PREVALENCE AND DETERMINANTS OF NUTRITIONAL ANAEMIA AMONG UNDER FIVE CHILDREN IN SABON GARI LOCAL GOVERNMENT AREA OF KADUNA STATE NIGERIA

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JULY, 2017

DECLARATION

I declare that the work in this Dissertation entitled “Prevalence and Determinants of Nutritional Anaemia among Under Five Children in Sabongari local Government Area of Kaduna State Nigeria” was carried out by me in the Department of Biochemistry under the supervision of Dr A.B Sallau and Dr M. Musa. The information derived from the literature has been duly acknowledged in the text and a list of references provided. This thesis was not previously published or presented for another degree or diploma at this institution or other institutions.

NAFISA MOHAMMED ---------------------------- ----------------------

Signature Date

CERTIFICATION

This Dissertation entitled "Prevalence and Determinants of Nutritional Anaemia among Under Five Children in SabonGari local Government Area of Kaduna State Nigeria" by Nafisa Mohammed (P13SCBC8054) meets the regulations governing the award of the degree of master in nutrition of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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Dean of post graduate school Signature Date

DEDICATION

The research work is dedicated to Almighty Allah (SWT), the source of my strength and inspiration.

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In the name of Allah, the compassionate, the merciful, all praise and glory be to Allah the beneficient, the merciful and the creator of mankind, the function of wisdom and knowledge. He made it possible for me to undergo this research work successfully, thanks be to Allah.

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ABSTRACT

Nutritional anaemia is a decrease in the amount of red blood cell volume below 11.0g/dl in children under the age of five years due to a poor diet which is deficient in iron, folic acid and vitamin $B_{12.}$ A descriptive cross-sectional study design was used to assess the prevalence and determinants of nutritional anaemia among under five years children in SabonGari local government area of Kaduna state. Stratified random sampling technique was used for the selection of respondents. 311 structured questionnaires were distributed to caregivers of children under the age of five yearshowever 284 questionnaires were retrieved which were used for the study. Socioeconomic and demographic characteristics ofthe respondents (caregivers of childrenunder five years) were studied and also biochemical analysis was done among the under five children to determine their serum iron concentration level, serum folic acid levels and serum vitamin B_{12} levels. The data obtained from the study were analyzed using SPSS version 20 and revealed that of the 284 respondents, 154(54.2%) falls under low socioeconomic background which lead to poverty and food insecurity in most of their households. The study demonstrated that poor feeding practices do adversely affected the health and nutritional anaemic status of the children. Exclusive breastfeeding was not practiced by majority of the mothers (67%).A total of 191(67.3%) practiced the combination of both breastfeeding and bottlefeeding. 81.4% of the household consume carbohydrate food like rice, maize, yam and noodles. The socioeconomic status of the care givers is significantly correlated at p-value < 0.05 with nutritional anaemia. The prevalence of serum iron deficiency in the study was 53.9% and that of folic acid was 36.3% while that of vitamin B12 was 49.6%. In conclusion this study revealed high rate of nutritional anaemia among under five children in Sabongari local government area of Kaduna State Nigeria. There is need for iron supplementation and nutritional education inSabonGari LGA.

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ABBREVIATIONS

MCV - Mean Corpuscular Volume

STFR – Serum Transferrin Receptor

SFe – Serum iron

UNDP – United Nations Development Programme

UNICEF- United Nations Children Fund

WHO – World Health Organization

PHC- Primary Health Care Clinic

Hb – Haemoglobin

AI – Adequate intake

RDA – Recommended Dietary Allowance

DRI – Daily Reference Intake

EAR – Estimated Average Requirement

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of Study

Anaemia is defined as a decrease in the amount of red blood cell (RBC) volume or haemoglobin concentration below the range of values occurring in healthy persons. In children under five anaemia is present when haemoglobin is below 11.0g/dl (Nelson, 2000).

The most common types of anaemia are: iron deficiency anaemia, thalassaemia, aplastic anaemia, haemolytic anaemia, sickle cell anaemia, pernicious anaemia, fanconi anaemia, megaloblastic anaemia, and hypochromic anaemia (Stoltzfus and Dryfuss, 2011).

Nutritional anaemia refers to a reduced red blood cell count due to a poor diet which is deficient in iron, folic acid, and /or vitamin B12 (WHO, 2005). Nutritional anaemia is common among infants and children, from 0-59 months of age. Effects of anaemia in many field of studies done in many countries like Indian, Somalia and Ethiopia has been associated with delayed psychomotor development and impaired cognitive performance in school children which leads to poor performance in language skills, motor skills, and coordination corresponding with a low intelligent Quotient (IQ) score in this group of children (WHO, 2014).

The presence of nutritional anaemia in children is a serious health problem because it negatively impacts mental development and future social performance in children. Children suffering from iron deficiency anaemia during their first 2 years of life have slow cognitive development and poor school performance in later years (WHO, 2008).Iron deficiency anaemia has also been associated with a diminished ability to fight infections by impairing cell-mediated immunity resulting in greater rates of morbidity due to acute infections and linear growth (UNICEF, 2004).

The causes of nutritional anaemia are multi-factorial and are interrelated in a complex way the relative importance of each factor for example, folic acid deficiency or vitamin B12 deficiency varies in different communities it is higher in rural communities than urban communities (Stoltzfus, 2001).Anaemia may be chronic example secondary to iron deficiency, or it may be acute, owing to a sickle cell crisis or infection. The situation is complicated further because anaemia in childhood can result not only from events in childhood but also from maternal iron deficiency and anaemia, which are associated with impaired foetal development, iron deficient and anaemic babies (Stoltzfus, 2001). Socioeconomic status may also affect the risk of anaemia by affecting nutritional status, family size, and interval as well as intensifying problems of affordability and accessibility of preventive and curative measures (Park, 2005).

1.2 Statement of the Problem

Anaemia remains a major public health problem in the world especially in developing countries (WHO, 2014). Societies are often ignorant of anaemia's capacity to cause permanent cognitive defects, denying children their right to full mental and emotional development, before they ever reach a classroom (WHO, 2014).Studies in Nigeria showed the prevalence of nutritional anaemia among children to be 10% - 60% depending on geopolitical zones (UNICEF, 2004). Studies in northern Nigeria revealed the prevalence to be higher than those in the southern region, but the prevalence was higher in rural areas than urban areas in both geopolitical zones (UNICEF, 2004). Studies done in some communities by UNICEF in Kaduna revealed that the Prevalence of nutritional anaemia among Under Five Children in the Communities (ZangonAya, KwananFarakwai, Yalwa, BirninYaro and Jaji) to be 16%-67.6% (UNICEF, 2004).

1.3 Justification for the Study

To the best of our knowledge no such study on nutritional anaemia was ever done in the proposed study community. It is very relevant to the health and development of the area, the state, and the nation in general.

A study of this kind in the study area would be useful in showing the relevant authorities with certainty of the nutritional needs of these children and so aid in reducing morbidity and mortality rate by delivering of necessary nutritional interventions.

1.4 Null Hypothesis

There are no nutritional anaemia in Sabongari local government area and hence no determinants of nutritional anaemia in Sabongari local government area of Kaduna State Nigeria.

1.5 Aim and Objectives

1.5.1 Aim

The aim of this study was to determine the prevalence of nutritional anaemia and its determinants among under five children inSabongari local government area Kaduna State.

1.5.2 Specific Objectives

I. To determine the socio-demographic characteristics of the care givers of the children under five years of age in Sabongari local Government area of Kaduna State.

II. To determine the prevalence of nutritional anaemia among under five children in the study area using haemoglobin estimation, serum iron concentration, folic acid and vitamin B_{12} levels in blood.

III. To assess the predisposing factors of the determinants of nutritional anaemia (iron, folic acid, and vitamin B_{12}) in the study area.

IV. To assess the food consumption pattern of the children and their care givers using food frequency questionnaire.

V. To determine any relationship between the annual income of caregivers and their children nutritional anaemia.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Nutritional Anaemia in Infants and Childhood

Anaemia is defined as a decrease in the amount of red blood cell (RBC) volume or haemoglobin concentration below the range of values occurring in healthy persons. In children underfive anaemia is present when haemoglobin is below 11.0g/dl, nutritional anaemia refers to a reduced red blood cell count due to a poor diet which is deficient in iron, folate and /or vitamin B12 (Nelson and Nelson, 2000).

Anaemia is one of the most extensive pandemics affecting mostlydeveloping countries about 3.5 billion persons are affected by anaemia in developing countries (WHO, 2008). In most cases anaemia is caused by iron deficiency, although a smaller proportion is due to deficiencies of other micronutrients such as folate and vitamin B_{12}, some diseases accompanied by blood loss, parasitic infection such as filariasis and chronic diarrhoea may also result in anaemia (WHO, 2004).

2.2 Global Trends/Challenge of Nutritional Anaemia

Anaemia remains a major public health problem affecting about a quarter of the world's population (WHO, 2008).Iron deficiency anaemia affects more people than any other condition constituting a public health condition of the epidemic proportionsits adverse health consequences affect people with varied degrees of affluence and from all age groups, particularly women of childbearing age and children (WHO, 2014). About two billion people are iron deficient with half of them manifesting clinical signs of anaemia (WHO, 2014). The micronutrient status of high-risk populations has recently received extensive attention as it adversely affects pregnancy outcome, working ability, intellectual capacity, and immunity, including enormous economic drainage (WHO, 2014).

2.3 National Trend of Nutritional Anaemia

In Nigeria's estimated population of 120 million in 2006 (projected from National population census), makes Nigerian the largest country in sub-Saharan Africa and the tenth most populated country worldwide (UNICEF, 2004). Nigeria's population is largely rural, with 63.7 percent of the population living in rural areas. Currently about 45 percent of Nigeria's total population are less than the age of 15 years, with about 20 percent under five years of age. The sheer numbers involved in the population are the under five years, therefore demand that child survival issues should be placed in the forefront of the national agender(UNICEF, 2004). Despite its wealth of human and natural resources, Nigeria is ranked among the 13th poorest country in the world, which leads to limited access to adequate nutrition, quality health care and other basic social services, especially among vulnerable groups (women and children) andthese facts adversely affect the survival of children, child survival in Nigeria is threatened by nutritional deficiencies and illnesses (UNICEF, 2004).

2.4Determinants of Nutritional Anaemia

2.5 The Mineral Iron

Iron is a mineral that is part of the protein haemoglobin which carries oxygen from the lungs throughout the body. Each haemoglobin molecule is a conjugate of a protein (globin) and four molecules of haemoglobin. A low haemoglobin concentration is associated with hypochromia, a characteristic feature of iron deficiency aneamia. Iron also helps the muscles store and use oxygen. Iron is also a part of many enzymes. Iron deficiency is a condition resulting from inadequate iron in the body and the iron requirements cannot be met by absorption from the diet such as during the period of growth (infancy, adolescent), in pregnancy and lactation, and as a result of menstrual or pathological blood loss (Ekwochi and Odetunde,2013). Developing countries' diets are predominantly dominated by plant-based foods and so limit iron absorption due to their high phytate and polyphenol contents

(Bhandari and Chihetri, 2013). These result in iron deficiency, the consequences of which include:

I. Delay in normal infant's motor function(normal activity and movement) or mental function (normal thinking and processing skills) Akman et al., (2004).

II. Iron deficiency anaemia during pregnancy can increase risk for gestational age (preterm) babies Scholl et al(1992). Preterm babies are more likely to have health risk. Iron deficiency can cause fatigue that impairs the ability to do work in children and adolescent.

III. Young children and pregnant women are at higher risk of iron deficiency because of rapid growth and higher iron needs. Among children, iron deficiency is seen most often between six months and three years of age due to rapid growth and inadequate intake of dietary iron (Stoltzfus, 2001). According to American Centre for Disease Control and prevention (1998), infants and children at highest risk are the following groups:

Babies who were born early or small.

Babies who were given cow's milk before age 12 months.

Breastfed babies who after 12 months are not being given plain iron fortified cereals or another good source of iron from other foods.

Children aged one to five years who get more than 24 ounces of cow, goat, or soymilk per day. Excess milk intake can decrease the child's desire for food items that are greater in iron content, such as meat, or iron fortified cereals (Stoltzfus, 2001). Children who have special health needsfor example children with chronic infections.

Iron deficiency is the most prevalent micronutrient deficiency globally, affecting more than one half of the infants in developing countries. Nigeria has iron anaemia prevalence rate of 25% among children under five years (WHO, 2010).

2.5.1 Iron status

Iron functions as a component of proteins and enzymes. Almost two- third of the iron in the body (approximately 2.5 grammes of iron) is found in haemoglobin, the protein in red blood cell that carries oxygen to the tissues, and about 15% is in the myoglobinof muscle tissuesFulwood el al., (1982). Every balanced diet contains some amount of haem and nonhaemiron.Haeme iron is found in foods that originally contained haemoglobin and myoglobin, found in red meat, fish and poultry. Nonhaem iron is found in plant foods, such as lentils and beans and also is provided in iron-enriched and iron –fortified foods. Haem iron has a higher bioavailability than nonhaem iron (Miret,2003). Ascorbic acid, meat, and seafood can enhance nonhaem iron absorption, whereas phytate (present in grains and beans) and certain polyphenols have some opposite effect (Hurrell and Egli, 2010). Each day the body absorbs approximately 1-2 mg of iron that the (nonmenstruating) body loses (Institute of medicine, 2001).

2.5.2 Assessment of Iron Status

There are many approaches to assess iron status. There is no single biomedical test for assessing iron status therefore model that uses two or more different indicators of iron status have been developed (Domellop, 2001). The two most commonly used are the ferritin model and the more recently introduced body iron model. The third model is the mean corpuscular volume (MCV) model. The ferritin model (also known as the three indicator model) uses three indicators: serum ferritin, transferrin saturation and erythrocyte protoporphyrinMei et al., (2011). The body iron model uses two indicators: serum ferritin and soluble transferrin receptor (STFR) (CDCP, 2008). The mean corpuscular volume (MCV) Model uses MCV, transferrin saturation, and erythrocyte protoporphyrinas indicators (ESWG, 1985). Both the ferritin model and the MCV model require at least two or three indicators to be normal Cogswell et al., (2009). The ferritin models on the other hand tend to overestimate the presence of iron deficiency because it includes ferritin which reflects stores in the first stage of iron depletion (Lee and Nieman, 2013). The MCV on the other hand includes biochemical tests, all of which indicates altered red blood formation (LSROFASEB, 1989). Both model are capable ofidentifying persons in the second and third stages of iron depletion, but they may fail to distinguish iron-deficiency anaemia from other common causes of anaemia such as inflammation, acute and chronic diseases and lead poisoning, because they include erythrocyte protoporphyrin as a variable (CDCP, 2008). Of the three models, the body iron model is considered superior because it is less affected by inflammation than are the ferritin and the MCV models.Only two measures are used in the body iron model as compared to three in the other two (Gibson, 1990). The greater simplicity of the body iron model makes it more suitable for use in areas where resources are limited and where anaemia due to inflammation, chronic diseases and nutrients deficiencies other than iron are relatively common (Lynch, 2011).

2.5.3 Serum Ferritin

Ferritin is formed when protein apoferritin combines with iron. It is the primary store of iron in the body located in the liver, spleen, and bone marrow (Centre for disease control and prevention, 2008). Approximately 30% of iron in the body is in the storage form, most as ferritin and some as hemosiderin (a degradation product of ferritin) (CDCP, 2008). Tissuse ferritin levels and serum ferritin decrease as iron depletion progresses. Low serum ferritin concentration is a sensitive indicator of early iron deficiency. However ferritin is an acute phase protein and its concentration increases in acute and chronic diseases thereby masking iron deficiency (Gibson, 2005).

2.5.4 Soluble Transferrin Receptor

The measurement of soluble transferrin receptor (sTfR) has become popular because it is sensitive to the inadequate delivering of iron to the bone marrow and tissue Cook el al., (2003). The sTfR fragment is cleaved from the membrane bound transferrin receptor found on nearly all cells Genc et al (2002). The predominant donors of these fragments to the serum pool are the cells of the developing red cell mass the erythroblasts and reticulocytes Genc, et al., (2002). The concentration of sTfR reflects erythropoietic activity. Factors that may affect the concentration of sTfRin plasma or sera include acute or chronic inflammation and the aneamia of chronic disease, ,malaria, malnutrition, age, and pregnancy (Skikne, 2008). Cells acquire iron when the iron transport protein transferrin forms a complex with a highly specific transferrin receptor (TfR) (Skikne, 2008).

2.5.5 Transferrin, Serum Iron, and Total Iron-Binding Capacity

Iron is transported in the blood bound to transferrin, a β-globulin protein molecule synthesized in the liver (Lonnerdal and Hernell, 2010). Transferrin accepts iron from the sites of heamoglobin destruction (the primary source of iron bound to transferrin), from storage sites, and from iron absorbed through the intestinal track. It then delivers the iron to bone marrow for haemoglobin synthesis as well as other storage site and placenta for foetal needs. Each molecule of transferrin has capacity to transport two atoms of iron (Cousin, 2006).

Serum iron level is the measure of the amount of iron bound to transferrin while total iron binding capacity (TIBC) measures the amount of iron capacity of being bound to serum proteins and provides an estimate of serum transferrin (Lynch, 2011). Transferrin saturation is the percent of transferrin that is saturated with iron. The measure of serum iron, TIBC, transferrin saturation is the percent of transferrin that is saturated with iron. The measure of serum iron, TIBC, transferrin saturation and serum ferritin concentration are useful in distinguishing iron deficiency from other disorders capable of causing microcytic anaemia (King, 2011).

2.5.6 Erythrocyte Protoporphyrin

Protoporphyrin is a precursor of haem. When the amount of haem that can be produced is limited by iron deficiency,protoporphyrin accumulates in red blood cells (erythrocytes). Erythrocyte protoporphyrin increases as iron depletion worsens (King, 2011).

2.5.7 Iron Overload

Children with normal intestinal function have very little risk of iron overload from dietary sources of iron (Aggett, 2012). Iron overload is a disorder of iron metabolism that results in the accumulation of excess iron in body tissues. Iron overload is mainly the result of haemochromatosis, which is a group of genetic disease characterized by excessive intestinal iron absorption and deposition of excessive amount of iron in parenchymal cells with eventual tissues damage (Powell, 2012). Organs particularly affected by haemochromatosis are the liver, heart, and pancreas, leading to the failure of these organs and possibly death. Iron overload can also result from multiple blood transfusions and excessive intake of iron from fortified foods and supplements Cook et al., (2003).

2.5.8 Stages of Iron Depletion

As the body's iron stores are depleted, the risk of iron deficiency increases. Iron depletion occurs in three stages:

Stage one is the depletion of iron stores which represents a state of vulnerability and not associated with any adverse physiologic effects (Adamson, 2012). At this stage low stores (reflected by decreased serum ferritin levels) are recorded for healthy persons and appear to be the usual physiologic condition for growing children and menstruating women.

Stage two is early functional iron deficiency without anaemia however the adverse physiologic consequences are beginning to manifest. This stage is characterized by changes indicating insufficient iron for normal production of haemoglobin, myoglobin and iron containing enzymes Wood et al., (2006). The stage is characterized by decrease transferrin saturation and increased erythrocyte protoporphyrin levels. Erythrocyte protoporphyrin is the precursor of haemoglobin, its concentration increase when too little iron is available for the synthesis of haemoglobin level but it does not show because it has not reached the lowest levels. Therefore haemoglobin is not a useful indicator of the two stages (PM, 2001).

Stage three is characterized by decreased serum ferritin, transferrin saturation, haemoglobin, and MCV and increased erythrocyte protoporphyrin (Adamson, 2012).

2.6.1 Haemoglobin

Haemoglobin is an iron containing molecule found in red blood cells that is capable of carrying oxygen and carbon dioxide. The amount of haemoglobin in the blood depends primarily on the number of red blood cells (Pagana, 2010). Despite its use as a screening test for iron deficiency anaemia, isolated measurements of haemoglobin concentration or haematocrit level are not suitable as the sole indicator of iron status because they tend not to become abnormal until the late stage of iron deficiency and also fail to distinguish between iron deficiency anaemia and anaemia of inflammation (Cook, 2003).

2.6.2 Mean Corpuscular Volume

Mean corpuscular volume (MCV) is the average volume of red blood cells. It is calculated by dividing the haematocrit value by the RBC count (the unit is in femtolitres). Macrocytosis (resulting from increase in MCV) is cause by deficiencies of folate or vitamin B12, chronic liver disease, alcoholism, and cytotoxic chemotherapy. On the other hand microcytosis (caused by decreased MCV) is a result of chronic iron deficiency, thalassemia, anaemia of chronic disease and lead poisoning (Adamson, 2012).

2.7.1 Folate

Folate is a vitamin and it includes naturally occurring food folate and folic acid in supplements and fortified foods. Folate coenzymes function in the acceptance and transfer of 1-carbon (1-C) units involved in the synthesis, interconversion, and modification of nucleotides, amino acids, and other key cellular components (Solomons and Ruz, 2000).

Factors that may negatively influence folate-dependent 1-C metabolism include inadequate folate intake, reduced bioavailability, folate-related genetic polymorphisms, and interactions with various nutrients and drugs (Cook, 2001).

2.7.2 Dietary Sources: Naturally OccurringFolate Containing Food and Folic Acid-Fortified Foods

Naturally occurring food folate is concentrated in selected foods like orange juice, dark green leafy vegetables, asparagus, strawberries, peanuts, and legumes such as kidney and lima beans (Suitor, 2000). In the United States, folic acid is now added to enriched grain food (Colman, 1982). Since January 1, 1998, all cereal grain products labelled as enriched (example bread, pasta, flour, breakfast cereal, rice) and mixed food items containing these grains have been required by the U.S food and Drug Administration (FDA) to be fortified with folic acid Lewis et al.,(1999). It is estimated that several thousand food items have been modified by fortification with folic acid (Lewis et al,1999). In addition, many other foods such as ready- to- eat breakfast cereals, functional foods, and meal replacement products contain more folic acid than FDA requires for enriched grain products (FDA, 1996). The impetus for the FDA-mandate regulation was to increase folic acid intake by women of reproductive age and thereby reduce risk of a neural tube defect (NTD) affected pregnancy. Several reports indicate that the population’s folate status has been positively affected as a result of the 1998 FDA mandate (Jacques et al, 1999). Data are not sufficient to estimate the effect of folic acid enrichment on the overall incidence of NTDs (Cook, 2011).

2.7.3 Bioavailability of Folate

In the context of folate, bioavailability is most appropriately used to describe the overall efficiency of utilization, including physiological and biochemical processes involved in intestinal absorption, transport, metabolism, and excretion (Babu, 1997). Bioavailability of folate from naturally occurring food sources is variable and frequently incomplete. Many dietary variables, physiological conditions, and pharmaceuticals may affect the bioavailability of food folate, including entrapment of naturally occurring folate in the cellular structure or insoluble matrix of certain foods, instability of certain labile 5-methylTHFs (THFs) during passage through the gastric environment (Tamura, 1998). Direct inhibition of the de-conjugation of dietary polyglutamyl folates, direct inhibition of folate absorption and indirect impairment de-conjugation and absorption by alteration of jejuna pH, because of variation among individuals in folate digestion, absorption, and metabolism, considering variability in the bioavailability of food folate is common and substantial conflicts exist within published studies (Prinz-Langenohi, 1999). For example, a study reporting that folate in mixed fruits and vegetables is 60-90% bioavailable (Brouwer ,1999). contradicts another study reporting that such dietary folate sources did not improve folate status, in addition to variation among individuals (Cuskelly, 1996).

Estimates of the bioavailability of folates naturally occurring in foods are best expressed relative to a folic acid standard consumed under fasting conditions when folic acid absorption is nearly complete (Gregory, 1997). The best estimate of bioavailability in a mixed diet was provided in a study in humans that compared blood folate response with food folate and folic acid (Bandari, 1992). Sauberlich el al., (1995) concluded that the bioavailability of food folate was no more than 50% that of folic acid. A series of studies conducted by Colman suggested that the bioavailability of folic acid added to South African cereal-based foods was comparable to that reported for naturally occurring food folate. On the basis of these data, human metabolic studies were conducted in which the bioavailability of folic acid mixed with food was assumed to be the same as that of naturally occurring food folate (O'keefe, 1995). Shortly before the implementation of cereal grain enrichment, the results of a series of studies using isotope tracers indicated that folic acid incorporated into bread, pasta, and rice is highly available for absorption in humans (Pfeiffer, 1997). When folic acid was consumed with a light breakfast, the absorption was reduced by 15% relative to an equivalent dose of folic acid taken alone while fasting (Pfeiffer, 1997). These data have been translated to mean that folic acid consumed with food (as is the case with fortified foods) is 85% bioavailable (Food and Nutrition Board, 1998). Thus the addition of folic acid to enriched foods is an effective means of delivering available folate to a population. This conclusion was supported by further experimentation with human subjects and by examination of population-base data after the institution of national enrichment of many cereal-base foods Jacques et al., (1999).The bioavailability of folic acid consumed in tablet form appears to be very high as shown by the wide range of studies documenting the efficacy of commercial folic acid preparations. However, incomplete dissolution was found in an examination of selected commercial prenatal multivitamin products that has an in vitro dissolution protocol indicating the need for further examination of folate bioavailability from supplements Hoag el al., (1997).

2.7.4 Dietary Reference Intakes of Folate

Folate requirement traditionally have been defined as the intake necessary to prevent deficiency with clinical symptom. The recent (1998) edition of the daily reference intakes (DRIs) shifted the focus of nutrient intake recommendations to identifying intakes that promote optimum health (Food and Nutrition Board, 1998).The DRI for folate includes the following recommendations: Estimated Average Requirement (EAR), Recommended Dietary Allowance (RDA), Adequate Intake (AI), and Tolerable Upper Limit Intake (UL) (Food and Nutrition Board, 1998). The DRIs for folate are expressed as DFEs (Dietary Folate

Equivalents), a unit that addresses typical differences in bioavailability between folic acid and food folate. The table summarizes the AI and RDA estimates for all ages and sex categories.

Table 2.1 Dietary Reference Intakes of Folate(μg/l) DFE/day

Group	Adequate Intake (μg/l)
Infants 0-6 months	65
6-11 months	80
Children 1-3 years	150
4-8 years	200
9-13 years	300
Adolescents 14-18 years	400
Adults >19 years	400
Pregnant women, all ages	600
Lactating women, all ages	500

Source: Food and Nutrition Board (1998). Dietary reference intakes for thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin and choline. Washington DC: National Academic Press.

DFE- Dietary Folate Equivalents.

2.8.0 Vitamin B_{12}

Vitamin B_{12} (Cobalamin, Cbl) holds a unique position in the science of human nutrition because there is a specific disease (pernicious anaemia) that results in the isolated mal-absorption of vitamin B_{12} that was ultimately fatal before the development of vitamin therapy. This unique syndrome of megaloblastic anaemia and demyelinating lesions of the central nervous system was recognized and described by Thomas Addison as early as 1855 (Castle, 1997). Pernicious anaemia has such specific manifestation and such a dramatic response to the replacement of vitamin B_{12} that a patient response could actually be used as a bioassay. In 1992 Minot and Murphy showed that a diet containing large amounts of liver stimulated red blood cell production in patients with pernicious anaemia. Their early work eventually culminated in the purification of vitamin B_{12} from liver by Folkers at Merck, Sharp and Dohme in 1948 and by Smith and Parker at Glaxo in the same year. During the next 50 years, the structure, x-ray crystallography, synthesis of coenzyme forms, and chemistry and biochemistry of the cobamides were elucidated (Hogenkamp, 1998).

The role of vitamin B_{12} in metabolism and the pathophysiology of the deficient state have been determined by studying patients with pernicious anaemia, since this accident of nature results in a very selective model of a deficiency disease not complicated by protein-calorie malnutrition or multiple vitamin and mineral deficiencies (Hogenkamp, 1998).

2.8.1 Clinical Manifestations of Vitamin B_{12}

Megaloblastic anaemia.- In humans, vitamin B_{12} and folate deficiency cause identical forms of megaloblastic anaemia (Jacques et al, 1996). This constellation of morphologic changes and clinical and laboratory abnormalities is due to an imbalance of decreased DNA synthesis and adequate RNA synthesis and is present in other clinical situations where DNA synthesis is impaired, because vitamin B_{12} synthesis and folate deficiency cause identical lesions, it is thought that the secondary block in folate metabolism in vitamin B_{12} deficiency is the underlying cause (Castle, 1997). The nuclei of the developing bone hematopoietic precursor cells in the bone marrow remain immature compared with the cytoplasm, which is maturing normally. The morphologic result is a macrocytic red blood cell (high mean cell volume), with an open chromatin pattern in precursor nuclei. The white blood cells are enlarged and the matured granulocytes show hyper-segmentation of their nuclei. Many cells die in the bone marrow, possibly by apoptosis. This is termed ineffective erythropoiesis and lead to the cellular release of bilirubin and lactate dehydrogenase into the blood Jacques et al., (1996).

When extremely severe, the profound anaemia and decreased white blood cell and platelet counts combined with a cellular bone marrow packed with very immature-appearing erythroblasts have led to the mistaken diagnosis of acute leukemia. The bone marrow lesion can be completely cured with vitamin B_{12} treatment. There is a rapid response with correction of hyper-segmentation and the production of new red blood cells (reticulocytes). The megaloblastic anaemia of vitamin B_{12} deficiency can be partially corrected with folate treatment which leadsto diagnostic errors. Neurologic abnormalities – Vitamin B_{12} deficiency, whether naturally occurring or induced by nitrous oxide, leads to a demyelinating disorder of the central nervous system in humans, non primates, fruit bat, and swine, but not in other animal species Kauwell et al., (2000). This lesion was described long before the underlying vitamin B_{12} dependence was recognized. It has been termed “subacute combined degeneration” Jacques et al, (1996). The pathology includes swelling of myelin sheaths and patchy vacuolation of myelin with spongy degeneration of the spinal cord, starting in the thoracic and cervical dorsal columns and progressing to the lateral columns. Lesions are also seen in the brain and optic nerves and possibly peripheral nerves. Signs and symptoms vary considerably among individuals, but the most common symptom seen in a large review of well documented cases was painful paresthesia of the extremities Chango et al., (2000). The most common sign was loss of proprioception and vibration sense in the toes or ankles. One of the most intriguing discoveries has been the inverse relationship between the severity of the hematologic and the neurologic abnormalities Chango et al., (2000).

Only about a third of patients with pernicious anaemia develop neurologic abnormalities McGuire et al., (1984). Approximately 25% of these will have almost completely normal hematologic parameters, which caused great difficulty in diagnosis in the past Kauwell et al., (2000).

Clinical spectrum of vitamin B_{12} deficiency in infants is also markedly different from that in adults. Infants fed vitamin B_{12} deficient breast milk develop lethargy, failure to thrive, irritability, and poor brain growth leading to permanent developmental delay in some cases Leclerc et al., (1998).

2.8.2 Causes of Vitamin B_{12} Deficiency

All animal require vitamin B_{12} and obtain it ultimately from the products of microbial synthesis, ruminant animals carry bacteria that synthesize cabolamins in their rumen. Other vegetarian animals including humans obtain vitamin B_{12} from the products of animal origin, including meats, dairy products, and eggs. It is possible that humans also obtain vitamin B_{12} from sewage-contaminated foods. In the last 30 years, synthetic vitamin B_{12} has been added to many cereals and other foods in the western world, so fortification is also a major source of the vitamin (Haslted, 1990).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study Area

The study was carried out in primary health care (PHC) centres in SabonGari Local Government Area, of Kaduna State. SabonGarilocal Government Area is boarded with latitude11.0700°N 07.4400°E and longitude 11.1167°N 07.7333°E (Abbas, 2012). Sabongari local Government Area is boarded to the south by Tudun Wada bridge to the east by Zaria dam to the west by Giwa local government area and to the north by Kaduna-Kano expressway SabonGari Local Government Area (LGA) with an area of 70206 km^2 and a population of 633,096 (NPC, 2006). (Olufunmilola, 2011). The inhabitants of the area are mainly Hausa, Fulani, Bajju, Yoruba, Igbo and other tribes Abubakar *et al.*, (2015).

SabonGari local government area comprises of eleven wards; these areGabas, Basawa, Jushi,Jama'a, Dogarawa, Hanwa, Chikaji, Samaru, Bomo, Zabi and Muchia wards Youngu *et al.*, (2012).

3.2 Study Population

The study population was all under five year children attending child welfare clinics in PHC of Sabongari local government area of Kaduna state.

3.3 Inclusion Criteria

All apparently healthy children and children without medical complication (Sickle cell anaemia) who are between the ages of 0 to 59 months with their mothers/caregivers who attend child welfare clinics in PHC ofSabonGari Local Government Area Kaduna state, and also not physically challenged

Figure 3.0 Map of Kaduna state of Nigeria showing the study area
Source:*https://www.researchgate.net/figure/271023623_fig1_Figure-1-Map-of-Kaduna-state-of-Nigeria-showing-the-study-area*

3.4 Exclusion Criteria

Children attending primary health centres in Sabongari local Government, who are not within the range of 0 to 59 months of age

3.5 Ethical Consideration

Ethical clearance was obtained from ministry of health Kaduna state. Detailed justification of the research was explained to the health workers to gain their confidence and co-operation.

3.6 Informed Consent

Informed consent of the respondents was sought prior to the commencement of the study. They were told that the proposed study is voluntary without undue influence, inducement or intimidation, that the study does not involve threat, injury and discomfort, confidentially will be maintained from the commencement to the end of the research. Pre-study visit was made to the local Government chairman, the Head of Health, primary health care department,SabonGari local Government for the purpose of getting them well informed with the proposed research.

3.7 Sample Size Determination

The sample size was calculated using the formula described by (Naing et al, 2006).

$$N = \frac{z^2pq}{d^2}$$

Where:

N = sample size of the study

P = Proportion of under five children having nutritional anemia (Prevalence rate which is 27%, from previous study conducted among under five children in Giwa LGA, Kaduna state) (Gambo, 2012).

q = 1 - p (i.e proportion of under five children without desire characteristics for nutritional anaemia).

Where p = 0.27

so q = 1 - 0.27 = 0.73

d = Degree of accuracy desired in the study (precision) referred to as 0.05 level

z = 95% confidence level (standard normal deviation) = 1.96

thus, n was obtainable by substituting the respective values for p, q, d, and z in the formula

$n = (1.96)^2 (0.27) (0.75) /(0.05)^2$

n = 311

3.8 Sampling Techniques

A stratified random sampling technique was used. SabonGari local government area has eleven wards with a PHC located in each ward. The sample size was divided/allocated equally among the eleven PHCs, and simple random sampling method was used for the actual selection of respondents.

3.9 Study Design

A descriptive cross-sectional design was used for the study to determine the prevalence and determinants of nutritional anaemia among underfive children in SabonGari local Government Area Kaduna State.

3.10 Instrument for Data Collection

The following instruments were used to collect data:

I. Questionnaire

II. Syringe (2mls) and needle

III. Specimen bottles

3.11 Methods of Data Collection

3.11.1 Questionnaire

Structured questionnaire were administered by the researcher to the parents/caregivers of the children under five year that participated in the study and can read and write. Interpreters (research assistants) were used for those who could not communicate in English, The questionnaire collected information on socioeconomic and demographic characteristic, food eating habit as well as food consumption pattern.

3.11.2 Dietary Assessment of the Respondents

Food consumption pattern of the children and mothers was determined using Food Frequency Questionnaires (FFQ) (FAO, 2014). The mother was asked to estimate from a food list the frequency in which they consume food, mention food based on specified frequency categories indicated such as consumption per day, week, and month or never consumed.

3.11.3 Determination of the Relationship between the Socio-economic characteristic and Nutritional Anaemia

To determine the relationship between the socio-economic status of the children's caregivers and their children nutritional anaemia, the computed status of the selected index for the nutritional statuses of the children were cross-tabulated with the socio-economic statuses and a chi-square statistic was computed to establish the significance of the relationship.

3.12 Blood Sample Collection

The blood sample collection process was done according to methods described by Cheesbrough, (2000); Fidenza (1991); WHO; (1994) and modified method of Nwosu et al., (2014). Having taken all precautionary/ethical measures, 2mls of blood sample for each child was collected intravenously by venipuncture from the median cubital vein in the cubital fosa of the forearm after thorough cleaning of the site with cotton swab soaked with hibitane, using 2mls syringe and needle into sample bottles. The samples were immediately taken to Ahmadu Bello University Teaching Hospital Laboratory for analysis.

3.13 Biochemical Analysis

3.13.1 Haemoglobin Concentration Determination

Urit (-12 Full haemoglobin meter haemoglobinometer mission Acon made in USA)was used for Hb estimation. Haemoglobin concentration was taken in the clinics using the haemoglobinometer through finger pricks.

Procedure

The child's thumb was cleaned with a swab and a lancet was used to prick the thumb. Capillary tube was then used to collect the blood which was dropped on the haemoglobinometer strip, and the reading was taken from the haemoglobinometerand recorded immediately.

3.13.2 Quantitative Determination of Iron (Young, 2001)

Principle

The iron is dissociated from the complex of serum ferritin and soluble transferrin in a weakly acidic medium. The liberated iron is reduced into the bivalent form by means of acid medium (ascorbic acid) Ferrous iron reacts with ferrozine to give a coloured complex and the absorbance was read at 562nm using a spectrophotometer.

Transferrin (Fe^{3+}) + Ascorbic acid $\longrightarrow$ Fe^{2+} + Transferrin

Fe^{2+}FerrozineColoured complex $\longrightarrow$

The intensity of the colour formed is proportional to the iron concentration in the sample.

Procedure

Working reagent was obtained by dissolving the contents of the tube containing the reductant (ascorbic acid) 2g in the bottle of the buffer (acetate pH 4.9). This was capped and mixed gently to dissolve contents. The reduced iron reacts with ferrozine, a colour to produce a coloured complex. The intensity of the colour was proportional to the concentration of iron in the sample.

Iron (µg/dl) = (A) sample - (a) sample Blank x 100 (calibrator concentration).

Conversion Factor: µg/dl x 0.179 = µmol/L (Young, 2001).

3.13.3 Quantitative Determination of Folic Acid (ELISA Assay Kit)

Assay Principle

The folic acid ELISA assay is a quantitative assay based on the principle of the Enzyme Linked Immune Sorbent Assay.

Procedure

Samples were pipetted and were poured into the appropriate wells of the microtiter plate. Immediately folic acid antibody were added into each well, covered with a plastic foil and was incubated for 60 minutes at room temperature, on a microtiter plate shaker the plates were then washed three times thoroughly. The samples were added into each well covered with plastic foil and incubated again for 60 minutes at room temperature and thereafter they were washed three times again and kept in a dark cupboard for 20 minutes. Stop solution (0.5M H_2S0_4) 100µl was added into each well, and the blue colour turned yellow. After thorough mixing it was measured using an ELISA reader.

Conversion factor: n g/dl x 2.266 = n mol/L

3.13.4 Quantitative Determination of Vitamin B_{12}

Principle

Vitamin B_{12} quantitative test is based on the principle of the Enzyme Linked Immune Sorbent assay.

Procedure

Samples were prepared and were poured into the appropriate wells of the microtiterplate, immediately 50 µl vitamin B_{12} peroxidase conjugate was added into each well covered with a plastic foil and was incubated for 60 minutes at room temperature on a microtiter plate shaker. The plates were washed three times and residual liquid were removed by striking the plate against a paper towel. Substrate solution 100 µl was pipetted and poured into each well and was kept in a dark cupboard for 20 minutes at room temperature. Stop solution 100µl (0.5 M H_2S0_4) was added into each well. The blue colour turned into yellow upon addition which was mixed thoroughly and its absorbance measured at 450nm (reference wavelength 620 nm), using an ELISA reader Thompson et al., (1998).

Conversion factor = n x 0.738pmol/l.

3.13.5 Determination of Prevalence of Nutritional Anaemia

The index of nutritional anaemia assessed were observed serum iron concentration, folic acid and vitamin B12 level in blood of the children under five as well as haemoglobin level for anaemia. Deficiency levels were determined by comparing the observed levels with the standard by the WHO for each of the parameters. Percentage of prevalence rate of each determinant was calculated by dividing the frequency of the deficiency by the total number of both deficient and normal multiply by one hundred.

3.14 Statistical Data Analysis

Data collected were analysed with the Statistical Package for the Social science (SPSS) IBM window version 20. Socio-demographic data were analyzed and presented in percentages. The chi-square procedure was used to determine the relationship between the socio-economic status of the parents or the caregiver and the children nutritional anaemia. Determinants of nutritional anaemia were established with the aid of multinomial logistic regression because of the nominal scoring of the variables. Tests for significance were conducted at the probability level of 0.05 using one way ANOVA.

CHAPTER FOUR

4.0 RESULTS

4.1 Descriptive analysis of the socio-demographic and socio-economic characteristics of the caregivers of children under five in SabonGari local Government area of Kaduna State

A total of 311 questionnaire were distributed, however 284 were retrieved and analysed giving a response rate of 91.3%.

Socio-demographic and socio-economic characteristics of the caregivers of children under five in SabonGari local Government area of Kaduna State were presented in tables 4.1 and table 4.2. Table 4.1 revealed the classification of the children by their age groups. Children between 49 to 59 months were only 1.1% (3), Those within the age group of 37 to 48 months were 4.9% (14), while 8.8% (25) of the total number of children involved in the study were within the age group of 25 to 36 months of age children who were between 13 to 24 months were 26.4% (75), while 58.8% (167) were between 1 to 12 months. The table also showsclassification of the children by their sex,from the table, 43.0% (122) of the children were male while 57% (162) were female.The table also shows the classification of the children by their ethnic grouping. From the table, Hausa/Fulani ethnic group constituted the bulk of the respondents and accounted for 71.5 % (203) of the total population. The caregivers religious affiliation revealed that those from the Islamic faith were 231 or 81.3% while 53(18.7%) were of the Christian faith. The distribution showed that 75.4% were from parents whose residence is in urban locations in SabonGari local government area. Those who were from rural locations in SabonGari local government were 24.6% (70).

Table 4.1 Socio-demographic Distribution of Under five Children

Variable	Frequency	Percentage (%)
Age classification of under five		
0 – 12 months	167	58.8
13 – 24 months	75	26.4
25 – 36 months	25	8.8
37 – 48 months	14	4.9
49 – 59 months	3	1.1
Total	284	100.0
Classification of the Children by sex		
Male	122	43.0
Female	162	57.0
Total	284	100.0
Caregivers Ethnic group		
Hausa/Fulani	203	71.5
Igbo	17	6.0
Yoruba	25	8.8
Others	39	13.7
Total	284	100.0
Caregivers Religious affiliation		
Islam	231	81.3
Christianity	53	18.7
Total	284	100.0
Caregivers Residential Location		
Urban (Dogarawa, Muchia, Chikaji, Jushi, Hanwa Zango and Samaru)	214	75.4

Rural (Gwanda, Sakadadi, Basawa and Bomo)	70	24.6
Total	284	100.0

Table 4.2 showed the classification of the children by their caregivers level of educational qualifications. From the table 6% (17) of the children were from caregivers who have no

formal education. Those with primary school education were 27.8% (79) while those from caregivers with secondary school certificates were 43.3% (123). Children whose caregivers had tertiary certificate were 22% (65) of the total number involved in the study.

The table also showed that 34.2% (97(34) of the children were from head of household who were civil servants. Those from head of household who are involved in businesses were 38.4% (109) while 17.3% (49) were farmers. Others whose occupations were not stated were 10.2% (29) of the total number of children involved in the study.From the table only 34.5% (98) of the total number of children involved in the study were from monogamous families, the rest 65.5% (186) were from polygamous families.

Table 4.2 also showed classification of the children by the sizes of their families. From the table, that 48.2% (137) of the children were from homes with between 1 and 5persons in the family. Those who were from homes that had between 6 and 10 persons in the family were 44.7% (127) while 4.6% (13) of the children were from homes with between 11 and 15 persons and 2.5% (7) were from homes with 16 to 20 persons.

The estimated annual income of majority of the head of household 54.2% (154) falls within 50,000 naira and 200,000 naira, and 29.9% (85) falls within less than 50,000 naira while 15.8% (45) earns above 200,000 naira.

Table 4.2 Socio-economic Characteristic of Caregivers of Under five Children

Variable	Frequency	Percentage (%)
Caregivers educational status		
No formal education	17	6.0
Primary school	79	27.8
Secondary school	123	43.3
Tertiary school	65	22.9
Total	284	100.0
Occupation of head of household		
Civil servant	97	34.2
Farmer	49	17.3
Business	109	38.4
Others	29	10.2
Total	284	100.0
Classification of the children by family type		
Monogamous family	98	34.5
Polygamous family	186	65.5
Total	284	100.0
Classification of the children by The sizes of their families		
1 – 5 persons	137	
6 – 10 persons	127	48.2
11 – 15 persons	134.6	44.7
16 – 20 persons	7	2.5
Total	284	100

Estimated annual income of household heads		
50,000 – 100,000 naira	85	29.9
150,000 – 200,000 naira	154	54.3
Greater than 200,000 naira	45	15.8
Total	284	100.0

4.2 Prevalence of Nutritional Anaemia Among the Under five Children in SabonGari local Government Area of Kaduna State

The distribution of anaemia by age based on Haemoglobin levels is presented in table 4.3. From the table children between 0 to 12 months who had low haemoglobin (less than 11g/dl) were 30.6% compared with 28.2% of the children who have normal levels of haemoglobin (greater than 11g/dl) within that age. At the age of between 13 to 24 months the low levels among the children was 18.7% compared to only 7.7% who had normal levels. At the age of between 25 to 36 months 8.5% had low haemoglobin level while only 0.4% had normal haemoglobin levels, children between 37 to48 months who had low levels of haemoglobin were 3.9% while 1.1% had normal haemoglobin levels, children between 49 to 59 months who had low haemoglobin levels were 0.7% while 0.4% had normal haemoglobin levels. The total prevalence rate of low levels of haemoglobin among the children 0 to 59 months of age was 62.4%.

Table 4.4 showed the prevalence rate of nutritional anaemia due to serum iron concentration for children between 0 to 12 months, the percentages of deficiency in serum iron concentrations was 28.5% while those with normal serum iron concentration are 30.3%. Children between 13 to 24 months were 16.2% deficient in their serum iron concentration levels while 10.2% had normal serum iron concentration levels, children between 25 to 36 months who are deficient in serum iron concentration levels were 4.9% while 3.9% had normal levels of serum iron concentration. Children between 37 to 48 months who had deficiency in serum iron concentration were 3.5% while 1.4% had normal level of serum iron concentration, children between 49 to 59 months who had deficiency in serum iron concentration were 0.7% while 0.4% had normal serum iron concentration and the prevalence rate was 53.8%.

Table 4.3 Prevalence of Anaemia Based on Age Distribution of Under five Children in SabonGari Local Government Area

	Haemoglobin (g/l)	Reference 11g/l	Value

Age of Children	Low level (<11g/l)		Normal(>11g/l)		% Prevalence
	Frequency	percentage	Frequency	percentage	
0 – 12 months	87	30.6	80	28.2	30.6
13 –24 months	53	18.6	22	7.7	18.7
25 – 36 months	24	8.5	1	0.4	8.5
37 – 48 months	11	3.8	3	1.1	3.9
49 – 59 months	2	0.7	1	0.4	0.7
Total	177	62.2	107	37.8	62.4

Table 4.4 Distribution of Serum Iron Concentration Among Under five years Children in SabonGari Local Government Area

	Serum Iron Concentration (µmol/l)	**Reference Value 50 – 170 µmol/l**

Ages of children	Deficiency		Normal levels		% Prevalence rate
	Frequency	percentage	frequency	percentage	
0 – 12 m	81	28.5	86	30.3	28.5
13-24m	46	16.2	29	10.2	16.2
25-36m	14	4.9	11	3.9	4.9
37–48m	10	3.5	4	1.4	3.5
49-59 m	2	0.7	1	0.4	0.7
Total	153	53.8	131	46.2	53.8

Table 4.5 showed the prevalence rate of nutritional anaemia due to serum folic acid concentration among the under five children. From the table, children between 0 to 12 months who had deficiency in serum folic acid concentration levels were 17.6% deficient while 41.2% had normal serum folic acid levels. Children between the age of 12 to 24 months of age who had deficiency in serum folic acid concentration levels were 11.3% while 15.1% had normal levels of serum folic acid levels, children between 22 to 36 months who had deficiency in serum folic acid concentration levels were 4.9% while 3.9% had normal levels

of serum folic acid levels, children between 37 to 48 months who had deficiency in their serum folic acid concentration levels were 2.1% while 2.8% had normal levels of serum folic acid level, children between 49 to 59 months who had deficiency of serum folic acid concentration levels were 0.4% while 0.4% had normal serum folic acid levels. The prevalence rate was 36.3%.

Table 4.6 showed the prevalence rate of nutritional anaemia among under five in SabonGari LGA due to serum vitamin B_{12} from the table, the children who are between 0 to 12 months who had deficiency in serumvitamin B_{12} levels were 25% while 33.8% had normal serum vitamin B_{12} levels, children between 12 to 24 months who had deficiency in theirserum vitamin B_{12} levelwere 13.7% while 12.7 had normal serum vitamin B_{12} level, children between 25 to 36 months who had deficiency in their serumvitamin B_{12} level were 6.3% while 2.5% had normal serum vitamin B_{12} level, children between 37 to 48 months who hadserum vitamin B_{12}deficiency were 3.9%while 1.1 had normal serum vitamin B_{12} level. Children between 49 to 59months who had deficiency of serum vitamin B_{12} were 0.7 % while only 0.4% had normal serum vitamin B_{12} level. The prevalence rate was 49.6%.

Table 4.5 Distribution of Serum Folic Acid Concentrations Among Under five years Children in SabonGari Local Government Area

Ages	**Folic Acid Level (nmol/l)**	**Reference Value 7 – 45nmol/l**

	Deficiency		Normal level		% Prevalence
	Freq.	%	Freq.	%	
0-12 months	50	17.6	117	41.2	17.6
13-24 months	32	11.3	43	15.1	11.3
25-36 months	14	4.9	11	3.9	4.9
37-48 months	6	2.1	8	2.8	2.1
49-59 months	1	0.4	2	0.7	0.4
Total	103	36.3	181	63.7	36.3

Table 4.6 Distribution of Serum Vitamin B_{12} Concentration Among Under Five Years Children in SabonGari Local Government Area

	Vitamin B_{12}Concentration (pmol/l	ReferenceValue
		81 – 590pmol/l

Ages	Deficiency		Normal level		% Prevalence
	Freq.	%	Freq.	%	
0-12 months	71	25.0	96	33.8	25.0
13-24 months	39	13.7	36	12.7	13.7
25-36 months	18	6.3	7	2.5	6.3
37-48 months	11	3.9	3	1.1	3.9
49-59 months	2	0.7	1	0.4	0.7
Total	141 49.6		14250.5		49.6

4.3 Assessment of the Predisposing Factors to the Determinants of Nutritional Aneamia Among under-five Children in the Study Area.

Table 4.7 shows the significant association of the predisposing factors to nutritional anaemia among under five children. From the table it revealed that Socio-economic status of children's caregivers. Breast feeding method adopted, food used for weaning the child and adequacy of food in the household were significant predisposing factors to the children's nutritional anaemia ($P < 0.05$). But age of child at weaning was not found to be a significant predisposing factor to the children under five haemoglobin levels ($P > 0.05$).

Table 4.8 shows the significant association of the predisposing factors to nutritional anaemia with serum iron concentration among the children under-five years. The table revealed that the socio-economic status of the caregivers, weaning food and adequacy of food in the house were found to be significant predisposing factors to serum iron deficiency ($P < 0.05$). Breast feeding method and age at weaning were not significant predisposing factors to the children's serum iron concentrations levels ($P < 0.05$).

Table 4.9 shows the significant association of the predisposing factors to nutritional anaemia and folic acid level. From the table it revealed that socio-economic status, breast feeding method, age at weaning and adequacy of food always in the house was a significant predictor of children's folic acid levels ($P < 0.05$). Weaning food was not significant predisposing factors to folic acid level ($P > 0.05$).

Table 4.7 Multinomial Logistic Regression of the Predisposing Factors to Haemoglobin Levels in Under five years Children in PHCs Clinics of SabonGari Local Government Area of Kaduna State

Predisposing Factors	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	Df	Sig.
Socio-economic status	113.119	32.318	2	.000

Breast feeding method	91.531	10.730	2	.005
Age at weaning	88.352	7.551	5	.183
Weaning food	91.616	10.815	3	.013
Adequacy of food	97.767	16.966	1	.000

Table 4.8 Multinomial Logistic Regression of the Predisposing Factors to Serum Iron Concentration Levels in Under five years Children in PHCs Clinics of SabonGari Local Government Area of Kaduna State.

Predisposing Factors	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	Df	Sig.
Socio-economic status	119.487	27.111	2	.000
Breast feeding method	95.938	3.563	2	.168

Age at weaning	96.843	4.468	5	.484
Weaning food	100.039	7.664	3	.053
Adequacy of food	101.539	9.164	1	.002

Table 4.9 Multinomial Logistic Regression of the Predisposing Factors to Serum Folic Acid Concentration Levels in Under five years Children in PHCs Clinics of SabonGari Local Government Area Kaduna State.

Predisposing factors	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	Df	Sig.
Socio-economic status	111.924	6.105	2	.047
Breast feeding method	112.493	6.674	2	.036
Age at weaning	128.949	23.130	5	.000
Weaning food	112.514	6.695	3	.082
Adequacy of food	111.982	6.163	1	.013

Table 4.10 shows the association of the predisposing factors to nutritional anaemia and vitamin B_{12} concentration among the children under-five years of age. The table revealed that Socio-economic status of children's care givers Breast feeding method and adequacy of food in the house were significant predisposing factors to the children's vitamin B_{12} levels ($P < 0.05$) but age of child at weaning and food adopted for weaning, the extent of their associations as predisposing factors was not found to be significant ($P > 0.05$).

Table 4.10 Multinomial Logistic Regression of the Predisposing Factors to Serum Vitamin B_{12} Concentration Levels in Under five years Children in PHCs Clinics of SabonGari Local Government Area of Kaduna State.

Predisposing Factors	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	Df	Sig.
Socio-economic status	115.058	32.870	2	.000
Breast feeding method	88.415	6.227	2	.044
Age at weaning	87.784	5.596	5	.348
Weaning food	89.702	7.514	3	.057
Adequacy of food	89.089	6.901	1	.009

4.4 Assessment of Food Consumption Pattern of the Household

The opinion of the care givers on the foods and frequencies of consumption are presented in Table 4.11. The table shows that grains mainly rice, maize and noodles have the highest frequency of consumption by the household. Next in this pattern of consumption is pap and bread these types of food were consumed between six and seven times per week. Foods like meat, fish, eggs, milks, beverages and vegetables were only consumed occasionally Food consisting of vitamin supplement like multivitamin syrup and syrup ascorbic acid were never consumed in most cases.

Table 4.11 Frequencies of Foods Consumption and Pattern by the Household

Foods	Never		Occasionally		Once a week		2-3 times a week		4-5 times a week		≥6 times in a week	
	Feq	%	Feq	%	Feq	%	Feq	%	Feq	%	Feq.	%
Meat	26	9.2	137	48.2	18	6.3	55	19.4	40	14.1	8	2.9
Fish	23	8.1	117	41.2	33	11.6	61	21.5	37	13.0	13	4.6
Egg	25	8.8	166	58.5	20	7.0	53	18.7	14	4.9	6	2.1
Milk	11	3.9	71	25.0	37	13.0	51	18.0	21	7.4	93	32.8
Beans products	25	8.8	13	4.6	23	8.1	105	37.0	40	14.1	78	27.5
Fruits	21	7.4	146	51.4	48	16.9	42	14.8	16	5.6	11	3.9
Vegetables (moringa, spinach)	21	7.4	133	46.8	31	10.9	59	20.8	26	9.2	14	5.0
Grains/Noodles	23`	8.1	6	2.1	7	2.5	8	2.8	9	3.2	231	81.4
Beverages	29	10.2	132	46.5	9	3.2	26	9.2	24	8.5	64	22.5
Pap/bread	26	9.2	29	10.2	9	3.2	32	11.3	5	1.8	183	61.4
Vitamin supplement	238	83.8	41	14.4			1	.4			4	1.5

4.5: Relationship between the Annual income of the Caregivers and their Children's Nutritional Anaemia

Table 4.12 shows the result of the test of relationship between the annual income of the caregivers and their children's nutritional anaemia. The table revealed that the nutritional levels of anaemia among the children are significantly correlated with the annual income of their caregivers. In the table, the observed chi-square value for haemoglobin association with the annual income was 37.823 obtained at 2 degree of freedom. The probability level of significance for the test was $P < 0.05$. For serum iron concentrations, the observed chi-square value is 42.967 while the observed value of chi-square for folic acid levels was 19.053 all at significant levels of $P < 0.05$ respectively. The observed chi-square value for vitamin B_{12} concentration was 48.176 at a significant level of 0.05 obtained at 2 degrees of freedom.

Table 4.12 Test of Relationship between Caregivers Annual income and their Children's Nutritional Anaemia

Annual income of caregivers	Nutritional index	Deficiency		Normal level		Total	
		Observed	Expected	Observed	Expected	Observed	Expected
50,000 – 100,000 Naira	Haemoglobin levels	84	96.0	70	58.0	154	154.0
150,000- 200,000 Naira		75	53.0	10	32.0	85	85.0
Greater than 200,000 Naira		18	28.0	27	17.0	45	45.0
Total		177	177.0	107	107.0	284	284.0
Pearson Chi-Square= 37.823, DF = 2 P-value = <0.05							
50,000 – 100,000 Naira	Iron level	71	83.0	90	71.0	154	154.0
150,000- 200,000 Naira		64	45.8	14	39.2	85	85.0
Greater than 200,000 naira		18	24.2	27	20.8	45	45.0
Total		153	153.0	131	131.0	284	284.0
Pearson Chi-Square= 42.967, DF = 2 P-value = <0.05							

50,000- 100,000 Naira	Folic acid level	47	55.9	110	98.1	154	154.0

150,000-200,000 Naira		44	30.8	38	54.2	85	85.0
Greater than 200,000 Naira		12	16.3	33	28.7	45	45.0
Total		103	103.0	181	181.0	284	284.0
Pearson Chi-Square =19.053, DF 2, P-value = <0.05							
50,000-100,000 Naira	Vitamin B_{12} level	67	76.5	89	77.5	154	154.0
150,000–200,000 Naira		65	42.2	18	42.8	85	85.0
Greater than 200,000 Naira		9	22.3	36	22.7	45	45.0
	Total	141	141.0	143	143.0	284	284.0
Pearson Chi-Square = 48.176, DF = 2, P-value = <0.05							

CHAPTER FIVE

5.0 DISCUSSION

This study provides an insight on the prevalence and determinants of nutritional anaemia among under five years children in SabonGari local government area of Kaduna state, which was before now not determined.

The prevalence of serum iron deficiency in the study was 53.8% and that of folic acid deficiency was 36.3% while that of vitamin B_{12} deficiency was 49.6%. This implies that the prevalence of nutritional anaemia in SabonGari local government is high. This is as a result of poor feeding practices in the area which do adversely affect the health and nutritional status of the children. Exclusive breastfeeding was not practiced by majority of the mothers, of the total number of 284 respondents, 191(67.3%) practiced the combination of both breast feeding and bottle feeding, this practice thereby makes the children exposed to the risk of infection because of unhygienic handling of the bottles used for the feeding.Furthermore majority of the caregivers (90.1%) used pap (akamu) to wean their children, pap (akamu) is a plant-based complementary food which often contain high levels of phytate, a potent inhibitor of iron, zinc and calcium absorption Gibson et al., (2010). Pap (Akamu) is made from refined flour of milled maize if not properly prepare it retains the phytate content in it, and in this study majority of the caregivers do not prepare pap properly. This is in line with WHO and UNICEF reports(1998) that a high phytate content in maize inhibit the absorption of iron, this contribute to the high prevalence rate of stunting and anaemia in west AfricaMuller et al., (2003).

Iron content is particularly very low in tubers and refined cereals, fruits and vegetables because of their high phytate content Gibson et al., (2010). These are the main weaning foods of majority (67.3%) of the population of children below five years of age in Sabongari local government area of Kaduna state. Children aged below five years are at high risk of iron deficiencies because of higher demand of nutrients due to rapid growth and developmentBreastfed infants who do not receive iron-rich complimentary foods by six months of age can quickly become iron deficient because breast milk has low iron content (Lynch and Stoltzfus, 2003).In this study, the under five children typically consumed little meat or animal product, iron deficiency was therefore common. This is in line with world

Health Organization that iron deficiency affects more people than any other condition, constituting a public health condition of epidemic proportions with a devastating heath consequence (WHO, 2003).

Infants solely breastfed for a long period of time developed pernicious anaemia due to dietary vitamin B_{12} deficiency because vitamin B_{12} content is more in plant and animal protein than in breast milk (Gregory, 1997). In this study food that are rich in vitamin B_{12} such as meat, fish and eggs are consumed occasionallyby the household and nutrition in children below five years of age depends critically on nutrition of the household, these leads to the high prevalence rate of vitamin B_{12} in the study area.

Educational level and annual income of the caregivers are the important socio-economic characteristic that links to the factors which determine health seeking behaviors and nutritional status of a household. In this study majority of the caregiver (43.3%) have secondary education, 27.8% have primary education, 22.9% have tertiary education while 6.0% have no formal education. 29.9% of the caregivers earns 50,000 to 100,000 naira per annum, majority (54.3%) earns between 150,000 to 200,000 naira per annum while only 15.8% earnsabove 200,000 naira per annum. Caregivers educational level and income are inversely related to their children's risk of malnutrition and death (UNICEF, 2013).

The predisposing factors to nutritional anaemia are (socio-economic status, breast feeding method, age at weaning, weaning food and adequacy of food in the household) where significant predictors to nutritional anaemia ($p<0.05$). This is due to the fact that low income of the caregivers leads to household food insecurity which predisposed the children to nutritional anaemia. Knowledge on breast feeding and weaning methods is an important factor in preventing nutritional anaemia but in this study, majority of the care givers lacked knowledge on breast feeding method and weaning which contributed to the risk of exposure to nutritional anaemia in these children, although age of child at weaning was not found to be significant ($p > 0.05$) predictors to nutritional anaemia, this is due to the fact that majority of the caregivers weaned their children at the age between 12 to 24 months which is within the normal age for weaning, these are the periods where breast milk will not be enough for the child due to rapid growth and development and the vitamins needed by the body are found in complimentary food. The finding here agrees with Suitor (2000), who reported that naturally occurring food folate is concentrated in selected foods including orange juice, dark green leafy vegetables, asparagus, strawberries, peanuts, and legumes such as kidney and lima beans. Cook (2005) opined that factors that may negatively influence folate-dependent 1-C metabolism include inadequate folate intake, reduced bioavailability, folate-related genetic polymorphisms, and interactions with various nutrients and drugs.

The food consumption pattern of the household was mainly carbohydrate based food like rice, maize, and noodles. This pattern of food consumption inhibit the absorption of iron and by implication leads to nutritional anaemia which agrees with Gibson et at., (2010), who reported that iron content is particularly very low in tubers and cereals fruit and vegetables because of their high phytate content. Foods like meat, fish, eggs and milk were only consumed occasionally and these are foods that enhance the absorption of iron, and the foods are consumed occasionally due to the poor socio-economical background of the caregivers of the under five children in the study area.

Socio-economic status of the caregivers was significantly correlated ($p<0.05$) with their children under five years nutritional anaemia and these implies that the children whose caregiversearns more than 200,000 thousand naira per annum have good nutritionalanaemic status while those that earns between 50,000 to 100,000 per annum have poor nutritional anaemic status.In this study the caregivers socio-economic characteristic (educational level and estimated annual income) was low which leads to the high prevalence rate of nutritional anaemia among their under five year children. The findings of this study agrees with Park, (2005), who reported that socio-economic status affects the risk of anaemia by affecting nutritional status, family size and interval as well as intensifying problems of affordability and accessibility of preventive and curative measures.

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary

A total of 311 questionnaires were distributed, however 284 were retrieved and analyzed giving a response rate of 91.3%. The selection of the respondents was undertaken through stratified random sampling techniques. Iron, folic acid and Vitamin B_{12} were assessed as determinants of nutritional anaemia. Socio-economic status, breast feeding method, weaning method, weaning food, adequacy of food in the household and age at weaning are found to be the predisposing factors to nutritional anaemia.

Carbohydrate based foods are the highest food consumed by majority of the household which is the main hindering factor of iron absorption.Socio-economic characteristics (estimated annual income and educational level) of the children's caregiver is significantly correlated ($p > 0.05$)to the children's nutritional anaemia.

6.2 Conclusion

From the analysis of the data of the study the following conclusions are hereby drawn:

1.The study revealed that socio-economic status of the respondent caregivers were poor resulting in poor access to foods rich in iron, folic acid and vitamin B_{12}. This is because the people depend mainly on carbohydrate based diets like maize, yam, cassava and rice.

2. There was high rate of nutritional anaemia among under five children in the study area with prevalence of 53.8% iron, 36.3% folic acid and 49.6% vitamin $B_{12.}$

3. The predisposing factors of the determinants of nutritional anaemia (iron, folic acid and vitamin B_{12}) are socio-economic status, weaning method, weaning food, breast feeding method and adequacy of food in the household, these factors are significantly related ($p< 0.05$) to the determinants.

4. The pattern of food consumed in the household was not found to be advantageous for improving the nutritional anaemic status of the children under five years, the food consumed

in the household are mainly carbohydrate based food like maize, yam, cassava, noodles and rice.

5. Nutritional anaemia is significantly correlated with the socio-economic statuses of the children's caregivers ($p<0.05$).

6.3 Recommendation

Based on the outcome of this study, I recommend that nutritional education should be emphasized by health care providers during ante natal and post natal clinic.

There should be increased advocacy for dietary diversification so as to increase consumption of iron and folate rich foods by the children from early age.

The Government should introduce iron and folate supplementation programmes in the child welfare clinics in the state. And the study should be replicated on a wider scale within the state.

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APPENDIX I

SURVEY QUESTIONNAIRE

Instruction: Please kindly provide answers to the following questions.

Social Data

Clinic/Hospital ---

Card number ---

Age of child (months/years) ---

Haemoglobin, iron, folic acid, and vitamin B12 level

	Haemoglobin	Iron	Folic acid	Vitamin B12
Level in blood				

Sex of child:1=Male2=Female()

How are you related to the child?:1= Mother2= Foster parent3= Relative()

Ethnic group: 1= Hausa2= Igbo3= Yoruba4= Others()

Religion:1= Islam2= Christianity3= Others()

Mother's level of education: 1= Primary school2= secondary school3= Tertiary school ()

Residence: 1= Urban2= Rural()

Occupation ofFather: 1= Civil servant2= Farmer3= Business4= Others()

Occupation ofmother: 1= Housewife2= Business3= Civil servant 4= Others()

What is the annual income of father-----------------

HOUSE HOLD COMPOSITION

Your family is:1= Monogamous2= Polygamous()

How many people are there in your family?including all dependents--------------

How manyunderfive children are there in the household?--------------

What are the ages of the children mentioned above:

1= <1 year

2= 1 year

3= 1 – 2years

4= 3 – 4years

5= 4 – 5years()

FEEDINGPRACTICE.

18 what is the best method of feeding a baby?

1=Breast feeding

2=Bottle feeding

3=Combining both()

19 if bottle feeding is practiced, what kind of food do you give?

1=Cerelac

2=Nan

3=Goat milk

4=Pap()

20 At what age (months) do you start to wean your baby?--------------

21 What kind of food do you use to wean your baby?

1=Pap ,yam ,rice, noodles.

2=bean, akara, moimoi, wara.

3=meat

4=fish()

22 Do you always have adequate food for your child?

1= yes2= No()

23 ifno to question 22, what is your reason?

1= there is no enough money to buy food.

2=there are too many children in the household to feed.

3=there is no one around to cook till at night.

4=Not applicable.

APPENDIX II

FOOD FREQUENCYQESTIONNAIRE

How often do you give your child the following food (please tick which is applicable)

	Every day	Once a week	2-3 times a week	4-5 times a week	6-7 times a week	Occasionally	Never
Meat							
Fish							
Egg							
Milk							
Beans,akara,wara,alale							
Fruits							
Green leafy vegetable							
Maize,rice,wheat,noodles							
Coffee,tea,bourvita,milo							
Pap(kunu),bread							
Vitamin supplements							

Thank you for your time and response.

Plate 3.1: the Researcher Explaining the Purpose and Procedure of the Research to the Respondents at Bomo PHC.

Plates 3.2: The Researcher interviewing theRespondents using structured questionnaire at BomoPHC centre.

Plate 3.3: The Researcher Explaining the Purpose and Procedure of the Research to the Respondents at HayinDogo PHC centre.

Plate 3.4: The Researcher with Medical lab Tech. Taking blood samples of Respondents

Reference Value/Normal range (WHO, 2014).

Haemoglobin----- 110g/l

Iron--------------- 50-170µmol/l

Folate------------ 7-45nmol/l

Vitamin B12---- 81-590pmol/l

FACULTY OF LIFE SCIENCES

AHMADU BELLO UNIVERSITY, ZARIA

Dear Sir,

I am Mohammed Nafisa an MSc student in the Department of Biochemistry of the above named institution; I am carrying out a research on **“Prevalence and Determinants of Nutritional Anaemia among underfive in SabonGari local Government, Zaria kaduna state**”. Participation is voluntary and involves collection of certain information on socioeconomic and food consumption pattern as well as blood sample of your child for assessment of haemoglobin, iron, folic acid and vitamin B_{12} in order to determine nutritional anaemia in your child.

The information collected from you will be used strictly to achieve the objectives of this study and for scientific publication. I assure you that this study has been reviewed and approved by my supervisors and the State Committee on Research Ethics.

Thank you for your understanding.

Yours sincerely,

Mohammed Nafisa

APPENDIX III

CONSENT TO PARTICIPATE IN RESEARCH

PREVALENCE AND DETERMINANTS OF NUTRITIONAL ANAEMIA AMONG UNDERFIVE IN SABONGARI LOCAL GOVERNMENT AREA, KADUNA STATE

INTRODUCTION

You are kindly being asked to participate in a research study conducted by Mohammed Nafisa for a Master of Science degree under the supervision of Dr A.B Sallau from the Department of Biochemistry, Faculty of life Sciences, Ahmadu Bello University, Zaria.

If you have any questions or concerns about the research, please feel free to contact: Mohammed Nafisa, Faculty of sciences, Ahmadu Bello University, Tel: 07037926154.

PURPOSE OF THE STUDY

The purpose of this project is to determine the Prevalence and determinants of nutritional anaemia among underfive children in SabonGari local Government. This study is in partial fulfilment of requirements for the award of M.Sc. degree in Nutrition, Department of Biochemistry, Ahmadu Bello University, Zaria.

WHY ARE YOU BEEN ASKED TO PARTICIPATE?

You are being invited because you are attending underfive Clinic in PHC ofSabongari local Government of Kaduna State.

WHAT WILL HAPPEN DURING THIS STUDY?

Information pertaining demographics (i.e. age, sex, etc.), and food consumption pattern of your child will be collected using a questionnaire. Sample of your child’s blood will be collected.

POTENTIAL RISKS AND DISCOMFORT

This study does not pose any form of physical, emotional or psychological risks to you.

POTENTIAL BENEFITS TO PARTICIPANTS

The result of this study will help in assessing your child's nutritional anaemic status. This research work can also be used in planning, evaluation and advocacy in Kaduna State and can lead to the implementation of interventions to improve health and survival.

WILL THERE BE ANY COST FOR PARTICIPATING?

Aside from your time, there are no costs in taking part in the study.

REMUNERATION FOR PARTICIPATION

Participation will not attract any financial benefit.

CONFIDENTIALITY

Every effort will be made to ensure confidentiality of any identifying information provided by participants in. You will not be identified in any reports or publications resulting from the study.

PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise that warrants doing so.

RIGHTS OF RESEARCH PARTICIPANTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. This study has been reviewed and received ethical clearance from ministry of health Kaduna, Kaduna State. If you have any questions regarding your rights as a research participant, you can obtain further information about the research or voice your concerns to:

Dr A.B Sallau

Department of Biochemistry,

Faculty of Life Sciences,

Ahmadu Bello University.

SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE

I have read the information provided for the study "Prevalence and Determinants of Nutritional Anaemia among Underfive Children in SabonGari local Government area, Kaduna state" as described here. I have been given a copy of this form.

____

Name of parent/ guardian

____________________________________ _______________

Signature of parent/ guardian Date

APPENDIX IV

PREVALENCE AND DETERMINANTS OF NUTRITIONAL ANAEMIA AMONG UNDERFIVE IN SABON GARI LOCAL GOVERNMENT AREA, KADUNA STATE

Name: Mohammed Nafisa

Position: MSc Student

Contact Address: Department of Biochemistry, Faculty of life Sciences, Ahmadu Bello University, Zaria

I confirm that I have read and understood the information sheet for the above study and have had the opportunity to ask questions.

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason.

I agree to take part in the above study.

____

Name of Participant　　　　　　　Date　　　　　　　Signature

____

Name of Researcher　　　　　　　Date　　　　　　　Signature

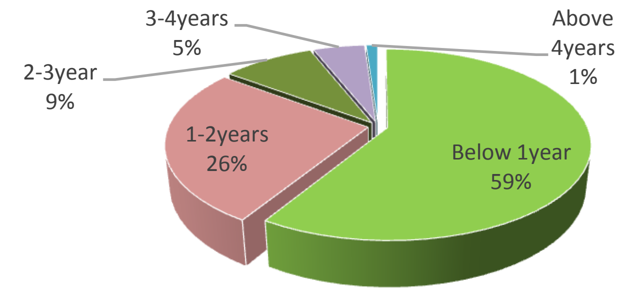

Fig. 1: percentage classification of the children by their age rangesPercent

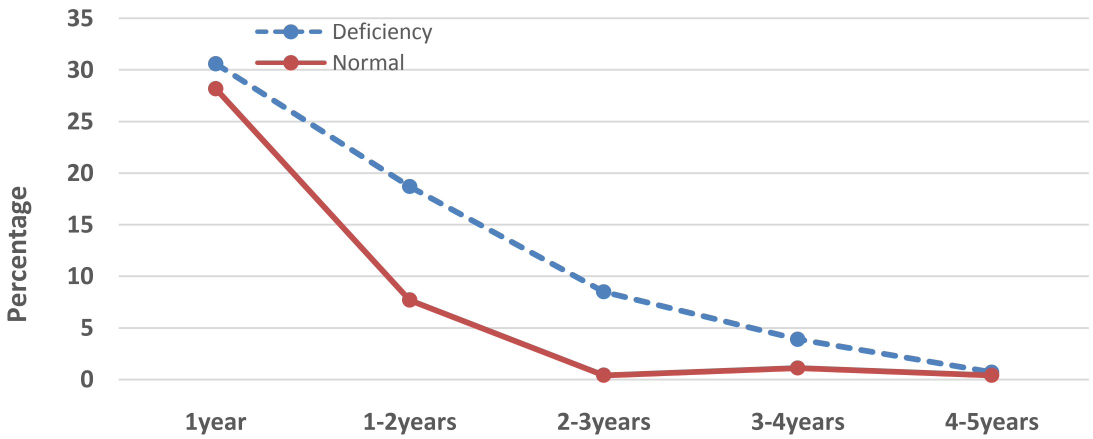

Fig. 3: Percentage classification of the children's ages by standard levels of haemoglobin

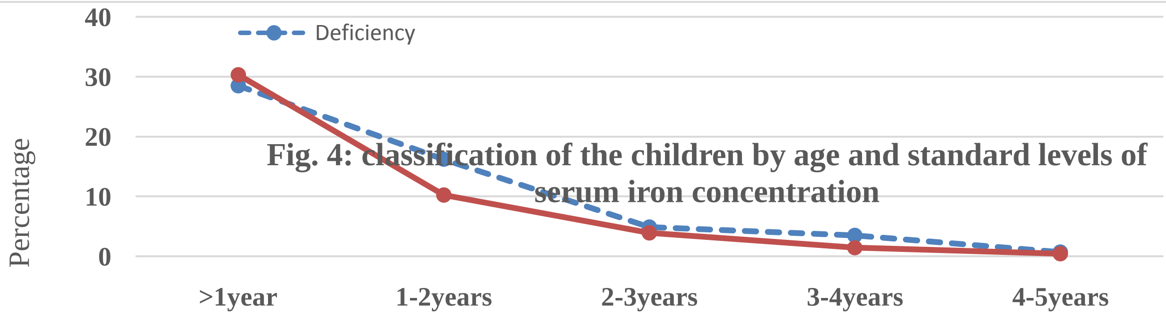

Fig. 4: classification of the children by age and standard levels of serum iron concentration

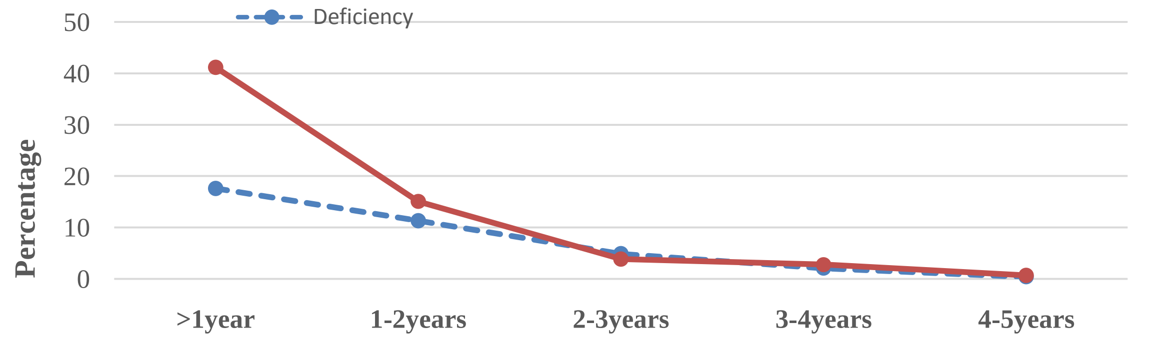

Fig. 5: Standardized classification of the children by levels of folic acid

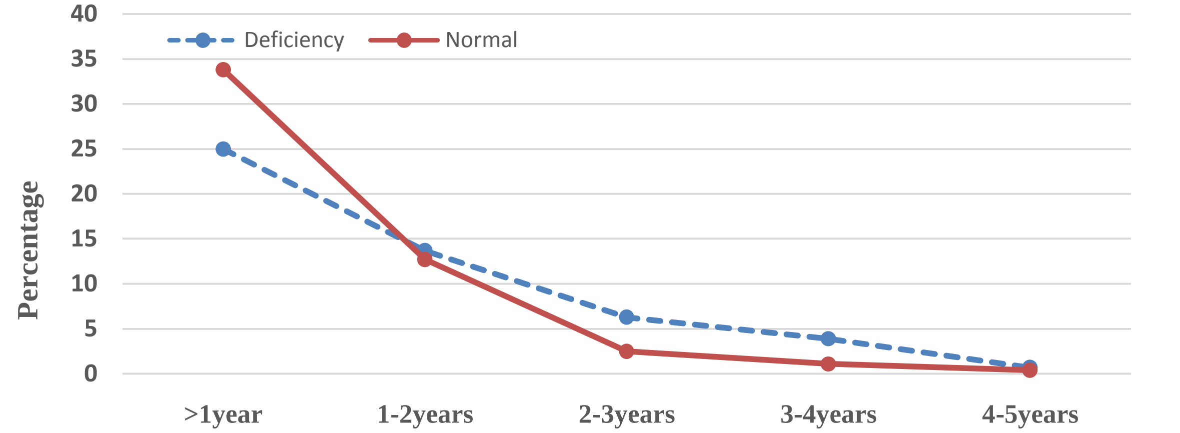

Fig. 6: Standardized classification of the children by age and levels of vitamin B12

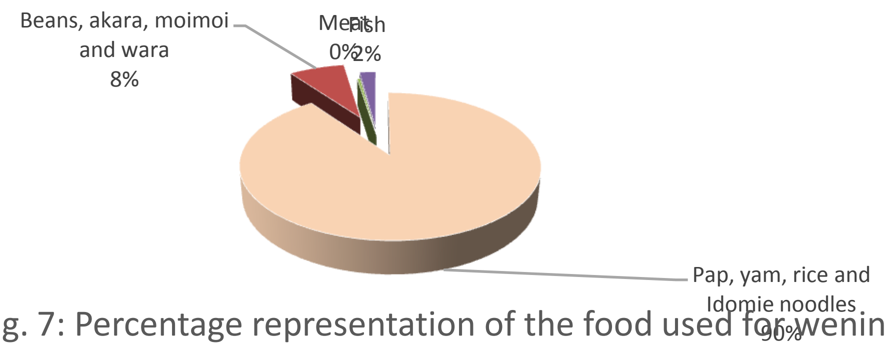

Fig. 7: Percentage representation of the food used for wening the children by their mothers

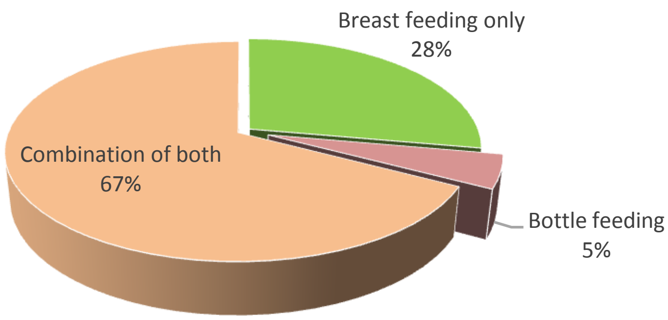

Fig. 9: Percentage representation of the breast feeding practices by the mothers

Age at weaning in months	Frequency	Percent
4 months	1	.4
6 months	44	15.5
7 months	110	38.7
8 months	63	22.2
9 months	40	14.1
10 months	26	9.2
Total	284	100.0

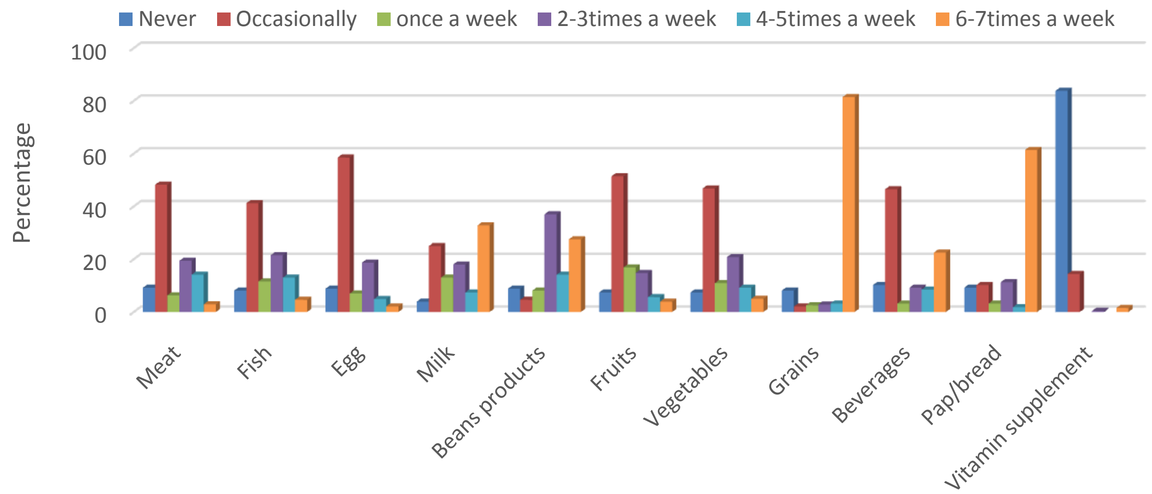

Figure 10: Percentage representation of food pattern and frequencies of consumption by the children and their caregivers