PREVALENCE OF ANEMIA IN INFANTS 3-6 MONTHS IN RELATION TO BREASTFEEDING PRACTISES: A CASE OF MAMA LUCY KIBAKI HOSPITAL, NAIROBI-KENYA

BY

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DEDICATION

This work is dedicated to The Almighty God, my late dad Dr. James Obisi Nyamasege, my mum Mrs.Drusilla Bochere Nyamasege, my siblings Felix, Emily, Ruth and Job and my dear classmates for the support they have given me since I started my studies.

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ABBREVIATIONS

ANP	Applied Nutrition Programme
BFI	Baby Friendly Hospitals,
CF	Complementary Feeding
EBF	Exclusive Breast Feeding
ENA	Emergency Nutrition Assessment
ERC	Ethical Research Committee
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
GDP	Gross Domestic Product
IFAS	Iron and Folic Acid Supplements
IDA	Iron Deficiency Anemia
IOM	Institute of Medicine
IQ	Intelligence Quotient
KNH	Kenyatta National Hospital
KDHS	Kenya Demographic Health Survey
MLKH	Mama Lucy Kibaki Hospital
MUAC	Mid-Upper-Arm-Circumference.
SCN	Sub-Committee on Nutrition
SE	Standard Error
SPSS	Statistical Package for the Social Sciences
UON	University of Nairobi
UNICEF	United Nations International Child’s Fund.
WHO	World Health Organization

DEFINITION OF TERMS

Anemia: This is a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs

Complementary Food: These are foods that are readily consumed and digested by the young child and that provide addition nutrition to meet all the growing child's needs. They comprise of all liquid, semisolid and solid foods other than breast milk which are fed to infants being weaned from the breast.

Complementary Feeding: This is the process of introducing complementary foods. It involves feeding an infant on any other food or fluids in addition to breast milk or a breast milk substitute, (WHO, 2002).

Exclusive Breast-feeding: Giving an infant no food or drink except breast milk, not even water or breast milk substitute, with exceptions of drops of syrup containing vitamins, mineral supplements or medicines.

Heme iron is derived from hemoglobin hence originate from animal source while non-heme irons do not come from an animal source.

Iron deficiency: is a condition in which there are no mobilizable iron stores and in which signs of a compromised supply of iron to tissues, including the erythron, are noted.

Mixed Breast-Feeding: Means that besides human milk the infant receives infant milk formula.

Partial Breast-Feeding: Means breast-feeding together with complementary food (German National Breast-feeding Committee, 2007).

Predominant Breastfeeding: The infant's predominant source of nourishment is breast milk. However, the infant may also receive water and water-based drinks (sweetened and flavoured water, teas, infusions etc.); fruit juice; oral rehydration salts solution; drop and syrup forms of vitamins, minerals and medicines; no food-based fluid is allowed under this definition.

Weaning: The transition from exclusive breastfeeding to the cessation of breastfeeding through introduction of complementary food and which gradually leads to a dietary pattern customary in the infants.

ABSTRACT

Although studies have been carried out on breastfeeding and supplementary feeding of infants, so far, little information exist on the relationship between breastfeeding practices and the development of anemia in infants. This study was therefore designed to assess the association between breastfeeding type, maternal iron status and other associated factors on hemoglobin concentration in the blood of 3-6 months old infants.

The study was cross sectional survey involving both descriptive and analytical components. The study was conducted at Maternal and Child health clinic in Mama Lucy Kibaki Hospital in Nairobi and targeted 3-6 months old infants. A previously pretested structured questionnaire was administered to collect socio-demographics and socio-economic characteristics of the household, infant feeding practices, morbidity, their nutritional status and anthropometry of the mothers. Results were analyzed using Chi-square test and linear regression to determine the difference between proportions and odds ratios to estimate the relative risk. The statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS), version 12.

In total, 250 mother infant dyads participated in the study. Majority (91.5. %) of the respondents were aged 20-35, years while only 4.5% were 19 years and below and 4% aged between 36-45 years. The mean age of the mothers was 26.53 with a range of 15-45 years. The mean household size was 4.3 members and the national average mean household size is 4.6 for urban areas. The dependency ratio was 74. Among the infants studied, 52% were males and 48.0% were females. The greatest share of the infants were aged 5 months (38 %) followed by those aged 4 months (36%) then those who were aged 3 months (26%). The mean age of the infants was 4.12 ranging from 3-6 months.

The prevalence of exclusive breastfeeding was 57.0% among the infants followed by those who were partially breastfed at 38% then those who were mixed breastfed at 4.8%. The birth weight of the infant, anemia experiences of the mother during pregnancy and sickness in the past two weeks were significantly ($p<0.05$) associated with the breastfeeding type.

The rates of under nutrition were low with wasting at 1.2% underweight at 2.0% and stunting at 11.2%. Of the stunted children, 10.4% were moderately stunted and 0.8% severely stunted. Growth pattern and stunting were found to be significantly ($p<0.05$) associated with marital status of mothers, birth order, sex, birth weight and weaning age of the infant. Up to 96.3% of the infants had been immunized completely for their age.

The mean weight of the mothers at delivery was 72.6 kg, with a range of 50-106 kg, while the mean weight obtained at the time of data collection was 67.4 kg with a range of 43.2-115kg. Their mean height was 1.59 m with a range of 1.45-1.71m. Up to 43.5% of the mothers were overweight and 37.5% had normal weight. Most women (76%) took the Iron and Folic acid supplementation with 35% taking the supplements for one or two months, 24% for 3 or 4 months and 12% for 5 or 6 months. The mean hemoglobin level of mothers during pregnancy was 11.9 g/dl with a range of 9-14.3 g/dl. The prevalence of moderate and mild anemia during pregnancy was 15.5% and 5.5% respectively with no reported cases of severe anemia.

The mean prevalence of anemia in the infants was at 54.5%, with 32.5% mild 22.5% moderate and 0.5% severe. The mean hemoglobin level was 10.7 g/dL. Low birth weight (P=0.029), maternal iron supplementation during pregnancy (P=0.023), infant sickness in the preceding two weeks prior to the survey (P=0.02) and breastfeeding practices (OR=1·46; 95 %=1.3, 2.6, P=0·04) were significantly associated with anemia in infants.

Of the infants, 42.5% had experienced sickness two weeks preceding the survey of which 38.0% sought medical intervention.

The study concludes that exclusively breastfed infants are at a higher risk of developing iron deficiency anemia as compared to those who are introduced to complementary feeds earlier than six months and those given infant formulas alongside breast milk.

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND INFORMATION

Nutrition is the most important factor in child health promotion, growth and development; especially during the first two years of life, when the speed of neuropsychomotor growth and development is greatest. The health and nutrition of mothers and their children are intimately related, World Health Organization (WHO, 2006).The effects of nutrition begin even before conception, promoting intrauterine growth and development, physical growth and mental development. Therefore, the nutrition status of an individual is determined by balance of intake of proteins, energy and micronutrients (vitamins and minerals).

Iron is one of the most important minerals in nutrition. It is found naturally in many foods at varying levels. It is involved in many physiological functions in the body. Poor iron intake can lead to iron deficiency and later to anemia. Globally, Iron Deficiency Anemia, affects up to 60% of children aged 48 months and above globally, with the highest prevalence being found in developing countries (McLean et al., 2009). Therefore, anemia is amongst the most important contributing factors to the global burden of disease during childhood.

According to a recent report on the global prevalence of anemia, one in four people are affected by anemia worldwide with pregnant women and preschool-age children at the greatest risk. Based on recent estimates from the WHO, the prevalence of anemia is 24.8% globally and the highest rates are found in preschool-age children (67.6%) and pregnant women (57.1%) in sub-Saharan Africa. (McLean et al., 2009; WHO, 2008).Two-thirds of preschool-age children are affected in developing regions of Africa and South East-Asia, and about 40% of the world's anemic preschool-age children reside in South-East Asia. Of the 293.1 million children who suffer from anemia worldwide, 83 million (28%) are in sub-Saharan Africa (McLean et al., 2009; WHO, 2008). In a study conducted in four towns in the Brazilian state of Pernambuco, infants were recruited at birth and followed up to 6 months, the frequency of anemia among the 330 infants assessed at 6 months of age was 65.2% with 26 children 7.9%; having hemoglobin below 9.0 g/dL and just 1% with hemoglobin $<$ 7.0 g/dL. Mean hemoglobin was 10.5 g/dL (standard deviation = 1.2 g/dL) and the frequency of maternal anemia (hemoglobin $<$ 12 g/dL) was 31.5% (95% CI 26.8-36.9) (Teixeira et al., 2010). In Kenya, a study conducted by Frederick et al.

(2012), on 680 children aged 6-35 months, the mean prevalence of iron deficiency was 61.9 ± 2.2% .Iron deficiency especially among pregnant and lactating women in Kenya is high (>70%). Possibly children who are born with iron deficiency continue to be so even with breastfeeding because mother's milk supply of the mineral element is low (Kumar, 2008). The little information available indicates that iron deficiency in children is high.

WHO recommends exclusive breastfeeding for six months. However, iron deficiency is a concern for exclusively breastfed infants especially in vulnerable populations (Beard, 2007). There is consensus that there is no substitute for breastfeeding during the first months of a child's life. However, the duration of exclusive breastfeeding continues to be the subject of debate. In a recent review specialists concluded that the available evidence is sufficient to recommend exclusive breastfeeding for the first six months of life. Exclusive Breastfeeding rate is low in Kenya. It last measured at 31.9% in 2009, a report by KDHS (2008/2009). Experience has shown that the complementary foods given to the child even earlier than 6 months are mainly based on cereals which are low in iron and contain anti-nutrients like phytates. Moreover, most of the infant milk formulas consist of cow milk with little iron content although few manufacturers fortify it with iron.

In Kenya, most mothers have a high fertility rate, hence a high parity and this increases chances of them becoming anemic. As a result, transfer of iron via the placenta reduces and the fetus becomes at risk of iron deficiency. There is evidence that even children with normal birth weights, but born of anemic mothers, will have low iron reserves at birth and are more likely to develop anemia (Fall, 2004). Therefore, there is a high prevalence of anemia in infants and young children, which can be attributed possibility to the fact that infants are becoming anemic early in life because the iron reserves are not adequate to meet their iron needs. Anemia in pre-school children has adverse health effects on cognitive function, impaired motor development and growth, poor school performance, poor immune function, susceptibility to infections, decreased responsiveness and activity and increase in body tension and fatigue (Carter, 2010).

1.2 STATEMENT OF PROBLEM

The iron content of human milk is low at 0.4-0.8 mg/L in colostrum and 0.2-0.4 mg/L in mature milk compared to the 0.27 mg/day required by infants from birth up to 6months old. The mean human milk intakes of exclusively breast-fed infants in developing countries at the age of (1 -6) months range between 699, and 854 mL/ per day (Butte, 2002). Much of the iron is highly bio-available but it decreases with the length of lactation. The, iron content is not affected by maternal iron status. Moreover, infants born of mothers with anemia are more likely to have low iron stores and require more iron than may not be supplied by breast milk alone.

The introduction of complementary foods before six months is not recommended by WHO breastfeeding guideline (Kramer, 2012). Introducing other liquid or solid foods during the first six months of life, which is a common practice by Kenyan mothers, can interfere with the absorption of the iron from breast milk. The situation is further affected by traditional dietary practices that include giving young children at and between meals foods with flour from cereals. Mothers practice partial breastfeeding from as early as two months due to their belief that breast milk alone is not sufficient for the baby. The teas most commonly used in developing countries contain polyphenols that impair absorption of the iron. The cereal flours also contain phytates that may bind the iron, resulting in impairment of iron absorption. Tannins may also bind proteins that are linked to the (iron-globin) as well as (haem-iron) (Dewey, 2007).

Current guidelines for iron supplementation in young children are based on the assumption that iron present at birth and in breast milk is sufficient to meet requirements for the first six months of life (Zeisel, 2009). However, this assumption depends on a number of factors not often present in low-income countries: adequate maternal iron and nutritional status because iron supplementation of a mother ceases at birth, low birth weights, adequate birth practices that promote the transfer of a portion of the birth iron via placental blood and exclusive breast-feeding that avoids pathological iron loss via damage to the integrity of the intestinal wall (Chaparro, 2006).

Although, iron deficiency has been reported as the most common nutritional deficiency in the world, information on the prevalence of iron deficiency anemia in children below six months is limited. This is despite the fact that it is understood to be the most common micronutrient deficiency and cause of anemia among infants.

1.3 STUDY JUSTIFICATION

During the first six months of life, the main source of iron is fetal iron that is stored at birth and iron released from fetal hemoglobin during the first two weeks of life, umbilical cord clamping time, and prenatal iron supplementation influence total body iron at birth. Weight gain during postnatal period, which is associated with expanding hemoglobin and myoglobin, mass also influences iron requirements.

National policies have been developed to provide iron supplements to pregnant women, and to lesser extent to young children, as the primary strategy for preventing iron deficiency and anemia (WHO, 2006). By the fourth month of age, neonatal iron stores are reduced by half, and exogenous iron is required to maintain hemoglobin concentration during the rapid phase of growth above 4 months of age. This usually comes from the supplemented food. Therefore, if unattended to, it leads through a process of iron store depletion and iron deficient erythropoiesis to iron-deficiency anemia.

An infant risk of developing iron deficiency begins in utero, because premature delivery deprives the baby of the accumulation of iron near the end of pregnancy and smaller babies generally have less body iron. Unfortunately, iron in the breast milk cannot prevent the exhaustion of iron reserves in the first 4-6 months brought about by rapid growth. Poor weaning practices and inadequate feeding during childhood contribute further to the persistence or development of iron deficiency. As a result, infants 3-6 months are at risk of developing iron deficiency. Deficiencies are associated with large adverse effects on child cognitive, motor development, reduced growth rate, compromised immunity among many other many defects (Lozoff 2006). WHO has advised that iron supplementation should only be targeted to those who are anemic and at risk of iron deficiency in malaria endemic areas such as Kenya (WHO, 2006). Hence results from this will provide baseline information for policy makers to come up with intervention to address anemia in infants. The findings of this study can also benefit researchers as a reference for subsequent studies and contribute to information aimed at imparting knowledge to mothers on prevention of iron deficiency anemia in infants.

1.4 OBJECTIVES

1.4.1 Main Objective

To assess the prevalence of iron deficiency anemia among infants 3-6 months old in relation to breastfeeding type, infant and maternal nutritional status and morbidity experience of the infants.

1.4.2 Sub Objective

1) To determine the socio-economic and socio-demographic characteristics of the families of the infants
2) To determine infant feeding practices of exclusive, partial or mixed breastfeeding.
3) To determine the nutritional status of the mother and the infant.
4) To determine the hemoglobin concentration in the blood of the infants.
5) To determine morbidity experience of the infants.

1.5 STUDY HYPOTHESES

Breastfeeding practices are related to anemia among infants 3-6 months old.

Infant nutrition status is related to the development of iron deficiency anemia (IDA).

CHAPTER TWO: LITERATURE REVIEW

2.1 OVERVIEW OF INFANT NUTRITION

Infant nutrition is the most significant aspect in child wellbeing, growth and development. Breastfeeding is the recommended method of feeding by all major infant health organizations (Gartner et al., 2005). If breastfeeding is not possible or desired, bottle feeding is done with expressed breast-milk or with infant formula. Infants are born with a sucking reflex allowing them to extract the milk from the nipples of the breasts. Therefore, breast milk is recommended to be the best meal for infants. Adequate food consumption at an early age is vital for an infant's development. From birth to six months, infants should consume breast milk or an unmodified milk substitute. As an infant's diet matures, finger foods may be introduced as well as fruit, vegetables and small amounts of meat after the sixth month (WHO, 2001).

As infants grow, food supplements are added. Many parents choose commercial, ready-made baby foods to supplement breast milk or formula for the child, while others adapt their usual meals for the dietary needs of their child. Whole cow's milk can be used at one year, but lower-fat milk should not be provided until the child is 2 to 3 years old. Weaning is the process through which breast milk is eliminated from the infant's diet through the introduction of solid foods in exchange for milk (Marriott, 2003)

2.2 BREASTFEEDING TYPES COMMONLY PRACTICED ON INFANTS

The historical evolution of infant feeding includes exclusive breast feeding, directly from female human breasts for instance via lactation, use of the feeding bottle to give breast milk or cow milk, and infant formula. The other forms of breastfeeding are continued breastfeeding which is defined as nursing beyond six months, whether or not other foods and liquids are added to complement breast milk and mixed breastfeeding which is giving infants formula feeds and partial breastfeeding (Marriott, 2003).

2.2.1 Exclusive Breastfeeding

Exclusive breastfeeding means that the infant receives only breast milk. There are no other liquids or solids given not even water with the exception of oral rehydration solution, or drops/syrups of vitamins, micronutrients like iron supplements or medicines. Experts recommend that children be breastfed within one hour of birth, exclusively breastfed for the first six months, and then breastfed until age two with age-appropriate, nutritionally adequate and safe complementary foods. The major advantage of exclusive breastfeeding from 4 to 6 months includes reduced morbidity due to gastrointestinal infection (Kramer, 2002).

Some of the major factors that affect exclusivity and duration of breastfeeding include breast problems such as sore nipples or mother's perceptions that she is producing inadequate milk, societal barriers such as employment and length of maternity leave, inadequate breastfeeding knowledge lack of familial and societal support; lack of guidance and encouragement from health care professionals. These factors in turn promote the early use of breast milk substitute (Cherop, 2009). The Breast milk, which is 90% water, consists of: nutrient proteins, non-protein nitrogen compounds, lipids, oligosaccharides, vitamins, minerals, hormones, enzymes, growth factors and protective agents. The typical; milk volume is as follows, from birth to 24 hours, colostrum averages about 37 ml, from 24 to 96 hours, there is a slow rise in volume, at the fifth day, approximately 500 ml/day, three to five months: 750 ml/day and at six months: 800 ml/day. The iron content of human milk is low (0.4-0.8 mg/L in colostrum and 0.2-0.4 mg/L in mature milk). While, the Iron requirement as determined by factorial, balance and stable isotope methods which has been estimated to be 0.5 mg/day and 0.9 mg/day at 0-6 months and 6-12 months of age, respectively (Butte et al., 2002).

According to Butte et al., (2002) the mean human milk intakes of exclusively breast-fed infants in developed countries at the age of 1 to 11 months range from 699 to 910 mL/day. In a recent study, data pooled from 404 exclusively breast-fed infants in six studies from four different countries (Ghana, Honduras, Mexico, Sweden). The percentage of infants with iron deficiency (ferritin <12 μg/L) was 6% and the percentage of infants with iron deficiency anemia (hemoglobin<105 g/L) was 2% in Sweden. It was concluded that male infants and those with a birth weight of less than 2.5 kg-2.9 kg are at higher risk of iron deficiency and iron deficiency anemia. This is because weight gain during postnatal period, which is associated with expanding hemoglobin and myoglobin, mass also influences iron requirements (Yang et al., 2009).Therefore, there is need for dietary iron increases from about four months after depletion of the iron stores.

When direct breastfeeding is not possible, a mother can express, artificially remove and store her milk. With manual massage or by using a breast pump, a woman can express her milk and store it in the freezer for a maximum of six months using storage bags and containers made specifically for breastmilk, a supplemental nursing system, or a bottle ready for use. Breast milk may be kept at room temperature for up to six hours, refrigerated for up to eight days or frozen for up to six to twelve months (Hanna, 2004).

2.2.2 Mixed Feeding

Mixed feeding involves breastfeeding a baby at some feeds and giving formula milk at one or more feeds. The nutrient content of infant formula is regulated by the Food and Drug Administration (FDA) in the USA as well as Kenya Bureau of Standards in Kenya. They are based on certain recommendations that ensure the infant formulae mimic breast milk in terms of the nutrient contents. However, infant formula lacks many factors present in human milk, including numerous types of living cells, cholesterol, polyamines, free amino acids, enzymes and a wide range of other bioactive substances. Furthermore, the sterilization process used in manufacturing formula slightly modifies the structure of the cow milk proteins. Compared with unmodified cow milk and early efforts to manufacture infant feeds, most of the modern infant formulas contain reduced protein and electrolyte levels and have added iron, vitamins (including A, B group, C, D, E and K).

Although research into the development of formulas is continuing, it is unlikely that these products could ever duplicate the variety of nutrient and active factors present in human milk or Other contents which must be included in all formulas produced in the include: linoleic acid, riboflavin, Vitamin (B_2), B_6, B_{12}, thiamin (B_1), Niacin, Folic acid, Minerals like magnesium, zinc, manganese, copper, Phosphorus, Iodine, Sodium chloride, Potassium chloride, Pantothenic acid, Calcium, and Carbohydrates . This means that very few infant formulas like Cow and gate manufactured by Danone Baby Nutrition, is fortified with iron at (0.53mg of per 100ml) in the form of Iron Sulphate .Some studies have found an association between infant formula and lower cognitive development, including iron supplementation in baby formula being linked to lower IQ and other neuro developmental (Désirée, 2008). However, other studies have found no correlation (Stanley, 2007).

2.2.3 Partial Breastfeeding

Partial Breastfeeding means introducing other foods or liquids before 6 months of age alongside breastfeeding. This has negative effects for the infant and mother. Infant, receiving foods and liquids other than breast milk can lead to decreased nutritional status because of the low nutrient content and nutrient bioavailability of liquids and foods commonly fed to infants. There is also an increased risk of illness and death from infection. Providing other non-breast milk (and thus, non-sterile) liquids and foods not only provides an easy route of entry for viruses and bacteria, but also compromises the barrier function of the intestinal lining, which serves as a primary line of defense against pathogens and can lead to iron deficiency since most of the foods given are plant source that contain non-heme iron with low iron bioavailability, (German National Breast-feeding Committee, 2007).

2.3 IRON DEFICIENCY AND ANEMIA IN INFANTS

There are several different types of anemia and each one has a different cause, although iron deficiency anemia is the most common type. The other types are as follows, firstly is the aplastic anemia which is a blood disorder in which the body's bone marrow doesn't make enough new blood cells. Secondly is haemolytic anemia which is a condition in which red blood cells are destroyed and removed from the bloodstream before their normal lifespan is up. Thirdly, thalassaemias are inherited blood disorders which cause the body to make fewer healthy red blood cells and less hemoglobin, an iron-rich protein in red blood cells. Whereas sickle cell anemia is a serious disease in which the body makes sickle-shaped,"C"-shaped, red blood cells. In addition, pernicious anemia is a condition in which the body can't make enough healthy red blood cells because it doesn't have enough vitamin B12 (a nutrient found in certain foods) while fanconi anemia, or FA, is a rare, inherited blood disorder that leads to bone marrow failure (Adaman, 2005)

Iron deficiency is defined as a condition in which there are no mobilizable iron stores and in which signs of a compromised supply of iron to tissues, including the erythron, are noted. The more severe stages of iron deficiency are associated with the development of anemia (Mansvelt, 2009). Whereas, anemia is defined as a significant reduction in hemoglobin concentration, hematocrit, or the number of circulating red blood cells at a level below that is considered normal for age, sex, physiological state, and altitude.

The term infant of a well-nourished mother is born with a store of iron (body content about 75 mg/kg body weight, which can be increased by about 30-35 mg of iron by late cord clamping (at least two minutes) of the umbilical cord (Hutton, 2007). This amount of iron is sufficient to supply the iron needed for the formation of hemoglobin and myoglobin concomitant with growth until about six months of age in fully breast-fed infants (Chaparro et al., 2008).

Anemia in children has effects on their health and effective interventions to combat iron deficiency during infancy will likely promote health and development. However, it is difficult to recognize effective, safe and feasible, intervention strategies for implementation during the first six months because in sub-Saharan African, conditions which increase the risk for anemia in children are complex and multi-dimensional. A first step for evidence-based interventions and policies towards the control and elimination of iron deficiency anemia is a better understanding of prevalence and these risk factors (Chaparro, 2007). Iron supplementation is permitted within the WHO definition of ‘‘exclusive breastfeeding,’’ but may have adverse consequences for infants who are not iron deficient.

In Tanzania, a study on 309 children aged 3-23 months showed a mean Hb concentration of 9.3 +/- 1.9 g/dL, 68% of the infants were moderately anemic (7 < or =11 g/dL), and about 11% were severely anemic with Hb below 7 g/dL, while 21% were non-anemic Hb (> or =11 g/dL) (Mamiro,2005). In Kenya, a study conducted by Grant. (2012) on 680 children (aged 6-35 months) the mean (±SE) prevalence of Iron Deficiency was 61.9 ± 2.2%, whereas the prevalences based on abnormal ferritin, transferrin or ZP concentrations or an abnormal transferrin/ ferritin index were 26.9 ± 1.7%, 60.9 ± 2.2%, 82.8 ± 1.6%, and 43.1 ± 2.3%, respectively, for unadjusted values (Grant, 2012.)

According to a study on 858 children 6-35 months of age in western Kenya, moderate anemia (71.8%) and severe anemia (8.4%) were common. Overall 16.8% of anemia cases were associated with malaria, 8.3% with iron deficiency, and 6.1% with inflammation (Foote, 2013). Nearly half (43.2%-46%) of preschool children in Kenya have been estimated to be iron deficient (Mwaniki et al., 1999 and Verhoef et al., 2001). Iron deficiency is considered to be 2 to 2.5 times the rate of anemia. This estimate applies when malaria is not endemic in the region and there are no reasons to suspect widespread hemoglobinopathies.

There is inadequate literature on the prevalence of anemia among children less than 6 months old in Kenya, because of the assumption that at this age breast milk suffices to provide the necessary iron, irrespective of maternal nutritional status. Only in extreme cases of deprivation would maternal deficiency affect the child.

2.4 METHODS OF MEASURING IRON STATUS

Individuals begin to suffer from the adverse effects of iron deficiency well before they become frankly anemic and hence detectable by biochemical tests. Special laboratory tests have therefore been developed for the detection of iron deficiency. Such tests can serve to show whether the anemia present in a given population is associated to iron deficiency or to another cause, such as parasitic infections, which would require therapeutic and preventive measures. Tests of iron deficiency are thus suitable for monitoring the iron status of population groups. There are different methods for nutrition assessment of iron status; they can either be classified as clinical methods or the biochemical assessments. Clinical methods involve assessment of the physical signs and symptoms associated with iron deficiency with include pale skin, palms gums, eyelid linings and spoon shaped nails. Other symptoms may include weakness, irritability, shortness of breath, brittle nails, decreased appetite in infants and sore tongue, (Janz, 2013).

2.4.1 Biochemical Methods

Biochemical assessment involves measuring the concentration of, ferritin and transferrin, even though not all anemias is caused by iron deficiency. Measurements of serum ferritin and transferrin receptor provide the best approach to measuring the iron status of populations. In places where infectious diseases are common, serum ferritin is not a useful indicator because inflammation leads to a rise in the concentration of serum ferritin as a result of the acute phase response to disease (WHO 2004). Serum iron concentration measures the amount of ferric iron bound mainly to serum transferrin but does not include the divalent iron contained in serum as hemoglobin. Serum iron concentration is decreased in many people with iron-deficiency anemia and in people with chronic inflammatory disorders. The generally accepted cut-off level for serum ferritin below which iron stores are considered to be depleted is 15 ng/mL for people aged 5 years and older and 12 ng/mL for people younger than 5 years of age (WHO, 2001).

2.4.1.1 Hemoglobin concentration

Laboratory test on Hemoglobin levels are often used to determine iron status. The commonly used indicators and values for diagnosis recommended by WHO are Hb <110 g/L and serum ferritin <10–12 μg/L for infants 6–12 months of age (Michaelsen 2000). Alternative cut-off levels for insufficient Hb have been proposed as <105 g/L for infants 3 and 6 months and <100 g/L for infants 9 months of age. Mild anemia is defined as Hb <110 g/L, moderate anemia as <70 g/L and severe anemia as <50 g/L. The 110 g/L cut-off value is based on international convention (Lozoff, 2007). Therefore, hemoglobin concentration can provide information about the severity of iron deficiency.

Table 2.1: Classification of Iron Deficiency Anemia

Age Group		Anemia		
	Normal	**Mild**	**Moderate**	**Severe**
4-5.99months	≥ 115g/L	110-114g/L	70-109g/L	<70g/L
6 – 59 months	>110g/L	100-109g/L	70-99g/L	<70g/L
Pregnant women	>110	100-110g/L	70-99g/L	<70g/L

Adopted from WHO, 2011

2.5 CAUSES OF IRON DEFICIENCY AND ANEMIA IN INFANTS

Under normal circumstances, infants should have sufficient iron stores at birth to last for approximately the first 6 to 8 months of life (Chaparro, 2007). However, several conditions prevent many infants from reaching this goal, this among others include: haemolysis occurring with malaria; glucose-6-phosphate dehydrogenase deficiency; congenital hereditary defects in hemoglobin synthesis, hookworm manifestation and deficits in other nutrients, such as vitamins A, B12, and C, and folic acid. Ensuring adequate maternal iron status during pregnancy and before will ensure adequate infant iron reserves at birth, (de Pee. 2002).

2.5.1 Maturity and Birth Weight

The size of birth iron stores (in liver and other tissues) is positively related to birth weight. The last 8 weeks of gestation are particularly important for the increase in total iron in these storage organs. Prematurity (< 37 weeks gestation) and low birth weight (< 2.5 kilo grams) have an association with the development of Iron Deficiency. Thus smaller infants and those born prematurely will have smaller iron reserves at birth and are at greater risk of developing anemia.

2.5.2 Delivery Process

Clamping the umbilical cord immediately after birth will prevent the infant from receiving adequate blood from the placenta and thus the full endowment of total body iron at birth. Between 30-50% of newborn blood volume is provided through delayed cord clamping (for example at the end of cord pulsations, approximately 2-3 minutes after delivery). Thus immediate clamping, by preventing significant transfer of placental blood to the infant, will also reduce the size of total body iron at birth (Dewey, 2007). In many countries in the Latin American and Caribbean region, as well as other world regions, maternal iron deficiency is prevalent, low birth weight and preterm deliveries are common, and immediate umbilical cord clamping is frequently practiced (Hutton, 2007).

2.5.3 Exclusive Breast Feeding

Some of the factors contributing to iron deficiency anemia in young children in the developing countries are low rates of exclusive breastfeeding. Although many mothers breastfeed for up to and sometimes beyond one year, the practice of exclusive breastfeeding for four to six months is rare. In addition, introduction of non-breast milk liquids and solids before 6 months of age is common, which also can contribute to poor iron status (Dewey, 2007).

Despite substantial work during the 1990s to promote breastfeeding through education of medical staff and to initiate Baby Friendly Hospitals, throughout the region, most national authorities as well as officials of WHO and UNICEF suggest that much more needs to be done before exclusive breastfeeding becomes the common standard of infant feeding during their first four to six months of life.

2.5.4 Iron Bioavailability from Diets

A related problem is the common use of cow milk with much less absorbable iron as a complementary food or substitute for breast milk. Cow milk contain 0.6 mg/L of iron out of which only 10% is absorbed compared to breast milk which contains 0.8 mg/L and its absorption is 50%. Early introduction of cow milk also results in gastro-intestinal micro bleeding and therefore exacerbates the degree of iron deficiency anemia and frequently has a negative effect on breastfeeding (Dewey, 2007). Where infant formula must be used, it should be fortified with iron. Moreover, giving young children at and between meals tea and porridge, made with flour that includes high levels of polyphenols and phytates respectively, inhibit the absorption of the non-haem iron contained in cereals to the baby's body. Therefore, during the rapid growth of infancy, children need to receive and absorb iron in greater quantities in proportion to their weight and normal dietary intake than during other periods of their life (Reilly, 2005).

2.6 CONSEQUENCES OF IRON DEFICIENCY ANEMIA IN INFANTS

Recent studies on the economic costs of anemia expose the massive cost burden of this disease and the cost effectiveness of reducing iron deficiency anemia rates in children and women. Such studies consider lost productivity, health costs and life time costs related to the permanently impaired cognitive development of young children who develop iron deficiency anemia. Horton (2003) estimated the median productivity lost due to iron deficiency anemia alone to be about US$2.32 per capita or 4.05% of gross domestic product (GDP). The authors estimated an additional US$14.46 per capita lost in cognitive function, for a total annual loss (cognitive and productive) of about $50 billion in gross domestic product worldwide from iron deficiency.

Infants who become anemic may also suffer permanent impairment of cognitive development. Anemia in young children has now been shown to correlate with lower cognitive test scores 12 with IQ tests showing a loss of 10–15 points. These effects do not improve when the anemia is corrected or in later years (Grantham-McGregor, 2001). Another important consequence of iron deficiency is an apparent increased risk of heavy-metal poisoning in children. Iron-deficient individuals have an increased absorption capacity that is not specific to iron. Absorption of other divalent heavy metals, including toxic metals such as lead and cadmium, is also increased. Prevention of iron deficiency, therefore, reduces the number of children susceptible to lead poisoning and boosts their immune system (Abalkhail, 2002).

2.7 APPROACHES TO ENSURE ADEQUATE IRON STATUS IN EARLY INFANCY

There are different approaches that can be practiced by mothers to ensure adequate iron reserves for themselves and their children and they include:

2.7.1 Adequate Total Body Iron at Birth

Total body iron at birth is one of the most important factors for maintaining adequate iron status during the first half of infancy. Interventions to prevent iron deficiency in young children need to start early during their mother's pregnancy by supplementing her and continue at birth by delayed umbilical cord clamping and promoting early initiation of breast-feeding with the first hour of birth, (Hay and Refsum 2007). In Kenya, pregnant women are given free supplements of iron and folic acid (IFAS) which is provided at most of the antennal clinics in public health facilities during their first visit till the last trimester. Preventative actions to optimize birth total body iron include:

2.7.2 Adequate Maternal Iron Status before Conception and During Pregnancy

To ensure adequate iron status of women during pregnancy, it is essential to improve the iron status of women before they conceive. This includes improving nutritional status in adolescents particularly, as the nutritional demands of pregnancy will be combined with their own nutritional needs for their continued growth. Actions to improve iron status among women of reproductive age before and during pregnancy include: encouraging consumption of iron-rich (e.g. a source of heme-iron, such as that found in red meat) and iron-fortified foods. Consumption of heme iron, in particular, also improves the absorption of the non-heme forms of iron found in plants. Further, reducing intake of phytates found in whole garin cereals by modifying the food product through soaking before cooking, fermentation, germination or avoiding consumption of food stuffs containing polyphenols such as coffee, tea during meal time will also improve iron absorption. Finally, treating intestinal parasites in the second trimester in areas where hookworm is endemic (20-30% prevalence). In areas where hookworm infection prevalence exceeds 50% anti-helminthic treatment should be repeated in the third trimester and supplementing pregnant women with iron will allow them to meet their iron requirements (WHO, 2006).

2.7.3 Ensuring Maximum Birth Weight

Actions to decrease the risk of low-birth-weight and preterm births include: reducing adolescent pregnancies, improving maternal nutritional status before pregnancy (including adequate energy, protein, and micronutrient intake) to ensure appropriate pregnancy weight (with respect to both underweight and obesity) and nutrient reserves, and spacing pregnancies at least 2 years apart

(WHO, 2006). In addition ensuring adequate maternal weight gain during pregnancy, eliminating smoking during and preventing and treating maternal malaria is important to reducing anemia.

2.7.4 Proper Birth Process

Waiting just 2-3 minutes (i.e. at the end of cord pulsations) to clamp the umbilical cord at birth provides the newborn with adequate blood volume and the full endowment of total body iron, which is essential for preventing the development of iron deficiency during the first 6 months of life. The difference in body iron stores at 6 months of age between early and delayed clamped infants is equivalent to 1-2 months of iron requirements (Chaparro et al, 2004).

2.7.5 Proper and Adequate Infant Feeding

Breastfeeding has enormous benefits to infant nutrition and prevention of infant morbidity and mortality. Although breast milk is not high in iron, its iron is relatively well-absorbed, (range from 12-56%) particularly for infants with lower iron levels (Hicks, 2006). Introducing other liquids or solids during the first 6 months of life can have negative effects on infant iron status; these foods (except for iron-fortified formula) are generally low in iron which is poorly absorbed, and can also interfere with the absorption of breast milk iron. In low birth weight infants, even introducing iron fortified solids before 6 months of age can interfere with the absorption of iron from supplements, which are recommended for this group of infants (Dewey, 2004). Preventative actions to protect infant iron status include:

Early initiation of breastfeeding prevents neonatal illness and death and will improve long-term breastfeeding practices. Hospital practices and environments that are known to promote early initiation and establishment of breastfeeding include: immediate skin-to-skin contact between mother and infant, putting the infant to the breast within the first hour of life, delaying routine newborn procedures for at least 1 hour after birth, rooming-in to encourage breastfeeding on demand and avoidance of non-breast milk fluids, pacifiers or artificial nipples. Providing foods and liquids other than breast milk to the infant leads to the mother’s decreased breast milk production which shortens the duration of breastfeeding and decreased length of lactation amenorrhea, which will negatively affect maternal iron status because of the return of menstruation, and can also decrease birth spacing intervals in the absence of contraception further compromising maternal iron stores, (Colen, 2014) and Greer et. al 2008).

CHAPTER THREE: STUDY DESIGN AND METHODOLOGY

3. 1 STUDY DESIGN

A cross-sectional study involving both descriptive and analytical methods covering the infants between 3-6 months and their mothers was conducted. The mothers who partially breastfeed their infants described the types of foods fed to the infant and data was collected using a food frequency questionnaire. The nutritional status of the mothers was assessed using anthropometric measurements. It consisted of some retrospective components such as how many months the mother consumed the Iron and Folic Acid supplements and her weight just before delivery.

3.2 METHODOLOGY

3.2.1. Study Setting

The study was conducted at Mama Lucy Kibaki Hospital in Embakasi constituency in Nairobi. This is a district hospital owned by the Ministry of Health. It is located on Spine road, Umoja 3, near Kayole off Kang'undo road, Nairobi County with a latitude of 1.2737363 ^{o} s and longitude 36.8993431 ^{o} E. It is a new hospital with a bed capacity of 137 beds.

It is located in a highly populated area of Nairobi serving an estimated population of two million people. It began limited operations in 2011 but the hospital was officially opened on February 26, 2013 by his Excellence the former President of Kenya Mwai Kibaki. It consists of most of the departments with the Paediatric Department being a little more congested with children and quite busy as compared to the other departments. Mr Zacharia Lihumbazi the human resources manager indicated that the facility handles up to 800 outpatients in a day, most of them being children attending the well-baby clinic and 6,000 maternity deliveries in a month.

The other Departments include Obstetrics and Gynecology, Compressive Care Center, (CCC), male and female medical and surgical wards and the outpatients' clinics. The Mother Child Health Clinics (MCH) usually receives around 300 mother-child pair daily. Most of these children are below 9 months since most mothers reduce their visits to well-baby clinics after the ninth month vaccination (measles)**.** Those attending this well baby clinic range from the high to middle and the low class households from such area as Umoja, Doonholm, Mwiki and Kayole.

3.2.2 Study Population

The population studied was drawn from the mother infant pair visiting the hospital irrespective of the estate they reside in. It comprised of infants 3-6 months both female and male accompanied by their mothers who were part of the study population and respondents of the interview.

3.2.3 Sampling

3.2.3.1 Sample size calculation

The sample size was calculated using the Fisher *et al. (*1991) formula

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

N-Desired Sample size

p- Proportion in the large population estimated to have iron deficiency anemia in infants less than 6 months was 19.1% according to a micronutrient report on a survey conducted in Kenya (MoH, UNICEF 1999).

q- Proportion expected not to be anemic (1-p) (1-0.19) =0.81

z- The standard normal deviation set at 1.96 of the 95% confidence interval.

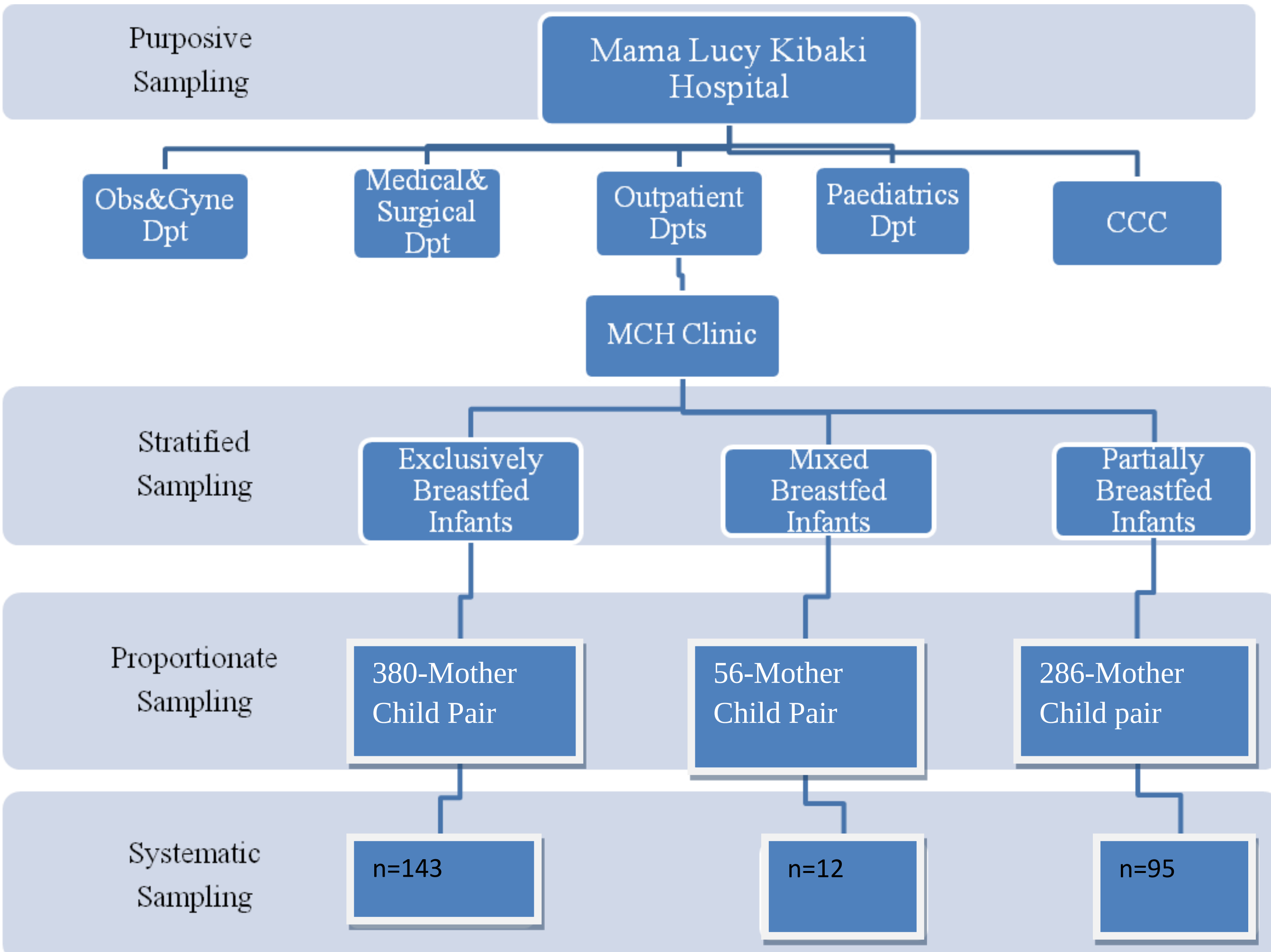
d- The degree of accuracy desired set at 0.05 significance.

5%-Attrition

Therefore N= $(1.96)^2(0.19)\ (0.81)/\ (0.05)^2$=236 +11 (attrition) =247 rounded off to 250 infants.

3.2.3.2 Sampling procedure

Figure 3.1: Sampling procedure



Purposive sampling was used to select Mama Lucy Kibaki Hospital as the study setting. Stratified sampling method which involves the division of the study population into three smaller groups known as strata was conducted at the study site. The strata were formed based on mothers who either practice excusive breastfeeding, mixed breastfeeding or partial breastfeeding. A sample from each stratum was taken in a number proportional to the sample size required. To determine the mother infant pair to sample, systematic sampling was carried out whereby the first mother infant pair was picked from those on the sitting queue after which every third mother infant pair was selected from the same stratum to give the desired sample per stratum.

3.3 INCLUSION CRITERIA

Mother infant pair attending the Mother Child Clinic (MCH) for growth monitoring and immunization irrespective of the estate they reside in. Only infants aged 3- 6 months whose mothers voluntarily accepted to participate in the study were included. This was by signing the consent form after being explained to what the study entailed and giving permission for their infants to be assessed.

3.4 EXCLUSION CRITERIA

A sick infant did not participate as well as infants 3-6 months old whose parents did not give consent. Infants accompanied by other members of the family other than their mothers were not able to participate since most of the questions were geared to the biological mother.

3.5 DATA COLLECTION

3.5.1 Data Collection Tools

1) A semi structured pre-tested questionnaire was administered by a trained field assistant. The questionnaire collected four types of information as follows:

a) Socio-demographic and socio-economic information of the households and the care giver for example; name, age, sex, marital status, relationship to the household head, education level and others.
b) Infant information inclusive of breastfeeding types, feeding practices, complementary feeding practices, health information and anthropometric measurements.
c) Maternal nutrition status, iron supplementation status during pregnancy, incidences of anemia and the birth process like the length of time that elapsed before the umbilical cord was clamped.
d) Morbidity experience of the infant.

2) A food frequency questionnaire for those infants who were partially breastfed.

3.5.2 Recruitment and Training Research Assistants

Three research assistants were recruited, 2 of them holders of a nutrition diploma while the other one was a lab technician working at Mama Lucy Kibaki Hospital. He drew blood from the selected infants and measured their hemoglobin levels. The research assistants were able to speak fluent English and Kiswahili and had basic knowledge on taking anthropometric measures in infants and adults. They were trained for 1 day to equip them with knowledge on how to administer and fill questionnaires as well as king of anthropometric measurements.

3.5.3 Pretesting of Questionnaires

Pretesting was carried out at Kangemi Health Center, targeting at least 10 mother infant pairs and the information collected was used to modify questions so as to give the desired results.

3.5.4 Data Collection Procedures and Methods

The interviewer approached the mother infant pair using the systematic sampling procedure. The interviewer then created a rapport before explaining to the respondent what the research entailed. He/she explained the nature of the study, the purpose, its benefits, rights as volunteers and risks/discomforts expected then requested her to voluntarily accept to participate in the study. The interviewer also assured the respondent of the confidentiality of the information given so as to encourage participation. If she was able to read then, a consent form was issued to the mother to read and sign if she agreed to participate in conjunction with their infants voluntarily. If not able to read the interviewer read and explained the contents on the consent form to the respondent in detailed. Data was then collected from the mother child pair one at a time to enhance accuracy.

Data on the household profile was included in the structured questionnaire section A, this included gender and age structure of the people in that household, relationship to index infant, marital status of each member of the house hold, socio-economic status of the parents, educational level and the occupation as shown on the questionnaire. This information gave insight in the socio-economic situation, which in turn does influence the infant’s breastfeeding practices, dietary intake and dictates his or her nutritional status as well as that of the mother.

A semi-structure questionnaire was administered and filled with data on name of the child, date of birth, age, sex, breastfeeding practices which specified duration and the breastfeeding type. Those on complementary feeding, time of introduction of food other than breast milk, number of feeds in a day was recorded. A food frequency questionnaire was used to assess the adequacy of the diet fed to infants on partial breastfeeding.

3.5.4.1 Anthropometric measurements

The anthropometric measurements are universally accepted to be the most useful tool for assessing the nutrition status, and risks of poor health and survival in infants and young children.

a) **Age and Sex Determination:** Age was calculated in months from the birth date based on clinic cards and birth certificates. The sex of the infant was observed physically during examination. Mothers' age was obtained by asking the mothers to state their age to the interviewer and this was confirmed from the clinic booklet for the latest indicated age.
b) **Birth weight-** To determine the birth weight the mother was requested to produce the clinic cards or booklet. All mothers were required to have the clinic card or booklet since when they come for weight monitoring and immunization at the MCH clinic, they do not fail to carry them for recording the measurements done on that particular day.
c) **Height Measurement-** A length board was used to measure recumbent length of the index child by making the infant lie flat on the length board facing upwards. One research assistant ensured the infant was lying properly and with the assistance of the mother pressed the feet of the infant to ensure they were straight. Mother's heights were taken using a stadiometer while standing on bare feet and head straight. Two readings of their length and height were taken to the nearest 0.1 cm and 0.1 m respectively and the average of the readings calculated.
d) **Weight Measurement-** Weight was measured to the nearest 0.1kg while using a Salter scale and a weighing scale. The infants were weighed twice in minimum clothing, probably a vest and without shoes. Two measurements were taken and the mean value was obtained for analysis. A calibrated weighing scale was used to determine the weight of the mother in minimum clothing and without shoes. Weight was measured to the nearest 0.1kg. Two readings were taken and the mean calculated.

Two anthropometric indices applied to assess nutritional status of the infants 3-6 months were **weight-for-age**, and **weight-for-length**. The anthropometric measurements made in studying populations were reported in relation to international standards; the reference standards developed by the United States National Center for Health Statiscs (US NCHS) recommended for international use by the WHO, (2006) Secondly, the measurements were related to the reference population by standard deviation scores (Z-scores). Children with a Z-score below -2SD were considered underweight or moderately malnourished while -3 SD severely malnourished, using the indicators and the reference standards. Those identified to be severely and moderately malnourished were referred to the nutrition clinic for close monitoring and other medical procedures such as admitting severely malnourished infants. MUAC readings, weight and height measurements were used to determine maternal nutritional status.

MUAC tapes were used to take the circumference of a straightened mothers arm. The tape was wrapped around the arm at the midpoint. The tape has three colours, with the red indicating severe acute malnutrition, the yellow indicating moderate acute malnutrition and the green indicating normal nutritional status. The readings were then entered in the questionnaire in cm. MUAC thresholds < 210 and < 185 WHO cut off points for moderate and severe malnutrition respectively were used.

3.5.4.2 Hemoglobin determination

A drop of capillary blood was collected by venipuncture from each infants toe/finger prick by a lab technician using a BD contact activated lancets (BD Microtainer). Micro curvets were used to collect the blood sample which was inserted into the Haemcue Hb analyzer and the Hemoglobin level read and recorded. Infants found to be moderately anemic were reffered to the nutrition clinic for further assessments and counseling of the mother as well a close monitoring done while those reported to be severely anemic were referred to the pediatric department for further medical procedures.

3.6 ETHICAL CONSIDERATION

The permission to carry out the study was obtained from Kenyatta National Hospital by submitting the research proposal to the KNH/UON-Ethics and Research Committee. To minimize the discomfort and inconveniences the survey team explained the objectives, purposes, and possible benefits of the study in a non-threatening and culturally relevant manner. The participant was given an opportunity to ask questions and decline participation if necessary or participate by signing a consent form. Safety of the infant was assured by providing adequate procedures to ensure no accidents occurred during taking measurements. Confidentiality and privacy was maintained and the caregiver was assured of this. Physical acts and physiological comments to hurt the respondent were avoided.

3.7 DATA QUALITY ASSURANCE

To achieve quality of data, the principle investigator ensured calibration of scales which was done on a daily basis to ensure accuracy of the measurements. All the laboratory equipments were calibrated too before use.

The principal investigator also ensured frequent supervision of the research assistants during data collection. Field assistants received proper training from the principal investigator so as to avoid errors in recordings. To avoid parallax during reading of measurements an average of two subsequent readings on the same mother and infant were taken during weight measurements.

The completed questionnaire was cross-checked and examined after measurements by the principal investigator to ensure completeness of data consistency of answers and the eligibility of the measurements obtained.

3.8 DATA ANALYSES

Descriptive statistics (means, percentages, standard deviations and range) were computed for demographic and socio-economic data. Analyses were stratified by age sex and other characteristics. The Chi-square test and correlation were used to test the strength of association between factors influencing anemia such as nutritional status, birth weight, growth pattern, morbidity status and maternal nutritional status at a significance level of 0.05. Logistic regression was also performed to ascertain the determinants of anemia. Data entry and analysis was done using specific computer packages namely Statistical Packages for Social Science (SPSS) and Emergency Nutrition Assessment (ENA) for SMART. Odds ratios were calculated to identify risk among those who were either partially or exclusively breastfed and the development of anemia. Available errors during data entry were noted and counterchecked using the questionnaires.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents results and discussions from the study. The results are organized according to specific objectives and presented in narratives, Tables and Figures. Discussion of the findings has also been done in this chapter after every finding.

4.2 SOCIO-DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS OF THE HOUSEHOLDS

4.2.1 Socio-demographic Characteristics

The sampling population was drawn from 25 different residential estates in eastland part of Nairobi. The sampled respondents were not picked based on their respective residential estates. Most of the study population (34.4%) resided in Umoja estate, followed by (16.4%) Kayole estate and Doonholm estate (9.6%), (Table 4.2).

Table 4.2: Proportion of Respondents

Estate	Frequency n=250	Percent % N=250
Umoja	86	34.4
Kayole	41	16.4
Donholm	24	9.6
Saika	23	9.2
Utawala	15	6.0
Ruai and Molem	15	6.0
Dandora	10	4.0
Kasarani and Mwiki	9	3.6
*Others	21	8.4
Age Distribution		**N=1059**
1-14 (Years)		42.5
15-64 (Years)		57.4
65-100 (Years)		0.1
Dependency Ratio :(0.74) or 74%		

*****Makadara, Greenspan, Huruma, Jericho, Baraka, Kariobangi, Maisha, Joska, Muthurwa &Nasra

Majority (98.4%) of the respondents were monogamously married, while 19.3% were single mother households. Most of the mothers had completed secondary school (29.1%) with 25.4% going up to college and 18.9% having studied up to the level of university, (Table 4.3).

Table 4.3: Socio-demographic Characteristics of the Respondents

Characteristics		**Percent % (N=250)**
Marital Status		
Married		78.1
Single		19.3
Separated		1.4
Divorced		0.7
Widowed		0.5
Education Level		
Primary Drop out		3.9
Completed Primary		5.1
Secondary dropout		15.4.
In Secondary		2.2
Completed Secondary		29.1
College		25.4
University		18.9
Age group of the Mothers (Respondents)		
14-19	11	4.5
20-35	229	91.5
36-45	10	4.0
Parity (Number of Pregnancies).		
1 Child	116	46.5
2 Children	80	32.0
3 Children	35	14.0
4 Children	9	3.5
5 Children	8	3.0
6 Children	2	1.0

The overall average household size in this targeted population was 4.3 with a range of 2-12 members. Children aged below 15 years constituted the greatest proportion of the population (42.5%) while those aged above 65 years constituted the smallest proportion (0.1%).Of the total persons in the households, 47.7% were males and 52.3% were females giving an overall sex ratio of 1.1. The dependency ratio of the study population was 74%.

The reason as to why majority of the study population resided in Umoja and Kayole is due to the fact that they are the estates neighboring Mama Lucy Kibaki Hospital and usually mothers are advised to visit the nearest well baby clinic. The mean household size in this study was higher than the Kenya national size of 3.1 (KNBS and ICF Macro, 2010). This is because the Kenyan urban statistics reflects both slum and non-slum settlements in urban areas while the study was restricted to a formal urban settlement with few households from an informal settlement. The dependency ratio (76) was lower than the national figure of 96 as reported by KNBS and ICF Macro (2010) and 82.14 by World Bank (2012) probably because there were more young people and few elderly people.

Similar studies by (Ayisi, 2013) in Kangemi- Nairobi showed that more than half (55.8%) of the mothers were 25 years old or younger and 44.2% were over 25 years old. The mother's mean age was 25 years. This can be explained by the fact most of the people living in urban centers are young families with an average of at least 2 children who are also young.

4.2.2 Socio-economic Characteristics of the Respondents

Most of the mothers (23.9%) were self employed with 21.5% salaried. The other occupations were casual labour (19.5%), housewives (20.5%) and only two farmers (0.2%) while the household major source of income was salary and own business (Table 4.4).

Table 4.4: Socio-economic Characteristics of the Mothers

Characteristics	Percent %(N=250)
Occupation	
Salaried Employee	21.5
Farming	0.2
Self Employed	23.9
Casual Laborer	19.5
Student	5.5
Housewife	20.5
Unemployed	8.9
Main Source of Income	
Animal and animal product sale	0.5
Casual Labor	18.5
Salaried or Waged	45.5
Own Business	35.5
Others	0.5

The results above show that most of the households had a source of income. The main source of income for most households in the study was salaried while the least common income source was farming due to the fact that most households do not practice farming activities in the urban centers.

4.3 CHARACTERISTICS OF THE STUDY INFANTS

Table 4.5 shows the distribution of the study children by age and sex. The total boy girl ratio was 1:1. The mean age of the study children was 4.12 with a range of 3.02-5.98 months. The greatest share of the infants who participated in the study were those aged 5-6.0 months (38 %) followed by those aged 4-4.99 months (36%) then those who aged 3-3.99 months (26%).

Table 4.5: Distribution of the study infants by age and sex

	Boys		Girls		Total		Ratio
AGE (mo)	**no.**	**%**	**no.**	**%**	**no.**	**%**	**Boy: girl**
3-3.99	34	52.3	31	47.7	65	26.0	1.1
4-4.99	51	56.7	39	43.3	90	36.0	1.3
5-6.0	45	47.4	50	52.6	95	38.0	0.9
Total	130	52.0	120	48.0	250	100.0	1.1

These findings on age distribution can be compared to those reported by Ayisi et al. (2013) whose findings were as follows. The mean age of the index infants was 3±1.8 months. About (33 %) of the infants were aged 3-4 months, 30.7% were aged 1-2 months, 26.8% were aged 5-6 months and 9.3% less than one month old.

In the same research by Ayisi et al, infant's birth order in their respective households was as follows, 48.5% were first born, 32% second born 12.5% third born and the percentages reduced to 4.5%, 1.5%, and 1% for fourth, fifth and sixth born respectively. Most of the infants had a normal birth weight (86%) with only 6% born with a low birth weight and 8% being overweight at birth (Table 4.6).

Table 4.6: Characteristics of the study Infants

Characteristics	Frequency n=250	Percent % (N=250)
Sex		
Male	130	52.0
Female	120	48.0
Birth Order		
1 (First born)	121	48.5
2 (Second born	80	32.0
3 (Third born)	31	12.5
4 (Fourth born)	11	4.5
5 (Fifth born)	4	1.5
6 (Sixth born)	3	1.0
Birth Weight		
Low Birth weight	15	6.0
Normal birth weight	215	86.0
Overweight	20	8.0
Immunization Coverage		
Fully Immunized (up to 3 months)		
Yes	240	96.3
No	10	3.7

These results are comparable with those reported by Ayisi et al. (2013) whereby most of the infants (74.1%) were either first or second borne. Prevalence of low birth weight compares with the national figure of 7.70% in Kenya (World Bank, 2009).

4.4 INFANT FEEDING PRACTISES

Data was collected on timely initiation of breastfeeding, giving of colostrum, breastfeeding types practiced by the mothers and types of feeds given to infants who were weaned before six months.

4.4.1 Breastfeeding Practices

Those who were exclusively breastfed were the majority at 57.0% followed by those who were partially breastfed at 38% then those who were mixed breastfed at 4.8% (Table 4.7).

Exclusive breastfeeding was higher in males than females with a prevalence of 32% and 25% respectively. Those introduced to complementary feeds earlier than six months were 18% males and 20% females while 2.5% males and 2.3% females were fed on a combination of infant formulae and breast milk (Table 4.7)

Table 4.7: Exclusive Breastfeeding

Characteristics	Frequency n=107	Percent % (N=250)
Age in months when the mother stopped EBF		
1	4	3.7
2	11	10.2
3	35	32.7
4	25	23.3
5	32	29.9
Frequency of EBF per day		
7-10		10.0
11-14		33.0
15-18		14.0
Not EBF		43.0

Majority of the infants (68%) were initiated to breast milk within one hour after birth therefore benefiting from the mother's colostrums which contains a higher content of iron than the mature breast milk. Mothers who practiced exclusive breastfeeding cited that they breastfed their child between 7-10 times a day, 11-14 times a day and 15-18 times a day with a prevalence of 10%, 33%, 14% respectively. About 10.5% were started on infant formulae instead on breast milk.(Figure 4.2).

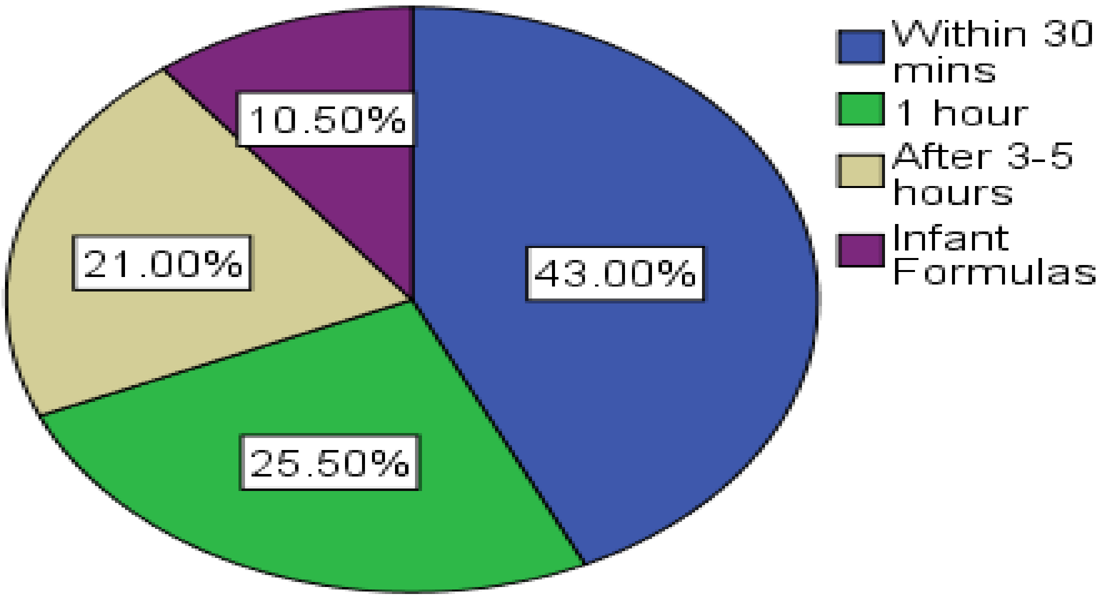


Figure 4.2: Time of Initiation of breast milk-and infant formulae

Overall, the rate of exclusive breastfeeding is higher than the national rate of 32% (KNBS and ICF Macro, 2010). However this rate is far from reaching the recommended level of 90% by WHO/UNICEF (2009) for exclusive breastfeeding of all infants less than six months. A study conducted by Mututho (2012) recorded a prevalence of exclusive breastfeeding among infants less than 6 months in Kasarani-Molo to be (56.7%, 95% C.I) which is almost similar to the findings in this study. The increase may be due to increased awareness on the importance of practicing EBF and majority of the mothers were housewives giving them time to breastfeed the baby exclusively for the first six months. Scientific evidence has consistently shown that breastfeeding from birth to 2 years and beyond plays a critical role in ensuring proper growth and development of an infant (Iliff *et al.*, 2005), Bahl *et al.*, 2005 and Venneman *et al*., 2009).

The study conducted by Muthutho (2012) on factors influencing exclusive breastfeeding established that only 3.4% were fed on infant formulae as compared to 4.8 % of the current study. Breastfeeding at least every two to three hours helps to maintain milk production. Women who practice eight breastfeeding or pumping sessions every 24 hours keep their milk production high as reported by UNICEF (1999). Feeding a baby on demand helps to maintain milk production and ensures the baby's needs for milk and comfort are met (WHO, 2003).

The findings of 43% of those introduced on complementary feeds before six months has reduced from the Kenya figure whereby supplementation of breast milk starts early with 60% of children aged 4-5 months being given complementary food (KNBS and ICF Macro, 2010). Use of infant formulae instead of colostrum was due to reasons cited by the mother such as recovering from a cesarean operation, the baby was born underweight so taken to the nursery for some few days and delayed milk production. The findings of infants breastfed within one hour of birth (68.5%) shows an improvement on the percentage of babies' breastfed within one hour of birth from the national figure of 58.1% as reported by KDHS (2008/09). As is the case in other studies in many sub-Saharan countries and Kenya in particular, (Kimani-Murage *et al,* 2011; KNBS and ICF Macro, 2010;), initiation of breastfeeding was universal with nearly all the children having been breastfed as in the case of this study.

A cross tabulation of age and the current feeds given to the infant showed that the infants stopped breastfeeding exclusively as they grew old. Other complementary feeds were given as early as 1 month. (Figure 4.3 and Table 4.8.)

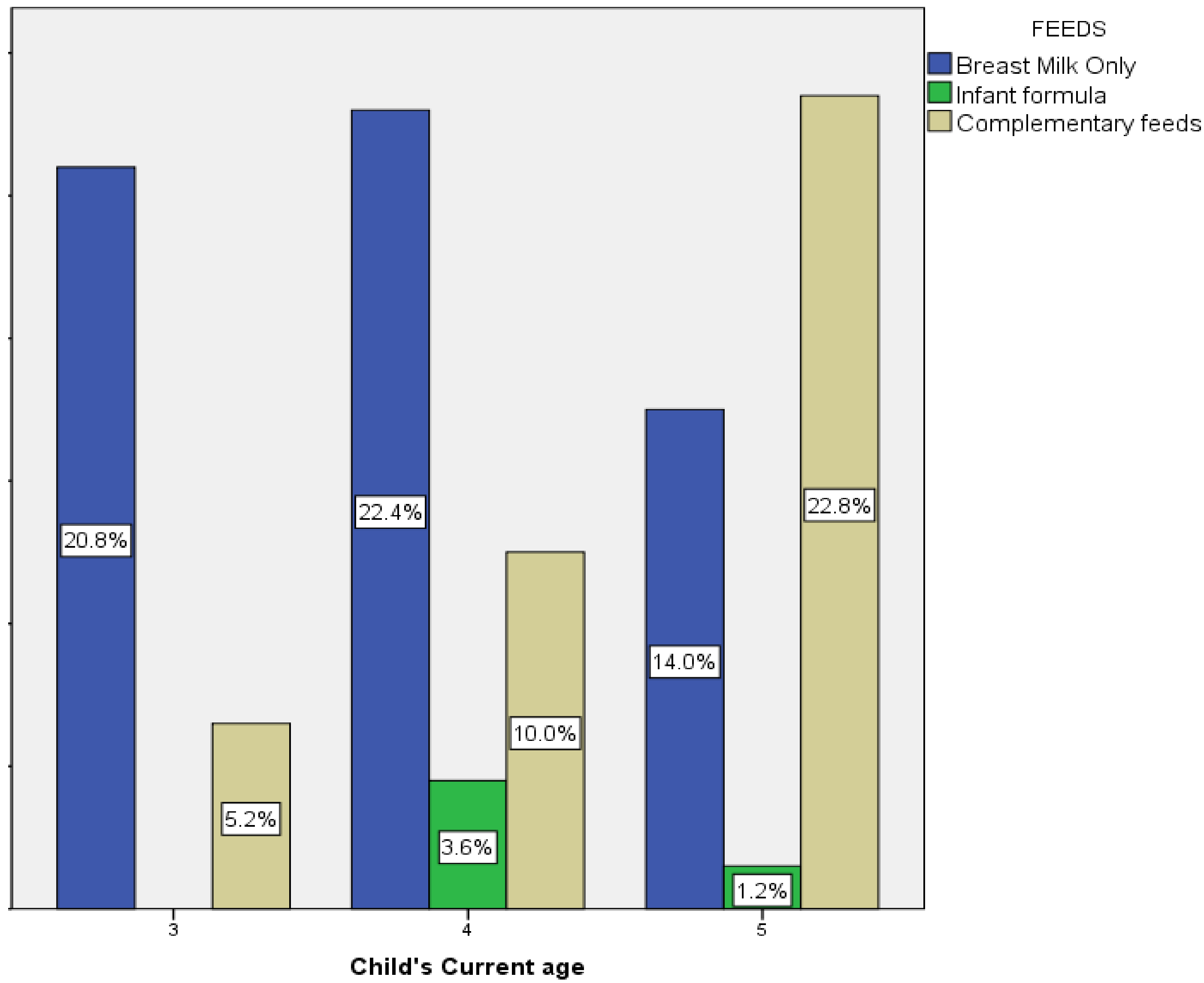


Figure 4.3: Age of the infants and the type of feeding practices

The reduction in exclusive breastfeeding as the infant grows older can be explained by the fact that most mothers resume their work places as their maternity leave expires. According to self report by some mothers, they complained that their own breast milk was not sufficient to satisfy the baby. These reasons compare with those of a study conducted in Kibera informal settlement in Nairobi by Ochola (2008). The 5% infants who were introduced to infant formula from 4 months and above are similar to finding by KDHS (2003) whereby 8.8% of the infants were given infant formulae.

A similar trend in continuous exclusive breastfeeding since birth is observed in Kangemi, Nairobi-Kenya whereby the prevalence of exclusive breastfeeding was 45.5% among infants aged 0-6 months (Ayisi et al. 2013). In Kasarani informal settlement, Molo-Kenya, exclusive breastfeeding rate was 38.9% at 3 months, 21.7% at 4 months and 17.1% at 5 months according to a study conducted by Muthutho (2012) while in Nigeria, exclusive breastfeeding was 19% at two months, 13% at four months and 4% at 5 months (Agho *et al*., 2011).

4.4.2 Dietary Intake and Food frequency

Most of the infants who were weaned early (43% of the total population) received one to three meals a day with a mean meal frequency of 3.4. Table 4.8 shows their food frequency.

Table 4.8: Food consumption Frequency for none EBF infants

Food Sources	1-2 times*	3-4 times*	5-6 times*	Daily	Never consumed
Milk	3.7	3.7	0.0	69.1	23.5
Infant formulae	1.2	8.5	0.0	9.8	80.5
Porridge[1]	2.4	6.1	2.4	22.0	67.1
Porridge[2]	2.4	11.0	0.0	29.3	57.3
Potatoes	7.3	22.0	6.1	12.2	52.4
Cassava	1.2	0.0	0.0	0.0	98.8
Ugali	12.2	3.7	0.0	4.9	79.3
Rice	1.2	0.0	0.0	0.0	98.8
Green Bananas	6.1	24.4	0.0	4.9	64.6
Pumpkins	2.4	20.0	2.4	17.1	57.3
Spinach	11.1	12.3	2.5	6.2	67.9
Amarathus	8.6	6.2	0.0	1.2	84.0
Meat and products	0.0	0.0	0.0	0.0	100
Beans	2.5	0.0	0.0	0.0	97.5
Green grams	1.2	0.0	0.0	0.0	98.8
Eggs	0.0	0.0	0.0	0.0	100
Breakfast cereal	2.5	2.5	0.0	3.7	91.4
Fruits	16.0	24.7	2.5	16.0	40.7

[1](one type of flour) [2](Mixed flour) * % consumed per week

Some of the infants were fed three times a day with a prevalence of 20.0% followed by those fed four times a day at 8.5% and two times a day at 8%. Only 3% were fed once per day and 2% fed six times a day. This resulted into most of the infants achieving minimum meal frequency as per the WHO (2008) recommendations. Majority of the households (88%) purchased most of the food consumed by the family, while only 12% depended on farm produced food sent from home,

Most of the iron came from plant food sources which were highly consumed foods for example amarathus, pumpkins and spinach however their iron bioavailability is low, (Rady, 2009). Most mothers (42.7%) fed their infants on porridge containing mixed flours which may contain phytates and other anti-nutrients that may bind iron and reduce its bioavailability to the body, (Bonoist, 2008).

Appropriate weaning diet must include a balanced composition of foods containing adequate amount of macro and micronutrients (with special attention to iron, zinc, calcium, vitamin A, vitamin C and folic acid) to ensure optimal growth after the age of 6 months. Consumption of a diverse diet (of 4 or more out of 7 food groups) as recommended by WHO (2008) is irrespective of routine Vitamin A and iron supplementation.

4.5 INFANT AND MATERNAL NUTRITIONAL STATUS

Introduction

The dependent variables showing child nutritional status was modeled both as continuous and categorical variables. The continuous variables included Length-for-Age Z scores (LAZ), Weight-for-Length Z scores (WLZ) and Weight-for-Age Z scores (WAZ). Categorical variables capturing stunting (WAZ), wasting (WLZ) and underweight (WAZ) levels were generated from the continuous variables. The categories representing nutritional status were: overweight and obese (≥+2 Z scores), normal (>-2 to <+2 Z scores), moderately malnourished (≤-2 to >-3 Z scores), and severely malnourished (<-3 Z scores).

4.5.1 Nutritional Status of the infants

The mean weight for the infants was 7.84 kg with the lightest child weighing 5.10 kg while the heaviest child weighed 11.0kg. The mean length of the children surveyed was 63.1 ± 0.19 cm.

The tallest child was 73.50cm while the shortest was 54.30 cm. Malnutrition cases among infants were evident. Cases of underweight were significantly low (2.0 %), compared to those of infants above six months, cases of wasting were 1.2 % while cases of stunting were 11.2% (Table 4.9, 4.10 and 4.11).

4.5.1.1 Weight-for age (Underweight)

Only 2.0%, of the children were moderately underweight while none was severely underweight and 7.2% were mildly underweight. Infants aged 5 months had the highest prevalence of moderate underweight (1.2%). The results show that the prevalence of underweight significantly increased with age. Those aged 3 and 4 months had a prevalence of 0.4% moderate underweight. (Table 4.9).

The mean wasting for the children was 4.11±0.77. More boys than girls were significantly moderately underweight p value (0.046) with a prevalence of 3.1%, and 0.8%, respectively. 71.2% of the study children had a normal weight for age Z-scores with significantly more males than females (36.8%) and (34.4%) respectively having a normal weight for age Z score. Those who were overweight and obese constituted 14.4% and 5.2% of the infants respectively. More females than males were overweight with a prevalence of 8.0% and 6.4% respectively.

The Z – score values were compared with the WHO Child Growth Standards (WHO, 2006), which is used to assess the nutritional status of children all over the world. Similar reports by Ayisi et al (2013) showed that the rates of under nutrition were low among infants 0-6 months in Kangemi-Kenya whereby, 4.5% were underweight, 3.1% of infants were wasted and 9.3% were stunted. This can also be compared with the KDHS (2008-2009) value of 2.5%**.** A similar trend for underweight infants is reported in a study conducted in the rift valley by Keino (2014) on the double burden of malnutrition among infants 0-6 months Narok county. Mildly underweight was reported among 15.7% of the infants, 6.0% were moderately underweight and 2.2% were severely underweight.

4.5.1.2 Weight for height (Wasting)

The mean weight-for-length Z-score for the children was 4.52±0.83. The total percentage of infants category wasted was 1.2%. Majority (55.6%) of the infants aged 3-6 months old had normal weight for length Z scores. 27.2% of the infants were overweight and 14.8% obese while 7.2%, 0.8%, and 0.4% were mild, moderately and severely wasted respectively. Total percentage of infants wasted by sex was: 2.5% in girls while none in boys were wasted. The prevalence of moderate malnutrition was 1.7% in girls and none in boys and prevalence of severe malnutrition was 0.8% in girls none in boys (Table 4.10).

4.5.1.3 Height-for-age (Stunting)

The mean length -for-age Z-score for the infants was 3.43 ±0.94. The study established that 11.2% of the children were stunted of whom 10.4% were moderately stunted, while 0.8% were severely stunted as sown on Table 4.11. Those who were mildly stunted were 24% with the majority (64.8%) having a normal length -for-age Z-score. More boys than girls were significantly stunted with a prevalence of 13.8% and 9.2% respectively. While 13.1% boys and 7.5% girls were moderately stunted. Those exclusively breastfed had a slightly higher prevalence of mild, sever and moderate stunting (24%) than those who were weaned early (4%) p values-(0.032). (Table 4.12)

Table 4.9 Distribution of the children by underweight

Age (mo)	Severe underweight (<-3 z-score) n	%N=250	Moderate underweight (>= -3 and <-2 z-score) n	%N=250	Mild Underweight (<-1 and <=-2 z score) N	%N=250	Normal (>=-1 and <2 Z scores) N	%n=250	Overweight (>=2 and <=3 Z score) n	%N=250	Obese (>=3 z Scores) n	%N=250
3-3.99	0	0	1	0.4	5	2.0	47	18.8	8	3.2	4	1.6
4-4.99	0	0	1	0.4	8	3.2	69	27.6	6	2.4	6	2.4
5-5.99	0	0	3	1.2	5	2.0	62	24.8	22	8.8	3	1.2
Total	**0**	**0**	**5**	**2.0**	**18**	**7.2**	**178**	**71.2**	**60**	**14.4**	**13**	**5.2**

Table 4.10 Prevalence of acute malnutrition by age, based on the level of Wasting

	Severe Wasting (<-3 z-score)		Moderate Wasting(>= -3 and <-2 z-score)		Mild Wasting (<-(>-1 and <=-2 z score)		Normal (>=-1 and <2)		Overweight (>=2 and <=3)		Obese (>=3 z Scores)	
Age (mo)	**n**	**%N=250**	**n**	**%N=250**	**n**	**%N=250**	**N**	**%n=250**	**n**	**%N=250**	**n**	**%N=250**
3-3.99	1	0.4	0	0	1	0.4	37	14.8	13	5.2	13	5.2
4-4.99	0	0	1	0.4	0	0	53	21.2	28	11.2	8	3.2
5-5.99	0	0	1	0.4	2	0.8	49	19.6	27	10.8	16	6.4
Total	**1**	**0.4**	**2**	**0.8**	**3**	**1.2**	**139**	**55.6**	**68**	**27.2**	**37**	**14.8**

Table 4.11 Distribution of infants by stunting

	Severe Stunting (<-3 z-score)		Moderate Stunting (>= -3 and <-2 z-score)		Mild Stunting (<-1 and <=-2 z score)		Normal (>=-1 and <2 Z scores)	
Age (mo)	**n**	**%N=250**	**n**	**%N=250**	**N**	**%N=250**	**n**	**%n=250**
3-3.99	1	0.4	11	4.4	13	5.2	40	16.0
4-4.99	1	0.4	6	2.40	24	9.60	59	23.60
5-5.99	0	0.0	9	3.6	23	9.20	63	25.2
Total	**2**	**0.8**	**26**	**10.4**	**60**	**24.0**	**162**	**64.8**

Table: 4.12. Associations between stunting, underweight and wasting with breastfeeding pactices

Indicator	**Exclusively breastfed Infants (%N=107)**					**Non-exclusively Breastfed infants (% N=143)**					
	Normal	***Overweight***	***Moderate***	***Mild***	***Severe***	***Normal***	***Overweight***	***Moderate***	***Mild***	***Severe***	***X^2 P-value***
LAZ	33.0	N/A	7.0	16.0	1.0	29.5	N/A	4.0	9.5	None	0.322
WAZ	40	12.0	1.5	3.5	None	33.0	6.0	1.0	3.0	None	0.603
WLZ	28.5	27.5	None	0.5	0.5	26.0	15.5	0.5	1.0	None	0.185

The Chi square P-values indicate that growth pattern were not found to be significantly (p<0.05) associated with the breastfeeding practice.

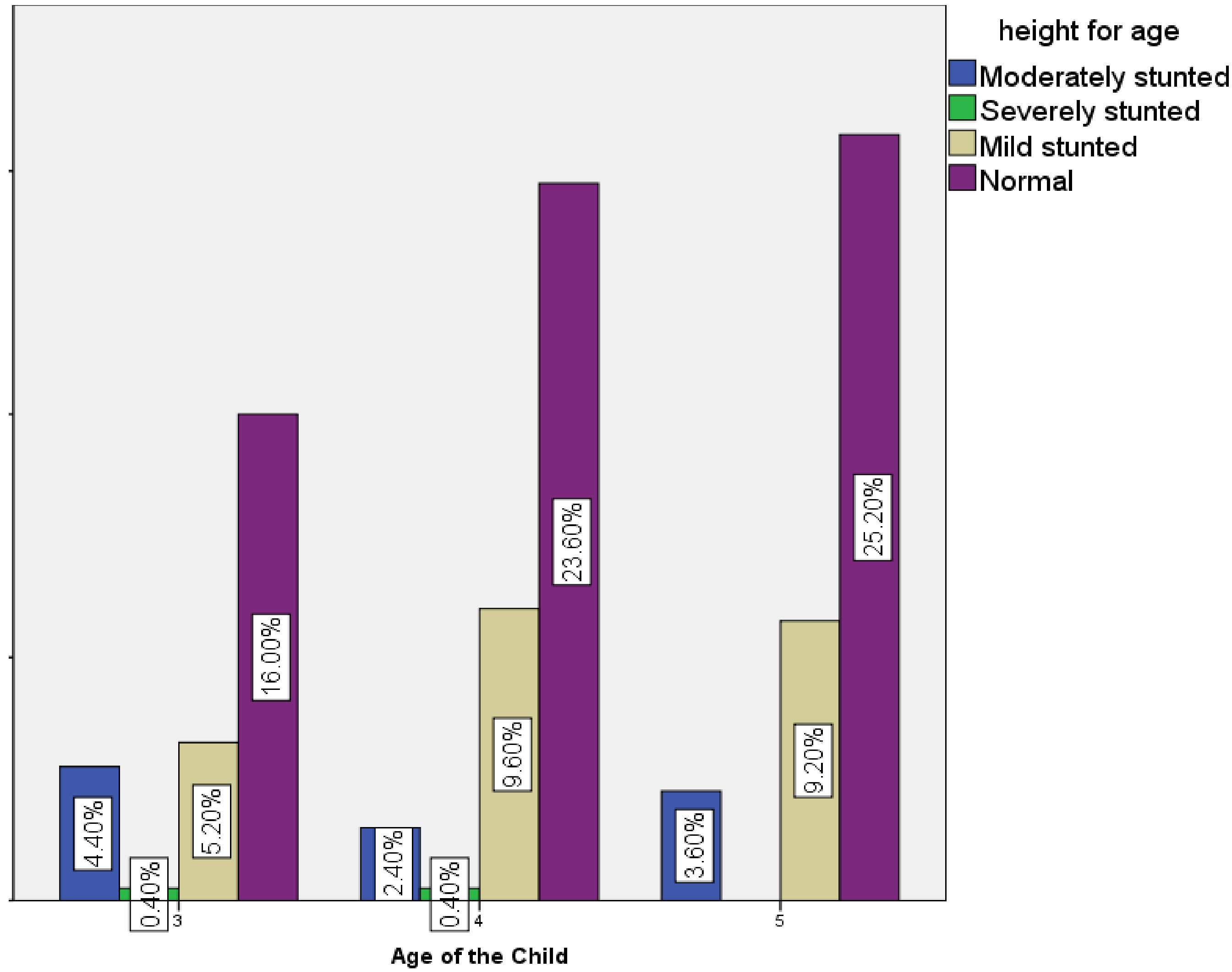


Figure 4.4: Distribution of infants by Height for age z-scores

The results for overweight children are almost similar to the findings (17.0%) of the children aged 6-23 months old who were overweight and obese in a study conducted by Korir (2013) among infants aged 6-23 months in Korogocho slums and those reported by Cattaneo (2010) in Europe.

These results for underweight are similar to studies in Africa that have found boys to be at a higher risk of undernurition (Parraga *et al.*,1996, Shahabuddin *et al.*, 2000, El Hioui *et al.*, 2011) Studies conducted in Ecuador (Sebastion and Senti, 1999) and in Tanzania (Lwambo *et al.*, 2000) show that boys were more commonly affected than girls. In a study carried out on infants less than 6 months by John et al (2013) in Morogoro municipality Tanzania showed that majority of infants (89.7%) were within the range of normal weights. There was a higher prevalence

(6.1%) of underweight among female than male infants (4.2%) infants. Only 8% of children were wasted. Generally in most studies conducted all over the world show boys to be more underweight than girls

The trends of wasting in s study reported by John et al. (2013) indicate that more baby girls are wasted compared to baby boys. It is estimated that worldwide, 8.5 million infants under 6 months are wasted. Moderate acute malnutrition (MAM) defined as weight-for-height affects 4.7 million infants. In this age group there is lack of data on the outcomes of malnutrition, on the use and interpretation of anthropometry and on potential interventions. The current case definition of acute malnutrition for infants is inferred from results of studies conducted among older children aged 6 to 59 months and is therefore problematic when applied to infants under 6 months. In a similar study reported by Keino (2014) on the double burden of malnutrition among infants 0-59 months in Narok county, the prevalence of stunting was 12.3% mildly stunted, 4.8% moderately stunted and 2.6% were severely stunted. In the similar study carried out on infants less than 6 months by John et al. (2013) in Tanzania, the stunting rate of females and males combined was 13%.

Prevalence of stunting was above the acceptable levels for a developmental area which is an issue of concern (WHO, 1995). This trend in under-nutrition rates is comparable to those of a study conducted in Ethiopia and Zambia (Disha *et al*., 2012) and Kenya (KDHS-2009). However the two studies assessed children 6-59 months old in households from all the socio-economic strata.

4.5.2 Maternal Nutrition status

The mean age of the mothers was 26.53 years and the age range was 16-41 years. Majority (91.5%) of the mothers were aged 20-35 years. The average weight of the mothers just before delivery was 72.56 kg with a range of 50-106 kg. The current mean weight was 67.35 kg with a range of 43.2-115kg and mean height was 1.59 m ranging from 1.45-1.71m (Table 4.13).

Table 4.13: Maternal Nutritional Status after Delivery and Iron Status during Pregnancy

Characteristic	Frequency n=250	Percent % N=250
Nutritional Status (MUAC)		
Normal	94	37.5
Overweight	109	43.5
Obese	47	19.0
Prevalence of Anemia during pregnancy		
Non- Anemic (Normal)	198	79.0
Mild anemia (100-109g/L) Hb	38	15.5
Moderate anemia (70-99 g/L) Hb	14	5.5
IFAS Intake during Pregnancy		
Took supplements	190	76.0
Did not take supplements	60	24.0
Number of Months IFAS was taken		
1-2	89	35.5
3-4	60	24.0
5-6	31	12.5
7-9	10	4.0
Anemia Incidences during Pregnancy		
Anemic	79	31.5
Non-anemic	171	68.5

The mean hemoglobin level during pregnancy as obtained from the clinic booklet was 11.9 g/dl with a range of 9-14.3 g/dl. Most women (76%) took the Iron and Folic acid supplementation with 4% taking the supplements for the required period.

These findings correspond to the 3% of underweight women prevalence from (Nairobi Province) with most of the mothers being overweight and obese. Probably most mothers gain weight during pregnancy and it takes some time to shade the gained weight. Women who are undernourished and have multiple micronutrient deficiencies are also at higher risk of infection, pregnancy and labor complications, (Victoria 2008). They also recover more slowly from illnesses hence posing heightened morbidity and mortality risks for their children, (Smith 2010).

Anemia incidences during pregnancy were defined according to WHO cut-off points of pregnant women (110g/L or higher for non anemic, 100-109g/L for mild, 70-99 g/L moderate and lower than 70g/L for severe) (WHO, 2011). These findings are consistent with those from other studies by Khoushabi et al. (2010) in India. The overall prevalence of anemia during pregnancy was 21% with no reported cases of severe anemia. This findings are also almost similar to those reported by Teixeira (2010), frequency of maternal anemia was 31.5% and Buseri (2008) in Nigeria whereby anemia in pregnancy were found to be 23.2% and 6.7% respectively.

In Kenya's micronutrient survey the prevalence of anemia among pregnant women was 55.1% (Mwaniki et al., 2002) which is higher than the study finding. This could be due to the fact that most of the pregnant women took IFAS or the difference in the trimester when the hemoglobin levels were recorded in the clinic booklet. However 31.5% mothers reported to have experienced anemia incidences during pregnancy. This was ascertained by asking them if they experienced symptoms of anemia namely weakness, pale hands and dizziness.

The findings for IFAS supplementation are similar to those reported studies by KDHS; KNBS and ICF Macro (2010) whereby 73% consumed IFAS tablets while 27% did not during the first visit to the ANC clinic with only 1% receiving a proper dosage totaling up to 180 IFAS tablets throughout the expectancy period. Those who did not take the IFAS supplements or just took for a month cited that: providers did not have access to adequate supply; they did not receive adequate tablets because they had little access to care, others started the antenatal clinic late hence did not have make enough visits to the clinic making it difficult to obtain the 180 tablets; providers did not provide adequate counseling or follow-up; they did not adhere to the regimen, which may be due to difficulty in remembering to take the tablets daily, not knowing all the tablets are necessary, fear of having a big baby, side effects and tablet-related issues like (bad taste, size, color, coating, packaging/storage problem). WHO recommends that all pregnant women receive a standard dose of 30–60 mg iron and 400 μg folic acid beginning from as soon as possible during gestation (WHO, 2012). Ideally, women should receive iron-containing supplements no later than the first trimester of pregnancy, which means ideally taking a total of 180 tablets before delivery.

4.6 PREVALENCE OF ANEMIA AMONG THE INFANTS

Table 4.14 shows the prevalence of anemia among the infants as per their gender, age and the breastfeeding type respectively. The mean Hb level of the infants was 10.7 ± 1.2 g/dL. The prevalence of anemia was 54.5% with 22.5% of the infants presenting moderate while 32.0% had mild anemia and only 0.5% had severe anemia. Almost half (45.0%) of the infants had normal hemoglobin levels cut-off points by (WHO 2011). More males were significantly moderate anemic hemoglobin than females.

A prevalence of 20.5% mild and moderate anemia was reported in 4 months old infants followed closely by 5 months old (20.0%) and three months old (14.0%). Therefore, hemoglobin levels reduce with age. The Chi square P-values indicate that gender and age were not found to be significantly ($p<0.05$) associated with the presence of anemia. These results are summarized in (Table 4.14, Table 4.15 and Table 4.16).

Table 4.14: Prevalence of anemia among infants by sex

Sex	n=130	Male (% N=250)	n=120	Female (% n= 250)	
Anemia Status					
Normal	51	20.5	61	24.5	
Mild	45	18.0	35	14.0	
Moderate	33	13.0	24	9.5	**P-value**
Severe	1	0.5	0.0	0.0	(0.39)
Total	**130**	**52**	**120**	**48**	

Table 4.15: Prevalence of anemia among infants by their age

(Anemia Status)	Non-Anemic	Mild %	Moderate %	Severe	
Age					
3 Months (n=65)	12.0	8.0	6	0 .0	**P-value**
4 Months (n=90)	15.5	12	8.5	0.0	(0.92)
5 Months (n=95)	17.5	12	8.0	0.5	
Total % n=250	**45.0**	**32.0**	**22.5**	**0.5**	

Table 4.16: Prevalence of anemia among infants by their feeding practices

(Anemia status)	Non-Anemic	Mild %	Moderate%	Severe	
Feeding practices					
EBF (n=143)	26.0	19.5	11.5	0.0	**P-value**
Mixed BF (n=12)	2.0	2.0	0.5	0.0	(0.04)
Partial BF (n=95)	17.0	10.5	10.5	0.5	
Total% n=250	**45.0**	**32.0**	**22.5**	**0.5**	

The Chi square P- values indicate that gender and age are not significantly ($P<0.05$) associated with the presence of anemia except for the breastfeeding type. Exclusively breastfed infants show a significantly (P=0.04) higher risk of developing mild and moderate anemia (19.5%) and (11.5%) respectively (Table 4.16).

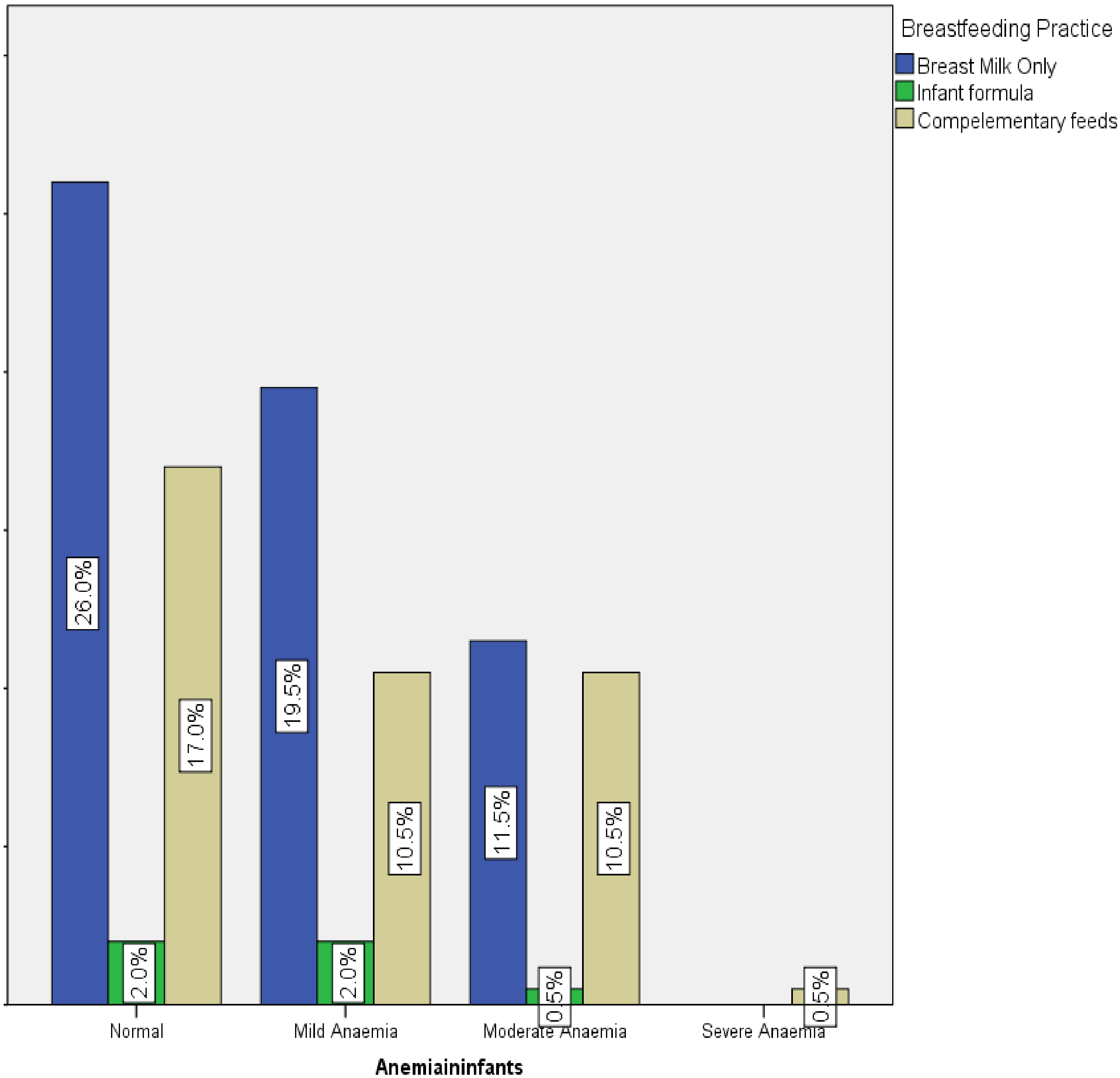


Figure 4.5: Relationship between breastfeeding practices and anemia

According to a study on 858 children 6-35 months of age in western Kenya, moderate anemia was 71.8% and severe anemia was 8.4%. Overall 16.8% of anemia cases were associated with malaria, 8.3% with iron deficiency, and 6.1% with inflammation (Foote, 2013). This study findings are also similar to those by Dewey et al. (1998) who while working in Honduras also found out 66% and 32% of exclusively breastfed full term infants born to first time mothers had hemoglobin concentration of <11.0 and <10.3g/dL respectively. Similarly a study in Indonesia on infants aged 3-6 months showed the prevalence of anemia to be 37% (Dee pee et al, 2002).

Few studies have been published in Kenya on the prevalence of anemia among infants 0-6 months. The only available data by Grant on 680 infants (aged 6-35 months) the mean prevalence of Iron Deficiency was 61.9 (Grant, 2008). In a study conducted in four towns in the Brazilian state of Pernambuco, infants were recruited at birth and followed up to 6 months, the frequency of anemia among the 330 infants assessed at 6 months of age was 65.2% with a range of 59.9-70.2. 7.9%; had hemoglobin below 9.0 g/dL and just one with hemoglobin < 7.0 g/dL (Teixeira et al. 2010).

4.7 MORBIDITY EXPERIENCE OF THE STUDY INFANTS

The morbidity experiences of the children two weeks immediately prior to the study are shown in Table 4.17.As indicated, 42.5% of the infants involved in the study reported to have suffered some illnesses while 57.5% did not report any illnesses. The disease suffered by most of the infants was common cold at 64.1% followed by diarrhea at 17.0%. The other illnesses reported were serious acute respiratory illness (ARI), malaria related symptoms and vomiting. Table 4.17 also shows the action taken by mothers when their children became sick. 68.8% of the mothers sought treatment from a health facility and 10.4% did not seek any medical attention. The study established that the mean number of times a child became sick within the previous two weeks was 1.58. All these results are shown in Table 4.17.

Table 4.17: Distribution of the study infants by morbidity experience

Type of illness	Frequency=106	Percent (%) N=250
Diarrhea	18	17.0
Pneumonia	6	5.7
Malaria	5	4.7
Vomiting	2	1.9
Common Cold	68	64.1
Others	7	6.6

Table 4.18 Medication of Sick Infants

Seeking Medication	n=106	Percent (%) N=250
No assistance sought	11	10.4
Homemade medication	10	9.4
Private Clinic/Pharmacy	19	17.9
Public Health facility	54	50.9
Pharmacy	12	11.3

More females (22.5%) than males (20%) were reported to have fallen sick two weeks prior to the study period. However the difference is not significant. Morbidity among infants has not been widely documented in many studies involving infants less than six months. Infants are especially susceptible to infections due to the fact that their immunity is not well developed and, in turn, develop diseases like common cold, pneumonia and other infections.

A similar trend of morbidity experience among infants in Kangemi-Nairobi is reported by Ayisi et al. (2013) whereby assessment of morbidity status indicated common cold at 22.1% to be the common illness experienced by infants two weeks prior to the study. Majority of the households (87.5%) owned a mosquito net with (87%) of the infants reported to have slept under a mosquito net the previous night. This may explain the low prevalence of malaria (2%) among the study infants and the fact that malaria is not a common problem in Nairobi. Similar findings are also reported by Oadi (2005) in Ghana.

4.7 INDEPENDENT DETERMINANTS OF ANEMIA

Correlation was determined by linear regression p-value <0.05 for the three objectives of the study which were to determine the prevalence of anemia in infants, their nutritional status, feeding practices and morbidity experience. (Table 4.19, 4.20 and 4.21).

Table 4.19: Results of Logistic Regression for Determinants of Anemia

Variable	β	P-Value
Sickness in the past two weeks*	0.87	0.01*
Mosquito net present*	0.72	0.02*
Sex of the infants	0.94	0.75
Anemia incidences to the mother	-0.28	0.23
Number of months IFAS taken	0.71	0.38
Breastfeeding type	1.13	0.04
Birth weight*	1.06	0.03*
Child Birth order	-1.67	0.89
Nutritional Status of the mother	0.12	0.27
Stunting	0.91	0.098
Infant's age*	0.83	0.019*
Occupation	-0.37	0.16

*The variables showing significant association with development of anemia (Chi square ($p<0.05$).

The significantly associated factors for anemia were birth weight of the infant, presence of a mosquito net, infant's age, breastfeeding practice and infant's sickness two weeks preceding the survey.

4.8 FACTORS ASSOCIATED WITH BREASTFEEDING PRACTICE

Infant breastfeeding type was significantly associated with the level of education of the mother, age of the infants, birth weight and infant birth order while morbidity experience was significantly associated by availability of a mosquito net, stunting and age of the infant, (Table 4.20).

Table 4.20: Table 4.5: Results of logistic regression analysis for variables associated with breastfeeding practices

Variable	P-Value
Sickness in the past two weeks	0.26
Birth weight	0.004*
Infant Birth order	0.027*
Nutritional Status of the mother	0.91
Occupation	0.28
Place of residence	0.15
Level Education of the mother	0.045*
Sex of the infant	0.48
Birth Spacing	0.01*
Place of residence	0.99
Age of Infant	0.049*

The study findings showed that infants birth order, birth weight, maternal education level and the age of infants, were associated ($p<0.05$) with exclusive breastfeeding. This compares well with findings from other studies. In a study conducted in Yatta Division, Kitui, the age of the child was found to be related with exclusive breastfeeding practices (Maundu, 2007). These findings suggest that the younger the child the higher the chances of being exclusively breastfed. In Namibia, the age of child was also significantly ($p=0.001$) associated with exclusive breastfeeding (Amadhila, 2005). Other socio-demographic factors such as the age of mother, marital status, religion of the mother, household size, highest education level of the mother and father, main income earner in the household, occupation of both the mother and father and monthly household income did not influence exclusive breastfeeding practice. Similarly, Maundu (2007) found that marital status, household head, education and household income were not related with exclusive breastfeeding.

4.9 FACTORS ASSOCIATED WITH INFANT NUTRITION STATUS

Table 4.21: Variables Associated with Infant Nutrition status

Variable	Stunting P-Value	Underweight P-Value	Wasting P-Value
Sickness in the past two weeks	0.258	0.049	0.514
Anemia incidences to the mother	0.00*	0.36	0.01*
Breastfeeding type	0.016	0.46	0.44
Birth weight	0.00*	0.104	0.985
Infant Birth order	0.68	0.07*	0.86
Nutritional Status of the mother	0.89	0.74	0.79
Occupation	0.76	0.045*	0.198
Age of weaning	0.03*	0.59	0.768
Place of residence	0.013*	0.100	0.481
Education	0.94	0.11	0.21
Sex of the infant	0.021*	0.26	0.23
Main source of income	0.74	0.97	0.96

*The variables showing significant association with infant nutritional status (Chi square ($p<0.05$).

Stunting is significantly associated with the sex of the infant, age when the infant was started on other complementary feeds, place of residence, anemia instance in the mother during pregnancy and the infant's birth weight. Underweight is associated with infant birth order and occupation while wasting is significantly associated with anemia instance in the mother during pregnancy.

4.10 FACTORS ASSOCIATED WITH INFANT MORBIDITY EXPERIENCE

Table 4.22: Results of logistic regression analysis for factors associated with Morbidity Experience

Variable	P-value
Nutritional Status of the mother	0.68
Occupation	0.57
Place of residence	0.89
Education	0.84
Sex of the infant	0.15
Birth Weight	0.74
Availability of mosquito net	0.01*
Age of infant	0.015*
Underweight	0.49
Wasting	0.50
Stunting	0.025*

*The variables showing significant association with breastfeeding type morbidity experience. (Chi square ($p<0.05$).

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

Based on the findings of this study, it is evident that acute malnutrition (wasting and underweight) among infants below six months is not a major problem. However, chronic malnutrition (stunting) remains a problem even in infants.

The prevalence of exclusively breastfed infants in this study population is higher than the national prevalence and also higher than the prevalence of Nairobi County. Both food quantity and quality consumed by infants are inadequate in terms of micronutrients such as iron which is required for proper growth and good health.

Infantile anemia showed a significant public health problem among infants 3-6 months. The study concludes that exclusively breastfed infants are at a higher risk of developing iron deficiency anemia as compared to those introduced to complementary feeds earlier than six months and those given infant formulas alongside breast milk.

Based on this study, maternal malnutrition during and after pregnancy is an insignificant problem with most of the mothers exhibiting over nutrition cases (overweight and obesity). Most mothers do not adhere to the IFAS regime with many failing to consume the tablets throughout the pregnancy period.

Malnutrition and childhood diseases are interconnected and mutually reinforce one another with acute respiratory infections such as common cold being the most prevalent among infants. Educational levels of the caregiver, and dietary diversity of a child determines a child’s morbidity status.

5.2 RECOMMENDATIONS

The prevalence of infantile anemia should be viewed by mothers and the government as a public health concern therefore guidelines on iron supplementation of infants born underweight should be strengthened to ensure every infant born underweight is supplemented with iron and for those who are weaned early given in form of sprinkles on food.

Maternal iron supplementation should continue after birth to ensure exclusively breastfed infants get enough iron from breast milk. Every stakeholder and healthcare providers should ensure that these guidelines are followed strictly. Interventions that address the nutrition of infants and their mothers should be strengthened in all health facilities.

Further studies need to be carried out to determine the impact of iron supplementation on hemoglobin levels of infants born underweight as compared to those who do not receive any iron supplements. Further studies also the reasons as to why expectant mothers fail to adhere to the recommended Iron and Folic Acid regime by WHO.

During growth monitoring, infant’s weight and height measurements as well as the age should be measured in all health facilities, (public and private) and the mother should be updated on the infant’s progress. Those found to be wasted, stunted and underweight as early as below six months should be referred to the nutrition clinic for further monitoring

Major policy makers such as Kenyan Government and WHO should review and change the policy that promotes all mothers to exclusively breastfeed their babies up to six months.

It is extremely important that childhood diseases are identified, and treated. Parents and caregivers should be given education on the importance of seeking medical care during infant illness.

REFERENCES

Abalkhail B, Shawky S. (2002). Prevalence of daily breakfast intake, iron deficiency anemia and awareness of being anemic among Saudi school students. Int J Food Sci and Nutr, 53(6): 519‒28.

Adaman J.W, Dan L. (2005). Anemia and polycythemia. Section-10 Hematological Alterations. In Harrison’s Principles of Internal Medicine 16th ed. Vol. 1, editors Kasper DL Fauci AS Longo DL Braunwald E Hauser SL Jameson JL; pp 334-336 McGraw Hill, N. Y.

Agho K.E Michael J.D**,** Justice I.O, Sunday M.O. (2011). Determinants of exclusive breastfeeding in Nigeria, MSc Thesis, School of Medicine, the University of Western Sydney, NSW, Australia.

Amadhila F. (2005). Factors that influence exclusive breastfeeding in Windhoek District in Namibia. MPH Thesis, Department of Applied Nutrition, University of the Western Cape.

Andang'o PE, Osendarp SJ, Ayah R, et al. Efficacy of iron-fortified whole maize flour on iron status of schoolchildren in Kenya: a randomised controlled trial. Lancet 2007; 369:1799.

Ayisi R.K, Thuita F, Njeru E. (2013). Prevalence of exclusive breastfeeding and associated factors among infants aged 0 – 6 months in a peri-urban settlement of Kangemi, Nairobi. MSc Thesis, School of Public Health, University of Nairobi.

Baker R. (2003). "Human milk substitutes. An American perspective". Minerva Pediatr 55 (3): 195–207

Beard J. (2007). Recent evidence from human and animal studies regarding iron status and infant development. J Nutr ;137: 524S–30S.

Bonoist, B., McLean, E., Egli, I., Cogswell, M. (2008).Worldwide Prevalence of Anemia 1993-2005: WHO Global Database on anemia. World Health Organization Press

Butte N.F, Lopez-Alarcon M.G, Garza C. (2002).A report on nutrient adequacy of exclusive breast-feeding for the term infant during the first six months of life. Geneva, WHO, ISBN

Carter RC, Jacobson JL, Burden MJ, et al, (2010). Iron deficiency anemia and cognitive function in infancy. Pediatrics; 126:e427.

Cattaneo A, Monasta L, Stamatakis E, Lioret S, Castetbon K, Frenken F, Manios Y, Moschonis G, Savva S, Zaborskis A, Rito A.I, Nanu M, Vignerova J, Caroli M, Ludvigsson J, Koch F.S, Serra-Majem L, Szponar L, van Lenthe F and Brug J. (2010). Overweight and obesity in infants and pre-school children in the European Union: a review of existing data. Obes Rev.;11(5):389–398. doi: 10.1111/j.1467-789X.2009.00639.x

Chaparro C.M, Neufeld L.M, Tena Alavez G, Eguia-Liz Cedillo R, Dewey K.G. (2006). Effect of timing of umbilical cord clamping on iron status in Mexican infants. In: a randomized controlled trial. Lancet; 367: 1997-2004.

Chaparro C.M. (2008). Setting the stage for child health and development. In: prevention of iron deficiency in early infancy. J. Nutri. 138,: 2529-2533.

Chaparro C.M. Dewey KG, (2007). Session 4: Mineral metabolism and body composition Iron status of breast-fed infants. ProcNutrSoc; 66(3): 412-422.

Cherop C.E, Keverenge-Ettyang A.G, and Mbagaya G.M. (2009), "Barriers to exclusive breastfeeding among infants aged 0–6 months in Eldoret municipality, Kenya,"In: East African Journal of Public Health, 6, 1: 69–72.

Colen, Cynthia G., and Ramey, David M. (2014) "Is breast truly best? Estimating the effects of breastfeeding on long-term child health and wellbeing in the United States using sibling comparisons." Social Science and Medicine. 109.: 55-65.

de Onis M, Onyango A.W, Van den Broeck J, Chumlea W.C, Martorell R. (2004). Measurement and standardization protocols for anthropometry used in the construction of a new international growth reference. Food Nutr Bull. Mar;25(1 Suppl):S27-36.

De Pee S, Bloem M.W, Sari M, Kiess L, Yip R, Kosen S. (2002). The high prevalence of low hemoglobin concentration among Indonesian infants aged 3-5 months is related to maternal anemia. J Nutri ;132: 2215-2221.

Dewey K.G, Chaparro C.M. (2007) Session 4: Mineral metabolism and body composition Iron status of breast-fed infants. Proc Nutr Soc; 66(3): 412-422.

Dewey K.G, Cohen R.J, Brown K.H. (2004). Exclusive breast-feeding for 6 months, with iron supplementation, maintains adequate micronutrient status among term, low-birth weight, breast-fed infants in Honduras. J Nutr ; 134: 1091-1098.

Domellöf M.D, Cohen R.J, Rivera L.L, Dewey K.G, Hernell O, Lönnerdal B.(2002). Iron supplementation affects growth and morbidityof breast-fed infants. In: Results of a randomized trial in Swedenand Honduras. *J Nutr*; 132**:**3249-3255.

Domellof M.D, Dewey K.G, Lonnerdal B, Cohen R.J, Hernell O. (2002). The diagnostic criteria for iron deficiency in infants should be reevaluated. J Nutr; 132:3680–6.

Faldella G, Corvalia L, Lanari M, Salvioli G.P. (2003). Iron balance and iron nutrition in infancy. Acta Paediatr Suppl.;91: 82-5.

Fall C. (2004). Iron requirements and iron status during infancy, International Nutritional Anemia Consultative Group. Report of the 2004 symposium.In: Iron deficiency in early life challenges and progress. Lima: 13-6.

FAO.(2006). The double burden of malnutrition: Case studies from six developing countries. FAO Food and nutrition paper No84, Rome.

Farnaud S, Evans R.W. (2003). "Lactoferrin—a multifunctional protein with antimicrobial properties". *Mol. Immunol.* 40 (7): 395–405.

Fischer A.A, Lang J.E. Stoeckel J.E, and Townsend J.W. (1991). Hand book for family planning operations, Research Design 2nd Edition. The population council , NewYork.

Fomon S.J, Nelson S.E, Ziegler E.E. (2000). “Retention of iron by infants,” In: Annual Review of Nutrition, 20: 273–290.

Foote E.M, Sullivan K.M, Ruth L.J, Oremo J, Sadumah I, Williams T.N, Suchdev P.S. (2013). Determinants of anemia among preschool children in rural, western Kenya. Am J Trop Med Hyg. 88(4): 757-64.

Frederick K.E, Reynaldo Martorell, Rafael Flores-Ayala, Conrad R, Cole, Laird J, Ruth, Usha Ramakrishnan, and Parminder S. (2012). Comparison of indicators of iron deficiency in Kenyan children Am J Clin Nutr 95: 1231-1237;

Gartner L.M, Morton J, Lawrence R.A, Naylor A.J, O'Hare D, Schanler R.J, Eidelman A.I. (2005). "Breastfeeding and the Use of Human Milk". Pediatrics 115 (2): 496–506.

Grant F.K, Martorell R, Flores-Ayala R, Cole C.R, Ruth L.J, Ramakrishnan U, Suchdev P.S, Grantham-McGregor S, Ani C. (2008). A review of studies on the effect of iron deficiency on cognitive development in children. J Nutr.;131: 649S–668S.

Greer, F. R.; Sicherer, S. H.; Burks, A. W. (1 January 2008). "Effects of Early Nutritional Interventions on the Development of Atopic Disease in Infants and Children: The Role of Maternal Dietary Restriction, Breastfeeding, Timing of Introduction of Complementary Foods, and Hydrolyzed Formulas". *Pediatrics* **121** (1): 183–191

Hanna N, Ahmed K, Anwar N, Petrova A.M, Hiatt M, Hegyi T. (2004). "Effect of storage on breast milk antioxidant activity". In: Arch Dis Child Fetal Neonatal Ed (BMJ Publishing Group Ltd) 89 (6): F518–20.

Hay G, Refsum H, Whitelaw A, Lind Melbye E, Haug E, Borch-Iohensen B. (2007). Predictors of serum ferritin and serum soluble transferrin receptor in newborns and their associations with iron status during the fi rst 2 y of life. Am J Clin Nutr ;86: 64-73.

Hicks P.D, Zavaleta N, Chen Z, Abrams S.A, Lonnerdal B. (2006). Iron deficiency, but not anemia, up regulates iron absorption in breast-fed Peruvian infants. J Nutr; 136: 2435-2438.

Horton S, and Ross J. (2003). "The Economics of Iron Deficiency." Food Policy 28(1): 51-75.

Hutton E.K, Hassan E.S. (2007). Late vs. early clamping of the umbilical cord in full-term neonates: Systematic review and meta-analysis of controlled trials. JAMA.; 297: 1241–52

Janz, TG; Johnson, RL; Rubenstein, S.D. (2013). "Anemia in the emergency department: evaluation and treatment.". Emergency medicine practice **15** (11): 1–15.

John G. Safari, Stella C. Kimabo, Lwelamira J. (2013). Feeding practices and nutritional status of infants in Morogoro Municipality, Tanzania, Journal of Health Research http://dx.doi.org/10.4314/thrb.v15i3.5

Keino S. (2014). prevalence and risk factors of malnutrition among children in Kenya, Linking childhood under-nutrition and infant feeding to overweight later in, J Nutr; **133**: 336–340.

Kenya National Bureau of Statistics (KNBS) and ICF Macro. (2010). *Kenya Demographic and Health Survey (2008-09)*. Calverton, Maryland: Kenya National Bureau of Statistics and ICF Macro.

Kerr, Martha, Désirée Lie. (2008). “Neuro developmental Delays Associated With Iron-Fortified Formula for Healthy Infants”. In: Medscape Psychiatry and Mental Health.

KNBS (2010). Kenya 2009 Population and Housing Census Highlights.

Kramer M.S, Kakuma R. (2002). "Optimal duration of exclusive breastfeeding". In: Kramer, Michael S. *Cochrane Database Syst.*

Kramer MS, Kakuma R (2012); Optimal duration of exclusive breastfeeding. Cochrane Database Syst Rev. Aug 15;8:CD003517. doi: 10.1002/14651858.CD003517.pub2.

Kramer, MS; Kakuma, R (15 August 2012). "Optimal duration of exclusive breastfeeding.". The Cochrane database of systematic reviews **8**: CD003517.

Kumar A, Rai AK, Basu S, et al. (2008). Cord blood and breast milk iron status in maternal anemia. Pediatrics; 121:e673.

Lozoff B, Angelilli M.L, Zatakia J, Jacobson S.W, Calatroni A, Beard H. (2007). Iron status of inner-city African-American Infants. Am J Hematol. ;82: 112–21.

Lozoff B, Jimenez E, Hagen J, Mollen E, Wolf A.W. (2000).Poorer behavioral and developmental outcome more than 10 years after treatment for iron deficiency in infancy.*Pediatrics* 105 : 1-11.

Lozoff B, Jimenez E, Smith JB (2006). Double burden of iron deficiency in infancy and low socioeconomic status: a longitudinal analysis of cognitive test scores to age 19 years. Arch Pediatr Adolesc Med; 160:1108.

Lwambo N.J, Brooker S, Siza J.E, Bundy D.A & Guyatt H. (2000). Age patterns in stunting and anemia in African schoolchildren: a cross-sectional study in Tanzania. Eur. J. Clin. Nutr. 54, 36–40.

Mamiro P.S, Kolsteren P, Roberfroid D, Tatala S, Opsomer A.S, Van Camp J.H. (2005). Feeding practices and factors contributing to wasting, stunting, and iron-deficiency anemia among 3-23-month old children in Kilosa district, rural Tanzania. J Health Popul Nutr. ;23 (3): 222-30.

Mansvelt EPG.(2009). Iron deficiency and iron deficiency anemia (IDA). PNT;13(1):29-30.

Maundu J. M. (2007). Assessment of feeding practices and the nutritional status of children 0-36 months in Yatta Division, Kitui. MPH Thesis, University of Nairobi. McLeod, D., Pullon, S. and Cookson, T. (2002). Factors influencing continuation of breastfeeding in a cohort of women. *Journal of Women Lactation, 18(4):335-45.*

McCann J.C, Ames B.N. (2005). "Is docosahexaenoic acid, an n-3 long-chain polyunsaturated fatty acid, required for development of normal brain function? An overview of evidence from cognitive and behavioral tests in humans and animals". *Am. J. Clin. Nutr.* 82 (2): 281–95.

McLean E, Cogswell M, Egli I, Wojdyla D, de Benoist B. (2009). Worldwide prevalence of anemia, In: WHO Vitamin and Mineral Nutrition Information System, 1993-2005. Public Health Nutr; 12: 444–54.

Michaelsen K.F, Weaver L, Branca F, Robertson A.(200). Control of iron deficiency. In: Feeding and Nutrition of Infants and Young Children. Guidelines for the WHO European Region. Copenhagen: WHO.

MOH, UON, KEMRI, SOMA-NET, UNICEF (1999). Anemia and the Status of Iron, Vitamin-A and Zinc in Kenya. National Micronutrient Survey Report.

Moy R.J. (1999). New approaches to the detection of iron-deficiency anemia. J Trop Pediatr.;45:320-1.

Mututho L.N, Elizabeth K. Sophie O. (2012). Factors influencing exclusive breastfeeding among infants less than 6 months in Kasarani informal settlement, Molo district, Kenya. MSc Thesis, Food Nutrition and Dietetics, Kenyatta University.

Mwaniki D.L, Omwega A.M, Muniu E.M, Mutunga J.N, Akelola R, Shako B.R, Gotink M.H, and Pertet A.M. (2002). Anemia and status of iron, vitamin A and zinc in Kenya. The National Survey. Nairobi: Ministry of Health.

Nestel P. (2002). Comité de pilotage de l'INACG, . *Adjusting hemoglobin values in program*

Oadi KO, Kuitunen M. (2005) Childhood diarrheal morbidity in the Accra Metropolitan Area, Ghana: Socio-economic, environmental and behavioral risk determinants. J Health Pop Dev Countries :33-46.

Onyango A, Koski K.G, Tucker K. L. (1998). "Food diversity versus breastfeeding choice in determining anthropometric status in rural Kenyan toddlers. Intl J Epidemiol; 27:484-489 actice Center.

Oppenheimer S.J. (2001). Iron and its relation to immunity and infectious disease. J Nutr ;131: 616S–33S (discussion 633S–5S).

Rady S., Pinna K., Whitney E. (2009). Understanding Normal and Clinical Nutrition. Wadsworth, Belmont. Eighth Edition.

Reilly J.J, and Wells J.C. (2005). Duration of exclusive breast-feeding In: Introduction of complementary feeding may be necessary before 6 months of age. Br. J. Nutr. 94: 869-872.

Sazawal S, Black R.E, Ramsan M. (2000). Effects of routine prophylactic supplementation with iron and folic acid on admission to hospital andmortality in preschool children in a high malaria transmission setting:community-based, 62andomized, placebo-controlled trial. Lancet 20

Schmidl M.K., Labuza T.P. (2000)."Infant formula and Medical Foods. In: Essential of Functional Foods". Aspen Publishers. pp. 137–164.

Smith L. R. (2010) .The Clinical and Economic Burden of Anemia. The American Journal of Managed Care.16, S59-S66.

Stanley I.P, Mei Chung, Gowri Raman, Priscilla Chew, Nombulelo Magula, Deirdre DeVine, M.Litt, Thomas Trikalinos, Joseph Lau. (2007). Breastfeeding and Maternal and Infant Health Outcomes in Developed Countries. In: Tufts-New England Medical Center Evidence-Based Pr

Stoltzfus R. (2001). Defining iron-deficiency anemia in public health terms: a time for reflection. J Nutr 2001;131:565S–7S.*surveys.* International Nutritional Anemia Consultative Group (INACG), 6 p.

Teixeira M.L, Lira P.I, Coutinho S.B, Eickmann S.H, Lima M.C. (2010) Influence of breastfeeding type and maternal anemia on hemoglobin concentration in 6-month-old infants. J Pediatr J.; 86(1): 65-72.

Tympa-Psirropoulou E, Vagenas C, Psirropoulos D, Dafni O, Matala A, Skopouli F. (2005). Nutritional risk factors for iron-deficiency anemia in children 12-24 months old in the area of Thessalia in Greece. Int J Food SciNutr; 56: 1-12.

UNICEF-WHO the World Summit for Children: In Strategy for Reducing Iron Deficiency Anemia in Children. The UNICEF-WHO Joint Committee on Health Policy, JCH. UNICEF and WHO, p. 5.06; 367:133–43.

United Nations, Sub-Committee on Nutrition (ACC/SCN). (2000). International Food Policy Research Institute. Nutrition throughout the life cycle. 4th report on the world nutrition situation: Geneva.

Victoria C.G, Adair L, Fall C, Hallal P.C, Martorell R, Richter L, Sachdev H.S, Maternal Maternal and Child Undernutrition Study Group (2008). Maternal and Child Undernutrition: consequences for adult health and human capital. Lancet 371: 340-357.

WHO, (2006). Multicentre Growth Reference Study Group: WHO Child Growth Standards: Length/ height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Geneva, World Health Organization,. Available at: http://www.who.int/childgrowth/standards/technical_report/en/index.html

WHO, UNICEF. (2006). Planning guide for national imple|mentation of the global strategy for infant and young child feeding. World Health Organization, Geneva.

WHO. (2001). Iron deficiency anemia – Assessment, prevention, and control. A guide for programme managers. World Health Organization Geneva.

WHO. (2001).The optimal duration of exclusive breastfeeding. Report of an Expert Consultation. World Health Organization Geneva, Switzerland.

WHO. (2011). Hemoglobin concentrations for the diagnosis of anemia and assessment of severity. Vitamin and Mineral Nutrition Information System. Geneva, World Health Organization.(WHO/NMH/NHD/MNM/11.1)(http://www.who.int/vmnis/indicators/hemoglobin.

WHO/CDC (2004). Best indicators to assess iron deficiency, a major cause of anemia. 7th May 2004. *http://www.who.int/.(Dr* Bruno de Benoist-email:debenoist@who.int.).

World Bank (2012). World Bank Report.

World Health Organization (WHO). (2012). Guideline: Daily Iron and Folic Acid Supplementation in Pregnant Women. Geneva, World Health Organization.

World Health Organization, (2009). Infant and young child feeding: Model Chapter for textbooks for medical students and allied health professionals. Geneva, WHO.

Yang Z, Lönnerdal B, Adu-Afarwuah S, Brown K.H, Chaparro C.M, Cohen R.J, Domellöf M, Hernell O, Lartey A, Dewey K.G, (2009). Prevalence and predictors of iron deficiency in fully breast-fed infants at 6 months of age. In: comparison of data from 6 studies. Am. J. Clin. Nutr. 89, 1433-1440.

Zeisel S.H (2009). Is maternal diet supplementation beneficial? Optimal development of infant depends on mother’s diet. Am J Clin Nutr.;89(2):685S–687S

Zimmermann M.B, Hurrell R.F. (2007). Nutritional Iron Deficiency. Lancet 370: 511-520

ANNEXES

ANNEX 1: STUDY PARTICIPATION CONSENT FORM

CONSENT FORM FOR INTERVIEWEES PREVELENCE OF IRON DEFICIENCY ANEMIA IN INFANTS 3-6 MONTHS IN RELATION TO BREASTFEEDING TYPE

Principle investigator: Carolyne Kemunto Nyamasege

Introduction

Miss. Carolyn Kemunto Nyamasege, a student at the University of Nairobi doing masters in Applied Human Nutrition is conducting a survey among mothers with infants aged between 3-6 months. You together with your child have been selected by chance to participate in this study. This consent form is to give you information to help you decide to participate or not. Please read it carefully or listen as I read. You may ask questions on anything not clear to you on the purpose of the study, procedures, risks, benefits, compensation and your rights as a volunteer.

Purpose

The purpose is to get information about the relationship between the breastfeeding type and hemoglobin levels of infants aged 3-6 months. The information you provide will be useful in finding the prevalence of anemia in infants 3-6 months.

Procedure

If you agree to participate in the study you will be asked questions. The nature of the questions will be pertaining to your household, infant feeding practices and morbidity experience, postnatal and antenatal care practices. The interviewer will also access your antenatal card to check for weight gain during pregnancy, iron supplementation and birth weight of your child. We will draw a drop of blood from your child's finger by a prick with the help of the lab technician and check for the hemoglobin levels. Your weight and that of the child will also be taken.

Risks/Discomfort

This study will involve doing a hemoglobin test to detect the hemoglobin levels. This will involve a lancet prick to obtain a drop of blood from your child's finger. During this procedure your child may experience a slight pain but it is minimal. You will also be asked questions which may cause psychological discomfort. You are free not to answer any such questions if you feel so. In addition, the questions will also be asked in a private environment and confidentiality will be assured at all times to ensure your comfort.

Benefits

In case your baby is found to be anemic, hemoglobin of less than 105 g/L, he/she will be appropriately referred to the pediatrician for treatment to improve his/her health. You will also be referred to the nutritionist in charge for counseling or any supplements required. This study will help us to know the current prevalence of iron deficiency anemia among infants and the information obtained may be used to improve the quality of infant health in our communities. A copy of this report will be submitted to your health facility (MLKH). The facility may use it for planning development project to address the finding.

Confidentiality

Your confidentiality will be maintained at all times. The questionnaires will be assigned Identifiers which will be assigned randomly. The filled questionnaires will be stored in a lockable filing cabinet only accessible to the principle investigator and research assistant. Electronic data will be stored in a password protected database accessible only through the principle investigator .The analysis and report of the study will only use the study numbers and no detail will be provided at any point that might identify an individual. There shall be no mention of names or identifiers in the report or publications which may arise from the study. The information obtained will be used only for the purpose of the study.

Compensation

There will be no compensation for participation in the study in form of money or any other gift however the information you give will be highly appreciated.

Voluntariness and rights as a Volunteer

Participation in the study is voluntary. If you choose not to participate, you will not be denied any service. You will be free to withdraw from the study at any time. Your participation in the study will be highly appreciated.

For any questions/ clarification, contact the principle investigator on:
P.O. BOX, 315-00517, Nairobi, Kenya
Telephone number: 0712573097
Email address: nkemunto2030@gmail.com

You can also contact my supervisor:
Prof. Jasper K. Imungi
P.O BOX 29053 – 00625, Kangemi, Nairobi – Kenya
imungijk@yahoo.com
Phone: +254-721-46-8181

As well as the Chairman KNH/UON-ERC on:
P.O.BOX 19676, Nairobi, Kenya.

PARTICIPANT'S STATEMENT

I Mr/Mrs/Miss.. being a person aged 18 years and over, having read/ been explained to the above and in the knowledge that it is voluntary, I acknowledge that a thorough explanation of the nature of the study has been given to me. I hereby give consent for myself/ my child to participate in this study. I understand that I/ my child have the right to withdraw from the research at any time, for any reason, without penalty or harm.

....
Parent/ Guardian's signature
Date:..

....
Mothers signature on behalf of the child (Assent)
Date:..

....
Reseacher/Assistant

Date:..

ANNEX 2: QUESTIONNAIRE

IDENTIFICATION

Estate………… Mother Child Pair No………..

Name of interviewer……………………………… …….Date of interview………/……../2014

Respondent's name………………………………………………………………………………

Name of the index child____________________ Sex ___________ 1) Male 2) Female

SECTION A: DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS

Q1. Household profile 1 = monogamous 2 = polygamous ( )

S/No	Name	Relationship to HH head -codes-	Age (years)	Education Level	Main Occupation -codes-	Religion	Marital Status
1							
2							
3							
4							
5							
6							
7							
8							
9							

RHHH	Education	Occupation	Religion	Marital Status
1= HHH 2=Spouse 3=son 4=Daughter 5= Grandson 6=Grand daughter 7=Relative 8=Parent 9=Employee	1= In Primary 2=Primary drop-out 3=Completed primary 4=Secondary drop-out 5=In secondary 6=Completed secondary 7=Tertiary level 8=University 9=Adult education 10= Other (specify)	1= salaried employee 2=farmer 3=Self employment 4=Casual laborer 5=Student 6=Unemployed 7=Others (specify)	1=Christian 2=Muslim 3=Traditional 4=Others (Specify)	1=Married 2=Separated 3=Widowed 4=Single 5=Divorced 6=N/A

1b) what is your household main source of income? 1=Animal and animal product sale 2=Casual labor 3= Salaried or waged 4=Crop sale 5= Gifts 6=Trade 7=others (specify)

SECTION B: CHILD INFORMATION

Q2 – 9 FEEDING PRACTICES OF INFANTS AGED 3-6 MONTHS (SUB OBJECTIVE 2)

FIRST NAME	Q2 Date of birth	Q3 Time of Initiation of BM after Birth 1=Within 30 mins 2=1 hr, 3=After 3-5 hours 5=Infant Formulas 6=Others?	Q4 Are you breastfeeding the child Exclusively? (if no, skip toQ6) 1=Yes 2=No	Q5 If EBF, how many times a day?	Q6 How old was the child when you stopped EBF?	Q7 What are you currently feeding your child on apart from BM? 1=Infant formula 2= Cow Milk 3=Other CF	Q 8 If giving Infant Formula, which types do you use and how many mls a day? 1=Cow & gate 2=Nan 3= Soy based4= Others specify	Q 9 How many times do you feed the child in a day?

Q10-Q13 IMMUNIZATION

I.D number	Q 10 do you have a health card 1=yes 2= no	Q11 BCG @ birth 1=yes 2= no	Q12 DPT			Q13 OPV			
			DPT_1 1=yes 2= no	DPT_2 1=yes 2= no	DPT_3 1=yes 2= no	OPV_0 1=yes 2= no	OPV_1 1=yes 2= no	OPV_2 1=yes 2= no	OPV_3 1=yes 2= no

SECTION C: Q 14– Q24 ANTHROPOMETRY AND HEMOGLOBIN FOR INFANTS AGED 3-6 MONTHS.

I.D No	Q14 Child Birth Order	Q15 Date of birth(verify from card)	Q16 Age (Months	Q17 Birth Weight in (Kg)	Q18 Weight 1 (0.1 kg)	Q19 Weight 2 (0.1 kg)	Q 20 Mean Weight (0.1kg)	Q21 Height1 (0.1cm	Q21b Height2 (0.1cm)	Q22 Mean Height (0.1kg)	Q 23 Bilateral Oedema	24 Hemoglobin Levels

Q25-Q34 RETROSPECTIVE INFORMATION ON HEALTH AND ATHNROPOMETRY MEASUREMENT FOR MOTHERS TO THE INDEX INFANT (SUBOBJECTIVE 3)

Q25 Age (Years)	Q26 No of subsequent births	Q 27 Did you take Iron suppleme ntduring the whole period of pg 1=Yes 2= No	Q 28 If No, for how long did you take them?	Q29 Any Anemia incidence 1=Yes 2=No	Q30 Time in minutes before umbilical cord clamping	Q 31 Weight before pregnancy in kg to be obtained from card/memory	Q32 Current Mean Weight (0.1kg)	Q 33 Height in m (0.1m)	Q 34 MUAC in cm

Q31-35 – Q MORBIDITY OF INFANTS AGED 3– 6 MONTHS (SUBOBJECTIVE 5)

I.D No	Q31 Has the child experienced or shown any sign of illness within the last 2 weeks? 1=Yes 2 =No	Q32 If Yes which disease did the child suffer from in the last 2wks 1=Diarrhea 2= Serious ARI[1] 3= Febrile illness/suspected Malaria[2] 4= Vomiting 5=Common cold 6=Anemia or related symptoms 7=Others (specify)	Q33 Where did you seek healthcare assistance when child was sick? 1=No assistance sought 2=Own Medication 3-=Traditional healer 4=Private clinic/pharmacy 5=Public health facility 6=Pharmacy 7=other(Specify	Q34 Do you have a mosquito net? 1=yes 2=No	Q35 Did the child sleep under a mosquito net last night 1=yes 2= no

SECTION F Q36-39 FOOD AVAILABILITY AND ACCESSIBILITY

Q36 What is your main source of food for the entire household?

1=Purchase 2=Produce from the farm(sent from home) 3=Food Aid 4= Others (specify)

Q37 Have you experienced food shortages in the last 1 month? 1=Yes 2=No

Q38 If yes, how often did this happen?

1=Once a week 2= Twice a week 3=Once a month 4= Others (Specify)

Q39 If no, how would you categorize your household?

1=Food Secure 2=Food Insecure 3= Don’t know

FOOD CONSUMPTION QUESTIONARE FOR PARTIALY BREASTFED INFANTS

ANNEX 3: FOOD FREQUENCY QUESTIONNAIRE

FOOD EATEN	No of days consumed in a week				After 2 weeks	Once a month	Seasonal	Never consumed
	1-2	3-4	5- 6	Daily				
Porridge								
Potatoes								
Chips								
Cassava								
Ugali								
Chapatti								
Mandazi								
Bread								
Rice								
Green Bananas								
Cakes, Biscuits								
Liver								
Beef								
Chicken								
Fish								
Eggs								

Food eaten	1-2	3-4	5-6	Daily	After 2 weeks	Once a month	Seasonal	Never Consumed
Omena								
Lentils								
Beans								
Peas								
Green grams								
Mala								
Fresh Milk								
Yoghurt								
Pumpkin								
Spinach								
Kales								
Managu								
Terere								
Ripe Bananas								
Avocado								
Pineapple								
Paw paw								
Watermelon								
Mangoes								
Oranges								
Sodas and juices								
Oil								
Sugars,cakes								
Others								

ANNEX 4: FIELD ASSISTANTS TRAINING PROGRAM

DAY	TIME	SUBJECT MATTER	LEARNING METHOD	LEARNING AIDS
1	9.00-10.30 am	**Introduction and Overview of the study** ○ General objectives ○ Specific objectives	○ Lecture	○ Flip charts ○ Marker pens ○ Note books ○ Pens/pencils
	10.30-11.00 am	Tea Break		
	11.00-1.00 pm	**Data collection techniques** ○ Questionnaire filling (all sections), translating to Kiswahili	○ Lecture ○ Role play ○ Demonstration ○ Brainstorming	○ Sample questionnaire
	1.00-2.00 pm	Lunch Break		
	2.00-4.00 pm	**Data collection techniques (cont')** ○ Anthropometry - Taking height - Taking weight - Recording measurements ○	○ Demonstration ○ Role play	○ Seca scales ○ Mortise tape ○ Flip charts ○ Marker pens ○ Data form
	4.00-5.00 pm	**Ethics and conduct** ○ Professional conduct in the field ○ Confidentiality ○ Working hours ○ Allowances ○ Q & A	○ Lecture ○ Discussion	○ Flip charts ○ Marker pens
2	9.00-9.30 am	Recap of the previous day	Discussion	Flip Charts
	9.30-1.30 pm	Pretest questionnaire	Discussion	Questionnaires
	2.30-3.30 pm	Lunch Break		
	3.30-5.30	Revise questionnaire based On results of the pretest. Conclusions and Closing	Discussions	Flip charts Marker pens Qustionnaires

ANNEX 5: AERIAL VIEW OF MAMA LUCY KIBAKI HOSPITAL.

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
(254-020) 2726300 Ext 44355

30 JUL 2014

KNH/UON-ERC
Email: uonknh_erc@uonbi.ac.ke
Website: www.uonbi.ac.ke

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/244

Link:www.uonbi.ac.ke/activities/KNHUoN

30th July 2014

Nyamasege KemuntoCarolyne
Dept. of Food Science, Nutrition and Technology
University of Nairobi

Dear Carolyne

RESEARCH PROPOSAL: THE PREVALENCE OF IRON DEFICIENCY ANAEMIA IN INFANTS 3-6 MONTHS IN RELATION TO BREASTFEEDING TYPE (P195/04/2014)

This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and **approved** your above proposal. The approval periods are 30th July 2014 to 29th July 2015.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
g) Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

For more details consult the KNH/UoN ERC website www.uonbi.ac.ke/activities/KNHUoN.

Protect to Discover

REPUBLIC OF KENYA
MINISTRY OF HEALTH
NAIROBI CITY COUNTY

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020 - 2297000

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MAMA LUCY KIBAKI HOSPITAL.
P.O. Box 1278-00515
NAIROBI

When replying please quote

OUR REF: MLKH/ADM/RES/1/4/(79)

DATE: 11th August 2014

Carolyne K. Nyamasege
P. O. BOX 315 – 00517
NAIROBI

RE: PERMISSION TO CARRY OUT RESEARCH

TITLE: PREVALENCE OF IRON DEFICIENCY ANAEMIA IN INFANTS 3 – 6 MONTHS IN RELATION TO BREASTFEEDING TYPE

Your request for permission to carry out the above named study was discussed by the Research Committee Meeting held on 5th August 2014.

Permission granted is subject to compliance with the following requirements:-

- Only approved documents will be used
- All changes are submitted for approval by a Research Review Board before implementation and permission for this sought from the Hospital Administration
- Death and life threatening problems and severe adverse events are reported to the hospital within 24 hours
- Submit an executive summary report within 30 days upon completion of the study
- Provide reports on the study progress every 3 months
- Indemnify the hospital against any claim that may arise from the research

On completion submit a hard copy of the study findings to the hospital research committee c/o Office of the Medical Superintendent

Soft copy to be sent to mlkhresearch@gmail.com

DR. JULIUS OGATO
MEDICAL SUPERINTENDENT