ANEMIA AND ASSOCIATED FACTORS AMONG BREASTFEEDING INFANTS 0-6 MONTHS OLD AT KANGEMI SLUMS, KENYA

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A Dissertation Submitted in partial fulfillment of the requirements for the award of the Degree of Master of Science in Applied Human Nutrition of the University of Nairobi,

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DECLARATION

I hereby declare that this dissertation is my original work and has not been presented for a degree in any other University or institution of higher learning.

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DEDICATION

To my Dear Mum, Hannah Njeri, and my Late Father, Gacheru I. Kihiu.Your love, sacrifice, faith and encouragement throughout my life continue to be the driving force and ultimately led to the success of this work at all stages.

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ABBREVIATIONS AND ACRONYMS

ANC	Antenatal Care
BMI	Body Mass Index
CDC	Centre for Disease Control and Prevention
EBF	Exclusive Breastfeeding
EPI	Expanded Programme on Immunization
ERC	Ethics and Review Committee
FAO	Food and Agriculture Organization
ID	Iron Deficiency
IDA	Iron Deficiency Anemia
IDD	Iodine Deficiency Disorders
IFA	Iron and Folic Acid
IoM	Institute of Medicine
IYCF	Infant and Young Child Feeding
KDHS	Kenya Demographic and Health Survey
MCH	Mean Cell Hemoglobin
MCV	Mean Cell Volume
MOPHS	Ministry of Public Health and Sanitation
NNAP	National Nutrition Action Plan
RDA	Recommended Dietary Allowance
RDW	Red cell Distribution Width
RoK	Republic of Kenya

SPSS	Statistical Package for Social Sciences
UN	United Nations
UNICEF	United Nations Children's Fund
UNU	United Nations University
VAD	Vitamin A Deficiency
WHO	World Health Organization
ZPP	Zinc protoporphyrin

TABLE OF CONTENTS

DECLARATION ii

DECLARATION OF ORIGINALITY FORM iii

DEDICATION iv

ACKNOWLEDGEMENTS v

ABBREVIATIONS AND ACRONYMS vi

TABLE OF CONTENTS viii

LIST OF TABLES xii

LIST OF FIGURES xiv

OPERATIONAL DEFINITION OF TERMS xv

ABSTRACT xvi

CHAPTER ONE: INTRODUCTION 1

1.1 Background of the Study 1

1.2 Problem Statement 3

1.3 Justification 3

1.4 Aim of the Study 4

1.5 Purpose of the Study 4

1.6 Study Objectives 4

1.7 Study Hypotheses 5

CHAPTER TWO: LITERATURE REVIEW 6

2.1 Exclusive Breast Feeding 6

2.2 Evidence based studies for iron deficiency and IDA for exclusively breast fed infants .. 6

2.3 Infant Feeding and Child Survival 9

2.4 Micronutrient Deficiencies in Kenya 9

2.4.1 Iron deficiency 10

2.4.1.1 Probable causes of iron deficiency in infants 10

2.4.1.2 Stages of iron deficiency.. 11

2.4.1.3 Consequences of iron deficiency in early life... 12

2.4.2 Methods of determining anemia 13

2.4.3 Assessment of iron status.. 14

2.4.3.1 Hematocrit.. 16

2.4.3.2 Serum ferritin 16

2.4.3.3 Serum transferrin receptor concentration... 17

2.4.3.4 Mean cell volume... 17

2.4.3.5 Red cell protoporphyrin 17

2.4.3.6 Measurement of hemoglobin 18

2.5 Gaps in Knowledge 19

CHAPTER THREE: RESEARCH METHODOLOGY 20

3.1 Study Location 20

3.2 Study Population 20

3.4 Sampling... 21

3.4.1 Sampling frame.. 21

3.4.2 Sample size determination 21

3.4.3 Sampling 22

3.4.4 Sampling procedure 22

3.5 Data Acquisition Methods.. 24

3.5.1 Data collection tools 24

3.5.2 Recruitment and training of research assistants.. 26

3.5.3 Pre-testing of tools 26

3.5.4 Anthropometric measurements 26

3.5.5 Determination of anemia.. 28

3.6 Ethical Considerations.. 29

3.7 Data Quality Assurance/Control 29

3.8 Data Analysis 30

4.1 Social Demographic and Economic Characteristics of Study households......................... 33

4.1.1 Social-demographic characteristics 33

4.1.2 Socio-economic characteristics of the study households.. 35

4.2 Infant Feeding Practices.. 36

4.2.1 Breastfeeding information 37

4.3 Maternal Health and Nutritional Status.. 38

4.3.1 Utilization of ANC services.. 38

4.3.2 Micronutrient Supplements Intake of the breastfeeding mothers 39

4.3.3 Nutritional status of the mothers... 41

4.3.4 Dietary patterns of the lactating mothers 42

4.3.5 Prevalence of anemia among the lactating women.. 45

4.3.6 Factors associated with maternal anemia/hemoglobin levels 46

4.4 Health and Nutritional Status of the Infants.. 47

4.4.1 Nutritional status of the infants.. 48

4.4.2 Immunization Status of the infant 50

4.4.3 Prevalence of anemia among exclusively breastfed infants 51

4.4.4 Associations and relationships of infant anemia with selected factors 51

4.4.5 Comparing the means between the anemic versus non-anemic infant groups based on selected variables 54

4.4.6 Predictors of hemoglobin levels of infants 55

CHAPTER FIVE: DISCUSSION 58

5.1 Socio-demographic and Economic Characteristics 58

5.2 Infant Feeding Practices at Kangemi Slums 62

5.3 Iron and Folic Acid Intake Patterns of the Lactating Mothers 65

5.4 Maternal and Infant Nutritional Status 67

5.5 Dietary Intake Patterns of the Breast Feeding Mothers 70

5.6 Maternal and Infant Anemia 72

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS 75

6.1 Conclusions 75

6.2 Recommendations 76

REFERENCES 77

APPENDICES 94

Appendix 1: Study Questionnaire 94

Appendix 2: Informed Consent Form 101

Appendix 3: Child Assent Form 104

Appendix 4: Training Package 107

Appendix 5: Ethical approval 109

LIST OF TABLES

Table 1: Cut-off points for anemia in children 14

Table 2: Anemia cut-offs for non pregnant women (≥15 years) 14

Table 3: Stages in the development of iron deficiency anemia and their indicators 15

Table 4: Data acquisition matrix 25

Table 5: Data analysis matrix 32

Table 6: Selected socio-demographic characteristics of the study households 34

Table 7: Selected socio-economic characteristics of study households 35

Table 8: Monthly income status of the households 36

Table 9: Gestational age at first Antenatal care visit 39

Table 10: Distribution of mothers by services received at the ANC and PNC 39

Table 11: Maternal nutritional status (BMI) by age 41

Table 12: Frequency of food consumption of the lactating mothers 43

Table 13: Factors associated with maternal anemia 46

Table 14: Comparison of mean hemoglobin levels among the lactating mothers 46

Table 15: Selected characteristics of study infants 48

Table 16: Per cent distribution of acute malnutrition (Weight-for-Length Z-scores < -2) by sex 49

Table 17: Per cent distribution of stunting (Length-for-Age Z-score < -2) by sex 49

Table 18: Per cent distribution of underweight (Weight-for-Age < -2 Z-scores) by sex 50

Table 19: Per cent distribution of immunization status of study infants 50

Table 20: Anemia status and sex of infant... 51

Table 21: Feeding type and anemia 51

Table 22: Associations and relationship between infant anemia and selected variables.............. 52

Table 23: Comparing means between the anemic versus the non-anemic infant groups............. 55

Table 24: Summary of the regression model for predictors of hemoglobin levels of infants 56

Table 25: Logistic regression for factors associated with anemia among breastfeeding infants.. 57

LIST OF FIGURES

Figure 1: Sampling schema for study households 23

Figure 2: Infant feeding practices 36

Figure 3: Infants' exclusive breastfeeding status with age 37

Figure 4: Antenatal care attendance of the mothers during their last pregnancy 38

Figure 5: Duration of IFA supplementation during mother's last pregnancy 40

Figure 6: Distribution of lactating mothers by their Body Mass Index (BMI) 41

Figure 7: Distribution of the lactating mothers by types of food groups consumed 44

Figure 8: Distribution of the lactating mothers by dietary diversity tertiles 45

OPERATIONAL DEFINITION OF TERMS

Anemia	A condition of reduced red blood cells or blood hemoglobin level. It can also be defined as lowered oxygen carrying capacity of the blood. In this study anemia is defined as hemoglobin concentration <11.0 and <12g/dl for infants and lactating mothers respectively.
Iron deficiency anemia	Anemia due to reduced hemoglobin and red blood cells as a result of inadequate dietary intake/absorption of iron or blood iron loss.
Low birth weight	A weight less than 2,500 grams at birth
Malnutrition	A condition attributed to insufficient or excess dietary intake of nutrients resulting in health problems.
Micronutrient deficiency	Lack of adequate micronutrients (vitamins and minerals) essential for health.
Primi-gravidae	A woman who is pregnant for the first time
Stunting	Low height for age (< -2 SD) compared to the median height for age of the reference population.
Underweight	Low weight for age (<-2SD) compared to the median weight for age of the reference population.
Wasting	Low weight for height (< -2 SD) compared to the median weight for height of the reference population.

ABSTRACT

Controversies surrounding exclusive breast feeding for the first six months of life and the risk of developing anemia exist. Studies worldwide have indicated uncertainties on the way forward given the World Health Organization's firm stand on exclusive breastfeeding as the most appropriate practice for infants less than six months old. Research on anemia among infants below six months in Kenya is scanty. The objective of this study, conducted in March and April, 2014, was to determine the prevalence of anemia and associated factors among breastfeeding infants 0-6 months in Kangemi slums, Nairobi, Kenya.

A cross-sectional study was conducted on 139 breastfeeding infants aged 0-6 months and their respective mothers. An interviewer administered questionnaire was used to capture data on demographic and socio-economic characteristics, breastfeeding practices, iron and folic acid intake patterns and dietary patterns. Nutritional status of mothers and infants was assessed through anthropometric measurements. Anemia status was assessed using the rapid hemoglobin test kit (HemoCue®). Infants' blood was drawn from the heel while mothers' blood was from a finger prick. Data were analyzed using the Statistical Package for Social Sciences (version 20) and Microsoft Excel (2007). Socio-demographic and economic data were analyzed using descriptive statistics. Nutritional status of infants was classified according to the World Health Organization Child Growth Standards of 2006 and the mother's Body Mass Index was classified according to WHO 2000 BMI cut-offs. Factors associated with anemia were analyzed using logistic regression. The level of significance was determined at p-value <0.05.

Average household size was 3.8±1.12 members. Anemia prevalence (35.3%) was of moderate public health significance with 36.8% among exclusively breastfeeding compared to 28% of non-exclusively breastfeeding infants (χ^2=0.702, df=1, p=0.402). There was no significant

difference in mean hemoglobin levels between infants exclusively breastfed and those non-exclusively breastfed ($t_{0.025,\ 137}$=-1.040, p=0.300). Prevalence of anemia among breastfeeding mothers was 30%. Majority of infants (82%) were on exclusive breastfeeding, a proportion that gradually decreased with age. A reduced estimated relative risk of anemia (OR=0.713, 0.95CI: 0.34-1.50) was observed among infants aged less than 4 months as compared to those aged 4-6 months. Over two thirds (68.4%) of the mothers had received IFAs supplementation below the recommended threshold of 90 days in their last pregnancy. No significant difference was noted in mean hemoglobin levels of the mothers based on the duration of IFAs intake (F=0.818, p=0.486). There was no significant association between IFAs intake and maternal anemia. Global Acute Malnutrition rate was 5.8% with 5.2% and 6.2% among male and female infants respectively. Underweight and stunting levels were 2.2 and 19.4% respectively. Maternal BMI had a significant positive relationship with the infants' nutritional status as well as their hemoglobin levels (r=0.176, p=0.039 and r=0.182, p=0.032 respectively). A small proportion (3.6%) of the mothers were underweight with a considerable proportion (39%) being overweight/obese. The mean Women Dietary Diversity Score (WDDS) was 6±1.26 food groups, with 71.2% of the lactating women consuming a diet high in diversity. A significant correlation was found between maternal BMI and WDDS (p=0.576).

In conclusion, there is a likelihood of exclusively breastfed infants below 6 months being anemic in Kenya, to a level of moderate public health significance, and to a level that is not statistically different from the non-exclusively breast fed infants. Key factors of significant positive association with infant anemia include maternal nutritional status (both Body Mass Index and hemoglobin levels) and amount of household income spent on food. Hence special attention is warranted for maternal nutrition and low income households for exclusive breast feeding to

adequately address anemia in infants. In addition, supplementation of lactating mothers with iron/folic acid should be considered. A study to assess the iron content of breast milk among at risk mothers in resource poor settings is recommended to effectively address this problem.

Key words: anemia, exclusive breastfeeding, infants below 6 months, lactating mothers

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

The UNICEF/WHO Global Strategy for Infant and Young Child Feeding recommends exclusive infant breast feeding (EBF) for the first six months of life (WHO/UNICEF, 2003). Breast milk is crucial during this period to achieve optimal growth development and health of the infant. It further recommends complementary feeding to start at six months where appropriate, safe and nutritionally adequate complementary food should be introduced with continued breastfeeding up to two years and/or beyond (WHO/UNICEF, 2003). Among the well documented and articulated benefits of exclusive breastfeeding include the uniqueness in composition and function. It has been found to contain an ideal balance of nutrients that are easily digestible by the infant (WHO/UNICEF, 2003). Additional benefits include essential substances contained in breast milk which are crucial and critical in the optimal brain development of the young infant. Breast milk contains important growth factors that help to mature the infant gut (Catassi et al., 1995) and also immune factors to prevent and fight illnesses specific to the mother's and the infant's environment (Hanson, 2004).

Breast feeding facilitates bonding between the mother and the infant which contributes to emotional and psychological development of the infant. It is recommended that breast feeding be initiated within the first one hour of birth (WHO/UNICEF, 2003). Some studies indicate that extended and continued exclusive breastfeeding is associated with a reduced risk of the sudden infant death syndrome (SIDS) (Ford et al., 1993).

On the other hand, breast feeding is also beneficial to the mother in that early initiation helps to contract the uterus, expulsion of placenta and reduce post-partum bleeding (Kramer and Kakuma, 2002). Exclusive breast feeding may further delay return of fertility which reduces the risks associated with short birth intervals and prolonged breast feeding may reduce risk of certain types of cancer such as breast and ovarian cancers (Chilvers, 1993; Brinton et al., 1995; Enger et al., 1997; Rosenblatt & Thomas, 1993). However, recent studies indicate that iron deficiency may not be ruled out for some exclusively breast fed infants below six months particularly in vulnerable and/or high risk populations (Baykan et al., 2006; Torres et al., 2006; Yurdakok et al., 2004; Arvas et al., 2000).

Currently, there is growing controversy that exclusively breast fed infants are also at risk of developing anemia, some experts recommending the use of supplemental iron alongside breast milk to reduce this possible risk (Glader, 2004; Luo et al., 2014). Others have recommended exclusive breastfeeding for six months with iron supplementation for low term, low birth weight infants (Dewey et al., 2004; Kramer and Kakuma, 2002). This is in contrary to the WHO recommendation which recommends provision of iron supplements to infants and children 6-24 months in only those areas with anemia prevalence exceeding 40% (WHO, 2001b).

Birth weight, weight gain and sex have been significantly associated with plasma ferritin levels of infants. Male infants especially those with a birth weight of 2500-2999g have been shown to have an increased risk of iron deficiency and iron deficiency anemia (Yang et al., 2009). No such studies have been conducted in Kenya regarding the possibility that some exclusively breast fed infants could be anemic. The current study focused on determining anemia among exclusively breastfeeding infants (0-6 months) and the associated factors at Kangemi Slums, Nairobi, Kenya.

1.2 Problem Statement

WHO/UNICEF recommends that Exclusive Breastfeeding for the first 6 months is the appropriate practice for an infant less than six months (WHO/UNICEF, 2003) as breast milk contains all the essential nutrients that a child needs at this time and age. However, the WHO committee cited that there is probability of infants on exclusive breastfeeding developing anemia (WHO, 2001). In addition, there is growing controversy that exclusively breast fed infants are at risk of developing anemia; some experts recommending the use of supplemental iron/home fortification alongside breast milk to reduce this possible risk (Glader, 2004; Luo et al., 2014) and others suggesting that iron supplementation should only be given to pre-term, low birth weight infants (Kramer and Kakuma, 2002; Dewey et al., 2004). Evidence of probability of anemia among exclusively breastfeeding infants has been indicated in Brazil (Torres et al., 2006) and USA (Chantry et al., 2007). In India and Bangladesh, no evidence of iron deficiency or iron deficiency anemia was found among exclusively breastfed infants (Shashi et al., 2008; Eneroth, 2011).

In the light of these controversies, this study was designed to find out the prevalence of anemia and its associated factors among breastfeeding infants 0-6months in a low income urban setting of Kenya.

1.3 Justification

With the growing need to ensure that infants receive non but breast milk for the first 6 months of life as recommended by the WHO, there is need to ensure that the breast milk provides a balanced intake of both macro and micro nutrients to curb any deficiencies that may result if this is not the case. Inappropriate infant feeding may lead to stunting which may in addition lead to increasing child mortality and consequently affect future productivity and economic progress of a country (UNICEF, 2011). Stunting, iron deficiency, among other two other factors (iodine deficiency and cognitive stimulation) when tackled, constitute the four key factors effective in early childhood development interventions (Engle et al., 2007). Consequently, when stunting and iron deficiencies are reduced, appropriate infant and young child feeding can significantly and positively impact on child growth and development. Given that this age is also within the window of opportunity beyond which certain interventions may not work and any growth retardations and/or health problems may be irreversible (Victoria et al., 2010), there is need to conduct a study to investigate the probable prevalence of anemia among this vulnerable group.

1.4 Aim of the Study

The aim of the current study was to contribute to the scanty information available on the anemia status of breastfeeding infants 0-6 months in Kenya.

1.5 Purpose of the Study

The purpose of the study was to provide information relevant in guiding the feeding of infants 0-6 months in the context of the existing controversy.

1.6 Study Objectives

1.6.1 Main Objective

The main objective of this study was to determine the prevalence and factors associated with anemia among breastfeeding infants 0-6months in Kangemi slums, Nairobi.

1.6.2 Specific objectives

The specific study objectives included the following:

1. To determine the socio-demographic and socio-economic characteristics of the study households.
2. To assess the infant (0-6 months) feeding practices and dietary patterns of their mothers at Kangemi slums in Kenya.
3. To assess the dietary and Iron/Folic Acid (IFA) intake patterns of the mothers during their last pregnancy.
4. To determine the anemia and nutritional status of the breastfeeding infants (0-6 months) and their mothers.

1.7 Study Hypotheses

The prevalence of anemia among infants 0-6 months old is not significantly associated with:

- the infant feeding practices
- maternal dietary patterns
- dietary and Iron/Folic Acid (IFA) intake patterns during mother’s last pregnancy
- maternal anemia and nutritional status

CHAPTER TWO: LITERATURE REVIEW

2.1 Exclusive Breast Feeding

Exclusive breastfeeding means that the infant receives nothing else other than breast milk, not even water with the exception of oral rehydration solution, drops/syrups of vitamins, minerals and/or medicines. Complementary feeding should be initiated at six months with continued breastfeeding up to two years or more (WHO/UNICEF, 2003).

The World Health Organization recommends exclusive breastfeeding for the first six months of life (WHO/UNICEF, 2003). It is indicated that breast milk contains all the nutrients an infant needs during this period. In addition, it protects against common childhood diseases such as diarrhea and pneumonia (Kramer et al., 2001) and may have other benefits such as lowering blood pressure (Martin et al., 2004) and cholesterol (Singhal et al., 2004) and reduces the prevalence of obesity and type-2 diabetes (Ip et al., 2007) later in life.

2.2 Evidence based studies for iron deficiency and IDA for exclusively breast fed infants

Several studies have found out that iron deficiency is a concern for infants below 6 months who have been exclusively breastfed. A study by Soh et al., (2004) in New Zealand found that iron deficiency was rare among exclusively breast fed infants with a birth weight of more than 3000g. Studies conducted in Ghana, Honduras, Mexico and Sweden showed that iron deficiency anemia (IDA) is rare in infants with a birth weight of >2500g (Yang et al., 2009). Yang et al., (2009) found that birth weight, weight gain and sex were significantly associated with ferritin in the multiple linear regression models. Male infants, particularly those with a birth weight of 2500-2999 were found to have an increased risk of iron deficiency and iron deficiency anemia. In addition, birth weight and sex were also found to have a significant association at six months of age. However, Meinzen-Derr et al., (2006) found no significance of infant gender, birth weight, maternal education and weight gain in relation to infant anemia. A WHO committee also pointed out the probability of exclusively breastfed infants being iron deficient (WHO, 2001). A study in Honduras found that there was low risk of iron deficiency among exclusively breast fed infants (Dewey et al., 1998). However, the results indicated significantly lower hemoglobin levels among exclusively breast fed infants than those fed complementary foods fortified with iron though the fortification was not adequate to prevent anemia among those infants.

Previous history of infant and maternal anemia at 0, 3 and/or 6 months was significantly associated with risk of infant anemia at 9 months of age (Meinzen-Derr et al., 2006). In general, term infants with normal birth weight have adequate iron stores for the first 4-6 months of age. However, those born to anemic mothers have reduced iron stores and highly probable of developing anemia (Colomer et al., 1990; Kilbride et al., 1999; Morton et al., 1988; De Pee et al., 2002).

Meinzen-Derr et al., (2006) examined the risk of anemia in relation to the duration of exclusive breastfeeding and maternal anemia in a Mexican birth cohort. Hemoglobin levels were measured at 9 months for 183 infants of whom 12.5% were found to be anemic. In addition, exclusive breast feeding for greater than six months was found to be associated with increased risk of infant anemia compared to EBF for 4-6 months. The study indicated increasing trends in proportion of anemic exclusively breast fed infants in relation to the duration of exclusive breast feeding. Among those exclusively breast fed for less than 4 months, 9% were found to be anemic whereas for those exclusively breast fed for 4-6 months, 15% were anemic and those exclusively breast fed beyond 6 months, 60% were anemic. In total, these results indicate a 24% prevalence of anemia among 0-6 months exclusively breast fed infants. The findings further indicated that maternal anemia was independently and significantly associated with a 3-fold increased risk for infant anemia. The study did not find any confounding factors (either maternal or infant) explaining these associations. Extended duration of EBF for infants (greater than 6 months) may pre-dispose them to increased risk of anemia, particularly for mothers with a poor iron status (Meinzen-Derr et al., 2006).

A Brazilian study (Torres et al., 2006) investigating the behavior of hemoglobin levels and anemia among low income exclusively breastfed full term infants found anemia prevalence varying from 8.3 to 37.5% between 3 and 6 months. In addition to the World Health Organization's 1968 cut-offs for diagnosis of anemia, the study used other two international standards (Saarinen & Siimes, 1978; Brault-Dubuc et al., 1983 criteria). The WHO 1968 standards were applied for diagnosis of anemia at 6 months. The said study also expressed concern and recommended special focus (by paediatricians) especially to exclusively breastfed infants who present with risk factors for iron deficiency from low income countries.

Another US based study by Chantry et al., (2007), designed to examine risk of anemia in association with duration of exclusive breastfeeding found that infants on EBF for 4-<6 months had a reduced risk of iron deficiency compared to those who were on EBF for 6 months and beyond. Anemia prevalence in EBF for "4-<6" months and 6 months or more was 2.3% and 10.0% respectively, the difference being statistically significant. This study also concluded by pointing out that fully exclusively breastfed US infants are also at increased risk of iron deficiency. Additionally, the study states that typical complementary diets may fall short of providing sufficient iron, therefore the need for special attention for this vulnerable group. Most of these studies did not include information on use of iron supplements among the infants and where such information was provided, it was incomplete (US study) and this was taken into account during data analysis.

2.3 Infant Feeding and Child Survival

The benefits of exclusive breastfeeding for the first six months cannot be overlooked as stated and outlined in the Global Strategy for Infant and Young Child Feeding (IYCF) (WHO/UNICEF, 2003). Exclusive breastfeeding up to six months of age was ranked first among the 15 preventative child survival interventions. Complementary feeding was ranked third with the two interventions estimated to prevent about one-fifth of under five mortality in developing countries (Jones et al., 2003). In addition, optimal IYCF especially exclusive breast feeding was noted to have a significant impact on child survival It was estimated to prevent about 1.4 million deaths annually among children under five (Black et al., 2008).

The Kenya National Nutrition Action Plan (NNAP) 2012-2017 has a strategic objective to improve the nutritional status of children under five (RoK, 2012). This is expected to be achieved through enhanced EBF, timely introduction of complementary feeding among other important factors. The overall expected benefits of such interventions include reduced stunting, wasting, anemia, underweight, obesity and above all infant mortality. However, prevalence of EBF among infants less than six months still remains low at only 32% in Kenya (KNBS and ICF Macro, 2010). This implies that majority of infants 0-6 months in Kenya are on mixed feeding but the extent of the impact of this on infant anemia levels in the country is scarcely documented.

2.4 Micronutrient Deficiencies in Kenya

Children malnutrition persists in Kenya and key indicators on IYCF have been on the decline for the past two decades where poor breastfeeding and infant feeding practices have contributed to more than 10,000 deaths per year (MOPHS, 2007). Micronutrient deficiencies are common among children under five years and women. The most common micronutrient deficiencies include Vitamin A Deficiency (VAD), Iron Deficiency Anemia (IDA), Iodine Deficiency

Disorders (IDD) and Zinc deficiency (Mwaniki et al., 1999). In Kenya, children under five years have the highest prevalence of anemia (74%) (Mwaniki et al., 1999) and this has been classified as a nationwide public health concern of a scale sufficient to impede socio-economic growth (Lungaho and Glahn, 2009).

IDA is a serious public health problem and impacts on psychological and physical development, behavior and work performance. Globally, it is the most prevalent micronutrient deficiency and has affected more than 2 billion persons (WHO, 2001: Global Report, 2009). Global estimates indicate that 47.4% of the preschool-age population is anemic and approximately 600 million children (both preschool-age and school-age) are anemic (WHO/CDC, 2008). However, little is documented on micronutrient deficiencies in infants 0-6 months old, in the face of the fact that exclusive breastfeeding rates are still low.

2.4.1 Iron deficiency

Iron deficiency results when an inadequate amount of iron is absorbed to meet the body's requirement. This inadequacy may be brought about by insufficient iron intake in the diet, increased iron needs due to infections and/or pregnancy and reduced bioavailability of dietary iron (IoM 2001; Dewey and Brown, 2003). Prolonged iron deficiency may result in iron deficiency anemia (RoK, 2008). The most vulnerable groups for IDA include preschool children, infants and women of reproductive age. Pregnant women have the greatest risk of developing iron deficiency anemia (Demaeyer et al., 1989).

2.4.1.1 Probable causes of iron deficiency in infants

In the past, infants 0-6 months have not been identified as high risk groups and they are assumed to have normal iron status (National Academy of Sciences, 1991). High risk group among children under five has only been identified to be those aged between 6 months and 2 years

(RoK, 2008). With the recent evidence from studies, the probability of anemia in exclusively breast fed infants 0-6 months can no longer be over looked and warrants some attention.

Probable risk factors for iron deficiency among infants below six months may include having lower ferritin levels at birth which continue up to nine months of age and duration of clamping the umbilical cord during delivery (Georgieff et al., 2002; Chaparro et al., 2006). Chaparro et al., (2006) indicated that infants who received immediate cord clamping had lower ferritin levels at six months as compared to those who were clamped two minutes post delivery. Therefore, sub-optimal iron reserves may contribute to iron deficiency for fully exclusively breastfed infants (Looker et al., 1997).

Iron deficiency in infants older than six months may be attributed to too early introduction of non-iron rich complementary feeding especially plant based foods such as cereal based porridge mixtures with low iron bioavailability (Chantry et al., 2007). This may be due to inhibitory factors such as phytates, oxalates and malic acid which are high in these foods. Whole cereals such as millet, wheat, sorghum, maize and oats are examples of those foods recommended during initial introduction of complementary feeding and this may negatively impact on iron bioavailability (RoK, 2008).

2.4.1.2 Stages of iron deficiency

Stage 1: Iron depletion

This is the initial stage of iron deficiency where iron stores are reduced significantly and/or sometimes absent. There is no overt effect on erythropoiesis. Blood hemoglobin levels remain normal and iron deficiency may be undetectable by hemoglobin or hematocrit screening (Beutler, 2006). This stage is also characterized by low serum ferritin levels (Expert Scientific Working Group, 1985).

Stage 2: Iron deficient erythropoiesis

During this stage, there is a shortage of iron available to the erythroid precursors in the bone marrow for hemoglobin synthesis (Cook, 2005). This stage may be characterized by abnormalities in particular iron parameters including low transferrin saturation levels and high levels of free erythrocyte protoporphyrin Hemoglobin levels may be reduced but the resulting mild anaemia may not be detectable using normal cut-off values for hemoglobin (Expert Scientific Working Group, 1985). Iron deficient erythropoiesis may be difficult to detect using traditional laboratory parameters. In this stage, storage iron may be normal or even increased due to impaired release of iron into circulation (Cook, 2005).

Stage 3: Iron deficiency Anemia

At this stage, iron stores are insufficient to maintain red blood cell synthesis which results in anemia (Cook, 2005). Iron deficiency anemia is characterized by a significant reduction in the hemoglobin levels and a decrease in mean corpuscular volume (Expert Scientific Working Group, 1985).

2.4.1.3 Consequences of iron deficiency in early life

Due to the increased nutrient demand for rapid growth, children under five, including infants are at increased risk of both iron deficiency and iron deficiency anemia. This is most worsened by inappropriate diets with low bioavailable iron (IoM 2001; Dewey and Brown, 2003). Therefore, iron deficiency and IDA in young children is an important health problem. Its consequences include premature and low birth weight babies, impaired cognitive and physical growth and/or development in infants, pre-school and school-age children (RoK, 2008; Lozoff et al., 2000; Lozoff et al., 1991). In addition, it leads to impaired immune system and increased morbidity, reduced physical performance (Haas and Brownlie, 2001) and decreased visual and auditory function (Algarin et al., 2003). During early childhood, some of these consequences are irreversible and may lead to reduced productivity in later life (Iannoti et al., 2006). Overall, it leads to increased infant and child mortality.

2.4.2 Methods of determining anemia

The US Centre for Disease Control and Prevention (CDC) recommends use of the Hemoglobin (Hb) Concentration and Hematocrit (Hct) to screen for IDA since it is inexpensive, easy and can be performed rapidly in a short time. However, since the changes in hemoglobin concentration and hematocrit occur in the later stages of iron deficiency, the tests are not good indicators of iron deficiency in its early stages. Regardless of this limitation, the test is crucial for determining IDA and used widely in clinical and public health settings for determination of anemia (CDC, 1998).

The CDC, however, does not recommend blood screening for determination of anemia in the general infant population. It only recommends for screening of IDA in high risk infants, preschoolers and those in non-high risk populations but with known risk factors (CDC, 1998). Other methods for assessment of anemia entail measurement of indicators such as Mean cell volume, serum ferritin concentrations, transferrin saturation and erythrocyte protoporphyrin (WHO/UNICEF/UNU, 2001).

The cut-off points for anemia in children and women (15 years and above) are as indicated in Table 1 and 2 respectively.

Table 1: Cut-off points for anemia in children

Age	Hemoglobin concentration (g/dl)	Hematocrit (%)
CDC recommendation		
6months-2 years	<11.0	<32.9
2-5 years	<11.0	<33.0
California Department of Health Services (CHPD) Programme		
<2 years	<11.0	<33.0
2-<5 years	<11.2	<34.0

Source: Centre for Disease Control, 1998.

Anemia cut-offs for non-pregnant women aged from 15 years and above are as shown in Table 2.

Table 2: Anemia cut-offs for non-pregnant women (≥15 years)

Anemia Category	Hemoglobin levels (g/dl)
Non-anemia	≥12.0
Mild	11.0-11.9
Moderate	8.0-10.9
Severe	<8.0

Source: WHO, 2011

2.4.3 Assessment of iron status

Iron forms an important component of hemoglobin which helps in carrying oxygen in red blood cells. Measurement of hemoglobin in whole blood may be the most probably widely used test for iron deficiency anemia (Gibson, 2005). Other indicators are as outlined depending on the stage of iron deficiency (Table 3). Gibson (2005) further indicates that hemoglobin can only be used as the sole indicator of iron deficiency anemia under very special circumstances such as large scale field studies to assess the prevalence and etiology of anemia mostly due to costs or operational constraints. It can also be used in developing countries where besides inadequate intake of dietary iron, other factors such as hemoglobinopathies and parasitic infections also affect production of red blood cells.

Table 3: Stages in the development of iron deficiency anemia and their indicators

Stage of iron deficiency	**Indicator**
Normal/iron depletion	Stainable bone marrow iron, transferrin concentration, plasma ferritin
Early functional iron deficiency (iron deficient erythropoiesis)	Serum iron, transferrin saturation, Red cell protoporphyrin, plasma transferrin receptor concentration, Reticulocyte hemoglobin concentration
Iron deficiency (iron deficiency anemia)	Red cell indices (Mean Cell Volume (MCV), Mean Cell Hemoglobin (MCH), Red Cell Distribution Width (RDW)

Source: Gibson, 2005.

These indicators can be employed in combination or singly in evaluation of iron status of individuals and populations. Research has shown that a single abnormal indicator has a little predictive value for anemia diagnosis (Cook, 2005). Use of multiple indicators has been applied in some studies and this increases specificity for diagnosing IDA but tends to under-estimate the prevalence of iron deficiency (Sean et al., 2007). A Joint WHO/Centre for Disease Control and prevention reviewed the use of iron in assessing iron status and recommended the five indicators namely hemoglobin, Mean cell volume, serum ferritin concentration, serum transferrin receptor concentration and red cell protoporphyrin (Zinc protoporphyrin/hemoglobin ratio) (WHO/CDC, 2005).

The best determination of hemoglobin is through use of anti-coagulated venous blood. On the other hand, capillary blood may be used and can be collected from ear, heel and/or finger pricks (Gibson, 2005). However, use of capillary blood gives less precise results than those of venous blood mainly due to dilution by interstitial fluid (Burger and Pierre-Louis, 2003). Factors that affect hemoglobin concentrations include biological variation, age and sex (Gibson, 2005), especially for younger subjects, race, pregnancy, altitude, IDA, certain micronutrient deficiencies (van den Broek and Letsky, 2000; Fishman et al., 2000), parasitic infections (Stolzfus et al., 2000; Nestle and Davidsson, 2002), certain disease states and smoking habits (Gibson, 2005).

2.4.3.1 Hematocrit

This is also referred to as the "Packed Cell Volume" (PCV) and defined as the volume fraction of packed red blood cells. During iron deficiency, the hemoglobin is first impaired and then follows a fall in hematocrit levels (Gibson, 2005). Both hemoglobin and hematocrit are only reduced in very severe iron deficiency anemia. However, limitations of this indicator include poor sensitivity, specificity and precision (Gibson, 2005).

2.4.3.2 Serum ferritin

This is a semi-quantitative and precise measure of iron storage status but only used in healthy subjects in the early stages of development of iron deficiency anemia. In addition, serum ferritin, being an acute-phase protein elevates during infections and inflammations. In such cases, transferrin receptor becomes an alternative though is more expensive (Asobayire et al., 2001). However, WHO/CDC recommends serum ferritin as the best indicator of iron status and should be measured together with hemoglobin in all evaluations (WHO/CDC, 2004). It is also the only indicator that can reflect a deficient, normal or excess iron status. With continued depletion of iron reserves, serum ferritin does not reflect the severity of iron deficiency (Gibson, 2005). Its measurement is also expensive in terms of equipment and personnel.

2.4.3.3 Serum transferrin receptor concentration

This is also a semi-quantitative measure of iron deficiency and is applicable even in infections unlike serum ferritin but the rate of erythropoiesis affects the values and further limitations include lack of standard methods for its usage (Beesley et al., 2000; Stoltzfus et al., 2000; Mockenhaupt et al., 1999).

2.4.3.4 Mean cell volume

This is also referred to as the Mean Corpuscular Volume (MCV) and is a measure of mean size of red blood cells. It is expressed in femto-litres (Gibson, 2005) and is only useful when inflammation and thalassemia have been ruled out. The measurement process also requires expensive equipment (WHO/CDC, 2004).

2.4.3.5 Red cell protoporphyrin

This is measured as a ratio of Zinc protoporphyrin/hemoglobin (ZPP/H). When iron supply is limited, ZPP, a metabolic intermediate of hemoglobin synthetic pathway accumulates in Red blood cells (Labben et al., 1999). ZPP levels remain unchanged in the entire lifespan of Red Blood Cells and therefore results indicate iron status in the preceding three months. A limitation for this indicator is that elevated red cell ZPP/H does not specifically indicate iron deficiency.

Other confounding factors may include exposure to lead, disorders and diseases affecting synthesis of hemoglobin.

2.4.3.6 Measurement of hemoglobin

Various methods exist for the measurement of hemoglobin. These include the cyanmethemoglobin method, electronic measurement through an automated counter using EDTA-anti-coagulated blood and in remote field settings, use of a portable hemoglobin photometre is employed (Gibson, 2005). This is a HemoCue machine which is battery operated and uses Sodium azide, a dry reagent and micro-cuvette for collection and subsequent measurement of hemoglobin. Studies have shown comparable values of hemoglobin obtained from the HemoCue and those from the Cyanmethemoglobin method (Von Schenck et al., 1986; Sari et al., 2001). Hemoglobin cut-off values for infants were not previously defined but Domellof et al., (2002) defined these cut-offs to be <105g/l for 4-6 month old infants and <100g/l at 9months of age.

The Joint WHO/CDC consultation recommended that the prevalence of iron deficiency cannot be reliably estimated from prevalence of anemia only and that hemoglobin can be used on a routine basis since it is an important indicator of health. It further recommended a combination of serum ferritin and transferrin receptor concentrations as the most sensitive and specific approaches that may allow predictions using relatively smaller sample sizes (WHO/CDC, 2005). A combination of transferrin receptor and serum ferritin is useful in calculating body iron reserves (Cook et al., 2003).

2.5 Gaps in Knowledge

Most studies on micronutrient deficiency in children under five years have been conducted in children from 6 months of age with the assumption that those below this age are less likely to have such deficiencies especially if they have or are being exclusively breast fed. Based on this assumption, few studies have been conducted to find out the prevalence of iron deficiency anemia among infants less than six months. There is limited information with respect to iron status and anemia in infants less than 6 months old. However, in developing country settings where newborn iron stores may be suboptimal, it is possible that EBF with no iron supplementation during the six months may compromise hematologic status (Kramer and Kakuma, 2002).

Contrary to this finding, Dewey et al., (2002) did not see the need of recommending the introduction of iron-rich foods or therapeutic iron to exclusively breastfed infants before the age of six months of life for fear of health consequences/harm to the growing infant.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Study Location

The study was based at Kangemi, one of the slums among many others located in Nairobi County. According to KNBS (2010), Nairobi's population is over 3.1 million with half of this population living in informal settlements. Slums occupy about 1% of Nairobi's total land area and 5% of the total residential area (Mitulla, 2003). Kibera is the largest slum under Nairobi County with an estimated population of 950,000 people. Mathare slum has over 500,000 people, followed by Korogocho with approximately over 150,000 people. Mukuru Kwa Njenga is estimated to have over 100,000 people (Umande Trust, 2007). According to Umande Trust (2007) report, majority of these slum dwellers live in very deplorable conditions with inadequate basic amenities such as housing, water and sanitation, health services and lack of solid waste management facilities.

Kangemi is located in Westlands Constituency on the outskirts of Nairobi city and bordered on the north by middle class neighbourhoods of Loresho and Kibagare and Westlands on the west. It connects with Kawangware, another large slum on its southern border and Mountain View another middle class enclave, on its eastern border. It is situated off Waiyaki way on the road connecting Nairobi with Naivasha. Kangemi has an estimated population of 650,000 residents of multi-ethnic origin (KNBS, 2010).

3.2 Study Population

The study population was comprised of all breastfeeding children and their mothers/care givers residing at Kangemi.

3.3 Study Design

The study design used was descriptive-cross sectional with some retrospective and analytical components.

3.4 Sampling

3.4.1 Sampling frame

The sampling frame included all breastfeeding infants aged 0-6 months and their mothers.

3.4.2 Sample size determination

The sample size was obtained as described by Fischers et al., (1991) as follows:

$$n=\frac{Z^2 \times P\,(1-P)}{d^2}$$

Where **n**=desired sample size,

Z=Standard Z value set at 95% confidence interval,

P=Expected prevalence of anemia among infants under six months (90%)[1]

d=design effect of 5%

$$=\frac{1.96^2 \times 0.90 \times 0.10}{0.05^2}$$

=**139 women-infant pairs**

[1] Data on the prevalence of anemia among infants less than 6 months old is scarce in Kenya. Recent unpublished data indicates a prevalence of 79% in a resource-constrained setting at the South Coast of Kenya (Njenga et al., 2013). Older data from the 1999 Micronutrient Survey (Mwaniki et al., 1999) showed a prevalence range of 97-100% of anemia in infants less than 6 months. We therefore expected the prevalence of anemia in the study population to be within a similar range (79-100%) and used 90%, the mid-point of this average.

3.4.3 Sampling

Selection criteria

The inclusion criteria into the study were:-

- Apparently healthy mother-infant (0-6 months old) pairs.
- The infant must be breastfeeding.

The following were excluded from the study:-

- Infants older than 6 months.
- Non-breast feeding infants aged 0-6 months.
- Apparently sick infants and mothers.
- Infants (and their mothers) with physical deformities such as cleft lip palate and other chronic illnesses/disorders.

3.4.4 Sampling procedure

Kangemi location was purposively and conveniently selected since it is a slum area which harbors a predominantly low income population with multi-ethnic groups. A multi-stage cluster sampling was employed. Kangemi location has 3 sub-locations namely; Kangemi Central, Gichagi and Mountain View. It has a population of approximately 650,000 persons. The study was conducted in the first two sub-locations i.e. Kangemi Central and Gichagi sub-locations which were purposively selected since they harbour most of the low-middle income earners. Kangemi central has 6 villages namely; Keroka, Waruku, Bottomline, Kihumbuini, Dallas and St. Florence. Gichagi has 12 villages of which 10 villages were randomly selected from the two sub-locations and households were also randomly selected from these villages using the EPI-

Random Walk method. Equal women-infant pairs (14 of them) were selected from each of the 10 randomly selected villages. Figure 1 shows the sampling schema.

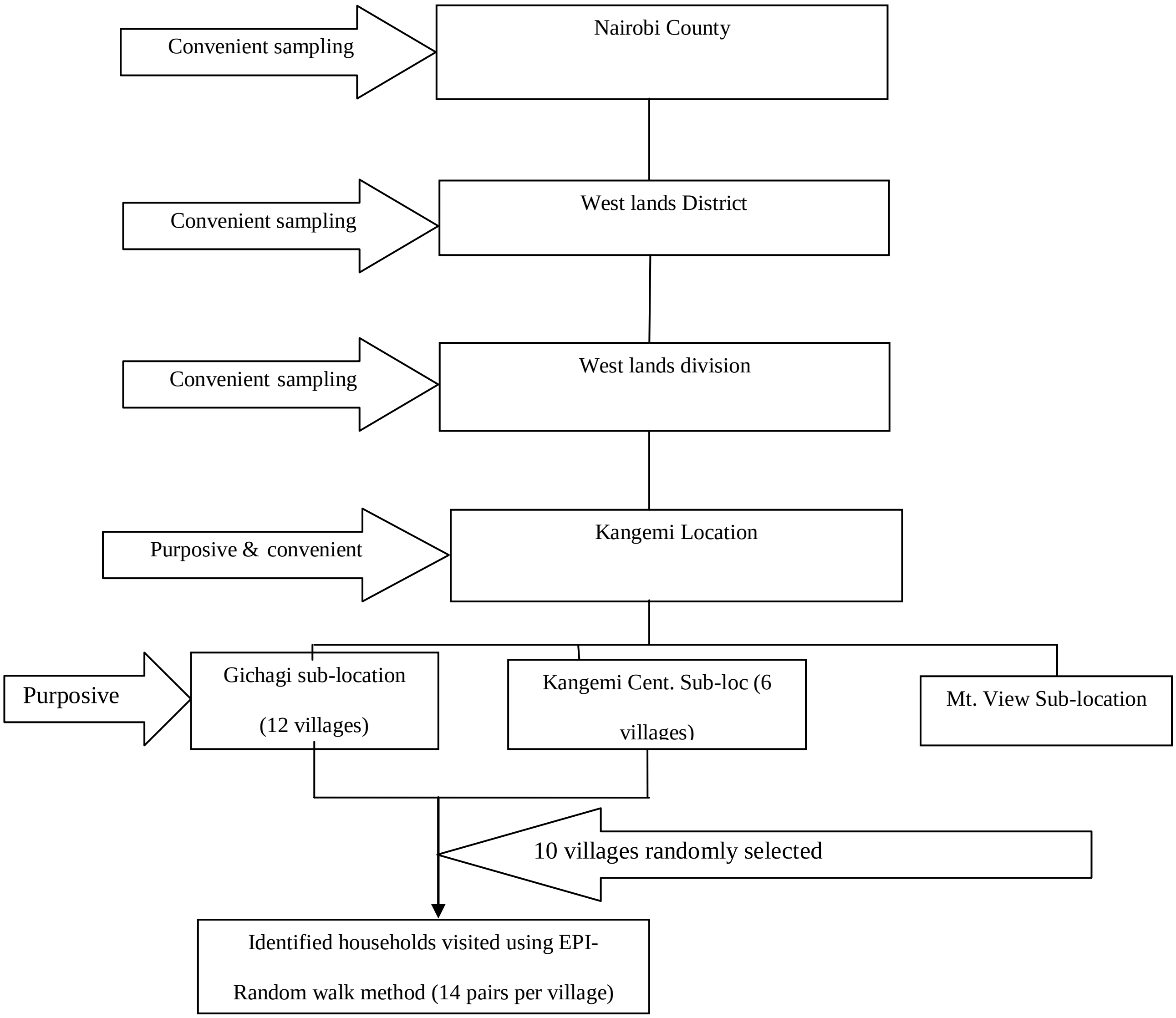


Figure 1: Sampling schema for study households

3.5 Data Acquisition Methods

3.5.1 Data collection tools

Primary data was obtained through a semi-structured questionnaire (*appendix1*) administered to the mother and contained the following sections:

- Socio-demographic and economic profile of the study households.
- Infant feeding practices.
- Maternal pregnancy history and feeding practices.
- Anthropometric data for the infant and mother.
- Biochemical data (hemoglobin levels) for both mother and infant.

Immunization status data was obtained from the clinic cards/booklet. Observation method was also used for clinical diagnosis of anemia. The data acquisition matrix was as illustrated in Table 4.

Table 4: Data acquisition matrix

Objectives	Variables	Data acquisition method	Activity	Instrument/tool	Indicator
Main objective *To determine the prevalence and factors associated with anemia among breastfeeding infants 0-6months old in Kangemi, Kenya*	Hemoglobin (Hb) levels, socio-demographic & economic variables, maternal nutritional status, infant nutritional status, maternal dietary intake, infant feeding practices	Laboratory tests for Hb, interviewing, anthropometric measurements	Performing laboratory tests for Hb on both subjects, questionnaire administration by interviewing mother/caregiver	Hemocue machine for rapid Hb test, questionnaire, electronic bathroom scales, stadiometer/length board	Proportions of subjects anemic (infants <11.0 g/dl & mothers <12.0g/dl), Proportions for categorically defined socio-demographic characteristics, BMI cut off points, WHO Z scores, Proportion of subjects on different feeding modes
Specific objectives *To determine socio-demographic & economic profile of study households*	Age Sex Marital status Education level Occupation	Interviewing	Questionnaire administration by interviewing the mother/caregiver	Interviewer administered questionnaire	Descriptive statistics
To assess the infant feeding practices & dietary patterns of lactating mothers of infants 0-6 months old	Types of foods introduced before 6 months Food groups particularly those rich in iron, folic acid and vitamin A	Interviewing	Questionnaire administration by interviewing the mother	Questionnaire	Proportion of infants 0-6 months old on EBF, proportion on mixed feeding dietary diversity scores of mothers
To assess the dietary and Iron/Folic Acid (IFA) intake patterns of the mothers during their last pregnancy	Types of foods taken in relation to iron bioavailability e.g tea, coffee IFA intake Vitamin A supplementation	Interviewing & review of ANC cards/booklets	Questionnaire administration by interviewing the mother reviewing ANC cards/booklets	Questionnaire ANC cards/booklets	Proportions of highly consumed foods reflecting on iron bioavailability check against recommended intake levels
To determine the anemia and nutritional status of the breastfeeding infants 0-6 months old and their mothers	Anemia-blood hemoglobin (Hb) levels nutritional status-weight, height/length	Anemia-observation for any clinical signs, anthropometric measurements(both subjects	Measurement of Hb using rapid test kits through finger pricking measurement of weight & height/length	HemoCue machine, cuvettes, lancet, methylated spirit, swab, safety box questionnaire, stadiometer/length board, bathroom scales	Anemia (infants) - age and sex specific cu-offs for Hb nutritional status-WHO-Z scores; Anemia (mothers)-hemoglobin cuts for women nutritional status-BMI cut offs for adults

3.5.2 Recruitment and training of research assistants

Four research assistants (RAs) with nutritional knowledge were recruited and briefed on the overall objectives of the study. At least graduate level of education was preferred with some field experience/exposure. In addition, two phlebotomists/laboratory technologists were recruited for measurement of hemoglobin. Minimum requirements included at least a diploma in the relevant field with some practical fieldwork experience. They were trained on how to use the study tools (questionnaire and equipment), filling in the questionnaires correctly and checking for the credibility of the information provided by the respondents. The research assistants were trained on key areas such as study objectives, sampling, study tools, interviewing techniques, activity matrix for data collection, accurate taking of anthropometric measurements, and field ethics among other important field protocols (*appendix 4*).

3.5.3 Pre-testing of tools

Pre-testing of the tools was conducted on 10 mothers in Kawangware slums before the actual study. This served to ensure collection of the required data during the actual study and testing the applicability of the tools to be used. Relevant modifications to the tools (especially the questionnaire) were made prior to the actual study.

3.5.4 Anthropometric measurements

Anthropometry method as described by Gibson (2005) was used. Two basic variables, height and weight and a single derived variable (Body Mass Index) were employed. BMI was used to describe the nutritional status of the mothers. All the measurements were taken following standard techniques. The mothers were first weighed on a Seca® electronic scale (Seca GmbH & Co. KG, Hamburg, Germany) without shoes and with light clothing. The weighing scale was placed on a flat hard surface. The weight was then recorded to the nearest 0.1kg.

For height measurement, a Seca® stadiometer (Seca GmbH & Co. KG, Hamburg, Germany) was used. The subject was made to remove shoes, stand with heels together, arms to the side, legs straight and the shoulders relaxed. The head was positioned in the Frankfurt horizontal plane ("Looking straight ahead") with the heels, buttocks, scapulae and back of the head against the vertical board of the stadiometre. The subject was then made to inhale deeply while holding the breath and maintain an erect posture. The head board was lowered onto the highest point on the head with some slight pressure to compress the hair. The measurement was recorded to the nearest 0.1cm at eye level with the head board to avoid errors of parallax. The Body Mass Index (BMI) was computed by using the formula: BMI =Weight (kg)/Height (m^2) and compared with that of a reference population according to WHO (2000) reference standards.

The infant was weighed by first weighing the mother; then the scale was tared. She (the mother) was made to hold the infant, who was lightly dressed and the weight was subsequently determined. Recumbent length was determined using a length board with a movable foot board. Two persons were involved; the measurer and his/her assistant. The infant's mother assisted in removing off excess clothing and shoes prior to taking any measurements. The infant was laid in a supine position where one person preferably the mother of the infant held the child's head against the backboard, with the Frankfurt plane perpendicular to the backboard. The other person dragged the foot board against the bottom of the feet while keeping child's leg straight and against the back board. The measurement was read to the nearest 0.1cm. Due care was exercised to ensure the feet are compressed firmly and gently without diminishing the vertebral column length.

3.5.5 Determination of anemia

Measurement of hemoglobin was used to determine the anemia status of the study subjects. This was done using a rapid method which requires a hemoCue® machine (Hemo-control, EKF-diagnostic GmbH, Barleben/Magdeburg, Germany) and cuvettes. The test was performed by trained and qualified technicians. The process was as follows:

Standard Clinical Procedure for measurement of hemoglobin

Hands were washed with soap and warm water and dried thoroughly with a clean cloth or paper towel. A pair of disposable procedure gloves was put on and the heel/finger to perform the test selected. Fingers/heels that were calloused or injured were avoided. The selected finger/heel was then pressed with the gloved thumb and the test area cleaned with an alcohol wipe and allowed to air dry before performing the prick. The finger/heel was held with the gloved hand, using gentle pressure to support both the finger/heel and the entire hand/leg.

Using a lancet, a small puncture was made on the side of the test finger/heel. The lancet was later discarded in a sharps container. The first drop of blood was wiped off using a sterile gauze pad since it contains a high concentration of tissue fluid, which may cause a low reading. Slight pressure was applied to the distal far end of the finger/heel to produce a large drop of blood. Squeezing the finger/heel near the puncture site was avoided so as to prevent release of more tissue fluid into the sample. The tip of the collection device was placed in the center of the blood drop and blood was drawn into the tube. When the tube was completely filled, a drop of blood was then placed in a cuvette and results were read at 15-60 seconds (Standard Nursing Clinical Practice Manual, 2012). The measurements so obtained were subjected to the age specific cut-offs as follows:

The normal ranges are:

- Children: 11 to 13 gm/dL
- Adult women: 12 to 16 gm/dL

3.6 Ethical Considerations

Before embarking on the actual data collection, ethical approval (approval number, P383/07/2013) (*appendix 5*) was obtained from Kenyatta National Hospital/University of Nairobi Ethics and Review Committee before collecting any data from the respondents. Permission was also sought from the relevant local authority and the administrative section of Kangemi. Furthermore, the mothers were informed of the purpose, objectives, possible benefits and risks of the study. They were then requested to voluntarily give consent by signing an informed consent form (*appendix 2*). A child assent form was also provided to be signed by the mother on behalf of the child (*appendix 3*). The respondents were assured of confidentiality of the information provided and that it would not be used for any other purposes except for the one stated as indicated in the consent documents (*appendix 2 and 3*). No names/ participant identifiers would appear anywhere, be it the questionnaires or the final report.

3.7 Data Quality Assurance/Control

Data quality control was conducted throughout the study period to ensure accuracy, validity and credibility of the information. This was done at various levels: First through selection of an appropriate team of research assistants (RAs) i.e. those knowledgeable in the area of nutrition, possessing relevant skills and experience in data collection. The weighing scales were checked and calibrated daily before any measurements were made to reduce instrument bias and maintain accuracy throughout the study. The hemoCue® machine is factory calibrated and hence did not require further calibration. It is based on the cyanmethemoglobin method and has been known to be stable and durable in field settings (WHO/UNICEF/UNU, 2001). The hemoCue® measurements were standardized using the cyanmethemoglobin method as per the WHO/UNICEF/UNU (2001) requirements.

In addition, the control cuvettes were thoroughly cleaned before and after use (with swab and alcohol) to minimize errors/deviations and ensure accuracy. The cuvette holders were also thoroughly cleaned with alcohol/mild soap solution and allowed to remain dry for accurate measurements. The hemoCue® machine and the microcuvettes were stored at the recommended temperatures of 0-50°C and 15-30°C respectively. The first drop of blood was wiped off since it contains a high concentration of tissue fluid which may give inaccurate readings.

Piloting of the questionnaire was done prior to the actual study and any necessary modifications/alterations made. The questionnaires were checked daily for any errors, discrepancies and omissions. During data entry, the data was cleaned of any obvious outliers. During data analysis, Computer Softwares (e.g. SPSS) with in-built checks and controls were employed to further ensure high quality data.

3.8 Data Analysis

Demographic data was analyzed using descriptive statistics. Simple counts/frequencies and proportions were computed on sex, age and education level of the study participants. The nutritional status of the mothers was determined using Body Mass Index and classification based on WHO 2000 BMI classification. The measured hemoglobin values were first subjected to altitude adjustments as per the WHO (2011) recommendations. A correction factor of (-5) g/L was applied in all the measurements for the two subjects based on the elevation above sea level of the study site (1795M).

Anemia status of the mothers and infants was expressed as proportions based on the age and sex of the study subjects. Chi-square tests and bi-variate correlations were used to determine the associations/relationships between the variables such as anemia status and the socio-demographic variables of age, occupation and education level among other important variables. Further associations included the relationship between the anemia status of the mothers versus that of the infants and feeding practices.

Unpaired T-tests were run to find out statistically significant differences between the anemia status of infants exclusively breastfed versus those not exclusively breastfed. Analysis of Variance (ANOVA) was used to compare means of more than two groups. Odds ratios (OR) were computed to estimate the relative risk of anemia depending on the different exposure factors. Logistic regression analysis was performed to find out factors associated with anemia in the infants and the level of significance determined at p-values <0.05. A detailed data analysis matrix is as illustrated in Table 5.

Table 5: Data analysis matrix

Specific objective	Variable	Descriptive analysis	Inference analysis
Main objective	Hemoglobin (Hb) levels, socio-demographic & economic variables, maternal nutritional status, infant nutritional status, maternal dietary intake, infant feeding practices	Frequencies/proportions with abnormal Hb levels (mild, moderate, severe), mean, standard deviation, proportions on categorically defined socio-demographic characteristics e.g. education level, marital status etc, proportions of mothers & infants with normal/abnormal nutritional status, proportions of mothers based on consumption of different food groups, proportions of infants based on mode of feeding	Tests for associations (Chi-square, Pearson correlations, Fishers Exact) between various independent variables and dependant variable (infant anemia) multiple linear and logistic regression for associated factors
Specific Objective 1	Age, household size, income level, occupation, educational level	Simple counts, proportions mean, median standard deviation (house hold size, income) Kurtosis and Skewness for distribution	Chi-square test for statistical association between socio-demographic variables and anemia status of the subjects ($p<0.05$)
Specific Objective 2	The types of foods/fluids given before six months	Frequencies of foods commonly introduced before 6 months	Unpaired T-tests for statistically significant differences between EBF & Non EBF group
Specific Objective 3	Types of foods consumed intake level of IFA	Simple counts/frequencies, proportions Descriptive statistical analysis	Chi-square tests for associations among these factors and anemia logistic regression to find out factors associated with anemia
Specific Objective 4 (i)	Hemoglobin (Hb) levels weight, length, age	Frequencies/proportions with normal Hb levels mean, median and standard deviation (Hb) levels Proportions of infants with normal/abnormal nutritional status in terms of Z-scores	Logistic regression to find out factors significantly associated with hemoglobin levels (anemia) and nutritional status
Specific Objective 4 (ii)	Hemoglobin (Hb) levels weight, height	Frequencies/proportions with normal Hb levels mean, median, standard deviation (Hb) proportions of mothers underweight, normal, overweight and obese	Logistic regression (statistically significant factors (anemia) Unpaired-T-tests statistically-significant differences (anemia status of the mothers versus that of the infants)

IFA=Iron and Folic acid; EBF=Exclusive breastfeeding; Hb=Hemoglobin

CHAPTER FOUR: RESULTS

4.1 Social Demographic and Economic Characteristics of Study households

4.1.1 Social-demographic characteristics

Table 6 shows selected socio-demographic characteristics of the study households. Out of the 139 households surveyed, 84.2% had monogamous family set up, single parent family were 13.7% while the remaining few (2.2%) were polygamous. The mean household size was 3.8 (SD 1.12) members ranging from 2 to 7 members. Majority of the respondents (85.6%) were married, 8.6% were single parents while the rest (5.8%) were either separated and/or divorced. The results of the study indicate that mothers were the main caregivers (96.4%). Only a few of the infants had grandmother and house help as the primary caregiver. The average number of children per woman was 2.12 ± 1.4 children.

Table 6: Selected socio-demographic characteristics of the study households

Household characteristics	Frequency (No.)	Per cent of households (N=139)
Household Profile		
Monogamous	117	84.2
Single parent	19	13.7
Polygamous	3	2.2
Education level of household head		
Completed primary	28	20.1
Primary drop out	17	12.2
Completed secondary	52	37.4
Secondary drop out	19	13.7
Tertiary	23	16.5
Primary care giver's details		
Relationship to the child		
Mothers	134	96.4
Others	5	3.6
Age (years)		
15-19	4	2.9
20-29	95	68.3
30-39	38	27.3
40-49	2	1.4
Education level of main caregiver		
None	2	1.4
Completed primary	41	29.5
Primary drop out	19	13.7
Completed secondary	33	23.7
Secondary drop out	28	20.1
Tertiary	16	11.5

The average age of the primary caregiver was 26.74 years (SD 4.71) while the youngest and oldest were 18 and 42 years old respectively. Slightly more than half (53.2%), had acquired basic level of education while only a minority (1.4%) had no formal education. 11.5% had tertiary level of education. More than half (57.5%) of the household heads had attained basic level of education i.e. completed both primary and secondary. A quarter of them (25.9%) had not attained form four level of education and had either dropped at primary or secondary level. Only a few of them (16.5%) had attained tertiary level of education.

4.1.2 Socio-economic characteristics of the study households

Table 7 shows a summary of socio-economic characteristics of the study households.

Table 7: Selected socio-economic characteristics of study households

Household characteristic	Frequency (No.)	Per cent of households (N=139)
Main Source of Livelihood		
Casual labour	62	44.6
Salaried/waged	57	41.0
Petty trade/business	15	10.8
Others		
Occupation of household head		
Casual labour	61	43.9
Formal employment	48	34.5
Business	27	19.4
Unemployed	2	1.4

Approximately 44.6% of the households relied on casual labour as their main source of livelihood while 41% depended on salaried or waged breadwinners. The rest (14.6%) relied on other means such as petty trade, begging, sale of crops among other ways of earning a livelihood. About 35% of the household heads were on formal employment, nearly half of them (44%) worked as casual labourers and approximately a fifth were on business. Only a few of them (2.1%) were either unemployed or in farming. Table 8 shows the monthly income status of the households and the amount spent on food in terms of Kenya shillings and US dollars. As shown in Table 8, the average amount of income for the households studied was Ksh. 13,865.08 ($157.8), with the lowest and highest levels being Ksh.5, 000 ($56.9) and Ksh.50, 000 ($569.1) respectively.

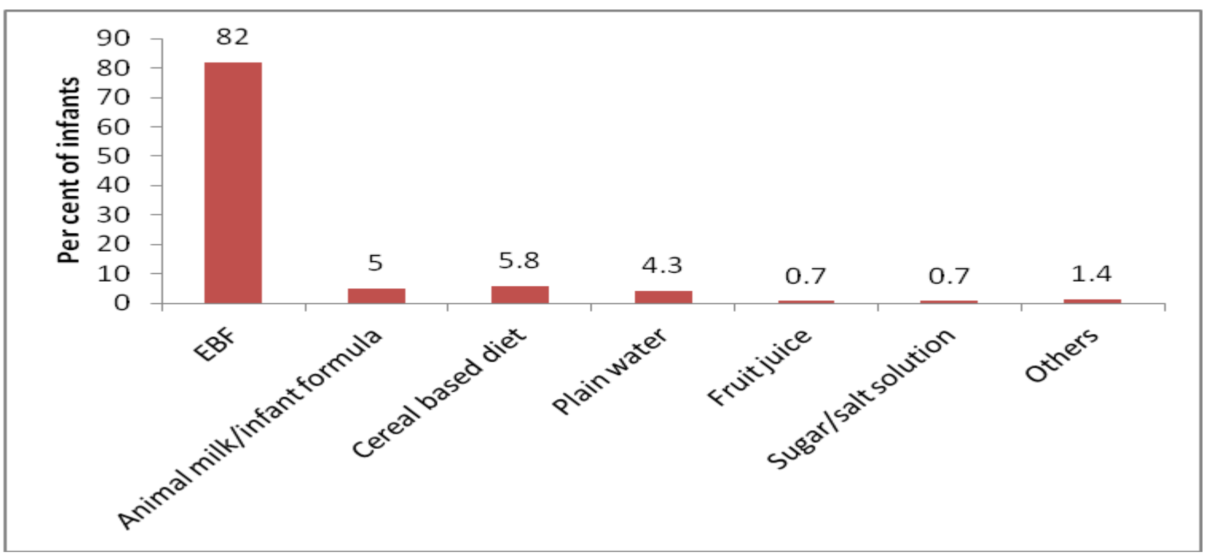
Table 8: Monthly income status of the households

Monthly income	Kenya Shillings (Ksh)	US Dollars ($)
Minimum	5,000	56.9
Average	13,865	157.8
Maximum	50,000	569.1
Range	45,000	512.2
Minimum food expenditure	900	10.2
Maximum food expenditure	18,000	204.9

On average, the households spent about 40.28% of their monthly income on food with the minimum and maximum amounts spent on food being Ksh. 900 ($10.2) and 18,000 ($204.9) respectively. Almost all the households (95%) lived in rental houses while only 5% lived in self-owned homes.

4.2 Infant Feeding Practices

The distribution of study infants by types of foods they are fed on including breast milk is shown in Figure 2. It should be noted that the other foods were given alongside breast milk.



EBF=Exclusive breastfeeding

Figure 2: Infant feeding practices

Majority of the mothers (82%) reported to have been practicing Exclusive breastfeeding (EBF) while about a fifth (18%) had introduced foods/fluids such as cereal based diets, powdered/animal milk and infant powders among other feeding options. The mean age of introduction of foods was 3 months with the earliest being 2 weeks and latest being 5 months. Figure 3 shows EBF status with age where the prevalence is highest among infants less than 2 months and gradually decreases with age.

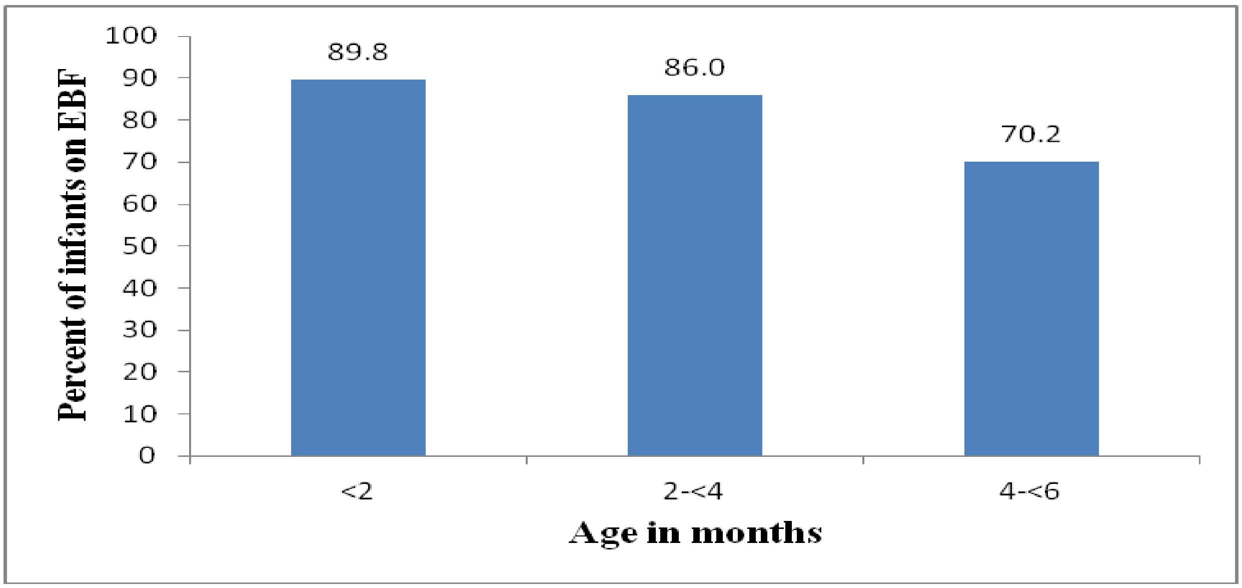


Figure 3: Infants' exclusive breastfeeding status with age

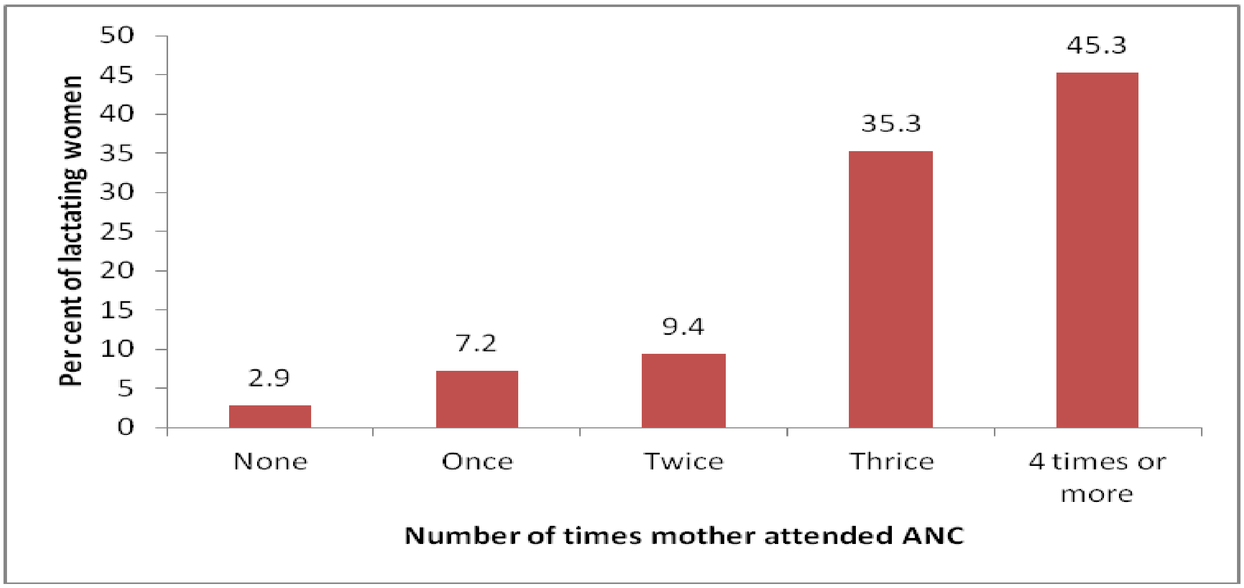
4.2.1 Breastfeeding information

More than four-fifths (85.6%) of the lactating women indicated that they started breastfeeding their infants within one hour of child delivery, while 10.1% introduced breastfeeding within 24 hours of birth and the rest (4.3%) initiated the practice after the first day. Additionally, majority of the mothers (77%) reported to have fed their infants colostrums for the first 3 days post delivery.

4.3 Maternal Health and Nutritional Status

4.3.1 Utilization of ANC services

Nearly all (97.1%) of the study mothers reported to have attended Antenatal care during their last pregnancy. The distribution of the mothers by the number of times they attended ANC during their last pregnancy is as illustrated in Figure 4.



ANC=Antenatal care

Figure 4: Antenatal care attendance of the mothers during their last pregnancy

Less than half of the mothers (45.3%) reported to have attended antenatal care clinic at least 4 times during their last pregnancy. Only a few of them (2.9%) did not attend ANC at all during the same period. Additionally, the number of months the mother was pregnant at time of first contact with ANC clinic was as illustrated in Table 9.

Table 9: Gestational age at first Antenatal care visit

Gestational age	Frequency	Percent of Lactating Women (N=135)
0-3 months	28	20.7
4-6 months	90	66.7
7-9 months	17	12.6

The results indicate that only a fifth (20.7%) of women received antenatal care early in pregnancy i.e. within the first 3 months as compared to the majority (66.7%) who started attending ANC clinic from the 2^{nd} trimester beginning 4 months through 6 months.

4.3.2 Micronutrient Supplements Intake of the breastfeeding mothers

Table 10 shows some routine services (with regard to IFA intake) as provided at the ANC during the mothers' last pregnancy.

Table 10: Distribution of mothers by services received at the ANC and PNC

Type of ANC service	Proportion of women (%)
Screening for anemia (n=135)	
-Yes	85.0
-No	15.0
Hemoglobin status (n=115)	
-Normal	80.9
-Abnormal	13.0
-Do not know	6.0
IFA supplementation (n=135)	
-Yes	72.0
-No	28.0

ANC=Antenatal Care; IFA=Iron and Folic Acid; PNC=Postnatal Care

Majority (85%) of the mothers reported to have been screened for anemia as compared to about 15% who did not receive such services. About four fifths (80.9%) of those who reported to have been screened for anemia indicated that their anemia status after such screening, was found to be within normal. Only 13% reported that it was 'not normal' while 6% did not know their hemoglobin status after such screening. Of those who reported to have attended ANC, 72% had received IFA supplements. Among the mothers who had received IFA supplementation during their last pregnancy, the mean duration that mothers took the supplements was 33.65 days (SD 22.7) with the duration ranging from1-120 days. Figure 5 shows the categorized IFAs intake patterns for the mothers during their last pregnancy.

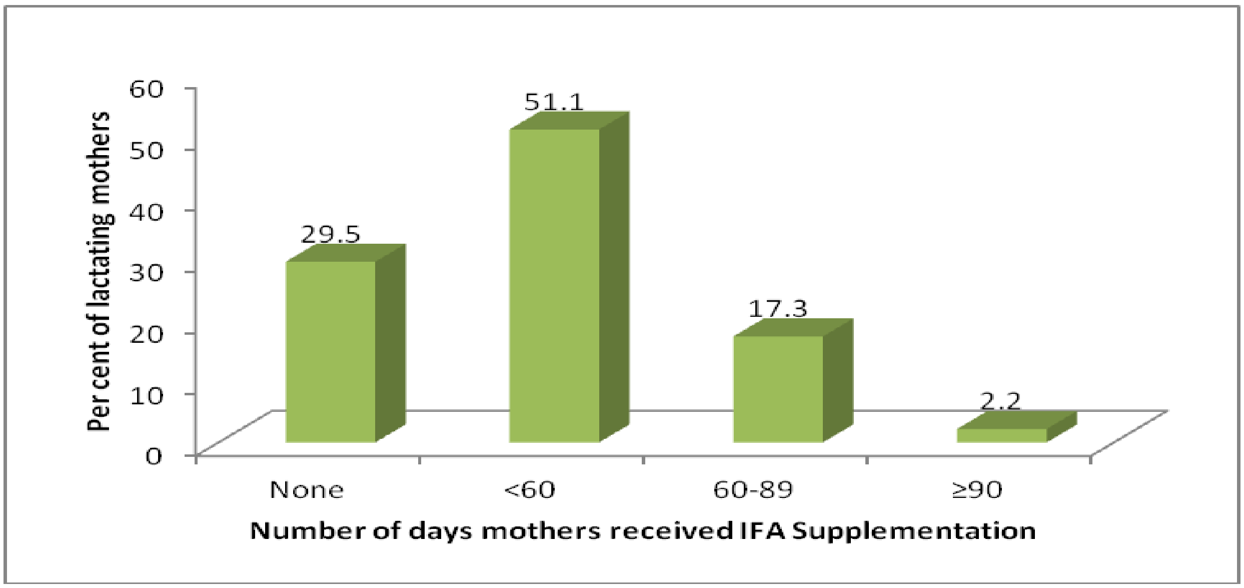


Figure 5: Duration of IFA supplementation during mother's last pregnancy

About a half (51.1%) of the mothers reported to have taken IFA supplements for less than 60 days during their last pregnancy while nearly a third (29.5%) reported that they did not take any IFA tablets during their last pregnancy.

Nearly 50% of the women reported to have received Vitamin A supplementation post-partum.

4.3.3 Nutritional status of the mothers

Figure 6 shows the distribution of the lactating mothers by their nutritional status in terms of BMI.

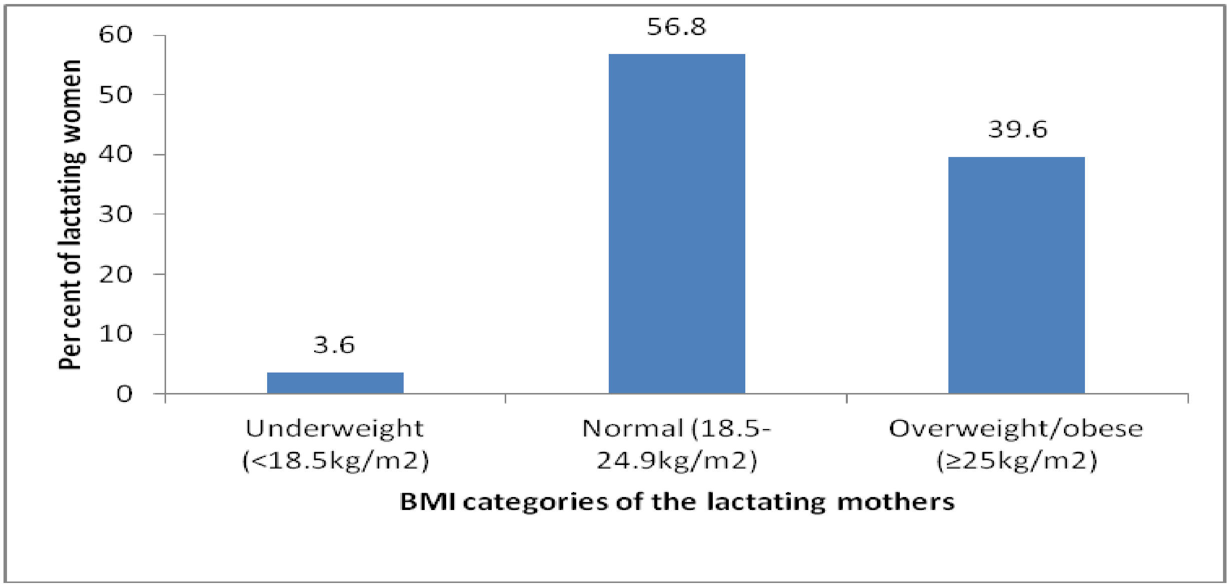


Figure 6: Distribution of lactating mothers by their Body Mass Index (BMI)

The mean BMI was 24.7±3.8kg/m^2 with the lowest and highest being 16.7 and 39.7kg/m^2 respectively. Approximately 4% of the mothers were underweight, 57% were normal and a considerable proportion (39%) was overweight and/or obese.

BMI categories by age were as indicated in Table 11.

Table 11: Maternal nutritional status (BMI) by age

		BMI categories for mother			
Mother's age (years)	Frequency (N=139)	Underweight (n=5)	Normal (n=79)	Overweight/obese (n=55)	% Overweight/obese within age category
15-19	4	0	3	1	25.0
20-29	95	4	55	36	37.9
30-39	38	1	19	18	47.4
40-49	2	0	2	0	0

Among the women found to be overweight/obese, the proportion was highest (65.5%) among the women in the 20-29 age category and lowest among the 15-19 age category (1.8%). Additionally, overweight/obesity was highest across the 30-39 age category (47.4%) and lowest in the 15-19 age category (25%).

4.3.4 Dietary patterns of the lactating mothers

4.3.4.1 Food frequency data

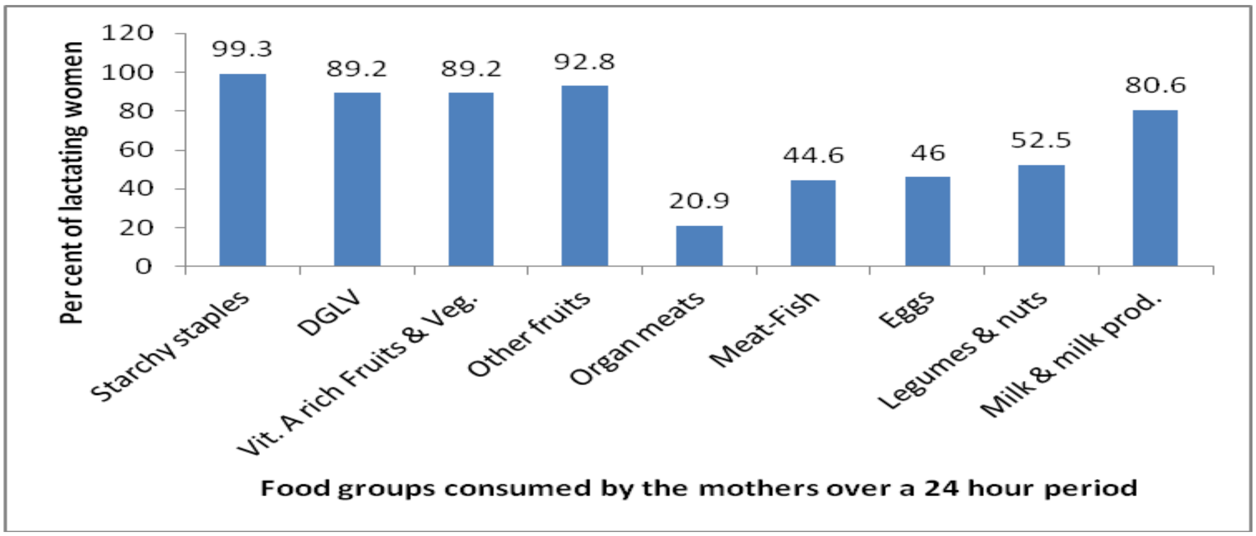
On a typical week, the most commonly consumed whole cereal was maize (54.7%), followed by mixed flours (25.2%) then rice (23%). Approximately 8% and 6% of the lactating mothers consumed red meat and organ meat respectively, at least four times on a typical week. Kales were the most commonly consumed vegetables (59.7%) followed by spinach (36%) and the least consumed vegetables were pumpkin leaves (12.2%). Two thirds (67%) of the lactating mothers consumed fresh milk at least four times on a typical week. Over three-quarters of them (78.3%) took a beverage (tea, coffee, chocolate) at least four times a week. Table 12 shows a summary of the food frequency of the lactating mothers on a typical week.

Table 12: Frequency of food consumption of the lactating mothers

Food group/item	Weekly Consumption (Per cent of respondents (N=139)) < 4 times	≥ 4 times	Rarely/never
Whole cereals			
Maize	38.1	54.7	7.2
Rice	73.4	23.0	3.6
Wheat	49.6	21.6	28.8
Mixed flours	34.5	25.2	40.3
Finger millet	33.1	18.0	48.9
Animal proteins			
Red meat	64.0	7.9	28.1
Organ meats (iron rich)	50.4	5.7	43.9
Eggs	94.2	0.8	5.0
Fish	65.5	0.7	33.8
Chicken	54.0	1.4	44.6
Omena	54.0	7.9	38.1
Dark green leafy vegetables			
Kales	34.5	59.7	5.8
Spinach	30.2	36.0	5.8
Cowpeas leaves (kunde)	55.4	22.3	22.3
Black night shade (managu)	55.4	22.3	22.3
Amaranthus	49.6	12.2	38.2
Pumpkin leaves	45.3	4.9	49.8
Milk and milk products			
Fresh milk	26.6	66.9	6.5
Yoghurt	36.7	6.5	56.8
Sour milk (mala)	49.6	7.2	43.2
Legumes			
Kidney beans	52.5	10.0	37.5
Soy beans	33.1	0.8	66.1
Fruits (Vitamin C rich)			
Oranges	66.2	12.9	20.9
Lemons	48.9	2.9	48.2
Lime	28.8	0.7	70.5
Guavas	28.8	0.7	70.5
Beverages			
Tea, coffee, cocoa, chocolate	14.5	78.3	7.2

4.3.4.2 Dietary diversity score of the lactating mothers over a 24 hour period

The Women's dietary diversity (WDDS) was computed using 9 food groups as described in the FAO (2011) dietary diversity guidelines. The WDDS was used as a proxy indicator for the micronutrient adequacy in this case focusing on iron in the diet. The mean dietary diversity score for the 9 food groups was 6.15±1.27 while the lowest and highest were 3 and 9 food groups respectively. Figure 7 shows the types of food groups consumed by the lactating mothers over the last 24 hours preceding the interview.



DGLV=Dark green leafy vegetables

Figure 7: Distribution of the lactating mothers by types of food groups consumed

As shown in figure 7, the main food groups consumed by the mothers were starchy foods (99.3%), other fruits (92.8%), dark green leafy vegetables (89.2%) and vitamin A rich fruits and vegetables (89.2). As compared to the others, foods of animal origin were consumed at a lesser extent with the highest consumption being in the milk and milk products. Only 21% of the lactating mothers consumed organ meats which are considered rich in iron.

The dietary diversity scores for the 9 food groups were later transformed into tertiles as per the FAO guidelines. The tertiles were used to classify the lactating mothers in the study into low (≤ 3 food groups), medium (4-5 food groups) and high (≥6 food groups) dietary diversity scores. Figure 8 shows the distribution of the lactating mothers based on the dietary diversity tertiles.

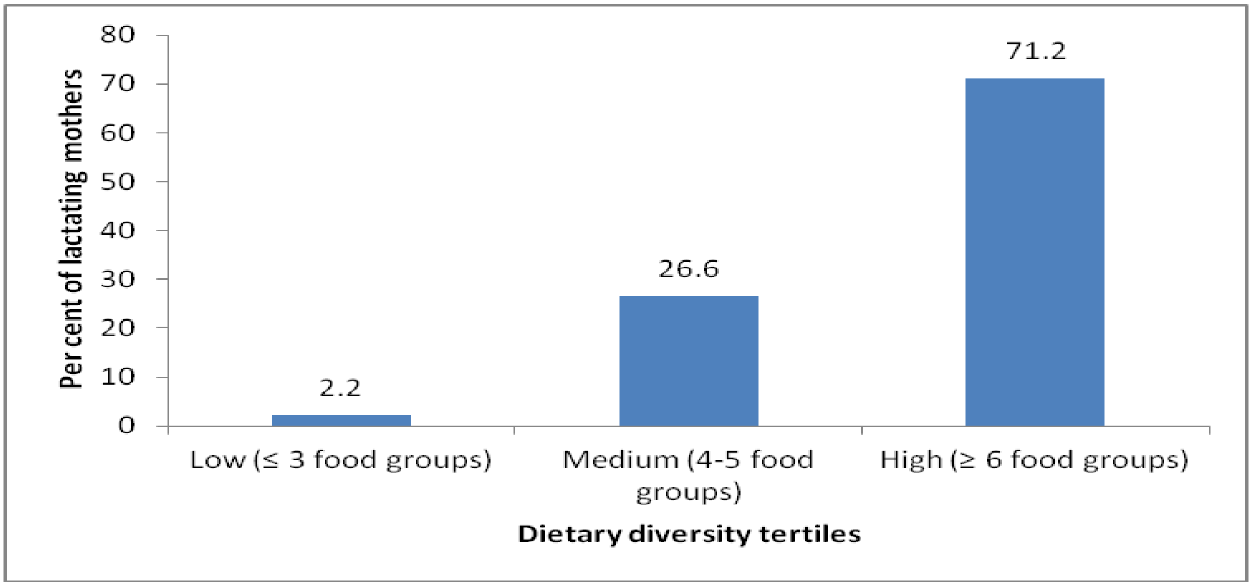


Figure 8: Distribution of the lactating mothers by dietary diversity tertiles

As shown in Figure 8, almost three-quarters of the mothers (71.2%) were found to fall within high DDS, 26.6% within medium and only 2.2% within low DDS.

4.3.5 Prevalence of anemia among the lactating women

The mean hemoglobin level for the mothers was 12.6±2g/dl with the lowest and highest levels being 7.0 and 16.3 g/dl respectively. Approximately one-third (30%) of the breastfeeding women were anemic. Those with mild, moderate and severe anemia were 14.4%, 11.5% and 4.3% respectively. The results indicate that mild anemia (14.4%) falls within the range considered to be of public health significance according to the WHO (2011) classifications.

4.3.6 Factors associated with maternal anemia/hemoglobin levels

Table 13 shows the association of selected factors with maternal anemia.

Table 13: Factors associated with maternal anemia

Factor (categorical)	Test	Sig.
Maternal education	Fisher's Exact(2.499)	0.789
IFA intake duration	Fisher's Exact (2.387)	0.493
WDDS	Fisher's Exact (1.157)	0.576
Maternal BMI	Fisher's Exact (2.134)	0.399
Post-partum Vitamin A supplementation	Chi-square (χ^2=0.041, df=1)	0.840

IFA=Iron and Folic Acid; WDDS=Women Dietary Diversity Score; BMI=Body Mass Index

No significant association was found between education level and maternal anemia (Fisher's Exact value=2.499, p=0.789) but mothers with less/low education status (at most primary level) were more likely to develop anemia than those with at least some secondary education (OR=1.19; 0.95CI: 0.58-2.46). The study found no significant association between anemia status of the mothers and IFAs intake during their last pregnancy (Fisher's Exact value=2.387, p=0.493). No significant association was found between WDDS and maternal anemia. Table 14 shows the comparison of mean hemoglobin levels of the lactating women across selected factors.

Table 14: Comparison of mean hemoglobin levels among the lactating mothers

Factor (categorical)	Sum of squares	Degrees of freedom	Mean square	F	Sig.
IFA intake duration	9.429	3, 135	3.143	0.818	0.486
Maternal BMI	8.582	2, 136	4.291	1.123	0.328
Age of mother	5.234	3, 135	1.745	0.450	0.718

IFA=Iron and Folic Acid; BMI=Body Mass Index

As shown in Table 14, the mean hemoglobin levels for the mothers based on the duration of IFAs intake showed no significant difference ($F_{3, 135}$=0.818, p=0.486) among these groups. A comparison of mean hemoglobin levels of the mothers by BMI showed no significant difference across the 3 BMI categories ($F_{2, 136}$=1.123, p>0.05). Additionally, the study found no significant association between nutritional status (BMI) of the lactating women and maternal anemia (Fisher's Exact value=2.134, p=0.399). A comparison of mean hemoglobin levels by age showed no significant difference across the 4 age categories ($F_{3,\ 135}$=0.45, p>0.05). In addition, no significant difference was found between the mean hemoglobin levels of younger mothers (18-34 years) and the older ones (35-49 years) (p>0.05). Though subjective, no significant associations were noted between Vitamin A supplementation post-partum and maternal anemia (χ^2=0.041, df=1, p=0.840).

4.4 Health and Nutritional Status of the Infants

Table 15 shows selected characteristics of the study infants.

Out of the 139 infants studied, females were the majority (58%) while males were 42%. Nearly two thirds (66.2%) of the infants were aged less than 4 months while the rest were between 4 and 6 months. The mean weight and length of the infants was 5.90 kg and 59.3cm respectively. Majority of the infants (92%) had normal birth-weight (greater or equal to 2.5kg) while only a few (8%) had low birth weight (less than 2.5kg). A significant negative correlation was found between total number of previous pregnancies and birth weight (r=-0.227, p=0.008). Birth weight was found to be positively correlated with BMI. Majority of the infants (82%) were reported to be on EBF with the mean duration of exclusive breastfeeding being 2.6 months. The mean hemoglobin level of the infants was 11.55g/dl with lowest and highest levels recorded as 4.3 and 16.6g/dl respectively.

Table 15: Selected characteristics of study infants

Characteristic	Frequency (no.) (N=139)	Per cent of infants (N=139)
Sex		
Male	58.3	41.7
Female	81	58.3
Birth weight		
Low birth weight (<2.5kg)	11	7.9
Normal birth weight (≥2.5kg)	128	92.1
Age of infant (months)		
0-1.99	49	35.3
2-3.99	43	30.9
4-5.99	47	33.8
Mode of feeding		
EBF	114	82
Non EBF	25	18
Colostrum		
Yes	107	77
No	32	23
Immunization status		
Fully immunized for age	125	89.9
Not fully immunized for age	14	10.1

EBF=Exclusive Breast Feeding

4.4.1 Nutritional status of the infants

The median weight and length of the study infants was 6.0 kilograms and 58.7 centimetres respectively with the modal weight and length being 6.0 kilograms and 60.0 centimetres in that order. The lightest and heaviest infant weighed 2.8kg and 9.8kg respectively.

Table 16 shows the proportion of infants with acute malnutrition by sex.

Table 16: Per cent distribution of acute malnutrition (Weight-for-Length Z-scores < -2) by sex

Acute malnutrition category	All (%) N = 139	Males (%) n = 58	Females (%) n = 81
Global	5.8	5.2	6.2
Moderate	2.9	3.4	2.5
Severe	2.9	1.7	3.7

Global=< -2 Z score; Moderate=< -2 and ≥ -3 Z score; Severe=< -3 Z score and/or oedema

Overall, the Global Acute Malnutrition (GAM) rate for the present study stood at 5.8%, with the rate being higher among female infants than the male ones. On the other hand, the proportion of moderate and severe acute malnutrition was similar (2.9%). However, the levels of severe acute malnutrition were higher in females as compared to males but moderate acute malnutrition levels indicated vice versa. The levels of stunting among the infants are as shown in Table 17.

Table 17: Per cent distribution of stunting (Length-for-Age Z-score < -2) by sex

Stunting category	All (%) N = 139	Males (%) n = 58	Females (%) n = 81
Stunting	19.4	20.7	18.5
Moderate	13.7	13.8	13.6
Severe	5.8	6.9	4.9

Stunting=<-2 Z score; Moderate=<-2 and ≥ -3 Z score; Severe=< -3 Z score and/or oedema

As shown in Table 17, 19% of the infants were stunted with almost equal levels in both males and females. Prevalence of severe stunting was approximately 6% with more males than females being severely stunted. The levels of underweight among the study infants are as shown in Table 18.

Table 18: Per cent distribution of underweight (Weight-for-Age < -2 Z-scores) by sex

Underweight category	All (%) N = 139	Males (%) n = 58	Females (%) n = 81
Underweight	2.2	3.4	1.2
Moderate	0.7	1.7	0.0
Severe	1.4	1.7	1.2

Underweight=<-2 Z score; Moderate=<-2 and ≥-3 Z score

As indicated in Table 18, 2.2% of all the infants were underweight with only 1.4% being severely underweight.

4.4.2 Immunization Status of the infant

As shown in Table 19, majority of the infants had received the first dose of each of the vaccines, with the highest proportion having received OPV2 and DPT2 and the lowest being OPV3 and DPT3. Majority (90%) of the infants studied were fully immunized for their age except for only a few (10%). Table 19 shows details of the immunization status of the infants.

Table 19: Per cent distribution of immunization status of study infants

			Type of vaccine received					
Response type	BCG (n=139)	OPV0 (n=128)	OPV1 (n=101)	OPV2 (n=75)	OPV3 (n=48)	DPT1 (n=101)	DPT2 (n=75)	DPT3 (n=48)
Yes by card	94.2	93.5	93.5	97.4	87.3	94.4	97.4	87.3
Yes by recall	2.9	1.9	1.9	1.3	1.8	1.9	1.3	1.8
Yes (both card & recall)	97.1	95.4	95.4	98.7	89.1	96.3	98.7	89.1
No	2.9	4.6	4.6	1.3	10.9	3.7	1.3	10.9

BCG=Bacteria Culmette Guerin (tuberculosis vaccine); OPV=Oral Polio Vaccine (dose 1, 2 and 3); DPT=Diphtheria/whooping cough (pertussis) (dose 1, 2 and 3).

4.4.3 Prevalence of anemia among exclusively breastfed infants

35% of the infants regardless of the feeding type, were anemic (i.e. hemoglobin levels < 11.0 g/dl). Over two thirds (69.4%) of the anemic infants were females while the remaining one third (31%) were males (Table 20).

Table 20: Anemia status and sex of infant

Anemia status	Sex (%)		Total (n)
	Males	Females	
Anemia	30.6	69.4	49
Non anemia	47.8	52.2	90

82% of the infants were found to be on EBF of whom approximately 37% were diagnosed with anemia. On the other hand, among the few (18%) who were not on EBF, 28% were found to be anemic. Table 21 illustrates the cross-tabulation between the type of feeding and anemia status of the infants.

Table 21: Feeding type and anemia

Mode of feeding	Anemia status (%)		Total (n)
	Anemia	Non anemia	
EBF	36.8	63.2	114
Non EBF	28.0	72.0	25

EBF=Exclusive breastfeeding

4.4.4 Associations and relationships of infant anemia with selected factors

To find out factors associated with anemia in infants, several chi-square tests and bivariate correlations were done and significant associations determined at the 0.05 significance level. The results are as shown in Table 22.

Table 22: Associations and relationship between infant anemia and selected variables

Variable	χ^2 value	Correlation coefficient (r)	Sig.	Odds ratio (OR)	95% CI for OR
Sex of infant	3.845	0.166	0.05	0.48	0.23-1.01
Age category of infant	10.148	-0.346	0.006*	-	-
WAZ	0.005**	-	1.000	-	-
WLZ	0.409**	-	0.712	-	-
LAZ	0.047	-	0.829	-	-
EBF/Non EBF	0.702	0.071	0.402	1.50	0.58-3.90
EBF duration	2.986	-0.417	0.008*	2.04	0.22-1.11
Birth weight	7.112	0.228	0.017*	5.53	1.39-21.94
Immunization	0.304	0.047	0.770	1.40	0.42-4.74
Vit. A supp. Post partum	1.157	0.091	0.282	1.47	0.73-2.95
IFA supp (yes/no)	0.285	0.046	0.594	1.24	0.56-2.77
IFA supp. duration	1.811	-0.180	0.834	-	-
Maternal anemia	5.735	0.203	0.017*	2.46	1.17-5.20
Maternal BMI		0.182	0.032*		
Maternal education	13.865	-0.004	0.011*	0.98	0.49-1.98
Total number of pregnancies	-	-0.236	0.005*		
Total income	-	0.246	0.003*		
Income spent on food	-	0.276	0.001*		
Household size		-0.203	0.016*		

*Association was significant at $p<0.05$ **Fisher's Exact Test

WAZ=Weight-for-age Z score; WLZ=Weight-for-Length Z score; LAZ=Length-for-Age Z score; EBF=Exclusive Breastfeeding; IFA= Iron Folic Acid supplements; BMI=Body Mass index

Significant associations (with respect to anemia) were found between birth weight, infant age category, EBF duration, maternal education and maternal anemia. Infants from mothers with less/low education had an increased likelihood of being anemic compared to those from mothers with at least some secondary education (OR=1.02; 0.95CI: 0.50-2.05).

There was no significant association between age (of primary caregiver) and infant anemia ($\chi2$= 0.809, df=1, Fisher's Exact Test, p=0.452). Maternal BMI, household income (both total and amount spent on food), total number of pregnancies and the size of household were significantly related with the hemoglobin levels of the infants. As expected, age of the infants had a significant inverse relationship with their hemoglobin levels (r=-.346, p=0.000). Additionally, infants less than 4 months had 29% lower risk of anemia than those aged 4-6 months (OR=0.713, 0.95C1; 0.34-1.50).

The present study found no significant association between the mode of feeding (EBF versus Non-EBF) and anemia ($\chi2$=0.702, df=1, p=0.402). On the other hand, those infants whose mothers were anemic had more than two times risk of being anemic (OR=2.464 0.95CI: 1.17-5.20). On the contrary, the study found out that the exclusively breastfed infants had 1.5 times the likelihood of being anemic than those who were not exclusively breastfed (OR=1.5, 0.95CI 0.58-3.89). The results of the study further indicate a significant positive relationship (r=0.446, p=0.000) between the hemoglobin levels of the infants and that of their mothers.

The mean hemoglobin levels for the exclusively breastfed and non-exclusively breastfed infants was 11.4±2.3g/dl and 11.9±2.4g/dl respectively, but there was no significant difference with respect to these means (Students't test, $t_{0.025,\ 137}$=-1.040, p= 0.300) at the 0.05 significance level. However, a significant difference in mean hemoglobin levels was noted between infants exclusively breastfed for less than 4 months versus 4-6 months (Students't test, $t_{0.025,\ 112}$=3.122, p=0.002).

The study found a significant association between birth weight and infant anemia and the odds ratio indicated a more than 5 fold increased risk of anemia for an infant with a low birth weight (<2.5kg) as compared to the one with normal birth weight (≥2.5kg) (OR=5.52; 0.95CI: 1.39-

21.9). On the other hand, the study found no significant association between the sex of the infant and anemia although the odds ratio showed that male infants had 52% lower risk of anemia as compared to their female counterparts (OR=0.48;0.95CI:0.23-1.01).

4.4.5 Comparing the means between the anemic versus non-anemic infant groups based on selected variables

Independent T-tests performed to compare means between the anemic and non-anemic infant groups based on selected factors produced the results as shown in Table 23.

Among the two groups of infants (anemic versus non-anemic), significant differences were noted in their hemoglobin levels with respect to some factors including mother's hemoglobin levels, nutritional status and the total number of pregnancies. In addition, significant differences were also noted in terms of total household income and the proportion of income spent specifically on food. Age of the infant and duration of exclusive breastfeeding also indicated significant differences with respect to anemia. No significant differences were noted in terms of nutritional status among these two groups as indicated by the 3 indices in Table 23.

Table 23: Comparing means between the anemic versus the non-anemic infant groups

Factor	t	df	p value	mean diff	SED	95% CI for difference	
						Lower	Upper
Maternal BMI	2.273	137	.025*	1.532	.6738	.1994	2.8639
LAZ	.045	137	.964	.0130	.2913	-.5628	.5891
WAZ	1.950	137	.053	.3835	.1967	-.0054	.7724
WLZ	1.735	137	.085	.5322	.3068	-.0744	1.1388
Maternal Hb	-4.060	137	.000*	-1.338	.3294	-1.9889	-.6861
Household total income	-2.133	137	.035*	-2959.309	1387.3	-5702.706	-215.912
Income spent on food	-2.731	137	.007*	-1548.367	566.902	-2669.376	-427.3580
Age of the mother/caregiver	.666	137	.507	.558	.837	-1.098	2.2130
Total No. of pregnancies	2.210	137	.029*	.536	.243	.056	1.0160
Gestational Age_1st ANC	-.435	137	.664	-12.932	29.704	-71.6704	45.8056
Birth weight	-.440	135	.660	-.0351	.0799	-.1932	.1228
Age of infant	2.890	137	.004*	.8695	.3009	.2745	1.4645
Duration of EBF	3.429	112	.001*	1.075	.3135	.4538	1.6961
Immunization Status	-.548	137	.584	-.029	.0540	-.1360	.0770
Gestation age at 1st ANC visit	-.340	133	.734	-.0352	.1035	-.2399	.1695

*difference is significant

WAZ=Weight-for-age Z score; WLZ=Weight-for-Length Z score; LAZ=Length-for-Age Z score; EBF=Exclusive Breastfeeding; ANC= Antenatal Care; BMI=Body Mass index; Hb=Hemoglobin

4.4.6 Predictors of hemoglobin levels of infants

Multiple regression analysis to find out predictors of hemoglobin levels for the infant was performed using the “enter” method where a significant model emerged ($F_{16, 95}$ =4.624, p<0.000, Adjusted R square=0.343). Statistically significant predictors of hemoglobin levels for the infants were mother’s hemoglobin status, nutritional status (BMI) and amount of household income spent on food (Table 24).

Table 24: Summary of the regression model for predictors of hemoglobin levels of infants

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	10.745	2.610		4.117	.000
Household total income	007	.000	-.002	-.018	.985
Amount of income spent on food	.000	.000	.233	2.014	.047*
Mother/caregiver's age	.022	.050	.045	.437	.663
Total no. of pregnancies	-.215	.197	-.138	-1.094	.277
Gestational age_ANC	.001	.001	.076	.878	.382
IFA supp. Duration	-.005	.008	-.055	-.657	.513
Birth weight	.487	.465	.093	1.046	.298
Exact age of infant	-.453	.361	-.338	-1.254	.213
EBF duration	.158	.378	.114	.419	.676
Weight for age Z scores	-.564	1.048	-.263	-.538	.592
Length for age Z scores	.442	.840	.307	.526	.600
Weight for length Z scores	.207	.732	.156	.283	.778
Maternal BMI	-.167	.052	-.280	-3.184	.002*
WDDS	-.057	.177	-.027	-.323	.747
Maternal Hb	.309	.111	.257	2.769	.007*
Household size	-.055	.240	-.028	-.230	.819

Dependant Variable: Infant hemoglobin levels
*prediction is significant
IFA=Iron Folic Acid; ANC=Antenatal Care; BMI=Body Mass Index; EBF=Exclusive Breastfeeding; WDDS=Women Dietary Diversity Score; Hb=Hemoglobin

To ascertain the factors associated with infant anemia, logistic regression was performed where a statistically significant model emerged (χ^2 (7) = 33.629, p < 0.000). All the factors which were found to have significant associations with the dependant variable, 'infant anemia' were included in the model. More than one-third (35%) of the variation in anemia cases in the infants was explained by the model (Nagelkerke R^2=0.354). Three key factors associated with infant anemia included the mother's nutritional status (BMI), maternal hemoglobin levels and amount of household income spent on food (Table 25).

Table 25: Logistic regression for factors associated with anemia among breastfeeding infants

Predictor Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Income spent on food	.000	.000	4.982	1	.026*	1.000
Duration of EBF	.320	.535	.358	1	.549	1.378
Maternal BMI	.167	.069	5.895	1	.015*	1.182
Birth weight	1.387	1.189	1.362	1	.243	4.005
Maternal Hb	-.295	.125	5.578	1	.018*	.745
Fertility rate	.209	.207	1.017	1	.313	1.232
Age of infant	-.176	.519	.116	1	.734	.838
Constant	-.864	2.122	.166	1	.684	.422

*statistically significant
Dependent Variable: Anemia status of infant
EBF=Exclusive Breastfeeding; BMI=Body Mass Index; Hb=Hemoglobin

CHAPTER FIVE: DISCUSSION

5.1 Socio-demographic and Economic Characteristics

The mean household size (3.8±1.12) of the study households was significantly lower (p=0.000) than the national figure of 4.2 and 4.7 as reported by the KDHS 2008-09 (KNBS and ICF Macro, 2010) and the Kenya population and housing census report of 2009 (KNBS, 2010) respectively. According to KDHS 2008-09 report, the average urban household size is smaller (3.1 persons) than the rural one (4.6 persons) (KNBS and ICF Macro, 2010) and this could probably explain this difference given that this study was based in a low income urban setting. In addition, this study only focused on lactating mothers with infants aged 0-6 months while the KDHS sample was all inclusive and included all households; rural and urban including older women with more children. This discrepancy may also be attributed to the impact of the recent increased public sensitization and awareness on family planning through the Community Strategy, mass media and private organizations spear headed by government agencies such as the National Council for Population and Development.

The significant negative relationship of household size and total number of previous pregnancies with the hemoglobin levels of infants could be an indirect one and was unexpected. The lack of significant relationship between the total number of pregnancies (proxy to parity) and mother's hemoglobin levels implies that risk of maternal anemia post-partum is not significantly associated with parity. Studies have revealed increased risk of maternal anemia in pregnancy with high parity (5 or more pregnancies) (King et al., 1991; Silver, 1992; Rooney, 1992; Al-Farsi et al., 2011). Other studies have found no evidence of such association (Tanbo and Gumbum, 1987; Fayed et al., 1993; Toohey et al., 1995; Humphrey, 2003) while others have indicated positive association of high parity and reduction of anemia in pregnancy (Ozumba and Igwegbe, 1992; Rizk et al., 2001; Kumarl and Badrinath, 2002). This may imply an indirect relationship between previous pregnancies and maternal hemoglobin which ultimately affects hemoglobin levels of infants. The lack of association between total number of previous pregnancies and maternal anemia could probably be due to the fact that assessment of maternal anemia in this study was post delivery (lactation) and not during pregnancy.

Longer birth spacing has been associated with positive maternal and infant health outcomes (USAID, 2006; Contra Country Health Services, 2007). However, shorter (less than 18 months) and longer birth intervals (longer than 5 years) have been found to have negative pregnancy outcomes (still births, premature births, low birth weight and infant mortality) (Rutstein, 2005; Conde-Agudelo et al., 2005; Conde-Agudelo et al., 2006; Bhalotra et al., 2008) and this has been linked to micronutrient deficiencies including iron and folate deficiency (Smits and Essed, 2001; van Eijsden et al., 2008). Previous studies have indicated that women who have had previous pregnancies have a more relaxed attitude towards supplementation especially if such pregnancies were uncomplicated than primi-gravidae ones (Carmichael et al., 2006; Seck and Jackson, 2008).

The present study found mothers as the main caregivers (96.4%) which indicates optimal maternal care provided to children below six months especially with regard to infant feeding as these are supposed to be exclusively breastfed for 6 months according to the WHO/UNICEF global strategy for IYCF.

The lack of association between maternal age and infant anemia was unexpected. Young maternal age has previously been associated with increased risk of negative pregnancy outcomes such as small for gestational age, premature and low birth weight including infant anemia (Fraser et al., 1995; De Pee et al., 2002). Recent evidence has shown that first born children from younger women (from adolescents to 27 years) are more likely to be stunted, experience diarrhea including severe or moderate anemia as compared to those born to older women (27-29 years) (Finlay et al., 2011). As is evidence from these studies, age seems not to have a significant influence on maternal as well as infant anemia and other factors may have a greater impact. In addition, majority of the lactating mothers in the present study were past adolescence period where the risk of infant anemia is lower as compared to adolescent age where there are competing interest of nutrients for adolescent growth and that of the infants (De Pee et al., 2002).

The education level of mother indicated a significant association with infant anemia. According to Block (2002), maternal nutritional knowledge plays a key role in influencing micronutrient status of children (including hemoglobin levels) and has a greater impact as opposed to education level or number of schooling years. Findings of the same study suggest that maternal schooling has an indirect impact on micronutrient status of children (including hemoglobin levels) through its influence on maternal nutritional knowledge and probably household expenditure where schooling is not the main source of this knowledge. However, among other important socio-demographic factors, less maternal education was associated with increased risk of infant anemia in a recent Chinese study (Yang et al., 2012). However, a health facility based study in Central Kenya investigating factors influencing adherence to IFA intake among pregnant mothers revealed that adherence status is independent of their age and duration of schooling (Dinga, 2013). Dinga (2013) showed that most pregnant women have poor knowledge on anemia, its causes and negative effects during pregnancy which may contribute to poor adherence to IFA supplements during pregnancy which may contribute to low hemoglobin levels during lactation.

A similar study by Meinzen-Derr et al., (2006) found no significant association between maternal education and infant anemia although lower education level of the caregiver indicated an increased relative risk of anemia among the infants. According to Jasti et al., (2007), post secondary education has a positive influence on adherence to IFA supplementation while age and income have no effect.

Generally, education is a key factor in matters to do with success of an individual in the society and the overall growth and development of a country. Education of women is one of the strategies for women empowerment as enshrined in the Kenyan constitution (RoK, 2012) and is also part of the Millennium Development Goals (UNDP, 2003) which when addressed will significantly have a positive impact on health and nutritional status of children less than five years including infants. According to the Kenya Demographic and Health report (2008-09), mothers with at least post primary education are more likely to feed their children according to the recommended infant and young child feeding practices as compared to those with no education (KNBS and ICF Macro, 2010).

In Kenya, the recent free education policy which started in 2003 has resulted in more enrolment of children in school and the median years of schooling for both sexes has been on the increase though the margin is small. Since 2003, it has increased from 4.3 to 5.2 for females and 5.0 to 6.0 years for males as indicated in the 2008-09 KDHS report. This trend is expected to continue and efforts should now focus on ensuring that more people complete at least Secondary education to realize this impact. Further, nutritional knowledge should be stressed in all levels of education for maximum impact on maternal and infant anemia.

The significant positive correlation of total household income and proportion spent on food with hemoglobin levels of infants reflects that of a study in rural China where low household income and poor/crowded living conditions among other factors increased the risk of anemia among infants aged 0-18 months (Yang et al., 2012). Infant hemoglobin has been shown to have an inverse relationship with socio-economic status (Lartey et al., 1999). A study on the effect of income on nutritional status of Chinese children found no significant association but suggested that there may be an indirect relationship between these two parameters where increased average household income is expected to improve access to basic amenities such as better and quality health care including water and sanitation (Haibin and Yu, 2013). Another study, (Fatemeh and Saraswathi, 2012), revealed that gestational weight gain, fundal height, maternal hemoglobin levels and household income as significant factors for birth weight of neonates. The lack of association between income and nutritional status of the lactating mothers could be due to the fact that these mothers were already from a low income setting where their incomes were more or less similar (little power of analysis) as reflected by casual labour as the main source of livelihood for most of them.

5.2 Infant Feeding Practices at Kangemi Slums

The finding on exclusively breastfed infants having a more likelihood of anemia as compared to those on mixed feeding is similar to that of a recent Chinese study (Luo et al., 2014). This may suggest that those on mixed feeding, besides breast milk, could be receiving additional iron from infant foods especially formula foods, of which most are known to be fortified with micronutrients including iron (Luo et al., 2014). On the contrary, another study in rural China revealed associations between infant anemia and lack of predominant/exclusive breastfeeding in the first 4 months of life (Yang et al., 2012). Other previous studies have found no evidence of anemia among exclusively breastfed infants (Shashi et al., 2008; Eneroth, 2011) and this issue warrants more from both global and national bodies to review existing policies with regard to infant feeding before it becomes complex with irreversible effects. Increasing evidence has revealed that infants from resource constrained country settings tend to have lower iron reserves as compared to those from developed countries and this could be another possible factor that further explains this finding (Sultan and Zuberi, 2003; Meinzen-Derr et al., 2004; Zlotkin, 2012). On the other hand, breastfeeding has been shown to have a protective effect against childhood obesity as compared to formula feeding (Butte, 2009). Majority of the mothers (85.6%) initiated breastfeeding early in life i.e. within the first one hour post delivery, indicating a significant increase from both the national and regional figures of 58% and 56% respectively (KNBS and ICF Macro, 2010). This increment in the proportion of infants being introduced to breast feeding early in life could be attributed to the positive impact of the increased public awareness and sensitization on importance of early breast feeding through the recently introduced community strategy.

The mean duration of introduction of other foods was 3 months with the median being just after 3 months. Introduction of other foods starts as early as two weeks with the latest infant being introduced at 5 months of age. Global strategy for infant and young child feeding states that complementary feeding should start at 6 months (WHO/UNICEF, 2003). Early introduction of complementary foods has been linked to increased respiratory infections; allergy among other factors (Hendricks, 2003). Exclusive breastfeeding for at least 4 months has been shown to protect infants against atopic dermatitis and asthma in early life (Greer et al., 2008). Delayed introduction of these foods has also been associated with feeding difficulties (Northstone et al., 2001). Among the few who practiced mixed feeding, most of them introduced foods at the age of 4 months and some of the foods being introduced included powdered milk/cow milk, infant formula, cereal based diets, plain water among others. Luo et al., (2014) further revealed that age of introduction of solid foods among non-formula fed infants had a significant inverse relationship with their hemoglobin levels though no such relationship was found with prevalence of anemia. According to the same study, highest hemoglobin levels were noted among infants who were never formula fed. Early infant feeding among other factors has been associated with risk of obesity in later childhood (Owen et al., 2005).

A Malawian study showed that early complementary feeding led to increased risk of eye infections, morbidity from malaria and respiratory infections (Kalanda et al., 2008). The said study also revealed that early introduction of foods may lead to lower weight for age at 3, 6 and 9 months of age. Moreover, the environment under which these foods are introduced is often unhygienic and may be pathway for introduction of pathogens and diarrheal diseases have been common (Popkin et al., 1990; Piwoz et al., 1996).

The median duration of EBF of 2 months was significantly higher than the national figure of less than 1 month (p=0.000) and four times the regional figure as reported in the KDHS report of 2008-09 (KNBS and ICF Macro, 2010). This may also be attributed to the increased public awareness and sensitization on importance of exclusive breastfeeding through the recently introduced community strategy.

The mean duration of EBF (3 months) is similar to the national figure of the same report. Generally, early complementary foods are cereal based diets which are known to have high phytate content which leads to reduced iron bioavailability (Ma et al., 2005) and exposes infants to anemia. On other hand, prolonged breastfeeding may increase risk of infant anemia as breast milk iron and zinc contents are low and may not meet the increased demand due to growth and development in young infants.

In concurrence with other related studies, (Meinzen-Derr et al., 2006; Chantry et al., 2007; Yang et al., 2009; Luo et al., 2014), the study found a significant inverse relationship between duration of EBF and hemoglobin levels of the infants. The results of this study further indicated an increased estimated relative risk of infant anemia associated with longer duration of EBF and are similar with those of other recent studies (Meinzen-Derr et al., 2006; Chantry et al., 2007). Therefore, this issue requires special attention given that exclusive breast feeding for the first six months of life continues to be promoted and supported by both global and national policies. As found out by this study, there is no significant association between the mode of feeding (EBF versus mixed feeding) and infant anemia. These results seem to reflect those of a Brazilian study (Teixeira et al., 2010) where they concluded that feeding type exhibited no difference in hemoglobin levels among 6 months old infants.

5.3 Iron and Folic Acid Intake Patterns of the Lactating Mothers

The WHO recommends at least 4 ANC visits for a woman without complications the first of such visits being within the first trimester. Less than half of the mothers in the present study had attended ANC care at the recommended duration during their last pregnancy, a figure which is closely related to the national results of the KDHS 2008-09 (47%) though slightly lower than the one for urban women (60%) (KNBS and ICF Macro, 2010). The national health report (KDHS 2008-09) indicates that most pregnant women do not attend ANC care early in pregnancy. Only a few (15%) of them seek ANC care in the first trimester and this partly explains why most of them fail to attend ANC at the recommended threshold. Comparable results were realized in a related study in Central Kenya (Dinga, 2013). Studies have shown that long distances have a negative impact on accessibility and utilization of ANC services (Magadi et al., 2000; Tlebere et al., 2007). Early ANC attendance beginning from the first pregnancy trimester has been shown to be useful in early detection and management of anemia among pregnant women and has a direct effect on pregnancy outcomes (Umber et al., 2007).

The proportion of mothers (51.1%) reporting to have taken IFA supplements for less than 60 days during their last pregnancy is closely related to that reported by Kenya Demographic and Health Survey of 2008-09 (54%) and this also applies to the proportion (29.5%) not taking any IFA supplementation during their last pregnancy (KNBS and ICF Macro, 2010). On the other hand, the number of pregnant women reporting to have received IFA supplementation during the same period is slightly more than both the regional and national figures. However, the mean duration of IFAs intake (33 days), is just but a third of the recommended threshold of 90 days. This implies that most of the mothers were not taking the IFA supplements at the recommended duration during their pregnancy period and these findings agree with those of a related study in Central Kenya which revealed a much lower than average duration of IFAs intake (only 28 days) among pregnant mothers (Dinga, 2013).

These results indicate that IFA intake is still sub-optimal as a result of poor adherence of IFA supplementation during pregnancy as revealed by the same study. According to Dinga (2013), more than three quarters of pregnant mothers do not adhere to IFA supplementation. Adherence to IFA supplements may be influenced by such factors as place of residence, gestational age, and history of anemia, mother's knowledge on anemia and frequency of ANC visits (Dinga, 2013). Other reasons behind non-adherence may include mothers not taking the tablets due to their bad taste, inadequate knowledge on their significance and inadequate supplies from public health facilities (Galloway et al., 2002; Ritsuko et al., 2006).

When compared, the mean hemoglobin levels for the mothers under study showed no significant difference with respect to varying duration of IFAs intake. The study found no significant association between IFAs intake and maternal anemia, which implies that IFA supplementation during pregnancy, may not sustain hemoglobin levels after pregnancy. This may suggest the effect of other micronutrient deficiencies including vitamin A and riboflavin which have been shown to influence IDA where deficiency of riboflavin impairs absorption of iron (Dijkhuizen et al., 2001; Ahmed et al., 2008). Additionally, the form in which iron is presented as a supplement (Ferrous sulphate or Sodium iron EDTA) have been shown to influence iron bioavailability where the latter has a higher bioavailability and is not affected by iron inhibitors (Viteri et al., 1995).

A common habit among the lactating mothers was the high frequency of consumption of caffeinated beverages as compared to the level of consumption of Vitamin C rich foods which was generally poor and this could possibly explain why duration of IFAs intake produced no significant difference in mean hemoglobin levels of these mothers. Therefore, this underscores the need for lactating mothers to ensure they consume a balanced diet in terms of macronutrients as well as essential micronutrients such as iron, vitamin A and riboflavin to maintain normal hemoglobin levels post delivery.

5.4 Maternal and Infant Nutritional Status

More than half of the mothers were found to be of normal nutritional status as defined by the BMI with the proportion underweight (4%) being significantly lower than the national prevalence (12%) but similar with the regional (Nairobi) proportion (4%). The mean BMI of 24.7kg/m^2 compares closely with the national figure (23kg/m^2) for women within the reproductive age category (15-49 years). The proportion of overweight and/or obese women is

14% higher than the national figure (25%) and similar to the one reported for the former Nairobi Province (41%), presently Nairobi County (KNBS and ICF Macro, 2010). The probable reason why the proportion of overweight/obese women seems higher than the national figure may be due to the differences in sample characteristics where the KDHS sample included all women of reproductive age unlike the study sample which only included lactating women with infants aged 0-6 months. On the other hand this figure is typical of an urban area (39.8%) and differs with that of a rural area (20.1%) and this may be attributed to differences in lifestyle habits where urban women are more likely to be exposed to less diversified, unhealthy and/or poor diets often compounded with sedentary lifestyles which pre-dispose them to over-nutrition as compared to their rural counterparts.

Weight for height index is an indicator which describes recent nutritional status and may result from nutritional stress (inadequate food intake) or illness within a short period of time. Global acute malnutrition (GAM) is a combination of both moderate and severe acute malnutrition and is one of the indicators used in emergency settings to describe the severity of a humanitarian crisis. Overall, the GAM rate for the present study was 5.8% which describes a poor situation according to the 2004 Sphere project standards. This reflects a 4% reduction from the national figure (9.7%) for wasting among infants aged less than 6 months old (KNBS and ICF Macro, 2010) and this could be attributed to improved infant feeding practices including exclusive breastfeeding (82%) as reflected by this study. Height for age indicates chronic malnutrition through retarded linear growth and prolonged and continued growth deficits and as such is not a good indicator for current nutritional status. The stunting level (19.4%) is higher than the national figure of 11.2% among infants of similar age but generally lower than that of a typical urban area (26.4%). This level of stunting may reflect intra-uterine growth retardations; stunting has been previously associated with infant anemia (De Pee et al., 2002; Yang et al., 2012).

Weight for age is a composite index which encompasses the other two indices (weight for height and height for age) and therefore describes both acute and chronic malnutrition. The prevalence of underweight (2.2%) is significantly lower than both the regional (7.9%) and urban (10.3%) figures though severe underweight closely relates with the regional (1.6%) as well as that of a typical urban area (1.2%). The reduced prevalence rates of underweight may be attributed to improved exclusive breastfeeding rates as revealed by this study and sample size differences where the KDHS sample was much larger than our study sample. A recent study in rural China (Yang et al., 2012) revealed a significant relationship between child malnutrition and infant anemia where underweight, stunted and wasted children had higher risks of anemia as compared to those of normal nutritional status. Previous studies have also shown malnutrition as a risk factor for anemia among young children (Lynch et al., 2007).

As expected, BMI was significantly positively related to the nutritional status as well as the hemoglobin levels of the infants. Many studies have widely documented maternal anthropometric status as a key determinant for positive birth outcomes (Mavalankar et al., 1994; Neggers et al., 1995; Osrin and de Costello, 2000). Additionally, the women's dietary diversity score was found to have a significant positive relationship with their nutritional status though no such association was found between consumption of iron rich foods and maternal anemia. Consumption of iron rich foods was not measured quantitatively and intake of insufficient amounts may be attributed to this observation. This could also be due to the effect of inhibitory factors and/or gastrointestinal problems that affect bioavailability of iron (Conrad and Umbreit, 2000). Poor nutritional status of women has significant negative implications on work productivity, increased risk of illness, delayed recovery and poor pregnancy related complications and outcomes such as obstructed labour, low birth weight infants, reduced breast milk quality and increased morbidity due to postpartum hemorrhage (Allen, 2000). Therefore, improvement in dietary diversity of women is expected to indirectly translate to improved nutritional outcomes including biomarkers such as hemoglobin levels of infants.

5.5 Dietary Intake Patterns of the Breast Feeding Mothers

Dietary diversity for women (WDDS) is used as a proxy indicator for micronutrient adequacy of the diet. The results of this study indicate that most women consume a diet high in diversity although no significant association was found between WDDS and maternal hemoglobin. This may be attributed to deficiencies of other micronutrients such as vitamin A and riboflavin which complicate IDA (Dijkhuizen et al., 2001; Ahmed et al., 2008) and animal studies have shown that deficiency of riboflavin impairs iron absorption (Powers et al., 1988 and 1991). In addition, riboflavin has been shown to enhance iron release from ferritin (Sirivech et al., 1974; Crichton et al., 1975).

The effects of other factors (iron inhibitors, inappropriate cooking methods, and intestinal infections) have been known to have a negative impact on bioavailability of iron in the body could probably account for this. The high dietary diversity score among the mothers may be largely attributed to the proximity of the study population to the market (Kangemi) where a variety of food commodities are sold at reasonable prices. However, the nutritional status of women (BMI) seems to significantly increase with WDDS. This is expected under normal circumstances especially in most developing countries as has been evidenced by other studies (Onyango et al., 1998; Tarini et al., 1999; Gina et al., 2007; Nti, 2011). These studies have noted that increased dietary diversity is expected to translate to improved nutritional outcomes by increasing micronutrient and energy intake.

Most of the women also reported to be consuming a diet rich in heme iron which is recommended since iron bioavailability is high but no resultant positive impact was noted in terms of hemoglobin levels for both subjects. Deficiencies of other important micronutrients (riboflavin and vitamin A) have been known to affect IDA (Ahmed et al., 2003; Graham et al., 2007) especially in developing countries including resource-constrained settings (Bates et al., 1994) which could possibly explain this observation. This finding differs with what Ruel found concerning dietary diversity (food groups) being a better determinant of diet quality than just food items in isolation (Ruel, 2003). This may also be due to many factors which largely affect iron absorption.

Majority of mothers in this study had a high frequency of consumption of caffeinated beverages and low levels of consumption of iron enhancers such as Vitamin C rich fruits and this could be a possible reason of no significant impact of WDDS on maternal hemoglobin. Studies have shown that maternal diet and nutritional status has a weak/no effect on breast milk mineral content as compared to other micronutrients, particularly vitamins (Muslimatun et al., 2001; Krebs and Hambidge, 2007; American Academy of Pediatrics, 2006). In addition, some past studies have found no association of breast milk iron concentration and maternal iron stores (Celada et al., 1982). Another possible reason could be due to the fact that the current study did not take into account the quantities of the different foods consumed which may have an impact in the nutritional indicators.

5.6 Maternal and Infant Anemia

The prevalence of anemia among exclusively breastfed infants (37%) found in this study is significantly higher than what Meinzen-Derr et al., (2006) observed (24%) though the latter used a prospective study design. On the other hand, these results reflect those of a Brazilian study (Torres et al., 2006) which reported a prevalence of 8.3 to 37.5% among low income exclusively breast fed infants from 3 to 6 months. However, the said study applied two different cut-offs (Saarinen & Siimes, 1978; Brault-Dubuc et al., 1983 criteria) for diagnosis of anemia at ages 3, 4 and 5 months. Based on the two criteria, anemia prevalence varied from 18.2 to 21.5% between 3 and 6 months. The WHO 1968 standards were applied for diagnosis of anemia at 6 months. According to the WHO (2011) classification of anemia prevalence in populations, this figure is of public health significance and should be given special focus. These results also tend to be in line with what WHO (2001) Committee pointed out of the possibility that some exclusively breastfed infants could be anemic and this study supports this concern.

The observed inverse relationship between birth weight and infant anemia partially agrees with those of a similar study by Yang et al., (2009) although the latter used serum ferritin as an indicator for both iron deficiency and iron deficiency anemia. However, these results tend to differ with those of Meinzen-Derr et al., (2006) who found no significant associations among infant gender, birth weight and maternal education. Other studies (Soh et al., 2004; Dewey et al., 1998) also showed that higher birth weight (>3000g) was associated with reduced risk of iron deficiency among exclusively breastfed infants. Since hemoglobin level used in this study is a late indicator of iron deficiency, prevalence of iron deficiency cannot be ruled out and might be even worse.

Yang et al., (2009) found that male infants had an increased relative risk of anemia than their female counterparts. The present study found vice versa where the male infants had 15% lower risk as compared to the females. The significant relationship between maternal hemoglobin and hemoglobin levels of the infants is similar to what Yang and others found out in 2009 though the risk was slightly higher (3 fold) compared to two fold among anemic mothers. Similar observations on maternal and infant anemia were made in an Indonesian study (De Pee et al., 2002). Moreover, these findings agree with those of a Brazilian study, (Teixeira et al., 2010), which noted that among other factors, maternal hemoglobin and birth weight were significant in relation to hemoglobin levels of infants. However, these findings tend to strongly differ with those of other researchers, (Shashi et al., 2008; Eneroth, 2011), who found no evidence of anemia among exclusively breastfed infants. Hemoglobin levels of infants had a significant correlation with their age as they seemed to decrease with age. This trend is expected as iron reserves decline with age and for breastfeeding infants, the breast milk iron content follows a similar trend.

Approximately a third of the mothers were anemic with those who were mildly anemic falling within a category recognized to be of public health importance according to the WHO (2011) classifications. The lack of association was between maternal anemia and IFAs intake during their last pregnancy could possibly be explained by findings of a Chinese study which showed that a combination of iron and folic acid and other supplements (retinol and riboflavin) has a greater impact in reduction of anemia among pregnant women than just iron/folic acid alone (Ma et al., 2008). According to the same study, other micronutrient deficiencies may worsen the anemia prevalence and therefore probably dilute and/or reduce the effect of iron/folic acid supplementation. The said study also revealed better outcomes of iron supplementation with

NaFeEDTA than ferrous sulphate among anemic pregnant Chinese women. The fact that IFA supplements were taken during mother's last pregnancy and iron depletion may have occurred during and after delivery may also be a contributing factor to the present observation.

Studies have indicated increased risk of negative birth outcomes among anemic pregnant mothers as compared to those with normal hemoglobin levels (Umber et al., 2007; Agarwal et al., 2013). Given the significant association and relationship of maternal hemoglobin status with that of the infant, this warrants more serious consideration. A US based study (Chantry et al., 2007) designed to examine the risk of iron deficiency associated with longer duration of EBF recommended the need to prevent and control iron deficiency in pre-pregnancy state of reproductive age women. A similar recommendation was given by Teixeira et al., (2010) that maternal anemia should not only be prevented during pre-conception but also during pregnancy as well as the entire lactation period. Furthermore, the CDC has previously pointed out the increasing trend of iron deficiency among women of this age group and therefore this issue should be given special attention (CDC, 2000).

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Given the study findings and in line with study objectives, the following conclusions are made:

1. The prevalence of anemia among infants 0-6 months old including those on EBF is of moderate public health significance while that of their lactating mothers is of mild public health importance. In addition, maternal nutritional status, hemoglobin status and amount of household income spent on food are significant predictors of anemia in infants.

2. Maternal dietary patterns and infant feeding practices had no impact on infant anemia. There was poor consumption pattern of foods that enhance iron bioavailability in the body. On the other hand, though modest, women's dietary diversity score had a significant positive correlation with the maternal nutritional status which subsequently impacts positively on both the nutritional status as well as hemoglobin levels of the infants. The risk of anemia was lower among infants on mixed feeding as compared to those on exclusive breastfeeding probably because these could be receiving additional iron from iron fortified infant formula foods as has been indicated elsewhere (Luo et al., 2014).

3. IFAs intake pattern of the lactating mothers during their last pregnancy was generally poor and below the recommended threshold. This could be largely attributed to poor adherence rates as revealed by similar studies in Kenya (Dinga, 2013). However, this had no impact on maternal hemoglobin levels which means that IFAs intake during pregnancy may not sustain normal hemoglobin levels after delivery and during lactation.

4. Maternal anemia status and nutritional status (BMI) are associated with anemia status of the breastfeeding infants.

6.2 Recommendations

The following recommendations are made in line with study objectives:

1. A review of the global policy on infant and young child feeding with special focus on low income households. Further research to be conducted on the issue in question using different study designs (longitudinal) in support of this review.

2. A more detailed dietary intake assessment to be conducted among lactating mothers with special focus on micronutrient intake levels such as iron, Vitamin A and riboflavin to clearly determine the actual amounts taken and the relationships with the maternal and infant hemoglobin levels.

3. Regular sensitization of pregnant mothers on the importance of adherence to iron/folic acid supplements during pregnancy and education on anemia, its effects during pregnancy as well as birth outcomes.

4. Iron supplementation to lactating mothers should be considered to maintain normal maternal hemoglobin levels post partum.

Overall, the benefits of EBF for six months should further be assessed and weighed against the potential risks especially with regard to anemia.

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APPENDICES

Appendix 1: Study Questionnaire

ANEMIA AMONG BREASTFEEDING INFANTS 0-6 MONTHS AT KANGEMI SLUMS, NAIROBI

Questionnaire No: ____________________ Household number ____________________
Date: ___/____/____ (Day/Month/Year)
Name of interviewer: ____________________
Location: ___________________
Sub-location: ____________________
Village: _________________________

Household profile: monogamous_________ polygamous________ single parent________

SECTION A: HOUSEHOLD SOCIO-DEMOGRAPHIC PROFILE

No.	Name (first name only)	Age(yrs)	Sex	Marital Status	R/ship to HH Head	Education Level	Occupation	Contribution to HH Income
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Sex	**Marital Status**	**Rel./HHH**	**Education level**	**Occupation**	**Contribution to HH**
1=male 2=female	1=married 2=separated 3=widowed 4=single 5=divorced 6=N/A	1=HHH 2=spouse/wife 3=son/daughter 4=relative 5=parent 6=others(specify)	0=none 1=in primary 2=in secondary 3= completed primary 4=primary drop out 5=completed secondary 6=secondary drop out 7=college/university 8=N/A (age<6 yrs)	1=formal employment 2=business 3=farming 4=casual labour 5=unemployed 6=student 7=N/A (age<15 yrs) 8=others (specify)	1=nothing 2=money 3=labour 4=childcare 5=less than 15 years 6=savings 7=pension 8=others (specify)

Q2. What is your household's main source of income (livelihood)?

1=animal and animal product sales 2=casual labour 3=salaried or waged 4= begging 5=gifts 6=petty trade

7=crop sales 8=remittances 9= others (specify) ________________________________

Q3. What is your household's total income in the last one month? Ksh___________________

Q4. How much of this income was spent on food? Ksh__________________________

Q5. What is your house ownership type? 1=owned 2=rented 3= other (specify)____________

SECTION B: Qn 6: 24 HOUR DIETARY DIVERSITY-FOR THE BREAST FEEDING MOTHER

QNo.	FOOD GROUP	EXAMPLE	1 = Yes 0=No
1.	Cereals	Maize, wheat, rice, millet, sorghum and any other grains or foods made from these (e.g. bread, spaghetti, noodles, porridge, ugali, muthokoi/ githeri	
2.	Roots and tubers	Irish potatoes, yams, cassava, or other foods made from these (e.g. chips/French fries,	
3.	Vitamin A rich vegetables and tubers	Pumpkin, carrots, squash, orange-fleshed sweet potato, other locally available vitamin A vegetables e.g. red sweet pepper,	
4.	Dark green-leafy vegetables	Dark green-leafy vegetables including wild forms and locally available vitamin A rich leaves such as amaranth, cassava leaves, kales, spinach e.t.c	
5.	Other vegetables	Other vegetables e.g. tomato, onion, egg plant, green bananas and any other locally available vegetable	
6.	Vitamin A rich fruits	Ripe mango, apricots, ripe pawpaw, ripe banana, avocado, 100% fruit juice and any other locally available vitamin A rich fruits	
7.	Other fruits	Including wild fruits, 100% fruit juice made from this.	
8.	Organ meat (iron-rich)	Liver, kidney, heart and other organ meats and blood-based foods.	
9.	Flesh meats	Beef, pork, lamb, goat, rabbit, game, chicken, duck, other birds and insects.	
10.	Eggs	From chicken, duck, guinea fowl or any other eggs.	
11.	Fish and sea food	Fresh or dried fish	
12.	Legumes, nuts and seeds	Dried beans, dried peas, lentils, nuts, green grams, or food made from these e.g. peanut butter	
13.	Milk and milk products	Milk, cheese, mala, yogurt.	
14.	Oils and fats	Oils, fats, margarine or butter added to foods or used for cooking	
15.	Sweets	Sugar, honey, sweetened soda, sugar cane sweetened juice drinks, sugary foods such as chocolate, candies, cookies and cakes,	
16.	Spices, condiments, beverages	Spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, fermented beverages.	

Qn7: FOOD FREQUENCY

How often do you consume the following foods?

Foods	Never	Rare	< 1 per week	Weekly Frequency							
				0	1	2	3	4	5	6	7
Whole cereals											
Maize											
Sorghum											
Rice											
Wheat											
Finger millet											
Mixed flours											
Dark green leafy vegetables											
Spinach											
Kales											
Cowpeas leaves/kunde											
Managu											
Amaranthus leaves											
Pumpkin leaves											
Citrus fruits											
Oranges											
Lemons											
Lime											
Guavas											
Milk and other fermented products											
Milk											
Yoghurt											
Mala											

Foods	Never	Rare	< 1 week	Weekly frequency							
Fermented flours/porridges											
Animal products											
Eggs											
Organ meats(liver, kidneys, etc)											
red meat(beef, goat etc)											
Fish											
Chicken											
Omena											
Legumes											
Pigeon peas											
Peas											
Kidney beans											
Soy beans											
Cowpeas											
Tea, coffee, cocoa, chocolate, soya											

Q8. Do you take some beverage such as tea, coffee, cocoa etc during and/or after meals? 1=Yes 2=No

Q9.If yes, after how long do you take such beverages after meals?

0=takes together with meals 1=30 minutes or less 2= after 1 hour 3=more than 1 hour

SECTION C: MOTHER'S INFORMATION

Q10. Who is the primary care giver of the child? (Relationship to the child) 1=mother 2=grandmother 3=older sibling 4=house help 5=others (specify) ___________________________

Qn11. Age of the mother________________ (Years)

Qn12. Level of education of mother?

0= None
1= Not completed primary
2= Completed Primary
3= Not completed Secondary
4=Completed Secondary
5= College/Diploma/Degree

Mother's Pregnancy history

Qn13a.Total No. of pregnancies_________________13b. Number born alive__________________

Qn14. During your last pregnancy, did you have any food avoidances/cravings? 1=yes 2=No

Qn15. If yes, which ones: food avoidances/aversion (list them)

i. ______________________
ii. ______________________
iii. ______________________
iv. ______________________

Food cravings (list them)

i. _____________________
ii. _____________________
iii. _____________________
iv. _____________________

Qn16. Did you attend ANC during your last pregnancy? 1=Yes 2=No (if No skip to qn 23)

Qn17. If yes, at what gestational age did you start attending ANC clinic? _________(weeks/months)

Qn18. How many times did you attend these visits? 1= once 2=twice 3=thrice 4=times or more

Qn19. During these visits, was your anemia status checked? (May be through Hb measurement) 1=Yes 2=No

Qn20. If yes, how was it? (*Please verify this from the mother-child booklet information)* 1=normal 2=not normal 3=not done/do not know

Qn21. Were you given any Iron/folic acid supplements? 1=Yes 2=No

Qn22. If yes, for how many days? _________________________

Qn23.Where did you deliver this baby? 1=health facility 2=at home 3=any other (specify) __________________

Qn24. During this delivery, who attended you? 1=doctor 2=nurse 3=TBA/mid-wife 4=others (specify) __________

Qn25.Were you given any Vitamin A supplements post-partum? 1=yes 2=No

Qn26. Do you have a mosquito net? 1= Yes 2=No (if no skip to Qn28)

Qn27. If yes, did you (including the child) sleep under that net? 1= Yes 2=No

Qn28.What is your opinion on Exclusive breastfeeding for the first 6 months and infant anemia?

....

SECTION D: CHILD'S INFORMATION

Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41
Child No.	Child's name	Child Sex 1=male 2=female	Child's Date of Birth (Use Clinic Cards and Calendar of events (d/m/y)	Birth weight (kg)	Age of child in <u>months</u> (Use Clinic Cards or Calendar of events	How long after birth did you first put the child to the breast 1 = Within one hour 2 = In first day (within 24 hours) 3 = After first day (>24 hours)	Did you feed your child with fluid or liquid that came from breasts in the first 3 days after birth (Colostrum) 1 = Yes 2= No	Exclusive breast feeding: Other than breast milk, what other Foods /fluids are you giving the child? 1 =None other than breast milk 2=Powder/animal milk/yogurt 3 = Cereals based diet 4 = Plain water 5 = Fruit Juice 6=Sugar water 7 = Vegetables	How long have you exclusively breast fed? (*ask only if answer =1 to Qn 37*)	At what age did you start giving the child these foods/fluids? (months)	Is the child taking any supplements? 1=yes 2=No	If yes, which ones?(*list them)*

IMMUNIZATION STATUS-(*Please ask the mother for the clinic card/mother-child booklet and fill appropriately)*

Q42	Q43	Q44	Q45	Q46	Q47	Q48	Q49	Q50
Has......received BCG? **1**=Yes, Card **2**=Yes, recall **3**=No **4**=DNK	Has....received OPV0? (polio) **1**=Yes, Card **2**=Yes, recall **3**=No **4**=DNK	Has.....received OPV1? (polio) **1**=Yes, Card **2**=Yes, recall **3**=No **4**=DNK	Has......received OPV2? (polio) **1**=Yes, Card **2**=Yes, recall **3**=No **4**=DNK	Has....received OPV3? (polio) **1**=Yes, Card **2**=Yes, recall **3**=No **4**=DNK	Has....received DPT 1? **1**=Yes, Card **2**=Yes, recall **3**=No **4**=DNK	Has...received DPT 2? **1**=Card **2**=Yes, recall **3**=No **4**=DNK	Has...received DPT 3? **1**=Yes, Card **2**=Yes, recall **3**=No **4**=DNK	Fully immunized for age? 1=Yes 2=No

	Anthropometry and Determination of Iron Deficiency Anemia								
	Q51 **Weight in Kgs (Nearest 0.1kg)**			Q52 **Height/length in cm (Nearest 0.1cm)**			Q53**Bilateral oedema (both feet)**	Q54 **Clinical Assessment**	Q55 **Biochemical Assessment-Hb (g/dl)**
Name of subject	wt1	wt2	av.	h1	h2	av.	1=present 2=absent	Clinical signs (anemia) 0) No signs 1) Pallor in the eyelids, tongue, palms 2) Nail changes (flatness, softness to feel, spoon shaped) 3) Fatigue 4) Fissure at corner of mouth 5) Irritability 6) Short attention span, poor alertness	
Infant									
Mother									

Appendix 2: Informed Consent Form

Study Name: ***Anemia among Breastfeeding Infants 0-6 Months at Kangemi Slums, Nairobi***

Purpose of the research

The purpose of the proposed study is to provide information relevant in guiding the feeding of infants 0-6 months alongside ensuring that they wholly benefit from breast milk without running the risk of being anemic as has been evidenced by some studies. The main objective of this study, therefore, is to determine the potential prevalence of, and factors associated with anemia among breastfeeding infants (0-6months) in Kangemi slums, Nairobi.

Procedure

Upon your consent, both of you will be weighed and your height/length taken by a team of trained research assistants (RAs). In addition, both of you will be assessed for anemia through finger prick where a small amount of blood will be drawn and the hemoglobin level determined. The procedure is rapid and results are instant. You will also be interviewed on some areas such as socio-demographic characteristics, breastfeeding information, your last pregnancy history, dietary intake, morbidity experience (child) and immunization status of your child.

Your part in the research

You are requested to co-operate in this study by answering the questions in the questionnaire and providing any other information as pertains to the study. You are requested to be as honest as possible and the information collected will be treated with utmost confidentiality.

Possible benefits

It is my expectation that the study will be of benefit to you in terms of knowing your health and nutritional status including anemia status of your child. It is also expected to benefit your community in terms of knowledge on anemia, health status of mothers and infants and therefore provide information useful in guiding any interventions that may be appropriate to tackle the existing health and nutritional problems.

Possible Risks

There are no foreseen risks associated with the study. The measurements of height and weight do not pose any risk to you. However, the finger prick will involve a slight pain which dies off in a short period of time. Due care will be exercised during taking of the anthropometric measurements including the haemoglobin measurement.

Compensation

Your participation is voluntary and therefore, you will not receive any form of compensation. This also applies to the children participants.

Your Rights as a participant

This study is protected and approved by human ethics committee (KNH/UoN). In the event that you feel that you do not want to participate in this study you are free to do so without losing any benefits or entitlements (if any) that may/not have been specified earlier.

If you have any questions about your rights as a research participant, please contact: The Secretary, KNH/UoN Ethics Review Committee on P.O. BOX 1976/20723-00202 Nairobi, Kenya or Tel 254-020-2726300 Ext 44355 or Email: uonknh_erc@uonbi.ac.ke or by accessing their website at http://www.uonbi.ac.ke/activities/KNHUoN.

Volunteer Agreement

I have read the consent form describing benefits, risks and procedures for **"*Anemia among Breastfeeding Infants 0-6 Months at Kangemi Slums, Nairobi, Kenya.*"**

I voluntarily agree to participate.

Signature..   Date…………/…………/2013

Thumb print (*if participant cannot write***)..**

<u>For official use only</u>

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

Signature ………………………………………   Date………………………..

Appendix 3: Child Assent Form

Since the child cannot concede (below 18 years), this form must be filled by the mother alongside the informed consent form up on agreeing to participate in the study.

Study Name: ***Anemia among Breastfeeding Infants 0-6 Months at Kangemi Slums, Nairobi***

Purpose of the research

The purpose of the proposed study is to provide information relevant in guiding the feeding of infants 0-6 months alongside ensuring that they wholly benefit from breast milk without running the risk of being anemic as has been evidenced by some studies. The main objective of this study, therefore, is to determine the potential prevalence of, and factors associated with anemia among breastfeeding infants (0-6months) in Kangemi slums, Nairobi.

Procedure

Upon your consent, both of you will be weighed and your height/length taken by a team of trained research assistants (RAs). In addition, both of you will be assessed for anemia through finger prick where a small amount of blood will be drawn and the hemoglobin level determined. The procedure is rapid and results are instant. You will also be interviewed on some areas such as socio-demographic characteristics, breastfeeding information, your last pregnancy history, dietary intake, morbidity experience (child) and immunization status of your child.

Your Child's part in the research

On behalf of the child, you are requested to co-operate in this study by answering the questions in the questionnaire and providing any other information as pertains to the study. You are requested to be as honest as possible and the information collected will be treated with utmost confidentiality.

Possible benefits

It is my expectation that the study will be of benefit to you and your child in terms of knowing your health and nutritional status including anemia status of the child. It is also expected to benefit your community in terms of knowledge on anemia, health status of mothers and infants and therefore provide information useful in guiding any interventions that may be appropriate to tackle the existing health and nutritional problems.

Possible Risks

There are no foreseen risks associated with the study. The measurements of height/length and weight do not pose any risk to you or your child. However, the finger prick will involve a slight pain which dies off in a short period of time. Due care will be exercised during taking of the anthropometric measurements including the haemoglobin measurement.

Compensation

Your child's participation is voluntary and therefore, he/she will not receive any form of compensation.

Your Child's Rights as a participant

This study is protected and approved by human ethics committee (KNH/UoN). In the event that you feel he/she should not participate in this study he/she is free to do so without losing any benefits or entitlements (if any) that may/may not have been specified earlier.

If you have any questions about your rights as a research participant, please contact: The Secretary, KNH/UoN Ethics Review Committee on P.O. BOX 1976/20723 - 00202 Nairobi, Kenya or Tel 254-020-2726300 Ext 44355 or Email: uonknh_erc@uonbi.ac.ke or by accessing their website at http://www.uonbi.ac.ke/activities/KNHUoN.

Volunteer Agreement

I/ my guardian/mother has read the consent form describing benefits, risks and procedures for ***Anemia among Breastfeeding Infants 0-6 Months at Kangemi Slums, Nairobi***

I voluntarily agree to participate (*on behalf of child*).

Signature (mother/guardian)...

Thumb print (*If the participant cannot write***)..**

Date…………/…………/2013

<u>For official use only</u>

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

Signature ………………………………………   Date………………………..

Appendix 4: Training Package

DAY/TIME	TOPIC	TEACHING METHOD	TEACHING AIDS	MODERATOR
DAY ONE **8.30-10.30AM**	Work shop norms Introduction Study objectives, aim & purpose Activity matrix for data collection Code of ethics and conduct Sampling	Discussion Brainstorm Lecture Brainstorm, lecture	Flip charts, markers	Principal investigator (PI)
10.30-11.00AM	**TEA BREAK**			
11.00-12.30AM	Study tools -go through the main tool (Questionnaire) Translations of questions	Discussion	Flip chart Markers Sample questionnaires Pencils, sharpeners, erasers, clip boards	PI
1.00-2.00PM	**LUNCH BREAK**			
2.00-3.00PM	Go through the main tool-question by question Translations into Swahili, or some other language as appropriate	Discussion	Flip chart Markers Sample questionnaires Pencils, sharpeners, erasers, clip boards	PI
3.00-4.00PM	Practice taking measurements of height, weight,	Demonstrations Hand out	Height board, bathroom scales	PI

	Familiarize the team with Hb test kit			
DAY TWO **8.00-10AM**	Final practice in accurate taking of measurements	Demonstrations, role play	Height board, bathroom scales,	PI
10.00-1.00PM	Pre-test questionnaire	Field exercise at Kikuyu	Questionnaires, height boards, bathroom scales, stationery	PI
1.00-2.00pm	**LUNCH BREAK**			
2.00-3.30PM	Meeting with team, debriefing, reviewing questionnaires and materials	Discussions, sharing of experiences	Flip charts, marker pens, pre-tested questionnaires	PI
3.30-4.00PM	**TEA BREAK**			
4.00PM	**DEPARTURE**			

Appendix 5: Ethical approval

KENYATTA NATIONAL HOSPITAL
APPROVED
10 OCT 2013
ETHICS & RESEARCH COMMITTEE

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
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P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/303

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

10th October 2013

James K. Gacheru
Dept.of Food Science, Nutrition & Technology
University of Nairobi

Dear James

RESEARCH PROPOSAL: ANAEMIA AMONG BREASTFEEDING INFANTS 0-6 MONTHS AT KANGEMI SLUMS, NAIROBI, KENYA(P383/07/2013)

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 10th October 2013 to 9th October 2014.

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"