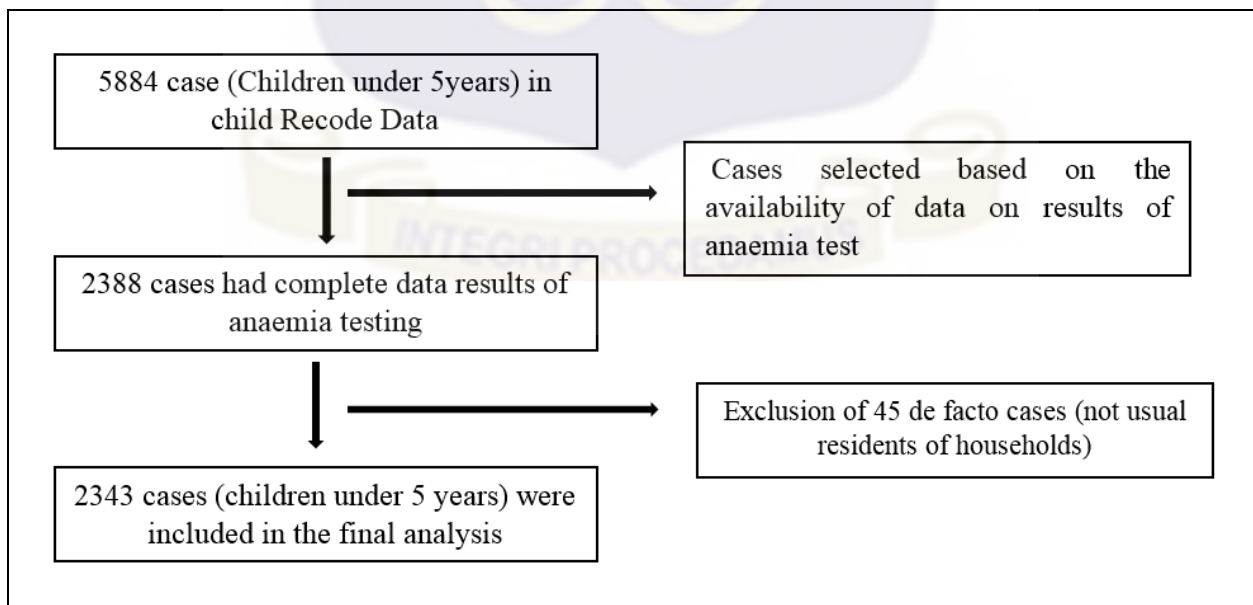


Figure 3.1: Data selection flow chart

3.4 Measurement and Recoding of Variables:

This part of the methodology explains how variables were measured and recoded for analysis in the study.

3.4.1 Outcome variable: Anaemia Status of Children under 5years

The main outcome variable in the study was anaemia status of children under five years in Ghana. In about 50% of the selected households for the DHS survey, blood samples for anaemia testing were obtained from all children aged 6-59 months after appropriate consents were obtained from either their parents or an adult responsible for them. For those who were 6-11 months old, blood samples were taken from a drop of blood following a heel prick, and for those aged 12-59 months, a finger prick was used. Blood was collected in a microcuvette and Hb analysis was conducted on-site using portable HemoCue analyser which operates on battery. In this study a child is diagnosed as anaemic based on WHO classifications. A child was diagnosed as anaemic when the Hb level was below 11.0g/dl. Children who were classified as anaemic were sub-divided into three severity levels. Children whose Hb levels below 7.0 g/dl were classified as having severe anaemia, those whose Hb levels ranged 7.0-9.9 g/dl were classified as having moderate anaemia, and those with Hb levels of 10.0-10.9 g/dl were categorized as having mild anaemia. Therefore anaemia status of the child was measured as an ordinal variable with four (4) levels including Non Anaemic, Mild Anaemia, Moderate Anaemia and Severe Anaemia.

3.4.2 Measurement of independents variables in the study

The independents variables of the study were categorized under three main headings: Child Level Factors, Maternal Level Factors, and Household Level Factors.

3.4.3 Child Level Factors

Child level factors measured and included in the study were age, gender, birth order, and history of fever, diarrhoea and vitamin A supplementation.

3.4.3.1 Age of Child

Child's Age is known in literature to be a determinant of anaemia. Child's age was measured in months since the study was among children under five years. It was grouped into five age categories: 6-11months, 12-23 months, 24-35months, 36-47 months and 48-59months. This was used in the first stage of the analysis (descriptive statistics). In the subsequent analysis Child's age was further categorized into two level 6-23months and 24-59months to ensure consistency with age categories predominantly reported in literature about anaemia in children under five years.

3.4.3.2 Gender of Child

Gender of child was measured as nominal variable with a dichotomous response: Male and Female.

3.4.3.3 Fever status of Child

History of fever within two weeks of the survey was recorded. This was measured as "Yes" or "No", where "Yes" means the child had fever within two weeks of the survey whiles "No" means that the child had no fever. This information was sought from mothers or guardians.

3.4.3.4 Diarrhoea Status of Child

Like Fever, history of diarrhoea within two weeks of the survey was recorded. This was measured as Yes or No, where “Yes” response means the child had diarrhoea within two weeks of the survey, whereas “No” response means that the child had no Diarrhoea.

3.4.3.5 Vitamin A supplementation

This was measured as vitamin A intake within the last six (6) months of the survey. This was measured as Yes or No, where “Yes” response means the child had taken Vitamin A within the last 6months of the survey while “No” response means that the child had not taken Vitamin A within the last 6months of the survey.

3.4.3.6 Birth Order of Child

This represent the order in which the child was born by mother. First born child was measured as birth order 1, second child is order 2, and third child is order 3 in that order. Originally birth order was measured as an ordinal variable but was categorized into five levels: order 1, Order 2, Order 3, Order 4-5 and order 6 and above. This was used in the descriptive statistics stage. In the second and third stages of the analysis, birth order was not categorized and hence the original variable which was a continuous variable was used instead.

3.4.4 Parental level factors

3.4.4.1.0 Maternal Factors

This section describes how maternal level variables were measured and recoded for analysis.

3.4.4.1.1 Mothers' Age

Mother's age was measured in quinary age groups. It was therefore grouped into seven (7) year groups: 15-19, 20-24, 25-29, 30-34, 35-39, 40-44 and 45-49 year groups.

3.4.4.1.2 Highest Educational level of mother

This was measured as an ordinal variable consisting of four (4) levels: No Education, Primary, Secondary and higher education levels.

3.4.4.1.3 Anaemia Status of mother

Mothers' anaemia status was measured as an ordinal variable at four (4) levels: Non Anaemic, Mild Anaemia, Moderate Anaemia and Severe Anaemia.

3.4.4.2.0 Paternal Factors

3.4.4.4 Highest Educational Level of Fathers

Like maternal education, fathers' educational level was also measured at four (4) levels: No Formal Education, Primary, Secondary and higher education levels.

3.4.5 Household Level Factors:

This section describes how child level variables were measured and recoded for analysis.

3.4.5.1 Household Wealth Status

Wealth status of households was also measured as an ordered variable with five levels (Wealth Quintile Levels). Households fell into any of the following income categories: Poorest, Poorer, Middle, Richer, and Richest.

3.4.5.2 Household Size

This is the measure of number of the members of the households of each child. It was categorized at two levels: Households with 1-5 members and those with 6 members and above.

3.4.5.3. Number of children under five years in household

The number of children under five years in each household was also recorded. It was grouped into three categories: 0-1 child, 2 children and 3 children and above.

3.4.5.4 Residence (Locality)

The locality of each household was also recorded. Locality of residence was either “rural” or “urban”.

3.4.5.5 Region

The regional location of each household was also recorded. Households were located in any of the ten (10) regions in Ghana. This included the Western, Central, Greater Accra, Volta, Eastern, Ashanti, Brong Ahafo, and Northern, Upper East, and Upper West regions.

3.4.5.6 Main floor material

There were five categories of main floor materials: Sand, Ceramic Tiles, Cement, Woolen/Synthetic carpets, and Rubber carpets.

3.4.5.7 Source of Water

Source of water was first categorized into five groups :(1) Pipe Water (piped into dwelling/Yard and public tap/standpipe) (2) Borehole (3) Protected Well/spring (4) Sachet water (5) Unprotected water source (Open River, Dam/stream, and unprotected well/spring). This was

further categorized in improved and unimproved water sources based on WHO and UNICEF Joint Monitoring Programme for Water Supply and Sanitation (WHO& UNICEF, n.d.). The improved water source included all forms of Pipe Water, Borehole, Protected Well/Spring, and Sachet water. The unimproved water source included Open River, Dam/stream, and unprotected well/spring.

3.5 Methods of Data Analysis

Since secondary data was used for the analysis, data was inspected for missing values, cleaned and variables which were not relevant to the study were dropped. Data analysis was done using the STATA (14) software. Data analyses were done in two main stages. The first stage involved descriptive analysis and the second stage involved crude and adjusted ordered logistic regression estimates of the determinants of anaemia in children under five years

3.5.1 Descriptive analysis

During the first stage, descriptive statistics was performed for the background characteristics of respondents. All the independent variables were cross tabulated with the outcome variable (Anaemia Status of Children under 5years) and their corresponding p-values for the chi-square (X^2) test statistic was reported.

Ordered logistic regression was subsequently performed to evaluate the strength of association between the independents variables and the outcome variable (Anaemia Status of children under 5years). The likelihood-ratio test of proportionality of odds was evaluated to ensure that the proportional odds assumption was satisfied.

3.5.2 Crude Ordered Logistic Regression Estimates

During the second stage, an ordered logistic regression analysis was performed to evaluate the strength of the association between anaemia status of children and each independent variable. The proportional odds ratios generated at this level were all crude estimates of the odds ratio since other variables were not controlled for.

3.5.3 Adjusted Ordered Logistic Regression Estimates

In the third stage, multivariate ordered logistic models were used. Four main models were used based on the conceptual framework for the study. Adjusted odds ratios were estimated and their corresponding confidence intervals were reported. The likelihood-ratio test of proportionality of odds was performed to ensure that the proportional odds assumption was satisfied under each model.

3.5.3.1 Model 1

Model one (1) included six (6) independent variables at the child level: Age of child, gender of child, birth order of child, history of fever, diarrhoea, vitamin A supplementation. The likelihood-ratio test of proportionality of odds across response categories showed that proportional odds assumption was satisfied under model one ($\text{Chi}^2(12) = 14.41, p = 0.275$).

3.5.3.2 Model 2

Model two (2) included four (4) independent variables at the parental level: Mothers' Age, Mothers' Highest Education, Anaemia status of mother and highest education of father. The likelihood-ratio test of proportionality of odds across response categories showed that proportional odds assumption was satisfied under model two ($\text{Chi}^2(8) = 10.87, p = 0.209$).

3.5.3.3 Model 3

Model three (3) consisted of seven (7) independent variables at the Household level: Household size, Number of children under 5years in household, Household Wealth Status, Source of Drinking Water, Main Floor Material, Locality, and Region. The likelihood-ratio test of proportionality of odds across response categories showed that proportional odds assumption was satisfied under model three ($\text{Chi}^2(14) = 7.52, p = 0.913$)

3.5.3.4 Model 4

This model combined variables which showed significant proportional odds ratio estimates in model 1, model 2 and model 3. The model consisted of 14 independent variables: Age of Child, Gender of Child, Birth Order of child, History of fever in child, History of diarrhoea, History of Vitamin A supplementation, mothers' age, mothers' education, mothers' anaemia status and fathers' education, Number of children under 5years in household, Wealth Status, Locality, and Region. The likelihood-ratio test of proportionality of odds across response categories showed that proportional odds assumption was satisfied under model four ($\text{Chi}^2(28) = 37.57, p = 0.107$)

3.6 Ethical Consideration

First and foremost, permission was sought from the Demographic and Health Surveys (DHS) program to use the 2014 Ghana DHS Survey data for analysis in this study. In addition, ethical clearance was also sought from the Ethical Review Committee (ERC) of the Ghana Health Service (GHS). No additional consents were required for this study because data had already been collected and de-identified. Participants in this study had no direct benefits or risk. There

was no risk to confidentiality as the DHS data is de-identified before making it available to researchers.



CHAPETR FOUR

RESULTS

4.0 Introduction

This chapter presents the results of the analysis of data used in the study. The chapter begins with the presentation of results on the prevalence of anaemia, followed by detailed description of the prevalence by child, parental and household level factors. In addition, the chapter also presents the results of the crude ordered regression estimates of the determinants of anaemia in children under five years. Finally, the chapter presents the results of the adjusted ordered regression estimates of the determinants of anaemia in children under five years using the four models already described in chapter three.

4.1 Prevalence of Anaemia and background Characteristics of children

In all, a total of 2343 children were included in the final analysis. Male to female ratio was 52:48. The overall prevalence of anaemia in children under 5years was 69.61% with 27.19% being mildly anaemic, 39.56% moderately anaemic and 2.86% severely anaemic.

However, anaemia prevalence varied across the different stratum of age categories of children under 5years. Among the children aged 6-11 months, the prevalence of anaemia was 78.03%. Prevalence was 79.15% among those aged 12-23months, 70.71% in children aged 24-35months, 63.51% among those aged 36-47months and 58.84% in children aged 48-59months ($p < 0.05$).

In terms of gender differences, prevalence was 71.19% in males and 67.89% in females ($p > 0.05$). Prevalence of anaemia increased with increasing birth order of the child. Prevalence was 65.39% among first-born children, 67.39% among second born Children, 68.45% in third-

born Children, 70.88% among forth-fifth born Children and 77.11% among sixth born children and above ($p < 0.05$). Details can be found in Table 4.1.

4.2 Prevalence of anaemia by history of fever, diarrhea and vitamin A intake in children under 5 years.

Majority of the children 1952(83.31%) had no fever in the last two weeks preceding the survey while 391(16.69%) had fever. Among those who had fever, 20.46% were mildly anaemic, 51.17% were moderately anaemic and 6.65% were severely anaemic. Among those who had no fever 28.35%, 37.04% and 2.01% were mildly, moderately and severely anaemic respectively ($p < 0.05$). Similarly, majority of the children (86.77%) had no diarrhoea within two weeks prior to the survey while 13.23% had a history of diarrhoea. Anaemia prevalence was 78.06% among those who had diarrhea and 68.32% among those who had no diarrhoea two weeks prior to the survey ($p < 0.05$). Prevalence of anaemia was 69.56% among children who had vitamin A within 6 months of the survey and 69.79% among those who had no vitamin A intake ($p > 0.05$). Details can be found in Table 4.2.

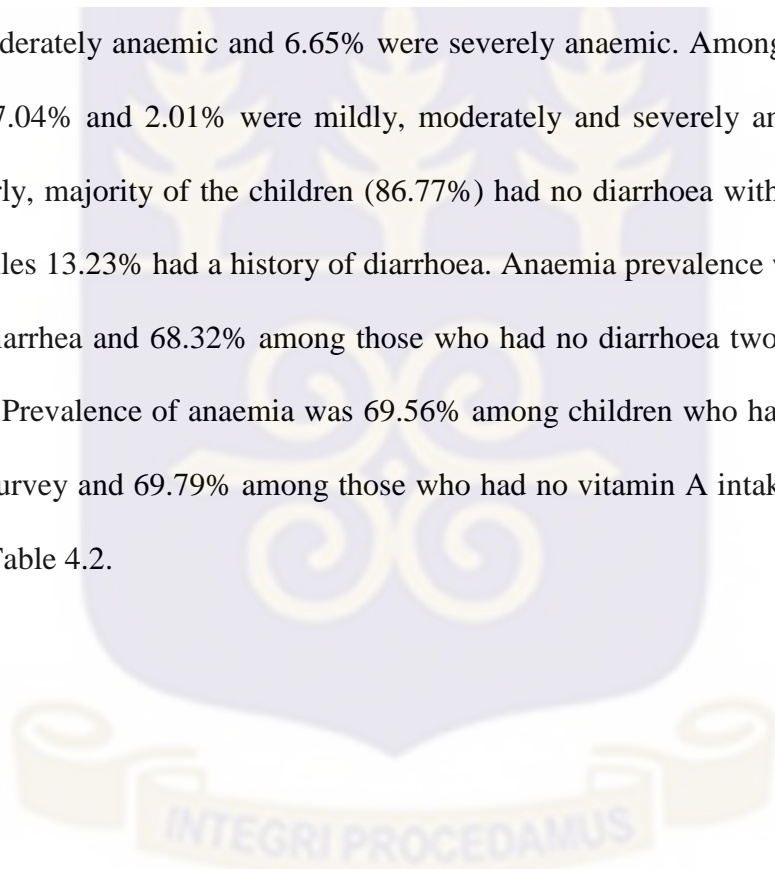


Table 4.1 Prevalence of Anaemia by Age, Sex and Birth Order of children

Variable	Category	No Anaemia n (%)	Mild Anaemia n (%)	Moderate Anaemia n (%)	Severe Anaemia n (%)	Total N (%)	p-value
Age (Months)	6-11	58 (21.97)	66 (25.00)	128(48.48)	12(4.55)	264 (100)	<0.001
	12-23	118 (20.85)	141 (24.91)	280 (49.47)	27 (4.77)	566 (100)	
	24-35	157 (29.29)	157 (29.29)	210 (39.18)	12 (2.24)	536 (100)	
	36-47	181 (36.49)	143 (28.83)	162 (32.66)	10 (2.02)	496 (100)	
	48-59	198 (41.16)	130 (27.03)	147 (30.56)	6 (1.25)	481 (100)	
	Total	712 (30.39)	637 (27.19)	927 (39.56)	67 (2.86)	2343(100)	
Sex of Child	Male	352 (28.81)	341 (27.91)	485 (39.69)	44 (3.60)	1222 (100)	0.057
	Female	360 (32.11)	296 (26.40)	442 (39.43)	23 (2.05)	1121 (100)	
	Total	712 (30.39)	637 (27.19)	927 (39.56)	67 (2.86)	2343 (100)	
Birth Order	1	172 (34.61)	130 (26.16)	182 (36.62)	13 (2.62)	497 (100)	0.005
	2	150 (32.61)	135 (29.35)	162 (35.22)	13 (2.83)	460 (100)	
	3	130 (31.55)	114 (27.67)	154 (37.38)	14 (3.40)	412 (100)	
	4 – 5	173 (29.12)	166 (27.95)	239 (40.24)	16 (2.69)	594 (100)	
	6 and above	87 (22.89)	92 (24.21)	190 (50.00)	11 (2.89)	380 (100)	
	Total	712 (30.39)	637 (27.19)	927 (39.56)	67 (2.86)	2343 (100)	

Table 4.2 Prevalence of anaemia by history of fever, diarrhea and vitamin A intake in children under 5years.

Variable	Category	No Anaemia n (%)	Mild Anaemia n (%)	Moderate Anaemia n (%)	Severe Anaemia n (%)	Total N (%)	p-value
Fever	No	631 (32.33)	557 (28.53)	723 (37.04)	41 (2.10)	1952 (100)	< 0.001
	Yes	81 (20.72)	80 (20.46)	204 (51.17)	26 (6.65)	391 (100)	
	Total	712 (30.39)	637 (27.19)	927 (39.56)	67 (2.86)	2343 (100)	
Diarrhoea	No	644 (31.68)	554 (27.25)	783 (38.51)	52 (2.56)	2033 (100)	0.001
	Yes	68 (21.94)	83 (26.77)	144 (46.45)	15 (4.84)	310 (100)	
	Total	712 (30.39)	637 (27.19)	927 (39.56)	67 (2.86)	2343 (100)	
Vitamin A supplementation	No	264 (30.21)	227 (25.97)	359 (41.08)	24 (2.75)	874 (100)	0.719
	Yes	442 (30.44)	404 (27.79)	566 (38.93)	42 (2.89)	1454 (100)	
	Total	706 (30.33)	631 (27.10)	925 (39.73)	66 (2.84)	2328 (100)	

4.3 Anaemia Prevalence in Children Under Five Years by Parental Factors

4.3.1 Maternal Age

In terms of maternal age, the highest prevalence of anaemia was 86.15% among children whose mothers were aged 15-19years. Anaemia prevalence were 73.53%, 68.22%, 67.02%, 67.33%, 71.75% and 73.42% among children whose mothers were aged 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49years respectively ($p<0.05$). There was a significant relationship between anaemia prevalence and maternal age (Table 4.3)

4.3.2 Maternal Education

Prevalence of anaemia was highest (80%) in among children whose mothers had no formal education. Prevalence decreased with increasing maternal education. Prevalence was 70.42%, 61.58%, and 45.07% among children whose mothers had attained primary, secondary and higher education respectively ($p<0.05$). Therefore, there was a significant relationship between anaemia prevalence in children under five years and maternal education (Table 4.3)

4.3.3 Anaemia Status of Mother

Prevalence of anaemia was lowest (64.06%) among children whose mothers had no anaemia and highest (81.12%) among children whose mothers had moderate anaemia. Prevalence was 75.41% and 80% among children whose mothers were mildly anaemic and severely anaemic respectively ($p<0.05$). There was a significant relationship between anaemia prevalence in children under five years and maternal anaemia status (Table 4.3).

4.3.4 Fathers Education

Like maternal highest education level, prevalence of anaemia was highest (81.28%) in children whose fathers had no formal education. Prevalence reduced with increasing level of fathers' education. Prevalence were 74.72%, 63.46%, and 55.32% in children whose fathers had attained primary, secondary and higher education respectively ($p < 0.05$). There was a significant relationship between anaemia prevalence in children under five years old and fathers' highest level of education (Table 4.3)

Table 4.3: Anaemia prevalence by parental factors

Variable Category	No Anaemia n (%)	Mild Anaemia n (%)	Moderate Anaemia n (%)	Severe Anaemia n (%)	Total N (%)	p-value
Age of Mother (years)						
15-19	9 (13.85)	15 (23.08)	37 (56.92)	4 (6.15)	65 (100)	
20-24	99 (26.47)	87 (23.26)	169 (45.19)	19 (5.08)	374 (100)	
25-29	184 (31.78)	159 (27.46)	227 (39.21)	9 (1.55)	579 (100)	
30-34	188 (32.98)	165 (28.95)	203 (35.61)	14 (2.46)	570 (100)	
35-39	148 (32.67)	126 (27.81)	168 (37.09)	11 (2.43)	453 (100)	
40-44	63 (28.25)	61 (27.35)	90 (40.36)	9 (4.04)	223 (100)	
45-49	21 (26.58)	24 (30.38)	33 (41.77)	1 (1.27)	79 (100)	
Total	712 (30.39)	637 (27.19)	927 (39.56)	67 (2.86)	2343 (100)	0.002
Highest Education of Mothers						
No Formal Education	171 (20.00)	226 (26.43)	423 (49.47)	35 (4.09)	855 (100)	
Primary	142 (29.58)	115 (23.96)	207 (43.13)	16 (3.33)	480 (100)	
Secondary	360 (38.42)	273 (29.14)	288 (30.74)	16 (1.71)	937 (100)	
Higher	39 (54.93)	23 (32.39)	9 (12.68)	0 (0.00)	71 (100)	
Total	712 (30.39)	637 (27.19)	927 (39.56)	67 (2.86)	2343 (100)	<0.001
Fathers' Education						
No Formal Education	129 (18.72)	183 (26.56)	344 (49.93)	33 (4.79)	689 (100)	
Primary	67 (25.28)	72 (27.17)	116 (43.77)	10 (3.77)	265 (100)	
Secondary	380 (36.54)	285 (27.40)	357 (34.33)	18 (1.73)	1040 (100)	
Higher	84 (44.68)	51 (27.13)	51 (27.13)	2 (1.06)	188 (100)	
Total	660 (30.25)	591 (27.09)	868 (39.78)	63 (2.89)	2182 (100)	<0.001
Mothers' Anaemia Status						
Non Anaemic	468 (35.94)	359 (27.57)	448 (34.41)	27 (2.07)	1302 (100)	
Mild	193 (24.59)	209 (26.62)	355 (45.22)	28 (3.57)	785 (100)	
Moderate	44 (18.88)	65 (27.90)	116 (49.79)	8 (3.43)	233 (100)	
Severe	1 (20.00)	0 (0)	3 (60.00)	1 (20.00)	5 (100)	
Total	706 (30.37)	633 (27.23)	922 (39.66)	64 (2.75)	2325 (100)	<0.001

4.4 Household Characteristic and anaemia prevalence in children under 5years

4.4.1 Household Wealth Quintile

Prevalence of anaemia decreased with increasing household wealth. Prevalence was highest (79.84%) among children from poorest household and lowest (46.42%) among children from richest households. Prevalence was 75.25%, 65.75%, and 63.29% in children from poorer, middle and richer households respectively ($p < 0.05$). There was a significant relationship between the prevalence of anaemia in children under five years old and household wealth status (Table 4.4).

4.4.2 Household Size

Prevalence of anaemia in children under 5years was 66.53% in households whose sizes ranged 1-5 members and 73.14% in household with 6 members and above ($p < 0.05$). Likewise, prevalence of anaemia increased with increasing number of children under 5years in household ($p < 0.05$). Results show a significant relationship between household size and the prevalence of anaemia in children under five years old (Table 4.4).

4.4.3 Source of Drinking Water

The prevalence of anaemia was 68.22% among children under five years whose households had access to improved water and 76.72% among children whose households had access to unimproved water ($p < 0.05$). Results show significant relationship between source of drinking water and prevalence of anaemia in children under five years (Table 4.4).

4.4.4 Main Floor Material

Prevalence of anaemia was highest (73.3%) among children from households whose main floor material was sand and lowest (51.82%) among those from households whose main floor material was ceramic tiles. Prevalence were 71.73%, 59.59% and 65.57% among children under five years from households whose main floor materials were cement, Woolen carpets, and rubber/synthetic carpets respectively ($p < 0.05$). The results show a significant relationship between anaemia prevalence and main floor material of households (Table 4.4).

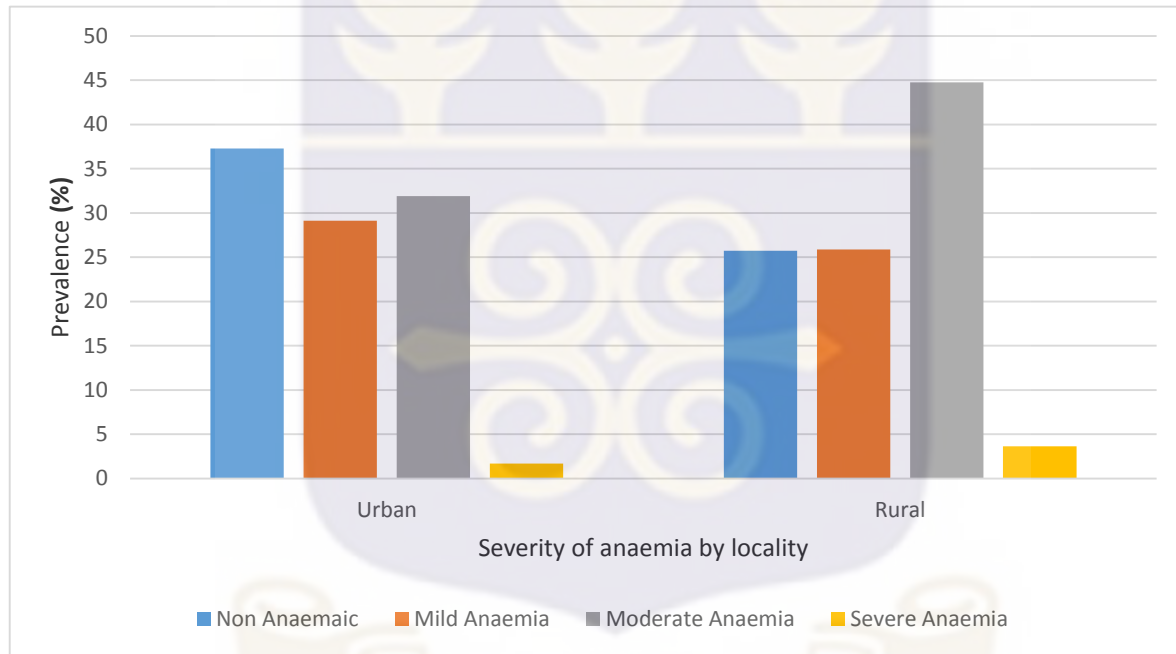
Table 4.4 Anaemia Prevalence by household Characteristics

Variable	No Anaemia n (%)	Mild Anaemia n (%)	Moderate Anaemia n (%)	Severe Anaemia n (%)	Total N (%)	p-value
Household Wealth						
Poorest	154 (20.16)	195 (25.52)	383 (50.13)	32 (4.19)	764 (100)	<0.001
Poorer	125 (24.75)	136 (26.93)	226 (44.75)	18 (3.56)	505 (100)	
Middle	149 (34.25)	101 (23.22)	172 (39.54)	13 (2.99)	435 (100)	
Richer	127 (36.71)	119 (34.39)	97 (28.03)	3 (0.87)	346 (100)	
Richest	157 (53.58)	86 (29.35)	49 (16.72)	1 (0.34)	293(100)	
Total	712 (30.39)	637 (27.19)	927 (39.56)	67 (2.86)	2343 (100)	
Household Size						
1-5 Members	419 (33.47)	350 (27.96)	456 (36.42)	27 (2.16)	1252 (100)	<0.001
6 and above	293 (26.86)	287 (26.31)	471 (43.17)	40 (3.67)	1091 (100)	
Total	712 (30.39)	637 (27.19)	927 (39.56)	67 (2.86)	2343 (100)	
Number of Children under 5yrs						
0-1 child	351 (36.11)	265 (27.26)	339 (34.88)	17 (1.75)	972 (100)	<0.001
2 children	271 (27.57)	273 (27.77)	406 (41.30)	33 (3.36)	983 (100)	
3 children and above	90 (23.20)	99 (25.52)	182 (46.91)	17 (4.38)	388 (100)	
Total	712 (30.39)	637 (27.19)	927 (39.56)	67 (2.86)	2343 (100)	
Source of drinking water						
Improved	619 (31.71)	533 (27.31)	747 (38.27)	53 (2.72)	1952 (100)	0.003
Unimproved	88 (23.28)	102 (26.98)	174 (46.03)	14 (3.70)	378 (100)	
Total	707 (30.34)	635 (27.25)	921 (39.53)	67 (2.88)	2330 (100)	
Main Floor Material						
Sand	51 (26.70)	44 (23.04)	83 (43.46)	13 (6.81)	191 (100)	<0.001
Ceramic Tiles	53 (48.18)	42 (38.18)	14 (12.73)	1 (0.91)	110 (100)	
Cement	463 (28.27)	432 (26.37)	700 (42.74)	43 (2.63)	1638 (100)	
Woolen Carpet	59 (40.41)	44 (30.14)	42 (28.77)	1 (0.67)	146 (100)	
Rubber carpets	73 (34.43)	65 (30.66)	67 (31.60)	7 (3.30)	212 (100)	
Total	699 (30.43)	627 (27.30)	906 (39.44)	65 (2.83)	2297(100)	

4.4.5 Prevalence of anaemia by Locality

Anaemia prevalence in children under 5years varied with regards to the locality of the child. Prevalence was 74.28% in rural areas and 62.72% in urban areas in Ghana. It was revealed that 44.77% of children in rural areas were moderately anaemic as compared to 31.89% of moderate anaemia seen in children living in urban areas. Severe anaemia prevalence was 3.65% in rural areas as compared to 1.69% in urban areas (Figure 4.1)

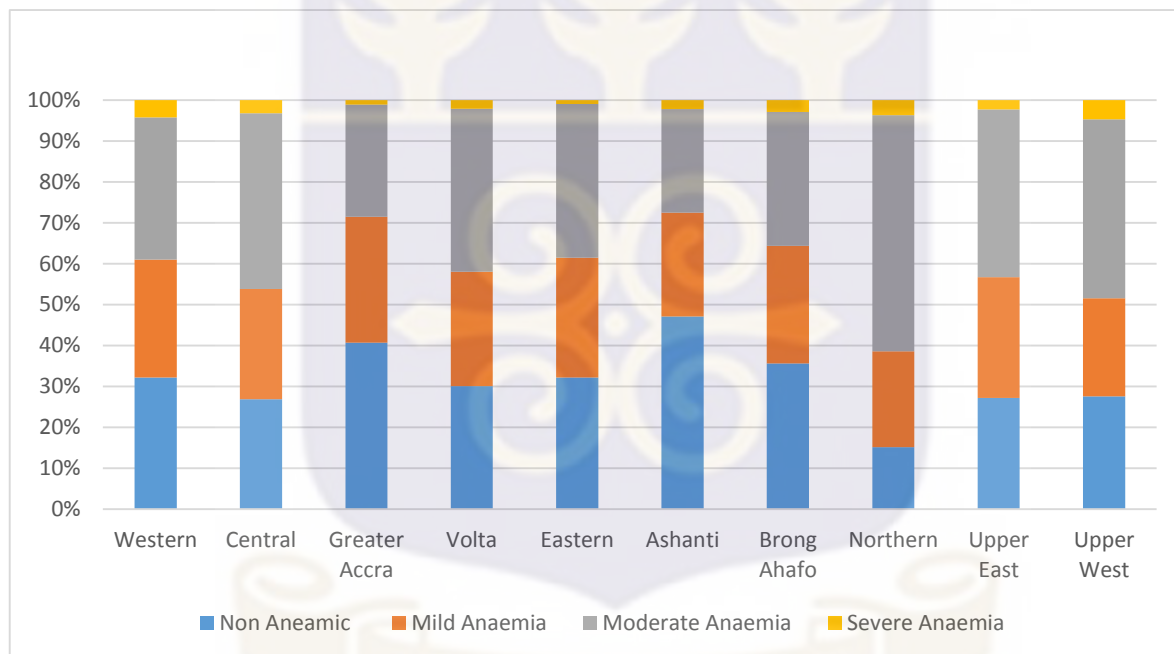
Figure 4.1 Severity of Anaemia in children under five years by Locality in Ghana



4.4.6 Prevalence of anaemia by Regions in Ghana

Moreover, regional variations in the prevalence and the severity of anaemia were observed. As compared to the national average, relatively low prevalence of anaemia were found in children under five years living in the Ashanti Region (52.89%), Greater Accra Region (59.34%) and Brong Ahafo Region (64.36%) whiles higher prevalence above the national average were found in the Northern Region (84.84%), Upper East (72.81%), Upper West Region (72.40%) and the Central Region (73.09%). Details can be found in Figure 4.2 below.

Figure 4.2 Severity of Anaemia by Regions in Ghana



4.5.0 Ordered Logistic Regression estimates of the determinants of anaemia in children under 5 years in Ghana.

This part of the results presents the crude and adjusted ordered logistic regression estimates showing the strength of the association between anaemia status of children under five years and child, parental, household level factors.

4.5.1.0 Child level factors and Anaemia Status of Children.

4.5.1.1 Relationship between Age of the Child and Anaemia Status of the Child

From Table 4.5, crudes ordered logistic regression estimates revealed a significant relationship between the age of child and anaemia status. For children aged 6-23months, the proportional odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was 2.08 times greater than for children aged 24-59months (OR=2.08 ,95% CI 1.77-2.43). Likewise, the odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was 2.08 times greater for children aged 6-23months compared to children aged 24-59months. Similarly, the effects in *model 1* had increased marginally and remained significant and positive. Thus after controlling for gender, birth order, history of fever and diarrhoea, and Vitamin A supplementation, the odds of having the combined severe, moderate and mild anaemia status versus non-anaemic status was 2.09 times greater for children aged 6-23months compared to children aged 24-59months (OR=2.09, 95% C1 1.78 - 2.47). Likewise, the effects in model 4 increased marginally and remained positive and significant (OR=2.14, 95%CI 1.79-2.56). Therefore, age of child was an independent determinant of anaemia in children under five years old (Table 4.5).

4.5.1.2 Relationship between Gender of the Child and Anaemia Status of the Child

As shown in Table 4.5, the crude ordered regression estimates revealed no significant association between gender and anaemia status of the child. Likewise, in model 1, there was no significant association between gender and anaemia status. However, in model 4, there was a significant association between gender and anaemia status in children under five years old. Thus, the odds of having the combined severe, moderate and mild anaemia status versus non-anaemic status was 1.26 times greater for males than for females (OR=1.26 95% CI 1.07-1.49), after controlling for age, birth order, history of fever, diarrhoea and vitamin A supplementation of the child, mothers' age, mothers' education, mothers' anaemia status, fathers' education, number of children under 5 years in household, household wealth status, locality, and region. Thus, overlooking the effects of all the variables controlled for in model 4 nullifies the strong association between gender and anaemia status in children under five as revealed in the crude estimates and model 1 (Table 4.5).

4.5.1.3 Relationship between Birth Order of the Child and Anaemia Status of the Child

Crudes estimates revealed that for every unit increase in birth order among children under five years, the proportional odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was 1.10 times greater (OR=1.10,95% CI 1.07-1.14). The effect in model one was maintained with the same magnitude and direction (OR=1.10, 95% CI 1.05-1.14). The effect was slightly reduced but remained significant and positive in model 4 (OR=1.07, 95% CI 1.01-1.14). Therefore, the results show that increasing birth order is associated increased odds of anaemia in children under five years old (Table 4.5).

4.5.1.4 Relationship between Fever and Anaemia Status of the Child

From the crude analysis, the odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was 2.19 times greater for children who had fever (within two weeks of the survey) compared to children who had no fever (OR=2.19, 95% CI 1.77-2.70). However, the magnitude of the effect declined marginally in model 1 but remained significant in the same direction (OR=2.09, 95% CI 1.68-2.59). The effects was slightly reduced in model 4: the odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was 1.96 times greater for children who had fever compared to those who had no fever (OR=1.96, 95% CI 1.55-2.48), after adjusting for age, birth order, gender, diarrhoea, and vitamin A supplementation of the child, mothers' age, education, and anaemia status, fathers' education , number of children under 5years in household, Wealth Status, Locality, and Region. Therefore, history of fever in child was an independent determinant of anaemia in children under five years old (Table 4.5).

4.5.1.5 Relationship between Diarrhoea and Anaemia Status of the Child

Like history of fever, the crudes analysis showed that the proportional odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was 1.58 times greater for children who had diarrhoea compared to those who had no history of diarrhoea within two weeks of the survey (OR=1.58,95% CI 1.26-1.97). The magnitude of the effect considerably reduced in model 1 but remained significant at 0.05 alpha level. Thus, after controlling for child's age, gender, birth order, history of fever and vitamin A supplementation, the odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was 1.26 times greater for children who had diarrhoea compared to those who had no history of diarrhoea (OR=1.26, 95% CI 1.01-1.59). However, there was no significant relationship between

diarrhoea status of the child and anaemia status of the child in model 4. Therefore, history of diarrhoea was not an independent predictor of anaemia in children under five years.

4.5.1.6 Relationship between Vitamin A supplementation and Anaemia Status of the Child

Crude ordered logistic regression analysis revealed that there was no significant association between vitamin A supplementation within six months of the survey and anaemia status of children under five years old but showed significant association in model 1. Thus, after having controlled for child's age, gender, birth order, history of fever and diarrhoea, the odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was decreased by 15% in children who had vitamin A supplementation as compared to those who did not have vitamin A supplementation in the last 6 months to the survey (OR=0.85 95%CI 0.73-0.99). This suggest that not controlling for other determinants in model 1 nullifies the protective effect of vitamin A supplementation on anaemia. However, there was no significant relationship in model 4. Therefore, history of vitamin A supplementation was not an independent predictor of anaemia in children under five years.



Table 4.5 Ordered logistic Regression estimates of the determinants of anaemia in children under 5years by child level factors

Category	Crude estimates				Model 1				Model 4			
	OR	p	[95% CI]		OR	P	[95% CI]		OR	p	[95% CI]	
Child's Age (Months)												
24-59 (ref)												
6-23	2.08	<0.001	1.77	2.43	2.09	<0.001	1.78	2.47	2.14	<0.001	1.79	2.56
Child's Gender												
Male Child	1.13	0.094	0.98	1.31	1.14	0.079	0.98	1.33	1.26	0.005	1.07	1.49
Birth Order	1.10	<0.001	1.07	1.14	1.10	<0.001	1.05	1.14	1.07	0.030	1.01	0.14
History of Fever												
Yes	2.19	<0.001	1.77	2.70	2.09	<0.001	1.68	2.59	1.96	<0.001	1.55	2.48
History of Diarrhoea (Yes)	1.58	<0.001	1.26	1.97	1.26	0.047	1.01	1.59	1.17	0.556	0.88	1.25
Vitamin A supplementation (Yes)	0.95	0.550	0.82	1.11	0.85	0.049	0.73	0.99	1.05	0.556	0.88	1.26

*****Model 1** included 6 independent variables: Age of Child, Gender of Child, Birth Order of child, History of fever in child, History of diarrhoea, History of Vitamin A supplementation.

*****Model 4** OR estimates was adjusted for 14 independent variables: Age of Child, Gender of Child, Birth Order of child, History of fever in child, History of diarrhoea, History of Vitamin A supplementation, mothers' age, mothers' education, mothers' anaemia status and fathers' education, Number of children under 5years in household, Wealth Status, Locality, and Region.

4.5.2 Relationship between parental level factors and anaemia status of children under five years

4.5.2.1 Maternal Age and Anaemia Status of the Child

Crude estimates revealed that increasing maternal age has a protective effect on anaemia in the child. The proportional odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was 0.56 times lower for children whose mothers were aged 20-24yrs compared to those whose mothers were aged 15-19years (OR=0.56,95%CI 0.34-0.94). Using maternal age group 15-19yrs as the reference, the proportional odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was 0.39 times lower for children whose mothers were aged 25-29(OR=0.39, 95%CI 0.24-0.63), 0.36 times lower for maternal age range 30-34(OR=0.36,95%CI 0.22-0.59), 0.37 times lower for children whose mothers were aged 35-39 (OR=0.37,95%CI 0.23-0.61), 0.46 times lower for

children whose mothers were aged 40-44(OR=0.46,95%CI 0.27-0.80) and 0.45 times lower for those children whose mothers were aged 45-49yrs (OR=0.45 95%CI 0.24-0.83).

The protective effect of increasing maternal age on anaemia was maintained in model 2. Thus as compared to children whose mothers were aged 15-19yrs, the proportional odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was 0.47 times lower for children whose mothers were aged 20-24yrs (OR=0.47,95%CI 0.24 0.91), 0.31 times lower for children whose mothers were aged 25-29yrs(OR=0.31,95%CI 0.16-0.60), 0.31 times lower for children whose mothers were aged 30-34yrs(OR=0.31,95%CI 0.16 -0.59), 0.28 times lower for children whose mothers were aged 35-39yrs(OR=0.15,95%CI 0.15-0.55),0.29 times for those whose mothers were aged 40-44yrs (OR=0.29,95% CI 0.15-0.58) and 0.27 times lower for children whose mothers were aged 45-49yrs (OR=0.27,95%CI 0.12-0.57), after controlling for mothers education, mothers anaemia status and fathers education.

The protective effect of increasing maternal age on anaemia was preserved in model 4 (Table 4.6). The greatest effect was seen in maternal age groups 40-44yr and 45-49yrs. As compared to children whose mothers were aged 15-19yrs, the proportional odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was 0.27 times lower in children whose mothers were aged 40-44yrs and 0.23 times lower in children whose mothers were aged 45-49yrs, after controlling for age, birth order, gender, fever , diarrhoea, and vitamin A supplementation of the child, mothers education and anaemia status, fathers' education, number of children under 5years in household, Wealth Status, Locality, and Region. Therefore, maternal age was an independent predictor of anaemia in children under five years (Table 4.6).

4.5.2.2 Maternal Education and Anaemia Status of the Child

The crude analysis revealed that increasing maternal education has a protective effect on the anaemia status of children under 5 years. As compared to children whose mothers had no formal education, the proportional odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was decreased by 30% among children whose mothers had attained primary education (OR=0.70, 95%CI 0.56-0.86), decreased by 59% among children whose mothers had attained secondary education (OR=0.41, 95%CI 0.35-0.49) and decreased by 81% among children whose mothers had attained higher education (OR=0.19, 95%CI 0.12-0.30). The protective effect of increasing maternal education on anaemia status of children was preserved in model 2 though the magnitudes were marginally reduced. For example, after controlling for mothers' age, mothers' anaemia status and fathers' educational level, the odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was decreased by 71% among children whose mothers had attained higher education as compared to those whose mothers had no education (OR=0.29, 95%CI 0.16-0.50). Moreover, it was observed in model 4 that the protective effect of increasing education on anaemia was reserved but the significant protective effects was observed exclusively in children whose mothers had at least secondary education but was not observed in primary education. Precisely, as compared to children whose mothers had no formal education, the odds having the combined severe, moderate and mild anaemia status versus the non-anaemic status was decreased by 29% and 52% and among children whose mothers had attained secondary education (OR=0.71, 95%CI 0.55-0.90) and higher education (OR=0.48, 95%CI 0.26-0.89) respectively, after controlling for all other variables in model 4. Therefore, highest education of mothers was an independent predictor of anaemia in children under five years (Table 4.6).

4.5.2.3 Maternal Anaemia status and Anaemia Status of the Child

The study further explored the strength of relationship between anaemia status of the mother and the anaemia status of the child. Crude analysis revealed that increasing severity of anaemia in mothers was associated with increasing odds of anaemia in children under five years. The proportional odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was 1.70 times greater for children whose mothers were mildly anaemic as compared to those whose mothers were non-anaemic (OR=1.70,95%CI 1.43-1.99). The odds were 2.07 times greater for children whose mothers were moderately anaemic (OR=2.07, 95%CI 1.60-2.69). For children whose mothers were severely anaemic, the odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was 8.30 times greater compared to those whose mothers were non-anaemic (OR=8.30, 95% CI 1.15-59.23).

The direction of the relationship between maternal anaemia status and child anaemia status was preserved in model 2 only for mild and moderate anaemia status of mother though their magnitudes had marginally reduced. Thus, as compared to children of non-anaemic mothers, the odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was 1.62 times greater for children of mildly anaemic mothers (OR=1.62, 95%CI 1.32-1.92) and 1.80 times greater for children of moderately anaemic mothers (OR=1.80, 95%CI 1.37-2.38), after controlling for age and educational level of their mothers and educational level of their fathers. The magnitude of the relationship was strengthened in model 4 over model 2 and that of the crude analysis. All levels severity of anaemia status of the mother were significant determinants of anaemia in children under five years in model 4 and the strongest effect was seen in children of severely anaemic mothers. It was observed that the odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was 9.14 times greater for

children of severely anaemic mothers as compared to those of non-anaemic mothers (OR=9.14,95%CI 1.37-61.11), 1.77 times greater in children of moderately anaemic mothers (OR=1.77,95%CI 1.33-2.35) , and 1.51 times greater for children of mildly anaemic mothers (OR=1.51,95%CI 1.26-1.81), after controlling for age, birth order, gender, fever , diarrhoea, and vitamin A supplementation of the child, mothers education and age , fathers' education, number of children under 5years in household, Wealth Status, Locality, and Region. Therefore, mothers' anaemia status was in independent predictor of anaemia in children under five years old (Table 4.6).

4.5.2.4 Fathers Education and Anaemia Status of the Child.

Crude analysis revealed the proportional odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was decreased by 27% for children whose fathers had attained primary education compared to those whose fathers had no formal education (OR=0.73 ,95%CI 0.56-0.95). However, odds of anaemia was not significantly different for children whose fathers had attained primary education as compared to those whose fathers had no formal education in model 2 and model 4.

Likewise, crude analysis showed that the proportional odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was decreased by 66% for children whose fathers had attained secondary education compared to those whose fathers had no formal education. (OR=0.44, 95%CI 0.36-0.52). After adjusting for maternal age, education and anaemia status in model 2, the odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was decreased by 39% for children whose fathers had attained secondary education compared to those whose fathers had no formal education (OR=0.61,95%CI 0.49-0.76). There was however no significant difference in the odds of

anaemia for children whose fathers had attained secondary education and those whose fathers had no education model 4.

As compared to children whose fathers had no education, crude analysis revealed that the proportional odd of having the combined severe, moderate and mild anaemia status versus the non-anaemic status decreased by 70% for children whose fathers had attained higher education compared to those whose fathers had no education (OR=0.30,95%CI 0.23-0.410). After adjusting for maternal age, education and anaemia status in model 2, the odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was decreased by 37% for children whose fathers had attained higher education compared to those whose fathers had no education (OR=0.63 ,95% CI 0.44-0.92). However, there was no significant difference in the odds of anaemia for children whose fathers had attained higher education and those whose fathers had no education in model 4.

Thus children whose fathers had attained at least secondary education appears to decrease the odds of anaemia as compared to children whose fathers had no education in the crude analysis and model 2 but this significant relationship was lost in model 4. Unlike mothers' educational status, fathers' educational status was not an independent predictor of anaemia in children under five years (Table 4.6).

Table 4.6 Ordered logistic regression estimates of the determinants of anaemia in children under 5years by Parental factors

Variable Category	OR	P	[95% CI]		OR	P	[95% CI]		OR	P	[95% CI]	
	Crude estimates				Model 2				Model 4			
Mothers' Age												
15-19	Ref											
20-24	0.56	0.027	0.34	0.94	0.47	0.026	0.24	0.91	0.50	0.044	0.25	0.98
25-29	0.39	<0.001	0.24	0.63	0.31	<0.001	0.16	0.60	0.34	0.002	0.17	0.66
30-34	0.36	<0.001	0.22	0.59	0.31	<0.001	0.16	0.59	0.33	0.002	0.17	0.67
35-39	0.37	<0.001	0.23	0.61	0.28	<0.001	0.15	0.55	0.30	0.001	0.15	0.60
40-44	0.46	0.004	0.27	0.80	0.29	<0.001	0.15	0.58	0.27	0.001	0.12	0.60
45-49	0.45	0.010	0.24	0.83	0.27	0.001	0.12	0.57	0.23	0.001	0.09	0.54
Mothers' Education												
No Formal Education	Ref											
Primary	0.70	0.001	0.56	0.86	0.75	0.016	0.59	0.95	0.89	0.355	0.69	1.14
Secondary	0.41	<0.001	0.35	0.49	0.50	<0.001	0.40	0.62	0.71	0.006	0.55	0.90
Higher	0.19	<0.001	0.12	0.30	0.29	<0.001	0.16	0.50	0.48	0.020	0.26	0.89
Mothers Anaemia Status												
Non Anaemic	Ref											
Mild Anaemia	1.70	<0.001	1.43	1.99	1.62	<0.001	1.36	1.92	1.51	<0.001	1.26	1.81
Moderate Anaemia	2.07	<0.001	1.60	2.69	1.80	<0.001	1.37	2.38	1.77	<0.001	1.33	2.35
Severe Anaemia	8.30	0.036	1.15	59.23	5.85	0.080	0.80	42.35	9.14	0.022	1.37	61.11
Fathers Education												
No Formal Education	Ref											
Primary	0.73	0.020	0.56	0.95	0.88	0.388	0.67	1.17	1.03	0.833	0.76	1.38
Secondary	0.44	<0.001	0.36	0.52	0.61	<0.001	0.49	0.76	0.79	0.063	0.61	1.01
Higher	0.30	<0.001	0.23	0.41	0.63	0.017	0.44	0.92	0.85	0.437	0.56	1.27

***Model 2 included 4 independent variables: mothers' age, mothers' education, mothers' anaemia status and fathers' education

***Model 4 OR estimates was adjusted for 14 independent variables: Age of Child, Gender of Child, Birth Order of child, History of fever in child, History of diarrhoea, History of Vitamin A supplementation, mothers' age, mothers' education, mothers' anaemia status and fathers' education, Number of children under 5years in household, Wealth Status, Locality, and Region.

4.5.3.0 Household factors and anaemia in children under 5 years

4.5.3.1 Household Size and Anaemia in children under 5years

Increasing household size is a known risk factor for anaemia in children under 5years old. Results of the crude analysis in Table 4.7 revealed that the odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was 1.4 times greater for children in households whose members were numbered greater than 6 as compared children in to households whose members were < 6 (OR=1.40, 95% CI 1.20-1.63). However, this relationship

was lost in model 3. Therefore, size of household was not an independent predictor of anaemia in children under five years (Table 4.7).

4.5.3.2 Number of children under 5years in household and anaemia in children under 5years

Crude estimates revealed that as compared to children in household with at most 1 child under 5years, the odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was 1.45 times greater for children in households with two children (OR=1.45,95%CI 1.23-1.70). However, after adjusting for household size, household wealth status, source of drinking water, main floor material, locality, and region in model 3, the odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was 1.33 times greater for children in households with two children under 5years as compared to household with just a child under 5years (OR=1.33, 95%CI 1.12-1.58). Moreover, the odds of anaemia was 1.24 times greater for children in households with two children in model 4 (Table 4.7).

Crude analysis also revealed that the odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was 1.87 times greater for children in households with at least three children under five years as compared to those in households with just a child. (OR=1.87, 95%CI 0.50-2.33). However, the magnitude of the effect declined in model 3 but remained positive and significant (OR=1.35, 95%CI 1.06-1.75). The magnitude of the effect was marginally reduced in model 4 but remained strong and significant (OR=1.32, 95%CI 1.02-1.70).

Therefore, as compared to children who live in household with just a child under 5yrs, children living in households with 2 children and above are more likely to be anaemic. This was evident

in the crude analysis, model 3 and model 4. Therefore, number of children in household was an independent predictor of anaemia in children under five years old (Table 4.7).

4.5.3.3 Household Wealth Status and Anaemia in children under 5years old

Crude estimates revealed that as compared to children from middle income households, the proportional odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was increased by 79% in children from poorest households (OR=1.79,95%CI 1.43-2.23) , and increased by 40% for children of poorer households (OR=1.40 95%CI 1.10-1.78). In model 3 the odds were increased by 80% and 55% respectively for children in poorest (OR=1.80, 95%CI 1.33-2.44) and poorer households (OR=1.55, 95% CI 1.19-2.02). In model 4, the proportional odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was increased by 36% for children from poorer households as compared to those from middle wealth quintile households, after adjusting for age, birth order, gender, diarrhoea, fever and vitamin A supplementation of the child, mothers' age, education, and anaemia status, fathers' education, number of children under 5years in household, locality, and region of residence (OR=1.36,95%CI=1.03-1.70).

A contrary finding was observed for children from richer and richest households. Crude analysis revealed that as compared to children from middle income households, the proportional odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was decreased by 31% and 63% respectively for children from richer households (OR=0.69, 95%CI 0.53 0.90) and richest households (OR=0.37 95%CI 0.28-0.48). Further analysis in model 3 revealed that that as compared to children from middle income households, the proportional odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was decreased by 33% and 65% respectively for children from richer households (OR=0.67, 95%CI

0.50-0.88) and richest households (OR=0.35 95%CI 0.24-0.49) , after adjusting for household size, number of children under 5years in household, source of drinking water, main floor material, locality, and region.

Similarly, it was revealed in model 4 that the odds of having severe anaemia status versus the combined moderate, mild and non-anaemic status was decreased by 52% for children from richest households as compared to those from middle income households (OR=0.48 95%CI 0.33-0.70), after controlling for age, birth order, gender, fever, diarrhoea, and vitamin A supplementation of the child, mothers education and age and anaemia status , fathers' education, number of children under 5years in household, Locality, and Region.

The results show that using the middle wealth quintile as the reference group, children from poorest and poorer household wealth quintiles were more likely to be anaemia whereas children from richer and richest households were less likely to be anaemic (Table 4.7).

4.5.3.4 Source of Drinking Water and Anaemia in children under 5years of Age.

Crude estimates of the proportional odds revealed that the odds of the combined severe, moderate and mild anaemia status versus the non-anaemic status was 1.45 times greater for children who used unimproved source of drinking water as compared to those who used improved water in their households(OR=1.45,95% CI =1.18-1.78). However, there was no association between source of drinking water and anaemia in status of children under 5years of age in model 3. Thus, source of drinking water was not an independent predictor of anaemia in children under years old (Table 4.7).

4.5.3.5 Main Floor material and Anaemia in children under 5years of Age

Crude estimate revealed that as compared to children who stayed in households with sand as the main floor material, the odds of the combined severe, moderate and mild anaemia status versus the non-anaemic status was 0.27 times lower for children who living in households with ceramic as the main floor material (OR=0.27,95%CI 0.18-0.42), 0.43 times lower for children living in household with synthetic carpets as the main floor material (OR=0.43,95%CI 0.29-0.65) and 0.57 times lower for children living in households with rubber carpets as the main floor material (OR=0.57,95%CI 0.39-0.82). However, no significant associations were observed between main floor material and anaemia status of children under 5years in model 3 (Table 4.7).

4.5.3.6 Place of residence (Locality) and Anaemia in children under five years old

Results of the crude estimates in Table 4.7 revealed that the odds of the combined severe, moderate and mild anaemia status versus the non-anaemic status was 1.80 times greater for children who reside in rural areas as compared to those who reside in urban areas (OR=1.80, 95%CI 1.54-2.09). However, contrary findings were observed in model 3. After adjusting for household size, number of children under 5years in household, source of drinking water, main floor material, wealth quintile, and region, the odds of the combined severe, moderate and mild anaemia status versus the non-anaemic status was 0.79 times lower for children who reside in rural areas as compared to those who reside in urban areas (OR=0.79, 95% CI 0.63-0.98). Nevertheless, there was no significant association between locality and anaemia status of children under 5years in model 4 (Table 4.7).

4.5.3.67 Region of residence and Anaemia status of the child.

Crude estimates revealed that as compared to children who reside in Greater Accra Region, odds of the combined severe, moderate and mild anaemia status versus the non-anaemic status was 1.54 times greater for children who reside in Western Region (OR=1.54 95%CI 1.08-2.21), 2.0 times greater for those living in the Central Region (OR=2.0,95%CI 1.41-2.84), 1.68 times greater for children living in the Volta region (OR=1.68, 95%CI 1.15-2.44), 1.47 times greater for children living in the Eastern Region (OR=1.47 95%CI 1.02-2.11), 3.64 times greater for those living in the Northern Region(OR=3.64,95%CI 2.62-5.07) and 1.83 times greater for children living in the Upper east region (OR=1.83,95%CI 1.28-2.63).

Further analysis in model 3 reveals that as compared to children living in Greater Accra region, the odds of the combined severe, moderate and mild anaemia status versus the non-anaemic status was 0.62 times lower for children residing in the Ashanti Region (OR=0.62, 95% CI 0.42-0.90) and 0.62 times lower for children residing in the Brong Ahafo Region (OR=0.62, 95% CI 0.42-0.91).

Similar effects were seen in model 4. It was revealed that as compared to children living in the Greater Accra Region, the odds of the combined severe, moderate and mild anaemia status versus the non-anaemic status was 0.65 times lower for children residing in the Ashanti Region (OR=0.65, 95% CI 0.43-0.98) and 0.62 times lower for children residing in the Brong Ahafo Region (OR=0.62, 95% CI 0.41-0.94), after controlling for controlling for age, birth order, gender, fever , diarrhoea, and vitamin A supplementation of the child, mothers education and age and anaemia status , fathers' education, household wealth quintile , number of children under 5years in household, and Locality.

Table 4.7 Ordered logistic regression estimates of determinants of anaemia in children under 5years by household factors

Variable	Category	OR	p	[95% CI]	OR	p	[95% CI]	OR	p	[95% CI]	
Crude estimates					Model 3				Model 4		
Household size											
	1-5 members				Ref						
	≥ 6 members	1.40	<0.001	1.20 1.63	0.97	0.725	0.81 1.15				
Number of children under 5years											
	0-1 Child				Ref						
	2 Children	1.45	<0.001	1.23 1.70	1.33	0.001	1.12 1.58	1.24	0.022	1.03 1.49	
	≥ 3 Children	1.87	<0.001	1.50 2.33	1.35	0.016	1.06 1.75	1.32	0.032	1.02 1.70	
Household Wealth Status											
	Poorest	1.79	<0.001	1.43 2.23	1.80	<0.001	1.33 2.44	1.37	0.05	0.99 1.89	
	Poorer	1.40	0.006	1.10 1.78	1.55	0.001	1.19 2.02	1.36	0.03	1.03 1.70	
	Middle	Ref			Ref						
	Richer	0.69	0.005	0.53 0.90	0.67	0.005	0.50 0.88	0.84	0.271	0.62 1.14	
	Richest	0.37	<0.001	0.28 0.48	0.35	<0.001	0.24 0.49	0.48	<0.001	0.33 0.70	
Source of Drinking Water											
	Unimproved	1.45	<0.001	1.18 1.78	0.87	0.258	0.69 1.10				
Main Floor Material											
	Sand				Ref						
	Ceramic	0.27	<0.001	0.18 0.42	0.76	0.301	0.46 1.27				
	Cement	0.80	1.129	0.60 1.07	0.96	0.810	0.71 1.31				
	Woolen/synthetic Carpets	0.43	<0.001	0.29 0.65	0.98	0.932	0.62 1.54				
	Rubber Carpets	0.57	0.002	0.39 0.82	1.03	0.895	0.68 1.56				
Locality											
	Rural	1.80	<0.001	1.54 2.09	0.79	0.039	0.63 0.98	0.82	0.107	0.64 1.04	
Region											
	Western	1.54	0.016	1.08 2.21	0.99	0.996	0.68 1.47	0.99	0.998	0.65 1.52	
	Central	2.00	<0.001	1.41 2.84	1.15	0.460	0.79 1.69	1.16	0.476	0.76 1.78	
	Greater Accra	Ref			Ref						
	Volta	1.68	0.007	1.15 2.44	0.82	0.367	0.54 1.25	0.76	0.236	0.48 1.19	
	Eastern	1.47	0.038	1.02 2.11	0.78	0.229	0.52 1.17	0.77	0.242	0.49 1.19	
	Ashanti	0.84	0.364	0.59 1.21	0.62	0.014	0.42 0.90	0.65	0.044	0.43 0.98	
	Brong Ahafo	1.31	0.117	0.93 1.85	0.62	0.015	0.42 0.91	0.62	0.026	0.41 0.94	
	Northern	3.64	<0.001	2.62 5.07	1.42	0.085	0.95 2.12	1.27	0.285	0.82 1.98	
	Upper East	1.83	0.001	1.28 2.63	0.74	0.183	0.48 1.14	0.77	0.266	0.49 1.21	
	Upper West	2.13	<0.001	1.47 3.12	0.92	0.701	0.59 1.41	0.85	0.498	0.53 1.36	

*****Model 3** OR estimates the was adjusted for 7 independent variables Household size, Number of children under 5years in household, Wealth Status, Source of Drinking Water, Main Floor Material, Locality, and Region.

*****Model 4** OR estimates was adjusted for 14 independent variables: Age of Child, Gender of Child, Birth Order of child, History of fever in child, History of diarrhoea, History of Vitamin A supplementation, mothers' age, mothers' education, mothers' anaemia status and fathers' education, Number of children under 5years in household, Wealth Status, Locality, and Region.

CHAPTER FIVE

DISCUSSION

5.0 Introduction

This chapter presents the discussion of the findings of the study in relation to reviewed literature. The chapter begins with the discussion of the overall prevalence of anaemia in children under 5years in Ghana. Regional variations of the prevalence of anaemia are then presented. It then proceeds to discuss the determinants of anaemia under three main themes which include child level, maternal level and household level factors.

5.1.0 Overall Prevalence of Anaemia in Children under five years.

The overall prevalence of anaemia in children under 5years found in this study was 69.61% with 27.19% being mildly anaemic, 39.56% moderately anaemic and 2.86% severely anaemic. This 69.61% prevalence is higher than the global average of 42.6% reported for the year 2011 (World Health Organization, 2015). Nevertheless, some studies have also reported higher prevalence above the global average as seen in this study. In Nepal, for example, Chandyo et al., (2016) reported a prevalence of 72% among infants 7-12-months. In Africa, Simbauranga et al., (2015) also reported a prevalence of 72.2% among children under 5years in Tanzania and Pinlap (2015) reported 61.3 prevalence in Cameroon. The high prevalence of anaemia found in this study is consistent with national studies reported in Ghana (Borbor et al., 2014; Ewusie et al., 2014; Fosu et al., 2014; Nikoi & Anthamatten, 2014). Ewusie et al., (2014) ,for example, reported a national prevalence of 78.4% in children under 5years in Ghana using the 2008 DHS data. Thus, although the overall prevalence of anaemia among children under five remains high, there was about 9% decrease in the national prevalence in 2014. Nevertheless, the high prevalence reported in the study is of public health significance.

5.1.1 Regional variations in the prevalence of anaemia in children under five years

Though an overall prevalence of 69.61% is reported by this study, it is again worth noting that regional variations were observed in the prevalence of anaemia in children under 5 years in Ghana. The highest prevalence was 84.84% found in the Northern Region. Other high prevalent regions were Upper East (72.81%), Upper West Region (72.40%) and the Central Region (73.09%). Conversely, relatively low prevalence of anaemia was found in children under five years living in the Ashanti Region (52.89%), Greater Accra Region (59.34%) and Brong Ahafo Region (64.36%) as compared to the three northern regions. These findings are consistent with reported regional variations in anaemia prevalence in children under five years in Ghana (Ewusie et al., 2014; Fosu et al., 2014). This study also reported that prevalence of anaemia decreased with increasing household wealth. Prevalence was highest (79.84%) among children from poorest household and lowest (46.42%) among children from richest households. Prevalence was 75.25%, 65.75%, and 63.29% in children from poorer, middle and richer households respectively ($p < 0.05$). In their Ghana Poverty and Inequality Report, Cooke, Hague, & McKay (2016) noted that the Northern, Upper West and Upper East regions continue to have the highest rates of poverty depth and severity. The high rate of poverty depth and severity may be associated with inadequate nutrition and poor household conditions which may explain the high rate of anaemia in children under five years in these areas.

5.2 Determinants of anaemia at child level

5.2.1 Age of Child

Age of child was found to be a significant determinant of anaemia in children under five years of age at the crude analysis, model 1 and model 4. The highest odds of anaemia was observed among children under 2years old. The study reports that the proportional odds of having the combined severe , moderate, and mild anaemia status versus non-anaemic status was 2.14 times greater than for children aged 6-23months (< 2yrs) as compared to those aged 24-59months (≥ 2 yrs), after controlling for birth order, gender, fever , diarrhoea, and vitamin A supplementation of the child, mothers' age, education and anaemia status, fathers' education, household size, number of children under 5years in household, Wealth Status, Locality, and Region (OR=2.14, 95%CI 1.79-2.56). This findings corroborate what has been reported in previous studies (Borbor et al., 2014; Pinlap, 2015; Tazhibayev et al., 2014; Souganidis et al., 2012; Villalpando et al., 2003). Borbor et al. (2014), for example, reported that children under 2years were 2 times likely to be anaemic as compared to children those aged 2-5yrs in Ghana (OR 2.10, $p < 0.000$). Magalhaes & Clements (2011) also reported similar findings in the study among three countries in West Africa including Ghana, Mali and Burkina Faso. Children aged 6-23months includes breast feeding children and those adapting to complementary feeding. High iron requirements especially in the first 12 months of life coupled with decline in maternal iron reserves makes it inadequate for breast milk to provide for the high iron requirements for children (FAO & WHO, 2001). Moreover, Onyango (2003) reported that complementary feeding in contemporary African societies are very monotonous consisting of mainly cereals which lacks the required minerals and nutrients required for growth immunity. Meanwhile high phytate

content in cereal foods reduces the bioavailability of iron (Al Hasan et al., 2016; Hurrell & Egli, 2010) which in turn may explain the high rate of anaemia in children under 2years.

5.2.2 Gender of Child

This study reports that the proportional odds of anaemia is 1.26 times greater for male children than for female children (OR=1.26 95% CI 1.07-1.49) in model 4 although this association was insignificant at 95% CI in the crude analysis and model 1 ($p>0.05$). Thus other variables in model 4, which were not controlled for in the crude analysis and model 1 might have skewed the odds ratios towards the null as seen in model 1 and the crude analysis. High odds of anaemia for male children reported by the study is congruent with some literature (Chandyo et al., 2016; Fosu et al., 2014; Ngesa & Mwambi, 2014, Simbauranga et al., 2015). However, this finding is incongruent with that of Borbor et al., (2014) and Ewusie et al., (2014) who did not find any significant gender difference in the prevalence of anaemia in children under five years in Ghana. Ewusi et al (2014), for example, did not perform a multivariate logistic regression analysis hence that may explain why they found no gender difference prevalence of anaemia. This is because, even in the present study, the crude estimates yielded no significant gender difference.

5.2.3. Birth Order

This study reports that every unit increase in birth order significantly increases the odds of anaemia in children under five years of age by 10% in crude analysis and by 7% in model 4 (OR=1.07, 95% CI 1.01-1.14). This means that birth order was as strong determinant of anaemia. This findings supports that of Ray et al. (2016) found that increasing birth order is significantly associated with decreasing hemoglobin levels among children under 5years. Similar findings have also been reported by other studies (Goswami & Das, 2015; Sinha et al., 2008). Increasing birth order may likely result in child living in larger households which in turn may result in small

quantities of scarce nutrients and hence increasing the risk of anaemia in children under five years. Another possible explanation is that increasing birth order is associated with increasing parity of mother which is significantly associated with lower maternal iron reserves (Miller, 2014). This may explain why high birth order is associated with anaemia in children under five years of age.

5.2.4 History of Fever

This study reports that having a recent history of fever increases the proportional odds of all forms of anaemia in children under-fives in both crude and adjusted estimates. In model 4, the proportional odds of anaemia was 1.96 times greater for children who had fever within two weeks of the study (OR=1.96, 95% CI 1.55-2.48). This means that fever was a stronger determinant of anaemia even after controlling for Age of Child, Gender of Child, Birth Order of child, History of diarrhea, History of Vitamin A supplementation, mothers' age, mothers' education, mothers' anaemia status and fathers' education, Household size, Number of children under 5 years in household, Wealth Status, Locality, and Region.

Fever is not an illness but a manifestation of underlying infections such as malaria. According to (Viana, 2011) some chronic febrile illness may result in low levels serum iron, a decrease in the total iron binding capacity and percentage reduction in plasma transferrin saturation which eventually leads to anaemia. However, acute infections, for example malaria, causes the destruction of Red Blood Cells (RBCs) which lead to anaemia (Viana, 2011). Magalhaes & Clements (2011) have also reported high burden of anaemia in children under five living in West Africa attributable to malaria and worm infestation. Acute febrile illness in children, chiefly

malaria has been reported in many other studies to be significantly associated with anaemia (Fosu et al., 2014; Ngesa & Mwambi, 2014; Simbauranga et al., 2015; Zanin et al., 2015).

5.2.5 History of Diarrhoea

The study reports that history of diarrhoea increases the odds of anaemia in children under five years in crude estimates and model one but OR estimates was not significant in model 4 when estimates was adjusted by Age of Child, Gender of Child, Birth Order of child, History of fever in child, History of Vitamin A supplementation, mothers' age, mothers' education, mothers' anaemia status and fathers' education, Household size, Number of children under 5years in household, Wealth Status, Locality, and Region. This may be that the significant findings seen in the crude analysis and model 1 may be the result of confounding effects of other variables or diarrhoea is not a strong predictor of anaemia in the presence of the other variables.

5.2.6 Vitamin A supplementation

The effects of vitamin A supplementation on anaemia showed mixed findings. Crude analysis showed no significant association yet after controlling for child's age, gender, birth order, history of fever and diarrhoea in model 1 showed that Vitamin A supplementation reduces the odds of anaemia in children under five. But the ordered regression estimate was not significant in model 4 ($p>0.05$).

5.3 Parental Level Factors

5.3.1 Maternal Age

The study reports that increasing maternal age is associated with decreasing odds of anaemia in children under five years old. The protective effect of maternal age on anaemia was reserved in crude analysis, model 2 and model 4 ($p<0.05$). This means that maternal age is a strong determinant of anaemia in children under five years of age. This findings is consistent with that

of other reviewed literature (Borbor et al.,2014; Leal et al., 2011; Zuffo et al., 2016). Younger mothers and teenagers are more likely to give birth babies with low birth weight and malnourished children (Save the Children, 2012). Thus, unlike younger and teenage mothers, relatively older mothers seems to have acquired the knowledge and experience about child care and nutrition which makes their children less prone to suffer anaemia and this may explain the results seen in this study.

5.3.2 Mothers' Anaemia Status

The study reports that children whose mothers had any degree of anaemia -mild, moderate and Severe- had greater odds of being anaemic in the crude analysis, model 2 and model 4 ($p < 0.05$). In model 4, for example, the proportional odds of the combined severe, moderate and mild anaemia status versus non anaemia status was 9.14 times greater for children whose mothers had severe anaemia as compared to those whose mothers were non-anaemic (OR=9.14,95% CI 1.37-61.11). Therefore, it can be inferred that mothers' anaemia status is a strong determinant of anaemia in children under five years in Ghana. This findings corroborate the finding reported by other authors (Ayoya et al., 2013; Leal et al., 2011; Pinlap, 2015; Wang et al., 2015). Children of anaemic mothers are likely to be exposed to the same risk factors that resulted in anaemia in their mothers and this may explain why mothers' anaemia status was a strong determinant of anaemia in this study.

5.3.3 Mothers' Education

The study revealed that as compared to children under 5years whose mothers had no education, the odds having the combined severe, moderate and mild anaemia status versus the non-anaemic status was decreased by 29% and 52% and among children whose mothers had attained secondary education (OR=0.71, 95%CI 0.55-0.90) and higher education (OR=0.48, 95%CI 0.26-

0.89) respectively, after controlling for all other variables in model 4. Therefore, mothers' education was a strong predictor of anaemia in children under five years old. Mothers with higher education and secondary education had a protective effect on the risk of anaemia on their children. This findings is consistent with the findings of several studies (Borbor et al, 2014; El Hioui et al., 2008; Leal et al., 2011; Ngesa & Mwambi, 2014; Pinlap, 2015). Pinlap (2015) , for example, reported that Children in rural areas whose mothers have a secondary level or higher education have a 22% lower risk of developing anemia than do the children of less educated mothers. Highly educated mothers are more likely to be gainfully employed and hence can afford better nutrition for their children. In addition, mothers' enhanced knowledge about sanitation and nutrition may explain why their children have decreased likelihood of being anaemic.

5.3.4 Fathers Education and Anaemia Status of the Child

Secondary and higher education of the father appeared to decrease the odds of anaemia in children under five years of age in the crude analysis and model 2 but there was no significant association between father's education and anaemia in model 4. Unlike mother's education, Fathers education was not a strong determinant of anaemia in children under five years old.

5.4.0 Household/ Community level factors

5.4.1 Household Size and Anaemia in children under 5years

The study report that crude analysis it was shows that the odds of having the combined severe, moderate and mild anaemia status versus the non-anaemic status was 1.4 times greater for children in households whose members were numbered at least 6 members as compared children in to households whose members were less than 6. (OR=1.40, 95% CI 1.20-1.63). However, the OR was not significant in model 3. Thus, having controlled for number of children under 5years in household, source of drinking water, main floor material, wealth quintile, region

and residence, there was no significant association between household size and anaemia. Therefore, Household size was therefore not a strong independent determinant of anaemia in this study.

5.4.2 Number of children under 5years in household

The finding of the study reveals that increasing number of children under five years in household is associated with higher odds of anaemia in children under five years. This was evident in the crude analysis, model 3 and model 4. It was revealed in model 4 that as compared to having one child in household, the odds of anaemia in children was 1.24times greater when there were 2 children under five in households (OR=1.24, 95%CI 1.03-1.49) and 1.32 times greater when children under five in households were three and above (OR=1.32, 95%CI 1.02-1.70). Therefore, number of children under five in household was a strong determinant of anaemia in children under five years of age in Ghana. This findings supports the findings of Leal et al., (2011) and Souganidis et al.,(2012). Increasing number of children under five years in household implies that children do not get enough nutrition and care they would have had if there was only a child under five years per household households hence making them at risk of diseases and malnutrition which can all result in malnutrition.

5.4.3 Household Wealth Status

The study reveals in model 4 that with reference to children from households in middle wealth quintile, children from poorer households were 36% more likely to be anaemic (OR=1.36, 95%CI=1.03-1.70) while children from richest households were 52% less likely to be anaemic (OR=0.48 95%CI 0.33-0.70) after adjusting for of child's age, gender, birth order, history of diarrhea, fever, vitamin A supplementation, mothers' age, mothers' education, mothers' anaemia status and fathers' education, household size, number of children under 5years in household,

locality, and Region. This implies that household wealth is a strong determinant of anaemia in children under five years. This findings are consistent with findings reported in other studies (Fosu et al., 2014; Semedo et al., 2014). Rich households have adequate supply of nutrients and good living conditions which reduces the risk of infections and hence may explain why children from rich households have reduced likelihood of anaemia in children under five years.

5.4.4 Source of Drinking Water

Crude estimates revealed that children who used unimproved source of drinking water were 1.45 likely to be anaemic (OR=1.45, 95% CI =1.18-1.78). However, there was no association between source of drinking water and anaemia in status of children under 5years of age in model 3. Therefore, source of drinking water was not a strong determinant of anaemia in children under five years of age in Ghana in this study.

5.4.5 Main Floor material

The findings of the study revealed no significant association between main floor material and anaemia in children under 5years in model 2. Therefore, main floor material was not a strong determinant of anaemia in children under five years of age.

5.4.6 Place of residence (Locality)

Crude estimates first revealed children from rural areas were more likely to be anaemic (OR=1.80, 95%CI 1.54-2.09). However, living in rural areas became a protective factor in model 3(OR=0.79, 95% CI 0.63-0.98) but was not significant at 95% CI in model 4 when more variables were controlled for. Thus, locality was not a strong independent determinant of anaemia in children under five years old.

5.4.7 Region of residence

The study reports from model 4 that as compared to children living in Greater Accra , children living in the Ashanti region were 35% less likely to be anaemic (OR=0.65, 95% CI 0.43-0.98) and those living in the Brong Ahafo Region were 38% less likely to be anaemia (OR=0.62, 95% CI 0.41-0.94). Region was therefore a strong determinant of anaemia in children under five years old.

5.5 Limitations of the Study

Despite the merits of this paper, some limitations were observed. The nutrition status of the child was not included in the analysis which could have provided more insight into the determinants of anaemia in children under five years. The study also involved the analysis single time point data hence could not reveal enough information on the trends in the prevalence and determinants of anaemia in children under five years in Ghana. Moreover, although the 2014 Ghana Demographic and Health Survey is an important source of data for this study, it may not necessarily contain data on all factors responsible for anaemia in children under five years in Ghana. The study was therefore limited to only variables in the DHS dataset. Nevertheless, future studies may address these limitations.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.0 Introduction

This chapter presents the summary, conclusions and recommendations of the study. It begins with the summary of the study after which the conclusion of the study is presented. The chapter also evaluates the contribution of the study contribution to knowledge and practice. Recommendations based on the study findings are also presented in this chapter. The limitations of the study are also discussed. The chapter also gives suggestions for future studies.

6.1 Summary of the Study

The study sought to investigate the determinants of anaemia in children under five years in Ghana. To achieve this, the study performed analysis of secondary data using the Demographic and Health Survey (DHS) 2014 which employed a two-staged cluster sampling to select households for the survey. Data was obtained following registration with the DHS programme and access to the data granted. Data was cleaned initially in SPSS software and later imported into STATA 14 software for further cleaning and analysis.

Data analysis involved descriptive analysis, crude and adjusted ordered logistic regression estimates of the determinants of anaemia in children under five years using four models. Model 1 included 6 independent variables at the child level: age of child, gender of child, birth order of child, history of fever in child, history of diarrhoea, history of vitamin A supplementation. Model 2 included 4 independent variables at parental level: mothers' age, mothers' highest education, anaemia status of mother and highest education of father. Model 3 consisted of 7 household level independent variables: Household size, Number of children under 5years in household, Wealth

Status, Source of Drinking Water, Main Floor Material, Locality, and Region. Finally model four (4) combined variables which showed significant proportional odds ratio estimates in model 1, model 2 and model 3. The model consisted of 14 independent variables: age of child, gender of child, birth order of child, history of fever in child, history of diarrhoea, history of vitamin A supplementation, mothers' age, mothers' education, mothers' anaemia status and fathers' education, number of children under 5years in household, Wealth Status, Locality, and Region.

The findings of the study revealed that the overall prevalence of anaemia in children under 5years in Ghana was 69.61% with 27.19% being mildly anaemic, 39.56% moderately anaemic and 2.86% severely anaemic. Prevalence of anaemia was higher than the national average in the three northern regions: Northern Region (84.84%), Upper East (72.81%), and Upper West Regions (72.40%) and the central region (73.09%). Conversely, relatively low prevalence of anaemia were found in children under five years living in the Ashanti Region (52.89%), Greater Accra Region (59.34%) and Brong Ahafo Region (64.36%).

Determinants significantly associated with increased odds of anaemia in children under five years were child's age below 2years (OR=2.14, 95%CI 1.79-2.56), being a male child (OR=1.26 95% CI 1.07-1.49), increasing birth order (OR=1.07, 95% CI 1.01-1.14), history of fever (OR=1.96, 95% CI 1.55-2.48), severe anaemia in mothers (OR=9.14, 95% CI 1.37-61.11), moderate anaemia in mothers (OR=1.77, 95%CI 1.33-2.35), mild anaemia in mothers (OR=1.51, 95%CI 1.26-1.81), having 2 children under five years in household (OR=1.24, 95%CI 1.03-1.49), three and more children under 5years in household (OR=1.32, 95%CI 1.02-1.70) and children from poorer households (OR=1.36, 95%CI=1.03-1.70).

Conversely, determinants associated with reduced odds (Protective factors) of anaemia in children under five years in Ghana were increasing Maternal age ($p < 0.05$), Secondary education of mothers (OR=0.71, 95%CI 0.55-0.90), higher education of mother (OR=0.48, 95%CI 0.26-0.89), children from richest households (OR=0.48 95%CI 0.33-0.70), residing in Ashanti Region (OR=0.65, 95% CI 0.43-0.98) and Brong Ahafo Region (OR=0.62, 95% CI 0.41-0.94).

Variables which were not significant determinants of anaemia were history of diarrhoea, vitamin A supplementation, fathers' education, household size, source of drinking water, main floor material, and locality.

6.2 Conclusion:

In a nutshell, the study reported a high prevalence of anaemia in children under five years. The determinants of anaemia in children under five years in Ghana were child's age, gender of child, birth order, history of fever, mothers' age, mothers' educational level, mothers' anaemia status, number of children under 5 years in household, household wealth status, and region of residence. The findings imply the need for holistic policy interventions to address the problem of anaemia in children under five years in Ghana.

6.3 Recommendations

6.3.1 Implication for clinical practice

- Health professionals must prioritize prevention, early detection and treatment of fever in children under five years old. Mothers must therefore be educated on the recognition of early signs of fever and must ensure that children under five years sleep under insecticide treated nets to reduce the risk of fever associated with malaria.
- Evidence from the study highlights the need for comprehensive history taking during health encounters at the antenatal and post-natal periods so that determinants of anaemia

in children under five years of age can be easily identified and appropriate interventions initiated.

6.3.2 Implication for Policy

- Policy makers, including public health professional, must ensure that holistic health policies are formulated to address all these multi-level independent factors to ensure effectiveness of policies aimed at addressing the problem of anaemia in children under five years.
- The findings of the study highlight the need to address the educational and income inequalities in the Ghanaian societies. Higher maternal education and richest households reduce the odds of anaemia in children under five years. Therefore, policies addressing educational and income inequalities must be strengthened in order to reduce the odds of anaemia in children under five years old.

6.3.3 Implication for Future Studies

- Future studies may include other variables such as nutritional status of the child so as to give a better understanding of the problem of anaemia in children under five years old.
- Future studies can also examine the time trends in the determinants of anaemia in children under five years in Ghana using different data points.

References

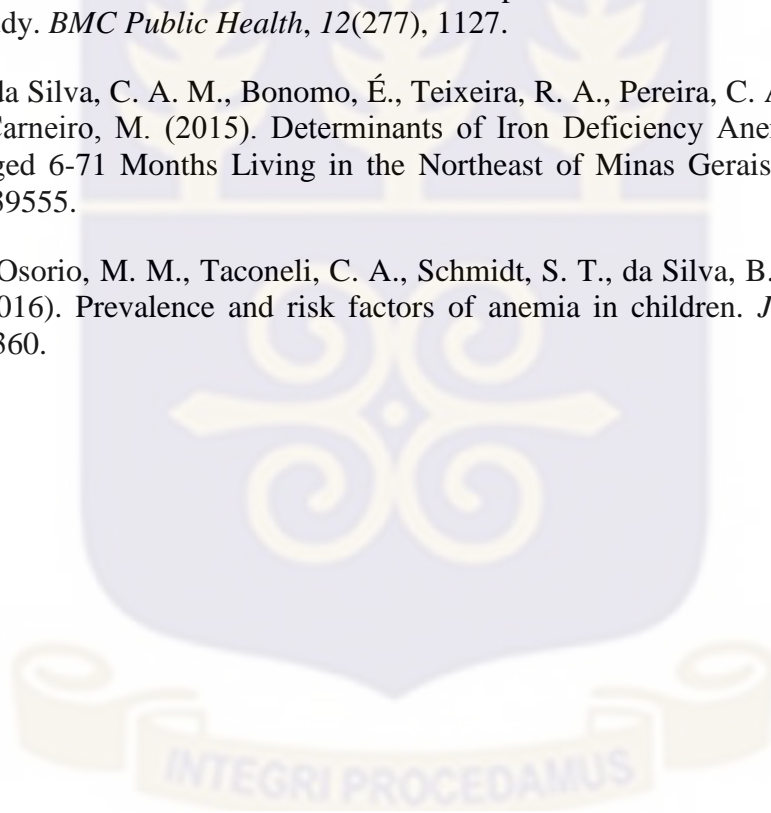
- Al Hasan, S. M., Hassan, M., Saha, S., Islam, M., Billah, M., & Islam, S. (2016). Dietary phytate intake inhibits the bioavailability of iron and calcium in the diets of pregnant women in rural Bangladesh: a cross-sectional study. *BMC Nutrition*, 2(1), 24.
- Ayoya, M. A., Ngnie-Teta, I., Séraphin, M. N., Mamadoultai bou, A., Boldon, E., Saint-Fleur, J. E., ... Bernard, S. (2013). Prevalence and risk factors of anemia among children 6-59 months old in Haiti. *Anemia*, 2013.
- Baranwal, A., Baranwal, A., & Roy, N. (2014). Association of Household Environment and Prevalence of Anemia Among Children Under-5 in India. *Frontiers in Public Health*, 2(October), 1–7.
- Borbor, F. M., Kumi-Kyereme, A., Yendaw, E., & Adu-Opong, A. (2014). A study of the determinants of anaemia among under-five children in Ghana. *International Journal of Development Research*, 4(4), 858-867.
- Chalasani, S. (2010). The Changing Relationship between Household Wealth and Child Survival in India. Retrieved from <http://www.popline.org/node/215710>.
- Chandyo, R. K., Henjum, S., Ulak, M., Thorne- Lyman, A. L., Ulvik, R. J., Shrestha, P. S., ... Strand, T. A. (2016). The prevalence of anemia and iron deficiency is more common in breastfed infants than their mothers in Bhaktapur, Nepal. *European Journal of Clinical Nutrition*, 70(4), 456–462.
- Commey, J. O., & Dekyem, P. (1994). Childhood deaths from anaemia in Accra, Ghana. *West African Journal of Medicine*, 14(2), 101–4.
- Cooke, E., Hague, S., & McKay, A. (2016). The Ghana poverty and inequality report: Using the 6th Ghana living standards survey. Retrieved from http://africainequalities.org/wp-content/uploads/2016/07/Ghana_Poverty_and_Inequality_Analysis_FINAL_Match_2016_1.pdf
- Dangour, A. D., Hill, H. L., & Ismail, S. J. (2002). Height, weight and haemoglobin status of 6 to 59-month-old Kazakh children living in Kzyl-Orda region, Kazakhstan. *European Journal of Clinical Nutrition*, 56(10), 1030–1038.
- DHS Methodology. (n.d.). Retrieved January 28, 2017, from <http://dhsprogram.com/What-We-Do/Survey-Types/DHS-Methodology.cfm>
- El Hioui, M., Ahami, A.O. T., Aboussaleh, Y., Rusinek, S., Dik, K., Soualem, a, ... Elqaj, M. (2008). Risk factors of anaemia among rural school children in Kenitra, Morocco. *East African Journal of Public Health*, 5(2), 62–66.
- Ewusie, J. E. (2014). Nutrition, Childhood Development and Prevalence of Anemia in Ghanaian Children: Analysis of Health Survey. Retrieved from <http://macsphere.mcmaster.ca/handle/11375/13805>

- Ewusie, J. E., Ahiadeke, C., Beyene, J., & Hamid, J. S. (2014). Prevalence of anemia among under-5 children in the Ghanaian population: estimates from the Ghana demographic and health survey. *BMC Public Health*, *14*, 626.
- FAO, & WHO. (2001). *Human Vitamin and Mineral Requirements*. Report of a Joint FAO/WHO Expert Consultation, Bangkok, Thailand." *Food and Nutrition Division, FAO, Rome* (2001): 195-247.
- Fosu, M. O., Frimpong, F. O., & Arthur, M. O. (2014). Factors Associated with Haemoglobin Prevalence among Ghanaian Children Aged 6–59 months. *Journal of Biology, Agriculture and Healthcare*, *4*(2), 132–140.
- Ghana Statistical Service (GSS), Ghana Health Service (GHS) & ICF International.(2015).2014 *Ghana Demographic and Health Survey*.Retrieved from <http://www.dhsprogram.com/pubs/pdf/FR307/FR307.pdf>
- Goswami, S., & Das, K. K. (2015). Socio-economic and demographic determinants of childhood anemia. *Jornal de Pediatria*, *91*(5),471-477.
- Hurrell, R., & Egli, I. (2010). Iron bioavailability and dietary reference values. *The American Journal of Clinical Nutrition*, *91*(5), 1461S–1467S.
- Igbal, K., Zafar, T., Igbal, Z., Usman, M., Bibi, H., Afreen, M., & Igbal, J. (2015). Effect of Iron Deficiency Anemia on Intellectual Performance of Primary School Children in Islamabad, Pakistan. *Tropical Journal of Pharmaceutical Research*, *14*(2), 287.
- Janus, J., Moerschel, S. K. (2010). Evaluation of Anemia in Children. *American Family Physician*, *81*(12), 1462–1471.
- Khan, J. R., Awan, N., Misu, F., McLean, E., Cogswell, M., Egli, I., ... Brooks, O. (2016). Determinants of anemia among 6–59 months aged children in Bangladesh: evidence from nationally representative data. *BMC Pediatrics*, *16*(1), 3.
- Leal, L. P., Batista Filho, M., Lira, P. I. C. de, Figueiroa, J. N., & Osório, M. M. (2011). Prevalência da anemia e fatores associados em crianças de seis a 59 meses de Pernambuco. *Revista de Saúde Pública*, *45*(3), 457–466.
- Magalhaes R.J.S., Clements, A. C. . (2011). Mapping the risk of anaemia in preschool-age children: The contribution of malnutrition, malaria, and helminth infections in West Africa. *PLoS Medicine*, *8*(6), e1000438.
- Malkanathi, R. L. D. K., Silva, K. D. R. R., & Jayasinghe-mudalige, U. K. (2010). Risk factors associated with high prevalence of anemia among children under 5 years of age in paddy-farming households in Sri Lanka. *Food and Nutrition Bulletin*, *31*(4), 475–482.
- Mayo Clinic. (2016). Symptoms and causes - Anemia - Mayo Clinic. Retrieved October 22, 2016, from <http://www.mayoclinic.org/diseases-conditions/anemia/symptoms-causes/dxc-20183157>

- Menendez, C., Fleming, A. F., & Alonso, P. L. (2000). Malaria-related Anaemia. *Parasitology Today*, 16(11), 469–476.
- Miller, E. M. (2014). Iron status and reproduction in US women: National health and nutrition examination survey, 1999-2006. *PLoS ONE*, 9(11), e112216.
- Ngesa, O., & Mwambi, H. (2014). Prevalence and risk factors of anaemia among children aged between 6 months and 14 years in Kenya. *PLoS ONE*, 9(11), 1–10.
- Nikoi, E., & Anthamatten, P. (2014). Childhood anaemia in Ghana: an examination of associated socioeconomic and health factors. *African Geographical Review*, 33(January), 19–35.
- Onyango, A. W. (2003). Dietary diversity, child nutrition and health in contemporary African communities. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology*, 136(1), 61-69.
- Pinlap, J. T. (2015). Anemia in Children Under 5 Years of Age in Cameroon. *Sight and Life* 29(2) , 78–80.
- Ray, S., Chandra, J., Bhattacharjee, J., Sharma, S., & Agarwala, A. (2016). Determinants of nutritional anaemia in children less than five years age. *International Journal of Contemporary Pediatrics* 3(2), 403–408.
- Santos, R. F. D., Gonzalez, E. S. C., Albuquerque, E. C. D., Arruda, I. K. G. D., Diniz, A. D. S., Figueroa, J. N., & Pereira, A. P. C. (2011). Prevalence of anemia in under five-year-old children in a children's hospital in Recife, Brazil. *The Revista Brasileira de Hematologia E Hemoterapia (Brazilian Journal of Hematology and Hemotherapy)*, 33(2), 100–104.
- Santos, J. N., Rates, S. P. M., Lemos, S. M. A., & Lamounier, J. A. (2009). Consequences of anemia on language development of children from a public day care center. *Revista Paulista de Pediatria*, 27(1), 67-73.
- Save the Children. (2012). *Nutrition in the First 1,000 Days. State of the World's Mothers 2012*. Retrieved from <http://www.savethechildren.org/atf/cf/%7B9def2ebe-10ae-432c-9bd0-df91d2eba74a%7D/STATE-OF-THE-WORLDS-MOTHERS-REPORT-2012-FINAL.PDF>
- Schellenberg, D., Schellenberg, J. R. M., Mushi, A., Savigny, D. D., Mgalula, L., Mbuya, C., & Victora, C. G. (2003). The silent burden of anaemia in Tanzanian children: a community-based study. *Bulletin of the World Health Organization*, 81(8), 581-590.
- Scott, S. P., Chen-Edinboro, L. P., Caulfield, L. E., & Murray-Kolb, L. E. (2014). The impact of anemia on child mortality: An updated review. *Nutrients*, 6(12), 5915–5932.
- Semba, R. D., & Bloem, M. W. (2002). The anemia of vitamin A deficiency: epidemiology and pathogenesis. *European Journal of Clinical Nutrition*, 56(4), 271–81.

- Semedo, R. M. L., Santos, M. M. A. S., Baião, M. R., Luiz, R. R., & da Veiga, G. V. (2014). Prevalence of Anaemia and Associated Factors among Children below Five Years of Age in Cape Verde, West Africa. *Journal of Health, Population, and Nutrition*, 32(4), 646–657.
- Siegel, E. H., Stoltzfus, R. J., Khattry, S. K., Leclercq, S. C., Katz, J., & Tielsch, J. M. (2006). Epidemiology of anemia among 4- to 17-month-old children living in south central Nepal. *European Journal of Clinical Nutrition*, 60(2), 228–35.
- Simbouranga, R. H., Kamugisha, E., Hokororo, A., Kidenya, B. R., & Makani, J. (2015). Prevalence and factors associated with severe anaemia amongst under-five children hospitalized at Bugando Medical Centre, Mwanza, Tanzania. *BMC Hematology*, 15, 13.
- Singh, R. K., & Patra, S. (2014). Extent of Anaemia among Preschool Children in EAG States , India : A Challenge to Policy Makers, *Anemia* , 2014.
- Sinha, N.; Deshmukh, P.R.; Garg, B. S. (2008). Epidemiological correlates of nutritional anemia among children (6-35 months) in rural Wardha, Central India. *Indian Journal of Medical Sciences*, 62(2), 45–54.
- Souganidis, E. S., Sun, K., de Pee, S., Kraemer, K., Rah, J. H., Moench-Pfanner, R., ... & Semba, R. D. (2011). Determinants of anemia clustering among mothers and children in Indonesia. *Journal of tropical pediatrics*, 58(3), 170-177.
- Stevens, G. A., Finucane, M. M., De-Regil, L. M., Paciorek, C. J., Flaxman, S. R., Branca, F., ... Ezzati, M. (2013). Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995-2011: A systematic analysis of population-representative data. *The Lancet Global Health*, 1(1), 16–25.
- Tazhibayev, S., Dolmatova, O., Yessimsiitova, Z., Bazarbayeva, Z., Muratbekova, N., Beisbekova, A., & Grjibovski, A. M. (2014). Prevalence of anaemia in under five-years-old children in three counties of Kazakhstan: a cross-sectional study: Mikhail Valkov. *European Journal of Public Health*, 24(suppl_2), cku165-076.
- Viana, M. B. (2011). Anemia and infection: a complex relationship. *Revista Brasileira de Hematologia E Hemoterapia (Journal of Hematology and Hemotherapy)*, 33(2), 90–92.
- Villalpando, S., Shamah-Levy, T., Ramírez-Silva, C. I., Mejía-Rodríguez, F., & Rivera, J. A. (2003). Prevalence of anemia in children 1 to 12 years of age: results from a nationwide probabilistic survey in Mexico. *Salud pública de México*, 45, 490-498.
- Wang, J., Wang, H., Chang, S., Zhao, L., Fu, P., Yu, W., ... & Yin, S. A. (2015). The influence of malnutrition and micronutrient status on anemic risk in children under 3 years old in poor areas in China. *PloS one*, 10(10), e0140840.
- WHO, U. (n.d.). Improved and unimproved water sources and sanitation facilities. Retrieved April 4, 2017, from <https://www.wssinfo.org/definitions-methods/watsan-categories/>

- WHO & Chan, M. (2011). Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. *Geneva, Switzerland: World Health Organization*, 1–6. Retrieved from <http://www.who.int/vmnis/indicators/haemoglobin.pdf>
- Wood, K. C., Smith, H., & Grossniklaus, D. (2001). *Piaget's Stages of Cognitive Development*. Retrieved November 28, 2016, from <http://projects.coe.uga.edu/epitt/%5Cnhttp://www.saylor.org/site/wp-content/uploads/2011/07/psych406-5.3.2.pdf>
- World Health Organization. (2015). The Global Prevalence of Anaemia in 2011. *WHO Report*. Retrieved from http://apps.who.int/iris/bitstream/10665/177094/1/9789241564960_eng.pdf
- Yang, W., Li, X., Li, Y., Zhang, S., Liu, L., Wang, X., & Li, W. (2012). Anemia, malnutrition and their correlations with socio-demographic characteristics and feeding practices among infants aged 0-18 months in rural areas of Shaanxi province in northwestern China: a cross-sectional study. *BMC Public Health*, *12*(277), 1127.
- Zanin, F. H. C., da Silva, C. A. M., Bonomo, É., Teixeira, R. A., Pereira, C. A. de J., dos Santos, K. B., ... Carneiro, M. (2015). Determinants of Iron Deficiency Anemia in a Cohort of Children Aged 6-71 Months Living in the Northeast of Minas Gerais, Brazil. *PloS One*, *10*(10), e0139555.
- Zuffo, C. R. K., Osorio, M. M., Taconeli, C. A., Schmidt, S. T., da Silva, B. H. C., & Almeida, C. C. B. (2016). Prevalence and risk factors of anemia in children. *Jornal de Pediatria*, *92*(4), 353–360.



APPENDICES

APPENDIX I: DHS PROGRAM APPROVAL NOTICE

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All DHS data should be treated as confidential, and no effort should be made to identify household or individual respondent interviewed in the survey. The data sets are not to be passed on to other researchers without the written consent of DHS. Users are required to submit a copy of any reports/publications resulting from using the DHS data to archive@dhsprogram.com.

The files you will download are in zipped format and must be unzipped before beginning downloading, please login at: http://www.dhsprogram.com/data/database/login_main.cfm. If you are approved for a large number of countries/dataset, we recommend that you use the new Bulk Downloading System. For instructions on downloading, please go to: <http://userforum.dhsprogram.com/index.php?t=m>

Following are some guidelines:

After unzipping, please print the file with the .DOC/DOCX extension (found in Male Recode Zips). This file contains useful information on country specific differences in the Standard Recode definition. You will also need the DHS Recode Manual: <http://dhsprogram.com/publications/publication-dhsg4-dhs-questionnaires-and-recode-manual>. This manual contains a general description of the recode data file, including the recoding; a description of coding standards and recode variables, and a list of recode dictionary, with basic information relating to each variable.

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

For problems with your user account, please email archive@dhsprogram.com or related questions, please register to participate in the DHS Program User Forum at: <http://userforum.dhsprogram.com>.

The Demographic and Health Surveys (DHS) Program
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Suite 500

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APPENDIX II: GHANA HEALTH SERVICE ETHICAL APPROVAL

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

*My Ref. GHS/RDD/ERC/Admin/App/17/517
Your Ref. No.*



Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Tel: +233-302-681109
Fax + 233-302-685424
Email: ghserc@gmail.com

Henry Ofori Duah
School of Public Health
University of Ghana
Legon

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	GHS-ERC: 122/02/ 2017
Project Title	Determinants of Anaemia in Children Under Five Years in Ghana
Approval Date	3 rd April, 2017
Expiry Date	2 nd April, 2018
GHS-ERC Decision	Approved

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report **after completion** of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
DR. CYNTHIA BANNERMAN
(GHS-ERC CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra