

**REGIONAL INSTITUTE FOR POPULATION STUDIES
UNIVERSITY OF GHANA**

FACTORS AFFECTING CHILD ANAEMIA IN CAMEROON

BY



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LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR
THE AWARD OF MA POPULATION STUDIES DEGREE**

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DECLARATION

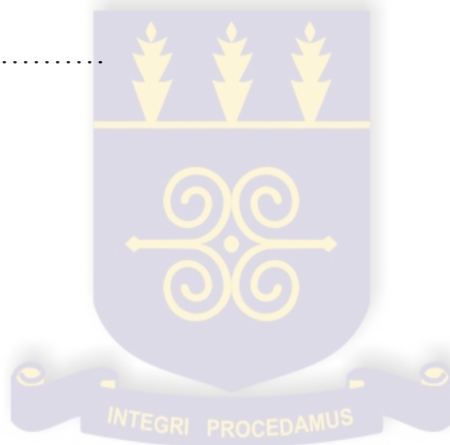
I, Jong Blaise Cha certify that apart from reference to other works, which have been duly acknowledged, the dissertation is the result of my research work carried under the supervision of Dr. Kyei Pearl.

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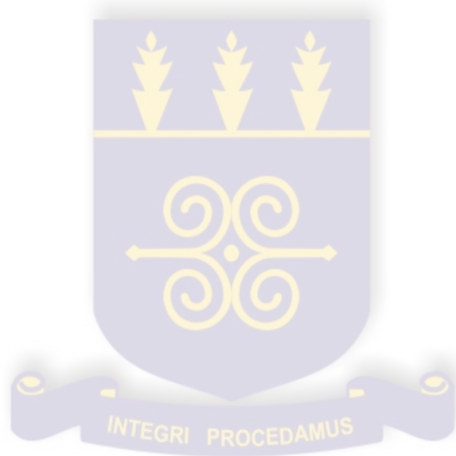
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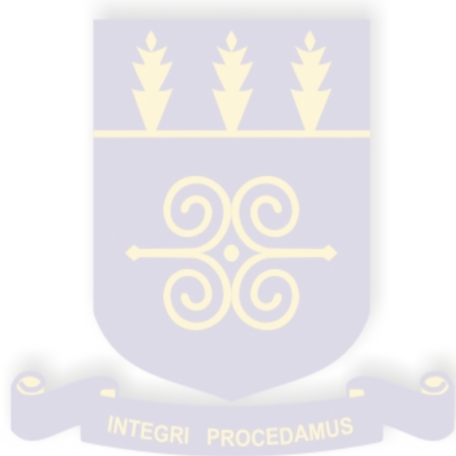
Thanks to God Almighty who has been my source of inspiration and has enabled me to finish this program successfully. Thanks to the Director of RIPS, Prof. S. N. A. Codjoe for the inspiration. I wish to express my sincere heart-felt gratitude to my supervisor, Dr Kyei Pearl for the guidance, support and attention throughout the study.

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DEDICATION

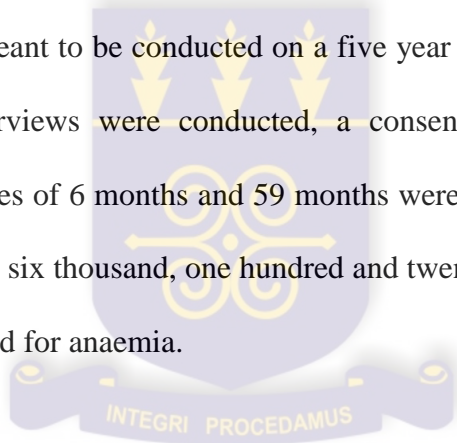
I dedicate this work to my Dad and mum: Mr. and Mrs. Nkweta, to my lovely wife Pauline, my son Marvelous and my brothers Johnson, Elias and Praise. I love you all.



ABSTRACT

Anaemia is a common cause of morbidity and mortality in the world. World Health Organization estimated that anaemia affects one-quarter of the world's population and is concentrated within preschool age children and in resource-poor countries like Cameroon. The aim of this study was to determine the factors that affect child anaemia in the country and to formulate recommendations that may help reduce its effect on these children.

Data for this study were collected as part of the Cameroon Demographic and Health Survey (CDHS) which was conducted in 2011. The CDHS is a nationally representative sample survey that is meant to be conducted on a five year interval. In about half of the households where interviews were conducted, a consent form was introduced and children between the ages of 6 months and 59 months were tested for anaemia using the Hemocue system. In all, six thousand, one hundred and twenty (6120) children below the age of five were screened for anaemia.



LIST OF ABBREVIATIONS AND ACRONYMS

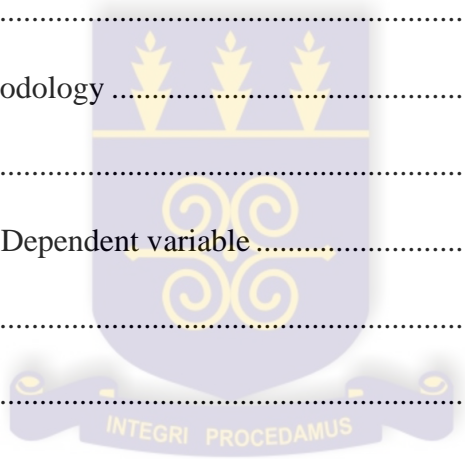
ASF	Animal Source Foods
CDC	Center for Disease and Control
CDHS	Cameroon Demographic and Health Survey
DHS	Demographic Health Survey
G/dl	Grams per deciliter
Hb	Haemoglobin
IDA	Iron deficiency Anaemia
MCV	Mean Corpuscular Volume
MDGs	Millennium Development Goals
RBC	Red blood cells
SES	Socio-economic status
SF	Serum ferritin
UNICEF	United Nations International Children Emergency Fund
UNU	United Nations University
USAID	United States Agency for International Development
WHO	World Health organization



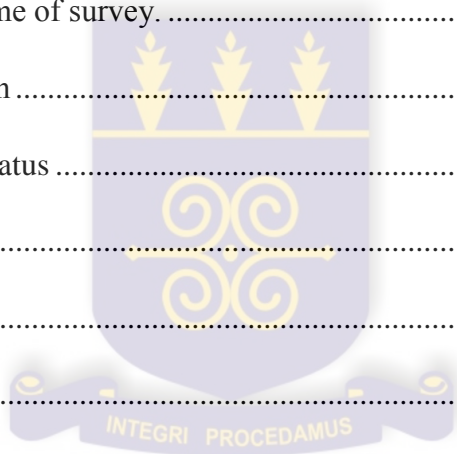
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CHAPTER ONE

1.1 Introduction

The health of children in particular and adults in general is very essential for their survival and for the future development of the country in question. Anaemia is a global public health problem affecting both developing and developed countries with major consequences for human health and socioeconomic development (Gayawan et al., 2014).

Iron deficiency is the most common and widespread nutritional disorder in the world. As well as affecting a large number of children and women in developing countries, it is the only nutrient deficiency that is significantly prevalent in industrialized countries. Although the etiology of childhood anaemia is multi-factorial, iron deficiency is usually the predominant cause (Stoltzfus et al., 1998). Other causes include infectious diseases, deficiencies of micronutrients, inherited conditions and environmental pollutions (Zhao et al., 2012). The relative importance of the different causes of anaemia varies with the regions of the world (WHO/UNICEF/USAID, 2003). Iron deficiency and anaemia reduce the work capacity of individuals and entire populations, bringing serious economic consequences and obstacles to national development. Overall, it is the most vulnerable, the poorest and the least educated who are disproportionately affected by iron deficiency, and it is they who stand to gain the most by its reduction (WHO, 2014).

1.2 Background

Anaemia (from the Ancient Greek *anaimia*, meaning "without blood") is defined as a "quantitative or qualitative deficiency of hemoglobin, a molecule found inside red blood cells (RBCs)" (Kumar, 2013). Anaemia in childhood is defined by the World Health Organization (WHO, 2011) as a haemoglobin (Hb) concentration below established cut-

off levels. These levels vary depending on the age of the child and on the laboratory in which the blood sample is tested. The WHO (2011) has suggested levels of Hb below which anaemia is said to be present. These levels are <11 g/dL in children aged 6-59 months, <11.5 g/dL in children aged 5-11 years and 12 g/dL in older children (aged 12-14). The condition that develops when the blood lacks enough healthy red blood cells or Hb. These red blood cells bring oxygen to body tissues (United States Food and Drugs Administration, 2012). Because all human cells are based on oxygen for their survival, different degrees of anaemia can have a wide range of clinical consequences.

There are many types of anaemia and the most common types include iron deficiency, malaria, sickle cell and vitamin deficiency anaemia. Iron deficiency is a decrease in the number of red blood cells in the blood due to lack of iron (Glader et al., 2007). Malnutrition causes iron deficiency anaemia, which is the most common form of anaemia in the world. The beginning of iron deficiency anaemia is slow even without any symptoms. Red Blood Cells (RBCs) deficiency begins when the body loses more iron than it derives from food and other sources. At the early stage of anaemia, RBCs look normal; but they are minimized in number. Then the body fights to compensate for iron deficiency by generating more red blood cells, which are normally small in size. Mostly symptoms develop at this stage. This type is caused from poor diet. (Culvert et al., 2006).

Concerning malaria anaemia, the increased clearance of infected cells is readily explained by the rupture of cells after completion of the parasite's intra-erythrocyte life cycle and opsonisation and clearance of intact infected RBCs. Rather less obvious is why and how uninfected cells are also cleared. It has been estimated that approximately 10

uninfected cells are cleared from the circulation for every infected cell and so the clearance of uninfected cells is of crucial importance for the development of malarial anaemia (Jakeman et al., 1999).

Child anemia is classified into three levels (severe, moderate and mild) according to hb concentration in the blood. It is considered severe if the level of hb per deciliter of blood is less than 7.0grammes, moderate if this value is in between 7 to 9.9dl/g and it is mild if the value falls between 10.0 to 10.9dl/g (CDC, 1989; WHO, 2011).

In general, the severity of anemia is differentiated by the severity of the reduction in hemoglobin (Hb) level (UNICEF/UNU/WHO, 2001). Severe anaemia usually comprises a small proportion of the cases in children but may cause a large proportion of the severe morbidity and mortality (Stoltzfus et al., 1998). A research on malaria-associated severe anaemia in Sub-Saharan Africa showed that children admitted to hospital with severe anaemia were more likely to die than those without anaemia (Schellenberg et al., 2003). A world-wide report also showed that moderate-to-severe anaemia increased the risk of mortality in the vulnerable population (WHO/UNICEF/USAID, 2003).

1.3 Statement of the problem

The world prevalence rate of anaemia stands at 43% as against 57.6% in Africa (WHO, 2008). Anaemia which is caused by advanced iron deficiency is classified by the World Health Organization as one of the ten most serious health problems in the modern world (Ezzati et al., 2002). In addition to anaemia's adverse health consequences, the economic effect of anaemia on human capital results in the loss of billions of dollars annually. (Yarlani et al., 2011). Nine out of ten anaemia sufferers live in developing countries,

about 2 billion people suffer from anaemia and an even larger number of people present iron deficiency (WHO, 2000). At its special session on children in 2003, the United Nations General Assembly set a goal to reduce the prevalence of anaemia by one third by 2010 (WHO, UNICEF, 2004). Despite this, the incidence of anaemia in children aged under 5 between 1990 and 2010 has actually increased, the most affected regions in the world being Central and West Africa mainly caused by iron deficiency and malaria (Kassebaum et al., 2013). Sickle cell anaemia contributes the equivalent of 25% of under 5 deaths in Africa, with up to 16% of such deaths occurring in some West African countries (Ocheyana and Opara, 2011). In Africa, more than 100 million children are thought to be anaemic (Brabin et al., 2001). In severe cases it is associated with an increased risk of death (Brabin et al., 2001).

Community-based estimates of anaemia prevalence in the blood concentration (<11 g/dl) in children in settings where malaria is endemic range between 49% and 76% (Premji et al., 1995; Muhe et al., 1999). Anaemia is one of the largest killers of children admitted to hospital in sub-Saharan Africa and children admitted to the hospital with severe anaemia (Hb <8 g/dl) are more likely to die than children admitted without anaemia (Fosu et al., 2014).

Recently, Cameroon has done a lot to reduce child anaemia through health promotion programs but the prevalence rate still remains very high. A 2004 national survey on anaemia in preschool children (< 5 years) revealed anaemia to be a severe public health problem in the country with a prevalence rate of 68.3% (Benoist et al., 2005). An estimated 50,000 children die every year in Cameroon due to various forms of malnutrition and iron deficiency (Helen Keller International, 2014). The national

prevalence rate of anaemia among children under five years old is almost 57%, with rates as high as 67% in certain regions. Also, according to Helen Keller International (2014), anaemia is a major contributor to maternal mortality, and anaemia rates among pregnant women exceed 52%; 360 pregnant women die each year because they are severely anemic.

Cameroon has made several advances in recent years in the improvement of health care and food security, though chronic malnutrition and micronutrient deficiencies in children under age 5 remains a public health concern. According to the Cameroon Demographic Health Survey (CDHS, 2011), 122 children out of 1000 die without reaching their 5th birthday, with malnutrition and iron deficiency being the underlying factors in a third of these deaths.

Low concentration of red blood cells (RBCs) is a reason for a number of health problems, including weakness, fatigue, mental confusion and strain on organs of the body. Anaemia adversely affects behavioral development as well as increased morbidity and mortality from infectious diseases in children (Marcia, 2003).

The presence of iron deficiency without anaemia is sufficient for the occurrence of functional disturbances (Akman et al., 2004). Besides, it is possible that children with anaemia explore the environment less and move less compared to their healthy counterparts and they may receive insufficient stimulus and have difficulty developing new skills (Abbott, 1998). The negative impacts of iron deficiency, especially early in life, on psychomotor and neurologic development do not seem to be reversible by iron

supplementation and it may cause permanent hazards in the brain (Connor & Menzies, 1996; Lozoff, 2007).

Severe malarial anemia requiring blood transfusion is a life-threatening condition affecting millions of children in sub-Saharan Africa. Up to 40% of children with severe malarial anemia are associated with lactic acidosis (Dhabangi et al., 2013). Lactic acidosis, defined by the WHO as a blood lactate level >5 mmol/L, is found in approximately 41% of children with severe malaria anaemia (Gazdewich et al., 2013). Lactic acidosis is directly associated with fatal outcomes in malaria and is present in 75% of fatal cases (Dzeing et al. 2005). Indeed, lactic acidosis is more pronounced in severe malaria anaemia compared with severe non-malaria anaemia and case fatality rates may be up to twice as high (9% versus 4%) in malaria for the same level of anaemia (Newton et al., 1997).

1.4 Objectives

1.4.1 General Objective:

The general objective of this study is to investigate the factors correlated with child anaemia in Cameroon.

1.4.2 Specific objectives

The specific objectives are:

- Determine the relationship between the type of nutritional intake and their effects on the hemoglobin levels of children.
- Determine whether malaria has any effect on children's hemoglobin levels.

1.5 Rationale

In developing countries, children are less privileged, particularly in respect to having proper food and health care facilities. The general health status of children can be improved greatly if diseases such as anaemia, one of the most common causes of morbidity and mortality in Cameroon are effectively controlled and managed. The main causes of this childhood disease include poor nutritional intake, malaria and mothers' lack of education.

Goal four of the Millennium Development Goals (MDGs) is to reduce by two thirds, between 1990 and 2015, the under-five mortality rate. This study seeks to determine if factors such as poor nutritional intake, malaria, the poor socio economic status of the household and mothers' lack of education when controlled would significantly reduce child anaemia and hence mortality in the country.

CHAPTER TWO

REVIEW OF LITERATURE

2.1 Introduction

Several studies have been carried out on anaemia in children across the globe and it has been found out that anemia is associated with socioeconomic, biological, environmental and nutritional factors.

Iron deficiency anemia is the most common cause of anaemia and blood diseases in the developing countries. It is estimated that 75% of anaemia is related to iron deficiency, followed by folate and vitamin B12 deficiencies (Yip and Ramakrishnan, 2002). In fact, the most common chronic diseases of human kind are iron deficiency anaemia and 30 percent of the people worldwide are affected to it. Brain enzymes are the first body functions which after being affected by iron deficiency are related to behavior and cognition. Effects of iron deficiency in infancy are irreversible. In the later stages of life, iron deficiency apart from ethnicity and social or physical environment, has undesirable consequences on mental and academic activities (Nevins, 2008).

Malaria inevitably leads to the manifestation of anaemia especially on children below the age of five through the reduction of haemoglobin concentration below the normal range. Malaria-associated anaemia leads to increased red blood cells destruction and it is a major cause of morbidity, admission, and mortality among children in malaria endemic areas of sub-Saharan Africa (Brabin et al., 2001).

According to a review of the literature, child anaemia is affected by dietary intake, malaria, mother's age, maternal education, socio-economic status, child's sex child's age and place of residence.

2.2 Child's Nutritional Intake and Anaemia

Poor nutrition in children leads to anaemia. Nutritional anaemia occurs due to insufficient intake of nutrients by cells (Nevins, 2008). Among the most important nutrients whose lack can cause deficiency anaemia are iron, folic acid, vitamin B12, vitamin B6, vitamin C and protein. (Nevins, 2008). It has been found that there are three common nutritional deficiencies which have different effects on behavior and learning and they are protein, iron and iodine (Nevins, 2008). Iron is found in several foods of animal origin (all kinds of meat, milk, and eggs) and of vegetable origin (dark green vegetables, beans, soy beans, among others). However, it is necessary to clarify the capacity of the body of absorbing the available iron so that it can accomplish several functions, which determines its bioavailability. (Nevins, 2008). It is unclear whether iron deficiency and its behavioral effects are correctable, particularly with regard to long-term developmental outcomes. More recent studies have reported that long-term effects of iron deficiency anaemia during infancy may be permanent. Severe iron deficiency anaemia during this period may cause permanent neurologic damage (Hurtado et al., 1999).

Anaemia frequently develops as breast milk is replaced by foods that are poor in iron and other nutrients. Cow's milk is a good example, because, although it has the same iron content as breast milk, its bioavailability is too low, and more often than not, mothers replace a meal with bottle feeding (Rolo et al. 2006). According to Harris (2007), the

potential seriousness of iron deficiency anaemia is often ignored, but it can lead to a poor neurodevelopmental outcome, poor growth and recurrent infections. Iron is essential for the maintenance of organ function at a cellular level, and thus its deficiency will have various clinical manifestations. It is best managed by advice on weaning unto iron-rich foods and avoidance of large intake of unmodified milk. (Harris 2007).

More than sixty percent of pre-school children in Ghana are believed to be suffering from anaemia due to low nutritional meals combination (Lartey 2013). Adequate protein and calorie intake during the first two years of life may improve cognitive function in children with malnutrition and their benefits also remain in later years when children enter adolescence and young ages. Studies on the impact of diet composition, including meat intake, on the parameters of nutritional iron status of infants are highly justified (Engelmann et al. 1998).

Some writers have used child nutritional intake for seven days as a measure of anaemia. That is, the type of food that the child was fed for the last one day or for the last seven days to determine the child's anaemic status.

2.3 Malaria Related Anaemia:

Anaemia is one of the most manifestations of malaria, that is, the reduction of haemoglobin concentration below the normal range. The severity of malaria infection can vary from mild (uncomplicated) to life threatening (severe malaria). Malaria-associated anaemia is a major cause of morbidity, admission, and mortality among children in malaria endemic areas of sub-Saharan Africa. Because anaemia presents with non-specific signs and symptoms, the condition is often unrecognized and under-treated

(Schellenberg et al., 2003). If left untreated, Anaemia is a major risk factor for mortality (Mabeza et al. 1998). Approximately three quarters of east African children less than 5 years of age suffer from anaemia, which is due, at least in part, to malaria and iron deficiency (Verhoef, 2001).

Malaria-related anaemia affects an estimated 1.5 to 6 million African children, causing a case fatality rate of 15% (Murphy and Breman, 2001). In areas of high malaria transmission, young children bear the brunt of malaria and in these settings the commonest presentation of malaria is severe anaemia. A study conducted by Mockenhaupt et al., (2004) showed that more than half of the children with severe malaria who were admitted to Tamale hospital showed severe anaemia (Hb) level of <5 g/dL. (Abdalla et al., 1980). In heavily endemic malaria areas, it is almost inevitable that malarial infection will be associated with anaemia, although malaria may not be the prime cause of it (Sumbele et al., 2013).

A study conducted in southern Cameroon showed an association between anaemia for the six month-old children and placental malaria infection. In this age group, a history of placental malaria infection was observed in 41% of the anaemic children and in only 14% of the non-anemic children (Muriel et al. 1998). A study carried out by Brabin et al.,(2001)in some African countries also showed that malaria was a risk factor for anaemia leading to child deaths. According to the study, the percentage of deaths of children aged 0–5 years due to anaemia was comparable for reports from highly malaria prone areas in Africa (Sierra Leone 11.2%, Zaire 12.2%, Kenya 14.3%). Evidence from a number of studies suggests that mortality due to malarial severe anaemia is greater than that due to iron-deficiency anaemia. (Brabin et al., 2001). Also, studies have shown that

severe malarial anaemia requiring blood transfusion is a life-threatening condition affecting millions of children in sub-Saharan Africa.

In terms of prevention, treated mosquito nets have been shown to improve haemoglobin concentration in children living in malaria prone areas (Lengeler 2003) but only recently has a potentially sustainable approach to the distribution of treated mosquito nets been shown to have similar effects (Abdulla et al., 2001).

2.4 Mother's Age

One of the factors that leads to child anaemia is the mother's age at birth. In a study using the World Fertility Survey, Trussell and Hammerslough found that the mother's age at birth was a significant risk factor for infant mortality in Sri Lanka (Trussell and Hammerslough 1983). Another investigation by Joycelyn et al., (2011) reveals two salient findings. First, in the sample of women who had their first birth between the ages of 12 and 35, the risk of poor child health outcome is lowest for women who have their first birth between the ages of 27 and 29. Second, the results indicate that anaemia is higher amongst indigenous children, in households with young mothers (Balarajan et al., 2011).

Luciana (2011) showed that mother's age was one of the variables associated with child anaemia. In a related study carried out by Leite et al., (2013) maternal age showed a protective effect for anaemia in children, with prevalence ratio between the first (less than 20 years of age) and the last stratum (40 years and over) reaching 0.75.

2.5 Mother's Education

In addition to dietary factors, malaria and the mother's age, education of the child's mother is also an important determinant of nutritional knowledge and diet (Variyam et al., 1999; Rahman et al., 2006). Studies have shown that the mother's education is also a factor influencing the child's iron intake, haemoglobin level and mean corpuscular volume (Male et al., 2001). Also, infants of mothers who were university graduates had significantly higher mean haemoglobin values than those whose mothers graduated from primary and high school (Male et al., 2001). Another study by Kikafunda et al., (2009), mothers' educational level was found to be a significant socio-economic factor for the occurrence of anaemia among both mothers and their children. Concerning the level of haemoglobin concentration, children of mothers with low education and children of mothers with normal education were 11.94 and 8.32 times as likely, respectively, to be classified as mildly or moderately anaemic as compared to children of mothers with high education (Hurtado et al., 1999).

A strong relationship may exist between a child's health and the educational level of his or her mother (Rahman et al., 2006). Higher maternal education has been shown to lead to increased knowledge about health and nutrition and to an increase in the quality of the diets of children (Variyam et al., 1999). Maternal education may also affect healthy decision making and thus influence the probability of a child meeting certain nutrition-related requirements (Mwanri et al., 2001). Research in developing countries has shown that children of formally educated or literate mothers had a reduced risk of stunting (Wamani et al., 2006 ; Chopra, 2006) A study conducted by, Zahira (2010) indicated that with the increase of education of mother, symptoms of anaemia decreased and level of hemoglobin increased both for the mother and child. Another study conducted in

Ecuador by Adams et al., (2011) showed that just 18.7% of women could name the two major iron-rich foods commonly available in the country - red meat and green vegetables. Worryingly, 14.1% suggested foods such as rice, bread and eggs as iron-rich sources, which actually contain very little iron unless specifically fortified. There was a vastly greater awareness of iron deficiency anaemia in university-educated women compared to non-university attendees (96.4% and 10.1% respectively). Of more importance in the prevention of iron deficiency anaemia is the consumption of iron-rich foods and only 8.3% identified red meat as an iron source (Adams et al., 2011).

The educational level of the mother is a primordial factor to be studied because an educated mother would have a mastery of the quality of food in terms of nutrients that the child needs to consume.

2.6 Household Socio-economic status

Reports have shown that there is definite correlation between socio-economic status (SES) and anemia. (WHO, 2001). A study conducted by Thavraj and Reddy (1985) showed iron deficiency among 20 percent of healthy non-anaemic high income group children. Hence it is evident that a significant proportion of the apparently healthy children belonging to the higher socio-economic class suffer from overt anaemia and may have latent iron deficiency anaemia if not anaemic. The possible reason for this could be the poor bio-availability of iron in Indian diet. Some studies performed in developing countries also showed that low SES is associated with high prevalence of anaemia (Shilpa et al., 2012).

2.7 Child's sex

According to available literature on anaemia, there exists some association between the sex of the child and his/her anaemic status. The gender difference in iron indicators as found in the Icelandic (Thorsdottir et al., 2003) and Norwegian (Borch et al., 2004) studies as well as in a Swedish study (Domellof et al., 2002) have been suggested to be due to faster growth velocity in boys with higher iron requirement than in girls. Domellof et al., (2002) concluded from their study of 9-month-old children, that difference in serum ferritin (SF) and mean corpuscular volume (MCV) values was to be expected between boys and girls due to genetic or hormonal variances and sex-specific cutoffs for these indices might therefore be needed. A higher prevalence of anaemia in boys may be due to the faster growth of pre-school boys compared to girls, which results in a high iron demand that cannot be met by diet alone (Santos et al., 2011). Following a study on early childhood anaemia and mild or moderate retardation by Hurtado et al., (1999) males were 2.17 times more likely to be classified as mildly or moderately retarded than were females.

According to Leite et al., (2013) the results of the National Survey of Brazil point to an association between sex and anaemia in indigenous children, with greater risk among boys. Other reasons of association between sex and anaemia may be differences in behaviour and breastfeeding patterns (Male et al., 2001).

2.8 Child's Age

Iron deficiency is most prevalent during the first 2 years of life when the infant brain is still developing. Infants below 2 years of age, especially preterm infants, represent major risk groups because of their low iron stores at birth, high iron requirements for growth,

and diets consisting of foods with low iron content and low iron bioavailability (Dallman et al., 1997). Iron reserves of the healthy, term newborn usually ensure an adequate supply of iron for the first 4–6 months of life. After 6 months of age the infant becomes critically dependent on dietary iron. In the United States of America, the prevalence of iron deficiency in early childhood has declined considerably over the last two decades, which may be attributed to improved infant feeding and more efficient preventive programmes (Dallman et al., 1997).

The prevalence of anaemia of nutritional origin is extremely high among children in many low income countries. For instance, with a cut-off level for Haemoglobin of 110 grams/litre, it has been reported to be 82% among 0–4-years-old children in Bangladesh (Ahmad, 1984), 38 to 73% among Indonesian children of the same age (Soemantoro et al., 1979), and 23% among Chinese kindergarten children (Chen et al., 1984). In early childhood, bad feeding habits, especially during the weaning period, exacerbate the problem.

2.9 Place of residence

According to studies carried out on mapping the risk of anaemia in preschool-age children by Ricardo and Archie, (2011) in Burkina Faso, Ghana and Mali, rural residences were significantly and negatively associated with the mean Hb. The results of the Egypt Demographic and Health Survey, (2001) showed that children 6 to 59 months in rural Upper Egypt and the Frontier governorates had the highest anaemia levels (38%) while children in urban Lower Egypt had the lowest levels (23%).

A study carried out by Ewusie et al., (2014) reveals that the prevalence of anaemia among rural children is about 17 percentage points higher than that of urban children. The prevalence of anaemia for the urban population stands at 67.5 percent, lower than that of the general population (78.4 percent). Meanwhile that of the rural population stands at 84.8 percent.

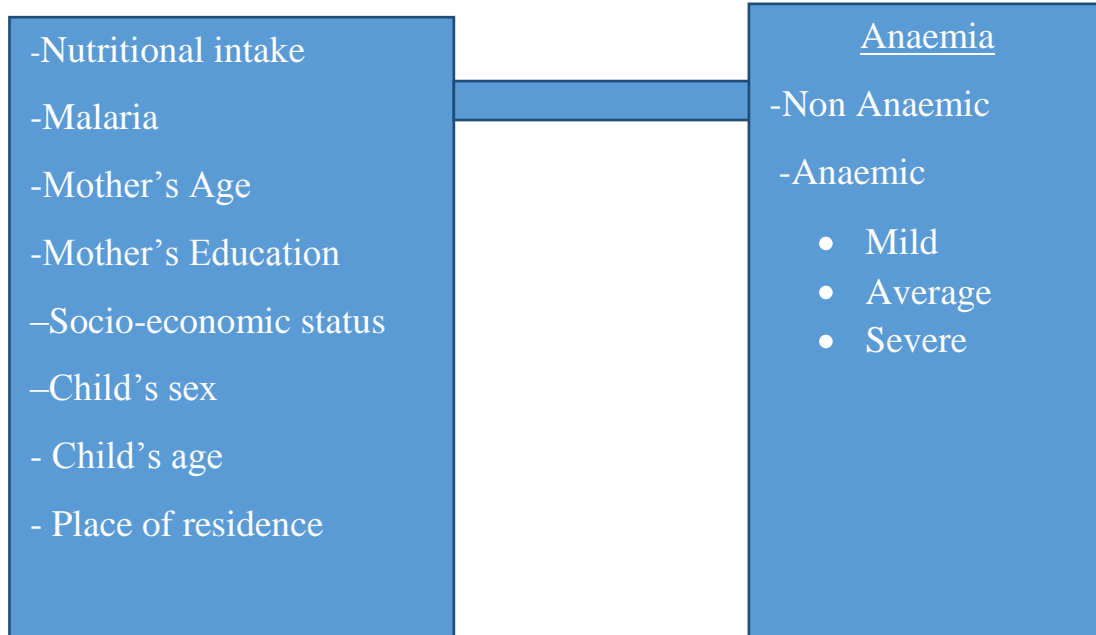
2.10 Conceptual Frame Work

The conceptual framework for the study seeks to describe the determinants of child anaemia. Several authors introduce varied conceptual frameworks to examine the determinants of anaemia and the extent to which they affect children.

The above framework is important because to effectively address the problem of child anaemia, it is necessary to have a clear understanding of the multiple causes that operate at the immediate, underlying and at the basic levels.

Independent Variables

Dependent Variables



Source: Adapted from UNICEF framework

The framework shows that among the factors that lead to anaemia in children are nutritional intakes, malaria, mother's age at birth mother's education and socio-economic status of the household. Nutritional intake (poor or insufficient) intake of iron rich food causes anaemia in children. Also, Malaria is thought to develop into anaemia through increased destruction or reduced production of red blood cells or a combination of both processes. In the case of Mother's age at the birth of the child, biological and social mechanisms play a role in explaining why children of young mothers have poorer outcomes. It has been shown that low socio economic status is associated with high prevalence of anaemia. Iron reserves of the healthy, term newborn usually ensure an adequate supply of iron for the first 4–6 months of life and after 6 months of age the infant becomes critically dependent on dietary iron. Higher maternal education leads to increased knowledge about health and nutrition and to an increase in the quality of the

diets of children. Women with higher education are likely to earn better incomes than those who have not acquired higher education. Thus they can purchase the quantity and quality of foods that can continuously restore the depleted iron stores and further provide them with the essential micronutrients. The prevention of anaemia on the basis of the household to purchase the right quantity and quality of foods also depends on the wealth status of that household. Studies have also revealed that the prevalence of anaemia among rural children is higher than that of urban children.

2.11 Hypothesis

In light of the observations made in the available literature on the determinants of anaemia, it is accordingly hypothesized that:

1. Children who do not consume foods rich in iron are more likely to be anaemic as compared to children who consume foods rich in iron.
2. Children who have malaria are more likely to have anaemia as compared to children who do not have malaria.

CHAPTER THREE

METHODOLOGY

3.1 Introduction to methodology

This chapter presents detailed research methods and design (techniques) that were employed in the study. The outline involves sources of data, methods of analysis, ethical clearance and the limitations of the data.

3.2 Data Source

Data comes from the 2011 Cameroon Demographic Health Survey (CDHS). The DHS is a nationally representative survey which collects detailed information on selected sample populations on various demographic characteristics such as education, health, employment, migration and housing conditions. The 2011 CDHS contains a sample of 11732 under-five children. Out of this figure, six thousand one hundred and twenty (6120) children between the ages of six (6) and fifty-nine (59) months tested for anaemia represents the sample size of this study.

3.3 Measurement of the Dependent variable

Each sample of blood was collected through capillary blood collection and the haemoglobin levels were tested according to the World Health Organization measurements. The following means were used to carry out the test of anaemia on the under-five children in the CDHS: An informed consent statement on haemoglobin was read to the mother of the child in which she had the right to determine if the child's blood sample would be collected for haemoglobin testing. In the case where the mother accepted, this followed through the use of the Hemocue system, that is the:

- Collection of capillary blood sample through the use of a non-reusable, self-retractable sterile.
- Introduction of the blood sample collected into a portable haemoglobinometer which in less than a minute displayed the results of haemoglobin concentration in grams per deciliter of blood (g/dl).
- Registration of the result obtained from the portable haemoglobinometer into the questionnaire.

The results collected from the sample either showed if the child was anaemic or not anaemic. A level of haemoglobin concentration in the blood of less than 11g/dl found on any of the results meant that the child was anaemic.

3.4 Method of analysis

Data for this study will be analyzed using the Statistical Package for the Social Sciences (SPSS) version 16.0, a comprehensive data analysis software. A univariate analysis will be carried out, that is the description of each independent variable in this work. Also bivariate analysis will be examined. This will involve the relationships between the different independent variables and the dichotomous dependent variable. Later, a multivariate analysis will be carried out which will deal with the logistic regression analysis. A logistic regression is used to predict a categorical (dichotomous) variable from a set of predictor variables.

The independent variables used in this study are nutritional intake, malaria, mother's age, mother's level of education, household wealth index the child's sex , age and the place of residence. Meanwhile the dependent variable is anaemia.

3.4.1 Nutritional intake

It deals with the type of food that the child consumes. Iron deficiency anaemic (IDA) is as a result of the lack of iron in the foods consumed by the child. Foods that are rich in iron are meat, milk, eggs, green vegetables, beans and soy beans. The type of food that the child is fed with has an effect on the level of iron in the child's blood and therefore affects the child's anaemic status. The mother of the child was asked the type of food that she gave to her child the previous day or night leading to the survey. A number of food items were enumerated for the mother to respond if the child took any of them. Thus the questions were asked: Gave child breast milk, tined, powdered or fresh milk, fortified baby food, porridge, bread, potato, cassava, or other tubers, eggs, meat, vegetables, fish etc. In this present study, it would be important to use the type of food the child was fed with on the day preceding to the survey as a proxy measurement of dietary intake since it is the main question that was asked in terms of child's nutrition. Animal source foods (ASF) will be used here as a proxy for iron intake while controlling for fish, fruits and vegetables as confounding variables since they only help to make iron bioavailable to the child.

3.4.2 Malaria

This present study is going to include malaria as a factor affecting child anaemia because Cameroon where the study is being carried out is a highly malaria prone country. The mothers of the under-five years were asked if their children had fever in the last two weeks before the survey. This will be used as a measure of malaria because fever is a symptom of malaria which in turn reduces the haemoglobin level in the blood of the child.

3.4.3 Mother's age

According to literature on anaemia, it has been observed that maternal age shows a protective effect for anaemia in children, with prevalence ratio between the first (less than 20 years of age) and the last stratum (40 years and over) reaching 0.75 (Leite et al., 2013). The mother's age will be measured in five years age groups which represents the reproductive ages of the women that were sampled in the survey. In the DHS, mother's age was requested in five years age groups from 15 to 49 years. It would be appropriate to study mother's age in this present research because young mothers are unable to provide adequate care for their children. Since they are the main care providers for their children (feeding, bathing, clothing cleaning, hospitalization etc), the need to study the relationship between their age and the anaemic status of their children is of high importance.

3.4.4 Mother's education

Mother's education has also been observed as one of the determinants of child anaemia (Rahman et al., 2006). Education here expresses the extent to which the child's mother is literate enough to help him/her consume the required nutritive foods that are rich in iron. From the survey, the highest educational level of the mother was asked in various categories. The categories that were registered included no education, primary education, secondary education and higher education.

3.4.5 Socio-economic status (SES)

It has been observed that the household SES has an effect on the child's dietary intake (WHO 2001). Socio-economic status of the household refers to the educational level, income (wealth index) and occupational level of the household. It will be important to

use wealth index as a proxy measure for socio-economic status because unlike educational and occupation levels, the wealth index would give a tangible measure of the goods that are easily evaluate. Also, concerning the socio-economic status and anaemia, it would be important to take into consideration the wealth index during the analysis phase since higher wealth is an indicator of a better standard of living. In the survey questionnaire, mothers of the under-five years were requested to answer if they had some basic equipment in their households. The questions were: Household has electricity, radio, television, bicycle, motorcycle/scooter, and car/truck. Using the wealth index, these households were grouped into poorest, poorer, middle, richer and richest households. The wealth index will therefore be used as a measure of socio-economic status and anaemia.

3.4.6 Child's Sex

Concerning the issue of sex of the child and his/her effect on anaemia, abundant literature has shown that boys are more anaemic than girls children due to their natural high demand for iron. However, it would be important to evaluate the issue of sex in this document because of the location and the cultural difference of the study area. African culture places value on boys than on girls and this may lead to different treatments given to both sexes. In this study, it will be necessary to look at the relationship between the sex of the child and his/her anaemic status. Therefore studying sex differentials and anaemia will help provide us with a better picture on how the sex of a child can be related to his/her anaemic status. According to the questionnaire, child's sex was represented by either male or female.

3.4.7 Child's age

Child's age has been shown as one of the factors that has a relationship with his/her anaemic status. The child's age will be studied from 6 months to 59 months. Within this age interval, the child's age will be broken down into two distinctive age groups, 6 to 24 months and 25 to 59 months. Reasons being that anaemia has been found to be more prevalent within the ages of 6 to 24 months due to the reduction of haemoglobin that was available during birth and also due to weaning which leaves the child fragile as he/she is introduced to new dietary foods.

3.4 8 Place of residence

Literature on child anaemia has informed us that children who reside in rural areas turn to be more anaemic as compared to children in urban areas. According to the CDHS, the place of residence had options as Yaoundé, Douala, other cities and rural. These options on place of residence have been regrouped into two; urban and rural for easy study.

3.5 Data Analysis

Using the WHO cut off point for anaemia, a haemoglobin concentration of 11grams/deciliter (11g/dl) of blood and above in an under-five years will be considered as non anaemic. Below 11g/dl, the child will be considered as anaemic. Thus the dependent variable, anaemia, will be dichotomous, that is non anaemic or anaemic. A further examination would be done to study the level of anaemia found in the child. It has been considered by the WHO that anaemia is severe if the level of hb concentration found in the blood is less than 7.0dl/g, moderate if this value is between 7 to 9.9dl/g. Lastly, it is mild if the value falls between 10.0 to 10.9dl/g.

3.6 Ethical Clearance

In order to carry out this research work on anaemia, I needed to obtain the Cameroon DHS data for 2011. Ethical clearance was sorted and granted by the Director General of the National Institute of Statistics and permission granted for the use of these data solely for the purpose of the research it is meant for.

3.7 Limitations of the data

- The collection of data on child's nutritional intake for only one day consumption of food by the under-five year is insufficient to capture the child's nutrition. Therefore using this as a proxy to measure the child's anaemic status is a limitation to this study.
- The use of fever (if the child had fever within the last two weeks) as a measure of malaria affection on the under-five year is in itself a limitation. This is due to the fact that not all fevers are caused by malaria. The fever may have been caused as a result of other infections (bacterial infections, viral infections, medications, consumption of illicit drugs and illnesses related to heat exposure) in the child's body other than malaria.

CHAPTER FOUR

BACKGROUND CHARACTERISTICS OF RESPONDENTS

4.1 Introduction

Although Cameroon has made several advances in recent years in the improvement of health care and food security, chronic malnutrition and micronutrient deficiencies in children under age 5 remains a public health concern. According to the Cameroon Demographic Health Survey (CDHS, 2011), 122/1000 die without reaching their 5th birthday, with malnutrition being the underlying factor in more than a third of these deaths.

4.2 Demographic and socio-economic characteristics of the respondents

The discussion in this section is the background characteristics of the study population. Background characteristics will play a key role in the analysis of this chapter because they are associated with the anaemic status of the under-five year children. These characteristics include nutritional intake, malaria, mother's age, mother's education, household socio-economic status, the child's sex and child's age. Some of the frequencies will not be up to six thousand one hundred and twenty (6120) because of missing cases.

4.2.1 Child anaemia

Child anaemia is the independent variable in this study which shows whether the child is anaemic or not anaemic. In the case where he/she is anaemic, it is looked upon if he/she is severely, averagely or mildly anaemic.

Table 4. 1: Under five anaemic level

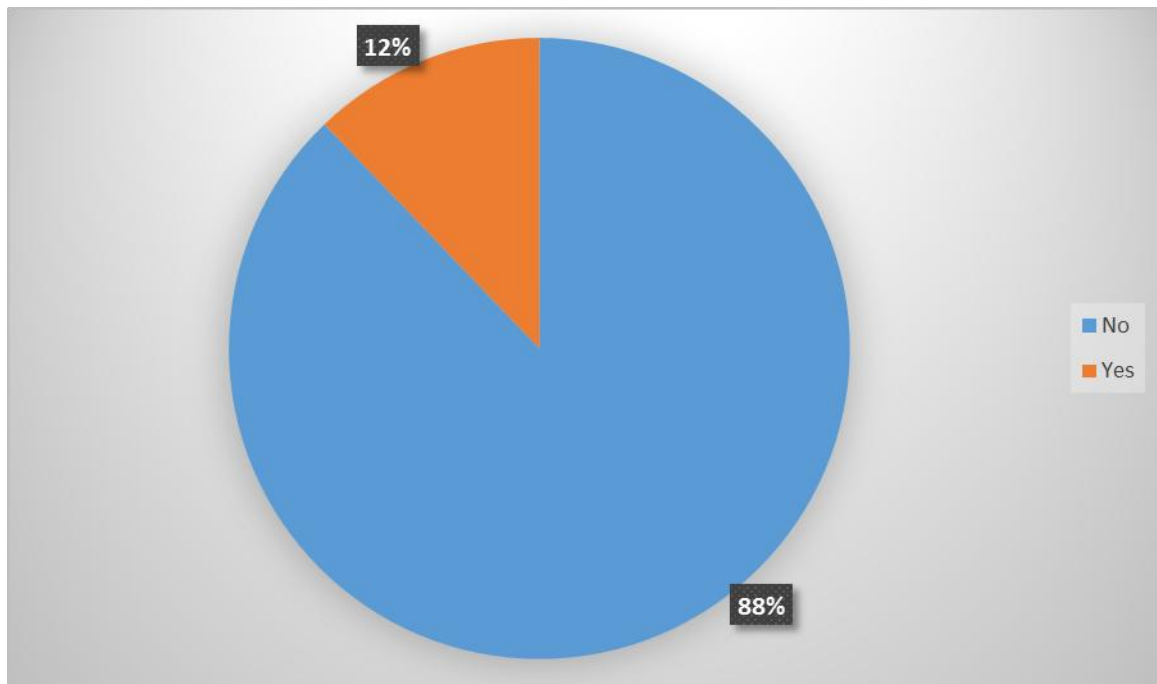
Anaemic status	Frequency	Percentage
Severe	22	0.4
Moderate	547	8.9
Mild	1768	28.9
Not anemic	3782	61.8
Total	6120	100

Source: Computed from 2011 Cameroon Demographic and Health Survey.

According to figure 4.1, the results of anaemia found in the blood of the under five children sampled shows that 0.36% were severely anaemic, 0.9 percent of the children whose blood samples were collected had a form of moderate anaemia meanwhile 29 percent of them were mildly anaemic. Still within the sample, 62 percent of the children had no anaemia in their blood. It could therefore be concluded that 38 percent of the children age 6 months to 59 months whose blood samples were collected during the 2011 CDHS were anaemic.

4.2.2: Nutritional intake

Nutritional intake which is the type of diet that the child took on the eve of the survey has been measured using animal source foods which is rich in iron.

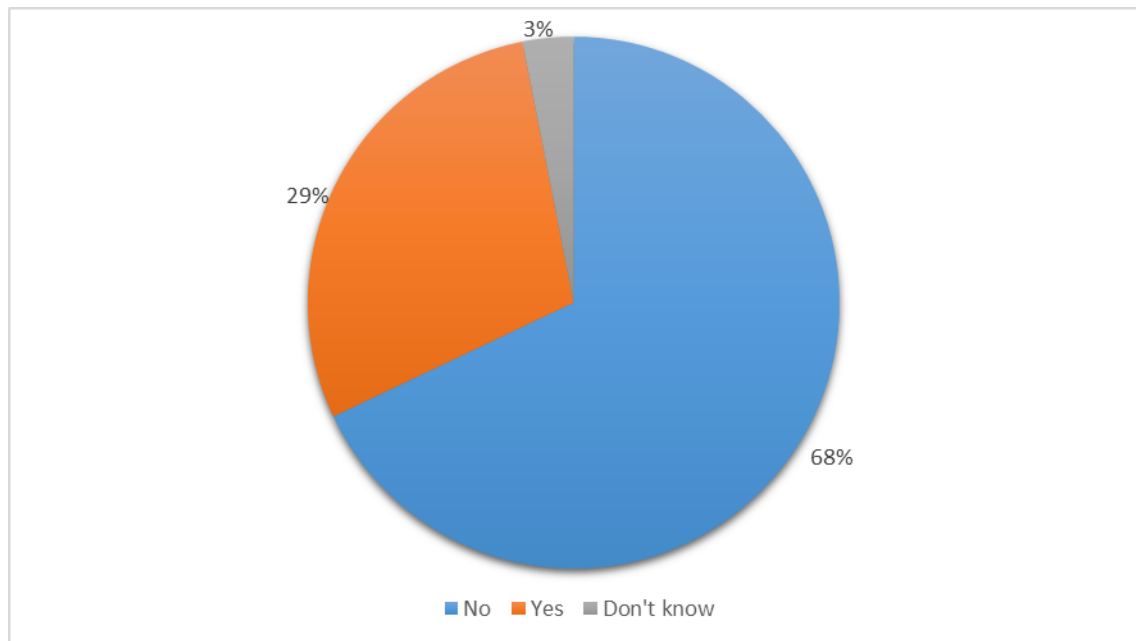
Figure 4.1: Animal Source Foods

Source: Computed from 2011 Cameroon Demographic and Health Survey.

According to figure 4.1 above, 88% of the mothers responded that they did not give any form of animal source foods to their children on the previous day or night before the survey, meanwhile 12% of the respondents gave animal source foods to their children on the eve of the survey.

4.2.3 Malaria

Menendez et al., (2000) observed in their study on malarial anaemia that malaria infection in humans by plasmodium species is associated with a reduction in haemoglobin levels, frequently leading to anaemia. Plasmodium falciparum causes the most severe and profound anaemia, with a significant risk of death. They went on to explain that anaemia of malaria origin is multifactorial, involving both the destruction of red blood cells (RBC) and the decreased production of RBC. With acute uncomplicated falciparum malaria, anaemia develops 48 hours after the onset of fever.

Figure 4.2: Fever level distribution within the last two weeks

Source: Computed from 2011 Cameroon Demographic and Health Survey.

From figure 4.2, it can be observed that 29 percent of the under-five children were reported by their mother as having gotten fever within the last two weeks before the survey. 68 percent of the children according to reports never had fever during the survey. Meanwhile, 3 percent of the respondents were unable to recall whether their child had had fever within the above stated time or not.

4.2.4 Mother's age at time of survey.

Following the 2011 CDHS, mothers were classified into their reproductive age groups (five years age groups) from 15 to 49 years.

Table 4. 2: Mother's age in five years age group.

Age in 5 years age group	Frequency	Percentage
15-19	495	8.1
20-24	1560	25.5
25-29	1772	29.0
30-34	1193	19.5
35-39	692	11.3
40-44	323	5.3
45-49	86	1.4
Total	6120	100

Source: Computed from 2011 Cameroon Demographic and Health Survey.

According to the table above, mothers between the ages of 15 to 19 constituted 8 percent of the total women population in the sample. Those in the age group of 20 to 24 represented 25.5 percent, while women in the age group 25 to 29 represented 29 percent of the total women sampled during the survey. 19.5 percent of the total women population in the survey were between the ages of 30 to 34 meanwhile 11 percent were between ages 35 to 39. The age groups 40 to 44 and 45 to 49 had lowest percentages of 5.3 and 1.4 represented respectively. The table therefore shows that from age 20 to age 34, fertility is highest representing 63 percent of the total children born between ages 19 to 49.

4.2.5 Mother's education

According to literature, the education of a mother has been observed as having a positive relationship with her child's nutritional intake hence reducing the child's chances of getting anaemia. This is because the mother is educated on the type of foods that the child can acquire to get the necessary iron nutrients and also help the child's hygienic and environmental conditions.

Table 4. 3: Mother's educational levels.

Level of education	Frequency	Percentage
No education	1686	27.5
Primary	2537	41.5
Secondary	1697	27.7
Higher	200	3.3
Total	6120	100

Source: Computed from 2011 Cameroon Demographic and Health Survey.

According to the above table, 28 percent of the women who were sampled in the survey had no formal education meanwhile 42 percent had at least completed primary education. Concerning those who had completed secondary education, 28 percent of these women were observed in the sampled population. Just 3 percent of these women had obtained a higher level of education. It could be concluded from the above table that 69 percent of women sampled in the survey had had at least primary education meanwhile 31 percent had received at least secondary education.

4.2.6 Socio-economic status

Wealth, a set of economic reserves or assets, presents a source of security providing a measure of a household's ability to meet emergencies, absorb economic shocks, or provide the means to live comfortably. Wealth reflects intergenerational transitions as well as accumulation of income and savings. Thus it is a simple measure that can show us how rich, middle or poor a household is which will help us to relate the results on the child's anaemic status in the said household.

Table 4.4: Wealth Index of the households

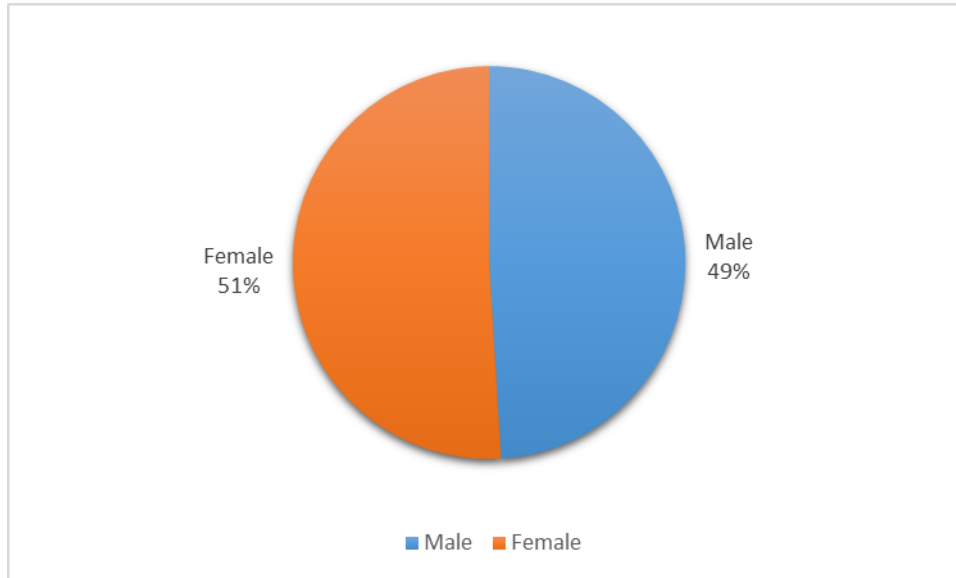
Level	Frequency	Percentage
Poorest	1424	23.3
Poorer	1334	21.8
Middle	1193	19.5
Richer	1180	19.3
Richest	989	16.2
Total	6120	100

Source: Computed from 2011 Cameroon Demographic and Health Survey.

According to the above table, 23 percent of the sampled households were the poorest and 22 percent were poorer. The results also showed that 19 percent of the households were neither poor nor rich, 19 percent were richer meanwhile 16 percent were the richest of all the total households sampled in the survey. It therefore means that 45 percent of the households sampled were at least poor meanwhile 35 percent were at least rich.

4.2.7 Child's sex

Figure 4.3: Sex of the child



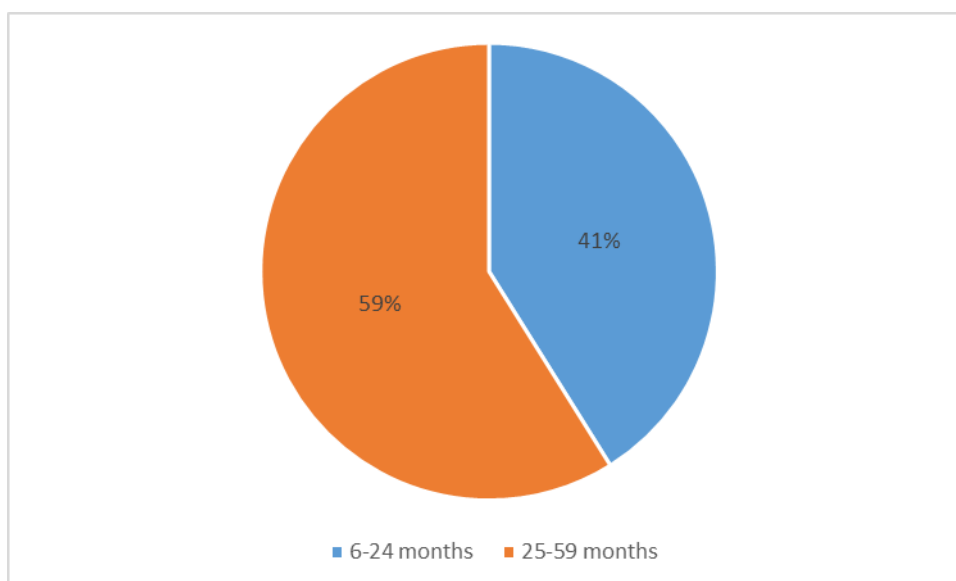
Source: Computed from 2011 Cameroon Demographic and Health Survey.

From figure 4.3 above, it can be viewed that the female sex constituted 51 percent of the children that were sampled in the survey meanwhile the male sex had 49 percent.

4.2.8 Child's age

The age of the child in which blood samples were collected varies from 6 months to 59 months. According to literature, child's age was shared into two groups, that is, from 6 to 24 months and from 25 to 59 months because of the fact that the different age groups have varying anaemic statuses.

Figure 4.4: Distribution of the age of the child



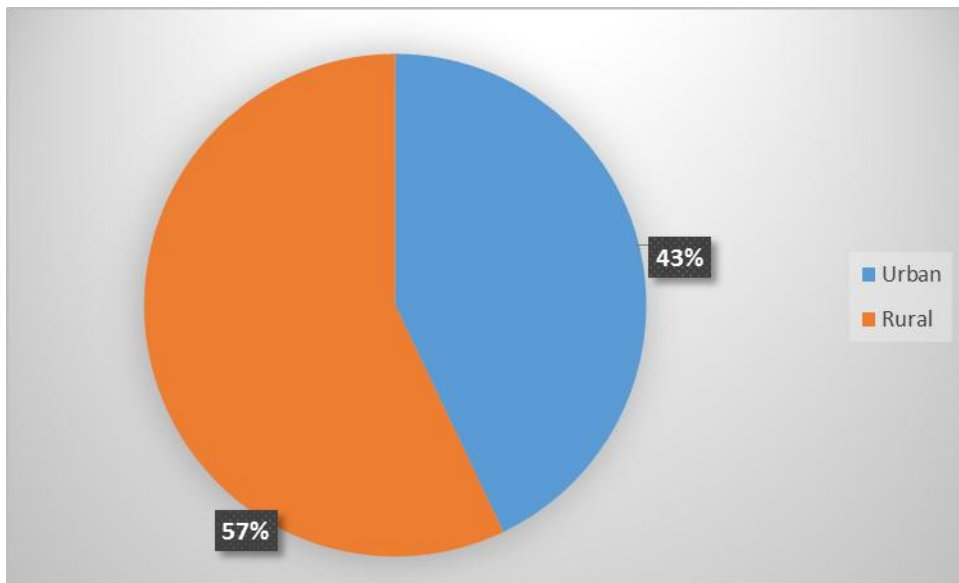
Source: Computed from 2011 Cameroon Demographic and Health Survey.

From the above chart, 59 percent of children between the ages of 6 to 24 months were sampled for anaemia meanwhile 41 percent of those between the ages of 25 to 59 months were also sampled for anaemia during the 2011 Cameroon Demographic and Health Survey.

4.2.9 Place of residence

The place of residence indicates whether a child who took part in the CDHS resided in the rural or urban area.

Figure 4.5: Distribution of place of residence



Source: Computed from 2011 Cameroon Demographic and Health Survey.

The results from figure 4.5 indicates that 57 percent of the children whose blood samples were collected for anaemia test were living in the rural areas meanwhile 43 percent of these children were living in the urban areas.

CHAPTER FIVE

LEVELS OF ANAEMIA AMONG CAMEROONIAN CHILDREN

5.1 Introduction

Bivariate analysis is the simultaneous analysis of two variables (attributes). It explores the concept of relationship between two variables (independent and dependent), whether there exists an association and the strength of this association, or whether there are differences between two variables and the significance of these differences. This chapter will involve the use of cross tabulations of each independent variable on the dependent variable. Some of the independent variables are categorical (animal source foods and had fever, education, socio-economic status and child's sex), while maternal age and child's age are numerical variables. The dependent variable here is a discrete one showing the various levels of anaemia (non anaemic, severe, moderate and mild), and values attributed.

5.2 Animal source foods and child anaemia

Table 5.1: Animal source foods and child anaemia (%)

ASF	Severe	Moderate	Mild	Not anemic	P-value
					0.068
No	0.4	9.0	29.4	61.2	
Yes	0.3	8.3	25.2	66.2	
Total	0.4	9.0	28.9	61.8	

Source: Computed from 2011 Cameroon Demographic and Health Survey.

From the above table, it can be observed that the percentage of children who did not take any form of animal source foods and were severely anaemic were 0.4 , 9 percent had

moderate anaemia, 29 percent had mild anaemia and 61% were not anaemic. Amongst those who consumed any form of animal source foods, .3% were severely anaemic, 8% had moderate form of anaemia, 25 percent were mildly anaemic and 66% had no anaemia. From table 5.1, reading from the p-value, it shows a difference between those who consumed animal source food and those who did not consume animal source food in relation to their anaemic status.

5.3 Had fever in the last two weeks and anaemic status

Table 5.2: Fever and child anaemia (%)

Fever	Severe	Moderate	Mild	Not anemic	P-value
					0.081
No	0.4	7.9	29.6	62.1	
Yes	0.3	9.6	28.8	61.3	
Don't know	0	12.7	22.5	64.7	
Total	0.3	8.6	29.2	62.0	

Source: Computed from 2011 Cameroon Demographic and Health Survey.

Table 5.2 above shows that children who did not have fever within the last two weeks preceding to the survey were reported to have 0.4 percent of severe anaemia, 8 percent moderate anaemia, 30 percent mild anaemia and 62 percent were not anaemic. As to those who were reported as having had fever within the last two weeks to the survey, 0.3 percent had severe anaemia, 10 percent had moderate anaemia and 29 percent had mild anaemia. 61 percent of them were not anaemic. Concerning those who reported that they did not know whether they had had fever within the last two weeks preceding to the survey, 35 percent of them were anaemic. Looking at the p-value, there exists an association between having fever and being anaemic.

5.4: Mother's age and child anaemia**Table 5.3: Mother's age and child anaemia (%)**

Age in 5 yrs	Severe	Moderate	Mild	Not anemic	P-value
					.000
15-19	0.6	9.9	31.9	57.7	
20-24	0.3	8.8	29.5	61.4	
25-29	0.3	10.3	27.3	62.2	
30-34	0.3	6.6	29.1	63.9	
35-39	0.1	8.7	31.4	59.8	
40-44	0.9	12.1	22.3	64.7	
45-49	2.3	2.3	34.9	60.5	
Total	0.4	9.0	28.9	61.8	

Source: Computed from 2011 Cameroon Demographic and Health Survey.

The above table shows the different age groups of mothers and the anaemic statuses of their children. Looking at the age group 15-19, it can be observed that 0.6 percent of the children whose mothers were in that age group were severely anaemic. Meanwhile 10 percent and 32 percent were moderately and mildly anaemic respectively. About 58 percent of the children whose mothers fall in that age group were not having any form of anaemia. At age group 35 to 39, severe anaemia drops to 0.14 percent and it increases to an outstanding figure of 2.33 percent from age group 45 to 49 years. Looking at the table, we can see that anaemia decreases with age as the percentage of children who were not anaemic increased continuously from 58% in age group 15-19 to 64 percent in age group 30-39. Also looking at the p-value, we see that the mother's age is highly significantly related to the anaemic status of the child.

5.5: Mother's education and child anaemia**Table 5.4: Maternal education and child anaemia (%)**

Level of education	Severe	Moderate	Mild	Not anemic	P-value
					0.000
No education	0.7	11.0	28.4	60.0	
Primary education	0.2	7.6	26.3	65.9	
Secondary education	0.5	9.4	34.0	56.1	
Higher Education	0	5	22	73	
Total	0.4	9.0	28.9	61.8	

Source: Computed from 2011 Cameroon Demographic and Health Survey.

Table 5.4 shows that children whose mothers had no education, 0.7% of them were severely anaemic, 11% had moderate anaemia, 28% had mild anaemia and 60% were not anaemic. Concerning children whose mother had obtained primary education, 0.2% of them were severely anaemic, 8% moderately anaemic, 26% mildly anaemic and 66% of them were not having anaemia. Children whose mothers had completed secondary education were 0.5% severely anaemic, 9% moderately anaemic, 34% mildly anaemic and 56% of these children had no anaemia. Children whose mothers had higher education had no severe anaemia and 5% and 22% of these children had moderate and mild anaemia respectively. Meanwhile a very high proportion (73%) of children born by higher educational mothers had no anaemia. It could be concluded that anaemia decreases with increase in education. Looking at the p-value of 0.000 which is far below 0.05, it can therefore be said that education is highly significantly related to anaemia.

5.6 Wealth index and child anaemia

Table 5.5: Wealth index and anaemia (%)

Wealth Index	Severe	Moderate	Mild	Not anemic	P-value
					.000
Poorest	0.3	8.2	26.7	64.8	
Poorer	0.5	8.3	26.8	64.4	
Middle	0.6	8.2	28.1	63.1	
Richer	0.2	11.6	33	55.3	
Richest	0.2	8.7	30.9	60.2	
Total	0.4	9.0	28.9	61.8	

Source: Computed from 2011 Cameroon Demographic and Health Survey.

Table 5.5 shows the relationship between wealth and anaemia. Looking at the households that were the poorest in the survey, 0.3 percent of the children in these households had severe anaemia, 8 percent had moderate anaemia, 27 percent had mild anaemia and 65 percent of these children were not anaemic. Concerning poorer households, 0.5 percent were observed as being severely anaemic, 8 percent moderately anaemic, 27 percent mildly anaemic and 64 percent were not having any form of anaemia. On the other hand, concerning those children who were registered in the survey as coming from richer households, 0.2 percent, 12 percent and 33 percent of them were respectively severely, moderately and mildly anaemic, while 55 percent of these children had no anaemia. With regards to children from the richest households registered in the survey, 0.2, 9 and 29 percent of them had severe, moderate and mild anaemia

respectively, while 60 percent of the children were not anaemic. Generally speaking, there exists a relationship between child anaemia and the socio-economic status of the household, represented by the p-value of 0.00. We can observe from the data on table 5.5 that children who were anaemic were registered as 35, 34, 37, 45 and 40 percent respectively as poorest, poorer, middle, richer and richest. The relationship indicates that the lower the socio-economic status of the household, the lower the effect of child anaemia in that household.

5.7 Child's sex and anaemia

Table 5.6: Child's sex and anaemia (%)

Sex of child	Severe	Moderate	Mild	Not anemic	P-value
					0.740
Male	0.4	8.6	29.2	61.9	
Female	0.3	9.3	28.6	61.8	
Total	0.4	9.0	28.9	61.8	

Source: Computed from 2011 Cameroon Demographic and Health Survey.

From the table above, we can observe that 0.4% of the male children whose blood samples were collected in the survey had severe anaemia while 9% and 29% had respectively moderate and mild anaemia. 62% of these male children were reported not anaemic. Concerning the female sex, those who had severe anaemia represented 0.3%, those with moderate and mild anaemia also represented 9% and 29% respectively and 62% of these females never had anaemia. There exists therefore no statistical difference in the prevalence of anaemia in male and female children.

5.8 Child's age and anaemia

Table 5.7: Child's age and anaemia (%)

Age in months	Severe	Moderate	Mild	Not anemic	P-value
					.001
6 to 24	0.2	7.3	26.3	66.3	
25 to 59	0.4	9.1	30.2	60.2	
Total	0.3	8.4	28.6	62.7	

Source: Computed from 2011 Cameroon Demographic and Health Survey.

Child's age and anaemia on table 5.8 above indicates that about 0.2% of the children aged 6 to 24 months had severe anaemia meanwhile 7% and 26% had moderate and mild anaemia respectively. Within the above mentioned age group, 66% had no anaemia at the time of the survey. Concerning the age group 25 to 59 months, 0.4% were severely anaemic, 9% moderately anaemic and 30% mildly anaemic, while 60% were not having any form of anaemia. The p-value indicates that there is a relationship between the child's age and child's anaemic status.

5.9: Place of residence and anaemia

Table 5.8: Place of residence and child anaemia(%)

Place of residence	Severe	Moderate	Mild	Not anaemic	P- value
					0.000
Urban	0.3	9.9	30.8	59.0	
Rural	0.4	8.2	27.5	63.9	
Total	0.4	8.9	28.9	61.8	

Source: Computed from 2011 Cameroon Demographic and Health Survey.

The results in table 5.8 show that 0.3 percent of the urban under-fives had severe anaemia, 10 percent had moderate anaemia and about 40 percent had mild anaemia. It also shows that 59 percent of the urban children were not having any form of anaemia. The results also show that 0.4 percent of those children who took part in the survey and were residing in the rural areas had severe anaemia. About 8 percent of them had moderate anaemia and about 28 percent had mild anaemia. Meanwhile 64 percent of the children living in rural areas were not anaemic. It should be noted that the percentage of children who had anaemia in urban areas was 41 meanwhile 36 percent of rural under-fives were reported as being anaemic. The table also shows us (looking at the p-value) that the place of residence and child anaemia are significantly related.

CHAPTER SIX

DETERMINANTS OF CHILD ANAEMIA (LOGISTIC REGRESSION)

6.1 Introduction

In this study, we want to predict child anaemic status, that is, the response variable (anaemic, not anaemic) based on predictors which are animal source foods (yes, no), had fever within the last two weeks (yes, no), maternal age, maternal educational level, wealth index, child's age, child's sex and place of residence. Thus the study would be carried out using the binary logistic regression with the dependent variable dichotomously scored, that is, anaemic or non anaemic. The dependent variable under the multivariate analysis will therefore be categorically measured.

Table 6.1: Factors associated with child anaemia

Variables	Wald statistic	Odds ratio	P-value	95% C.I. Lower	95% C.I. Upper
Consumption of animal source foods					
Met		Ref.			
Unmet	8.08	1.29	0.00	1.08	1.55
Fever					
Yes		Ref.			
No	2.23	0.91	0.14	0.80	1.03
Maternal education					
Higher education	42.89	Ref.	0.00		
No education	12.50	2.16	0.00	1.41	3.31
Primary education	3.10	1.45	0.08	0.96	2.18
Secondary education	12.53	2.04	0.00	1.38	3.03
Wealth index					
Richest	22.53	Ref.	0.00		
Poorest	10.64	0.60	0.00	0.44	0.81
Poorer	8.51	0.65	0.00	0.49	0.87
Middle	5.75	0.75	0.02	0.59	0.95
Richer	0.83	1.10	0.36	0.89	1.36
Sex of child					
Female		Ref.			
Male	0.11	0.98	0.74	0.87	1.11
Age of child					
25 to 59 months		Ref.			
6 to 24 months	17.09	0.77	0.00	0.68	0.87
Place of residence					
Urban		Ref.			
Rural	2.08	1.15	0.15	0.95	1.40
Maternal age					
30 to 49 years		Ref.			
15 to 29 years	0.73	1.06	0.39	0.93	1.20

Source: Computed from the 2011 Cameroon Demographic and Health Survey.

6.2 Interpretation of Results

According to the results presented on the table above, there is a significant relationship between the consumption of animal source foods and anaemia, controlling for all other independent variables. Children who did not consume animal source foods were 1.3 times more likely to be anaemic as compared to children who consumed animal source foods. It can be seen that in 95 percent of samples drawn from this under-five survey, we can expect the interval from 1.08 to 1.55 to include the true parameter of 1.3 (odds ratio). According to studies reviewed, animal source foods include iron, found in several foods of animal origin (all kinds of meat, milk, and eggs) and of vegetable origin (dark green vegetables, beans, soy beans, among others). Therefore, the consumption of animal source foods by children will improve their protein intake and will go a long way to curb child anaemia as shown through research.

Looking at table 6.1, it can be noticed that with a p value of 0.14, anaemia among children with no fever was not different from that in children with fever. Using fever as a proxy measure of malaria, it goes a long way to disprove our review of the literature which has shown that most study cases of children with malaria were affected with anaemia.

The results also show that there is a relationship between maternal education and under-five anaemia. Children whose mothers had no education were 2.2 times more likely to be anaemic as compared to children whose mothers had acquired higher education. It can also be seen that children whose mothers had acquired primary education were reported to be 1.5 times more likely to be anaemic as compared to those whose mothers had passed through higher education. In the same vein, those whose mothers had succeeded

secondary education were 2 times more likely to be anaemic as compared to those whose mothers had higher education. Studies have shown that infants of mothers who were university graduates had significantly higher mean haemoglobin values than those whose mothers graduated from primary and high school. The multivariate analysis has therefore confirmed literature which shows a significant relationship between maternal education and child anaemia. The higher the level of education of the mother, the more likely she can be able to have a mastery of the best dietary intake for her child. Higher maternal education has been shown to lead to increased knowledge about health and nutrition and to an increase in the quality of the diets of children.

The multivariate results also show that there is a relationship between the wealth index and anaemia. It can be depicted that children whose households were checked as poor were less likely to be anaemic as compared to those children from richest households. The same goes to children from poorer and middle households. On the contrary, children from richer households were 1.1 times more likely to be anaemic as compared to children from richest households. From studies carried out, it is evident that a significant proportion of the apparently healthy children belonging to the higher socio-economic class suffer from overt anaemia and may have latent iron deficiency anaemia if not anaemic. This may be the case showing children from richer households less anaemic compared to children from richest households in this study.

There exists no significance in terms of the sex of the child and their anaemic status. Male and female children showed no difference in terms of child anaemia, thus showing a contradiction of literature. Studies have suggested differences due to faster growth velocity in boys with higher iron requirement than in girls. Most of the studies made

mention of were found in developed countries like Norway and Latin American countries (Brazil). It may be that African children could be different in terms of sex and its effect on child anaemia as compared to other continents.

It can also be acknowledged from the multivariate analysis that the age of the child is significantly related to anaemia controlling for other independent variables. Children between the ages of 6 to 24 months were less likely to be anaemic as compared to children whose ages lied between 25 and 59 months. The above analysis is in contradiction with studies which instead show that infants below 2 years of age, especially preterm infants, represent major risk groups because of their low iron stores at birth, high iron requirements for growth, and diets consisting of foods with low iron content and low iron bioavailability.

Concerning the place of residence, it can be viewed from the table above that children who resided in rural areas were about 1.2 times more likely to be anaemic as compared to children who were living in urban areas. The results show no significance in terms of disparities in child anaemia between urban and rural milieu, although they contradict literature which has shown that pre-school age children in rural areas were significantly anaemic with studies carried out in Burkina Fasso, Ghana and Mali.

The results of maternal age shows that children born by young mothers (from the ages of 15 to 29 years) were about 1.1 times more likely to be anaemic as compared to children born by older mothers of ages between 30 and 49 years, although the results are not showing any significance of child anaemia linked to the age of the mother. According to the literature, maternal age showed a protective effect for anaemia in children, with

prevalence ratio between the first (less than 20 years of age) and the last stratum (40 years and over).

6.3 Discussion

According to results from the wealth index, all levels of households were significantly related to anaemia except those households that were checked as richer, with the richest households as the reference. But the relationship was viewed to be a negative one for we could see that poorest, poorer and middle households were less likely to be anaemic as compared to the richest households. Badasu (2004) explains that in urban areas especially, the increasing need for women to work away from home in order to either supplement their families' income or solely provide a livelihood for their families, makes caring for children more problematic for the family. She continued that families or adults, parental care is now often delegated to unrelated house helps who in some cases are children or under-age and/or unskilled in child care. Some children are left in the care of untrained childcare attendants working in day-care centres that may not have adequate facilities. Some house helps even have the added task of housekeeping so that they are not capable of giving proper attention to the children in their care. Thus while working mothers who can afford substitute care may be better off than those who cannot, their children may also not be receiving any quality care relatively and may be prone to poor nutritional intake which may lead them to become anaemic.

Nutritional intake of children has shown to be highly significantly related to child anaemia. This is because iron which originates from animal source foods is essential for the maintenance of organ function at a cellular level, and thus its deficiency will have various clinical manifestations.

CHAPTER SEVEN

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

7.1 Summary of findings

Children of ages 6 to 59 months were subject of the study and numbered 6120. Out of this number, 38 percent had anaemia and 62 percent were not anaemic. Also, 41 percent were found in the 6 to 24 months age group and 59 percent in the 25 to 59 months age group. Children who lived in the urban areas constituted 43 percent of the study while those in the rural areas represented 57 percent.

Only a meagre one tenth of the children took any form of animal source foods that could be considered rich in iron and the rest (nine tenth) did not receive any animal source foods at the eve of the survey. 29 percent of the children had fever two weeks before the survey while 68 percent never had fever before the survey.

Concerning maternal age, mothers in age group 25 to 29 had the highest representation in the survey (29 percent), followed by those in age group 20 to 24 whose percentage stood at 25.5 percent. The last mother's age group that was represented was 45 to 49 which had 1 percent. About 28 percent of the women who responded in the survey had no education, while about 42 percent had obtained primary education. Also, about 28 percent of the women had secondary education and just a meagre 3 percent had received higher education.

The results from the survey shows that about 45 percent of the households were reported to be at least poor, about 36 percent at least rich, and about 20 percent were neither poor nor rich. Concerning the sex of the children, 51 percent of them were females and 49

percent were males. It has also been shown that 53 percent of the children in the survey were living in urban areas meanwhile 57 percent were living in rural areas.

The results also show that 39 percent of children who were not fed with animal source foods on the eve of the survey were anaemic while 34 percent of those who took animal source foods were anaemic. Among children who were reported of having been attacked by fever, 39 percent had anaemia and 38 percent of those children who never had fever had anaemia.

Mother's age was highly significantly related to child anaemia. This relationship showed an inverse one where as mother age increased, child anaemia decreased. Among mothers of age group 15 to 19, 42 percent of their children had anaemia. Child anaemia dropped to 35 percent among mothers of age group 40 to 44 and increased to 39 percent in age group 45 to 49. Maternal education was also highly significantly related to child anaemia, showing also an inverse relationship. The results shows that among mothers who had no formal education, 40 percent of their children had anaemia. With mothers who had obtained primary education 34 percent of their children had anaemia. Mothers who had acquired higher education had 27 percent of their children anaemic.

About 35 percent of the children from poor households had anaemia meanwhile about 38 percent of children from rich households were anaemic. The wealth index was therefore significantly related to anaemia showing a negative relationship between having wealth and being anaemic. There was no difference between age and anaemia as 38 percent of the females and males were respectively anaemic. Child's age showed a high significant relationship to anaemia. The result of the child's age shows that 34 percent of children

between 6 to 24 months were anaemic, while 40 percent of those between the ages of 25 to 59 months had anaemia. Place of residence was also highly significantly anaemic. Among children living in urban areas, 40 percent were anaemic and 36 percent of those in rural areas had anaemia.

7.2 Conclusion

The effects of seven independent variables on the dependent variable (anaemia) were examined in this study. Children who did not take animal source foods were more likely to have anaemia as compared to children who took animal source foods. The study shows therefore that there is a significant relationship between animal source foods and child anaemia. It has also been revealed from the studies that children from poorest, poorer and middle homes were significantly associated to child anaemia. The multivariate analysis has also revealed that children between the ages of 6 to 24 months were significantly associated to child anaemia as compared to children from 25 to 59 months of age. Studies have shown that children who did not have fever were less likely to have anaemia as compared to those children who had fever. Young mother's children had a greater probability of having anaemia compared to children of older mothers. The study has also shown that children from rural areas were more anaemic compared to children from urban areas. The results did not show any differences between boys and girls in terms of the proportion of sex that was highly anaemic.

7.3 Recommendations

Improvement of the IDA status in children in Cameroon might be achieved through continuous information dissemination about iron rich foods and iron absorption by the human body, the improvement of environmental conditions and the application of reliable, easy to use and cheap methods for Hb estimation.

The main source of iron for an infant from birth to 1 year of age is from breast milk, iron-fortified infant formula, or cereal. Mothers should be encouraged to breastfeed their babies for their first year. It is recommended that mothers should exclusively breastfeed for a minimum of 6 months, then gradually add solid foods while continuing to breastfeed until at least the baby's first birthday. Because human breast milk contains very little iron, it is recommended that full-term healthy infants receive a daily oral iron supplement of 1 mg/l beginning at age 4 months and continuing until iron-rich complementary foods, such as iron-fortified cereals, are introduced.

Preterm infants who are breastfed should receive an iron supplement of 2 mg/l by the time they are 1 month old. Infants who are not breastfed should receive iron-fortified formulas (4 - 12 mg/l for their first year of life). Parents should discuss the best formula with their doctor. Cow's milk for children under 1 year old should be highly discouraged because it leads to increased blood loss from the gastrointestinal tract, contributing to iron deficiency and anemia. The baby should begin drinking less formula or breast milk once solid foods become a source of nutrition. At 8 - 12 months of age, a baby will be ready to try strained or finely chopped meats. When cereals are begun, they should be iron fortified.

Children who are between the ages of 6 to 24 months have been shown to be significantly more anaemic compared to those between ages 25 months to 59 months. Nutritional policies (information dissemination, maternal education on child anaemia, sensitization campaigns etc) should therefore be focused on children between ages 6 to 24 months and they should also be given the necessary iron supplement doses. These children should be introduced to important sources of iron in their daily diets. Lean red meat should be included in their diets and other alternative sources of meat such as dried beans, lentils, chickpeas, canned beans, poultry, fish, eggs and small amounts of nuts and nut pastes.

Maternal education should be highly encouraged. A higher level of maternal education leads to increased knowledge about health and nutrition, which, in turn, leads to an increase in the quality of the diets consumed by children.

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