MAKERERE UNIVERSITY

COLLEGE OF AGRICULTURAL AND ENVIROMENTAL SCIENCES

SCHOOL OF FOOD TECHNOLOGY, NUTRITION AND BIO ENGINEERING

ANAEMIA STATUS IN CHILDREN AGED 6-59 MONTHS ATTENDING HOIMA REGIONAL REFERRAL HOSPITAL

BY

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BSC. HUMAN NUTRITION

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THIS PROJECT REPORT IS SUBMITTED TO THE SCHOOL OF FOOD TECHNOLOGY, NUTRITION AND BIO ENGINEERING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A BACHELOR'S DEGREE OF SCIENCE IN HUMAN NUTRITION OF MAKERERE UNIVERSITY

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DECLARATION

I hereby declare that this dissertation is my original work with the assistance of my supervisor and to my knowledge it has not been submitted to any other institution of higher learning.

.... 17/3/2022 ....

MUGANYIZI WILSON **Date**

This dissertation has been approved by the university supervisor:

.... 17/3/2022 ....

DR. GASTON A. TUMUHIMBISE Date

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DEDICATION

To my parent, Miss Margret Kabadaaki, my wife Basemera Joseline and my children; Kebirungi Shillar, Ahumuza Wilson and Kebirungi Esther.

ACKNOWLEDGEMENT

I thank God for the knowledge, protection and spiritual guidance provided in doing this research.

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DEFINITION OF TERMS

Anaemia	**:**	Hemoglobin concentration below cut-off levels depending on age, sex, and physiological status.
Anthropometric indices	**:**	These are calculated from anthropometric measurements of weight, height, and age.
Bioavailability	**:**	Refers to the degree to which iron is available for absorption in the gut and utilized for normal metabolic functions.
Iron Deficiency Anaemia	**:**	An advanced stage of iron depletion defined as iron deficiency (Hb<11.0g/dl).
Iron deficiency	**:**	A state of insufficient iron to maintain normal physiological functions of tissues.
Nutritional status	**:**	The condition of the health of a person that is influenced by the intake and utilization of nutrients. Normal nutritional status implies balanced food intake and normal utilization of nutrients.
Stunting	**:**	When young children have a low height for their age.
Underweight	**:**	When children are too light for their age.
Wasting	**:**	When children have a low weight for their height.

ABSTRACT

Background: Anaemia is one of the major causes of death among children under five years in Africa, with a prevalence of 64.6% among pre-school children. This study was conducted in Hoima Regional Referral Hospital in mid-western Uganda to determine the prevalence and risk factors associated with anaemia among children aged 6 to 59 months.

Methods: A total of 100 children aged between 6 to 59 months were enrolled. Venous blood samples were collected by finger or heel prick to estimate the haemoglobin level using a haemocue analyser. Anthropometric data including age, weight and height was collected for each child. A structured questionnaire was administered to the mother or an adult caregiver to collect household data. Ethical approval was sought and granted from the hospital director. Anaemia cut-off points were defined according to World Health Organization (WHO) standards for children aged 6–59 months.

Data was analyzed using GENSTAT computer package. All correlations were run to assess how all the variables relate over time. Descriptive summary statistics such as frequencies, means, medians and standard deviations were used to describe the characteristics of the study population .Inferential statistics such as odds ratio, confidence interval, and p-value were used to determine association between variables.

Results: The prevalence of anaemia was high (83.0%) and was highest among children aged 37 to 59 months (100%) and females (92.3%).females were 1.3 times more prevalent than their male counterparts. Children aged 37 to 59 and 25 to 36 months were more likely to be anaemic poverty, lack of access to cheap food, lack of cooking skills and equipment, comprised maternal level of education, poor dietary diversity, anti-nutrient intake, child birth order, maternal parity, mother's age, child's age, and other infections like malaria among others were significantly associated with anaemia. Young mothers generally have challenges with child care due to limited resources and experience with child care and their children were more susceptible to anaemia thus poorer health outcomes than those children from older and more experienced mother.

Conclusion: Anaemia is highly prevalent among children and there is need to invest in measures such as promoting maternal health, providing mothers with information about anaemia and a balanced diet, routine screening and management of anaemia may help in controlling anaemia incidence especially among children 37 to 59 months. Anaemia intervention programmes in children under five years should target younger and unemployed mothers as well as the intensification of maternal education on good dietary diversity for children.

Keywords: Anaemia, Prevalence, Children, Hoima Regional Referral Hospital, Uganda

CHAPTER ONE: INTRODUCTION

1.1 Background

It is estimated that aneamia prevalence is 47.4% (293 million) in preschool aged children globally (Mclean, 2005). According to world health organization (WHO), Africa has the highest prevalence of anaemia among children at 67.6 % (WHO Worldwide prevalence of anaemia 1993-2005).In Uganda anaemia among children under five years in 2011 was 56.2% (WHO Global anaemia and prevalence and trends 1995-2011).

Anaemia is a condition that develops when one's blood lacks enough red blood cells or heamoglobin. Heamoglobin is a pigment that binds oxygen. There are many causes of anaemia which are, Anaemia caused by blood loss, Anaemia caused by decreased or faulty red blood cells production, Anaemia caused by destruction of red blood cells (Arefacassobhoy, 2014).

Dietary factors like mineral and vitamin deficiencies also contribute to anaemia. An iron-poor diet especially in infants, children and vegetarians lead to anaemia. Iron in the bone marrow is used in the formation of heamoglobin, the part of red blood cells which transports oxygen to the body organs. Another mineral that can lead to iron deficiency anaemia is copper (Gropper, 2005).

Copper is an enzymatic factor of ceruloplasmin (ferroxydase) that is involved in iron metabolism during the haemoglobin synthesis. Vitamin deficiencies contribute to anaemia. These include vitamin A, folic acid, cyanocobalamine (B12), Pyridoxine and riboflavin. Poor vitamin A status has been associated with anaemia (Gamble & Semba, 2002)and vitamin supplementation has been shown to reduce prevalence of anaemia) (Semba, 2001).

Folic acid and cyanocoblamine deficiencies result in immature erythrocyte leading to macrocytic anaemia (Gropper 2005). Other factors include consumption of caffeinated beverages that hinder iron absorption and over cooking or eating too few vegetables which cause folate deficiency.

Anaemia is a significant public health problem that occurs worldwide in both developed and developing countries (Mclean, 2005).Infants under five years old have increased iron requirements due to rapid body growth and expansion of red blood cells. In children

Anaemia leads to low oxygenation of the brain tissue that leads to impaired cognitive function, poor growth and psychomotor development. Signs and symptoms of anaemia include palmer pallor, pallor of the mucus membrane, shortness of breath, dizziness, a fast heart rate and fatigue(child health 2^{nd} edition by paget stanfield Balldin and versluys).If the above dietary factors are addressed, morbidity and mortality rate among children can be reduced.

1.2 Problem statement

It is estimated that anaemia prevalence is 47.4%(UDHS 2016) in pre-school aged children and it affects one quarter of the world's population which is more concentrated in pre-school aged children, making it a global public health problem and also anaemia is one of the most common wide spread nutritional disorders in the world affecting industrialized and non-industrialized countries (Erin and Mclean 2005). According to World Health Organization (WHO), Africa has the highest prevalence of anaemia among pre-school children which is at 67.6 % (WHO, worldwide prevalence of anaemia in Uganda, anaemia 1993-2005).

In Uganda anaemia among children under five years in 2016 was 53% (UDHS, 2016).

It's therefore necessary to find out if there are dietary factors that contribute to anaemia among the under five children attending Hoima Regional Referral Hospital because the number of admissions due severe anaemia is increasing and the condition has attributed to the increase of mortality rate at the pediatric ward. There is no data pertaining the prevalence of anaemia among children under five years in Hoima as a district however anaemia cases have been found out in Western Uganda as a whole (The analysis of the Nutrition situation in Uganda FANTA May 2010).

1.3 Justification of the study

Anaemia is one of the largest killers of children admitted in hospitals in Sub- Sahara Africa. Even where blood transfusion is available there is significant case fatality rate of 6-18% (Simbauranga 2013). At Hoima Regional Referral Hospital, there are many cases of severe anaemia among children under five that get admitted and the results of this study will help determine if there are dietary case factors that contribute to the occurrence of the condition so that preventive measures can be sought.

1.4 Significance of the study

This study will provide information to the ministry of health that is necessary for developing strategies to improve nutrition among children in Uganda.

The study will also help other researchers in the same field to investigate more about anaemia and nutritional status of children under the age of five years.

It will also inform policy makers to make policies that focus on setting priorities to improve nutrition for children less than five years by increasing food production, food diversification and the use of micronutrient powders to reduce deficiency of micronutrients.

1.5 Research objectives

1.5.1 Main objective

The main objective of this study was to assess the prevalence of iron deficiency and the associated dietary factors in children aged 6-69 months attending Hoima Regional Referral Hospital.

1.5.2 Specific objectives

i. Assess the prevalence of anaemia among children attending Hoima Regional Referral Hospital
ii. To determine the nutrition status in children under five years attending Hoima Regional Referral Hospital
iii. To determine the food consumption patterns of children under five years
iv. To determine the breastfeeding and weaning practices of children under five years attending Hoima Regional Referral Hospital.

1.5.3 Research question

1. Is there an association between nutritional status and iron deficiency in children less than five years?
2. What food consumption patterns associated with iron deficiency in children less than five years?
3. What breastfeeding and weaning practices are significantly associated with iron deficiency in children less than five years attending Hoima Regional Referral Hospital?

CHAPTER TWO: LITERATURE REVIEW

2.1 Causes of iron deficiency

The Uganda Demographic and Health survey (UDHS) of 2011 reports that anemia is associated with impaired cognitive and motor development in children. Although there are many causes of anaemia, inadequate intake of iron folate, vitamin B12 or other nutrients usually account for a large proportion of anaemia in children under five years in malaria endemic areas. Other causes of anaemia include thalassemia, sickle cell disease, and intestinal worm infestation (UDHS, 2011).

A major etiological factor in iron deficiency is early introduction of cow's milk, which is very low in iron content. From the age of four months, children must obtain iron from exogenous sources and are at a risk if not provided with the additional dietary supplies. Pediatricians and nutritionists recommend a healthy weaning diet consisting of home prepared iron rich foods, but the reality is different. Not only do parents start weaning earlier than the recommended 4-6 months, but the foods they choose to give their children are of low iron content. The reasons for such a poor diet include poverty, lack of access to cheap food, lack of cooking skills and equipment, and a chaotic home environment where there are no fixed meal times (Murye., 2014).

The determinants of anaemia looked similar with little variation according to geographical region. In Tanzania, a study done at MNH showed anaemia was positively associated with malaria, malnutrition, deficiencies, HIV infection and low socioeconomic status (Mshana, 2012). Similar results were obtained from studies done in Kenya, Ghana, Burkina Faso and Mali while Helminthes and Schistosoma infections were additional factors in Burkina Faso, Mali and Ghana (Magalhaes &Clements, 2011).

2.2 Stages of Iron Deficiency

Iron deficiency occurs in three sequentially developing stages. The first stage is **depleted iron stores.** This occurs when the body no longer has any stored Iron but the haemoglobin concentration remains above the established cutoff levels. A depleted iron store is defined by a low serum ferritin concentration (<12µg/L). It is important to note that because ferritin is an acute-phase reactant, It's concentration in the blood increases in the presence of subclinical and clinical inflammatory/infectious diseases thus it cannot be used to accurately assess depleted iron stores in settings where poor health is common (Murye., 2014).

The second stage is known as **iron–deficient erythropoiesis.** Developing red blood cells have the greatest need for iron, and in this stage the reduced transport of iron is associated with the development of iron–deficient erythropoiesis. However the heamoglobin concentration remains above the established cut off levels. This condition is characterized by an increase in the transferrin receptor concentration and increased free protoporphyrin in red blood cells.

The third and most severe form of iron deficiency is **iron deficiency anaemia** (IDA). IDA develops when the iron supply is inadequate for heamoglobin synthesis resulting in heamoglobin concentrations below the established cut off levels. To diagnose IDA, measurements of iron deficiency as well as heamoglobin concentration are needed. For practical purposes the first and second stages are often referred to collectively as **iron deficiency** (Murye., 2014)**.**

2.3 Determinant factors of low Haemoglobin and Anaemia

2.3.1 Dietary iron

In food, iron occurs either as haeme iron in animal sources or as non- haeme in plant sources (Hunt, 2011). In many developing countries, non-haeme iron which has low bioavailability is the primary form of dietary iron as the diet is mainly cereal and legume based. There have been increased efforts to develop increased improved interventions involving food fortification, supplementation and dietary education in a combined strategy to prevent and control iron deficiency, but little progress has been made towards global elimination of iron deficiency. In most countries, policies have been implemented to provide iron supplements to pregnant women and to a lesser extent to young children as a primary strategy for preventing iron deficiency and Anaemia. (WHO, 2016).

2.3.2 Iron absorption

Iron absorption refers to the amount of dietary iron that the body obtains and uses from food. Health adults absorb about 10-15% of dietary iron, but individual absorption is influenced by several factors including the bioavailability of the two types of iron consumed, individual iron status, presence of inhibitors such as phytates and enhancers such as ascorbic acid. In developing countries however, the absorption is usually about 5% or less due to high intake of cereal based diets with low amount of meat and vitamin C which involves its bioavailability (Zimmerman, 2005).

2.3.3 Iron uptake and bioavailability

There are two types of iron in the human diet; both of them are mostly absorbed in the proximal part of the duodenum. Hence iron originates from meat products and consists of iron complexed with the porphyrin ring from either heamoglobin or myoglobin. It only accounts for approximately 10%-20% of dietary iron, but for up to 50% of the iron actually entering the body (Murye., 2014).

The second part of iron is non-haeme iron from plants. Unlike haeme-iron, its uptake depends on the composition of the meal and other factors in the degradation pathway. Absorption by the enterocytes involves reduction from ferric (Fe^{3+}) to ferrous (Fe^{2+}) iron (Mackie, 2001) before co-transport with a proton across the membrane by divalent metal transporter (DMT).

Iron is then released into the blood stream by ferrous iron transporter (FPN) and absorbed by cells through the "transferrin cycle". Proton pumps create an acidic environment inside the endosome and iron is released from the transferrin. Iron is now available to the cell either for biologically active compounds or for storage, and the transferrin and its receptors are recycled back to the membrane and the cycle can be repeated.

Vitamins: Ascorbic acid (the active form of Vitamin C) keeps iron available for absorption through several mechanisms. First, it promotes acidic conditions in the stomach and intestines, thereby providing optimal conditions for iron absorption; second, it chelates ferric iron and maintains it in a stable and soluble complex, even at higher PH. Finally it reduces ferric iron to its ferrous form, thereby preventing it from precipitating as ferric hydroxide (Teucher., 2004).

Vitamin A or β-carotene also enhances iron absorption through formation of soluble iron complexes and to a certain extent it can reverse the effect of several inhibitors such as phytates and polyphenols (Murye., 2014). Meat is an important enhancer of the bioavailability of non-haeme iron. The "meat factor" is still largely unexplored, but recent findings suggest that it's due to peptides of myosin, generated by pepsin degradation in the gut, which binds and keeps iron in solution.

2.3.4 Iron inhibitors

The interactions between inhibitors and enhancers decide the final absorption level of the element in the gut. Despite these cofactors in iron uptake, the main inhibitor of iron absorption is phytic acid (PA). One of the best known properties of PA is its anti-oxidative ability by binding and thereby inactivating Fe ions in solution. This prevents the ferric irons from participating in the Fenton reaction (the formation of the hydroxyl radical ^{-}OH as a consequence of oxidation of Fe^{2+} to Fe^{3+} during reaction of Fe^{2+} with H_20_2 or peroxides).

2.4 The relation between Iron, Breastfeeding and weaning practices

Iron stores, from birth to the sixth months of life, when the infant receives exclusive breastfeeding, meet the infant's physiological requirements. Children at this age therefore do not need to be supplemented, and solid food do not have to be introduced. This is due to the high bioavailability of iron in human milk, from which approximately 50% of the iron is absorbed, thus compensating for low iron content, that is 0.1-1mg of iron/litre of blood (Murye., 2014).

However, this bioavailability can decrease by 80% when infants are fed other foods. Therefore early introduction of complementary foods is a risk factor for the development of iron deficiency anaemia. Osorio has shown that infants that are breastfed for more than four months had a mean haemoglobin level around 3g/dL higher than those who were not. After the sixth to the twelfth months, iron requirements increase with body weight, as the infant's weight will have tripled by the end of the first year of life (Osorio., 2001).

Approximately 30% of the iron that is necessary for erythropoiesis should come from the food. As the infant shows accelerated growth and depends on food as a source of iron, he /she tend to show negative iron balance. This situation is totally different from adults, who recycle about 95% of the iron required from the lysis of red blood cells, and need to obtain only 5% of the iron from blood (Murye., 2014).

2.5 The relationship between Iron and food consumption patterns

The wide varieties of factors that stimulate and inhibit iron absorption include two powerful stimulators of non-haeme iron absorption and are meats and vitamin. Several animal tissues including beef, poultry, fish, goat, liver and pork, increase iron content once they provide a high availability of haeme iron and enhance the absorption of non-haeme iron (Ayoya, 2013).

When ascorbic acid is added to the diet, there is a remarkable increase in iron absorption.

Phytates, tannins (polyphenols), calcium phosphates, eggs, and other types of food however, inhibit iron absorption by forming precipitates that bind to iron, thus hindering its absorption.

The inhibitory effect of whole cereals is also attributed to phytate content, while the inhibitory effect of calcium on iron absorption has a considerable nutritional importance. Studies of nutritive components of food have shown that milk-derived calcium strongly inhibits the absorption of haeme and non haeme iron (Osorio., 2001).

2.6 Consequences of iron deficiency in infants and young children.

Anaemia is a serious condition that impacts cognitive development and the effects of iron deficiency that are observed in the first six months of life can lead to permanent brain damage (Baker, 2010). An afflicted child is likely to remain vulnerable to infection and continue to have lower immunity towards infection throughout childhood. Also the overall appetite is reduced and this vicious cycle perpetuates a series of events that must be stopped, to ensure the child's health. Although it is well established that iron deficiency anaemia among children is responsible for higher morbidity and subsequent mortality, systemic studies to quantify them are practically difficult for a number of epidemiological reasons and therefore are not available (Oski, 1993).

Baker, 2010 continues to report that children with iron deficiency present worse performance in psychomotor tests than do non-anaemic children. The greatest prevalence of iron deficiency among breastfed infants coincides with the final period of rapid brain development (6-24 months, when the motor and cognitive skills take shape (Baker, 2010).

Iron deficiency can also negatively affect cellular immunity, even before the child becomes anaemic, and this can lead to an increase in illness such as diarrhea, respiratory disease and other infections (Ekiz, 2005).

These effects can be reduced by iron supplementation or food fortification. Infants born of mothers with iron deficiency anaemia are more likely to have low iron stores and to require more iron than can be supplied by breast milk at a younger age.

In South Africa, six to eight –year olds who were observed to have low iron reserves, presented with retarded growth in comparison with those who had normal reserves. A boost in the growth of iron-deficient preschool children was seen after supplementation of this mineral. Also, 12-18 months –old children with iron deficiency presented the same rate of psychomotor development as did non-anaemic children, after four months of treatment with iron supplements (Murye, 2014).

2.7 Treatment of Anaemia

If the cause is dietary iron deficiency, eating more iron-rich foods such as beans, and lentils or taking iron supplements, usually with Iron (11) Sulphate, ferrous gluconate, or iron amino acid chelate will usually correct the anaemia. Vitamin B12 injections can sometimes be recommended by the physician. There is evidence that the body adopts to oral iron supplementation, so that iron is often effectively started at a comparatively low dose, and then slowly increased.

There can be a great difference between iron intake and iron absorption, also known as bioavailability. Scientific studies indicate iron absorption problems when iron is taken in conjunction with milk, tea, coffee and other substances. There are already a number of proven solutions for this problem, including;

Fortification with ascorbic acid, which increases bioavailability in both presence and absence of inhibiting substances, but which is subject to deterioration from moisture or heat. Ascorbic acid fortification is usually limited to sealed dried foods, but individuals can easily take ascorbic acid with basic iron supplement for the same benefits.

Micro encapsulation with lecithin, which binds and protects the iron particles from the action of inhibiting substances, is also another way of treating anaemia. The primary benefits over ascorbic acid are durability and shelf life, particularly for products like milk which undergo heat treatment.

Using an iron amino acid chelate, such as NaFeEDTA, this similarly binds and protects the iron particles. A study performed by the Hematology unit of the University of Chile indicates that chelated iron can work with ascorbic acid to achieve even higher absorption levels (Olivares, 1997).

Separating intake of iron and inhibiting substances by a couple of hours and using non-dairy milk (such as soy, rice, or almond milk) or goats' milk instead of cows' milk is also useful in reducing loss of iron. Gluten-free diet also resolves some instances of iron deficiency anaemia, especially if the anaemia is a result of celiac disease. Consuming haeme iron, found only in animal foods such as meat, fish and poultry, as it is more easily absorbed than non-haeme iron, found in plant foods and supplements.

CHAPTER THREE: METHODOLOGY

3.1 Study design

A cross sectional descriptive study was carried out to determine the dietary factors contributing to anaemia in children less than five years attending Hoima Regional Referral Hospital. Questionnaires were used to collect information on socio demographic characteristics of the study population , illnesses, health and sanitation practices ,dietary habits, breastfeeding and weaning practices, and blood analysis using a hemocue B-analyzer to establish the haemoglobin levels of children less than five years.

3.2 Study site

Hoima hospital is in the City of Hoima district in the western region of Uganda. It is the referral hospital for the districts of Buliisa, Hoima, Kibaale, Kiboga, Kyankwanzi Kiryandongo, Kikuube and Masindi.

Hoima Hospital is a public hospital funded by the Uganda Ministry of Health, and general care in the hospital is free. It is one of the thirteen Regional referral hospitals in Uganda. The bed capacity of Hoima Hospital was reported to be 280 in 2013.

3.3 Study population

All children aged 6 to 59 months attending Hoima Regional Referral Hospital.

3.3.1 Inclusion criteria

All children under five years aged 6-59 months who were attending Hoima Regional Referral Hospital and their guardian or parents consented to participate in the study.

3.3.2 Exclusion criteria

- Active haemorrhage.
- Bleeding disorders (Haemophilia,Von Willebrand disease, idiopathic thrombocytopenic purpura, leukemia)
- History of blood transfusion within two months prior to admission.
- History of surgery within two months.

3.4 Sample size

A sample of 100 children aged between 6 to 59 months attending Hoima Regional Referral Hospital (HRRH) was selected for the study.

3.5 Study population

Children who were aged between 6 to 59 months attending Hoima Regional Referral Hospital.

3.6 Sampling technique

Hoima Regional Referral Hospital was chosen due to the researcher's interest. The researcher employed simple random sampling technique. Papers written on YES or NO were spread and only those who picked YES were considered for the study.

3.7 Clinical data collection

3.7.1 Measurement of Haemoglobin (Hb) using Hemocue

Dispensed venous blood drops or blood drops from finger prick were analyzed for heamoglobin concentration using the cyanmethemoglobin method with HemoCue 201+ portable photometer (Hemo Cue, Inc. Lake Forest, California) and it was expressed in g/dl of blood with a cut off Hb below 11.0g/dl of blood. Either the nurse or the interviewer assisting the nurse completed the haemoglobin measurement. Results were then recorded on the clinical sheet.

The photometer itself was tested every morning of the clinic for quality control purposes. High, medium and low control samples were tested and results compared with expected results. Results were also recorded on a log sheet and monitored to ensure consistency.

3.8 Food consumption patterns

A qualitative questionnaire was used to collect information on the types of foods and number of meals consumed by the index child over the past one week. Probing questions were used to get information on the food types consumed, ingredients used to prepare meals and the type of snacks used and the number of times the child eats a particular food in a week. Food frequency questionnaire and diversity score were used to determine the consumption pattern.

3.9 Data management and analysis

Data was analyzed using GENSTAT computer package. All correlations were run to assess how all the variables relate over time. Descriptive summary statistics such as frequencies, means, medians and standard deviations were used to describe the characteristics of the study population .Inferential statistics such as odds ratio, confidence interval, and p-value were used to determine association between variables.

3.10 Ethical considerations

Research permit was obtained from the hospital director to collect data from the hospital. Data was collected using structured questionnaires and mothers/caregivers who provided the information, were not forced to do so. The respondents were assured confidentiality of any discussion of any kind.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Results

This chapter is a comprehensive presentation of the data collected. A total of 100 children aged 6 to 59 months attending Hoima Regional Referral Hospital were identified for the study.

Age Range (months)	Number of children	Average Age(months)	Sex	Level of education of the mother	Marital status	Health care provider
6 -12	17	8.65	1.24	3.29	2.24	0.71
13-18	9	16.44	1.55	2.11	2.11	2.89
19-24	13	21.38	1.14	2.23	2.23	3.08
25-30	19	26.58	1.89	2	2.05	2.42
31-36	15	34	1.47	2	2.53	3.67
37-42	9	37.89	1.55	2	3.22	3.56
43-48	5	46.2	1.2	2	2.8	2
49-54	5	51.4	1.6	2	2.8	2.4
55-60	8	57.63	2	2.5	1.5	3
	TOT=100	**Av=28.78**	**Av=1.44**	**Av=2.30**	**Av=2.31**	**Av=2.57**

Table 1: A table of demographics of the children aged between 6-59 months attending Hoima Regional Referral Hospital (HRRH) that participated in the study.

A total of 100 children that participated in the study, 48% (48) were males while 52% (52) were females. Many of the children that participated in the study were in the range of 25 to 30 months of age, followed by the range of 6 to 12 months. And least of the participants were in the range of 43 to 48months & 49 to 54 months followed by the range of 55 to 60 months of age. The mean age of the children was 28.78 months.

Most of the mothers to the children that participated in the study had some primary education and were married and their children had been previously attended to in private clinics.

4.1.1 Food consumption patterns

The food consumption patterns of the patients attending Hoima Regional Referral Hospital (HRRH) as indicated in figure 1 below (carbohydrates-23%, proteins-11.4%, lipids-8.2%, vitamins-16.3%, minerals-17.9% and anti-nutrients at 22.9%) were not in line with the right way to achieve a balanced diet that contains carbohydrates, proteins, fat, fibre, vitamins and minerals in the right proportions to provide the body with ideal nutrition.

The required standards of a balanced diet which puts the carbohydrate component of the diet at about 60%, protein component at about 25%, fats component at about 15% and vitamins and the micro nutrients at about 1% with any anti nutrient component within our balanced diet. These food consumption patterns put the clients at risk of nutrient deficient diseases like anaemia, obesity, and hypertension and also miss out on the health benefits of a balanced diet like growth and development, maintains weight, improved energy levels, lowers risk of illness among others. Every individual is different and the right diet for good health may vary from person to person. However, by adhering to a diet that is holistic which covers all the food groups and is low in undesirable nutrients such as sodium, saturated fats, and sugar, you will be on the road to a healthy lifestyle.

A well-balanced diet helps with sustained weight control. Calorie requirements depend on age, physical activity level, and weight goals. An appropriately balanced diet includes low-calorie, nutrient-dense foods such as whole grains, lean protein, fruits and vegetables. Choosing a balanced and varied diet is a vital step towards leading a happy and disciplined lifestyle.

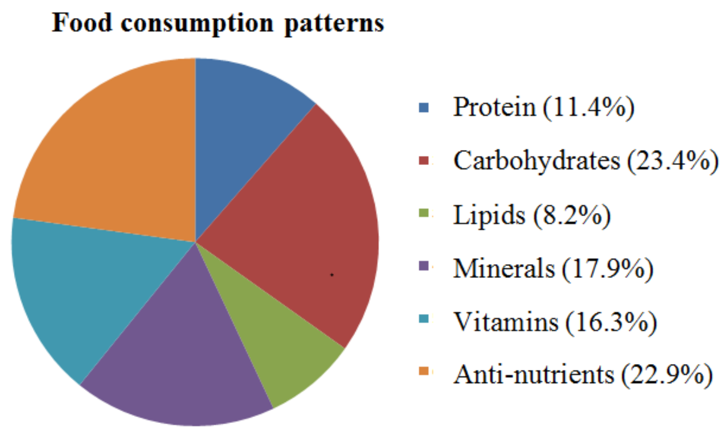

Figure 1; Percentage composition of the diet consumed by the clients attending Hoima regional referral hospital.

4.1.2 Prevalence of anaemia.

Anaemia diagnosis is classified as mild (Hb=10.0-10.9g/dl), moderate (Hb=7.0-9.9 g/dl), severe (Hb<7.0g/dl), and normal (Hb≥11.0 g/dl) Hb level concentration for children aged 6 to 59 months. 17% of the children that participated in the study were normal, 26% had mild anaemia, 33% had moderate anaemia and 24% had severe anaemia.

Anaemia was more prevalent in children whose families mainly depend on own food production (Those towards mean main food source value of 1) more than those whose families mainly depend on purchase (Those towards mean main food source value of 2). Children who received porridge as their initial weaning food were more susceptible to anaemia than those fed on other weaning foods like milk, matooke, beans and irish potatoes. The higher the anti-nutrient intake, the higher the prevalence of anaemia among the under five children attending.

Children that had higher mean food intake frequency per week had a lower anaemia prevalence than those with lower mean food intake frequency per week.

Children who were in the birth order of third, fourth and fifth had higher anaemia prevalence than those that were in the birth of first or second.

Children that received vitamin A supplement more frequently were less susceptible to anaemia than those that received less vitamin A supplement or not at all.

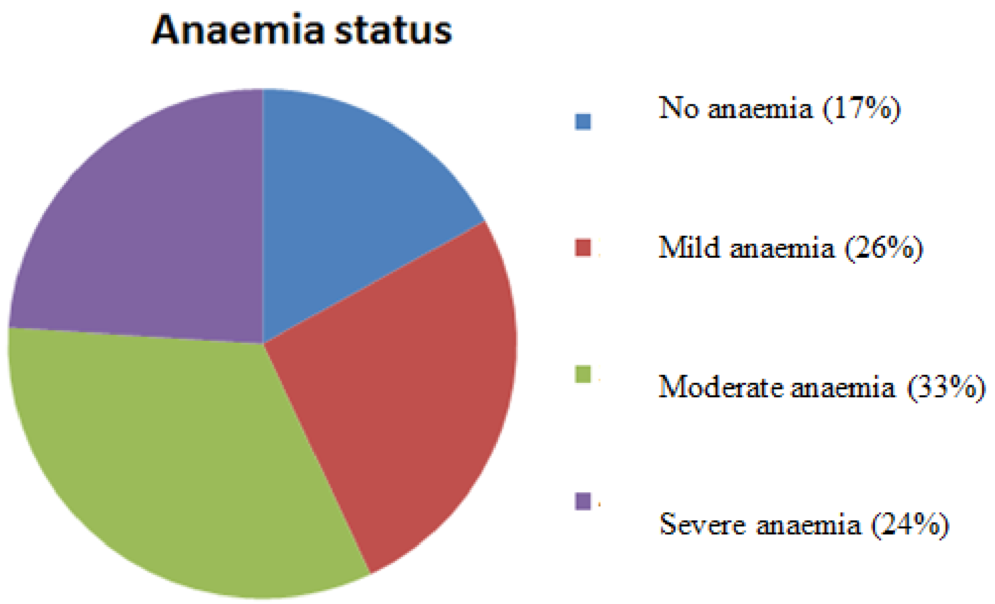

Figure 2; Anaemia status of the different children aged between 6-59 months attending Hoima Regional Referral Hospital.

Age Range (Months)	Anemia Status	Level Of Education Of The Mother	Weaning Foods	Vitamin A Supplement Frequency	Mean Food Intake Frequency	Anti-Nutrients Intake Frequency	Mean Main Food Source
6 -12	1.18	3.29	2.59	1.29	3.75	3.53	1.62
13-18	1.67	2.11	3.33	1.44	5.44	7	1.47
19-24	1.77	2.23	2.62	1.92	2.78	5.15	1.54
25-30	1.68	2	3.47	2.05	2.91	3.68	1.67
31-36	1.67	2	2.93	4.2	3.81	6.2	1.73
37-42	2.56	2	2.44	2.56	3.31	6.56	1.53
43-48	1.8	2	2.4	1.4	3.28	7	1.6
49-54	1	2	4	2.6	3.68	7	1.68
55-60	1.5	2.5	1	3	4.6	7	1.7
	AV=1.53	**Av=2.30**	**Av=2.80**	**Av=2.22**	**Av=3.75**	**Av=5.59**	**Av=1.61**

Table 2; Anaemia status of different age groups with level of education of the mother, weaning foods, vitamin A supplement, food intake, anti-nutrient intake and main food source.

4.1.3 Interaction effect level of education of the mother, weaning foods, vitamin A supplement, food intake, anti-nutrient intake and main food source on anaemia status of children less than five years attending Hoima Regional Referral Hospital.

As shown in table 2 above, the anaemia status is lower in children whose mothers have some level of education that is for children in the range of 6-12 months compared to children whose mothers had very low level of education that is for children in the range of 37-42 months of age.

It can also be noted from table 2 above that, children in the age range of 49-54 months that were weaned on foods other than juice and porridge had the lowest anaemia status which was in the mild range (Hb=10.0-10.9g/dl) compared to children in the age range of 37-42 months that were basically weaned on porridge had the highest anaemia status which is in the moderate range (Hb=7.0-9.9g/dl)

Also from table 2, children that were supplemented with vitamin A routinely like those in the age range of 31 to 36 months had a low anaemia status which was in the mild range (Hb=10.0-10.9g/dl) as compared to those children that were not getting routinely supplemented with vitamin A especially those in the age range of 37-42 months whose anaemia status was in the moderate range of Hb=7.0-9.9g/dl.

Also from table 2, anaemia status is inversely proportional to number of times of consumption of the food nutrients and it's also noted that children with a mean food consumption below 3 times per week had a higher anaemia status which was in the moderate range of Hb=7.0-9.9g/dl compared to children with a higher nutrient consumption of more than 3 times per that had a lower anaemia status with was either mild (Hb=10.0-10.9g/dl) or no anaemia at all.

It's also noted from table 2 that, the higher the anti-nutrient intake in drinks like tea, the higher the anaemia status. And it's also observed that families which mainly depend on food purchasing had their children less susceptible to anaemia as compared to families which mainly depend on own food production.

4.2 Discussion of results

Our study to the best of our knowledge was the first to describe prevalence of childhood anaemia and it is risk factors in children aged between 6 to 59 months attending Hoima Regional Referral Hospital (HRRH) in mid-western Uganda from the districts of Bulisa, Hoima, Kibaale, Kiboga, Kyankwanzi, Kiryandongo, Kikuube and Masindi and from the results presented in Figure 2 and Table 1, the prevalence of anaemia (Hb<11.0g/dl) among children aged 6 to 59months was 83%. This implies that, out of every 10 children attending Hoima Regional Referral Hospital (HRRH), 8 were anaemic. The most prevalent conditions were moderate (33%) and mild (26%) anaemia, probably because mild and moderate anaemia is usually asymptomatic and may remain undetected and untreated. This finding is consistent with results of a study by Kuziga et al., 2017 in Namutumba district in Uganda where the authors found out that the most prevalent conditions were moderate and mild anaemia probably because mild and moderate anaemia is usually asymptomatic and may remain undetected and untreated.

Anaemia prevalence was highest among the female children (92.3%) than the male children (73.0%) and those aged 37 to 59 months (100%) followed by children aged 25 to 36 months, (88.2%) and least in children aged 6 to 12 months.

The biologic, intermediate, and underlying factors that were significantly associated with anaemia comprised maternal level of education, dietary diversity, anti-nutrient intake child birth order, child's age, and other infections like malaria among others.

The prevalence of anaemia observed in this study was however higher compared to studies conducted in the Volta Region and in Adami Tullu District, Namutumba district in Uganda and South-Central Ethiopia. Those studies found the prevalence to be 69.9%, 58.8% and 36.8% respectively among children aged 6 to 59 months according to Gari et al., 2017. In a study undertaken in November 2016 by Kweku et al., 2017 among children under five years residing in the rural communities showed anaemia prevalence to be 48.1%. The prevalence in the present study was higher than their prevalence. Hence, the differences in prevalence could be because of the environment, climatic and agricultural systems as compared to the study of Kweku et al., 2017 which recorded lower prevalence probably due to the differences in seasons in which the studies were conducted. The study by Kweku et al., 2017 was conducted at the end of the rainy season when food and vegetables were in abundance.

In this study, the intermediate factor associated with anaemia was dietary diversity. Dietary diversity helps to measure the overall quality and nutrient adequacy of the diet that may influence blood formation. From the results presented in Table 2, children whose families mainly depend on own food production were more susceptible to anaemia than those whose families mainly depend on purchase.

This study confirms that children with poor dietary diversity that is those under own production due to monotony are more likely to have anaemia as compared to those with good dietary diversity that is those under purchase since they have ability to buy a variety of foods. Our findings are consistent with the results obtained by Woldie and Yigzaw., 2015 in an Ethiopian study which revealed that children with poor dietary diversity are 3 times more likely to have anaemia.

Our findings also supports results obtained in the study by Kuziga et al., 2017 in Uganda. In the study, Kuziga et al., 2017 reported that children with borderline and poor dietary diversity score had anaemia more than those who had an acceptable dietary diversity score.

From the results presented in Table 1 and Table 2, children who were in the birth order of third, fourth and fifth had higher anaemia prevalence than those that were in the birth of first or second. Families with four or more children were more likely to have anaemic children compared to those with fewer children and the prevalence of anaemia increased with increasing number of children in the family. Also high maternal parity has been associated with anaemia as a high number of children impacts on the ability to feed them appropriately. Most mothers, who had one to three children, were young mothers. Young mothers generally have challenges with child care due to limited resources and experience with child care and their children were more susceptible to anaemia thus poorer health outcomes than those children from older and more experienced mother.

From the results presented in Table 1, Table 2, Figure 1 and Figure 2, there exists significant relationship between nutritional status and iron deficiency in children aged between 6-59 months. This is in fact in agreement with (Ayoya, 2013) who suggested that there is a wide variety of food components that stimulate or inhibit iron absorption which include two powerful stimulators of non-haeme iron absorption and are meats, vitamins and several animal tissues including beef, poultry, fish, goat, liver and pork, increase iron content since they provide a high availability of haeme iron and enhance the absorption of non-haeme iron. He also added that there is a remarkable increase in iron absorption when ascorbic acid is added to the diet. In addition phytates, tannins (polyphenols), calcium phosphates, eggs, and other types of food however, inhibit iron absorption by forming precipitates that bind to iron, thus hindering its absorption and this puts the consumer at a greater risk of developing iron deficiency anaemia.

Is also observed from Table 2 that children who received porridge as their initial weaning food were more susceptible to anaemia than those fed on other weaning foods like milk, matooke, beans and irish potatoes. This is also in agreement with (Osorio., 2001) who attributed the prevalence of anaemia in such children to the inhibitory effect of whole cereals to iron absorption as attributed to phytate content, while the inhibitory effect of calcium on iron absorption has a considerable nutritional importance. Studies of nutritive components of food have shown that milk-derived calcium strongly inhibits the absorption of haeme and non haeme iron.

From the results in Table 1 and Table 2, all parents started weaning at the recommended 6 months, the use of porridge (cereals) as one of the most common weaning foods exposed such children to higher chances of anaemia. Children who received porridge as their initial weaning food were more susceptible to anaemia than those fed on other weaning foods like milk, matooke, beans and irish potatoes. According to (Murye., 2014) he attributed the poor choices of weaning foods that are of low iron content such as cereals (porridge) that expose children to high chances of iron deficiency anaemia to poverty, lack of access to cheap food, lack of cooking skills and equipment, and a chaotic home environment where there are no fixed meal time.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Our study describes the prevalence of childhood anaemia and it is risk factors in children aged between 6 to 59 months attending Hoima Regional Referral Hospital (HRRH) and the overall prevalence of anaemia was 83.0%.Which implies that, out of every 10 children, 8 are anaemic. Where the risk of anaemia was 1.3, times higher among girls than boys. There was a very high prevalence of child anaemia noted in children attending Hoima Regional Referral Hospital (HRRH), most prevalent among children aged 37 to 59 months (100%).

Poverty, lack of access to cheap food, lack of cooking skills and equipment, comprised maternal level of education, poor dietary diversity, anti-nutrient intake, child birth order, maternal parity, mother's age, child's age, and other infections like malaria among others were significantly associated with anaemia.

5.2 Recommendations

Children aged 6 to 59 months should be supplied with a balanced diet comprising of all foods from all major food groups in the right proportions to provide the body with ideal nutrition. Adhering to such a diet that is holistic which covers all the food groups and is low in undesirable nutrients such as sodium, saturated fats and sugars can enable one live a healthy lifestyle.

The findings of this study indicate that promoting maternal health and providing mothers with anaemia related information may help with controlling anaemia incidence.

We acknowledge that resources limited the scope of this study to one geographical region, that is; mid-western Uganda and, thus recommend similar studies in other geographical regions.

There is need to invest in age specific measures to prevent anaemia, including routine screening and management, especially among children 37 to 59 months, children in the rural areas and those with low caregiver education.

Given that iron supplementation during pregnancy does not protect children against anaemia, we recommend that anaemia intervention programmes in children under five years should target younger and unemployed mothers as well as the intensification of maternal education on good dietary diversity for children.

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APPENDICE

APPENDIX A: QUESTIONNAIRE

INTERVIEWERS SCHEDULE FOR MOTHERS OF CHILDREN UNDER FIVE YEARS ATTENDING HOIMA REGIONAL REFERRAL HOSPITAL ON DIETARY FACTORS CONTRIBUTING TO ANAEMIA.

DEMOGRAPHIC DATA

Demographic characteristics of the care taker

Sex of the respondent:

1). Male 2). Female

a. **Relationship to the child:**

   1).Mother 2). Father 3). Other

b. **Marital status of the caretaker**

   1). Single 2) Married 3). Divorced/separated 4). Widow

c. **Is the mother alive?**

   1). Yes 2). No 3). Do not know

d. **Level of education**

   1). No education 3). Completed primary/some secondary

   2).some primary 4). Completed secondary/Tertiary

Occupation of the care giver

1). House wife 3). Peasant

2). Business man/shop owner 4).Others specify

Child's Identification:

a. Name ………………………………………………….
b. Sex: 1). Male 2). Female
c. Age………………(months/years)
d. Birth order…………………………………….

   Morbidity data:

1. **Has your child been sick in the last two weeks**

   1). Yes 2). No

2. **Did you seek health care assistance when child was sick?**

   1). Yes 2).No

3. **If yes, where?..**

1). Own medication 2). Traditional healer 3).Private clinic/pharmacy 4).Public health facility 5).Other (specify)……

4. Did your child suffer from any of the following or have you noticed the following signs in your child of late?	Yes		No
If yes……………	No .of times	No. of days/occasion	
Diarrhea			
Malaria			
Poor appetite			
Pale eyes, palm of the hands			
Brittle finger nails			
Sleepiness/fatigue			
Passing out worms in stool			

INFANT AND YOUNG CHILD FEEDING PRACTICES (IYCF)

5. **When after birth did you put your baby to the breast?**

   1=immediately 2=within first day 3=within first three days

   4=more than three days 5=others

6. **Is…….still breast feeding?** 1=Yes 2=No

7. **If yes, how often do you breastfeed?**

   1=on demand 2=own choice 3=others

8. **At what age did you start giving food to your child?.............months**

9. **What foods did you start with?**

   1=juice 2=porridge 3= water 4=others

VITAMIN A SUPPLEMENTATION

10. Does your child receive vitamin A supplement?

    a).YES[ ]   b) NO [ ]

11. How many times did your child receive vitamin A supplement? Mother asked to present the child immunization card……………………………………

12. Did you receive vitamin A within the first month after delivery?

FOOD TABOOS ASSOCIATED WITH CHILDREN FEEDING

13 .What foods don't you give to your child because of food taboos?

…………………………………………………………………

Dietary Diversity questionnaire

Question number 14	**Food group**	**Examples**	**YES=1 NO=0**	**Mainsource:1=own production 2=purchase 3=gift 4=other(specify)**
1	CEREALS	Bread, noodles, biscuits, cookies, or any other foods made from millet, sorghum, maize, rice, wheat local foods e.g. ugali,porridge,or pastes or other locally available grains		
2	VITAMIN A RICH VEGETABLES AND TUBERS	Pumpkin, carrots, squash, or sweet potatoes that are orange inside plus other locally available vitamin A rich vegetables (e.g. sweet pepper)		
3	WHITE TUBERS AND ROOTS	White potatoes, white yams, cassava, or foods made from roots		
4	DARK GREEN LEAFY VEGETABLES	Dark green/leafy vegetables, including wild ones + locally available vitamin-A rich leaves such as cassava leaves etc.		
5	OTHER VEGETABLES	Other vegetables including wild vegetables		

6	VITAMIN A RICH FRUITS	Ripe mangoes, papaya +other locally available Vitamin A fruits		
7	VITAMIN C FRUITS	Lemon, oranges, wild fruits etc.		
8	ORGAN MEAT (IRON MEAT)	Liver, kidney, heart or other organ meats or blood –based foods		
9	FLESH MEATS	Beef, pork, lamb, goat, rabbit, wild game,chicken,duck or other birds		
10	FISH, EGGS	Fresh or dried fish or shellfish		
11	LEGUMES, NUTS, AND SEEDS	Beans, peas,lentils,nuts, seeds or foods made from these		
12	MILK AND MILK PRODUCTS	Milk, cheese,yorgurt, or other milk products		
13	OILS AND FATS	Oil, fats,or butter added to food or used for cooking		
14	SWEETS	Sugar, honey, sweetened soda or sugary foods such as chocolates, sweets or candies		
15	SPICES,CONDIMENTS,BEVERAGES	Spices(black pepper, salt, coffee, tea, alcoholic beverages or local examples		

Qn.15 FOOD EATEN	**No of times consumed in a week**							**Once in two weeks**	**Once a month/rare**	**Never consumed**
Milk	1	2	3	4	5	6	7			
Eggs										
Beef										
Liver										
Chicken										
Fish										
Fruits										
Legumes,beans,lentils										
Green vegetables										
Cereal porridge										
Fermented porridge										
Tea										
Coffee										
Ugali/cassava										
Ugali/maize										
Ugali/millet										
Rice										
Bread										