



**NUTRITIONAL STATUS AND ANAEMIA PREVALENCE, MALARIA AND
HELMINTHS INFESTATIONS LEVELS AMONG CHILDREN AGED 6-23 MONTHS
IN PERI-URBAN COMMUNITIES IN ACCRA**

BY

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FOOD SCIENCE, UNIVERSITY OF GHANA, LEGON IN PARTIAL
FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF
PHILOSOPHY (M. PHIL) DEGREE IN NUTRITION**

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DECLARATION

I hereby declare that except for references to other people's work, which I have duly acknowledged, this exercise is a result of my research under the guidance of Professor Matilda Steiner-Asiedu and Doctor Frederick Vuvor of the Department of Nutrition and Food Science, University of Ghana and that this thesis neither in whole nor in part, had been presented for another degree elsewhere.



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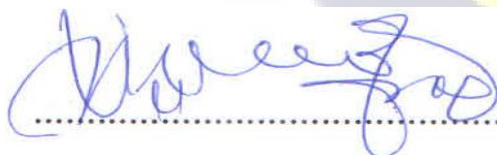
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ABSTRACT

Background and objective: The first two years of life is very critical. Children especially those under two years are vulnerable to stunting, wasting, and anaemia. However, information on these growth indices in peri-urban areas are scanty. In this study, we examined the nutritional status, anaemia prevalence, malaria and helminthes infestation levels among children aged 6 to 23 months old living in peri-urban areas in the La-Nkwantanang-Madina Metropolitan Assembly (LaNMMA) area.

Methodology: The study was cross-sectional. A one-time-point data was collected which involved 268 child/ mother (key caregiver) pairs from five peri-urban communities. A semi-structured questionnaire was used to interview mothers with children aged 6 to 23 months old about socio-demographic characteristics, dietary intakes and breastfeeding patterns. The weight, recumbent length and mid-upper arm circumferences (MUAC) of the children were taken using procedures specified by the World Health Organization (WHO). Five millilitres of blood samples were collected to determine haemoglobin (Hb) levels and malaria infection. Stool samples were also collected to determine helminth infestations. The anthropometric indices were converted to z-scores with the help of WHO Anthro software. The data were summarized through descriptive statistics. Crude binary logistic regression was employed to check for associations and the logistic regression model was employed to control and determine factors that predicted anaemia, wasting, stunting and underweight in lined with the objectives of the study.

Results: Anaemia prevalence among the study children was 85.1% with 2% being severely anaemic. However, stunting, wasting and underweight prevalence were relatively low; 9.0%, 8.2% and 10.1% respectively. About 1.5% of the study participants were infected with malaria and no helminthic infestation was detected. Colostrum, eating or drinking something else apart

from breast milk during the first three days after delivery, start month on complementary feeding, food made from vitamin A-rich dark green leafy vegetables, food made from oil, fat, or butter, red palm oil, palm nut soup/ sauce and number of times a child received solids, semi-solids, or soft foods during the day/ night significantly predicted anaemia ($p<0.05$). Mothers who were part time workers, sex of child, initiation of breastfeeding, breastfeeding duration and households salt used predicted wasting.

Conclusion: Very high anaemia prevalence was found in this study. Efforts to prevent increased anaemia prevalence especially in rural and peri-urban settings and to improve the nutritional status of young children are warranted.



DEDICATION

I dedicate this work to God the Most High

My lovely partner Talata and kids

You were there when I needed someone to lean on



ACKNOWLEDGEMENT

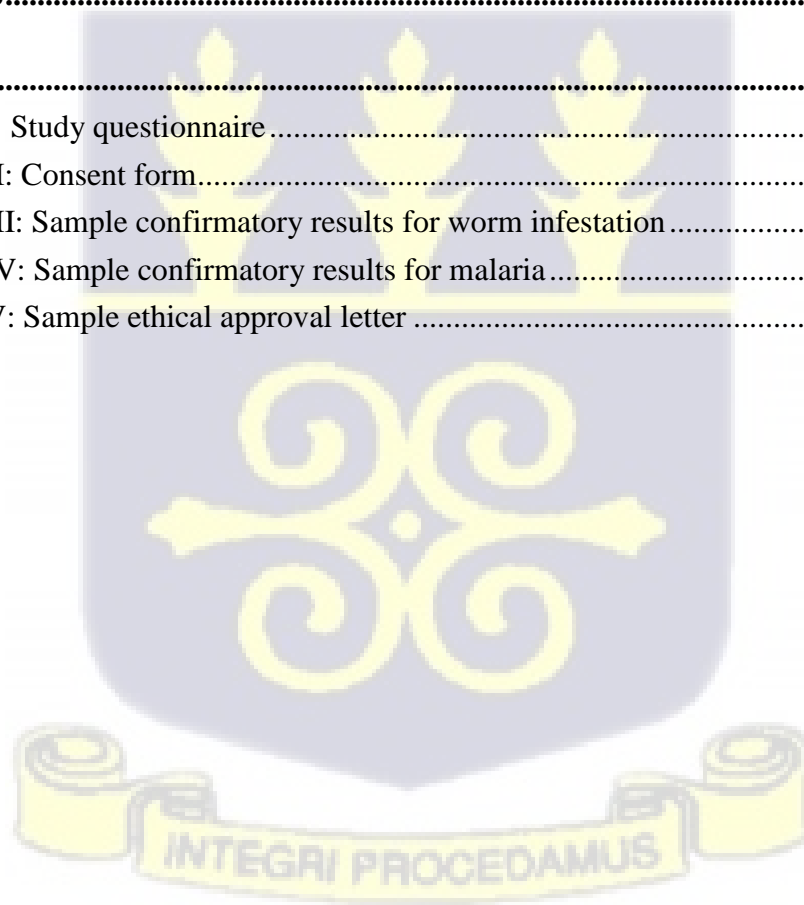
First, I wish to express my profound gratitude to God for bringing me this far and to all individuals and institutions that contributed in diverse ways towards the initiation, execution and completion of this research. I am especially thankful to Professor Kwabena Bosompem and Mr Jones Amponsah of the Noguchi Memorial Institute for granting me their support towards the execution of my practical work. Special thanks go to my supervisors, Professor Matilda Steiner-Asiedu and Doctor Frederick Vuvor of the Nutrition Department University of Ghana, Legon. This work could certainly not have been completed without their daily patient and expert guidance. Equally invaluable to the completion of this work was the practical advice, encouragement and support given by Doctor Theodosia Adom of the Ghana Atomic Energy Commission. I am also grateful to Professor Mary Boadu and all staff of RAMSRI especially the staff of the Nutrition Research Centre of the Ghana Atomic Energy Commission for their enormous support and direction. Not forgetting Mr. Paul of the Nutrition and Food Science Department, UG who always drove me to the field for all the period that my work lasted. I am indebted to the mothers and babies for their participation in the project and provided me with information and specimen. Also, my sincere thanks go to Richard Ansong and Adolf Awuah for their enormous help both on the field and in the laboratory. Not forgetting Obed Harrison, Barbara and Patience for helping me during the fieldwork. I also wish to thank the Head, lecturers and other staff of the Nutrition and Food Science Department of the University of Ghana, Legon for all the support I got from them. I am happy to remember the expert advice of Professor Firibu Saalia of the Nutrition and Food Science Department, UG and indeed the entire staff of GAEC, the administration, my colleagues and friends for their assistance, concern and companionship.

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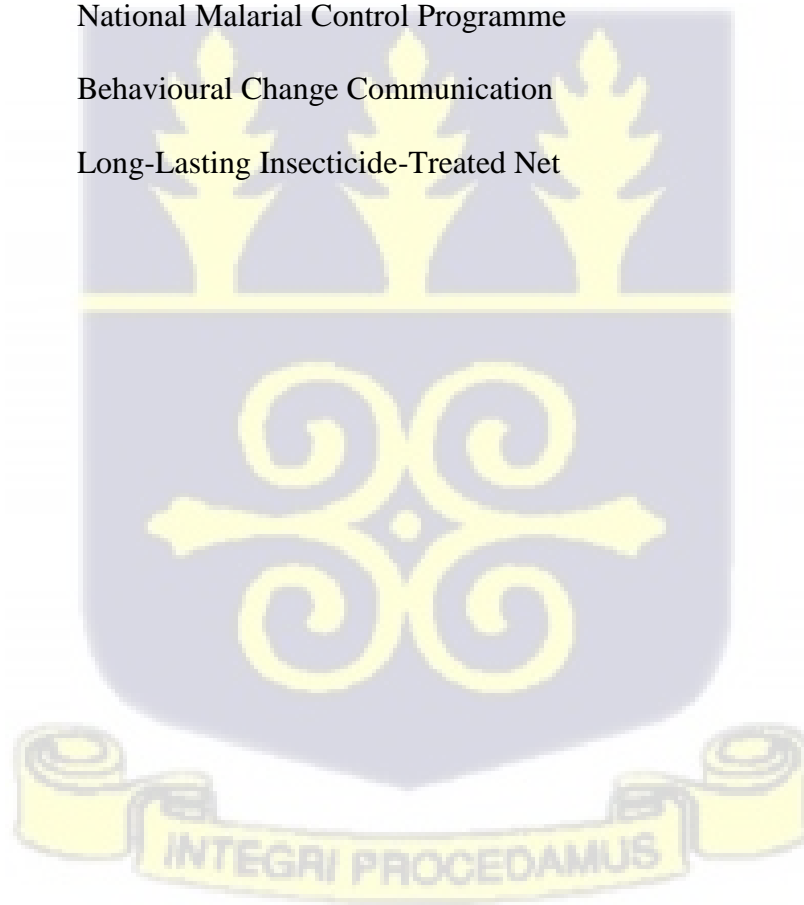


LIST OF ABBREVIATIONS

The following abbreviations are used in this thesis:

UNICEF	United Nations International Children Education Fund
LaNMMA	La-Nkwantanang-Madina Metropolitan Assembly
IYCF	Infant and Young Child Feeding
GDHS	Ghana Demographic and Health Survey
FAO	Food and Agriculture Organization of the United Nations
CF	Complementary Feeding
IDA	Iron Deficiency Anaemia
ID	Iron Deficiency
SD	Standard Deviation
BF	Breastfeeding
ARI	Acute Respiratory Infections
IRB	Institutional Review Board
MDD	Minimum Dietary Diversity
MMF	Minimum Meal Frequency
MUAC	Mid-Upper Arm Circumference
GDP	Gross Domestic Product
NCD	Non-Communicable Disease
WHO	World Health Organization
IDA	Iron Deficiency Anaemia
SES	Socioeconomic Status
ARI	Acute Respiratory Infection

DDS	Dietary Diversity Score
RDT	Rapid Diagnostic Test
CI	Confidence Interval
KVIP	Kumasi Ventilated Pit
NMIMR	Noguchi Memorial Institute for Medical Research
SPSS	Statistical Package for Social Science
STH	Soil Transmitted Helminths
IRS	Indoor Residual Spraying
L-A	Low Altitude
H-A	High Altitude
NMCP	National Malarial Control Programme
BCC	Behavioural Change Communication
LLIN	Long-Lasting Insecticide-Treated Net



CHAPTER ONE

1.0 INTRODUCTION

The early life starting from pre-pregnancy to two years is very critical. It forms the foundation for the development of every human life. A child who experiences good nutrition grows healthier, does well in class and perpetuates healthier progenies later in life. By having sufficient dietary intake (balanced diet) before, during and even after delivery by the mother (caregiver) optimizes the health of the child (Rao et al., 2011). Children who may undergo nutritional trauma during the formative years may become vulnerable to undernutrition (stunting, wasting, underweight and/ or anaemia).

Worldwide, several millions of children mostly in poor countries do not achieve their full growth potential as a result of undernutrition, which is one of the main factors that causes malnutrition. Globally, close to 150 million children below the ages of 5 years are stunted and 45 million are wasted (Aboagye et al., 2021). In 2019 alone, according to the WHO key findings of the 2020 edition of levels and trends in child malnutrition among under 5 years old, the number of children who were stunted, wasted and severely wasted stood at 57.5 million, 11.8 million and 3.0 million children respectively (Aboagye et al., 2021; WHO, 2020). In Africa, malnutrition is said to be the leading cause of disease and disabilities in children. It contributes to the death of about 3.45 million children below the ages of 5 years annually (Ali et al., 2017). Some consequences of malnutrition could be delayed mental and motor development, poor immune system development, and increased morbidity and mortality (WHO, 2021). In later years, poor intellectual ability, low work output, poor reproductive outcomes and overall poor health could manifest as a result of bad nutrition from childhood.

In children, anaemia is of importance because it affects children's physical, mental and social wellbeing (Saaka & Galaa, 2017). Poor dietary diversity has been shown to associate significantly with anaemia (Woldie et al., 2015). Over 40.0% of anaemia prevalence is due to lack of dietary iron, and this is attributed to low consumption of micronutrients and/ or consumption of foods containing high amounts of iron absorption inhibitors (Saaka & Galaa, 2017). Grains, root and tubers in our part of the world (Africa, Ghana to be specific) are usually the bulk of the food eaten by nearly all children after the first 6 months of life. The predominant plant-based diet (Corn dough/ Millet porridge, Rice, Tour zaafi, Banku, mashed Yam or Plantain) consumed, with little or no animal-sourced (chicken, fish, meat such as goat and cow meat) products are usually a precursor for anaemia and growth restrictions (stunted growth, wasting and underweight). Poor complementary feeding regardless of breastfeeding could also result in iron deficiency and anaemia following reduced intake of iron and subsequent decreased red cells production (Lanzkowsky, 2016; Zimmermann & Hurrell, 2007).

Optimal feeding during childhood gives a child the best possible start to life. It ensures adequate energy and nutrient intake, boosts immune system development, ensures proper organ formation including normal gut flora, cognitive and neurologic development, and prevent the child from contracting various forms of diseases (Savarino, Corsello & Corsello, 2021; Medise, 2021). Undernutrition in childhood occurs when maternal knowledge on appropriate feeding is poor. When mothers are deficient in nutritional knowledge, they are unable to judge appropriately foods to be used in/ or during complementary feeding. This can lead to inadequate nutrition thereby result in undernutrition. Research has revealed that about 70.0% of children aged 6 months and above in some parts of Ghana were undernourished because they were fed mainly of meals made from plain rice and soups deficient in nutrients (Awuuh, Appiah & Mensah, 2019). The food did

not support the proper growth and proper mental development of the children (Awuuh, Appiah & Mensah, 2019). In Ghana, it is estimated that only 13.0% of children under 5 years of age receives the recommended foods for their ages (GSS/GHS/ICF, 2015). This means that a high percentage (87.0%) of the children do not receive adequate foods for their ages to enable them to grow well.

1.2 Rationale

When a child is stricken with malnutrition, its effect remains with him for life. Malnutrition can refer to both undernutrition and over-nutrition, but in this study, it refers solely to undernutrition (stunting, wasting and underweight). The aftermath of malnutrition could be a weakened immune system and reduced cognitive abilities. Even though the national surveys in Ghana have reported decreased stunting (8.0% in 2003, 9.0% in 2008 to 5.0% in 2014) (GSS/GHS/ICF, 2015) and anaemia prevalence (76.0% in 2003, 78.0% in 2008 to 66.0% in 2014) (GSS/GHS/ICF, 2015) among infants and young children over the years, critical analysis of these national surveys and other current findings have revealed that the prevalence of poor nutritional status especially anaemia has consistently remained unacceptably high. Findings from Adokiya, Langu & Ali, 2019; Prieto-Patron et al., 2018; Woldie, Kebede & Tariku, 2015 and Ewusie et al., 2014, have proven that children aged 6 to 23 months old have very high anaemia prevalence of 95.0%, 70.0%, 60.9% and 85.1% respectively. Basic causes of the anaemia phenomena, therefore, needs to be studied.

Information on the basic causes when found, could be passed on to policy makers who may help find solutions to mitigate the problem. It is against this back drop that this study was designed to look at the nutritional status and anaemia prevalence among infants and young children in peri-urban communities in Ghana, where research has proven that the nutritional and health status of the people living here are worse-off than those living in urban and rural areas. In peri-urban settings,

nutritional status and overall health situations are said to be worse-off. The daily livelihood of the people living in peri-urban areas are said to be unstable, food insecure and therefore there are high levels of childhood morbidity (Saxena & Sharma, 2015; Maxwell et al., 2000). Hence, the selection of peri-urban setting for this study.

1.3 Research Questions

The project sought to find answers to the following questions:

1. What is the anaemia situation among children?
2. Is there any relationship between the socioeconomic factors, dietary practices and anaemia among the children?
3. What is the prevalence rate of stunting, wasting and underweight among the children?
4. Are there relationships between the socioeconomic factors and dietary practices and stunting, wasting and underweight levels among the children?
5. What are young child dietary practices among the mothers?
6. Are there infections and/ or infestation that affect anaemia and nutritional status among the study children?

1.4 Main Objective

The main aim of the present study was to study the nutritional status and anaemia prevalence, malaria and helminths infestation levels among children 6 to 23 months in selected peri-urban communities in the Greater Accra Region.

1.4.1 Specific Objectives

Specific objectives of the study were:

- 1) To assess anaemia prevalence (Hb levels < 11 g/ dl) among the children in La-NMMA.
- 2) To determine factors that may affect anaemia prevalence (Hb levels < 11g/ dl) among the children.
- 3) To determine wasting, stunting and underweight prevalence of the study children and associated factors that contribute to the undernutrition (wasting, stunting and underweight).
- 4) To determine infant and young child dietary practices among the mothers
- 5) To determine levels of malaria infection and helminthes infestation among the study children.



CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

A productive, prosperous and a sustainable nation depends on the national nutrition and health of its people. Nutrition and health status are interrelated. Both continuously interact with each other and with the environment. Optimal nutrition during infancy and early childhood is central to the development of each child's full human potential. Research have been established that the period from conception to the second birthday of a child is a "critical window" for the promotion of optimal growth, health and behavioural development (Taneja et al., 2020; Hennessy et al., 2020; Tessema, Belachew & Ersino, 2013). It is evidential that a child suffer from cognitive impairment, growth retardation, and performs poorly in school when not well nourished as well as become less economically productive later in life (Akombi et al., 2017; Saaka & Galaa, 2017). Inappropriate feeding practices including breastfeeding and complementary feeding are responsible for about a third of the cases of malnutrition in infants and more than 50% morbidity through infectious diseases. Child feeding practices and malnutrition are linked according to Kumar, Mittal & Misra, (2006).

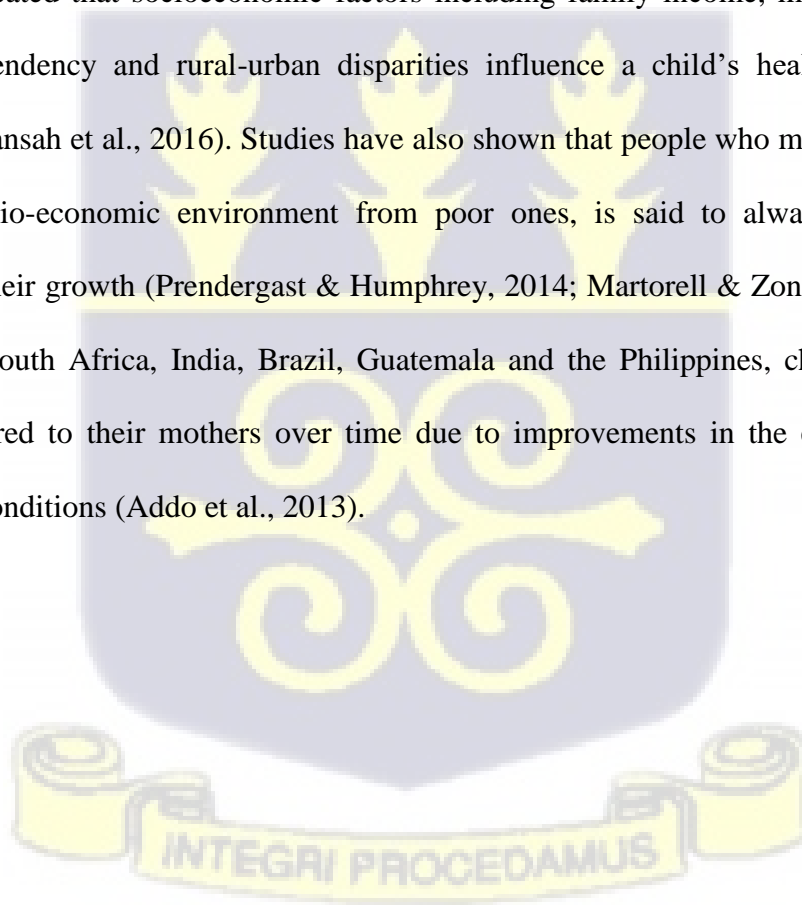
2.2 Nutritional Status

Nutritional status can be defined as the physiological state of a person that results from the relationship between intake and utilization of nutrients by the body. It includes the body's ability to digest, absorb and use these nutrients. Poor feeding practices including breastfeeding, high rates of disease and infection and food insecurity could be leading causes of malnutrition in children under 2 years of age (Abizari et al., 2017; Black et al., 2013). Some studies (de Groot et al., 2020; Awuuh, Appiah & Mensah, 2019) indicates that factors such as poor breastfeeding, inappropriate

feeding practices, childhood diseases, infection and infestations, food insecurity, poverty, poor sanitation, poor maternal knowledge and deficient child health care services contribute to poor nutritional status.

Deficiencies and imbalances in nutrients and/ or energy intake could be referred to as malnutrition. In other words, malnutrition could be undernutrition or over-nutrition. Undernutrition could lead to poor nutritional status encompassing anaemia, stunting, underweight, wasting and/ or all conditions at the same time. Over-nutrition could result in overweight which may also lead to non-communicable diseases which may pose dire health challenges in future life.

Studies have indicated that socioeconomic factors including family income, maternal education, high rate of dependency and rural-urban disparities influence a child's health (Frempong & Annim, 2017; Quansah et al., 2016). Studies have also shown that people who migrate to countries with a better socio-economic environment from poor ones, is said to always experience an improvement in their growth (Prendergast & Humphrey, 2014; Martorell & Zongrone, 2012). In a study involving South Africa, India, Brazil, Guatemala and the Philippines, children had better heights as compared to their mothers over time due to improvements in the environments and socio-economic conditions (Addo et al., 2013).



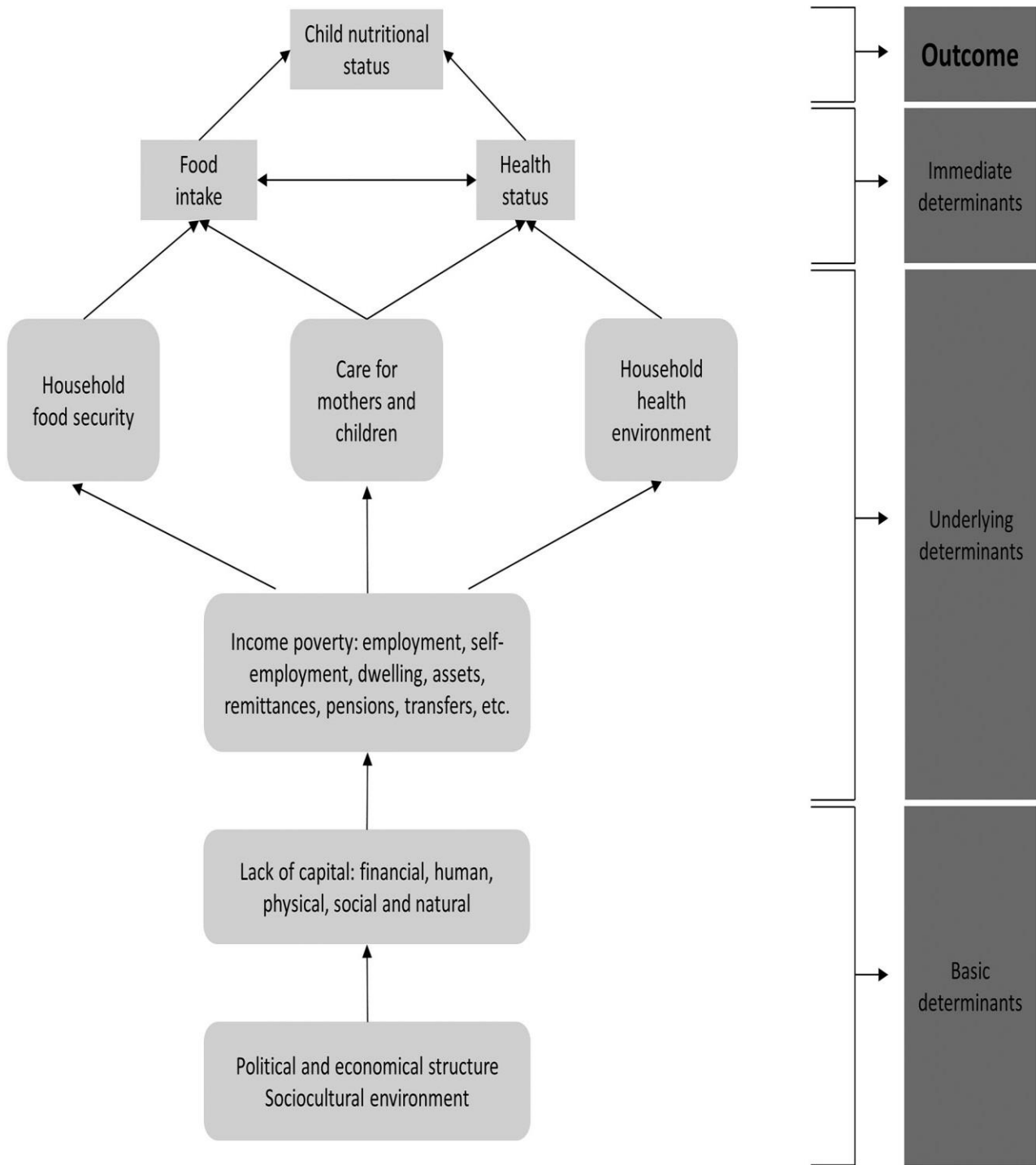
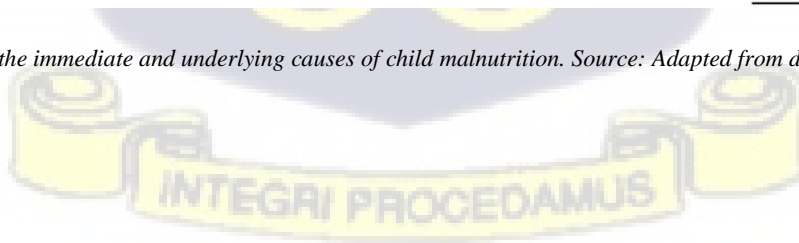


Figure 1. Framework of the immediate and underlying causes of child malnutrition. Source: Adapted from de Groot et al., 2020.



2.3 Cost of Malnutrition

All forms of malnutrition have a direct and indirect cost on a nation, households and individuals alike (WHO, 2016). It has been estimated that over 200 million children in low- and middle-income countries do not reach their growth potential in cognitive, language and socio-emotional development due to nutritional deficiencies, inappropriate feeding practices, chronic infections and inadequate learning opportunities, which by projections leads to over 20.0% loss in adult productivity in many countries (Gaikwad et al., 2020; Lake, 2011; Grantham-McGregor et al., 2007). Globally, malnutrition cost about US\$ 3.5 trillion a year while it cost an individual about US\$ 500. These costs have reduced economic growth in most states and human capital has also been lost as a result (Fanzo et al., 2019). The cost of child undernutrition is unacceptably high. Annually, undernutrition is said to kill about 3 million children under 5 years of age. These deaths affect the human capital of both a nation and its people (The Panel, 2016).

2.4 Nutritional Status Indices

2.4.1 Underweight

Underweight could refer to a person having a bodyweight lesser than the standard weight for one's age, height and build (Saaka & Aggrey, 2021). Childhood underweight (the proportion of children under 5 years who are below minus 2 and minus 3 standard deviations of the mean weight-for-age z-score) (Kahssay et al., 2020) could be a risk factor for the increased incidence of infectious diseases. These conditions could affect malnutrition, cognitive development, the long term intellectual defects and which could diminish work capacity when left untreated (WHO, 2016). In 2016 alone, about 99 million children under 5 years suffered from underweight globally (WHO, 2016). Out of this, about 30.0% came from Africa, indicating that 1/3 of all African children were

underweight (Dewey, 2016). In Ghana, the prevalence of underweight has seen a gradual decline over the years. The underweight prevalence has declined from 18.0% in 2003 to 14.0% in 2008 and then to 11.0% in 2014 (GDHS, 2014).

2.4.2 Wasting

Wasting can be defined as the proportion of children under 5 years that are below minus 2 and minus 3 standard deviations of the median weight-for-height z-score. This population accordingly includes children who are too thin for their height (UNICEF/WHO/WBG, 2015). Wasting reflects sudden malnutrition when the diet of an individual is not adequate in energy coupled with an increased incidence of infectious diseases. This is known as acute undernutrition. The functioning of the immune system can be impaired as a result. Globally, wasting affects about 49 million of the world's children with about 17 million of them being severely wasted (UNICEF/WHO/WBG, 2019). The bulk of these children reside in Asia (34.30 million) and Africa (13.9 million). The wasting prevalence in some African countries especially in the Sub-Saharan Region are Western part: 18.0% in Niger (2012), 15.5% in Burkina Faso (2010), 18.0% in Nigeria (2013) and 12.7% in Mali (2013). Eastern: Comoros (2012) and Ethiopia (2014), 11.1% and 8.7% respectively. Central: Chad (2014) and Sao Tome & Principe (2009) and South, Namibia (2013), 13.0%, 10.5% and 6.2% respectively. Wasting in under 5 years children in Ghana is 5.0% with less than 1.0% of the children being severely wasted (GDHS, 2014).

2.4.3 Stunting

Stunting is a chronic form of undernutrition and it is the proportion of children under 5 years of age who fall below minus 2 and minus 3 standard deviations from the median height-for-age z-scores of the reference value (Kahssay et al., 2020; Antwi, 2008). Evidence shows that early

childhood stunting could cause children to be vulnerable to infectious diseases, experience behavioural challenges and decreased cognitive abilities (Kahssay et al., 2020; Berkman et al., 2002). Also, stunted children who after 2 years of age undergo rapid weight gain are said to be at greater risk of type-2 diabetes, hypertension, stroke and coronary heart disease later in life (Adair et al., 2013). Stunting is associated with growth and development impairment due to poor nutrition, repeated disease and infection. Stunting is a very common and widespread phenomenon among children under 5 years across developing countries. It occurs due to prolonged periods of malnutrition and exposure to infectious diseases. Evidence suggests that over 70.0% of stunted growth occurs before a child turns 2 years (Leroy et al., 2014).

In 2016, about 155 million children who were stunted resided in developing countries and a third of them in Africa (Akombi et al., 2019; 2017). Although stunting rates globally are declining, across Africa especially the Sub-Saharan Region, the rates are still high with an average prevalence of 34.0% among children aged 5 years and below (Nshimiyiryo et al., 2019). At the country levels stunting prevalence in some African countries including Ghana are as follows:

Table 2.1: Stunting prevalence in some African Counties.

Country	Year	Percentage (%)
Burundi	2010	57.7
Malawi	2010	47.1
Niger	2012	43.9
Mali	2013	38.8
Sierra Leone	2013	37.9
Nigeria	2013	36.8
Democratic Republic of Congo	2014	42.7
Chad	2014	39.9
Ghana	2014	19.0
Ethiopia	2016	38.4

Danaei et al., 2016; GDHS, 2014; Kahssay et al., 2020.

2. 5 Micronutrient Deficiencies

Micronutrients are components of diets that are required in minute quantities in the body essential for the promotion of good health and performance of vital functions. Micronutrient deficiencies occur when diets do not contain adequate amounts of the essential vitamins (both fat- and water-soluble) and/ or minerals (Shergill-Bonner, 2017). Micronutrient deficiency affect many children in low- and middle-income countries because most of their diets are low in nutrients (vitamins and minerals) (Armar-Klimesu et al., 2018). Micronutrients enable the body to produce enzymes, antibodies and hormones that aid in growth and development (Onyeazor, Nwabunwanne & Bob-Eze, 2018; Wishart, 2017; Ekweagwu, Agwu & Madukwe, 2008). To achieve adequate micronutrient intake therefore requires a varied diet. Iron is essential for the synthesis of red blood cells and new tissues, iodine is required for the synthesis of thyroid hormones and brain myelin membranes, whereas, zinc is needed for the growth and regulation of the immune system. Calcium, vitamin D and phosphorus are important in the development of bones (Savarino, Corsello & Corsello, 2021).

Poor consumption of green leafy vegetables and fruits compromises the intake of micronutrients such as iron, vitamin A, folate, iodine and zinc from dietary sources (Ekweagwu, Agwu & Madukwe, 2008). The deficiencies of these micronutrients could lead to health problems such as anaemia (iron), blindness and/ or xerophthalmia (vitamin A), and goiter and/ or cretinism (iodine). These deficiencies, when occurs in children mostly hampers their growth, their immune system development and impairs their intellectual capabilities (Kyei-Arthur et al., 2020; Bailey, West & Black, 2015). In a study by Soares-Magalhaes & Clements in 2011 to look at the contribution of malnutrition to the risk of anaemia in preschool-age children in some three West African countries

involving Ghana, Mali and Burkina-Faso, it was estimated that 36.8% of the anaemia prevalence could be prevented if nutritional related factors including micronutrient deficiencies were treated.

Although in Ghana data on micronutrient deficiencies are limited, the scarce data indicated a high prevalence of some micronutrient deficiencies including iron (45.0%) and vitamin A (26.0%) (Wegmuller et al., 2020). These deficiencies are highest in the rural settings, poor households and in the northern parts of the country (Wegmuller et al., 2020).

2.6 Anaemia

Anaemia is a form of micronutrient deficiency which is the most widespread nutritional deficiency problem. Anaemia affects about 2.2 billion people globally and has a prevalence of 32.9% (Kassebaum et al., 2014). Anaemia can be defined as a state in which there is a reduction in the red blood cells concentration so that the blood can no longer circulate enough oxygen around the body to meet its physiological needs (WHO, 2011). Its aetiologies could be due to widespread aspects including haemoglobinopathies, deficiencies of other micronutrients such as folate, vitamins B₆ and B₁₂, parasitic infections including malaria and helminthes and inflammations. However, the single most important factor that contributes most to the disease burden is iron deficiency (Wegmuller et al., 2020; Simo et al., 2020; Wirth et al., 2016; Kassebaum et al., 2014).

Among children, the global prevalence ranges from 9.0% in countries with high incomes to over 70.0% in countries with low incomes (Abriha, Yesuf & Wassie, 2014; Abubakar et al., 2012). For instance, studies have indicated that in the Americas, about 22.3% of children aged 6 to 59 months old are anaemic whiles in South Asia and Africa the prevalence is more than 50.0% and 62.3% respectively (Kejo et al., 2018; Mahfuz et al., 2016; Khan et al., 2016). Literature indicates that

anaemia prevalence among children has been seen to be decreasing. In Ghana for example, the prevalence has decreased from about 78.0% in 2008 to 66.0% in 2014 (GSS/GHS/ICF, 2015).

2.7 Causes of Anaemia

Several factors have been found to cause anaemia. Nutritional factors such as deficiencies of iron, vitamins A, B₁₂, folic acid, ascorbic acid, zinc and others appear to be the most common ones. It is estimated that about 2 billion people the world over is iron deficient (Lopez et al., 2016). Among children, low intake of iron-rich foods and changes to gastrointestinal epithelium due to infection and subsequent diminished nutrient absorption significantly contribute to anaemia. Research has indicated that globally, about two-thirds of nutritional anaemia is associated with iron deficiency. According to Rajagopal et al., (2018), about 800,000 people perish every year because of iron deficiency and anaemia.

Iron deficiency anaemia (IDA) is known to be the commonest form of anaemia and it is caused by inadequate dietary intakes of iron-rich foods, poor iron bioavailability due to inhibitory factors in diets including polyphenols, tannins and phytates. IDA is known to be responsible for about half the global anaemia cases (Lopez et al., 2016). In low-income countries the complementary foods commonly consumed are mostly dominated by cereals and legumes which are rich in inhibitory factors (Gashu et al., (2016). The inhibitory factors form insoluble complexes in the body thereby reducing the bioavailability of iron (Lind et al., 2003). Also, high levels of calcium in certain diets affect iron absorption (Lopez et al., 2016). Their cumulative effect is that they impair the synthesis of erythrocytes and lead to the reduction of red blood cells (Egbi et al., 2018). Parasitic infestations of blood cells on the other hand reduce circulating red blood cells in the human body. Some of these notable parasites include *Trichuris trichiura*, *Necator americanus*. Some malaria parasites

also lead to anaemia. Factors such as sickle cell disorders, thalassemia and inflammatory bowel disease may also lead to anaemia (Ncogo et al, 2017).

2.8 Conceptual Framework of a Causal Pathway for Anaemia in Young Children

There are three broad categories of factors that affect anaemia directly or indirectly in children. Figure 2.1 outlines the possible risk factors and linkages/ network of various inter-related factors that contribute to infant anaemia. The arrows indicate in a simplified way, how a group of determinants can influence anaemia through other group variables. The first set of categories which forms the immediate factors include nutrition and dietary related practices which includes infant and young child feeding, dietary intakes and dietary components. Poor intake of micronutrients (iron-rich foods), animal-sourced foods (meat), fruits (vitamin C), and high intake of dietary inhibitors (polyphenols, tannins and phytate), affect the iron status of children.

Inappropriate practices such as poor meal frequency, poor acceptable diet, inappropriate complementary feeding and inadequate dietary diversity, all serve as drivers. Parasitic infections and infestation also contribute to the anaemia burden. Among children, changes to gastrointestinal epithelium due to infections, subsequently diminished nutrient absorption, significantly contribute to anaemia. The parasitic infestations of blood cells reduce the circulating red blood cells, hence, contribute to the anaemia burden. Several other factors have been found to contribute to the anaemia pandemic. Genetic factors such as sickle cell disorders, thalassaemia, autoimmune haemolysis, and chronic conditions such as human immunodeficiency virus (HIV), TB, inflammatory bowel and kidney diseases could contribute to it (Ncogo et al, 2017).

The third category of factors, the socio-environmental factors including maternal, household and community factors have been reported to increase the risk of being anaemic in early childhood. Through intermediate variables or determinants, these factors contribute to the burden of anaemia indirectly. The consumption of fruit, vegetables and meat and meat products which are rich in iron are usually low in children. The low consumption can be attributed to the lack of purchasing power among poor households. The lack of purchasing power (poverty), leads to increased food insecurity and poor access to health and sanitary facilities. This indirectly contributes to the anaemia burden. When social and environmental-related factors including the political economy, cultural norms, ecological factors, climatic conditions, etcetera, are not stable, they eventually end up affecting red blood cells or haemoglobin production. The ultimate consequences are impairments of cognitive abilities, immune system development and death.



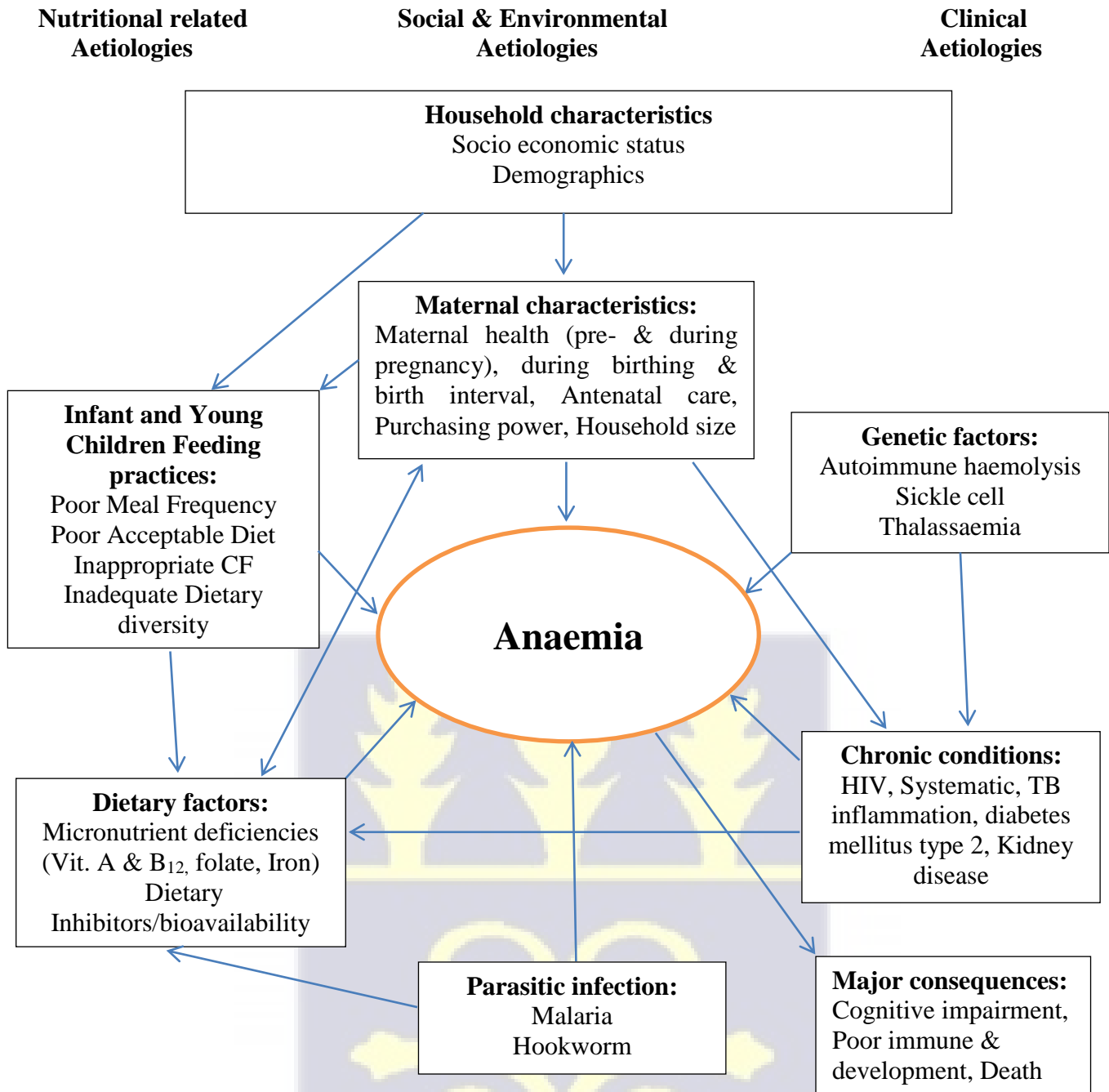
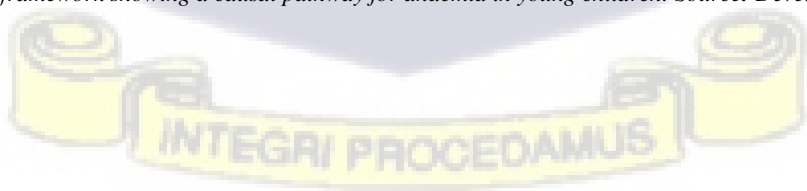


Figure. 2.2: Conceptual framework showing a causal pathway for anaemia in young children. Source: Developed by student



2.9 Dietary Practices and Associated Factors among Children

Dietary practices including breastfeeding and complementary feeding during childhood play very important role in the determination of a child's nutritional status. Dietary practices are associated with a dietary phenomenon that can be classified as good or poor dietary behaviours (Nana & Zema, 2018). For good health status, healthy dietary practices must start early in life. For instance, a study of young children in rural Sichuan in China in the 1990s established that poor child feeding practices including inappropriate breastfeeding and late introduction of complementary foods together with poor quality of complementary foods given (in this case, the main complementary foods being thin low-energy rice porridge) rather than inadequate household food resources were the perpetrators of growth faltering (Rand & Tarp, 2009; Guldan et al., 2000; 1993).

A better understanding of the types and kinds of foods children must eat by mothers/ caregivers could impact profoundly on the nutritional status of their children. Consumption of meat, poultry, fish or eggs regularly and eating fruit and vegetables daily helps improve health (Arimond & Ruel, 2004). Studies have shown that young children with mothers/ caregivers who had higher education had a high level of cognitive development than children with mothers/ caregivers who had low educational levels (Aboagye et al., 2021; Gaikwad et al., 2020). Also, children with mothers with longer schooling had significantly better nutritional status than children with mothers with low or no schooling (Walker et al., 2011; Paxson & Schady, 2007; Guldan et al., 1993).

The mother's/ caregiver's knowledge of breastfeeding practices supports growth and improvement in the cognitive development of the child (Gaikwad et al., 2020). This is known to confer on the child, long term health benefits such as reduction in the risk of becoming overweight in addition to contracting other non-communicable diseases (NCDs) in later life. Poor complementary feeding

practices regardless of breastfeeding could result in iron deficiency anaemia. People from the poor socio-economic background are at higher risk of becoming malnourished since they are not able to afford good and nutritious foods due to a lack of purchasing power (Saxena & Sharma, 2015). Poverty is the leading factor in the lack of resources to purchase or otherwise procure food even though the route causes of poverty are diverse. It is estimated that about 1.4 billion people now live in a total poverty than half a decade ago (about 40.0% more) (Bain et al., 2013), indicating that nearly one out of every four persons living today, exist only on the verge of survival, which means that one is too poor to obtain the basic necessities of life including to obtain the food they need to work, or provide adequate shelter, or get minimal health care services, not to talk of sending their children to school (Bain et al., 2013).

In China, for almost four decades from 1975 to 2010 where there was marked economic growth, simultaneously there were corresponding improvements in the heights of children and adolescents (Prendergast & Humphrey, 2014). In South Africa, a study by Chakona and Shekleton (2018) revealed that household food insecurity was 64.0% and 12.0% of these households being severely food insecure. The peri-urban and rural household was the most affected. In Nigeria, research has shown that a higher proportion of children under 5 years of age who were wasted, stunted and underweight lived in the rural areas and when a concentration indices analysis was done, it was observed that wasting, stunting and underweight all showed negative signs, indicating concentration among the poor households (Adesuyi, Kioko & Oleche, 2021). In the same study, it was also reported that as one went up the ladder of the SES, there was a significant decline in the rate of stunted growth observed. Numerous studies have indicated that a low household income had a direct bearing on the nutritional status of children (Lokossou et al., 2021; Ma'alin et al., 2016; Mengistu et al., 2013; Demissie & Worku, 2013).

In Ghana, children in, rural areas, from poorly educated mothers, and those living in poor households mostly had a higher nutritional deficit (de Groot et al., 2020). Other studies in developing countries indicate that the lower the socioeconomic status (SES), the higher your susceptibility to anaemia. Also, as the household income increases, iron uptake by the body increases (Islam, 2020; Animasahun et al, 2011). Children under 5 years born into families that have low and medium SES have a higher chance of being affected by mild, moderate, or severe anaemia compared with others of higher SES (Lozoff, Jimenez & Smith, 2006).

2.10 Effects of Sanitation and Hygiene on Malnutrition and Infections

Unsafe drinking water and a dirty environment can compromise the nutrition of a child through diarrhoea, parasites or intestinal diseases. Diarrhoea, respiratory infections and malaria have been identified as the cause for poor growth (Kaur, Bains & Kaur, 2019). Diarrhoea disease and acute respiratory infections (ARIs) are widespread among children, especially those under 2 years. The diarrhoea disease and acute respiratory infections lead to impairment of nutrient absorption, reduced food intake and increased endogenous nutrient losses which leads to malnutrition (GDHS, 2014). Research has shown that about 2.5 billion people in the world lack good sanitation amenities and close to 1 billion lack safe drinking water (Duressa, Assefa & Jida, 2019; Cardoso-Rurr et al., 2019). These unsanitary environments help in the proliferation of diarrhoea-causing pathogens and every year reported diarrhoea cases among children below 5 years is said to be around 2.4 billion. About 50.0% of these reported cases occur in Africa and South Asia (Fitzwater et al., 2019; Wang et al., 2016). According to Liu et al., in 2010, diarrhoea alone accounted for about 0.8 million deaths among children under 5 years old globally (Krumkamp et al., 2015; Liu et al., 2012).

2.11 Childhood Malaria

Malaria is a mosquito-borne protozoan disease. Malaria is widely distributed in the tropical and sub-tropical zones including South and South-East Asia, Africa, areas of the Middle East and Central and South America (Salam et al., 2018). The high malaria endemic regions are the regions with high childhood anaemia prevalence. More than two billion people live in these malaria-endemic transmission areas. Currently, Africa bears 82.0% of the world's cases of malaria and 90.0% of the global deaths due to malaria. Between 300 to 500 million people report clinical symptoms annually because of malaria resulting in 1 to 2 million deaths with approximately 1 million of them being children (Depetris-Chauvin & Weil, 2018; Erhabor *et al.*, 2018). The malaria parasites (*Plasmodium*) together with *S. Mansoni* and hookworm affect red blood cells. This leads to anaemia (Hb < 11 g/dl), which considerably impact negatively on a child's health. Children having anaemia in addition to parasitic infection (malaria parasites) are more at risk of becoming stunted as well as underweight compared to children who do not (Hailu *et al.*, 2018).

Malaria is caused by various *Plasmodium* species. These include *Plasmodium falciparum* (the most pathogenic which account for the majority of the infections especially in children), *P. malariae*, *P. vivax* and *P. Ovale*. The intensity of malaria induced anaemia is associated with the parasitaemia load. The destruction of RBCs by the malaria parasite is the cause of anaemia (Olukosi & Afolabi, 2018; Pathak, Colah & Ghosh, 2018; Dokunmu *et al.*, 2017; Nuchsongsin *et al.*, 2007). The use of bed nets is far acknowledged as an effective preventive strategy for malaria induced anaemia (Korenromp *et al.*, 2004; Ter-Kuile, 2003).



2.12 Worm infestation

Infants and young children in their quest to know or learn more about their surroundings are at greater risk of worm infestation (WHO, 2007). A parasite is a creature that resides in or on a host and derives its nourishment at the expense of the host. Helminthes such as hookworm or roundworm infestation can lead to poor nutrients absorption and anaemia thereby lead to poor physical and mental development in children (El-Sayed & Ramadan, 2017; El-Sehry, Fouda & Hassan, 2017; WHO/UNICEF Joint Water Supply, 2014; Bauomy et al., 2010). This is due to the way and manner the adult helminthes and their larvae feed attaching themselves to the walls of the mucosa of the host gastrointestinal tract leading to capillary blood loss (Bouchery et al., 2018; Kumar & Pritchard, 1992).

Some common predisposing factors for intestinal worm infestation include inadequate sanitation and hygiene, indiscriminate defecation, geophagia, and polluted water bodies (Baidoo *et al.*, 2010). In several parts of Africa, studies have shown direct correlation of the existence and density of worm infestation and malnutrition, poor mental development and anaemia (Osazuwa *et al.*, 2011; Sanou & Ngnei-teta, 2009; Calis *et al.*, 2008; Ezeamama *et al.*, 2008; Tolentino & Friedman, 2007; Lwambo *et al.*, 1999; Brooker *et al.*, 1999). In a study among school children in El Mehalla El Kobra district, about 80.0% of the children were infected with intestinal parasites and greater than 50.0% infected by one type of parasite, and nearly a quarter (23.0%) by two types of parasites (El-Sehry, Fouda & Hassan, 2017). In Nigeria, studies have reported prevalence rates between 30.3% and 45.5% helminthic infections (Emeka, 2013; Damen *et al.*, 2010). Across the country; *Ascaris lumbricoides*, *Trichuris trichuira*, *Strongyloides stercoralis* and hookworm having a prevalence of 46.0%, 9.0%, 11.0% and 23.0% respectively. In all the above narratives, 75.0% - 87.0% of the infected children had some form of anaemia (Emeka, 2013).

In Ghana, it is estimated that across the country intestinal parasitic infestation rates ranges from 0.1% to about 90.0% (Nkrumah and Nguah 2011; Ayeh-Kumi *et al.*, 2009). In Kumasi, Walana *et al.*, (2014) in their study concerning school children in peri-urban and urban areas to find out intestinal protozoan infestation rate, an overall intestinal protozoan infestation rate was 42.9%, *Giardia lamblia* recording the highest infestation rate (16.8%) followed by *Cryptosporidium parvum* (8.5%).



CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design

The study was a cross-sectional community-based study. It involved two months one-time-point data collection. A pre-tested semi-structured questionnaire was used to assess information concerning the mothers/ caregivers knowledge and complementary feeding practices. To assess the nutritional status of the children, anthropometric, biochemical and clinical measures were also taken.

3.2 Study Location

This study was undertaken in five peri-urban communities involving Ayi-Mensah, Kweiman, Danfa, Adoteiman and Otinibi, all located in La-Nkwantanang-Madina Municipal Assembly of the Greater Accra Region. The La-Nkwantanang-Madina Municipal Assembly stretches a landmass of 74.4 square kilometres situated between Latitude $5^{\circ} 81'3''$ N and $5^{\circ} 67'7''$ N, and Longitude $0^{\circ} 24'0''$ W and $0^{\circ} 13'1''$ W. It is bound on the South by the Accra Metropolitan Assembly, the East and West by the Adentan and Ga East Municipal Assemblies and the North-Western and North-Eastern parts by the Akwapim South and Kpone-Katamanso District Assemblies respectively. There are eighteen communities in the municipality with urban communities forming about 84.0% and the remaining 16.0% being rural settlements. The estimated human population of the assembly is about 136,421 inhabitants.



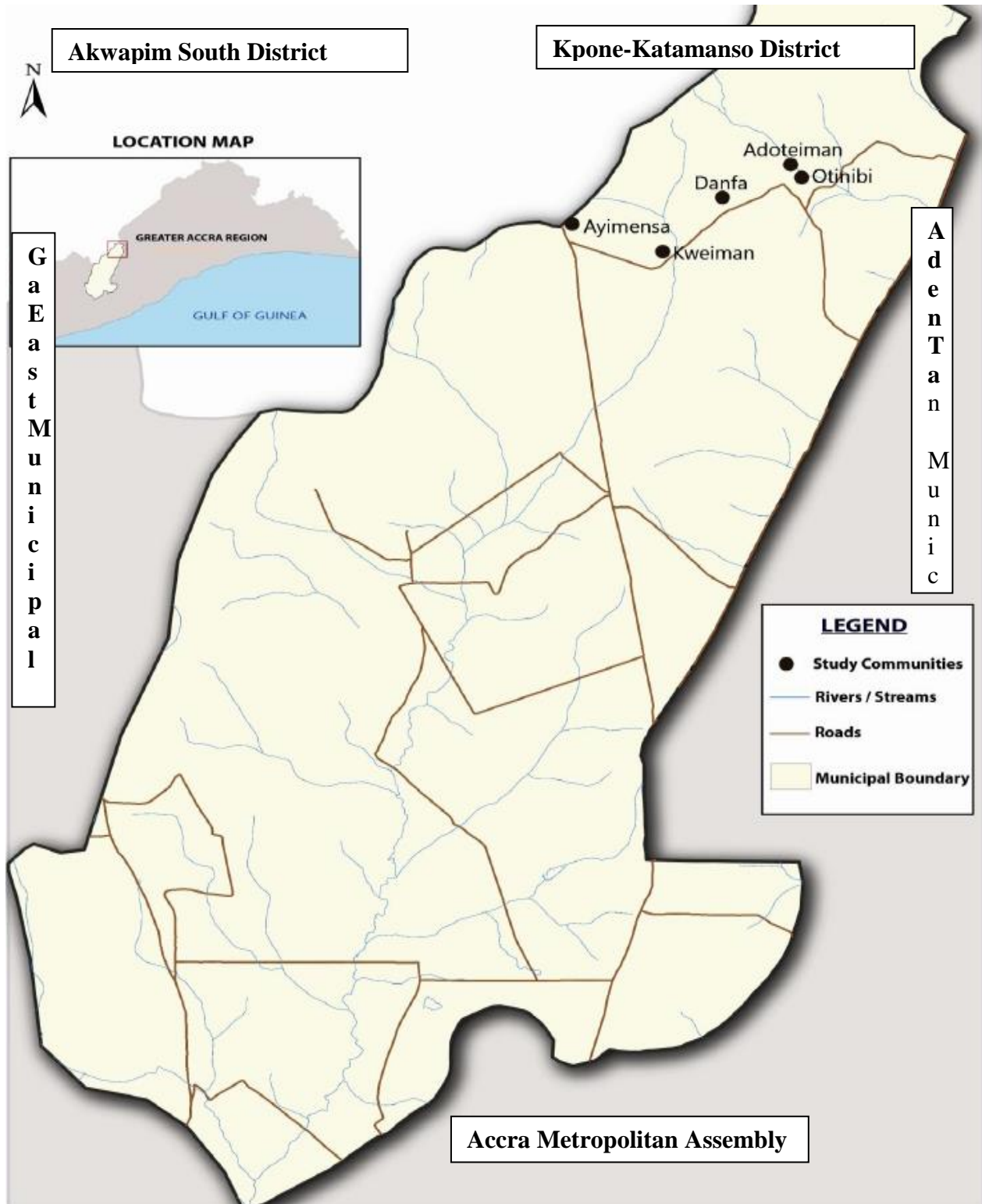


Figure 3.1: Map of LaNkwantanang-Madina Municipal Assembly.

3.3 Inclusion and Exclusion Criteria

Child-mother pairs were recruited and included in the study if:

- i. Mother and child (6 to 23 months old) pair had resided in the community for at least 5 months preceding the study.
- ii. The child's mother had consented to be involved in the study and had signed an informed consent form.
- iii. A respondent/ child was excluded if the child had any serious medical condition.

3.4 Study Population

The study included all households within the peri-urban communities with children less than two years of age and their mothers in the La-Nkwantanang-Madina Municipal Assembly.

3.5 Sample Size

The sample size was determined based on existing reports of anaemia prevalence in infant and young children in Ghana which is about 77.5% (GDHS, 2014), with a desired 95.0% confidence interval (CI); the sample size N is stated below.

$$N = \frac{[Z^2 * P(1-P)]}{d^2} \text{ (Daniel, 1999).}$$

Where; N = sample size, Z = Z-statistic for 95.0% CI which is 1.96, d = precision at a P-value 0.05 and P = expected prevalence

$$N = \frac{[1.96^2 * 0.775(1-0.775)]}{0.05^2}$$
$$= 268$$

The total sample size was 268 child-mother pairs.

3.6 Sampling Procedure

Simple random sampling was used in selection of the region and municipality. After zeroing down on the municipality, a purposive sampling was used to sample all the households. Within the LaNMMA, there are 5 peri-urban communities and all were included in the sampling. A house-to-house visit was made. Houses with children aged 6 to 23 months old were identified and sampled. The objectives, potential risks, voluntary nature of and confidentiality of the haemoglobin testing procedures were explained to each study participant's caregiver as part of the informed consent process. The sampling procedure was repeated from one community to the next until the last community was covered.

3.7 Data Collection and Instrument

The data was collected from the 1st of August to the 31st of September 2016. About 268 mother-child pairs were recruited for the study. Collection of the data involved the use of a questionnaire to obtain information on the following: socio-demographics, knowledge of mothers on feeding practices, dietary assessment and biochemical assessment (haemoglobin measurement). To fine-tune the data tools, a pre-testing of the questionnaire was carried out in a separate community that had similar characteristics as the studied communities.

3.7.1 Demographic Data of the Mother and Child

A semi-structured questionnaire was employed to obtain demographic information of the mothers and children. The information included the sex of the child, age, delivery place, age of mother, her educational level, family type, occupation, knowledge of the mothers on feeding, breastfeeding and complementary feeding practices as well as anthropometric and biochemical data.

3.7.2 Dietary Assessment

3.7. 2.1 Food Frequency (24 Hour Dietary Recall)

Data on the different food groups the children consumed within 24-hours preceding the interview was estimated through a single 24-hours dietary recall. The mothers were requested to remember all the foods including beverages that the children ate the previous day. Detailed cooking methods, sources of food and the time of day when the food was eaten by the children were collected. The weights or quantities of foods expended by the children were determined using various household food measures such as ladles, spoons, bowls, and models of portion sizes. Standard procedures were followed to obtain for instances, where mothers were unable to estimate the quantities of the purchased foods eaten by the children, the cost of the foods were obtained and the same amounts were bought from the same food vendors. These purchased foods were weighed using Adam food weighing scale (Model: AQT 5000 Compact Balance) with a maximum weight load of 5000g with $d = 1g$.

Information on the frequency of a particular food type eaten by a child during the day or at night in the past 24 hours were obtained using food group frequency questionnaires (FAO, 2011). Nine food groups including grains, roots and tubers, legumes and nuts, flesh foods, eggs, dairy products, vitamin A-rich fruits and dark green leafy vegetables, other fruits, other vegetables and food made with oil, fat or butter were obtained. The mothers were requested to remember the number of times in a day that the children ate from each of the nine food types.



3.7.2.2 Measurement of Dietary Diversity

The mothers were requested to recall the number of times in the past 24 hours, a child had received something to eat apart from breast milk, including meals and snacks. All the food groups and snacks that were eaten by the children were grouped into seven food types; (a) grains, roots, and tubers; (b) legumes and nuts; (c) flesh foods (meat, fish, poultry, liver, or other organs); (d) eggs; (e) dairy products (milk, yoghurt, cheese); (f) vitamin A-rich fruits and vegetables and (g) food made from oil, fat, red palm oil. All the food groups were assigned codes ranging from 0 to 7. Zero (0) being the minimum if none of the food items were consumed and 7, if all the food items were consumed. Using Dietary Diversity Score of 4 (minimum dietary diversity) as cut-off; a child was said to achieve “adequate dietary diversity” if the child had consumed 4 or more food items whilst a child consuming less than four food groups was considered as having “inadequate/ poor dietary diversity” (Aboagye et al., 2021; Woldegebriel et al., 2020; Khamis et al., 2019; Frempong & Annim, 2017; Saaka & Galaa, 2017; Arimond & Ruel, 2004; WHO, 2008).

3.8 Anthropometric Data

The anthropometric information that was collected included weight and recumbent length which were converted to growth indices (CDC, 2011). Mid-upper arm circumference (MUAC) measurement was also collected. Tools that were used for collecting the anthropometric data were salter-spring balance, infantometer and a tailoring measuring tape. The measurement of these dimensions was done following standard procedures (CDC, 2011).

3.8.1 Weight

The weight of the children was measured to the nearest 0.1 kg using a standard procedure (CDC, 2011). In weighing the children, UNICEF’s SALTER hanging scale model 235 6S, ranging from 0

to 25kg x 100g were used. To calm down the children and to take a correct measurement, the mothers were asked to assist. Tanita BWB 800 weighing scale was employed to weigh the mother and child, where a child was feeling restless. The mother's weight was first taken and then she was made to hold the child while standing on the scale and both weighed together. The mother's weight was then subtracted from the final weight (weight of both mother and child) to obtain the weight of the child. The weighing balance (hanging scale) used for the measurement of the child's weight was always set to zero after each measurement.

3.8.2 Recumbent Length

Following standardized procedures (CDC, 2011), recumbent lengths of the children were measured using Shorrboard ranging from 0 to 207 cm. In the recumbent length measurement, two people were in control; one person (the assistant) stood at the head end of the children to help position the head well against the headpiece of the board, the other person (the measurer) stood by the legs and feet along the graduated edge of the shorrboard. It was ensured that the children were positioned flat on the board, with their knees held together to straighten the legs out properly. The foot piece of the shorrboard was placed flat against the child's foot. The reading was read to the nearest 0.1 cm and the information recorded. The recumbent length was measured without diapers, this was because it made it possible for the measurer to hold and straighten the child's legs together. To calm the children and foster a sense of security for them, the mothers were made to stand by the children during the measurement.



3.9 Biochemical Data

A sample of blood was collected from each child. About 5 mills of blood were collected for the determination of haemoglobin and malaria parasites. In the malaria tests, rapid RDT and a confirmatory test were done. Stool samples were collected to check for worm infestation.

3.9.1 Haemoglobin Measurement

The haemoglobin concentrations were measured using a digital Photometer device (HemoCue 301) following the manufacturer's prescribed protocol. Using the child's middle or 'ring' finger, the site to be pricked was cleansed with alcohol and made to air dry completely. With a rolling movement of the thumb, the child's finger was pressed lightly from the top knuckle towards the tip. This action stimulates blood to flow towards the site to be pricked. The thumb, when it reached the fingertip, gentle pressure was maintained. The palm side of the finger midway between the nail and the finger pad was pricked in a quick motion, with a gun-like pistol containing a sharp needle-like lancet.

A new lancet was used for each participant. Using cotton wool, the first drop of blood was rubbed off to stimulate spontaneous blood flow. The finger was pressed gently if it became necessary until another drop of blood big enough to fill the well of the cuvette appeared. "Milking" the finger was always avoided. The drop of blood was tapped onto the dent of the cuvette and left for approximately 15 - 45 seconds within which time the results were displayed for 4 minutes and/ or until the cuvette was removed. The results were then recorded in the participant's information sheet. With a piece of cotton wool, mild pressure was applied at the puncture site to stop the blood flow. The cuvettes and sharp pins and all other materials not needed were disposed of in a

biohazard bag. To obtain good results, the photometer cell was always shielded away from excessive light including direct sunlight during the reading process.

3.10 Malaria and Worm Infestation Test

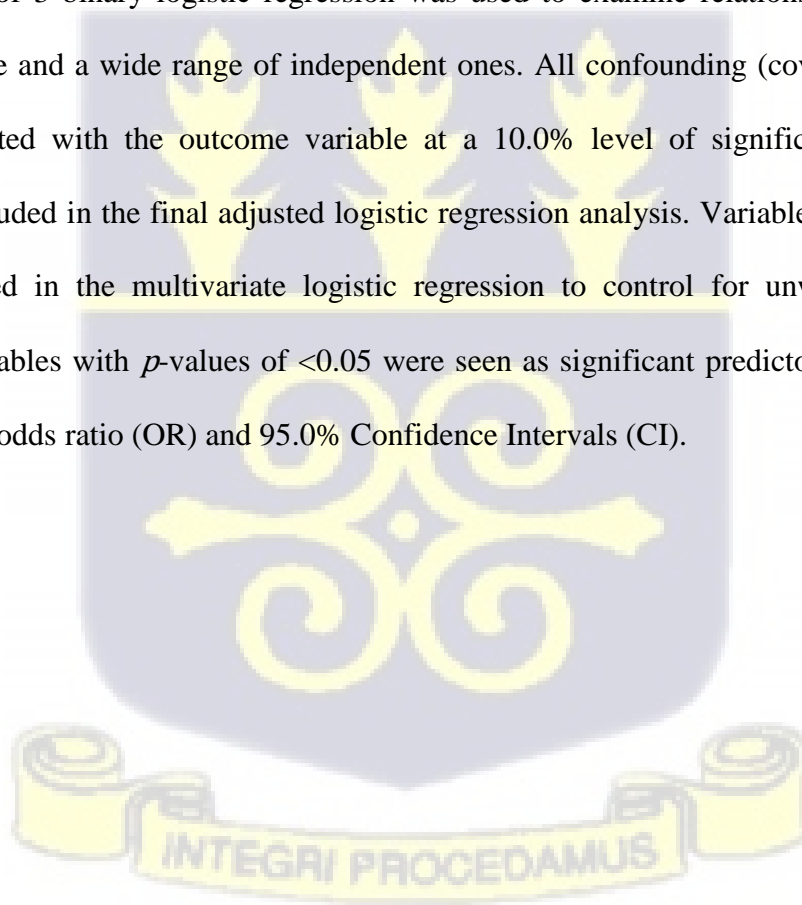
The malaria status was assessed using the RDT test on the field and a confirmatory test for the malaria status and the worm infestation test were done at the Immunology Department of the Noguchi Memorial Institute for Medical Research (NMIMR). For the RDT test, the manufacturer's procedure was followed and for the microscopic technique, two blood smears (one thick smear and one thin smear) were done for each sample as follows; a small drop of well-mixed blood was placed near the frosted end of a clean glass slide and a thick film with multiple layers of cells was prepared. Another small drop of well-mixed blood was placed near the thick film and using a new glass slide as a spreader, a thin film was prepared by streaking the blood on the slide close to the thick film to obtain an even monolayer of cells. The slide was air-dry, fixed and was then stained for microscopic examination to identify parasitic cells.

For the worm infestation test, stool samples were collected in clean, dry plastic screw-capped containers well labelled with participant's ID and sent to the laboratory on ice. These samples were arranged on a clean laboratory bench before analysis. Eighty-five per cent (85.0%) Normal saline solution was prepared and filtered for particulates. An equal volume of saline solution was added to the stool samples and mixed well with a wooden applicator. Twenty microns of emulsified stool was pipetted onto a clean slide and covered immediately with a cover slip. The wet stool preparation was observed under the microscope with the x10 lens followed by the x40 lens for confirmation of parasitic cells. The test was carried out at th NMIMR Laboratories by a competent laboratory technician.

3.11 Data Handling and Analysis

The data collected was entered and analysed using the Statistical Package for Social Science (SPSS) version 26 Software (Nie & Leung, 2011) and WHO Anthro Software Version 10.4 (Hey, 2007). Dietary Diversity Scores (DDS) were determined using the Food and Agriculture Organization (FAO) guidelines (FAO, 2011). Continuous and categorical variables were summarized using descriptive statistics. Means and standard deviations (SD) were used in reporting continuous variables and for categorical variables, frequencies and proportions were used. The results were presented using tables, charts and graphs.

For objectives 1, 3, 4, and 5 the results were analysed using descriptive statistics. For objective 2 and some aspect of 3 binary logistic regression was used to examine relationships between the dependent variable and a wide range of independent ones. All confounding (covariates) variables that were associated with the outcome variable at a 10.0% level of significance in bivariate analysis were included in the final adjusted logistic regression analysis. Variables with p -values \leq of 0.2 were added in the multivariate logistic regression to control for unwanted effects of confounders. Variables with p -values of <0.05 were seen as significant predictors. The outcomes were presented in odds ratio (OR) and 95.0% Confidence Intervals (CI).



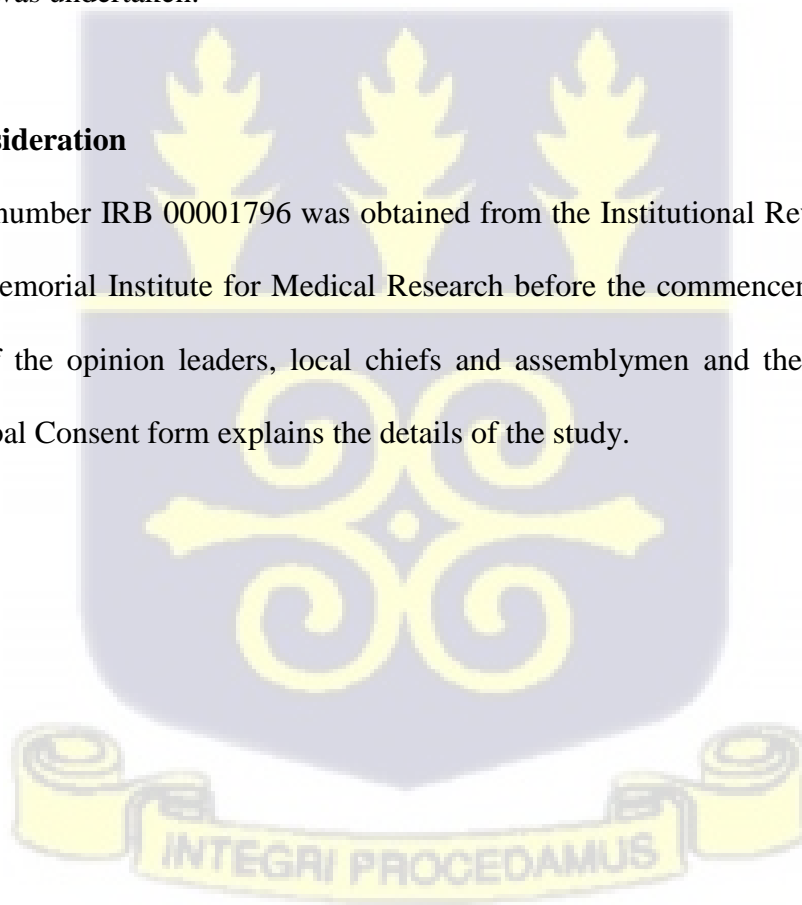
3.12 Quality Control

The quality control was done using designed questionnaires and anthropometric instrument as follows:

1. Two field assistants were recruited and retrained to collect all the data.
2. They were trained to administer the questionnaires in both English and the local dialects and to take an anthropometric measurement using standard procedures as a qualified nutritionist.
3. All the research instrument were pretested in Oyarifa, a peri-urban community which was not part of the study communities but had similar characteristics as the study ones.
4. All errors identified in the pretesting were used to correct the final copy before the actual fieldwork was undertaken.

3.13 Ethical Consideration

Ethical clearance number IRB 00001796 was obtained from the Institutional Review Board (IRB) of the Noguchi Memorial Institute for Medical Research before the commencement of the study. Verbal consent of the opinion leaders, local chiefs and assemblymen and the households were obtained. The verbal Consent form explains the details of the study.



CHAPTER FOUR

4.0 RESULTS

This chapter describes the result obtained in this work and the text is supported by tables and figures.

4.1 Background Characteristics

In this study, a total of 268 participants were recruited and participated. The study sample included 52.2% girls. The mean age of the children was 11.83 ± 4.09 months. In **Table 4.1**, 50.7% of the study children were within 6 to 11 months old and 49.3% were within 12 to 23 months. About 76.5% of the children were delivered at the hospital and the 23.5% at home. Mothers aged 25 years and above (81.0%) than mothers aged 24 years and below (19.0%) participated in the study. Many (63.4%) of the caregivers were from a nuclear family system. Close to 70.0% of them had some level of higher education (JHS and above). All the caregivers in this study were either salary (10.8%) earners or non-salary (89.2%) earners. Only 16.8% were employed in the formal sector, 3.0% were part time workers, 8.2% were full time wage workers, close to 50.0% were goods sellers and about 30.0% were artisans (masons, carpenters, painters, taylor and seamstress). About 33.0% of the caregivers had 1 child while about 77.0% had either two or more than 2 children.

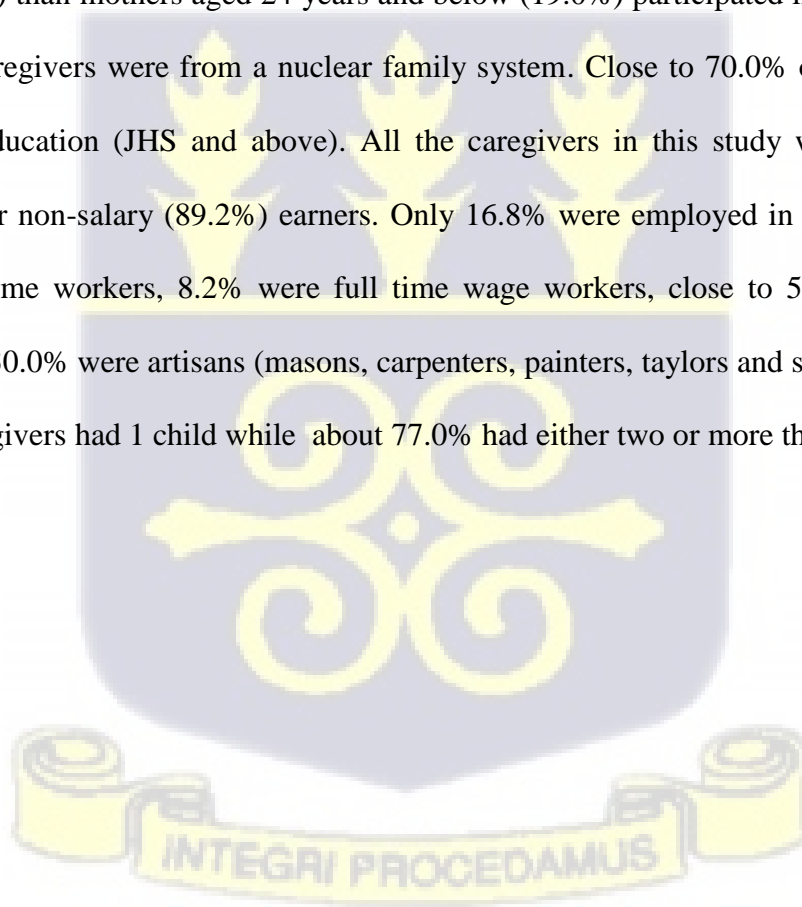


Table 4.1: Background characteristics of the study participants (N = 268)

Variable	Frequency (n)	Percentage (%)
Characteristics of the child		
Age (Months)		
6-11	136	50.7
12-23	132	49.3
Gender		
Male	128	47.8
Female	140	52.2
Place of delivery		
Hospital (private & public)	205	76.5
Home	63	23.5
Characteristics of the caregiver		
Age (Years)		
≤24	51	19.0
≥25	217	81.0
Family system		
Nuclear	170	63.4
Extended	98	36.6
Mother's educational status		
≤ Primary	86	32.1
≥ JHS	182	67.9
Occupation		
Salary earner	29	10.8
Non-salary earner	239	89.2
Not employed		
Yes	45	16.8
No	223	83.2
Part time wage labour		
Yes	8	3.0
No	260	97.0
Full time salary		
Yes	22	8.2
No	246	91.8
Selling goods		
Yes	120	44.8
No	148	55.2
Artisan		
Yes	76	28.4
No	192	71.6
Number of children		
1 Child	62	23.1
≥2 Children	206	76.9

JHS = Junior High School; SHS = Senior High School; ≥ Greater or equal to, ≤ less or equal to, artisan = dressmakers, carpenters, masons; full time salary = government workers who earn salary at the end of the month,

4.2 Anaemia Prevalence

From the study, 268 participants were recruited and participated and within this number, only 221 participants allowed me to test for their anaemia status. A large proportion of the respondents suffered from anaemia (Hb levels < 11.0g/ dl). The mean haemoglobin level among the children was 9.3g/ dl \pm 1.9 and the overall anaemia prevalence was 85.1%. Based on WHO classification, the distribution of anaemia as severe, moderate and mild were 8.1%, 26.7% and 50.2% respectively. (Table 4.2).

Table 4.2: Prevalence of anaemia among children 6-23 months old (N = 221)

Variable	Frequency (n)	Percentage (%)	Mean Hb
Mean haemoglobin			9.3g/ dl \pm 1.9
Non-anaemic	33	14.9	
Anaemic (Hb < 11.0g/dl)	188	85.1	
Severe anaemia (Hb < 7.0g/ dl)	18	8.1	
Moderate anaemia (Hb 7.0 – 8.9g/ dl)	59	26.7	
Mild anaemia (Hb 9.0 – 10.9g/dl)	111	50.2	

Hb = Haemoglobin, < = less than, > greater than

4.3 Stunting, Wasting and Underweight Prevalence among the Study Participants

The prevalence of stunting, wasting and underweight in this study were relatively low. In Table 4.3, about 9.0% of the respondents were stunted, 8.2% were wasted whereas about 10.1% were underweight with mean Z-scores of -0.35 \pm 1.70, -0.58 \pm 1.21 and -0.53 \pm 1.18 respectively.



Table 4.3: Stunting, wasting and underweight profiles (N=268)

Variable	Frequency (n)	Percentage (%)	Mean Z-score
Stunting			-0.35±1.70
Normal	244	91.0	
Stunted	24	9.0	
Wasting			-0.58±1.21
Normal	246	91.8	
Wasted	22	8.2	
Underweight			-0.53±1.18
Normal	241	89.9	
Underweight	27	10.1	

Mean±SD = Mean ± standard deviation, Mean Z-score = Mean of the Z- scores

4.4 Feeding Practices

4.4.1 Breastfeeding (BF) and Complementary Feeding (CF) Practices

The results revealed that almost all (99.3%) the caregivers had ever breastfed. Over 52.0% had initiated breastfeeding within the first 1 hour after delivery and close to 90.0% were still breastfeeding at the time of the data collection. A greater number (84.3%) of the children had received colostrum, the thick yellowish liquid that flows for the first time through the breast within the first three days. Most (about 82.8%) of the caregivers had breastfed their children beyond 12 months. One-fifth (20.0%) of the study children drank or ate something else during the first three days after delivery before they were fed breastmilk (**Table 4.4**).

Regarding complementary feeding, about 80.0% of the caregivers had started complementary feeding at the 6th months. Close to 50.0% of the children were fed three times or more, solids, semi-solids, or soft foods within 24 hours in a day. A few (17.5%) of them were fed through a bottle with a teat. The proportion of households that used iodized salt during cooking was about 50.0%. With respect to food groups that were consumed during the day or at night, almost all the participants ate foods made from grains, roots and tubers. A little over 20.0% ate foods made from

legumes and nuts and about 33.0% ate foods made from dairy products. Fifty percent of the participants ate meat and meat products while only about 17.5% of them ate eggs. The rest are vitamin A rich fruits and dark green leafy vegetables (22.4%), other fruits, about 27.0%, other vegetables, 30.6%, food made with oil, fat, or butter, red palm oil, palm nut pulp/ sauce, 58.6% respectively. Almost half (47.8%) of the study participants did not meet the minimum dietary diversity (MDD) score. However, about three-quarters (76.9%) met the minimum meal frequency (MMF) receiving solids, semi-solids or soft foods the minimum (2x and above) number of times or more during the past 24 hours and does not include breast milk received.



Table 4.4: Feeding practices among the mothers (N = 268)

Variable	Frequency (n)	Percentage (%)
Breastfeeding		
Ever breastfed?		
Yes	266	99.3
No	2	0.7
Breastfeeding initiation		
Within the first 1 hour	141	52.6
After 1 hour	127	47.4
Currently breastfeeding		
Yes	240	89.6
No	28	10.4
Colostrum		
Yes	226	84.3
No	42	15.7
Child received something else during the first 3 days of delivery		
Yes	51	19.0
No	217	81.0
Breastfeeding duration		
≤ 12 months	46	17.2
>12 months	222	82.8
Complementary feeding		
CF start age		
At 6 months	213	79.5
< 6 months	55	20.5
Number of feeding times solids, semi-solids, or soft foods within 24 hours in a day		
<4 times feeding times in a day	215	80.2
≥4 feeding times in a day	53	19.8
Bottle feeding		
Yes	47	17.5
No	221	82.5
Household salt use		
Iodized salt	136	50.7
Non-iodized salt	132	49.3

N = Total number of participants, n = number of participants, % = percentage,

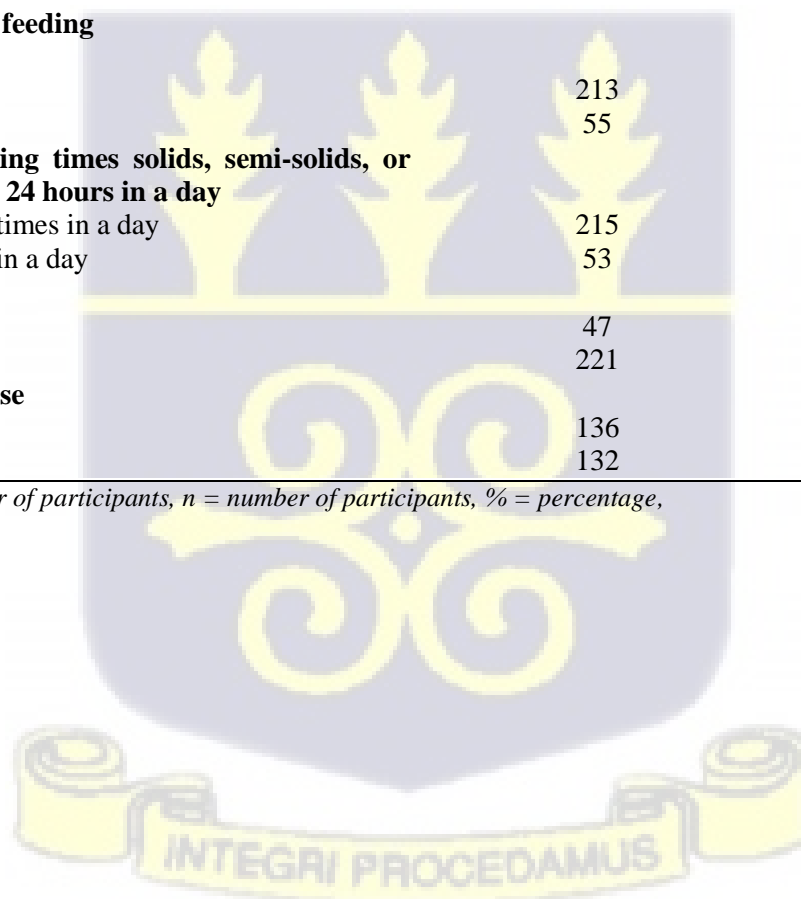


Table 4.4: Feeding practices among the mothers (N = 268) (Cont'd)

Variable	Number	Percentage
Grains, roots and tubers		
Yes	241	89.9
No	27	10.1
Legumes and nuts		
Yes	58	21.6
No	210	78.4
Dairy products		
Yes	89	33.2
No	179	66.8
Meat and meat products		
Yes	134	50.0
No	134	50.0
Eggs		
Yes	47	17.5
No	221	82.5
Vitamin A-rich dark green leafy vegetables		
Yes	60	22.4
No	208	77.6
Other fruits		
Yes	72	26.9
No	196	73.1
Other vegetables		
Yes	82	30.6
No	186	69.4
Oil, fat/ butter, palm oil		
Yes	157	58.6
No	111	41.4
Minimum Dietary Diversity		
Did not meet MDD	128	47.8
Met MDD	140	52.2
Minimum Meal Frequency		
Did not meet MMF	62	23.1
Met MMF	206	76.9

Met MMF = ate 2 or more times within 24-hours, Did not meet MMF = ate less than 2 times within 24-hours.

4.5: Relationship between Anaemia and Dietary Factors in Children Aged 6 - 23 Months

Table 4.5 shows the relationship between anaemia prevalence and type of foods fed to the children. Child received something else apart from breast milk within the first three days after

delivery [AOR = 3.37 (95% CI: 1.25 – 9.10, $P = 0.02$), start month on complementary feeding [AOR = 3.39 (95% CI: 1.05 – 10.92, $p = 0.04$)], food made from vitamin A-rich dark green leafy vegetables [AOR = 4.02 (95% CI: 1.06 – 15.24, $p = 0.04$), food made with oil, fat, or butter, red palm oil, palm nut soup [AOR = 3.20 (95% CI: 1.01 – 10.09, $p = 0.05$] and number of times child ate solids, semi-solids or soft foods [AOR = 5.28 (95% CI: 1.22 - 22.80, $p = 0.03$] significantly associated with anaemia. Although in the binary logistics, non of the above mentioned factors showed any association with anaemia apart from given anything elseto eat or drink which showed association with anaemia ($p = 0.02$).



Table 4.5: Relationship between anaemia and dietary factors (multivariate) (N = 268)

Variable	n	Unadjusted			Adjusted		
		Odds ratio	95% CI	P-value	Odds ratio	(95% CI)	P-value
Initiation of breastfeeding							
Within 1 hour	141	1			1		
After 1 hour	127	1.25	0.59-2.63	0.56	1.49	0.61-3.61	0.38
Colostrum							
No	42	1			1		
Yes	226	1.75	0.72-4.27	0.22	4.11	1.25-13.50	0.02
Received something else apart from breast milk during first 3 days							
No	217	2.63	1.16-5.99	0.02	3.37	1.25-9.10	0.02
Yes	51	1			1		
Currently breastfeeding							
No	28	1			1		
Yes	240	1.71	0.53-5.57	0.37	1.25	0.30-5.28	0.76
Duration of breastfeeding							
≤12 months	46	1			1		
>12 months	222	1.97	0.86-4.52	0.11	1.98	0.76-5.16	0.16
Complementary feeding start month							
<6 months	55	1.92	0.70-5.25	0.20	3.39	1.05-10.92	0.04
At 6 months	213	1			1		
Bottle feeding							
No	221	0.60	0.20-1.83	0.37	2.26	0.60-8.56	0.23
Yes	47	1			1		
Food made from grains, roots and tubers							
No	27	1			1		
Yes	241	1.10	0.35-3.43	0.87	1.99	0.46-8.54	0.35
Food made from legumes and nuts							
No	210	1			1		
Yes	58	1.56	0.57-4.30	0.39	2.85	0.84-9.69	0.09
Food made from dairy products							
No	179	1			1.58	0.58-4.33	0.37
Yes	89	1.41	0.62-3.21	0.41	1		
Meat and meat products							
No	134	1.16	0.55-2.43	0.70	1.01	0.38-2.27	0.98
Yes	134	1			1		

CI = confidence interval, n = number of participants, N = total number of participants

Table 4.5: Relationship between anaemia and dietary factors (multivariate) (Cont'd) (N = 268)

Variable	n	Unadjusted			Adjusted		
		Odds ratio	95 % CI	P-value	Odds ratio	(95 % CI)	P-value
Eggs							
No	221		1		1		
Yes	47	1.19	0.43-3.32	0.74	1.47	0.41-5.34	0.56
Food made from vitamin A-rich dark green leafy vegetables							
No	208		1		1		
Yes	60	1.96	0.65-5.90	0.23	4.02	1.06-15.24	0.04
Other fruits							
No	196		1		1.38	0.48-4.00	0.55
Yes	72	1.27	0.52-3.12	0.60		1	
Other vegetables							
No	186	1.38	0.64-3.00	0.41	1.03	0.37-2.86	0.95
Yes	82		1			1	
Food made with oil, fat, or butter, red palm oil, palm nut soup							
No	111	1.65	0.76-3.60	0.21	3.20	1.01-10.09	0.05
Yes	157		1			1	
Household salt use							
Non-iodized salt	132		1			1	
Iodized salt	136	1.87	0.87-4.01	0.11	1.84	0.77-4.40	0.17
Number of times child ate solid/semi-solid, or soft foods during day/night							
<4	215		1			1	
≥4	53	3.06	0.89-10.50	0.08	5.28	1.22-22.80	0.03

CI = confidence interval, n = number of participants, N = total number of participants

4.6 Association between Anaemia and other Factors among Study Children

Table 4.6 shows results from the multivariable logistic model that was run to assess factors that were associated with anaemia in children 6 - 23 months old. From the regression model, non of the items test showed any association with anaemia. However, in binary logistics analysis for the individual factors (**Table 4.6**), Family type [AOR = 2.27 (95% CI: 1.07 – 4.79, $p = 0.03$), part time wage labour [AOR = 6.35 (95% CI: 1.50 – 26.78, $p = 0.01$)], Selling of goods [AOR = 3.01 (95% CI: 1.38 – 6.58, $p = 0.01$)], Artisan [AOR = 4.92 (95% CI: 1.45 – 16.75, $p = 0.01$)], were associated

with anaemia but they did not remain in a regression model. The set of variables could explain only 20.4% of the variation in anaemia in the population (Nagelkerke R Square = 0.20) which suggest many more factors other than those measured in this study are responsible for anaemia.



Table 4.6: Binary logistics model to determine the association between anaemia and other factors (multivariate) (N = 268).

Variable	n	Unadjusted			Adjusted		
		Odds ratio	95 % CI	P-value	Odds ratio	(95 % CI)	P-value
Caregiver's characteristics							
Mother's age							
≤24 years	51	1.60	0.53-4.85	0.41	1		
≥25 years	217		1		1.05	0.29-3.77	0.95
Family type							
Nuclear	170	2.27	1.07-4.79	0.03	2.25	0.97-5.20	0.06
Joint	98		1		1		
Mother's education							
≤ primary education	86	1.22	0.53-2.79	0.64	1.46	0.60-3.59	0.41
≥ JHS	182		1		1		
Not employed							
No	223		1		1		
Yes	45	2.21	0.64-7.66	0.21	8.84	0.22-354.44	0.247
Part time wage							
No	260	6.35	1.50-26.78	0.01	1.80	0.06-58.25	0.74
Yes	8		1		1		
Full time wage							
No	246		1		1		
Yes	22	2.98	0.38-23.24	0.30	10.00	0.18-546.04	0.26
Selling							
No	148	3.01	1.38-6.58	0.01	1		
Yes	120		1		3.22	0.09-110.27	0.52
Artisan							
No	192		1		1		
Yes	76	4.92	1.45-16.75	0.01	15.55	0.50-481.61	0.12
Number of children							
1 child	62	2.877	0.84-9.90	0.09	2.56	0.57-11.47	0.22
≥2 children	206		1		1		
Child's characteristics							
Age							
6 - 11 months	136	0.59	0.39-1.71	0.82	1.22	0.54-2.75	0.63
12 -23 months	132		1		1		
Sex							
Male	128		1		1		
Female	140	1.25	0.60-2.6	0.55	1.01	0.43-2.34	0.85
Place of delivery							
Home	63	1.38	0.451-4.20	0.58	1.81	0.514-6.37	0.36
hospital	205		1		1		

CI = confidence interval, *JHS* = Junior High School, *n* = number of participants, *N* = total number of participants, *Artisan* = seamstress, mason, taylor and carpenter.

4.7: Factors Associated with Undernutrition (Underweight, Wasted and Stunting) among Children 6 to 23 Months

Tables 4.7, 4.8 and 4.9 shows binary logistic regression ran to assess the demographic characteristics and dietary practice factors that are associated with undernutrition. For stunting, non of the variables tested showed association with stunting, although, part time wage labour, child ate or drank something else, food made from grains, roots and tubers were about 2.76, 2.47, and 2.31 times more likely to be stunted ($p > 0.05$). For wasting, part time wage labour, sex of child, initiation of breastfeeding, breastfeeding duration and salt used during cooking significantly associated with wasting. For underweight, non of the virables tested also showed any association with underweight. Colostrum (Table 4.9), significantly associated with underweight in the logistic regression test but did not remaing in the final model.

Table 4.7: Factors associated with stunting (multivariate) (N = 268)

Variable	n	Unadjusted			Adjusted		
		Odds ratio	95% CI	P-value	Odds ratio	(95% CI)	P-value
Part time wage							
No	260		1		1		
Yes	8	3.61	0.69-18.94	0.13	2.76	0.37-20.40	0.32
Selling goods							
No	148	2.10	0.84-5.23	0.11	1.76	0.65-4.75	0.26
Yes	120		1		1		
Occupation							
Non-salary earner	239		1		1		
Salary earner	29	2.41	0.83-7.04	0.11	1.54	0.40-6.01	0.53
Initiation of BF							
Within 1 Hour	141	1.90	0.79-4.61	0.15	1.92	0.76-4.84	0.17
After 1 Hour	127		1		1		
Received something else apart from breast milk							
No	217		1		1		
Yes	51	1.87	0.73-4.79	0.19	2.47	0.91-6.75	0.08
Grains, roots							
No	27	2.66	0.90-7.81	0.08	2.31	0.69-7.75	0.18
Yes	241		1		1		
Oil, fat, butter							
No	111	1.76	0.76-4.09	0.19	1.59	0.61-4.14	0.34
Yes	157		1		1		

CI = confidence interval, BF = breastfeeding, n = number of participants, N = total number of participants

Table 4.8: Factors associated with wasting (multivariate) (N = 268)

Variable	n	Unadjusted			Adjusted		
		Odds ratio	95% CI	P-value	Odds ratio	(95% CI)	P-value
Part time wage							
No	260		1		1		
Yes	8	4.00	0.76-21.12	0.10	8.41	1.28-55.46	0.03
Sex							
Male	128	4.14	1.48-11.56	0.01	5.32	1.70-16.63	<0.01
Female	140		1		1		
Initiation of BF							
Within 1 Hour	141		1		1		
After 1 Hour	127	4.20	1.50-11.76	0.01	6.75	2.04-22.35	<0.01
Colostrum							
Did not receive	42	2.19	0.80-5.96	0.13	1.07	0.35-3.31	0.90
Received	226		1		1		
BF duration							
≤12 months	46	1.93	0.71-5.24	0.20	4.45	1.35-14.75	0.01
>12 months	222		1		1		
Household salt used							
Non-iodized salt	132	2.36	0.93-6.00	0.07	2.79	1.02-7.65	0.05
Iodized salt	136		1		1		

CI = Confidence interval, BF = Breastfeeding, n = number of participants, N = total number of participants

Table 4.9: Factors associated with underweight (multivariate) (N = 268)

Variable	n	Unadjusted			Adjusted		
		Odds ratio	95% CI	P-value	Odds ratio	(95% CI)	P-value
Part time wage							
No	260		1		1		
Yes	8	3.13	0.60-16.36	0.18	2.91	0.52-16.16	0.22
Initiation of BF							
Within 1 Hour	141		1		1		
After 1 Hour	127	1.70	0.76-3.82	0.20	1.58	0.67-3.74	0.30
Colostrum							
Did not receive	42	2.56	1.04-6.32	0.04	2.08	0.80-5.38	0.13
Received	226		1		1		
Currently bf							
No	28	2.15	0.75-6.23	0.16	2.15	0.72-6.38	0.17
Yes	240		1		1		
Bottle feeding							
No	221	2.87	0.66-12.56	0.16	2.90	0.65-12.95	0.16
Yes	47		1		1		
Dairy products							
No	179		1		1		
Yes	89	1.70	0.76-3.82	0.20	1.78	0.78-4.08	0.17

CI = confidence interval, BF = breastfeeding, n = number of participants, N = total number of participants

4.8: Malaria and Helminthic Infestation Status

The results revealed that about 1.5% of the children were infected with malaria. Regarding helminthic infestation, there were no visible helminths seen in the stool samples that were collected and tested.



CHAPTER FIVE

5.0 DISCUSSION

5.1 Preamble

Anaemia in childhood is a public health concern in many developing countries and Ghana is not an exception. Anaemia is known to have detrimental effects on children particularly those aged between 6 and 23 months old (Saaka et al., 2015). The current study investigated nutritional status and predictors of anaemia among children in some peri-urban areas of Accra, Ghana.

5.2 Anaemia Prevalence

Globally, it is a known fact that the burden of anaemia in childhood is immense especially during infancy (0-23 months old). This study revealed that 85.1% of the study children were anaemic. This is an exigent public health concern and requires immediate intervention to curb it because the prevalence of anaemia greater than 40.0% is of urgent concern (WHO, 2011). The study affirms the report by Ewusie et al., (2014), that revealed childhood anaemia prevalence to be 85.1% among infant and young children. A similar trend was recorded in a systematic review of representative population data; global, regional and national, estimating anaemia prevalence among children, pregnant and non-pregnant women from 1995 to 2011 (Stevens et al., 2013). In their analysis, anaemia prevalence was more than 85.0% in under 5 years children in Burkina Faso as of 2011, although the age group in our case was lower. Literature shows that anaemia is most prevalent among children especially those in the age bracket of 6 to 23 months since their dietary requirements for development are higher due to rapid growth and development experienced than in older children (Khan et al., 2016).

In rural Benin, a study involving 767 child-mother pairs reported high anaemia incidence above 80.0% in children 6 to 23 months old (Alaofe et al., 2017). In Northeast Ethiopia, an institution-based study made up of 347 infants and young children attending growth monitoring at a Health Centre, discovered that anaemia prevalence among the children was 66.6% (Woldie et al., 2015). Our finding also corroborates another study which revealed that across developing countries (Africa and Asia), anaemia prevalence is over 85.0% in high risk groups including children aged 6 to 23 months of age (Balarajan et al., 2011). Black et al (2013) also reported that in Africa, anaemia is prevalent among all age groups but the most affected ones are children below 2 years which ranges from 40.0% to 80.0% in rural settings.

Onyango in 2003, postulated that in developing countries, higher anaemia prevalence among children below 2 years was as a result of complementary foods being mostly cereal-based. Fortifications of infant formulas and foods made from cereals and grains with iron have been credited for improving the iron status of millions of children. Studies have shown that vitamin C is one micronutrient that participates in enzymatic reactions (biosynthesis of collagen, carnitine and norepinephrine) and helps in the absorption of non-haem iron as well as B₁₂ and folic acid thereby facilitating the process of erythropoiesis making them very necessary to be included in diets (Savarino, Corsello & Corsello, 2021; Zwolinska et al., 2006). Dark green vegetables and fruits remain a good source of vitamin C which are mostly at their richest when raw, slightly cooked or steamed. Nonetheless, children who consumed food groups that were rich in vitamins A, C, B₁₂ and folate in this present study was below 50.0%. An adequate nutrition guarantees proper physiological growth and prevent illnesses. The lack of micronutrients even one can have dire consequences including growth retardation or impairment and the subsequent attacks by illnesses

such as iron deficiency anaemia, rickets, cretinism and scorbutus (Savarino, Corsello & Corsello, 2021).

In Ghana, often the first foods given to children in complementary feeding are mainly made of grains, roots and tubers (Gyampoh, 2014). In this present study, the trend was similar, food types that were mostly eaten were food made from grains, roots and tubers (89.9%). In a study in Ho, Ghana, 64.6% of the main food items prepared for children less than 12 months were plain porridge “Koko”. This porridge was made from fermented maize; about 15.0% of the children were fed “banku” which was also made from cassava and corn doughs, whilst 10.6% were fed with weanimix, a specially prepared flour from soya beans and maize (Kweku et al., 2015). Cereals are known to contain some levels of phytates (inhibitors of iron), although food processing including, soaking and germination could remove substantial amounts of these phytates. Food processing (soaking, sprouting, milling and cooking using more heat) if not done well could lead to poor bioavailability of iron in foods.

Studies in the past have proven that inappropriate dietary and complementary feeding practices lead to lack of access to diverse foods which decreases the intake of food rich in iron; animal-sourced foods, legumes and nuts and dark green leafy vegetables, eventually exacerbating anaemia prevalence among children (Woldegebriel et al., 2020; Onyango, 2003). In this present study, similar results were reported from the food groups. Exactly 50.0% of the studied children ate meats and meat products, approximately 22.0% ate legumes and nuts and about 18.0% ate eggs. Dairy products which are highly rich in calcium as well as inhibitors of iron absorption and cereal-based, root and tuber meals which also contain phytates were consumed by 33.2% nearly 90.0% of the

study children respectively. Thus, these food groups consumed may have added to the high anaemia level noted in this study.

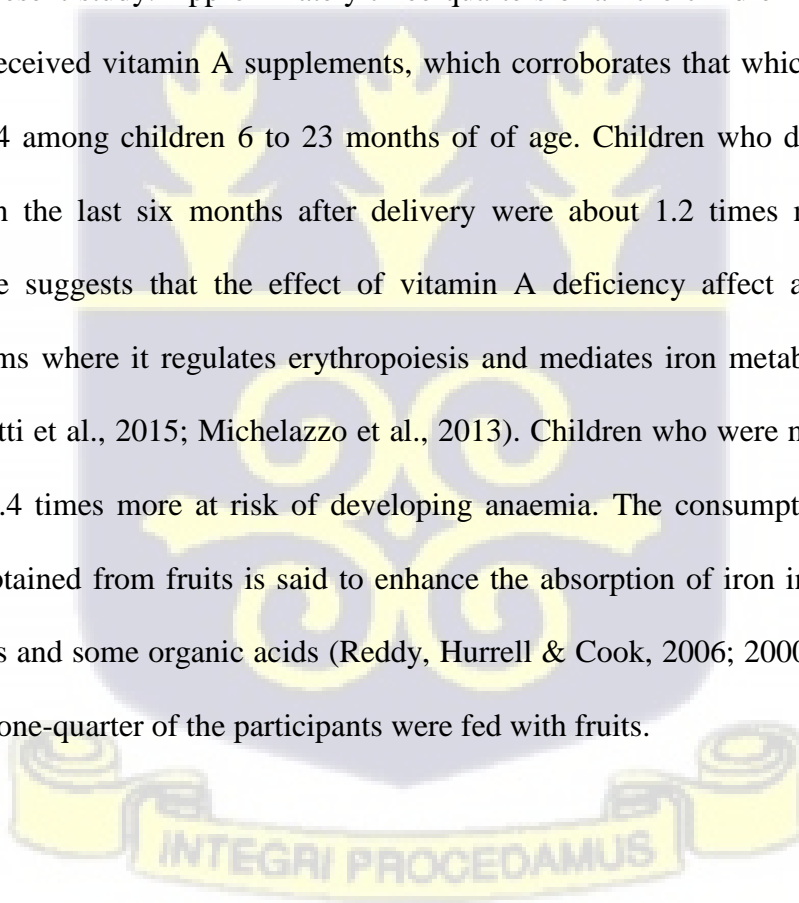
The present study discovered that about 31.0% of the study children had a history of late and early exposure to complementary foods. A similar finding by Onyango (2003) stated that late and early introduction of complementary foods conveys risks contributing to young child malnutrition and this practice are eminent for causing anaemia among young children. Again, Saldiva et al., (2011) indicated that digestive enzymes in the life of every child during the first 6 months are inadequate and so, giving the children either liquid or solid foods to children during this period could cause interference to the absorption of iron in breastmilk. In the African context, dietary iron mostly comes in a form of non-haem found in cereals, flour and grain foodstuffs that are enhanced or fortified with iron. Meinen-Derr et al., (2006) revealed that in young children introducing complementary foods that early in life can lead to an increase in microbial pathogens. This increases the children's risk of getting diarrhoeal disease which can lead to mal-absorption and loss of nutrients.

5.3 Dietary Factors Associated with Anaemia

There are a variety of causes of anaemia, made up of the interactions of both nutritional and non-nutritional factors. More important are the contributions of micronutrient deficiencies due to poor dietary habit, chronic infections, parasitic infections, inflammatory and genetic disorders (Mugisha et al., 2008). Household characteristics including poor sanitation, poor water source and lower monthly income have been reported as having a significant association with anaemia (Woldie et al., 2015). Studies have also proven that other factors including low maternal education, stunted growth, absence of bednets, rural residency, low community index and incomplete immunization

are risk factors for anaemia (Ngnie-Teta et al., 2007; Brabin et al., 2001). According to this present study, the most consistent predictors of anaemia are: colostrum, child given something else to eat or drink in the last three days after delivery before given breastmilk, complementary feeding start month, foods made from vitamin A-rich dark green leafy vegetables, legumes and nuts, oil, fat, or butter, red palm oil, palm nut soup and number of times child ate solid, semi-solids, or soft foods during day/ night ($p < 0.05$).

In the current study, almost all the participants were fed cereals-based foods (**Table 4.4**) which could possibly contain phytates and yet very little vitamin A-rich dark green vegetables and diets poor in animal products. This could have accounted for the high anaemia prevalence of 85.1% observed in this present study. Approximately three-quarters of all the children in this study were reported to have received vitamin A supplements, which corroborates that which was reported in the GDHS in 2014 among children 6 to 23 months of age. Children who did not receive the vitamin A dose in the last six months after delivery were about 1.2 times more likely to be anaemic. Evidence suggests that the effect of vitamin A deficiency affect anaemia primarily through mechanisms where it regulates erythropoiesis and mediates iron metabolism, its storage and release (Iannotti et al., 2015; Michelazzo et al., 2013). Children who were not fed other fruits were also about 1.4 times more at risk of developing anaemia. The consumption of vitamin C, which could be obtained from fruits is said to enhance the absorption of iron in the diet coupled with animal tissues and some organic acids (Reddy, Hurrell & Cook, 2006; 2000), was low in this study. Only about one-quarter of the participants were fed with fruits.



5.4 Nutritional Status of Infants and Young Children

Lartey, in 2008 stated that for a government of a country to be able to utilize the full potential of its human resource, such a government cannot afford to abandon the nutritional needs of its people. Constant monitoring of changes in the nutritional status of its population therefore is vital. It helps with the detection of nutritional stress, which is key to planning interventions aimed at achieving set targets for nutrition and child health promotions (WHO, 2009a). Whilst weight-for-height/length can enable us to detect short term changes in the growth of the people in a nation, height/length-for-age can enable us to measure long term change.

This present study assessed the nutritional status of the children using length-for-age, weight-for-age and weight-for-length indices among children 6 to 23 months in La-Nkwantanang-Madina Municipal Assembly. Length-for-age represents linear growth retardation mostly related to the repeated exposure to poor sanitation, harsh economic conditions, and collaborating effects of poor nutrient intakes and infections (SCN, 2010). Weight-for-age reflects current chronic or acute malnutrition and a common indicator used to monitor the magnitude of growth faltering over a period, which reflects the body mass of children (SCN, 2010). Low weight-for-length signifies acute malnutrition and could occur because of starvation or severe disease manifestation from chronic condition or combination of starvation and a chronic condition (SCN, 2010). Therefore, childhood mortality and morbidity could be reduced or eliminated if appropriate identification of under-nutrition at all levels is considered through regular monitoring by anthropometric measurements (Muller & Krawinkel, 2005).

This current study reported stunting, wasting and underweight prevalence of 9.0%, 8.2% and 10.1% respectively. The findings of stunted growth and underweight in the present study were

slightly lower as compared to what was reported in the GDHS as 19.0% and 11.0% respectively (GSS/GHS/ICF, 2015). However, the prevalence of wasting was slightly above that of GDHS of 5.0% (GSS/GHS/ICF, 2015). The difference may be attributed to the size of the sample and age group. The GDHS used the age range 0 to 59 months (GSS/GHS/ICF, 2015) whilst in the present study, the age range was 6 to 23 months. Egbi et al., (2018) stated that stunting mostly peaks in children at 24 to 35 months. This may have accounted for the differences in the stunting recorded in this study and that of the GDHS survey. Again, underweight and stunting noted in the present study was lower as against what was observed by Glover-Amengor et al., (2016). They reported underweight and stunting prevalence of 17.6% and 27.2% respectively in the northern part of Ghana. Wasting was almost similar (8.3%) to what was recorded in the present study. The difference between Glover-Amengor et al., (2016) and the current study could be attributed to the geographical location. It has been observed that children living in the northern part of Ghana have a higher stunted and underweight prevalence (GDHS, 2014). This trend was observed in other studies done in the African region. In Ethiopia, Tadesse et al., (2018) reported wasting and stunting among 645 under 5 years of age children as 15.3% and 27.4% respectively whilst Yalew et al., (2014) reported 47.3% and 47.3% respectively among 844 under 5 years old children in a rural setting of Lalibela, Northern Ethiopia. In all these studies, the high rates were as a result of high levels of poverty in the northern parts. Research has shown that the landscape of the northern parts are savannah in nature and has always been considered as the poorest and least developed regions with a subsistence-based economies (Aguey, 2021). The incidence of poverty is reflected in low purchasing power, limited access to basic infrastructure (health education) and a low standard of living (Aguey, 2021).

In the present study again, wasting prevalence was beneath what was reported by Mokori, (2012) among 219 children 6 to 23 months old in Northern Uganda as 11.0% and underweight was lower than what the early study reported as 18.0%. The fundamental disparity in the current finding and that of the earlier studies may be attributed to the sample size, age and differences in the locations. About the anthropometric indices that were assessed, stunting and wasting were beneath the threshold of public health concern, whilst wasting was on the mark of the threshold of public health concern. Tadesse et al., (2018), stated that any nutritional deficit of a given population that is higher than 10.0% is of public health concern. Also, according to UNICEF (2007), any country with a prevalence of 10.0% or more among under 5 years old children who are underweight require immediate attention but, in this study, the underweight prevalence although lower than that which was reported in the GDHS report, 2014 of 11.0%, was of public health concern.

5.5 Factors Associated with Stunting, Wasting and Underweight

5.5.1 Stunting

In the present study, none of the variables tested showed a significant relationship with stunting. Nonetheless, some showed a higher tendency of being stunted through correlation. Stunting is a measure of recurrent or chronic undernourishment (Srivastava et al., 2012). Contrary to what was reported in the GDHS report that stunting was more common in children of less-educated mothers (26.0%) and also more common with households with a low wealth index, the present study reveals that children from mothers who engaged in part time wage labour, selling of goods, initiation of BF after 1 hour of delivery, consumption of something else during the first three days after delivery before being fed breastmilk, consumption of foods made from grains, roots and tubers were more at risk of being stunted ($p > 0.05$)

5.5.2 Wasting

The study revealed that prevalence of wasting was higher than that which was reported in the GDHS report (5.0%) but corroborated with a study by Ali et al., 2017 (9.9%), where they looked at effect of maternal and child factors on stunting, wasting and underweight among preschool children in northern Ghana. In this study, multivariate analyses revealed that there was an association between wasting and part time wage labour ($p = 0.03$), sex of child ($p < 0.01$), late initiation of breastfeeding ($p < 0.01$), early cessation of breastfeeding ($p < 0.01$) and non-iodized salt use at home ($p < 0.05$). In bivariate analyses, the odds of a male child being wasted was about 4.1 times more at risk than their female counterparts. Likewise, late initiation of breastfeeding among the children, the odds of being wasted was also about 4.2 times more at risk among children who were breastfed late after an hour.

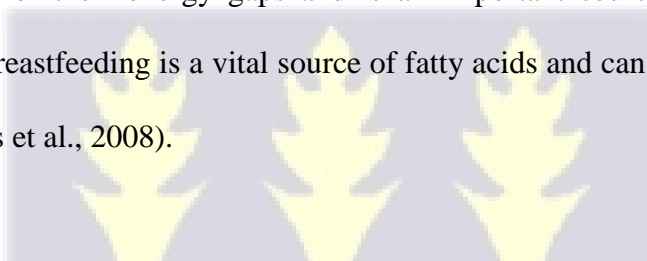
5.5.3 Underweight

Even though none of the variables was significant after adjusting for other confounders, children whose parents engaged in part time wage labour [AOR = 2.91 (95 % CI: 0.52-16.16), $p = 0.22$], initiated breastfeeding late [AOR = 1.58 (95 % CI: 0.67-3.74), $p = 0.30$], did not receive colostrum (the yellowish liquid that came from the breast during the first three days) [AOR = 2.08 (95 % CI: 0.80 - 5.40), $p = 0.13$], was not breastfed as at the time of the data collection [AOR = 2.15 (95 % CI: 0.72 - 6.38), $p = 0.17$], breastmilk had low dietary diversity scores [AOR = 2.64 (95 % CI: 0.88 - 7.90), $p = 0.08$] had the tendency of being underweight compared to their counterparts who had higher dietary diversity scores. Underweight is the common indicator that shows current, acute and chronic malnutrition. It is also a common indicator that is used to monitor changes in the greatness of malnutrition over time which reflects the body mass of children (SCN, 2010).

5.6 Feeding Practices

5.6.1 Breastfeeding

Breastfeeding from birth to the first 1000 days and beyond according to Korir (2013) is to ensure that proper development and growth of children especially infants and young children are achieved. In this study almost all the children had been breastfed. This finding is analogous to the GDHS report which revealed that 99.0% of Ghanaian children are breastfed (GSS/GHS/ICF, 2015). The study also corroborates with studies in Ethiopia (Agize, Jara & Dejenu, 2017) and Kenya (Korir, 2013). Meanwhile, previous studies have shown that during infancy, meeting the micronutrient requirements was a big challenge because the nutritional requirements during this period are high (Lartey, 2008). Breastfeeding significantly provides the total nutritional needs of the child, bridges most of their energy gaps and is an important source of vitamins A and C (Francis et al., 2008). Breastfeeding is a vital source of fatty acids and can provide the total energy needs of infants (Francis et al., 2008).



The present study revealed that about 52.6% of the study children received breastmilk within 1 hour after they were delivered. This finding was higher compared to findings in a study by Sharma et al., (2016) in Pradesh, India where early initiation of breastfeeding was found in only 38.6% of the study children. The introduction to breastmilk within 30 minutes to the first 1 hour immediately after birth ensures that the child receives the “first milk” or colostrum which is packed with protective factors that are crucial in the prevention of childhood illnesses, growth faltering and micronutrient deficiencies. In the current study, about 16.0% of the children were denied the consumption of colostrum by their mothers thereby denying them of the highly nutritious milk that is rich in antibodies that confers natural immunity to the infant.

5.6.2 Complementary Feeding

According to Black et al., (2013), the nutritional status of children below the age of 2 years are directly affected by child feeding practices. Lutter & Rivera (2003) also indicated that there is a greater threat of undernutrition, morbidity and mortality in children following inappropriate complementary feeding which reduces their chances of survival. Introducing on time either soft, semi-solid or solid foods is very important for the well-being of the child. Studies have shown that when a child has not attained 6 months and food supplements or other foods apart from breastmilk are given, the child's growth may falter (WHO, 2009a). Any growth deficit that may ensue as a result will be irreversible later in life. Complementary feeding is recommended to commence at 6 months into the life of a child whilst continue to breastfeed until the child's second birthday and beyond (Mugisha et al., 2008). In **Table 4.4**, 79.5% of the study children received complementary foods at the 6th month. This finding was comparable with the GDHS 2014 report (GSS/GHS/ICF, 2015). Also, about 80.2% of the study children were fed less than four times solid, semi-solid or soft foods which were comparable to a study in Kenya (Korir, 2013), but a little higher than what was reported in the GDHS 2014 (GSS/GHS/ICF, 2015).

5.7 Dietary Habits of Infants and Young Children

Minimum dietary diversity (MDD) indicates the quality of the complementary foods that are eaten by children (Agyiri, 2016). It is the percentage of children (6 to 23 months old) who had consumed food from 4 food groups or more (Onyango, 2003). In this study, about half (47.8%) of the study participants were found to have not met the MDD (**Table 4.4**). The study revealed that the diet composed largely of cereals, roots and tubers with moderate animal-sourced food and a little vitamin A-rich dark green vegetables. The study showed that a greater number of the study participants had eaten foods prepared from grains, root and tubers. However, the consumption of

protein-rich foods from animal and plant sources were low. None of the foods recorded more than 50.0% total consumption, except for foods made from grains, root and tubers (89.9%) and oil, fat or butter, red palm oil, palm nut pulp or sauce (58.6%). The 89.9% grains, root and tubers observed tallies with the national data of 88.0% of breastfed children who ate solid, semi-solid or soft foods.

A little over 20.0% consumed legumes and nuts which were higher than that which was reported in the GDHS 2014 report as 12.0% (GSS/GHS/ICF, 2015). Also, a little over 30.0% consumed dairy products and about one-fourth consumed fruits. Foods such as fish, meat and eggs consumed was about 68.0% all combined which corroborated the GDHS (2014) reported figures of 48.0% for meat, fish and poultry and 18.0% for eggs respectively (GSS/GHS/ICF, 2015) making a total of 68.0%. Close to 31.0% of the participants consumed other vegetables including cabbage and garden eggs which are rich in calcium and which are needed for building strong teeth and bones. To meet the nutrient needs, dietary diversity is recommended. Therefore, consumptions of various food types are thought to ensure that essential nutrient is adequately consumed and thus will promote good health and growth (Glover-Amengor et al., 2016).

5.8 Malaria and Helminths Status of the Study Children

This study found no helminthic infection and only three children had malaria, representing about 1.5%. The three malaria cases that were detected were referred to the nearest clinic to be given treatment. The most current national survey of malaria prevalence conducted among children under 5 years in Ghana was 26.7%. However, in the Greater Accra Region where the current study was conducted, 11.0% was recorded for children aged 6 to 59 months (GSS/GHS/ICF, 2015). According to the GSS report of 2015, the prevalence of malaria which was based on results

obtained through microscopy was higher in rural (38.0%) settings than those in urban (14.0%) settings and among children from poor homes (42.0%) as compared to those from rich homes (8.0%) (GSS/GHS/ICF, 2015).

In Ghana, the Health Ministry and the National Malarial Control Programme (NMCP) has adopted Behavioural Change Communication (BCC) to be a key strategy to ensuring that the Ghanaian people were adequately enlightened and also increase their knowledge, creating positive behavioural change in recent times. These steps may have led to the increased awareness in malaria management and control by using treated mosquito nets, effective treatment practices and seeking proper diagnosis within the shortest possible time (within 24 hours) after diagnosis. This is coupled with good sanitation practice among the study correspondents, hence the low level of infectious disease and parasitic infections detected in the present study. The BCC involves the broadcasting of messages on treatment and prevention of malaria through numerous media pathways (TV, radio, newspapers, leaflets and magazines) through health workers and community volunteer services (GSS/GHS/ICF, 2015).

The low levels of malaria prevalence that was found in this present study could be attributed to age differences, size of the sample differences and communities that were included in the studies as well as BCC messages put out there. In a cross-sectional community-based survey involving 325 under 5 years children from four selected rural settings, older children had a higher chance of contracting malaria than those who were younger (Kweku et al., 2015). From the study, it was observed that children 12 to 23 months old were about 2.5 times at risk of contracting malaria than those aged 6 to 11 months old. According to Kweku et al., (2015), poor maternal attention could be the cause. In this present study, the age group involved was low and this could have accounted for

the low malaria prevalence recorded due to intense maternal attention. Also, in the GDHS report, rural respondents were at a better chance of hearing a message on malaria from a health worker or a community volunteer (38.0% and 18.0% respectively) than their urban counterparts (28.0% and 9.0%) (GSS/GHS/ICF, 2015). These proportions are also higher in the poorest settings and reduce as the wealth quartile goes up which could also have accounted for the low levels (Zimmermann & Kohrle, 2002). Maternal knowledge enables the mother to take counter measures to protect their children from being exposed to mosquito bites. More so, the present study was conducted during the dry season. This may have reduced the overall burden of mosquito breeding in the study area which may have resulted in the low levels of malaria that was observed among the children.

During the period of the data collection, it was observed that malaria control and preventive approaches such as vector control of mosquito larvae increased, the use of indoor residual spraying and treated mosquito nets were adhered to by mothers. This was observed through verbal communication with the mothers. In Africa, studies have shown that there has been a high achievement of malaria control intervention, especially with the use of long-lasting insecticide-treated nets (LLINs) and the practice of indoor residual spraying (IRS). In Ghana, according to (Kweku et al., 2015), ownership and use of LLINs among Low-Altitude (L-A) and High-Altitude (H-A) children respectively were high. About 97.0% of the children own LLIN out of which 96.6% were from L-A and 97.4% were from H-A. Usage of LLIN was 77.9% with 79.9% from L-A and 75.5% from H-A (WHO, 2009b). Again, the adherence to the antenatal clinic, as well as child survival programmes such as intermittent preventive treatment of infants and young children and effective diagnosis and treatment of malaria, may have accounted for the low level of malaria that was detected in this current study. In 2013, the district was able to exceed its target (14.0%) of

antenatal care coverage rate by 15.7% with malaria reported cases declining from 41.2% to 36.9% between 2012 and 2013 (Nkwantanang-Madina, 2014).

Helminths may either live as free of a host, or parasites in terrestrial and aquatic ambiances. There are several types of helminths and the most commonly reported worldwide are soil-transmitted helminths (STH) or intestinal nematodes, schistosomes (parasites of schistosomiasis) and filarial worms, causing lymphatic filariasis and onchocerciasis (Wani & Kumar, 2018). Research has shown that certain practices, when not done well will lead to infection and picking-up of worms from the environment. Practices such as improper refuse disposal, poor hygiene practice, improper and washing, not wearing shoes and many more others are potential roots for child morbidity and infection (Stoltzfus & Klemm, 2017). Strunz et al., (2014) stated that helminthic infection control encompasses sanitation and hygiene, improving the quality of water supply as well as individual and mass treatment with anti-helminthic medication. At the district level, the proportion of rural households that depend on sachet water (64.0%) far outweighs their counterparts from the urban (61.5%) households (Nkwantanang-Madina, 2014). This means that the rural households, for lack of potable water are forced to spend more money on the water slightly more than their urban counterparts. According to the district's medium-term (2014 to 2017) development plan report, a higher proportion of the rural households depend more on water truck (10.3%), bottled water (1.3%), boreholes (2.1%), wells (1.1%) and public standpipes (2.8%) as well as rainwater for their water sources (Nkwantanang-Madina, 2014).

However, the present study did not present any helminthic infection among the study children. This probably could be as a result of the majority of them that use sachet or bottled water as drinking water. According to Stevens et al., (2013), improved sanitation, quality drinking water

and handwashing practice have been demonstrated to improve the effectiveness of nutrition interventions targeted at promoting good health. The absence of helminthic infection in this present study can be ascribed to reasons from Strunz et al., (2014). In that study, they observed that using treated water was seen to associate with lower odds of contracting soil-transmitted helminths (Odds Ratio (OR) 0.46, 95.00 % CI 0.36 - 0.60). Again, it was observed that most parents dewormed their children regularly following the child survival programmes instituted by the Ghana Health Services. Also, parents often gave their children sachet water, sometimes bottled water to drink. It was also evident that the parents always washed their hands each time they wanted to feed their children food. These practices to a large extent may have accounted for the absence of helminthic infections among the study children.

Said et al., (2017) in Dar'es Salaam, Tanzania reported helminthic infestation among pre-school-aged children of 16.0%. The median age of their study group was 26 months old which exceeded the upper age limit of this present study. This may have accounted for the high prevalence reported. One can infer that as children are growing, the maternal care or parental care reduces and the children become prone to infectious diseases as a result of continual playing in the soil where they end up picking up soil-transmitted helminths. This behaviour exposes children more to infections. STH causes significant morbidity in children. Studies show that infections from parasites contribute significantly to growth faltering in children through the vicious cycle of diarrhoea, reduced food intake, mal-absorption and increased nutrient losses (Erismann et al., 2017). Helminth's infestation can also lead to childhood anaemia; however, regular deworming to eliminate such organisms in children improves the overall well-being of children (GSS/GHS/ICF, 2015).

5.9 Limitations

Dietary intake relied on the ability of the mothers to recall, which might have resulted in alteration and errors in their diet. A repeated measure may need to be carried out since the 24-hour dietary recall for the dietary diversity may indicate only the present feeding. Another weakness of the study is that inflammation was not taken into account during the study. Inflammation could have serious ramifications on the haemoglobin levels as it may lead to disturbances in iron homeostasis thereby lead to anaemia. The sample size in the current study was also not a nationally representative sample and this could explain the fundamental disparities in the current finding and that of earlier studies.



CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

Based on the objectives of the study and the results that were obtained, the following conclusions were drawn:

1. The overall anaemia prevalence among participants was 85.1%. The mean Hb levels was 9.33 g/ dl.
2. Receiving colostrum, not giving child something else to eat or drink before feeding child breastmilk during the first three days after delivery, starting CF before the 6th month, eating foods made from vitamin A-rich dark green leafy vegetables, not eating foods made from oil, fat, or butter and the number of times a child eats solids, semi-solids, or soft foods during the day or at night all positively affected the haemoglobin levels.
3. Socio-demographic factors such as children whose mothers were not employed, were artisans, selling goods and were full time salary workers increased the risk of anaemia.
4. The prevalence of stunting (9.0%), wasting (8.2%) and underweight (10.1%) among the study participants were relatively low.
5. In this study, none of the variables tested predicted stunting or underweight. Wasting was predicted by factors such as part time wage labour, sex of child, initiation of BF after 1 hour, BF duration <12 months and household salt used.
6. The results showed that a small proportion of the children were infected with malaria (1.5%). However, there were no visible helminths seen in the stool samples that were tested.

7. The study revealed that most meals that were served to the children at home were mostly cereal-based. About 50.0% of the study participants did not meet the minimum dietary diversity.



6.2 Recommendations

Following the high anaemia prevalence and undernutrition observed in the current work, the following have been recommended to aid in curtailing the problem.

- Education regarding complementary foods implementation and exclusive breastfeeding should be stepped up at the community level.
- It is also recommended that a wider and in-depth study be undertaken to throw more light on causes and factors that impact anaemia among most children under 2 years in Ghana.
- For an effective health education programme on complementary foods, there is a need for further studies regarding the quantity and quality of foods given to children.
- Health personnel should expound to mothers the meaning of exclusive breastfeeding and inspire them to exclusively breastfeed for 6 months before introducing the children to water and complementary foods. This can be done during community durbars and at antennal and child welfare clinics.
- The study revealed that most meals that were served to the children at home were mainly cereal-based. Thus, mothers of children under 2 years should be encouraged to practice dietary diversity by including more green leafy vegetables, dairy products and organ meats in their children's meals, to help increase the nutrient quality of their diet.
- Further research should explore the full spectrum of the etiologies of anaemia among children 6 to 23 months of age residing in peri-urban areas.



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APPENDICES

Appendix I: Study questionnaire

QUESTIONNAIRE ON INFANT FEEDING KNOWLEDGE AND PRACTICES

SECTION A: PARENTS SOCIO-DEMOGRAPHIC STATUS

1. Date of interview.....
2. Serial number.....
3. What is the age of the mother?
A. ≤ 19 [] B. 20-24 [] C. 25-29 [] D. 30-34 [] E. ≥ 35 []
4. What type of family system is the mother engaged in?
A. Nuclear [] B. Joint []
5. What is the mother's educational status?
A. Primary school [] B. Middle school [] C. Secondary/Vocational school [] D. Tertiary [] E. None []
6. What type of work does the mother do?
A. Not employed B. Retired C. Part-time wage lab
D. Full-time salary, E. Selling goods F. Casual labour
G. Farming (subsistence) H. Farming (commercial) I. Full-time student
J. Artisan K. Driver L. Other (specify)
7. How many children do you have?
One [] Two [] More than two []

SECTION B: CHILD'S DEMOGRAPHY

8. Name of child.....
9. Serial number.....
10. Age of the child (in completed months).....
11. Sex of child
A. Male [] B. Female []
12. Where did you deliver this child?
A. Primary health centre [] B. Private hospital [] C. Public hospital []

D. Home []

SECTION C: KNOWLEDGE OF MOTHERS ON COMPLEMENTARY FEEDING

13. In your own opinion which age do you think it is appropriate to start complementary feeding?

14. How many times do you think a baby under 1 year should be fed?

- A. Once [] B. Twice [] C. Thrice [] D. 4-5times []

- E. 6-10times [] F. > 10 times [] G. As often as child requests

15. Which food groups would you recommend to be used for complementary feeding per day?

Food groups	Tick where applicable (could be more than one)
Grains, roots and tubers	
Legumes and nuts	
Dairy product (milk,yoghurt,cheese)	
Vegetables	
Fruits	
Meat/fish/Egg	
A small amount of butter/oil	

16. Are there some foods you think should not be given to children who are on complementary feeding?

17. What is your reason for Q17?

.....

.....

.....

SECTION D: BREASTFEEDING AND COMPLEMENTARY FEEDING PRACTICES

18. Did you ever breastfeed (CHILD)?

- A. Yes B. No

19. How long after birth did you first put (NAME) to the breast?

- A. Within the first one hour B. after an hour C. after 1 day D. after 1 week
E. after 1 month

20. During the first three days after delivery, did you give (NAME) the liquid that came from your breasts?

- A. Yes B. No

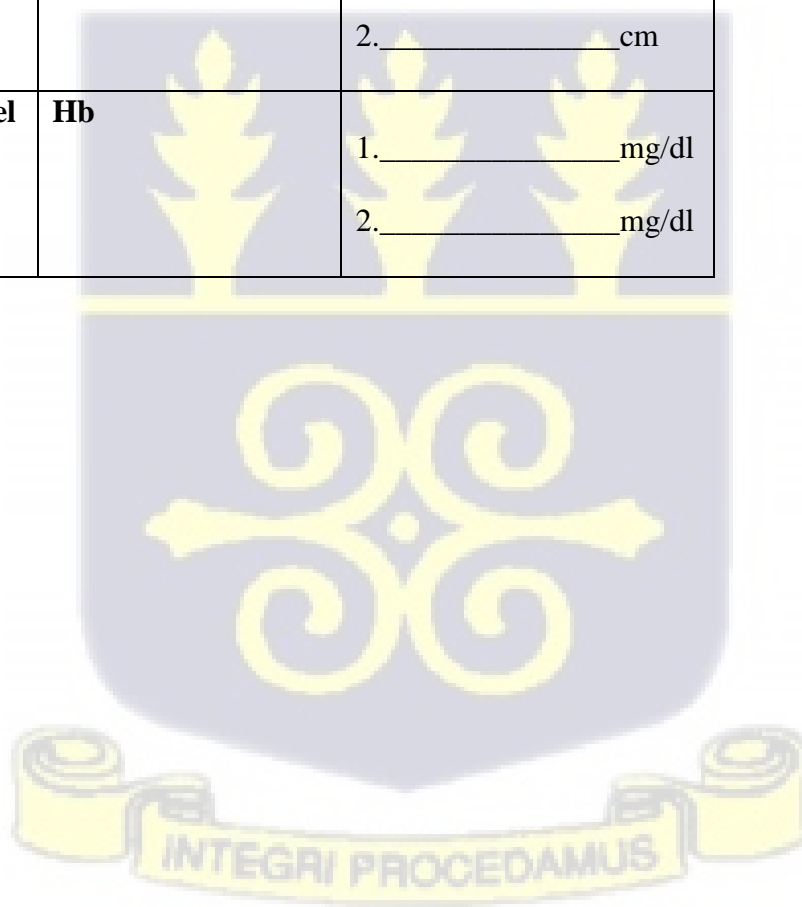
21. During the first three days after delivery, did you give (NAME) anything else to eat or drink before feeding him/her breastmilk?

- A. Yes B. No
22. If yes what did you give (NAME)? (Please circle all that apply)
A. Milk B. Plain water C. Water with sugar/salt D. Fruit juice
E. Tea/Porridge F. Honey G. Infant formula. Other (Please specify).....
23. Are you currently breastfeeding (NAME)?
A. Yes B. No
24. How long do you intend to breastfeed (Name)?
A. 1 year B. 2 years C. > 2 years D. other (please specify).....
25. At which month, did you start complementary feeding with (NAME)?
A. < 6 months B. At 6 months C. > 6 months
26. If mother did not start at the 6th month, what was the reason for the delay?
A. Did not know exactly when to start
B. Mother feels that the breast milk is enough for the child
C. Advice from family elders not to give food before one year
D. Mother feel child may not be able to digest food
E. Mother did not try as child had no teeth
27. Did (NAME) drink any of the following liquids yesterday during the day or at night? (Please circle all that apply)
A. Breast milk B. Plain water C. Infant formula D. Any other Milk E. Fruit juice
F. Coffee or tea G. Any other liquids H. Liquid traditional medicine
28. Did (NAME) drink anything from a bottle with a nipple yesterday during the day or at night?
A. Yes B. No
29. Did (NAME) eat any of the following foods yesterday during the day or at night? (Please circle all that apply)
A. Foods made from grain, roots or tubers (rice, banku, koko, yam, cassava, potato)
B. Legumes and nuts (beans, Groundnuts/peanuts, or any other nuts)
C. Dairy products (milk, Cheese or yogurt)
D. Flesh foods (Beef, pork, lamb, goat, rabbit, Chicken, duck, Fresh or dried fish or shellfish, Crabs, snails, Organ meats (liver, kidney))
E. Eggs
D. Vitamin A rich fruits and Dark green leafy vegetables (ayoyo, ademe, kontomre)
F. Other Fruits (orange, ripe mango, pawpaw, water melon)
G. Other Vegetables (Carrots, cabbage, garden eggs)
H. Food made with oil, fat, or butter, red palm oil, palm nut pulp/sauce
30. How many times did (NAME) eat solid/semi-solids, or soft foods yesterday during the day and at night?
A. Once [] B. Twice [] C. Thrice [] D. 4-5times []
E. 6-10times [] F. > 10 times []
31. May I see the salt that is used for cooking?
A. Iodized salt [] B. Ordinary salt []
32. Did (NAME) receive a vitamin A dose... in last 6 months
A. Yes B. No

THANK YOU

ANTHROPOMETRIC AND BIOCHEMICAL DATA

Measurement	Code	Readings
Weight	WT	1. _____ kg 2. _____ kg
Recumbent Length	LT	1. _____ m 2. _____ m
Mid Upper Arm Circumference	MUAC	1. _____ cm 2. _____ cm
Haemoglobin level	Hb	1. _____ mg/dl 2. _____ mg/dl



Appendix II: Consent form

CONSENT FORM

Title: *Efficacy of a complementary food on the nutritional status of children between 7-24 months of age*

Principal Investigator: Prof. Matilda Steiner-Asiedu

Address: Department of Nutrition and Food Science, Box LG 134, University of Ghana, Legon

Email: tillysteiner@gmail.com

General Information about Research

The purpose of this study is to quantify the effect of a complementary food on the nutritional status of Children between ages 7 to 24 months of age in a 6 month intervention study in the Ga East District of the Greater Accra Region. If you agree to participate in this research study, you will be asked some few questions about your knowledge on complementary feeding and some associated practices. Your child's food intake and also his/her hemoglobin level, weight, length and mid upper arm circumference (MUAC) measurements will be taken at 0, 2, 4 and 6 months. We will contact you 2 months after the intervention to repeat these measurements so as to see how your child is doing after the 6 months intervention period.

Possible Risks and Discomforts

There are no known risks associated with your participation in this study. The inconvenience you may experience is the time you would have to dedicate to complete the questionnaires.

Possible Benefits

Information gathered from this study will help inform educational campaigns and policies on infant feeding in your community and the Nation at large. Also your child's nutritional status will be improved

Confidentiality

Any information obtained from you will be kept strictly confidential. Your consent form will be kept separate from the data and the data will not be available to anyone other than the researchers. The information obtained may be used in presentations and/or research papers; however, your name will never be used. You should also know that the Ethics Committee of the Nugochi Memorial Research Institute may inspect study records as part of its auditing program, but these reviews will only focus on the researchers and not on participant responses or involvement. The Internal Review Board (IRB) for the Nugochi Memorial Research Institute is a group of people who reviews research studies to make sure they are safe for participants.

Compensation

You will receive one medium sized bucket at the end of this study as a token of appreciation for your participation.

Additional Cost

Your participation in this study will be at no cost to you.

Voluntary Participation and Right to Leave the Research

Your participation in this study is not compulsory. You are free to stop at any point in time if you so wish. You will not be penalized for withdrawing.

Contacts for Additional Information

We will be happy to answer any questions you may have about this study. If you have further questions or concerns related to your participation in this study, or if you have a research-related problem, you may contact the Principal Investigator of the study at the University of Ghana-

Legon, Prof. Matilda Steiner-Asiedu by telephone at 0541260704 or by email at tillysteiner@gmail.com).

Your rights as a Participant

This research has been reviewed and approved by the Institutional Review Board of Noguchi Memorial Institute for Medical Research (NMIMR-IRB). If you have any questions about your rights as a research participant you can contact the IRB Office between the hours of 8am-5pm through the landline 0302916438 or email addresses: nirb@noguchi.mimcom.org



VOLUNTEER AGREEMENT

The above document describing the benefits, risks and procedures for the research title (*Efficacy of a complementary food on the nutritional status of children between 7-24 months of age*) has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate as a volunteer.

_____ Date _____ Name and signature or mark of volunteer

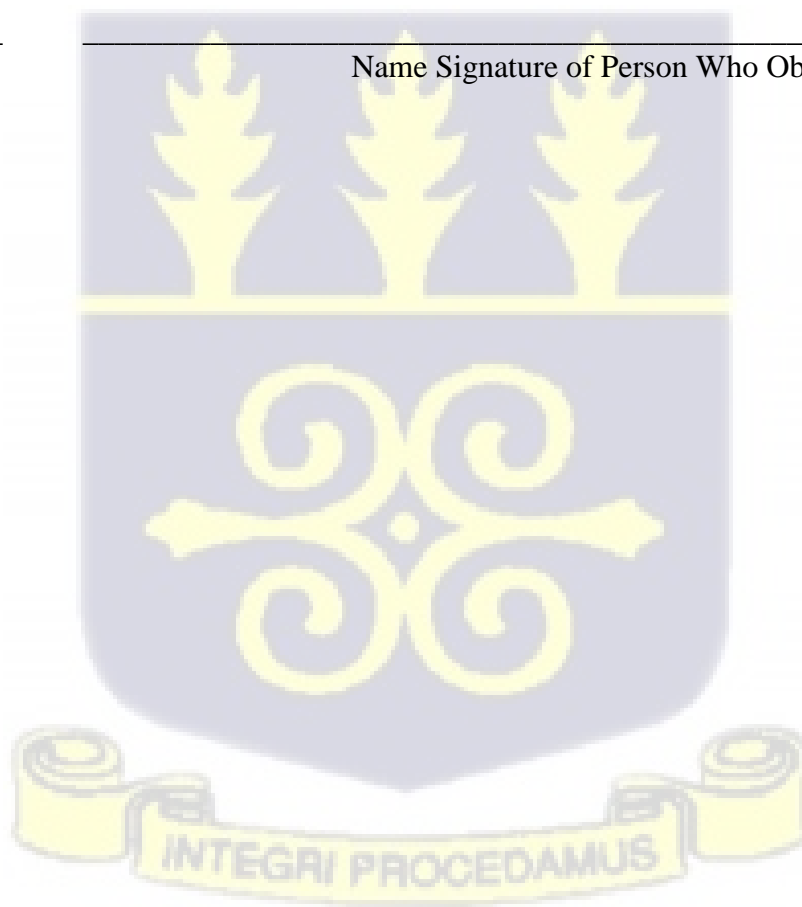
If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

_____ Date _____ Name and signature of witness

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

_____ Date _____ Name Signature of Person Who Obtained Consent



Appendix III: Sample confirmatory results for worm infestation

STOOL ROUTINE EXAMINATION RESULTS

<u>SAMPLE ID</u>	<u>MACROSCOPY</u>	<u>MICROSCOPY</u>	<u>HELMINTHS</u>
D04F0	Semi-formed specimen	Yeast cells (+3) seen,	not seen
D13F0	Formed specimen	NAD	not seen
D22F0	Loosed specimen	Yeast cells (+1) seen	not seen
D15F0	Loosed, mucoid specimen	NAD	not seen
D12F0	Semi-formed specimen	NAD	not seen
D45F0	Loosed specimen	NAD	not seen
D28F0	Loosed specimen	NAD	not seen
D09F0	Semi-formed specimen	Yeast cells (+4) seen	not seen
D02F0	Loosed specimen	Yeast cells (+4) seen,	not seen
D14F0	Loosed, mucoid specimen	NAD	not seen
K24F0	Semi-formed specimen	NAD	not seen
D25F0	Semi-formed specimen	NAD	not seen
D05F0	Loosed, mucoid specimen	Yeast cells (+4) seen	not seen
D36F0	Semi-formed specimen	NAD	not seen
D034	Semi-formed specimen	NAD	not seen
D23F0	Loosed specimen	NAD	not seen
D37F0	Loosed, mucoid specimen	Yeast cells (+3) seen,	not seen
D11F0	Loosed, mucoid specimen	Yeast cells (+2) seen,	not seen
D30F0	Loosed specimen	NAD	not seen
D29F0	Loosed specimen	Yeast cells (+3) seen,	not seen
D06F0	Loosed, mucoid specimen	Yeast cells (+3) seen,	not seen
K22F0	Semi-formed specimen	NAD	not seen
OT15F0	Loosed, mucoid specimen	Yeast cells (+1) seen,	not seen
OT09F0	Semi-formed specimen	Yeast cells (+4) seen,	not seen
K001F0	Loosed, mucoid specimen	Yeast cells (+3) seen,	not seen
OT12F0	Loosed specimen	NAD	not seen
K13F0	Formed specimen	NAD	not seen
K05F0	Loosed specimen	Yeast cells (+1) seen,	not seen
K15F0	Semi-formed specimen	NAD	not seen
A08F0	Loosed specimen	Yeast cells (+1) seen,	not seen
AY05F0	Formed specimen	NAD	not seen
K10F0	Loose, mucoid specimen	NAD	not seen
OT21F0	Loose, mucoid specimen	Yeast cells (+1) seen,	not seen
OT04F0	Loose, mucoid specimen	Yeast cells (+3) seen,	not seen
DANFA	Semi-formed specimen	NAD	not seen
A08F0	Loosed specimen	NAD	not seen
K003F0	Formed specimen	NAD	not seen
K07F0	Loose, mucoid specimen	Yeast cells (+1) seen,	not seen
OT14F0	Loose, mucoid specimen	NAD	not seen
OT02F0	Semi-formed specimen	NAD	not seen
K16F0	Semi-formed specimen	NAD	not seen

OT13F0	Loose, mucoid specimen	NAD	not seen
D27F0	Loose, mucoid specimen	NAD	not seen
D26F0	Loose, mucoid specimen	NAD	not seen
D31F0	Semi-formed specimen	NAD	not seen
OT19F0	Formed specimen	Yeast cells (+2) seen	not seen
OT35F0	Loose, mucoid specimen	NAD	not seen
OT06F0	Formed specimen	NAD	not seen
OT16F0	Formed specimen	NAD	not seen
OT22F0	Formed specimen	NAD	not seen
OT54F0	Loose, mucoid specimen	Yeast cells (+3) seen	not seen
OT28F0	Semi-formed specimen	NAD	not seen
OT47F0	Loose, mucoid specimen	NAD	not seen
OT24F0	Semi-formed specimen	Yeast cells (+) seen	not seen
OT49F0	Loose, mucoid specimen	NAD	not seen
OT44F0	Semi-formed specimen	Yeast cells (+2) seen	not seen
OT18F0	Loose, mucoid specimen	NAD	not seen
OT40F0	Loosed specimen	NAD	not seen
OT42F0	Formed specimen	NAD	not seen
OT36F0	Semi-formed specimen	Yeast cells (+) seen	not seen
OT43F0	Semi-formed specimen	Yeast cells (+2) seen	not seen
OT51F0	Semi-formed specimen	NAD	not seen
OT34F0	Semi-formed specimen	NAD	not seen
OT10F0	Formed specimen	NAD	not seen
OT56F0	Semi-formed specimen	Yeast cells (+) seen	not seen
OT26F0	Formed specimen	NAD	not seen
OT31F0	Formed specimen	NAD	not seen
OT37F0	Loose, mucoid specimen	NAD	not seen
OT07F0	Loose, mucoid specimen	NAD	not seen
OT27F0	Loosed specimen	NAD	not seen
AY07F0	Formed specimen	NAD	not seen
AY18F0	Formed specimen	NAD	not seen
AY19F0	Formed specimen	Yeast cells (+) seen	not seen
R11F0	Loosed specimen	NAD	not seen
OT79F0	Semi-formed specimen	NAD	not seen
AY24F0	Semi-formed specimen	NAD	not seen
K20F0	Loosed specimen	NAD	not seen
K23F0	Loose, mucoid specimen	NAD	not seen
OT72F0	Formed specimen	NAD	not seen
OT45F0	Loose, mucoid specimen	NAD	not seen
AY21F0	Semi-formed specimen	NAD	not seen
K28F0	Loose, mucoid specimen	Yeast cells (+2) seen	not seen
K2F0	Formed specimen	NAD	not seen
OT67F0	Formed specimen	NAD	not seen
OT48F0	Loose, mucoid specimen	NAD	not seen
AY01F0	Loose, mucoid specimen	NAD	not seen
AY23F0	Loose, mucoid specimen	NAD	not seen
AY03F0	Loose, mucoid specimen	NAD	not seen

Appendix IV: Sample confirmatory results for malaria

MALARIA CONFIRMATORY RESULTS

DATE	ID	P. COUNT	TWBCC	P. SPECIES	COMMENT
8/8/2016	K22FO	0	0	0	NEGATIVE
8/8/2016	K01FO	0	0	0	NEGATIVE
8/8/2016	K21FO	0	0	0	NEGATIVE
8/8/2016	K20FO	0	0	0	NEGATIVE
8/8/2016	K16FO	0	0	0	NEGATIVE
8/8/2016	K16FO	0	0	0	NEGATIVE
8/8/2016	K13FO	0	0	0	NEGATIVE
8/8/2016	K12FO	0	0	0	NEGATIVE
8/8/2016	K11FO	0	0	0	NEGATIVE
8/8/2016	K10FO	0	0	0	NEGATIVE
8/8/2016	K06FO	0	0	0	NEGATIVE
8/8/2016	K08FO	0	0	0	NEGATIVE
8/8/2016	K05FO	0	0	0	NEGATIVE
8/8/2016	K04FO	0	0	0	NEGATIVE
8/8/2016	K03FO	0	0	0	NEGATIVE
8/8/2016	K02FO	0	0	0	NEGATIVE
8/8/2016	OT03FO	0	0	0	NEGATIVE
8/8/2016	OT02FO	0	0	0	NEGATIVE
9/8/2016	OT01FO	0	0	0	NEGATIVE
8/8/2016	K26FO	0	0	0	NEGATIVE
8/8/2016	K25FO	0	0	0	NEGATIVE
8/8/2016	K24FO	0	0	0	NEGATIVE
8/8/2016	K23FO	0	0	0	NEGATIVE
9/8/2016	OT04FO	0	0	0	NEGATIVE
9/8/2016	OT06FO	0	0	0	NEGATIVE
9/8/2016	OT07FO	0	0	0	NEGATIVE
9/8/2016	OT08FO	0	0	0	NEGATIVE
9/8/2016	OT09FO	0	0	0	NEGATIVE
9/8/2016	OT10FO	0	0	0	NEGATIVE
9/8/2016	OT12FO	0	0	0	NEGATIVE
9/8/2016	OT13FO	0	0	0	NEGATIVE
9/8/2016	OT14FO	0	0	0	NEGATIVE
9/8/2016	OT15FO	0	0	0	NEGATIVE
9/8/2016	OT16FO	0	0	0	NEGATIVE
9/8/2016	OT18FO	0	0	0	NEGATIVE
9/8/2016	OT19FO	0	0	0	NEGATIVE
9/8/2016	OT20FO	0	0	0	NEGATIVE
9/8/2016	OT21FO	0	0	0	NEGATIVE
9/8/2016	OT22FO	0	0	0	NEGATIVE
9/8/2016	OT23FO	0	0	0	NEGATIVE

10/8/2016	D30FO	0	0	0	NEGATIVE
10/8/2016	D15FO	0	0	0	NEGATIVE
10/8/2016	D14FO	0	0	0	NEGATIVE
10/8/2016	D13FO	0	0	0	NEGATIVE
10/8/2016	D16FO	0	0	0	NEGATIVE
10/8/2016	D11FO	0	0	0	NEGATIVE
10/8/2016	D09FO	0	0	0	NEGATIVE
10/8/2016	D10FO	0	0	0	NEGATIVE
10/8/2016	D32FO	0	0	0	NEGATIVE
10/8/2016	D33FO	0	0	0	NEGATIVE
10/8/2016	D34FO	0	0	0	NEGATIVE
10/8/2016	D36FO	0	0	0	NEGATIVE
10/8/2016	D37FO	0	0	0	NEGATIVE
10/8/2016	D38FO	0	0	0	NEGATIVE
10/8/2016	D40FO	0	0	0	NEGATIVE
10/8/2016	D08FO	0	0	0	NEGATIVE
10/8/2016	D40FO	0	0	0	NEGATIVE
10/8/2016	D02FO	0	0	0	NEGATIVE
10/8/2016	D04FO	0	0	0	NEGATIVE
10/8/2016	D05FO	0	0	0	NEGATIVE
10/8/2016	D07FO	0	0	0	NEGATIVE
10/8/2016	D13FO	0	0	0	NEGATIVE
10/8/2016	D01FO	0	0	0	NEGATIVE
10/8/2016	D47FO	0	0	0	NEGATIVE
10/8/2016	D17FO	0	0	0	NEGATIVE
10/8/2016	D19FO	0	0	0	NEGATIVE
10/8/2016	D44FO	0	0	0	NEGATIVE
10/8/2016	D27FO	0	0	0	NEGATIVE
10/8/2016	D26FO	0	0	0	NEGATIVE
10/8/2016	D25FO	0	0	0	NEGATIVE
10/8/2016	D24FO	0	0	0	NEGATIVE
10/8/2016	D23FO	0	0	0	NEGATIVE
10/8/2016	D21FO	0	0	0	NEGATIVE
10/8/2016	D20FO	0	0	0	NEGATIVE
16/8/2016	K28FO	0	0	0	NEGATIVE
16/8/2016	K27FO	0	0	0	NEGATIVE
16/8/2016	K26FO	0	0	0	NEGATIVE
16/8/2016	K25FO	0	0	0	NEGATIVE
9/8/2016	OT74FO	0	0	0	NEGATIVE
11/8/2016	AY22FO	0	0	0	NEGATIVE
19/8/2016	OT73FO	0	0	0	NEGATIVE
11/8/2016	AY11FO	0	0	0	NEGATIVE
11/8/2016	AY07FO	0	0	0	NEGATIVE
11/8/2016	AY10FO	0	0	0	NEGATIVE
11/8/2016	AY13FO	0	0	0	NEGATIVE

11/8/2016	AY12FO	0	0	0	NEGATIVE
11/8/2016	AY02FO	0	0	0	NEGATIVE
11/8/2016	AY14FO	0	0	0	NEGATIVE
11/8/2016	AY15FO	0	0	0	NEGATIVE
11/8/2016	AY01FO	0	0	0	NEGATIVE
11/8/2016	AY05FO	0	0	0	NEGATIVE
11/8/2016	AY03FO	0	0	0	NEGATIVE
11/8/2016	AY04FO	0	0	0	NEGATIVE
11/8/2016	AY09FO	0	0	0	NEGATIVE
19/8/2016	OT75FO	0	0	0	NEGATIVE
19/8/2016	OT76FO	0	0	0	NEGATIVE
19/8/2016	OT77FO	0	0	0	NEGATIVE
19/8/2016	OT63FO	0	0	0	NEGATIVE
19/8/2016	OT72FO	0	0	0	NEGATIVE
11/8/2016	AY24FO	0	0	0	NEGATIVE
11/8/2016	AY23FO	0	0	0	NEGATIVE
11/8/2016	AY21FO	0	0	0	NEGATIVE
11/8/2016	AY08FO	0	0	0	NEGATIVE
11/8/2016	AY20FO	0	0	0	NEGATIVE
11/8/2016	AY19FO	0	0	0	NEGATIVE
11/8/2016	AY18FO	0	0	0	NEGATIVE
11/8/2016	AY17FO	0	0	0	NEGATIVE
11/8/2016	AY16FO	0	0	0	NEGATIVE
15/8/2016	OT26FO	0	0	0	NEGATIVE
15/8/2016	OT68FO	0	0	0	NEGATIVE
15/8/2016	OT67FO	0	0	0	NEGATIVE
12/8/2016	OT25FO	0	0	0	NEGATIVE
15/8/2016	OT66FO	0	0	0	NEGATIVE
15/8/2016	OT65FO	0	0	0	NEGATIVE
12/8/2016	OT28FO	0	0	0	NEGATIVE
12/8/2016	OT29FO	0	0	0	NEGATIVE
12/8/2016	OT36FO	0	0	0	NEGATIVE
12/8/2016	OT48FO	0	0	0	NEGATIVE
12/8/2016	OT30FO	0	0	0	NEGATIVE
15/8/2016	OT69FO	0	0	0	NEGATIVE
12/8/2016	OT27FO	0	0	0	NEGATIVE
12/8/2016	OT38FO	0	0	0	NEGATIVE
12/8/2016	OT35FO	0	0	0	NEGATIVE
12/8/2016	OT34FO	0	0	0	NEGATIVE
12/8/2016	OT50FO	0	0	0	NEGATIVE
12/8/2016	OT58FO	0	0	0	NEGATIVE
12/8/2016	OT56FO	0	0	0	NEGATIVE
12/8/2016	OT55FO	0	0	0	NEGATIVE
12/8/2016	OT54FO	0	0	0	NEGATIVE
12/8/2016	OT53FO	0	0	0	NEGATIVE

12/8/2016	OT52FO	0	0	0	NEGATIVE
12/8/2016	OT51FO	0	0	0	NEGATIVE
12/8/2016	OT43FO	0	0	0	NEGATIVE
12/8/2016	OT44FO	0	0	0	NEGATIVE
12/8/2016	OT45FO	0	0	0	NEGATIVE
12/8/2016	OT46FO	0	0	0	NEGATIVE
12/8/2016	OT47FO	0	0	0	NEGATIVE
15/8/2016	OT70FO	0	0	0	NEGATIVE
12/8/2016	OT42FO	0	0	0	NEGATIVE
12/8/2016	OT40FO	0	0	0	NEGATIVE
12/8/2016	OT41FO	0	0	0	NEGATIVE
12/8/2016	OT39FO	0	0	0	NEGATIVE
12/8/2016	OT37FO	0	0	0	NEGATIVE
12/8/2016	OT49FO	0	0	0	NEGATIVE
12/8/2016	OT24FO	0	0	0	NEGATIVE
15/8/2016	OT71FO	0	0	0	NEGATIVE
12/8/2016	OT32FO	0	0	0	NEGATIVE
12/8/2016	OT31FO	0	0	0	NEGATIVE
12/8/2016	OT33FO	0	0	0	NEGATIVE
15/8/2016	OT60FO	0	0	0	NEGATIVE
15/8/2016	OT61FO	0	0	0	NEGATIVE
15/8/2016	OT62FO	0	0	0	NEGATIVE
15/8/2016	OT63FO	0	0	0	NEGATIVE
15/8/2016	OT64FO	0	0	0	NEGATIVE
25/8/2016	OT102FO	0	0	0	NEGATIVE
25/8/2016	OT103FO	0	0	0	NEGATIVE
25/8/2016	OT99FO	0	0	0	NEGATIVE
25/8/2016	OT101FO	0	0	0	NEGATIVE
25/8/2016	OT100FO	0	0	0	NEGATIVE
24/8/2016	OT97FO	0	0	0	NEGATIVE
23/8/2016	OT82FO	0	0	0	NEGATIVE
24/8/2016	OT98FO	0	0	0	NEGATIVE
23/8/2016	OT81FO	0	0	0	NEGATIVE
25/8/2016	OT96FO	0	0	0	NEGATIVE
25/8/2016	OT80FO	0	0	0	NEGATIVE
23/8/2016	OT87FO	0	0	0	NEGATIVE
25/8/2016	OT94FO	0	0	0	NEGATIVE
	OT90FO	0	0	0	NEGATIVE
22/8/2016	OT79FO	0	0	0	NEGATIVE
25/8/2016	OT95FO	0	0	0	NEGATIVE
23/8/2016	OT88FO	0	0	0	NEGATIVE
22/8/2016	OT78FO	0	0	0	NEGATIVE
	OT92FO	0	0	0	NEGATIVE
23/8/2016	OT89FO	0	0	0	NEGATIVE
	OT91FO	0	0	0	NEGATIVE

23/8/2016	OT85FO	0	0	0	NEGATIVE
23/8/2016	OT83FO	0	0	0	NEGATIVE
23/8/2016	OT86FO	0	0	0	NEGATIVE
23/8/2016	OT84FO	0	0	0	NEGATIVE
		0	0	0	NEGATIVE
26/82016	D50FO	0	0	0	NEGATIVE
26/82016	D49FO	0	0	0	NEGATIVE
26/82016	D48FO	0	0	0	NEGATIVE
26/82016	D47FO	0	0	0	NEGATIVE
26/82016	D46FO	0	0	0	NEGATIVE



Appendix V: Sample ethical approval letter

NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH
Established 1979 *A Constituent of the College of Health Sciences*
University of Ghana

INSTITUTIONAL REVIEW BOARD

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Post Office Box LG 581
Legon, Accra
Ghana

My Ref. No: DF.22
Your Ref. No:

4th January, 2017

ETHICAL CLEARANCE

FEDERALWIDE ASSURANCE FWA 00001824

IRB 00001276

NMIMR-IRB CPN 031/15-16 revd. 2017

IORG 0000908

On 4th January, 2017, the Noguchi Memorial Institute for Medical Research (NMIMR) Institutional Review Board (IRB) at a full board meeting conducted continuing review and renewed your protocol titled:

TITLE OF PROTOCOL : **The efficacy of complementary food on nutritional status of children between 7 to 24 months of age in a 6 month intervention study in the Ga East District of the Greater Accra Region**

PRINCIPAL INVESTIGATOR : **Prof. Matilda Steiner Asiedu**

Please note that a final review report must be submitted to the Board at the completion of the study. Your research records may be audited at any time during or after the implementation.

Any modification of this research project must be submitted to the IRB for review and approval prior to implementation.

Please report all serious adverse events related to this study to NMIMR-IRB within seven days verbally and fourteen days in writing.

This certificate is valid till 3rd January, 2018. You are to submit annual reports for continuing review.

Signature of Chair:
Mrs. Chris Dadzie
(NMIMR – IRB, Chair)