FACTORS AFFECTING THE IRON STATUS OF 15-49 YEARS LACTATING AND NON-LACTATING MOTHERS IN MAKONGENI THIKA DISTRICT, KENYA.

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A THESIS SUBMITTED IN PARTIAL FULFILMENT FOR THE DEGREE OF MASTER OF SCIENCE IN FOODS, NUTRITION AND DIETETICS, KENYATTA UNIVERSITY.

AUGUST 2007

DECLARATION

This thesis is my original work and has not been presented for a degree in any other University or any other award.

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We confirm that the work reported in this thesis was carried out by the candidate under our supervision.

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DEDICATION

To my sons Muturi, Nyoro, Ndung'u, Kariuki and Munga.

ACKNOWLEDGEMENTS

This Masters Thesis was first made through consultations with Dr. Judith Kimiywe and Prof. Judith Waudo to whom I owe a lot of gratitude for their continuous support through my course work at Kenyatta University. I am greatly indebted to them for their most valuable support.

I also would like to register my gratitude to Dr. Joseph Ng'ang'a Murega, his team and the respondents for making it possible and enjoyable to carry out the research work in Uzima Care Medical centre; the staff of UNICEF, WHO, AMREF and Kenyatta University library for the great support they accorded to me during the study.

Special thanks go to the Government of Kenya through the Ministry of Agriculture for granting me study leave to pursue the Masters Programme at Kenyatta University.

Last, but not least, I greatly appreciate the continuous moral support by my family and friends, which kept me going strong in confidence and high aspirations. Thanks to my children who accepted the responsibility of typing the thesis and Mr. Mairura and Toure for guidance in data analysis.

MAY GOD BLESS YOU ALL!.

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ABBREVIATIONS

AMREF	-African Medical Research Foundation
ASL	- Above Sea Level
CBS	-Central Bureau of Statistics
CHO	-Carbohydrates
dl	-decilitre
FAO	-Food and Agriculture Organisation
g	-gram
GOK	-Government Of Kenya
Hb	-Haemoglobin
IDA	- Iron deficiency anaemia
Kcal	-Kilocalories
KDHS	-Kenya Demographic and Health Survey
Kshs	-Kenya shillings
MICS	-Multiple Indicator Cluster Survey
MOH	-Ministry Of Health
NAS	-National Academy of Sciences
P-value	-Probability value (level of significance)
RDA	-Recommended daily Allowances
SD	-Standard deviation
sTfR	-Serum transferrin
SPSS	-Statistical Package for social sciences
UNHCR	-United Nations High Commission for refugees
UNICEF	-United Nation Childrens Fund
WFP	-World Food Programme
WHO	-World Health Organisation

ABSTRACT

Iron deficiency is one of the most prevalent nutrient deficiencies in the world, affecting an estimated two billion people. Iron deficiency anaemia causes maternal deaths, decreased physical work and earning capacity, low birth weight and serious cognitive and psychomotor development in infants and children. In general, the 1999 national micro-nutrient survey found out that the prevalence of anaemia among the non- pregnant mothers was quite high in Kenya and in some clusters nearly half (41-50%) of the mothers were anaemic due to iron deficiency.Unfortunately,Thika was not included in this study. This study aimed to investigate the factors affecting the iron status of lactating and non-lactating mothers in Makongeni, Thika District.The objectives of the study were: -to establish haemoglobin levels of lactating and non-lactating mothers, to establish dietary iron intake of lactating and non-lactating mothers, to determine the factors that affect intake of dietary iron among lactating and non-lactating mothers, and to determine the relationship between the haemoglobin level and dietary iron intake of lactating and non-lactating mothers. The study was carried out in Thika district at Uzima Care Medical centre,a peri-urban area in Makongeni estate of Thika Town. The study targeted one hundred lactating and one hundred non-lactating mothers. Socio-demographic, food security, food preparation and consumption patterns, health and sanitation and biochemical data were collected. This was a descriptive cross-sectional survey and an interview schedule was used to collect data including biochemical data on haemoglobin. Data were analysed using SPSS version 11.5, MS Excel and dietary analysis software (Food metres UK 7) for nutrient composition. The 24hr dietary recall and food frequency was used to determine the dietary iron intake. A cut-off of <7g/dl as severe anaemia, 7-10.9g/dl as moderate anaemia, 10.8-11.9g/dl as mild anaemia and 12-16g/dl as normal was used to categorise the haemoglobin levels.The diets of the respondents consisted of plant foods and less intake of animal protein. Iron was significantly related to all vitamins, with the strongest correlation being thiamine(r=0.833, p<0.01). The weakest correlation for iron was carotene (r= 034, p<0.01). Iron indicated a positive significant correlation with most minerals, including calcium (r=0.341, p<0.01, zinc (r= 0.785, p<0.01), and selenium (r=0.503, P<0.05). Copper relationships were not significant. The study revealed that lactating mothers had haemoglobin levels ranging from 7-14 g/dl, while the non-lactating mothers had 9-15 g/dl. On average, lactating mothers had a lower mean (12.1 +1.1g /dl) than non-lactating mothers (12.4 +1.1g/dl. From the findings 25% had mild anaemia (10.9-11.9g/dl) and 8.5% had moderate anaemia (7-10.8g/dl). Mild anaemia (33%), moderate anaemia (17 %), and severe anaemia (1%) was prevalent in the lactating mothers, as compared to 29% mild anaemia and 15% moderate anaemia in non-lactating mothers after altitude adjustment at a calculated factor 0.5 for Thika altitude (1700m ASL). In the past, nutritional studies have placed emphasis on rural population only. An increasing proportion of the population now lives in peri-urban and urban areas and it is important to recognise the critical health care requirements of people living in these settings. The present study, therefore emphasizes the need for a comprehensive intervention strategy, which should include both the nutritional and health strategies to improve the iron status of the population.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND INFORMATION

Iron deficiency anaemia is a problem of serious public significance, given its impact on psychological and physical development, behaviour and work performance. It is the most prevalent nutritional problem in the world today, affecting more than 2 billion people which is about 30% of the world's population. These people are anemic, many due to iron deficiency, and in resource-poor areas, this is frequently exacerbated by infectious diseases. Malaria, HIV/AIDS, hookworm infestation, schistosomiasis, and other infections such as tuberculosis are particularly important factors contributing to the high prevalence of anaemia in some areas (Kilbride et al, 1999; WHO, 2002; WHO, 2007; DeMaeyer, 1989). Iron deficiency affects more people than any other condition, constituting a public health condition of epidemic proportions. More subtle in its manifestations than, for example, protein-energy malnutrition, iron deficiency exacts its heaviest overall toll in terms of ill-health, premature death and lost earnings. Iron deficiency and anemia reduce the work capacity of individuals and entire populations, bringing serious economic consequences and obstacles to national development (WHO, 2007).

Overall, it is the most vulnerable, the poorest and the least educated that are disproportionately affected by iron deficiency, and it is they who stand to gain the most by its reduction. Invisible yet ubiquitous in many developing countries, the true toll of iron deficiency and anaemia lies hidden in the statistics of overall death rates, maternal haemorrhage, and lowered productivity. Iron deficiency anaemia affects millions. The health consequences are stealthy but devastating, invisibly eroding the development potential of individuals, societies and national economies. This need not be so. We not only know the causes; we also have solutions that are both inexpensive and effective (WHO, 2007). Iron deficiency to a great extent is caused by poor iron absorption from the diet. Several dietary factors can influence this absorption. Absorption enhancing factors are ascorbic acid and meat, fish and poultry; inhibiting factors are plant components in vegetables, tea and coffee (e.g., polyphenols, phytates), and calcium (WHO, 2002). This insufficiency may also be due to inadequate iron intake or to chronic blood loss that leads to iron deficiency anaemia (WHO, 1995). This insufficiency could also be due to inadequate folic acid, Vitamin A, & B12 and zinc intake. Other causes are increased demands from many frequent pregnancies, increased losses from hookworm infestation, increased destruction and dyserythropoiesis from malaria and the haemoglobinopathies (Lassey, Kluflo, Annan, Wilson, 1999; Tatala, Ash, Makola, Latham, Ndosi, Grohn, 2002). Iron deficiency has its roots in the seasonal variation, social economic cycle, as most of such people are semi-illiterate with no regular income (Tatala et al, 2002; Kafwembe, 2001).

During the reproductive cycle, continuous depletion of iron has negative effects on mothers and infants. Studies have shown that even non-pregnant women are vulnerable to iron deficiency anaemia equally as the highly studied preschool children and pregnant mothers. Minimal information exists on the iron status of lactating and non-lactating mothers. Mothers need to eat quality diets rich in iron for their ability to enter pregnancy with enough stores of iron, sustain the foetus, and have successful delivery and lactation. Very little research work on iron status has been done in many pockets of Kenya therefore a thorough understanding of iron status of the lactating and non-lactating mothers is needed.

According to literature, in Kenya the exact magnitude and distribution of iron deficiency in many pockets of the country with Thika included, is not known. There was therefore need to study iron status of lactating and non-lactating mothers to establish their status. Eating habits have drastically changed especially in urban areas. Many adults go without major meals and may even eat one meal per day, which may not be properly balanced. This has been aggravated by increased poverty levels, which stands at a level of 48.4% for Thika (MOH, 2003), unreliable rainfall, drought and high prices of foodstuffs in the markets (Mukui, 2000). In view of these facts this study aimed at investigating the iron status of the lactating and non-lactating mothers.

1.2 STATEMENT OF THE PROBLEM

In Kenya, not much has been done at community level on iron deficiency anaemia though many surveys have been done on general nutritional status of the populations. Most studies on IDA have been conducted for the so called vulnerable groups of children, adolescents and pregnant mothers. Non-pregnant mothers have been less studied. According to studies the incidence of anaemia varies greatly in different parts of Kenya with some parts severely affected. Severe iron deficiency results in anaemia that can lead to reduced work performance (Agarwal, 2001; Kafwembe, 2001; Kilbride et al; 2000; Agyei, et al; 2001; Tatala et al; 2002). Severe anaemia lowers resistance to diseases and may cause death directly. For example, anaemic women have cardiopulmonary complications and do not tolerate blood loss as well as healthy mothers.

In general, the 1999 National Micro-nutrient survey found out that the prevalence of anaemia among the non- pregnant mothers was quite high and in some clusters nearly half (41-50%) of the mothers were anaemic due to iron deficiency (Micro-nutrient Survey,1999). Unfortunately Thika was not included in this study and therefore such a study was necessary to determine the iron status of mothers. According to Thika District Health Services Annual Report of year 2003 a high burden for anaemia was reported and was ranked number eleven among diseases causing morbidity and the same trend was observed in the year 2004 (MOH, 2004). The study therefore sought to establish iron status of the lactating and non-lactating mothers (15-49 years) at Uzima Care Medical Centre at Makongeni, Thika.

1.3 PURPOSE OF THE STUDY

The purpose of the study was to investigate the iron status of the lactating and the non-lactating mothers at Uzima Care Medical Centre in Makongeni, Thika.

1.4 OBJECTIVES

1. To determine factors including health related factors that affect intake of dietary iron among lactating and non-lactating mothers attending Uzima Medical Care centre in Makongeni.

2. To establish the dietary iron intake of lactating and non- lactating mothers attending Uzima Medical Care centre in Makongeni.

3 To establish the haemoglobin levels of lactating and non- lactating mothers attending Uzima Medical Care centre in Makongeni.

4 To determine the relationship between the haemoglobin levels and dietary iron intake status of lactating and non- lactating mothers attending Uzima Medical Care centre in Makongeni.

1.5 HYPOTHESES:

1. There is no significant relationship between the haemoglobin levels and the dietary iron intake of lactating and non-lactating mothers.
2. There is no significant difference in haemoglobin levels of the lactating and non-lactating mothers.

1.6 RATIONALE OF THE STUDY

According to the Thika District Health Services Annual report for year 2003, in-patient morbidity due to anaemia were 294 cases at Thika district hospital reflecting a high burden for anaemia (MOH, 2003). According to the curative services laboratory report the haemoglobin estimations for anaemia for year 2003 were 8806 cases with 14% cases having haemoglobin levels below 7g/dl, as compared to 6253 cases in year 2002. In year 2004 ,12% of the cases had haemoglobin levels below 7g/dl (MOH,2004).

From the aforementioned account, a study on iron deficiency anaemia in reproductive (15-49 years) age mothers was justified so that awareness on the status can be created.

1.7 SIGNIFICANCE OF THE STUDY

The results of the study will benefit the various health related organizations, such as the Ministry of Health, private health clinics, Ministry of Agriculture, policy makers and non–governmental organizations involved in the eradication of iron deficiency anaemia in Kenya. The results will also benefit organizations such as community based organizations involved in nutrition education, in planning intervention programmes that help mothers understand causes, effects, consequences, and solutions to iron deficiency anaemia. The study will immediately contribute to the existing knowledge regarding iron deficiency anaemia among this age group.

1.8 LIMITATION OF THE STUDY

The study was a descriptive cross sectional survey on women in reproductive age attending health clinic at Uzima care Medical Centre, therefore findings to a similar population in other parts of Kenya and the world should be generalized with caution.

1.9 OPERATIONAL DEFINITIONS

Iron rich diet: Diet containing at least one food whose iron content is 1mg/100 gm portion or more taken at least once a day.

Anaemic: Non-pregnant mothers whose haemoglobin levels were <12g/dl as defined by WHO for the group.

Anaemia: Is a condition where there are too few or small immature red blood cells with low haemoglobin due to slowed production or accelerated destruction of red blood cells.

Iron status: The haemoglobin level of the mothers because it has a direct relationship with dietary intake of iron.

Dietary iron intake: The types of iron rich foods the mothers eat.

Lactating: Those mothers who are currently breastfeeding.

Non-lactating: These are mothers who are not breastfeeding but are in the reproductive age bracket (non-pregnant).

Bioavailability: The extent to which a nutrient is capable of being absorbed or utilized within the body.

Enhancer: Substances that promote the absorption and bioavailability of micro-nutrients such as vitamin C in iron, especially non-haem iron.

Fortification: The addition of one or more nutrients to commonly eaten foods, with the aim of increasing the level of consumption of the added nutrients inorder to improve the nutritional status of a given population.

Inhibitor: Are anti-nutrients, which bind and form insoluble compounds with micro-nurients hindering absorption and thus making these micro-nutrients unavailable for use in the body. Examples are phytates, oxalates and tannins.

Metabolism: All the chemicals and biological processes by which body cells use nutrients to support life.

Micronutrients-A natural or synthesized vitamin, mineral or trace element required in the body in small amounts that is essential for normal growth, development and maintenance of life and whose deficiency will cause characteristic biochemical or physical changes.

Morbidity: Is the prescence of disease or the relative frequency of the occurrence of a particular disease in a particular area.

Mortality: Is the number of deaths that occur in a given place, group and at a given time.

Supplementation: Provision of a specified dose of nutrient preparation which may be inform of a tablet, capsule, oil solutions or modified food, for either treating an identified deficiency or prevention of the occurrence of such deficiency in an individual or a community.

High –risk groups: Refers to the nutritionally vulnerable groups, such as children less than five years and women of childbearing age due to their higher levels of micro-nutrient requirements for rapid growth and building of new cells.

2.0 ASSUMPTIONS OF THE STUDY

Lactating and non-lactating mothers did not differ in terms of socio-economic and socio-cultural practices.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

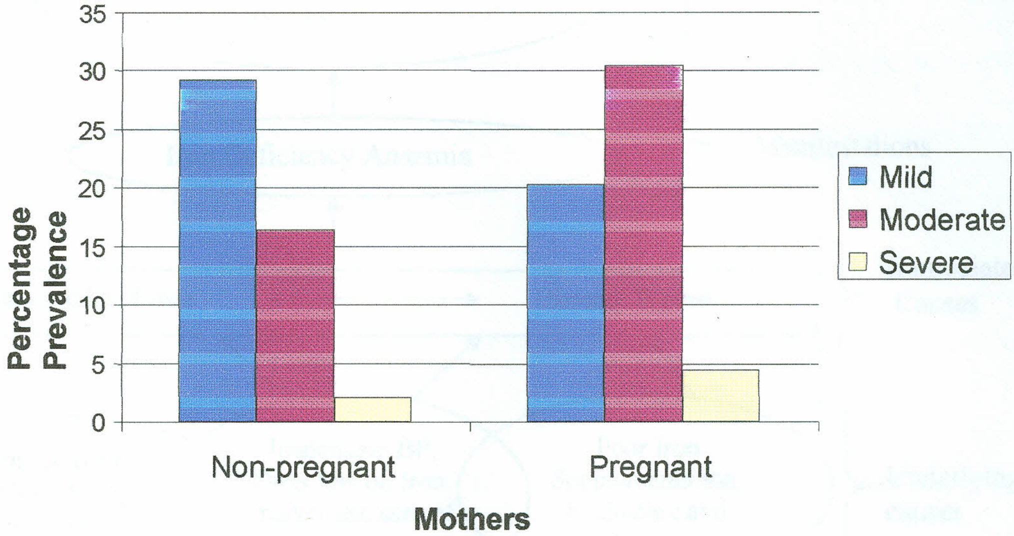
Iron is required in the tissues of the body for basic cellular functions, and is critically important in muscle, brain and red blood cells. Anaemia is simple to measure and has been used as a hallmark of iron deficiency severe enough to affect tissue functions. However, iron deficiency is not the sole cause of anaemia in most populations. Even in an individual, anaemia may be caused by multiple factors. Iron deficiency is one of the most prevalent nutrient deficiencies in the world, affecting an estimated two billion people (Kafwembe, 2001). Young children and pregnant and postpartum women are the most commonly and severely affected because of the high iron demands of infant growth and pregnancy. Iron deficiency may, however occur throughout the lifespan where diets are based mostly on staple foods with little meat intake leading to inadequate iron intake or due to chronic blood loss that leads to iron deficiency anaemia (WHO, 1995). This insufficiency could also be due to inadequate folic acid, Vitamin A, & B12 and zinc intake. Other causes are increased demands from many frequent pregnancies, increased losses from hookworm infestation, increased destruction and dyserythropoiesis from malaria and the haemoglobinopathies (Lassey et al; 1999; Mulira et al; 1999; Tatala et al; 2002). One-fifth of peri-natal mortality and one-tenth of maternal mortality in developing countries is attributable to iron deficiency. There is also evidence that iron deficiency decreases fitness and aerobic work capacity through mechanisms that include oxygen transport and respiratory efficiency within the muscle (Agarwal, 2001; Kafwembe, 2001).

Literature was reviewed under the following sub-topics-The prevalence of iron deficiency anaemia; risk factors for development of iron deficiency anaemia; causes of IDA; development and indicators of iron deficiency anaemia; consequences of iron deficiency anaemia; food sources of iron and summary of literature review.

2.2 PREVALENCE OF IRON DEFICIENCY ANAEMIA.

The World Health Organization (WHO, 1995) has produced the estimates of the global burden of deaths attributable to anaemia (all forms) in women of reproductive age. The total estimate is a minimum of 16,800 and a maximum of 28,000 annually with a greater risk of anaemia present in younger women (Brabin, Hakimi, Pelletier, 2001). Globally, around 600,000 women die every year from pregnancy related causes. Many of these women are short, thin, and anaemic and have a variety of micronutrient deficiencies, which could be prevented with attainable resources and skills (Tomkins, 2001; WHO, 1995).

Maternal anaemia is 50-100 times greater in women of developing countries than women of developed world, rates are high as 700 per 100,000 live births in many parts of Africa and in some countries in South Asia (Brabin et al; 2001; Tatala, 2000; Haider, Nekatibeb, Urga, 1999). A pregnant woman is considered to be anaemic when haemoglobin in her blood stream is below 11g/dl and non-pregnant when it is below 12g/dl. The highest rates of anaemia are found in Asia followed by Oceania and Africa (Abouzahr and Royston, 1991; Lassey, Kluflo, Annan, Wilson, 1999). Breast feeding women are more likely to be anaemic (56%) than pregnant women (51%) and non-pregnant women who are not breast feeding (45%). Studies from different parts of the world in the last two decades have shown that nutritional anaemia, usually due to iron deficiency, affects 40-90% of the population, particularly pregnant women, young children and adolescents (Agarwal, 2001; Sivakumar et al; 2001; Tatala et al; 2002; Kilbride, Baker, Parapia, Khoury, Shuqaidef, Jerwood, 2000; Agyei, Asare, Owiredo, Yeboah 2001). A study done in the three East African countries, Kenya,Uganda and Tanzania reported an overall prevlence of anaemia for women to be 61% (Waudo, Tuitoek, Msuya, Kikafunda, 2005). National Micro-nutrient Survey 1999 revealed a high prevalence of anaemia among women in Kenya (figure 1) and in Nandi 57% of pregnant women were said to be anaemic. The lactating women were living under constraints of limited food supply and demands of hard physical work (Etyang et al; 2003; Mulira, Macharia, Wafula, 1999).



Adopted from 1999 Micronutrient Survey.

Figure 1: Distribution of prevalence of anaemia among Pregnant and non-pregnant mothers

The Thika District Health services Annual report of year 2003 reflected a high prevalence of anemia of which 8806 cases were anemic with 14% cases having hemoglobin levels below 7g/dl.

2.3 RISK FACTORS FOR DEVELOPMENT OF IRON DEFICIENCY ANAEMIA

Hospital data (UNICEF, 1998) indicate that factors such as pregnancy haemodilution, concurrent infection, and haemorrhage prior to treatment or poor maternal nutritional status, malaria can rapidly lead to death (Brabin et al; 2001).The Kenyan situation follows similar trends (UNICEF,1998). Successive pregnancies, use of breastfeeding as a contraceptive, lactation and food insecurity have cumulative effects on specific nutrients like iron leading to maternal depletion syndrome (Etyang et al; 2003; Kilbride et al; 2001).

2.4 CAUSES OF IRON DEFICIENCY ANAEMIA

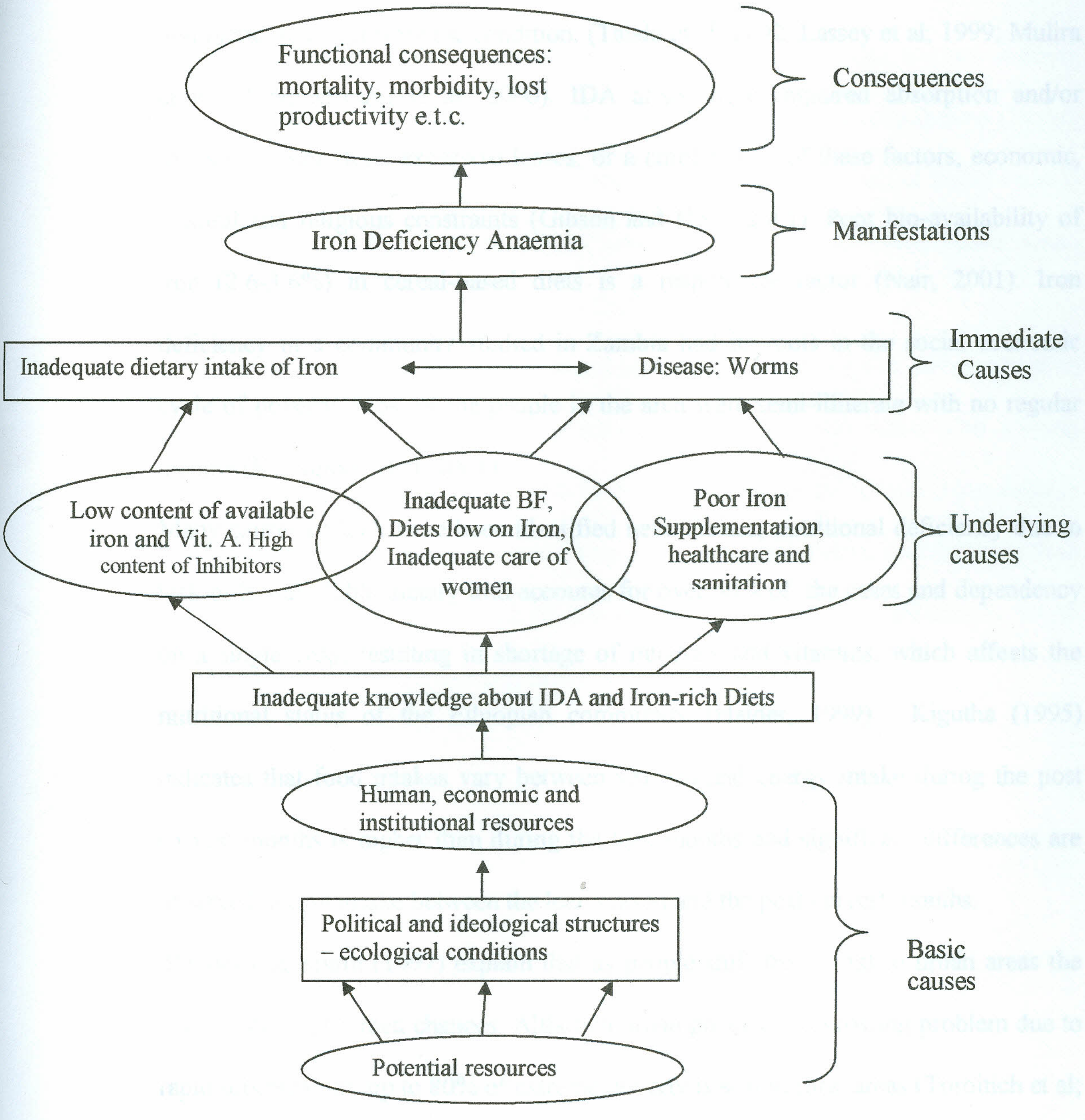


Figure 2: Conceptual framework of IDA – adopted from UNICEF (1998)

The aetiology is commonly multifactorial (fig.2) and includes inadequate intake of iron, vitamin B_{12}, vitamin A, zinc and folic acid, increased demands from many and frequent pregnancies, increased losses from hookworm infestation, low socio-economic status, increased destruction and dyserythropoiesis from malaria and the haemoglobinopathies. Furthermore dependence on cereal and legume based diets that often lack animal proteins as well as fruits and vegetables that enhance absorption of non-heme iron aggravate the condition. (Tatala et al; 2002; Lassey et al; 1999; Mulira et al; 1999; Mwanri et al; 2000). IDA arises from impaired absorption and/or utilization, inhibitors, excessive losses, or a combination of these factors, economic, cultural and religious constraints (Gibson and Hotz, 2001). Poor bio-availability of iron (2.6-3.6%) in cereal-based diets is a responsible factor (Nair, 2001). Iron deficiency in a community studied in Zambia had its roots in the social economic cycle of poverty. Most of the people in the area were semi-illiterate with no regular income (Kafwembe et al; 2001).

Many causes of IDA have been identified nevertheless, nutritional deficiency due to lack of bio-available dietary iron accounts for over 50% of the cases and dependency on a single crop, resulting in shortage of minerals and vitamins, which affects the nutritional status of the Ethiopian community (Haider, 1999). Kigutha (1995) indicates that food intakes vary between seasons and energy intake during the post harvest months is higher than during the lean months and significant differences are observed in iron intake between the lean season and the post harvest months.

Bender and Smith (1997) explain that as people shift from rural to urban areas the type of food consumed changes. Although urban poverty is a growing problem due to rapid urbanization, up to 80% of extreme poverty is still in rural areas (Toroitich et al; 1999).

Intravascular haemolysis associated with plasmodial infections, low tissue iron stores concomitant with increased requirements during pregnancy, or a combination of these dietary and non dietary factors, seasonal variation may be significant (Tatala et al; 2002; Huddle et al; 1999).

2.5 DEVELOPMENT AND INDICATORS OF IDA

The W.H.O. identifies an Hb level below 12g/dl for non-pregnant women as being anaemic. The percentage below this value identifies the anaemic populations (Brabin et al, 2001). Half of the iron (50%) in the body is present in the red blood cells in form of haemoglobin. In absence of acute haemolysis and frank blood loses, development of IDA takes an insidious stage wise progression.

(Table 2.1) Iron status can be considered as a continuum from iron deficiency with anaemia, to iron deficiency with no anaemia, to normal iron status with varying amounts of stored iron, and finally to iron-overload which can cause organ damage when severe. Iron deficiency is the result of long term negative iron balance. Iron stores inform of hemosiderin and ferritin are progressively diminished and no longer meet the needs of normal iron turnover (WHO, 2002).

Table 2.1: Biochemical Indicators of Progressive development of IDA.

Indices of iron status	**Early stage:** (depleted iron stores)	**Intermediate Stage:** (iron deficiency without anaemia)	**Late Stage:** (iron deficiency anaemia)
↓ Serum ferritin	- - - →	- - - →	- - - →
↓ Transferrin saturation		- - - →	- - - →
↑ Transferrin receptor		- - - →	- - - →
↑ Erythrocyte protophorphyrin		- - - →	- - - →
↓ Hemoglobin			- - - →
↓ Mean corpuscular volume			- - - →

Key:

↑ Elevated

↓ Depressed

Functionally the lack of mobilizable iron stores will eventually cause a detectable change in classical laboratory tests, including measurement of haemoglobin, mean corpuscular haemoglobin concentration, mean corpuscular volume, total iron-binding capacity, transferrin saturation and zinc-erythrocyte protoporphrin (WHO,2002).

In the early stages (pre-latent phase), depletion of iron stores takes place and serum ferritin is a reliable marker of depleted depot iron as well as iron overloads. An intermediate phase that is characterised by diminished transport iron, unsaturated transferrin and iron deficit erythropoiesis (latent phase) follows the transport system. However, sTfR levels could be affected by haemolytic anaemia, polycythaemia, haemoglobinopathies, aplastic anaemia and chronic renal failure. The late stage of IDA is characterised by decreased haemoglobin production and mean corpuscular volume (MCV), that manifest in microcytic and hypochromic red cells. Since low Hbc characterises the final stage, it is realistic to base large scale surveys on Hbc measurements as an indicator of absolute (storage) depletion (Micro-nutrient Survey,1999).

2.6 CONSEQUENCES OF IDA ON LACTATING AND NON-LACTATING MOTHER

Iron as a micronutrient, is required for regulation of brain transmitters by altering the pathway enzymatic system. Severe iron deficiency results in anaemia (figure.2) that can lead to reduced work performance. Individuals with iron deficiency anaemia who are engaged in hard physical labour have low productivity and therefore realise low income (Agarwal, 2001; Kafwembe, 2001; Kilbride et al; 2000; Agyei, et al; 2001; Tatala et al; 2002).

Severe anaemia lowers resistance to diseases and may cause death directly. For example, anaemic women have cardiopulmonary complications and do not tolerate blood loss as well as healthy women and are therefore more likely to die if they start to haemorrhage. They are also poor anaesthetics and operative risks and sub clinical iron deficient status also influences several physiological functions that govern cellular prolification and metabolism (Bhaskaram, 2001; Mwanri et al; 2000).

In latent iron deficiency (without anaemia), brain iron content, neurotransmitters and the related receptors are affected irreversibly during brain development (Agarwal, 2001).The economic implications of IDA are immense. The cost incurred by the public and private sectors in therapeutic measures for the prevalent level of anaemia is quite high. The societal consequences of increased maternal mortality and resultant restraints on productivity are devastating. The long term projected negative consequences of impaired mental development on human capital formation is immeasurable.The vicious cycle impairs individual, family,and community, as well as overall socio-economic development (WHO,2002).

2.7 FOOD SOURCES

The best food sources of easily absorbed iron are animal products (heme iron). Iron from vegetables, fruits, grains, and supplements (non-heme iron) are harder for the body to absorb. If you mix some lean meat, fish, or poultry with beans or dark leafy greens at meal, you can improve absorption of vegetable source of iron up to three times. Food rich in vitamin C (apple, orange, and guava) also increase iron absorption. Some foods decrease iron absorption. Commercial black or pekoe teas contain substances that bind to iron so it cannot be used by the body.

The evaluation of absorbable iron in a food is more accurate way to calculate iron available to the body than by simply recording the total iron content. Iron sources that have high iron availability are oysters, liver, lean red meat (especially beef), poultry, dark red meat, tuna fish, salmon, iron fortified cereals, dried beans, whole grains, eggs (especially egg york), dried fruits, dark leafy green vegetables. Reasonable amounts are also found in lamb, pork, and shellfish. Non-heme iron is found in whole grains such as wheat, millet, oats, and brown rice; legumes (lima beans, soybeans, dried beans and peas, kidney bean seeds such as almonds and Brazil nuts); dried fruits (prunes, raisins, and apricots); vegetables (broccoli, spinach, kale, collards, asparagus, dandelion greens). (Therapeutic diets – Iowa University, www.4collegewomen.com, 2007). The RDA for Iron is, 15 mg for non pregnant and lactating mothers.

2.8 SUMMARY OF LITERATURE REVIEW.

Iron deficiency anaemia is one of the major nutrient deficiencies in the world and is caused by multiple factors (fig 2). During the reproductive cycle, continuous depletion of iron has negative effects on mothers and infants. Lactating and pregnant mothers are at risk as well. Mothers need to eat quality diets rich in iron for their ability to enter pregnancy with enough stores of iron, sustain the foetus, and have a successful delivery and lactation. Anaemia is a problem of public health among all members of the family including the lactating mothers. Anaemia has detrimental physical, motor, psychological and social economic effects.

Even mild to moderate anaemia affects the sense of well being, resulting in fatigue, stress and decrease in work capacity for mothers to manage the household environment and care for children. Severe anaemia that occurs in developing countries is a major cause of maternal mortality and morbidity (Massawe, 2002). A non-pregnant woman is considered to be anaemic when the haemoglobin levels are below 12g/dl. A thorough understanding of iron status in lactating and non- lactating mothers is required.

CHAPTER THREE

METHODOLOGY

This Chapter gives a description of the study area, research design, study population, sample size, sampling procedures, data collection instrument, data analysis and presentation.

3.1 STUDY AREA

The study was carried out at Uzima Medicare Centre a peri-urban clinic in Thika Municipality (see map on appendix 5). The study targeted mothers attending the health unit. Thika is a cosmopolitan town with people of different ethnic origin, who mainly work in factories, pineapple plantations, coffee and flower farms, while some have small self-help businesses. Majority are of low income.

Apart from the natural population growth, there has been an influx of people into the area due to rural poverty forcing people out to urban areas to seek for jobs. The main tribes are Kikuyu and Kamba and the others tribes are a minority (Mukui,2000).

3.2 STUDY POPULATION

The target population for the study was 200 lactating and non- lactating mothers attending the health unit. The health unit is highly frequented by clients who are residents of the nearby estates and villages.The unit receives an average of 600 patients per month of which about 250 are women of reproductive age (Ng'ang'a, 2004). The study targeted 100 lactating and 100 non-lactating mothers using a purposive sampling method.

3.3 RESEARCH DESIGN

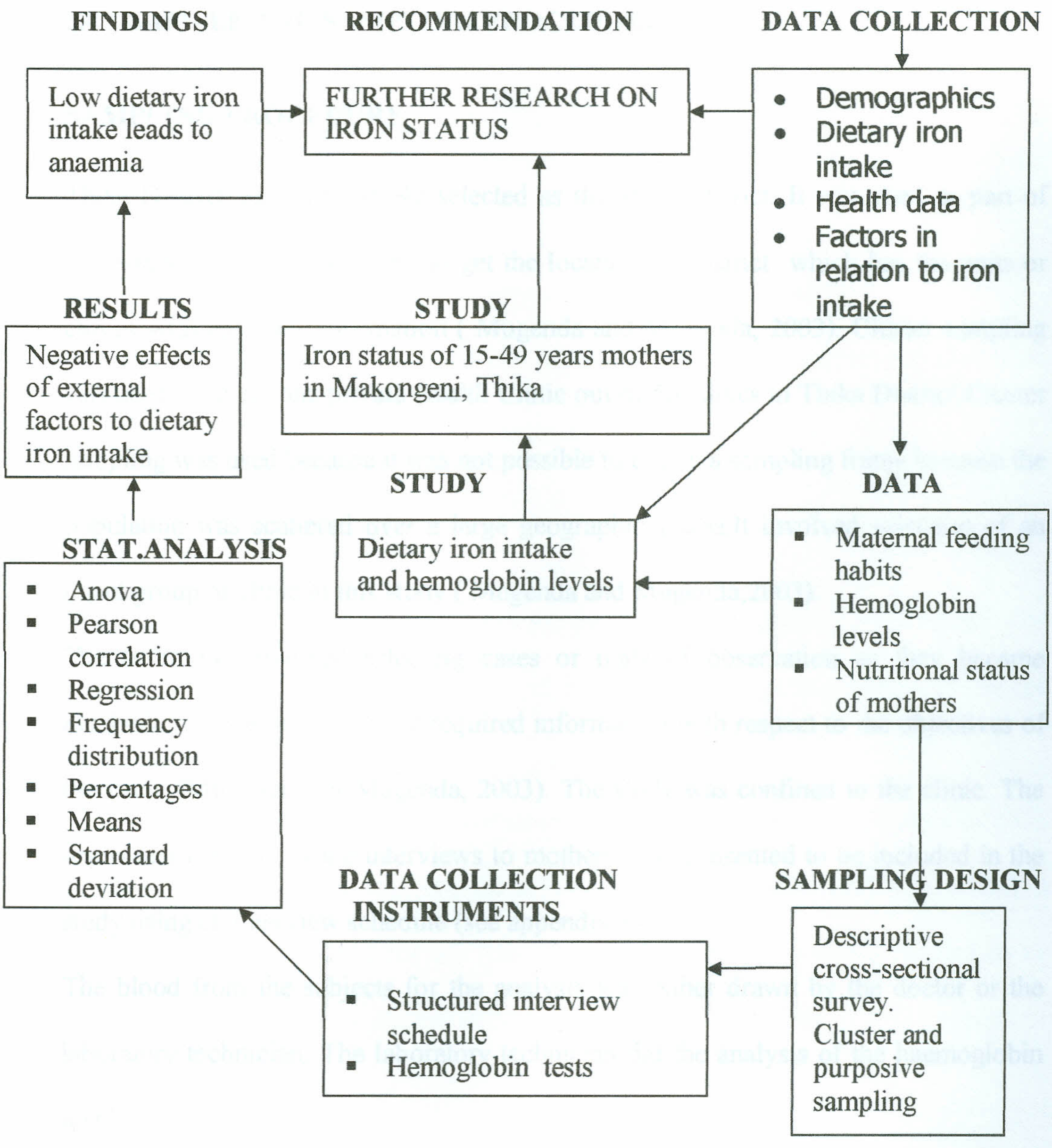


Figure 3: Research Design

A descriptive cross-sectional study was used since it yields both quantitative and qualitative data. Accurate information was collected at a single point in time with the purpose of describing the characteristics of a general sample of a population which included the relationship of variables like the level of income, dietary iron intake and haemoglobin levels (Touliatos et al; 1992).

3.4 PROCEDURES

3.4.1 SAMPLE AND SAMPLING PROCEDURE

SAMPLING PROCEDURE

Thika District was purposively selected as the study district. It was used as part of multistage sampling procedure to get the location or district which has the units or clinics with required information (Mugenda and Mugenda, 2003). Cluster sampling was used to select one private Health Clinic out of 50 clinics in Thika District.Cluster sampling was used because it was not possible to obtain a sampling frame because the population was scattered over a large geographical area.It involved selection of an intact group or clinic in this study (Mugenda and Mugenda;2003).

The technique involved selecting cases or units of observation as they became available and the ones with the required information with respect to the objectives of the study (Mugenda and Mugenda, 2003). The study was confined to the clinic. The researcher carried out the interviews to mothers who consented to be included in the study using an interview schedule (see appendix 3).

The blood from the subjects for the analysis was either drawn by the doctor or the laboratory technician. The laboratory technician did the analysis of the haemoglobin levels.

SAMPLE SIZE DETERMINATION

The sample size was determined on the prevalence of mortality rate of non-pregnant and lactating women found out in 18 hospitals (UNICEF, 1998) in Kenya using the following formulae for comparative studies (Fisher,1993).

$$n = \frac{2 z^2 x (pq)}{d^2}$$

n=Desired sample size for one population.

z= Standard normal deviate set at 1.96

p= proportion of the anemic in the population (7%) (UNICEF, 1998). Therefore the proportion of the anemic is 7/100=0.07

q=1-p estimated proportion of non- anemic women which is (1-0.07)

d=difference between the 2 populations taken as 10% at 95% confidence interval is 0.1.

$$\text{Thus } n = \frac{2 \times 1.96^2 \times (0.07) \times (1-0.07)}{(0.1)^2} = 50$$

Allowing for attrition rate of 10% (5) the desired sample size for each of the two populations is 55. The sample size of 55 for lactating and a sample size of 55 for non-lactating mothers.

But the Sahli method of Hb concentration measurements which has specificity (85) and sensitivity (85) as a standard for estimating Hb concentrations, requires that a sample of 100 respondents for any population be derived for accurate estimation of the prevalence and any conclusive deductions to be made out of the results (Robnett et al; 1996).

INCLUSION AND EXCLUSION CRITERIA

Inclusion:

All mothers 15-49 years who consented to be included in the study.

Exclusion:

Women who had some kind of acute illness and the pregnant mothers.

3.5 DATA COLLECTION

3.5.1 ETHICAL CONSIDERATIONS

Clearance to carry out research was obtained from the Kenyatta University Board of postgraduate (see appendix) . Ethical approval was obtained from the Ministry of Education headquarters in Nairobi and at District and Municipality level, Office of the President and the management of Uzima Medicare Centre (see appendix).

Participants were informed about the aim of the study , its procedures and oral consent was obtained. Participants were given their test results and women with some form of anaemia (Hb < 12g/dl) were referred to the physician in charge for further advice and treatment.

3.5.2 DATA COLLECTION INSTRUMENTS AND PROCEDURE

The main instrument for gathering data was the interview schedule.The interview schedule was used as much as possible but some probing was made in Kiswahili which is an official language and Kikuyu which is the most frequently spoken language. The 24hr dietary recall and food frequency were used to determine the dietary iron intake. Calibrated household measures like plates, cups, and spoons were used to estimate the food intakes(Appendix 4). Household visits were made to ascertain the household measures were correct. The household measurements were later converted into metric measures.

3.5.3 INTERVIEW SCHEDULE

The instrument was administered to the lactating and non-lactating mothers regarding demographics, household food security, food preparation and consumption methods, their health and sanitation data, and breastfeeding among others.

The interviewing was administered when the mothers gave consent to be included in the study. Before the interviews commenced, the researcher formed a rapport with the subjects by clearly explaining the purpose of the study.

3.5.4 STUDY PROCEDURES

The Hb tests and data collection were integrated into the usual services of the clinic. The researcher was given maximum assistance by the doctor and the laboratory technician where necessary.

3.5.5 BIOCHEMICAL DATA COLLECTION

Blood sample was drawn with a sterile disposable needle and syringe or a deep prick with a lancet and pipetted from the respondents after disinfections with methylated spirit swap and drying of skin. Venous blood was collected for (n=20) mothers acceptically from antecubital veins of the arm and was alliquotted into tubes with an anti-coagulant (sequestrene). This was done to mothers who could not be able to come back for a finger prick in the evening when usual procedures of analysis were undertaken by the laboratory technician.

Serum Hb measurements were performed using the Sahli hemometer (took 8 minutes to determine) and values were recorded for each subject. The mothers were categorized as having iron deficiency anaemia when found with Hb <12g/dl based on the WHO standard.

3.5.6 PRETESTING OF THE STUDY

In order to pre-test the interview schedule on the length, content, question wording, language and sensitivity, three respondents were interviewed. Those involved in the pre-testing did not participate in the final study. This avoided sensitisation that would affect the reliability of the data as cautioned by Mugenda and Mugenda (2003). Pre-testing was to facilitate modifications by correcting mistakes and eliminating ambiguous questions to ensure clarity and hence elicited the required information for better validity.

3.6. DATA ANALYSIS PROCEDURE AND PRESENTATION

The response from the mothers like the dietarty intakes which were in household measures were converted into metric values and with the haemoglobin values were subjected for statistical analysis. Data were coded, entered and analysed by use of Statistical Package for Social sciences (SPSS version 11.5, 2000) and Ms Excel computer package. Dietary analysis software from the internet (Food metres UK 7) for nutrient analysis was used for 24 hour dietary recall nutrient analysis.

Descriptive statistics were used to summarize data on demographic factors, that affect dietary iron intake and other variables. The frequencies and percentages, mean, standard deviation, correlation pertaining to the information was described. Inferential statistics were used to test the null hypothesis (Anderson,1996; Keppel, 1989).

Mean: The means of the haemoglobin levels for the lactating and non-lactating mothers were done and comparisons made. Mean was used because it is the most stable and reliable Index of central tendency (Davies et al;1999; Francesco, 1975)). It is the arithmetic average, which was computed for the haemoglobin levels by adding all the scores in the distribution and then dividing by the number of cases. This summary is appropriate for interval or ratio level data. It is one of the initial steps in analysis that latter permit advanced statistical treatment (Francesco,1975).

Standard deviation: The haemoglobin levels was also determined. It was used as a measure of dispersion in describing the distribution of the scores. It measured the spread of a set of scores around the mean (Mugenda and Mugenda,2003). The haemoglobin levels were measured and plotted, their frequency distribution approximated a normal frequency curve or normal distribution.

Pearson Product Moment Correlation Coefficient (r) was used to determine the presence of/and the degree of relationship between the Hb levels and the different variables among the lactating and non-lactating mothers. Correlation coefficient near 1.00 or –1.00 showed a high positive or negative relationship, between various variables and Hb levels. Coefficient correlation near 0.00 showed that the variable under study is not related to Hb levels (Francesco,1975).

The T-test: Is a parametric statistical technique (Anderson,1996) that was used to test the hypothesis whether there is a significance difference between the means of the haemoglobin levels of the lactating and non-lactating mothers.

ANOVA: established whether there is a variation in haemoglobin levels between the lactating and non-lactating mothers and to determine whether there was any significance difference at 95% confidence level. The means and differences between groups were analysed using one-way analysis of variance (Francesco,1975; Anderson,1996).

The regression coefficient: was employed to predict the relationship between the haemoglobin and independent variables such as income, marital status, health factors, foods rich in iron eaten by the lactating and non-lactating mothers among others. Summary of the qualitative data were done according to themes, generalizations and by use of direct quotations, which was done in the findings.

Tables, percentages, charts and figures present analysed descriptive data (Davies et al;1999). The dependant variable was the iron status (Hb) of the lactating and non - lactating mothers while the independent variables were dietary iron intake with intervening variables level of income, level of education, age, socio-cultural factors and health among others of the lactating and non-lactating mothers.

Altitude adjustment for Hb levels was done using WHO adjustment factor of 0.25g/dl per every 1000m asl rise in altitude due to the increase in haemoglobin concentration as an adaptive response to the lower partial pressure of oxygen and reduced oxygen saturation of blood with rise in altitude (Micro-nutrient Survey,1999). A cut-off of <7g/dl as severe anaemia, 7-10.9g/dl moderate anaemia, 10.8-11.9g/dl as mild anaemia and 12-16g/dl as normal was used to analyse the haemoglobin levels. WHO identifies Hb levels below 12g/dl for non-pregnant mothers as being anaemic (Brabin et al, 2001).

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter contains detailed presentation and discussion of the results of this research. It covers demographics; socio-economic/cultural characteristics; food intake levels of iron deficiency anaemia; factors associated with IDA; relationship between dietary iron intake and Hb levels. This was a cross sectional descriptive study carried out between March and May 2005 at Uzima Care Medical Center, situated in Makongeni Estate, Thika, Town. Nutritional studies in Kenya have tended to concentrate on children and not on lactating and non-lactating mothers.

The lactating and non-lactating mothers were chosen for this study because they are equally vulnerable to the documented iron metabolic interactions. During the reproductive cycle continuous depletion of iron stores has negative effects on both the health of the mother and infants. The findings are in conformity to other studies that have indicated that anaemia affects all members of the household including mothers (42.9%) as compared to preschool children (43.2%) (Micro-nutrient Survey,1999).

4.2 Demographic

Age, marital status, household size, socio-economic status, ethnicity, educational level, occupation, and income levels were analyzed.

4.2.1 Age of the respondents.

The age of a woman is crucial in determining the iron status irrespective of non-pregnancy status. The 100 lactating mothers consisted of those in age bracket 15-20 years (4%), 21-30 years (76%) and 31-40 years (20%). Within the non- lactating mothers, the age group 21-30 had the highest respondents (47%), followed by the 31-40 years age cohort (27%). The oldest women (41-50) years and teenagers (15-20) years were the least respondents in the study among non-lactating mothers. In total, 123 young women in the range of (21-30) years consisted most of the respondents in the sample (61.5%), with those the eldest bracket (41-50 years) being the least (6.5%). This compares well with the KDHS (2003) Survey whereby the majority of the respondents were of age 21-30 years and on the age specific fertility rates.

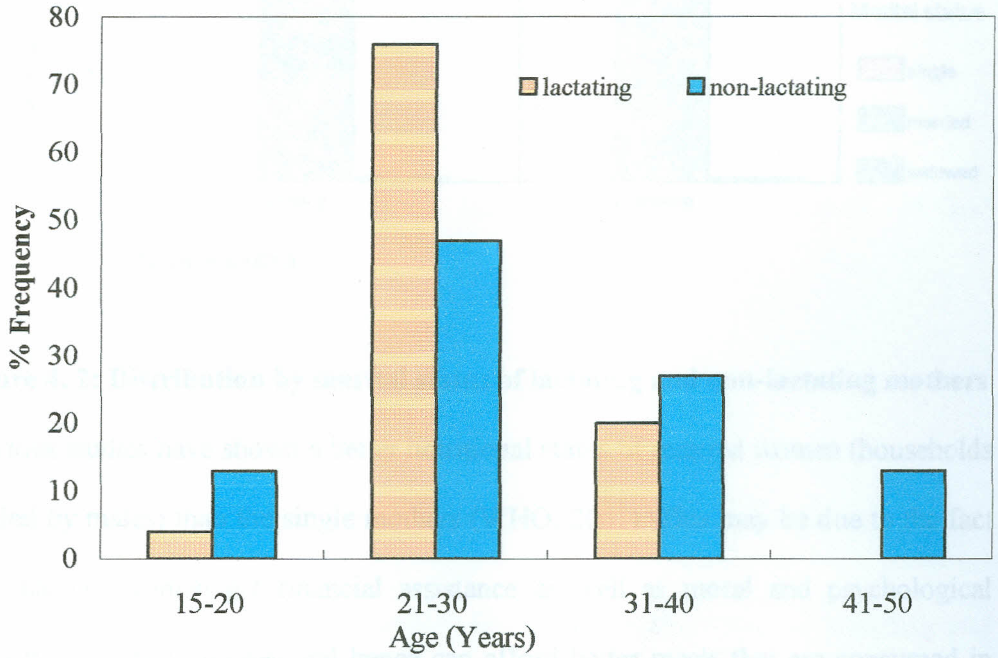


Figure 4. 1: Distribution by age of lactating and non-lactating mothers

From figure 4.1 majority of the respondents for both categories were in the age group 20-30 years associated with high fertility rates (KDHS, 2003).

4.2.2 Marital status of the respondents

The marital status contributes to the intra-household food distribution disparity and ultimately has an impact on the nutritional status of the respondents. The percentage distribution of the lactating and non-lactating mothers are shown in figure 4.2. In this study majority of the respondents both lactating (88%) and non-lactating (62%) were married. Male-headed households consisted of (89%) for lactating and (70%) for non-lactating respondents who were either husbands, brothers, fathers or guardians.

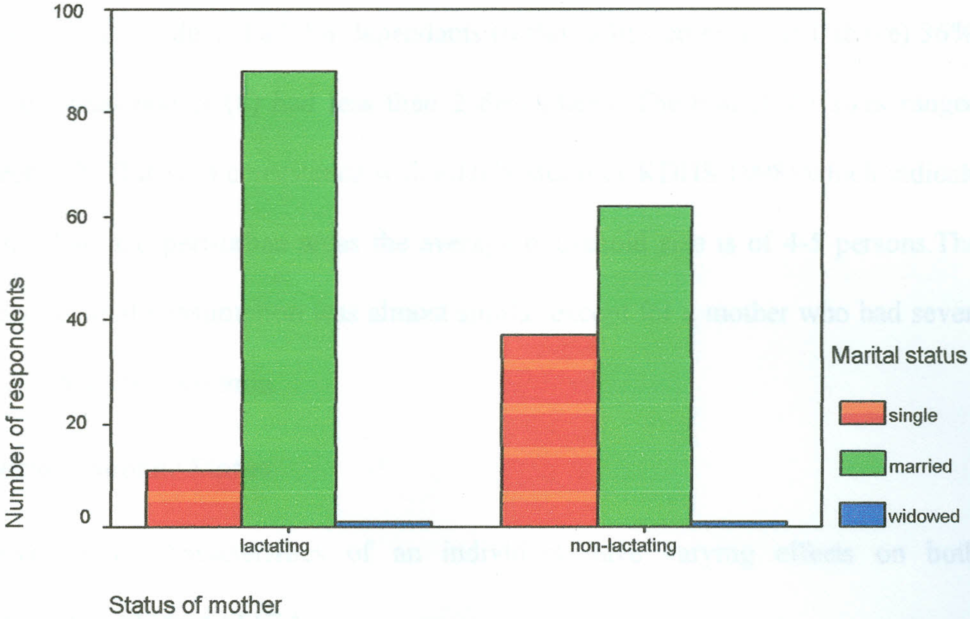


Figure 4. 2: Distribution by marital status of lactating and non-lactating mothers

Previous studies have shown a better nutritional status of married women (households headed by males) than the single mothers (WHO, 2001). This may be due to the fact that married women get financial assistance as well as moral and psychological support from their spouses and hence can afford better meals that are consumed in better mental and emotional state than the single mothers. This study did not find any significant difference in the nutritional status of the married and single mothers.

4.2.3 House hold size

Family size has an implication to nutrition and health because it determines levels of household consumption patterns and expenditure on food and health items Table 4.1.

Table 4.1 Distribution of number of dependents of lactating and non-lactating mothers.

Status of mother	1	2-4	5 and above	No dependants	Total
Lactating	0	70	30	0	100
%	0	70	30	0	100
Non-lactating	3	50	42	5	100
%	3	50	42	5	100
Total	3	120	72	5	200
%	1.5	60	36	2.5	100

Most of the respondents had 2-4 dependants (60%), followed by (5 and above) 36%. Very few respondents (8) had less than 2 dependants. The household sizes ranged between 1-7. This is in consistence with KDHS studies (KDHS,1998) which indicate that in urban and peri-urban areas the average household size is of 4-5 persons.The households food consumption was almost similar except for a mother who had seven child and had mild anaemia.

4.3 Socio-economic Status

Socio-economic characteristics of an individual have varying effects on both vulnerability and trend of IDA.

4.3.1 Distribution by Ethnicity

Every ethnic group has its traditional diets which influences the nutritional status of the population.Table 4.2 gives the distribution of Respondents By Ethnic background.

Table 4.2 Distribution of Respondents By Ethnic background of lactating and non-lactating mothers in Makongeni

Ethnic background	Status		Total %
	Lactating n=100	Non-lactating n=100	
Kikuyu	61	59	120
Kalenjin	1	1	2
Giriama	3	0	3
Marakwet	0	1	1
Embu	4	2	6
Meru	2	9	11
Kamba	13	13	26
Luhya	8	9	17
Luo	8	2	10
Somali	0	3	3
Boran	0	1	1
Total	100	100	200

Kikuyus were the majority representation with 61% lactating and 59% non-lactating with some 1% Kikuyu of each category who were from Rift Valley as their Province of origin. The next closest were the Kambas with 13% of each. The figures compare very well with the 2003 KDHS survey where the majority were Kikuyu (22%), followed by luhya, Kamba, Kalenjins, then Luos. The ethnic background plays a central role in terms of food habits adopted by the people including preference, beliefs, taboos, food preparations and intra-house food distribution (MOH/UNICEF, 2001).

4.3.2 Respondents educational level

The level of education is crucial as it determines job opportunity and income levels as well as aid in decision-making on food purchase and consumption.

The level of education of the respondents is shown on Table 4.3.

Table 4.3 Distribution by education level of lactating and non-lactating mothers.

Status	Education level				
	Primary	Secondary school	College	University	Total
Lactating					
Count	34	47	19	0	100
%	34	47	19	0	100
Non-lactating					
Count	31	55	11	3	100
%	31	55	11	3	100
Total					
Count	65	102	30	3	200
%	32	51	15	1	100

Most of the respondents had attained secondary school education (51%). This was followed by primary (33%) College (15%) and university (1.5%). This compares with 1998 Situation analysis of Children and Women in Kenya whereby 46% enrolment into Secondary school were females, 29% in university, 40% in colleges and 49% primary schools. This is also with agreement with KDHS (1998) which indicated that most urban women have at least secondary school education. Literacy enables mothers to provide more informed nutritional care to the household. Literacy also increases labour market opportunities and income generating ability of the mother, which in turn enable them to financially meet the food and health needs (Ruto, 1999). This study found out that most of the mothers did not have any form of employment.

4.3.3 Respondents occupation

Although wage and employment is a major source of income in the urban and peri-urban areas, income generating opportunities are limited to the dwellers especially women. Many women have difficulties in accessing jobs both in the formal and informal sectors. Figure 4.3 shows the distribution by occupation of lactating and non-lactating mothers in Makongeni.

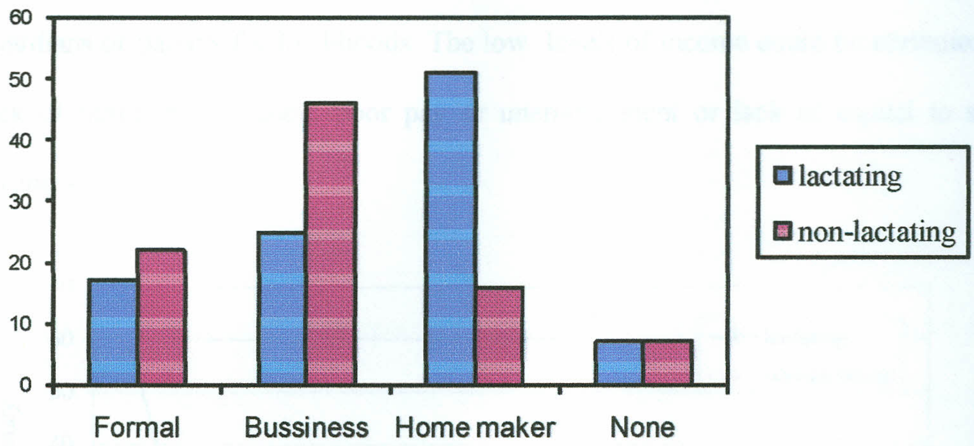


Figure 4. 3:Distribution by occupation of lactating and non-lactating mothers in Makongeni

Most of the women were either in the informal businesses or engaged in small scale trade at their homes. Those women in the formal sectors consisted 17 % of lactating mothers, while the non-lactating mothers were 22 % in employment. Up to 7 % were not engaged in specific activities in both categories of the lactating and non-lactating mothers. Most of the respondents were housewives and did not have any money generating projects so had no income. It should be noted that secondary education alone is not enough to enable one to compete effectively in the job market. This makes the women not competitive in job markets, which require high level of formal education among other qualifications. Higher levels of education for mothers are associated with better nutritional status in Kenya (KDHS, 1998). The kind of employment or business practiced by an individual determines their income levels, which in turn influences the food consumption patterns.

4.3.4 Respondents income

The level of income determines the food consumption patterns of the households. Figure 4.4 shows various levels of income for the mothers. The highest number of the respondents did not have a source of income and were dependent on their husbands, guardians or parents for livelihoods. The low levels of income could be attributed to lack of nutrition education, poor pay or unemployment or lack of capital to start business.

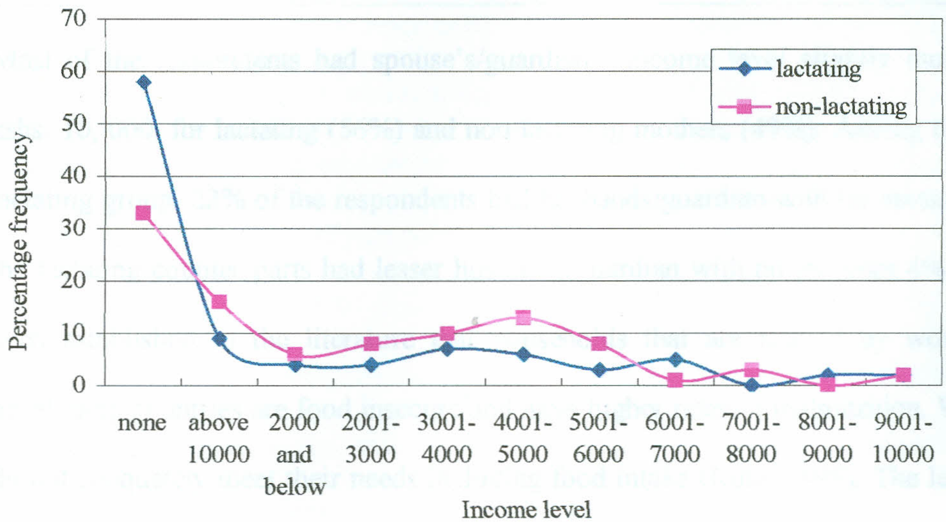


Figure 4.4: Average monthly income of lactating and non-lactating mothers in Makongeni

Studies have shown a positive relationship between education and the incomes. (UNICEF, 1998). Most of the respondents in the study, both lactating and non-lactating had no incomes.

4.3.5 Spouse average monthly income

The total household income determines the level of expenditure on goods and services and the welfare of the household in general. Table 4.4 shows spouses monthly income. Generally incomes are associated with better food security because of the ability to buy more and different foodstuffs that come with having income.

Table 4.4 Spouse average monthly income of lactating and non-lactating mothers

Income level	Lactating		Non-lactating	
	n	%	n	%
3001-4000	2	2	0	0
4001-5000	5	5	3	3
5001-6000	4	4	9	9
6001-7000	4	4	5	5
7001-8000	5	5	6	6
8001-9000	13	13	3	3
9001-10000	7	7	3	3
>10000	56	56	49	49
None	4	4	22	22
Total	100	100	100	100

Most of the respondents had spouse's/guardian's income level slightly more than kshs. 10, 000, for lactating (56%) and non-lactating mothers (49%). Among the non-lactating group, 22% of the respondents had husbands/guardian with no incomes, but the lactating counter parts had lesser husbands/guardian with no incomes 4%. It has been established in the literature that households that are headed by women in developing countries are food insecure and have higher rates of malnutrition. Women do not adequately meet their needs including food intake (Ruto, 1999). The levels of the spouses' income significantly influence food consumption patterns. But the National survey on household food security reported that 23% of Kenyans come from households where members of the family are unlikely to meet their minimum requirements even if the household concentrated all its spending on food (Etyang, 2003).

4.3.6 Respondents type of cooking pot

In Kenya the dominant cooking pot is aluminium (UNICEF, 2000). Table 4.5 shows the type of cooking pot. If food is cooked in an iron pot, it absorbs a considerable amount of iron from the pot and this becomes a significant source of iron and mitigates against iron deficiency.

Table 4.5 Cooking pot used by lactating and non-lactating mothers.

Status of mother	Stainless steel	Aluminium	Combined use of Aluminium & earthenware	Total
Lactating	0	83	17	100
%	0	83	17	100
Non-lactating	2	75	23	100
%	2	75	23	100
Total	2	158	40	200
%	1	79	20	100

Most of the mothers cooked their foods using aluminium containers while earthware and stainless steel were the least used. Among the lactating mothers, 83% used aluminium while 75% of non-lactating mothers used aluminium. Studies have evidenced that non- food sources of iron have significant potential to influence the iron intake. In Eritrea use of iron pots was associated with lower rates of anaemia and improved growth of children (Micro-nutrient survey report, 1999). In the current study the dominant cooking pot was aluminium. This calls for urgent considerations of strategies to increase the use of iron cooking pots even in peri-urban and urban areas since they have a potential to mitigate against iron deficiency.

4.4 Food intake and Dietary iron intake

The type and meal consumption pattern is crucial in determining the respondents' iron intake.

4.4.1 Restricted foods

Different ethnic groups traditionally restrict certain foods to women and children which could affect their nutritional status(Ruto, 1999) . Table 4.6 shows the food restricted to women.

Table 4.6 Foods restricted various socio-cultural factors for lactating and non-lactating mothers .

Status of mother	Yes	No	Don't know	Total
Lactating	1	98	1	100
%	1	98	1	100
Non-lactating	6	91	3	100
%	6	91	3	100
Total	7	189	4	200
%	3.5	94	2	100

From the data, there were indications that there were no major restrictions on diet. Only 7 women (3.5%) reported diet restrictions, most of whom were non-lactating (6). A total of 95% of all women agreed that there were no limitations to their choice of diet, while 2 % did not know. Among the sample there were few restrictions to specific foods, implying that most of the respondents had dietary choices. However restricted foods included liver (1%) tongue (1%), and head and leg parts of animals (1%). Most mothers said that there are foods given to mothers after delivery and they are culturally accepted. For Kikuyu, Embu, Meru, Kamba, a legume *Dolicos lablab* (Njahi), which is very nutritious and rich in iron, *fermented porridge*, *Stock(liquid from boiled animal bones)*, *mukimo or muthokoi* are given. Luos and luhya eat more of traditional vegetables, *ugali,* fish and meat while for Boran and Somali they eat more of *ajeera*, porridge, stock, meat and milk. Kalenjins and Marakwets eat more of *ugali*, fermented milk, and stock. A few said that there are no special foods for lactation (26% of both lactating and non-lactating mothers). The most common reasons for consumption of the foods was to regain health and increase milk production (69.5%), milk let down, and increase blood. About 12.5% did not have specific reasons. Studies have shown that culture, taboos and food preferences were common factors in some communities that influenced food consumption whereby women were not supposed to eat certain foodstuffs especially those of animal protein origin (Ruto, 1999). This study did not show that trend, probably because most urban dwellers have abandoned most of the traditions.

4.4.2 Food frequency and dietary iron intake.

According to Ruel (2001), iron can be obtained from both animal and plant sources. Table 4.7 shows consumption pattern of selected iron rich foods commonly found in Makongeni. Iron from plants (non-heme) is less bio available than iron from animal foods (heme a constituent of haemoglobin and myoglobin), such as meat, fish poultry. Heme iron is highly bio available (15-35% is absorbed) whereas non-heme iron is absorbed much less (only 2-20% is absorbed). Non-heme iron from plants is affected by phytates, which are present in cereals and legumes the main staples of the populations.

Table 4.7 Food frequency on consumption of selected iron rich foods by lactating and non-lactating mothers .

Foods	Daily	> or 3 times/wk	2 times a week	Once a week	Rarely	Never
Meats						
Meat	26 (13)	77 (38.5)	45 (22.5)	32 (16)	17 (8.5)	3 (1.5)
Fish	2 (1)	11 (5.5)	9 (4.5)	37 (18.5)	93 (46.5)	48 (24)
Poultry	1 (0.5)	0 (0)	1 (0.5)	23 (11.5)	171 (85.5)	4 (2)
Milk	190 (95)	4 (2)	2 (1)	2 (1)	(0)	2 (1)
Eggs	13 (6.5)	40 (20)	47 (23.5)	43 (21.5)	52 (26)	5 (2.5)
Liver	1 (0.5)	0 (0)	1 (0.5)	23 (11.5)	171 (85.5)	4 (2)
Legumes						
Soybeans	17 (8.5)	6 (3)	5 (2.5)	8 (4)	45 (22.5)	119 (59.5)
Beans	7 (3.5)	60 (30)	58 (29)	60 (30)	13 (6.5)	2 (1)
Peas	1 (0.5)	7 (3.5)	12 (6)	21 (10.5)	158 (79)	1 (0.5)
Green grams	2 (1)	31 (15.5)	43 (21.5)	67 (33.5)	53 (26.5)	4 (2)
Njahi	3 (1.5)	17 (8.5)	30 (15)	39 (19.5)	80 (40)	31 (15.5)
Fruits						
Lemon	3 (1.5)	0 (0)	9 (4.5)	12 (6)	158 (79)	19 (9)
Guava	1 (0.5)	1 (0.5)	3 (1.5)	12 (6)	163 (81.5)	20 (10)
Pineapple	29 (14.5)	17 (8.5)	25 (12.5)	42 (21)	78 (39)	9 (4.5)
Oranges	36(18)	18(9)	19(9.5)	31(15.5)	92(46)	4(2)
Pawpaw	25(12.5)	21(10.5)	19(9.5)	31(15.5)	92(46)	4(2)
Vegetables						
Amaranthus	8 (4)	29 (14.5)	19 (9.5)	30 (15)	77 (38.5)	37 (18.5)
Spinach	41 (0)	91 (0)	26 (0)	18 (0)	21 (0)	3 (0)
Kales	44 (22)	97 (48.5)	24 (12)	16 (8)	12 (6)	7 (3.5)
Cabbage	31 (15.5)	81 (40.5)	31 (15.5)	36 (18)	20 (10)	1 (0.5)
Tomato	191(95.5)	6(3)	2(1)	0(0)	1(0.5)	0(0)
Capsicum	43(21.5)	37(18.5)	14(7)	20(10)	52(26)	34(17)
Managu	4 (2)	9 (4.5)	7 (3.5)	11 (5.5)	46 (23)	123 (61.5)
Mrenda	(0)	2 (1)	5 (2.5)	6 (3)	41 (20.5)	146 (73)
Mitoo	(0)	3 (1,5)	3 (1.5)	5 (2.5)	49 (24.5)	140 (70)
Beverages						
Coffee	13 (6.5)	1 (0.5)	4 (2)	11 (5.5)	118 (59)	53 (26.5)
Tea	189 (94.5)	4 (2)	(0)	(0)	5 (2.5)	2 (1)

***( ) Values in parenthesis are column percentages.**

The iron rich foods selected provide more than 1mg/100g edible portion (Calculated by the method of Monsen et al; 1978) except for milk and the inhibitors(NAS,2004). Milk was a common food in the diet of the respondents, taken daily in tea or fresh, by 95% of them. Meat was taken by 41.5% of the respondents more than 3 times a week. Those who took meat once or 2 times a week were (77) 38.5 %. Only 2% of the respondents took fish daily. Up to 70.5 % of the respondents took fish rarely or never. Chicken and liver were used less than once a week by most of the respondents. Up to

85 % of the respondents consumed liver and chicken rarely with only 0.5% of the respondents using liver and chicken daily. Eggs were moderately used. These heme foods are enhancers of non-haeme iron absorption.

The most commonly used pulses were beans, *dolicos lablab* (njahi) and green grams. Over 60% of the respondents consumed the common bean more than twice a week. About 30 % consumed beans once a week. Green peas were rarely consumed during the study because they were out of season. A total of 59 % of the respondents never ate soya beans given its high biological value, while 22% used soya beans once or more than once a week in beverages such as porridge and tea. *Dolicos lablab* (njahi) was commonly consumed by over half of the mothers. Fruits, guavas, oranges as iron uptake enhancers were rarely consumed by over half of the respondents. It is only 36.5% of the respondents who consumed them twice or more than twice a week. About 15.5% of the respondents ate oranges once a week, while 32.5% ate pawpaw twice or more than twice a week and 15.5% once a week. A total of 35.5% of the respondents consumed pineapple twice or more than twice a week and 21 % once a week. Vitamin C from fruits and vegetables promotes iron absorption. For vegetables, the most commonly consumed was tomato by 96% of the respondents daily in all forms of cookery but the vitamin C was destroyed by overcooking of the vegetable. Kales (*sukuma wiki*) was consumed by 22% of the respondents' daily. The most common vegetables were spinach, kales and cabbages (*brassica sp*). *Managu* (*solanum nigrum*) , capsicum, *mitoo (Crotalaria ochroleuca), mrenda (Corchorus olitorius (Savala et al; 2003)),* and garlic were rarely used. Over 60% of the respondents never ate *mrenda (Corchorus olitorius), mitoo (Crotalaria ochroleuca),* and *managu* (*solanum nigrum*). Overcooking of these vegetables was cited by a number of mothers. Tea as a beverage was common, and predominately taken at breakfast by 95% of the respondents, while coffee was rarely used by 86% of the respondents. These beverages are known to contain tannins and caffeine respectively that inhibit iron uptake in the gut but were rarely consumed with main meals. There was high consumption of wheat and its products, maize and its products and rice. These foods are known to have high amounts of phytates which is an inhibitor of iron absorption but the women consumed some fruits which are enhancers of iron uptake. These findings are in agreement with other researches, which have shown low consumption of animal products and increased consumption of plant foods in developing countries (UNICEF, 2001).

4.4.3 Food accessibility

Food consumption patterns are greatly influenced by the ease at which the consumer accesses it. Table 4.8 shows the food source of the respondents. There is lack of adequate and nutritious foods due to urban poverty leading to an increasing number of people suffering from ailments that were previously not common like ulcers, diabetes, hypertension and cardiovascular diseases.

Table 4.8 Food source for lactating and non-lactating mothers

Status of mother	Purchase	Farm and purchase	Donations and Purchase	Total
Lactating	90	6	4	100
%	90	6	4.0	100
Non-lactating	80	17	3	100
%	80	17	3.0	100
Total	170	23	7	200
%	85	11.5	3.5	100

The main sources of food as shown in table 4.8 for lactating mothers were purchase (90%), farm (6%), donations and purchase (4%). The non-lactating mothers relied mainly on purchases (80%), farms and purchase (17%) donations and purchase (3%). Most mothers said that they could afford the basic foodstuffs (92%), mainly plant foods. A few said that they could not afford some of the foodstuffs, as they would wish due to their high costs. Proteins were ranked as the foodstuffs that some mothers felt they would like to eat more often but cannot afford. In urban areas the main source of food is purchase. Income is a key determinant of quality and quantity access of food. The adequate access to quality foods in turn affects the nutritional status of the individual.

Food intake in lactation

Food intake requirements are higher for the mothers immediately after delivery due to blood lost during delivery and also the demand for breast milk from the baby. Energy requirements for example increases by 500kcal over and above the recommended requirements for a non-lactating mother.Table 4.9 shows the duration of breastfeeding for the mothers.

Table 4.9 Duration of breast-feeding by lactating mothers .

Status of mother	1-3 months	4-6 months	6-9 months	10-12 months	Over one year	None	Total
Lactating	19	17	16	18	30	2	100
%	19	17	16	18	30	2	100
Non-lactating	0	0	0	0	0	100	100
%	0	0	0	0	0	100	100
Total/	19	17	16	18	30	100	200
%	9.5	8.5	8	9	15.	50	100

The lactating mothers who breast fed their children as shown in Table 4.9 for over 1 year, were 30%, while 18% breast fed for 10-12 months. Others breastfed for 6-9 months (16%), 4-6 months (17%), and 1-3 months (19%). Most mothers breast-fed their babies on demand since majority were housewives. The results reveals that a big number of mothers (98%) breast fed their babies which compares with 96% KDHS (2003). In East Africa 96.1% of the mothers give their children breast milk at the time of introduction of complimentary foods (Waudo et al; 2005). In this study exclusive breastfeeding was not common and babies were given complimentary feeds before 2 months inform of water, fruit juices and other milk. Most mothers did not have any breast-feeding problems (99%). It is only 1% of lactating mothers who experienced the problem of cracked nipples and little or no milk production. This could have been associated to hormonal imbalances. Most women agreed that there were special foods for lactation (86.5%). Only 13% did not agree, while 1% did not know. A study found out that 43.8% of lactating mothers in the rural Nandi were anaemic mainly due to inadequate food intake and hard physical labour (Etyang et al; 2003).

4.5 Health related factors that affected the iron status of mothers.

4.5.1 Illness

The effects of chronic and acute bacterial, parasitic and viral infections on erythropoieses, haemolysis, catabolism and food appetite are widely documented on the effects of Hb levels (Lassey et al; 1999). From the study a total of 23% and 53% of the lactating and non-lactating mothers respectively had complaints that they usually had a certain ailment. The main complaints were on ulcers and acidic stomach (17%), stomach ache (8%), Malaria (3%), chest problems (5%), Hypertension (5%), allergy (5%), Goitre (1%), tonsils (3%), typhoid (2%), diabetes (4%), anemia (2%), backache, headache, eye ache (18%), caesarean wounds (1%). About 43% of the respondents sought doctors attention for the more complicated ailments like diabetes, hypertension anemia and others, or buy on the counter drugs for lesser complicated ailments like headache, stomachache. There was a case of someone who sought treatment from traditional healers. Geophagy was noted in one non-pregnant woman who did not know the cause of such kind of a pica. From the clinic data incidences of parasitic infestations like hookworms were few. This is in agreement with Multiple Indicator Cluster Survey, 2000 report that the access rate to safe drinking water and fecal waste disposal and general sanitation is above 90% in urban areas which is important to the health and nutritional status of the population.

Respondents' parity

The number of children one has determines or influences the food consumption patterns and hence influences the Hb levels. Also a short birth interval may jeopardice maternal health and compromise replenishment of maternal stores. Table 4.10 shows the distribution by parity of the mothers in Makongeni.

Table 4.10. Distribution of the respondents by parity among lactating and non-lactating mothers.

Parity (number of Children)	Status Lactating n=100	Non-lactating n=100	Total
1	46	26	72
2	32	17	49
3	18	18	36
4-7	4	9	13
None	0	30	30
Total	100	100	200

Most of the mothers had 1-3 children. It is only one woman who had 7 children. Few mothers (7%) reported that they had a child or two dead. Delay in birth intervals will avoid maternal nutrient depletion (UNICEF,1998).

4.6 IRON DEFICIENCY ANAEMIA

4.6.1 Symptoms of anaemia

Iron deficiency anaemia is the end stage of a relatively long process of deterioration in hb levels. Hb levels are indicators of final stage of IDA. Figure 4.5 shows the distribution on symptoms of anaemia for mothers in Makongeni.

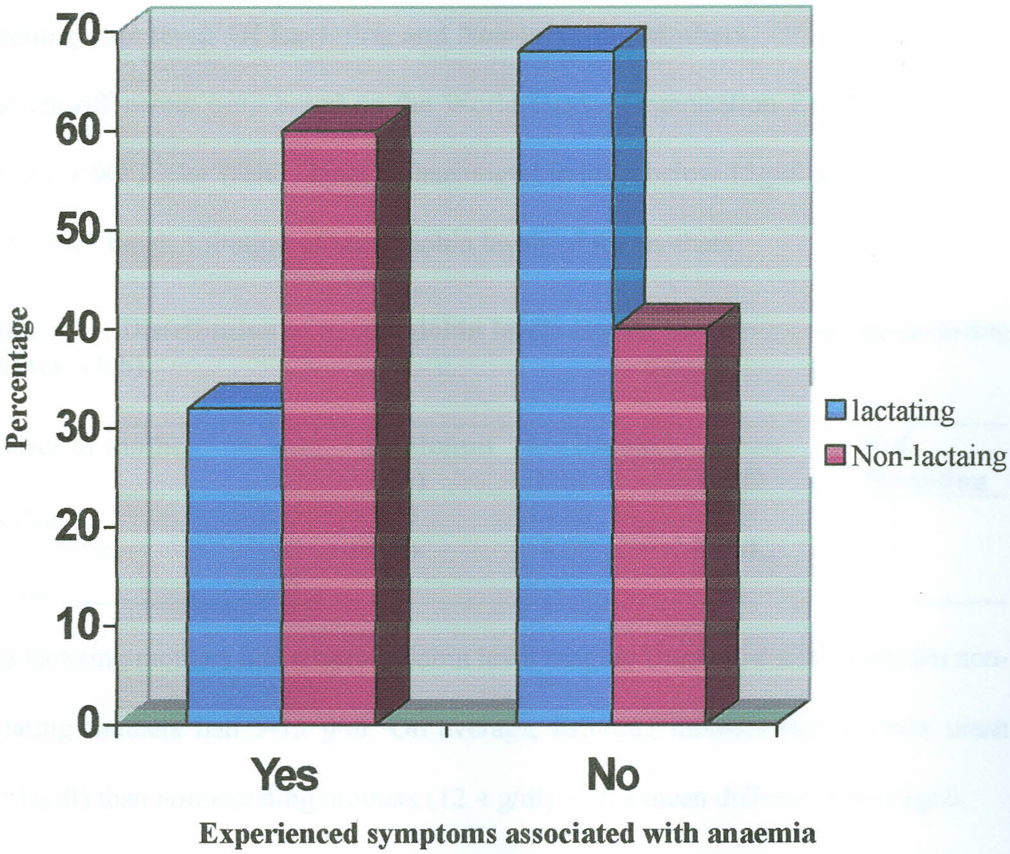


Figure 4.5 Distribution by the symptoms associated with anaemia for the mothers.

A big percentage, 32% and 60% of lactating and non-lactating mothers respectively complained of fatigue and dizziness. Of these 26% and 47% of the lactating and non-lactating mothers respectively rest, 2% and 6% sought doctors advice. Most of the complaints were not associated with any form of anaemia. In a study on an Ethiopian population ,it was reported that there was a high prevalence of anaemia (76%) and severe anaemia (10%) in respondents who complained of ear buzzing, fatigue, parlour and dizziness(Gies et al;2005).

Haemoglobin levels Of Lactating and Non-lactating Mothers

The cut-off points were based on the World Health Organisation Recommendations (WHO, 1989) .The WHO identifies haemoglobin level below 12g/dl as being anemic. Table 4.11 the distribution of hemoglobin levels of the mothers.

Table 4.11. Distribution of haemoglobin levels among lactating and non-lactating mothers (Hb)

Status of mother	n	Minimum (Hb)	Maximum (Hb)	Mean (Hb)	Std. Deviation
Lactating	100	7.00	14.00	12.1	1.1
Non-lactating	100	9.00	15.00	12.4	1.1
Total	200				

The lactating mothers had a haemoglobin level ranging from 7-14 g/dl, while the non-lactating mothers had 9-15 g/dl. On average, lactating mothers had a lower mean (12.1g/dl) than non-lactating mothers (12.4 g/dl) with a mean difference of 0.3g/dl.

4.6.3 Classification of respondents' haemoglobin cut offs based on the WHO.

Iron deficiency is the end stage of a relatively long process of deterioration of Hb levels, based on the World Health Organisation Recommendations. A cut-off of <7g/dl as severe anaemia, 7-10.9g/dl moderate anaemia, 10.8-11.9g/dl as mild anaemia and 12-16g/dl as normal was used to categorise the haemoglobin levels. WHO identifies Hb levels below 12g/dl for non-pregnant mothers as being anaemic (Brabin et al, 2001).

Hemoglobin cut-offs among lactating and non-lactating mothers .

Figure 4.6 shows the haemoglobin levels of the mothers.

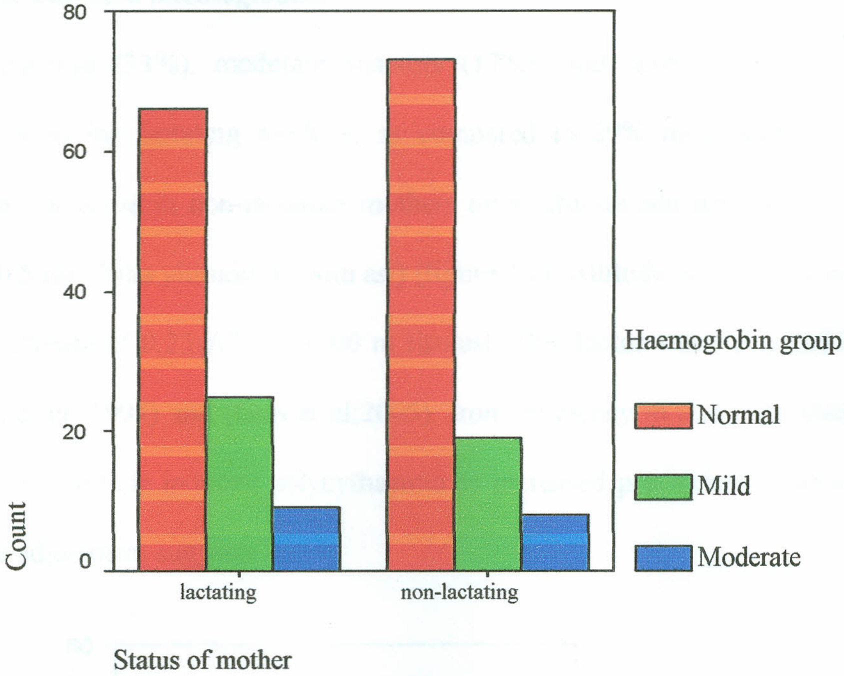


Figure 4.6: Haemoglobin levels for lactating and non-lactating mothers.

In general most of the lactating mothers (66%) had normal haemoglobin levels (12-16g/dl) as compared to (25%) who had mild anaemia (10.9-11.9g/dl) and (9%) who had moderate anaemia (7-10.8g/dl). In comparison 73% of the non-lactating mothers had normal haemoglobin levels, 19% had mild anaemia and 8% had moderate anaemia. Nevertheless, since IDA is the final stage of Hb levels deterioration, many persons are sufffering from iron deficiency, with its adverse effects on health and physical stamina, than are frankly anemic. The findings compared well with Etyang et al;(2003) report, that 43.8% lactating mothers in rural Nandi were anaemic compared to the prevalence of 43% in non-pregnant women in developing countries. In a rural area in Northern Natal a prevalence of anaemia in females 6-74 years was found to be 52% Ahmed et al;(2001). While in Bangladesh Ahmed et al; (1997) found a prevalence of 44% among adolescent female garment factory workers with rural roots having Hb <12g/dl.

Altitude adjusted haemoglobins:

Mild anaemia (33%), moderate anaemia (17%), and severe anaemia (1%) was prevalent in the lactating mothers, as compared to 29% mild anaemia and 15% moderate anaemia in non-lactating mothers after altitude adjustment at a calculated factor 0.5 for Thika altitude (1700m asl) (figure 4.7). Altitude adjustments were based on an increase of 0.25g/dl per 1000 m rise asl. This factor was suggested by WHO, (Dirren et al; 1994) and (Gies et al;2005). Iron deficiency in this population may be masked by altitude induced polycythaemia as increased prevalence of anaemia after altitude adjustment suggests.

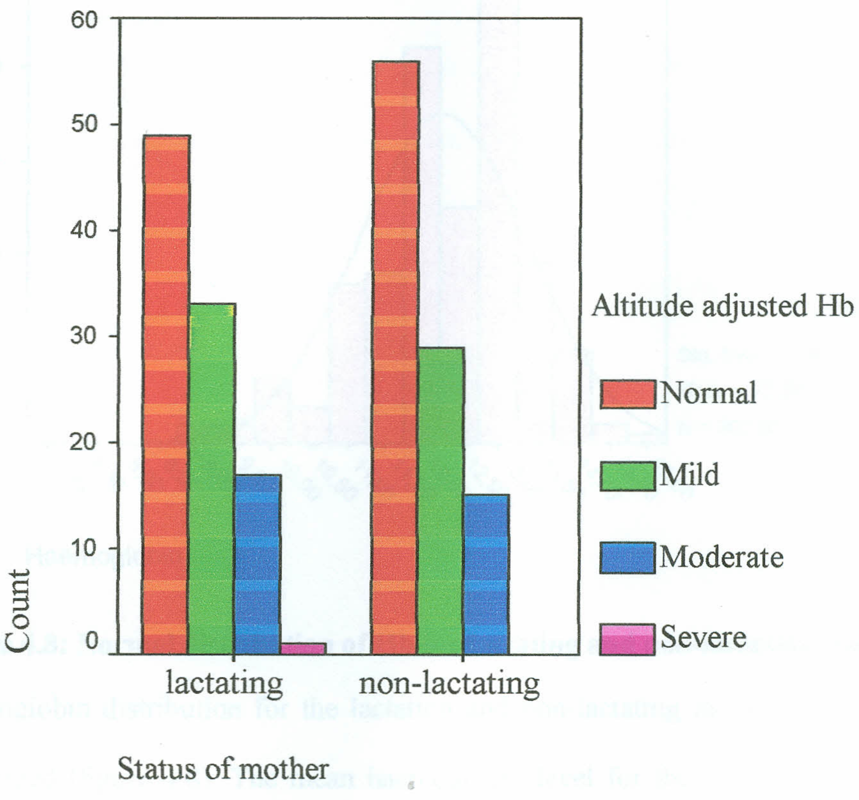


Figure 4.7: Altitude adjusted haemoglobins

Altitude adjusted haemoglobins revealed masked anaemia. There was one case of severe anaemia, while mild and moderate cases of anaemia increased. These results concur with the Micro-nutrient Survey (1999) whereby 47.9% of the non-pregnant mothers were anaemic. It should be noted that Thika as a cosmopolitan town has reported high prevalence of HIV/AIDS and though it was not investigated could have influenced the Hb levels of the mothers. In 1998 prevalence was reported to be 34% but MOH report of 2003 showed a decline to 8%. However, the decline in prevalence does not necessarily mean a decline in the rates of new infections. The decline could mean increased deaths (more deaths than infections) or it may mean actually new infections have reduced.

Normal distribution of Hb for mothers

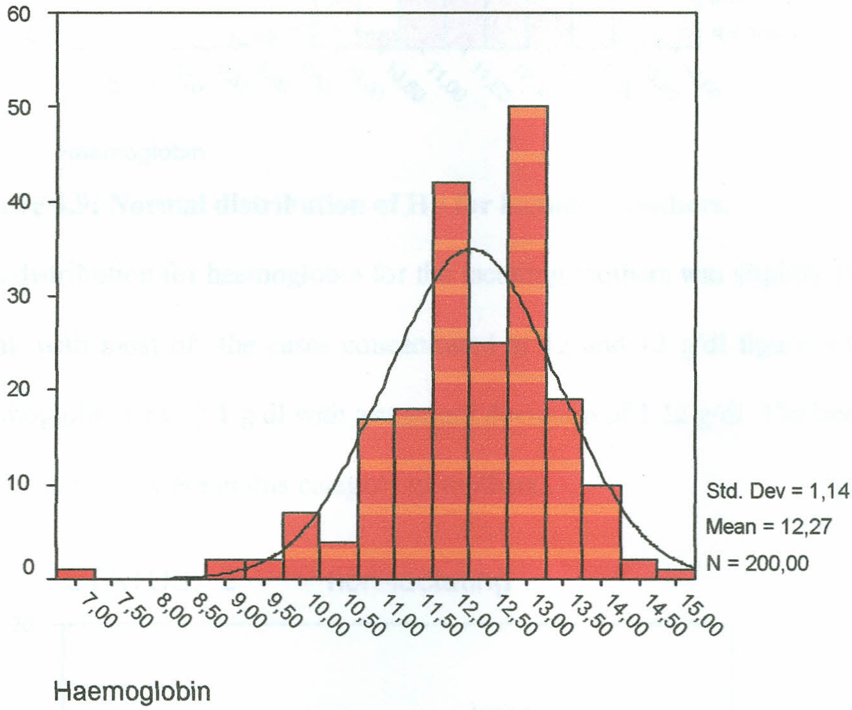


Figure 4.8: Normal distribution of Hb for lactating and non-lactating mothers.

Haemoglobin distribution for the lactating and non-lactating mothers was normally distributed (figure 4.8). The mean haemoglobin level for the two categories of the mothers was 12.3g/dl with a standard deviation of 1.14g/dl. The lowest recorded reading was 7g/dl and the highest was 15g/dl. These results are in agreement with other studies that women of child bearing age are at risk of iron deficiency throughout the reproductive years and not only during pregnancy (UNICEF, 1998.Viteri, 1997b, Massawe, 2000).

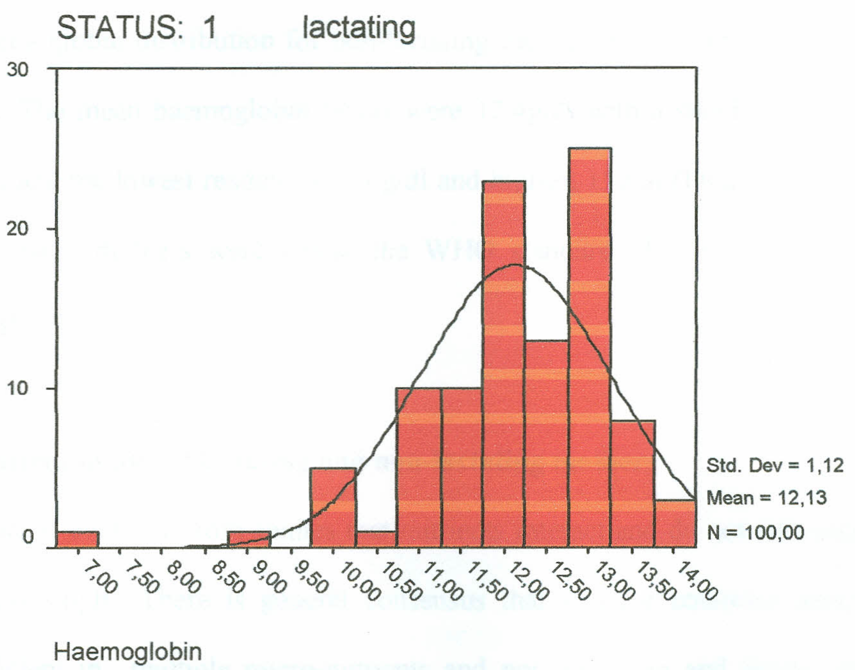


Figure 4.9: Normal distribution of Hb for lactating mothers.

The distribution for haemoglobin for the lactating mothers was slightly skewed to the right, with most of the cases concentrated at 12 and 13 g/dl figure 4.9. The mean haemoglobin was 12.1 g/dl with a standard deviation of 1.12 g/dl. The lowest readings of 7 and 9 g/dl were in this category of mothers.

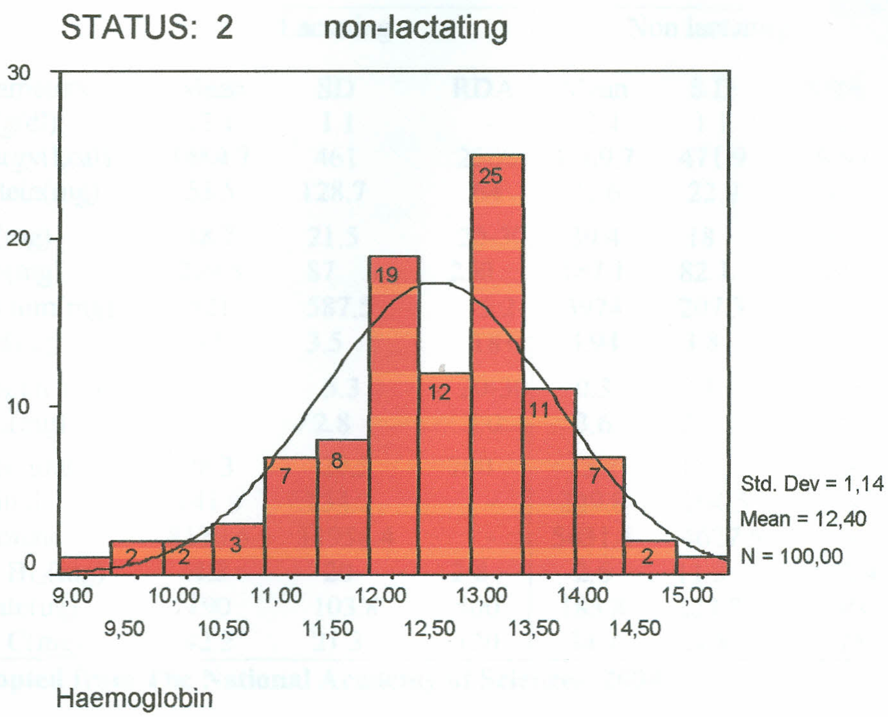


Figure 5.0: Normal distribution of Hb for non-lactating mothers .

Haemoglobin distribution for non-lactating mothers was normally distributed Figure 5.0. The mean haemoglobin levels were 12.4g/dl with a standard deviation of 1.14 g/dl and the lowest readings of 9 g/dl and highest 15g/dl (Figure 5.0). This indicates that most mothers were within the WHO standard of 12g/dl Hb levels for non-pregnant mothers.

Nutrient intake of lactating and non-lactating mothers

There is evidence from studies that nutrients interact and do not influence nutritional status singly. There is general consensus that in poor countries diets tend to be deficient in multiple micro-nutrients and not only iron and folate. Deficiency in vitamin B_{12}, vitamin A as well as zinc also contribute to anaemia. Table 4.12 shows mean Hb and nutrient intake of the mothers.

Table 4.12. Mean haemoglobin and nutrient intake of lactating and non-lactating mothers

	Mothers nutrient intake status						
	Lactating			Non lactating			
Parameters	Mean	SD	RDA	Mean	S.D	RDA	P=0.05
Hb(g/dl)	12.1	1.1	-	12.4	1.1	-	0.087
Energy(kcal)	1484.7	461	2500	1269.7	471.9	2000	0.087
Protein(mg)	53.5	128.7	64	42.6	22.9	44	0.002
Fat(mg)	38.7	21.5	20-30	39.4	18	20-30	0.403
Cho(mg)	229.5	87	250	187.1	82.1	250	0.809
Calcium(mg)	521	587.5	5.2	3974	207.3	1.2	0.049
Iron(mg)	6.5	3.5	18+	4.94	3.8	18	0.003
Copper(mg)	1	5.3	20-30	0.3	0.3	20-30	0.178
Zinc(mg)	4.6	2.8	7.0	3.6	2.3	5.5	0.004
Selenium(mg)	28.3	29.5	700	13.4	11	700	0.000
Retinol	141.9	134.2	-	249.8	104.5	-	0.314
Carotene	8170.5	11956.4	-	5431.4	4627.5	-	0.034
Vit. B_{12}(mg)	4.3	20	2.8	2.6	11.3	2.4	0.440
Folate(ug)	190	103.8	500	183.8	224.2	400	0.803
Vit. C(mg)	42.2	21.3	120	34.7	24.8	75	0.022

Adopted from The National Academy of Sciences, 2004.

The energy mean intakes for the lactating mothers (1485 Kcal) and non-lactating mothers (1290Kcal) were significantly below the RDA for an adult woman 15-50 years (2000-2500kcal). These results are in agreement with Waudo et al; 2005 that Kenyan women have low RDA for calorie intake as compared to Uganda and Tanzania . The mean intakes for other macronutrients were normal. These findings are in agreement with Waudo et al; 2005 that women in East Africa have better protein intake while the nutrients whose deficiency is associated with anaemia like folic acid, vitamin B_{12} and C mean intakes were significantly lower than the RDAs.

There were significant differences in energy with lactating mothers showing higher mean intake levels. This difference in energy intakes could have been attributed to the fact that lactating mothers culturally are given better nutritional attention more than any other time of reproductive cycle.

The copper intakes were higher in lactating mothers than their non-lactating counterparts ($p>0.05$). As regards vitamins, there were significantly higher readings for retinol, for lactating mothers as compared to non-lactating mothers. There was a statistical significance of Haemoglobin and protein, iron, zinc, selenium carotene and vitamin C at ($p<0.05$).With increased calorific intake, the level of other nutrient intakes also rises up (Kigutha, 1995). Most of the nutrient intake levels were below the RDA. The results are in agreement with Ruto (1999) study that 43% of women in sub-Saharan Africa do not get enough calories with a large number having anaemia. It also agrees with studies done in India which state that though rich women eat around 2500kcal a day, poor women eat around 1400kcal a day. The need for a national research to determine the extent of these other deficiencies has been emphasized as it is important on supplementation policies for vulnerable groups.

Table 4.13 Mean Hb values distribution by education levels, religion, marital status and ethnic background among lactating and non-lactating mothers .

	Mean	Std. Deviation	n
Education level			
Primary and below	12.3	1.0	65
Secondary school	12.3	1.1	102
College	12.1	1.3	30
University	13.6	1.3	3
Total	12.3	1.1	200
P=0.155, R=0 .162, R^2= 0.026			
Religion			
Orthodox	13.4	0.5	2
Catholic	12.2	1.1	50
Protestant	12.3	1.2	137
Islam	12.3	0.6	5
7th day Adventist	12.4	0.8	4
Traditional	12.5	0	1
Jehovah witness	12.0	0	1
Total	12.3	1.1	200
P. =0.919, R=0.101, R^2=0.01			
Marital status			
Single	12.2	1.1	48
Married	12.3	1.2	150
Widowed	12.9	1.3	2
Total	12.3	1.1	200
P=0.723, R=0.057, R^2=0.003			
Ethnic background			
Kikuyu	12.3	1.1	120
Kalenjin	14.5	0.7	2
Giriama	12.2	1.0	3
Marakwet	13.5	-	1
Embu	12.5	1.1	6
Meru	12.0	1.1	11
Kamba	12.2	0.9	26
Luhya	12.1	1.9	17
Luo	12.1	1.3	10
Somali	12.0	0.5	3
Boran	13.0	-	1
Total	12.3	1.1	200
P= 0.444. R=0.236, R^2 =0.056			

Respondents who attained university education had the highest haemoglobin levels (13.6 g/dl), followed by secondary school (12.3 g/dl), primary (12.3 g/dl), college, (12.1g/dl) (Table 4.13). There were no statistical differences in means by education groups at p=0.155. This may be due to the fact that even among the ones who were educated their incomes were low, poor source of iron in their diets and poor bioavailability. Hence they may not access iron rich foods. Another factor could be the source of iron in the diet versus bioavailability. It should however be noted that there was no equal representation of different education levels due to the sampling method employed.

The Hb means by religion were similar with small standard deviations and ranging from 12.3-13.4 g/dl (Table 4.13). Orthodox were the highest (13.4 g/dl), though they were 1%. The study indicates that 64% were protestants, 25% Catholics, 2.5% Islam, this compares with KDHS 2003 where 65% were protestants, 26% Catholics, 7% Islam respectively. Haemoglobin means were similar by religion, indicating that it was not a significant factor (P=0.919) for haemoglobin determination in Makongeni mothers. Marital status was not a significant factor (p=0.723) indicating almost similar group means, with the single having the least (Table 4.13). The number of married women were 75% which compares with 60% KDHS (2003). KDHS (2003) indicate 24% singles and 1% widowed. Ethnic background was not a significant factor (P= 0.444) in determining the distribution of haemoglobin (Table 4.13). There were similar means in haemoglobin across the ethnic strata.

Table 4.14 Comparison of haemoglobin mean by age among lactating and non-lactating mothers .

Age (years)	Mean	Std. Deviation	n
15-20	11.9	1.2	17
21-30	12.3	1.1	123
31-40	12.2	1.2	47
41-50	12.5	1.3	13
Total	12.3	1.1	200

P=0.428, R=0.118, R^2=0.014
F-ratio between groups =2.863, P= 0.092
F-ratio within groups= 0.917, P=0.434

Age was not a significant factor (P=0.428) that differentiated the means in haemoglobin (Table 4.14). Teenagers (15-20) had the lowest haemoglobin level (11.9 g/dl), while the older women (41-50) had the highest haemoglobin levels (12.5g/dl).

Table 4.15 Comparison of haemoglobin mean by average monthly income and number of dependants among lactating and non-lactating mothers .

	Mean	Std. Deviation	n
Average monthly income			
2000 and below	12.6	0.7	10
2001-3000	12.6	0.6	12
3001-4000	12.1	1.3	17
4001-5000	12.4	0.7	19
5001-6000	12.2	1.2	11
6001-7000	12.1	1.3	6
7001-8000	11.3	2.0	3
8001-9000	11.4	0.7	2
9001-10000	12.6	1.0	4
Above 10000~	13.0	0.9	25
None	12.1	1.2	91
Total	12.3	1.1	200
P=0.043, R=0.304, R^2= 0.093			
Number of dependants			
None	12.3	0.8	5
1	12.1	1.0	3
2-4	12.3	1.1	120
5 and above	12.3	1.2	72
Total	12.3	1.1	200
P=0.98, R=0.031, R^2=0.001			

The highest income group (over 10,000) (Table 4.15) had the highest mean haemoglobin levels (13.0 g/dl). The 7001 –8000 income group had the lowest mean haemoglobin (11.3 g/dl). Income was significantly different (p=0.043) between the income groups. The National survey on household food security reported that 23% of Kenyans come from households where members are unlikely to meet their minimum requirements even if the household concentrated all its spending on food (Etyang et al, 2003). In a study undertaken in a low-income peri-urban community who were considered at risk in relation to nutrient intake, Iron was a problem of health significance among all members of the family including lactating mothers. This study found the same trend. There were similar haemoglobin means of 12.3g/dl at (p=0.98) through number of dependants that the mothers had (Table 4.15). It is only those with 1 dependant that had 12.1 g/dl.

Table 4.16. Comparison of haemoglobin mean by the type of cooking pot among lactating and non-lactating mothers .

Cooking pot used	Mean	Std. Deviation	n
Stainless steel	13	0.7	2
Aluminium	12.3	1.1	158
Aluminium and earthenware	11.9	1.2	38
Total	12.3	1.1	200

P=0.597, R=0.098, R^2=0.01

The means in haemoglobin by cooking pot type (Table 4.16) was stainless steel (13.0 g/dl) in Makongeni, while those within the lowest values were those who used aluminium and earthen pot (11.9 g/dl). Type of cooking pot was not a significant factor (P=0.597) in determining the haemoglobin values. This could have been attributed by the fact that those who used the earthenware pot used it rarely or once a week in boiling foods that take long to cook. Studies have proved that earthen pots can mitigate against iron deficiency (Micro-nutrient Survey report, 1999).

Table 4.17. Comparison of haemoglobin mean by last date of taking deworming tablets among lactating and non-lactating mothers .

De-worming schedule (months)	Mean	Std. Deviation	N
3	12.4	1.2	26
6	12.4	1.1	10
9	12.3	1.3	7
>12	12.3	1.1	99
Never	12.1	1.1	58
Total	12.3	1.1	200

P=0.763, R=0.259 R^2= 0.067

The haemoglobin levels were highest in those women who had taken deworming pills 6 and 3 months ago (12.4g/dl) as compared to those who had never taken deworming pills (12.1 g/dl). The diferences were not siginficant (P=0.763). Those who took deworming pills recently had the highest mean (Table 4.17).

Mean Hb values distribution by Lactation and parity

Prolonged breastfeeding and child spacing is essential because it elongates birth intervals which is necessary for the nutritional status of the mother (Ruto,1999).

Table 4.18. Comparison of haemoglobin mean by duration of lactation and parity of mothers .

	Mean	Std. Deviation	n
Duration (Months)			
1-6	12.0	0.8	11
6-12	12.2	0.5	3
Above 12	12.1	1.2	86
Non lactating	12.4	1.1	100
Total	12.3	1.1	200
P= 0.393, R= 0.123, R^2= 0.015			
Number of children			
1	12.2	1.1	73
2	12.4	1.3	49
3	12.6	0.9	36
4	11.8	1.4	5
5	11.7	1.5	5
6	14.0	-	1
7	10.0	-	1
None	12.1	1.0	30
Total	12.3	1.1	200

P=0.097, R=0.259, R^2=0.067

Those who had lactated for 1-6 months had the lowest serum haemoglobin (12.0g/dl), while those who had lactated longer 12 months had (12.1 g/dl). The non-lactating average was (12.4g/dl). The differences were not statistically significant (p=0.393) (Table 4.18). A total of 80% of the lactating mothers had normal deliveries and 20% caeserian section compared to 58% of normal delivery and 12 % of caeserian section for the non-lactating mothers. The mothers who had caeserian mode of delivery and were <4 months had a lower Hb levels as compared to their counterparts who had normal deliveries. There was no significant difference in haemoglobin levels by duration of lactation among the mothers in Makongeni. Studies have shown that the length of lactation has the effect of delaying the return of ovulation and therefore increases birth interval which influences the nutritional status.

Most of the non-lactating mother had their last pregnancy more than 5 years ago (24%). And many did not intend to have many children due to economic hardships.

Gravidity ranged from 1-7 with 37% primigravidae. The highest haemoglobin level was (14 g/dl) with one woman who had 6 children. The lowest Hb by parity was for the primary level lactating mother who had 7 children (10g/dl), as compared to the University graduate who had 6 children with a Hb of 14g/dl. Few mothers (7%) reported that they had a child or two dead and was not associated with any nutritional cause (Table 4.18). There was no statistical difference (P=0.097) in haemoglobin groups by parity.

Table 4.19 Comparison of haemoglobin mean by illness and type among lactating and non-lactating mothers .

	Mean	Std. Deviation	n
Illness			
Yes	12.0	1.2	76
No	12.4	1.1	124
Total	12.3	1.1	200
$P=0.763$ $R=0.097$ $R^2=0.009$			
Type of illness			
Malaria	11.6	0.5	3
Chest problem	11.8	1.3	5
None	12.5	1.1	124
Stomachache	12.9	1.1	9
Ulcers/ acidic stomach	11.8	0.8	18
Allergy	11.4	1.1	5
Goitre	12.8	.	1
Hypertension	12.1	0.8	5
Tonsils	12.7	1.5	3
Caeserian section wounds	10.0	.	1
Typhoid	10.7	1.6	2
Diabetes	11.8	1.4	4
Anaemia	11.2	2.5	2
Back/head/eye ache	11.8	1.6	18
Total	12.3	1.1	200

$P=0.082$, $R=0.380$. $R^2=0.145$

The type of illnesses were not statistically significant in the determination of the haemoglobin levels of mothers in Makongeni at p=0.082 (Table 4.19).

Those who had a type of illness 2 weeks prior to the study had a lower haemoglobin value (12g/dl) than those who were well (12.4 g/dl) (Table 4.19). The diferences were not siginficant (P=0.763).

Mean Hb values distribution by cotraceptives and type,and length of menses.

The volume of menstrual blood lost is relatively constant for a given woman from month to month, but it varies greatly from woman to woman due to different factors. Some contraceptives have side effects that either reduce or increase monthly blood loss. Several studies have shown that the median blood loss during menses range between 25-30 mls per month. This represents an iron loss of 12.5-15 mg per month, or 0.4-0.5 mg per day over 28 days when basal losses are added the total iron loss is 1.25 mg per day. This means that iron requirements of 50% of all women are in excess of 1.25 mg/day. Taking into account the skew of the frequency of distribution of menstrual blood loss one can calculate that only 2.5% of women have iron requirements in excess of 2.4 mg/day. Table 4.20. Shows the comparison of haemoglobin mean by use of contraceptives and type,and length of menses among lactating and non-lactating mothers in Makongeni.

Table 4.20. Comparison of haemoglobin mean by use of contraceptives and type,and length of menses among lactating and non-lactating mothers .

	Mean	Std. Deviation	n
Contraceptive methods used			
Pills	12.3	1.0	34
Iud	11.4	1.7	9
Depo-Provera	12.7	0.7	53
Condoms	12.5	0.7	2
Norplant	12.2	1.2	10
Natural	12.7	0.7	5
None	12.1	1.3	83
Tubal ligation	11.1	1.3	4
Total	12.3	1.1	200
$P=0.008$, $R=0.305$, $R^2=0.093$			
Duration of menses			
2-4 days	12.2	1.2	123
4-6 days	12.4	1.2	13
6-8 days	12.1	0.7	8
More than 8 days	10.7	1.8	2
None at the time of the study	12.4	1.0	39
Spotting	13.7	0.8	4
After 2 months heavy prolonged & Irregular	12.1	0.8	3
Irregular	12.6	0.9	8
Total	12.3	1.1	200
$P=0.106$, $R= 0.243$, $R^2=0.059$			

A total of 67% and 51 % of the lactating and non-lactating mothers respectively used a method of family planning. The method commonly used was the Depo-Provera followed by the pills. Those who used the IUD had a lower mean haemoglobin level, which could be attributed to, the heavy menstrual flows caused by the type of contraceptive. The highest means were those who used Depo-Provera (12.7 g.dl) and natural methods, (12.7 g.dl) while the least was the IUD (11.4 g.dl) and tubal ligation (11.1 g/dl) (Table 4.20). Contraceptives were significant (P=0.008) in determining the serum haemoglobin for the mothers in Makongeni. This study compares with KDHS 2003 which corroborates trends in contraceptive method mix, namely a continuing increase in use of injectables (depo-provera) and decrease in use of pills, IUD as was the case in earlier KDHS reports. Contraceptives prevalence peaks among women 35-39 years and least in 15-20 years. Menstrual blood loss was not significant in haemoglobin determinations for the mothers at p=0.106 (Table 4.20).

Mean Hb values distribution by Oral iron supplementation

Iron supplementation acts in reversing anaemia in some individuals and prevent it from developing.

Table 4.21. Comparison of haemoglobin mean by oral iron supplementation and frequency of supplementation among lactating and non-lactating mothers .

	Mean	Std. Deviation	n
Oral iron supplements			
Yes	11.8	1.3	14
No	12.3	1.1	186
Total	12.3	1.1	200
P= 0.137, R= 0.106, R^2=0.011			
Frequency			
Daily	11.4	1.5	8
Monthly	12.1	0.9	6
None	12.3	1.1	186
Total	12.3	1.1	200
P=0.077, R=0.06, R^2=0.026			

The women who did not take iron supplements had the highest means (12.3g/dl) as compared to those who took iron supplements (11.9 g/dl), though the difference was not significant (p=0.137) in determining the haemoglobin levels (Table 4.21).

The women who did not take iron supplements had the highest mean serum haemoglobin (12.3 g/dl), while those who took daily had the lowest 11.4 g/dl though the difference was not significant (p=0.077) (Table 4.21).

Mean Hb values distribution by feacal waste disposal, water source and waste disposal.

Access to decent sanitary/fecal waste disposal is important in determination of health and nutrition status of the population. The access to decent safe drinking water is important in health and nutritional status of the people. Unclean drinking water exposes individuals to different microbial infestations such as amoeba, E. coli which have detrimental effects on the health and nutritional status of the people. A clean environment will enhance the health status of the population hence better food and nutrient intake. Table 4.22 shows the distribution by faecal waste disposal, water source and waste disposal.

Table 4.22. Comparison of haemoglobin mean by type of toilet, water source and waste disposal among lactating and non-lactating mothers .

	Mean	Std. Deviation	n
Type of toilet			
Closet type	12.3	1.2	179
Pit latrine	12.1	1.0	21
Total	12.3	1.1	200
P= 0.41, R=0.06, R^2=0.004			
Water source			
Tap water	12.3	1.2	193
Borehole	11.3	0.4	2
Roof catchments	12.0	-	1
River	11.5	-	1
Dam, /spring/roof catchments	12.8	0.4	3
Total	12.3	1.1	200
P=0.734,R=0.118, R^2=0.014			
Mode of waste disposal			
Municipal garbage collection	12.6	1.0	14
Garbage pit	12.1	1.4	33
In the open ground	12.3	1.1	153
Total	12.3	1.1	200
P=0.383, R= 0.098, R^2=0.01			

The women who used closet type of toilet (12.3 g/dl) had better mean serum haemoglobin than those who used pit latrines (12.1g/dl), though the difference was not significant (p=0.41) (Table 4.22).

The women who used dam or spring and roof catchments had the highest serum haemoglobin levels (12.8 g/dl); as compared to those who used bore hole (11.3g/dl) and river water (11.5 g/dl). Water source was not statistically significant (P=0.734) (Table 4.22). The access rate to safe drinking water was 97%. This was in agreement with the Multiple Indicator Cluster Survey (2000) that the access rate for safe drinking water is 89.7% in urban areas (Mukui, 2000).

Mothers who disposed their house hold waste through organised municipal garbage collection had a higher haemoglobin (12.6g/dl) than those who used garbage pit (12.1g/dl). The study revealed an average level of sanitation in the study area. All respondents came from families that had either a pit latrine or closet type of toilet, tap water but garbage disposal was poor (Table 4.22). But they were all not statistically significant (P=0.383). The results are in agreement with 1999 population and housing census that showed that Central province of Kenya has highest access to decent sanitary facility (99.1%) (Mukui, 2000). In the present study most families had piped water and acceptable modes of sanitation.

Correlation between Haemoglobins and other nutrients

Consumption of other nutrients was factored in because they equally affect the mobilization of depot iron and dietary iron into the tissues. For example, Calcium is the only reported dietary inhibitor of both heme- and nonheme-iron absorption. It has been proposed that the 2 forms of iron enter a common pool in the enterocyte and that calcium inhibits the serosal transfer of iron into blood (Roughead et al 2005) .

Table 4.23. Correlations between haemoglobin and vitamin intake among lactating and non-lactating mothers in Makongeni

	Hb	Iron	Retinol	Carotene	Vitb12	Folate	Vit. C
Hb	1.000						
Iron	-0.068	1.000					
Retinol	-0.008	0.275**	1.000				
Carotene	0.054	0.164*	0.037	1.000			
Vit.B_{12}	0.017	0.432**	0.485**	0.006	1.000		
Folate	-0.018	0.515**	0.177*	0.195**	0.294**	1.000	
Vitamin C	-0.115	0.304**	0.040	0.309**	0.069	0.448**	1,000

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Iron was significantly related to all vitamins, with a strong correlation with folate(r=0.515, p<0.01). The weakest correlation for iron was carotene (r= 0.164, p<0.05). Hb correlated negatively with retinol (r = -0.008, P<0.05), Folate(r = -0.018, P<0.05) and Vitamin C (r = -0.115, P> 0.05) (Table 4.23).

Table 4.24. Correlations between haemoglobin and mineral intake among lactating and non-lactating mothers in Makongeni

	Hb	Iron	Calcium	Copper	Zinc	Selenium
Haemoglobin	1.000					
Iron	-0.068	1.000				
Calcium	-0.051	0.341**	1.000			
Copper	0.022	0.057	0.059	1.000		
Zinc	-0.039	0.785**	0.412**	0.067	1.000	
Selenium	0.004	0.503*	0.254**	0.109	0.492**	1.000

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Iron indicated a positive significant correlation with most minerals, including calcium (r=0.341, p<0.01), zinc (r= 0.785, p<0.01), and selenium (r=0.503, P<0.05). Calcium was also significantly related to zinc (r=0.412, p<0.01) and selenium (r= 0.254, p<0.01). Copper relationships were not significant. Hb correlated negatively with iron (r = -0.06, P>0.05), Zinc (r = - 0.039, P<0.05) (Table 4.24). These nutrients were included in the study since they were considered important for the health of the woman and are very strong indicators of nutrition security. Iron consumption and the related nutrients affect the Hb levels. Calcium affects the absorption of iron while the other minerals enhance iron uptake. Vitamin C helps in the absorption of iron in the gut by helping to change it into a soluble compound absorbable through the gut wall. The parameters that were significantly independently related to haemoglobin included protein, fat, folate, while carotene indicated a negative regression on haemoglobin, though it was not significant.

Table 4.25. Correlations between macronutrient consumption and serum Hbs

	Lab Hb	Energy	Protein	cho	Fat	Iron
Lab Hb	1.000					
Energy	0.075	1.000				
Protein	-0.074	0.158*	1.000			
Cho	0.144*	0.850**	0.046	1.000		
Fat	0.021	0.584**	0.203*	0.196*		
Iron	-0.068	0.578	0.117	0.468	0.426	1.000

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed)

There were significant positive correlations between haemoglobin and CHO ($r=0.14$, $p>0.05$). Hb correlated negatively with protein ($r= -0.074$, $p>0.05$). Protein and energy also correlated significantly at ($r= 0.158$, $P>0.05$). Fat levels were also significantly related to energy ($r=0.584$, $p>0.01$), protein ($r=0.203$, $p>0.05$) (Table 4.25).

Table 4.26. Estimated multivariate determinants for nutrient intake on haemoglobin levels

Dependent	t	P=0.05
Energy	2.3	0.023
Protein	0.73	0.464
Fat	-0.87	0.387
Cho	-2.3	0.023
Dietary fibre	0.06	0.804
Calcium	-1.3	0.205
Iron	0.472	0.637
Copper	1.67	0.098
Zinc	-2.07	0.039
Selenium	1.1	0.259
Retinol	-0.730	0.509
Carotene	0.59	0.442
Vit.B12	0.479	0.633
Folate	-0.730	0.509
Vitamin C	0.964	0.337

By multiple regression analysis, intake of energy, CHO and zinc were found to have a significant independent relationship with haemoglobin levels. The overall t- ratio was significant for CHO, energy and zinc at $p<0.05$ (Table 4.26). Studies done by Ahmed et al 2001, Massawe et al 2005 showed that vitamin A and other nutrients play an important role in the haematological response to iron .

Bivariate linear associations for nutrient intake behaviour

Nutrients that influence the uptake of iron showed a positive linear relationship. The nutrients include copper, zinc, selenium, Vitamin C & B_{12}, folate and retinol.

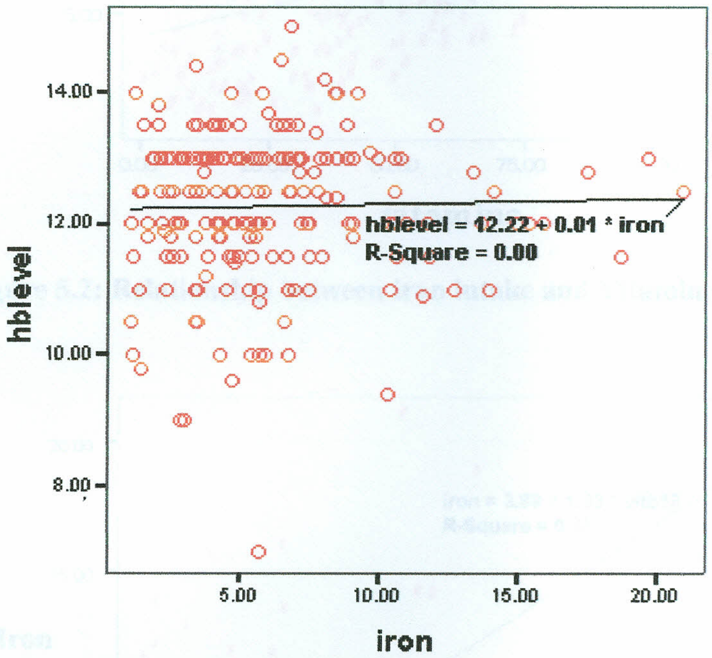


Figure 5.1: Relationship between haemoglobin and iron intake

A positive linear relationship between iron and Hb levels varied together in the same direction such that a increase in iron intake did not affect the Hb levels (Figure 5.0) It can be concluded that the Hb levels were not influenced by dietary iron intake alone other factors may have influenced. The direction also could be attributed to the fact that dietary information given was for one day by the data that were collected for the 24 hour dietary recall.

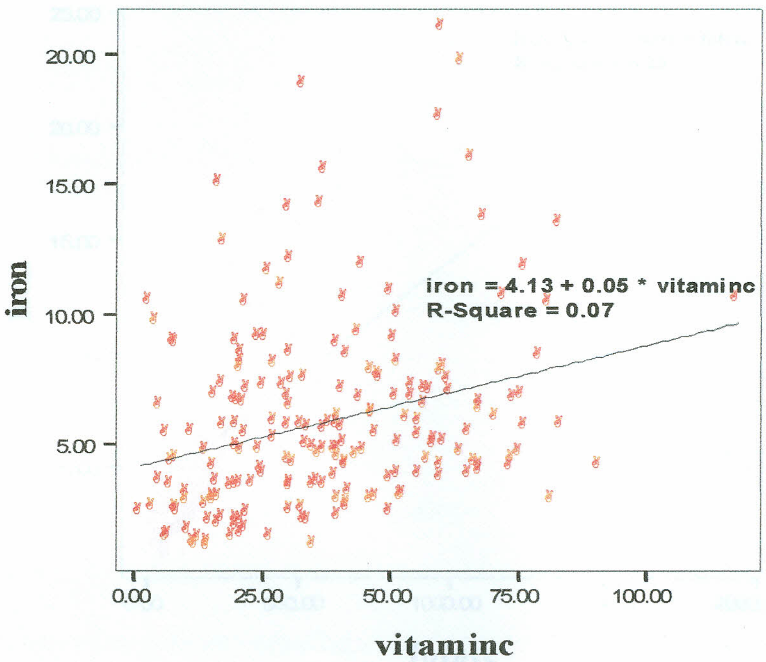


Figure 5.2: Relationship between iron intake and Vitamin C

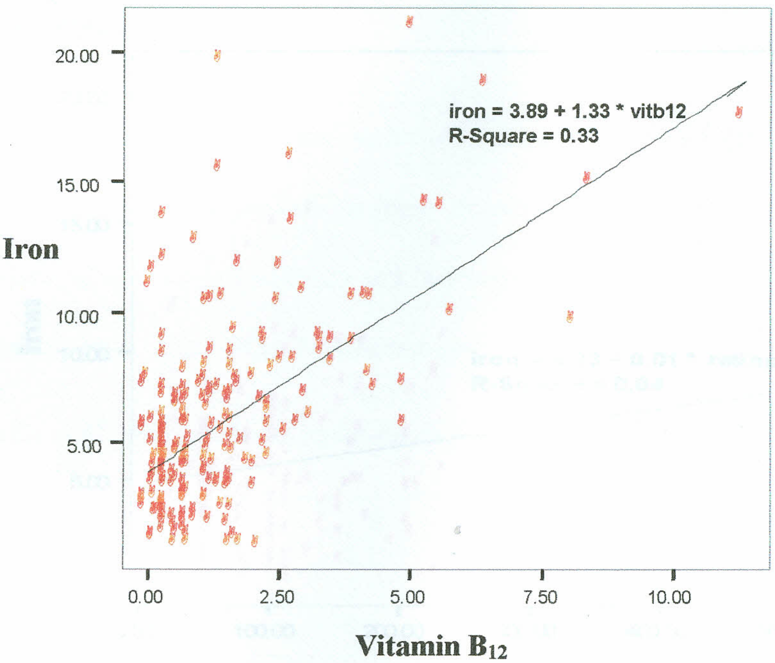


Figure 5.3: Relationship between iron intake and Vitamin B12

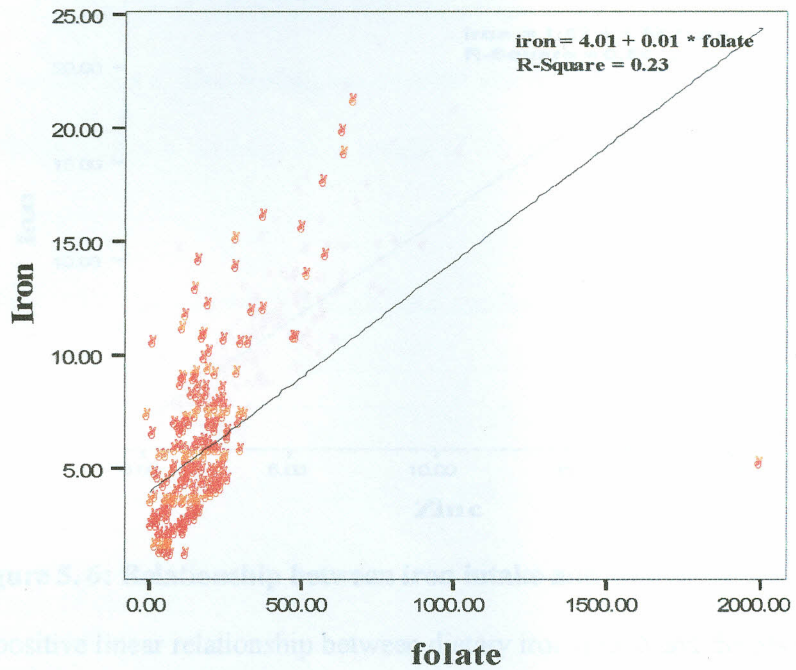


Figure 5. 4: Relationship between iron intake and and folate

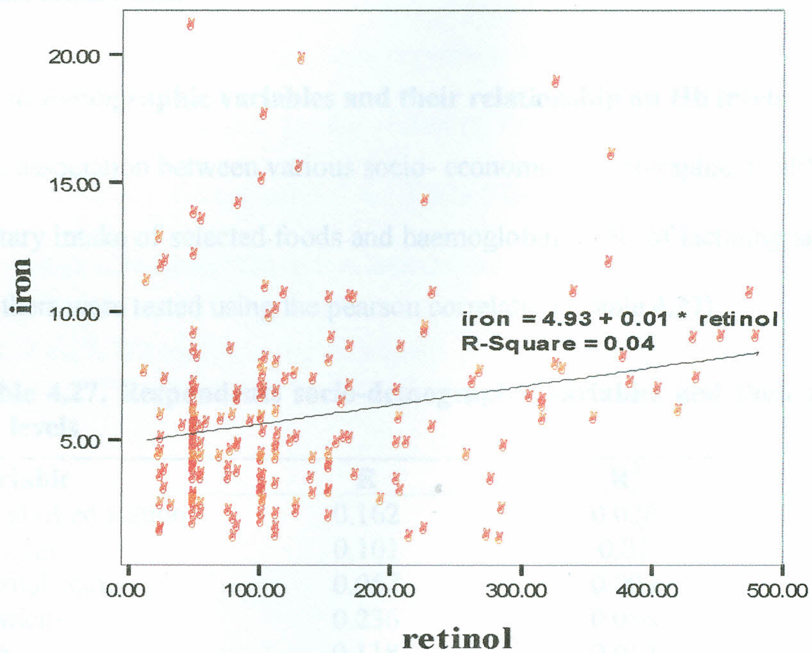


Figure 5. 5: Relationship between iron intake and retinol

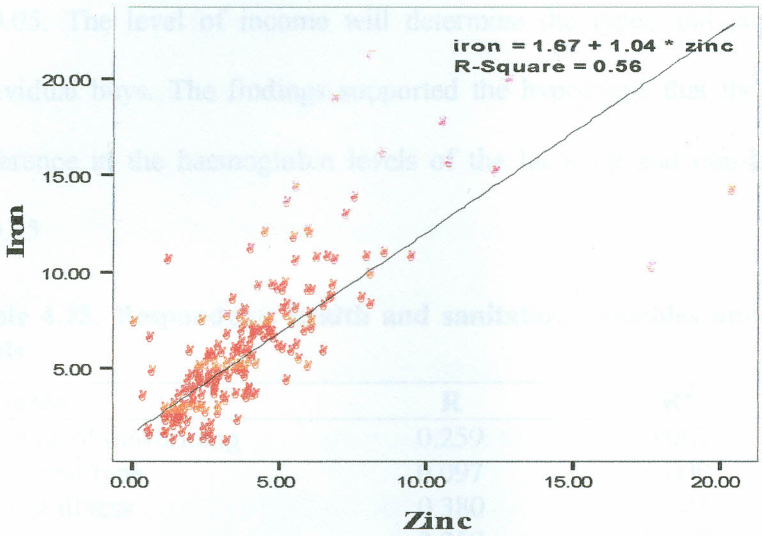


Figure 5. 6: Relationship between iron intake and zinc

A positive linear relationship between dietary iron intake and the above selected minerals and vitamins (Vitamin C and B_{12}, folate , retinol, and zinc) was positive such that an increase in the intake of the minerals and vitamins increased the intake of the dietary iron.

Socio-demographic variables and their relationship on Hb levels

The association between various socio- economic, demographic, health and sanitation, dietary intake of selected foods and haemoglobin levels of lactating and non-lactating mothers were tested using the pearson correlation (Table 4.27).

Table 4.27. Respondents socio-demographic variables and their relationship on Hb levels

Variable	R	R^2	P
Level of education	0.162	0.026	0.155
Religion	0.101	0.01	0.919
Marital status	0.057	0.003	0.723
Ethnicity	0.236	0.056	0.444
Age	0.118	0.014	0.428
Income	0.304	0.093	0.043
Household size	0.031	0.001	0.98
Cooking pot type	0.098	0.01	0.597
Status of lactation	0.123	0.015	0.393

There were significant positive correlations between haemoglobin and income at $P<0.05$. The level of income will determine the types and amounts of foods an individual buys. The findings supported the hypothesis that there is no significant difference in the haemoglobin levels of the lactating and non-lactating mothers at $p>0.05$

Table 4.28. Respondents health and sanitation variables and relatioship to Hb levels

Variable	R	R^2	P
Last date of deworming	0.259	0.067	0.763
Illness and type	0.097	0.009	0.763
Type of illness	0.380	0.145	0.082
Parity	0.259	0.067	0.097
Contraceptives and type	0.305	0.093	0.008
Length of menses	0.243	0.059	0.106
Oral iron Supplementation	0.106	0.011	0.137
Frequency of supplementation	0.06	0.026	0.077
Type of toilet	0.06	0.004	0.41
Water source	0.118	0.014	0.734
Waste disposal	0.098	0.01	0.383

There were significant positive correlations between haemoglobin and method of contraceptive at $p<0.05$. Multiple regression analysis (R^2) explained the variation in haemoglobin levels due to the different factors or variables, level of education explained about 3% and parity 7% (Table 4.28) of the Hb levels.

Correlation between Hb and selected nutrients

Table 4.29. Hb and selected nutrients

Variable	R	P
Iron	-0.071	0.003
Retinol	-0.008	0.314
Carotene	0.054	0.034
Vit B_{12}	0.017	0.440
Folate	-0.018	0.803
Vit.C	-0.115	0.022
Copper	0.022	0.178
Zinc	-0.039	0.004
Selenium	0.004	0.000
Energy	0.075	0.087
Protein	-0.074	0.002
Carbohydrate	0.144	0.809
Fat	0.021	0.403

There were significant positive correlations between haemoglobin and various nutrients that were analyzed, thus,Iron $p<0.05$, Carotene $p<0.05$, Vit.C $p<0.05$, Zinc $p<0.05$, Selenium $p<0.05$, Protein $p<0.05$ (Table 4.29). The mothers in Makongeni had below RDA of various nutrient intakes as explained in Table 4.12 which may have influenced the haemoglobin levels. The results rejected the hypothesis that there is no significant relationships between dietary iron intake and the haemoglobin levels at $P<0.05$.There was a signicant relationship in dietary iron intake and the haemoglobin levels. The findings are in agreement with a study done by Waudo et al (2005) that Kenyan women have lower nutrient intakes as compared to Uganda and Tanzania.

CHAPTER FIVE

SUMMARY, MAJOR FINDINGS, CONCLUSION AND RECOMMENDATIONS.

5.1 Summary

Iron deficiency anaemia is a serious health problem in the world affecting over 80% of women in many countries Kenya included. Studies have shown that even non-pregnant women are vulnerable to iron deficiency anaemia equally as the highly studied preschool children and pregnant mothers. Minimal information exists on the iron status of lactating and non-lactating mothers. The major objective of the study was to investigate the iron status of lactating and non-lactating mothers. A descriptive cross-sectional study was conducted at Uzima Medical Care Centre in Makongeni Thika, Kenya. A sample size of 100 lactating and 100 non-lactating mothers were purposively selected. Their demographic, socio-economic, health and haemoglobin levels data were taken. The 24-hour dietary recall and food frequency were used to determine the food consumption patterns.

5.2 Major findings

The majority of the women both lactating and non-lactating attending the Uzima Medical Care Centre are from a low economic classes residing in rented single rooms. They were either in low income earning groups or totally dependent to their spouses/guardians or parents for their entire daily needs including food.

Low economic status that was associated with IDA is a common characteristic among the lactating and non-lactating mothers. Despite the high nutrient requirement in reproductive age women, the women in this study had below the RDAs diets mainly due to financial constraints since their diets comprised mainly of the monotonous cereal and plant foods .The women in this study irrespective of age, marital status, ethnicity and education status consumed similar diets high in plant foods but less in fruits and animal foods. Food was mainly taken in three meals per day.

Most of the mothers used a type of family planning method and the method prefered by most mothers was the injectables (Depoprovera). The method of contraceptive used in family planning showed an association with the haemoglobin levels p==0.008. The majority of those who used the depoprovera complained of heavy monthly flows at the end of 2 months of administration of this injectable type of contraceptive. There were significant positive correlations between haemoglobin and various nutrients that were analyzed, thus, Iron $p<0.05$, Carotene $p<0.05$, Vit.C $p<0.05$, Zinc $p<0.05$, Selenium $p<0.05$, Protein $p<0.05$ (Table 4.29). The mothers in Makongeni had below RDA of various nutrient intakes as explained in Table 4.12 which may have influenced the haemoglobin levels. The results rejected the hypothesis that there is no significant relationships between dietary iron intake and the haemoglobin levels at $P<0.05$.There was a signicant relationship in dietary iron intake and the haemoglobin levels. The findings are in agreement with a study done by Waudo et al (2005) that Kenyan women have lower nutrient intakes as compared to Uganda and Tanzania.

Mild anaemia was prevalent in 33% of the lactating mothers, while 17 % had moderate anaemia and 1% severe anaemia (total 51%) compared to 29% mild anaemia and 15% moderate anaemia (total 44%) in non-lactating mothers after altitude adjustment. Haemoglobin levels were not significantly different among the lactating and non-lactating mothers with lactating mothers recording lower levels $P>0.05$ ($p=0.393$).

The findings are in agreement with findings from Tanzania where 49% of non-pregnant women (80% lactating) were anemic and nearly 2% severely anemic (Kitange et al;1993; Tatala et al;1998; Massawe, 2002); Zimbambwe (Sikusana et al;1998); Nigeria (Isha et al; 1985); Burkinafaso (Meda et al; 1996); and Massawe et al;2005).

5.3 Conclusions

Lactating and non-lactating women in low socio-economic classes irrespective of ethnicity, age, education levels, marital status have a common food consumption pattern characterised by monotonous diets high in plant based foods. High income levels increases consumption of animal based foods and fruits, ultimately improving the quality and quantity of nutrient content, particularly proteins of high biological value. Poor economic status as reflected by low profile occupations and low-income levels is associated with inadequate iron consumption both in quality and quantity.

Type of contraceptive was associated with low haemoglobin values. IDA was a common characteristic among the lactating and non-lactating mothers .The lactating mothers had higher incidences of anaemia including severe anaemia than the non-lactating mothers. The results emphasize the need to intervene and prevent or control anaemia in women.

5.4 Recommendations

The following recommendations are made based on the findings of the study.

To Policy Makers:

- The Government and stakeholders should device ways to fortify the commonly used foodstuffs like sugar, salt and fat with iron to mitigate against anaemia.
- Policy makers need to introduce free or a waiver on laboratory fees for haemoglobin test to make it affordable to all women because during the study the costs were quite high. This may be helpful to monitor the prevalence of anaemia among women for further interventions.

For Practice and interventions:

- Lactating mothers should be given Iron folate for a period of time after delivery.
- It is important to identify anaemic mothers accurately in order to deliver adequate antenatal care by use of biochemical indices.
- Introduction of community based projects like poultry production and kitchen gardening on public land for the housewives living in towns and their periphery for income generation and household consumption.
- There is need to promote nutritional counselling in all health facilities to enlighten on and encourage better eating habits within the resources available. Nutritionist should come up with nutritional counselling publications to be distributed freely at the health facilities.
- There is need for promotion of iron cooking pots and skillets in conjunction with energy saving devices like fireless cookers in urban and peri-urban areas to help mitigate against iron deficiency anaemia.

- A more indepth study for serum ferritin levels, together with dietary intake and morbidity patterns would be needed to confirm the findings.
- Mothers should be involved in the already existing government programmes and projects so that they can generate some incomes for themselves.
- Community nutrition education should be availed to women living in urban areas which should include dietary diversification, informed choices in purchasing and preparing locally available foods.
- The women should consume tea and coffee between meals instead of during meals.
- The women should increase meal time ascorbic acid intake.

5.5 Suggestions for further research

As a follow-up of this study the following suggestions for further research are made.

- A similar research study on HIV/Aids and iron status among the lactating and non-lactating mothers.
- A study on status of other micronutrients that interact with iron metabolism like serum Vitamin A and zinc in lactating and non-lactating mothers.
- A study on parasitic infestations and their effect on iron status among lactating and non-lactating mothers.

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APPENDICES:

APPENDIX 1: TIME SCHEDULE

ACTIVITIES	TIME
Proposal writing and development of interview schedule	September-October 2004
Defending proposal and corrections	November-December 2004
Pre-testing the instruments	January 2005
Data collection	March-May 2005
Data coding and entry	June 2005
Data analysis and report writing	June-July 2005
Submission of draft Thesis	July 2005

APPENDIX 2: RESEARCH BUDGET (Kshs)

ACTIVITY	QUANTITY	UNIT COST	TOTAL COST
Proposal writing	4 copies of 30 pages	40/=@ page	4,800
Summary copies	5 copies of 8 pages	40/=@ page	1,600
Transport costs to libraries	3 days per week for 3 months	300/= @ day	25,200
Pre-testing the instrument	5 copies of 8 pages	40/= @ page	1,600
Transport cost during pre-testing	2 days	200@ day	400
Data collection instrument	200 copies of 8 pages	40/= @ page	64,000
Transport cost for data collection	For 60 days	200/= @ day	12,000
Meals	For 60 days	200/=@ day	12,000
Salaries 4 for research assistants	For 60 days	2,000/=@ day	120,000
Sahli haemometer	1	6,000	6,000
HCL 0.1 N	1L	500	500
HB pipette	1set	500	500
Needles	200	5/=@ needle	1,000
Spirit	5 litres	360/=@ litre	1,800
Gloves	5 pairs	200/=@ pair	1,000
Cotton wool	1 roll	100	100
Coding entry and computer analysis	1 copy 200 pages	40/= @ page	15,000
Typing and photocopy of thesis	5 copies of 150 pages	5/=@ page	3,750
Binding of thesis	5 copies	1,000 @ copy	5,000
Miscellaneous	10% of total amount		30,000
Total			**306,250**

APPENDIX 3: INTERVIEW SCHEDULE

DEMOGRAPHIC INFORMATION

Respondent no.________ **Province** __________ **District** _________

Division _______ **Location** __________

Ethnic background ___________ **Date of interview** ___ /____2005

1. Head of household
   i. Father [ ]
   ii. Mother [ ]
   iii. Guardian [ ]

2. Marital status
   i. Single [ ]
   ii. Married [ ]
   iii. Divorced/ separated [ ]
   iv. Widowed [ ]

3. In which age group do you belong?
   i. 15-20 [ ]
   ii. 21-30 [ ]
   iii. 31-40 [ ]
   iv. 41-50 [ ]

4. What is the highest level of education attained?
   i. Primary and below [ ]
   ii. O level [ ]
   iii. College [ ]
   iv. University [ ]

5. What is your occupation? ____________________________

6. What is your religion?
   i. Orthodox [ ]
   ii. Catholic [ ]
   iii. Protestant [ ]
   iv. Islam [ ]
   v. 7th day Adventist [ ]
   vi. Traditional [ ]
   vii. Others (specify) [ ]

6. What is your average monthly salary/incomein (Kshs)?
   i. 2,000 and below [ ]
   ii. 2,001-3,000 [ ]
   iii. 3,001-4,000 [ ]
   iv. 4,001-5,000 [ ]
   v. 5,001-6,000 [ ]
   vi. 6,001-7,000 [ ]
   vii. 7,001-8,000 [ ]
   viii. 8,001-9,000 [ ]
   ix. Above 10,001 [ ]

7. What is your spouse's monthly income? ____________________

8. How many people apart from you depend on your salary/income
   i. None [ ]
   ii. One [ ]
   iii. 2-4 [ ]
   iv. 5 and above [ ]

9. What foods are restricted or avoided by women in your culture?
   i. Yes [ ]
   ii. No [ ]
   iii. Don't know [ ]

10.If yes, which ones? ___________________________________

11. Are there foods restricted for women during lactation (breastfeeding) in your culture?
   i. Yes [ ]
   ii. No [ ]

12. If yes, which ones? _________________________________

13. For how long have you breastfed your baby?
   i. 1-3 months [ ]
   ii. 4-6 months [ ]
   iii. 6-9 months [ ]
   iv. 10-12 months [ ]
   v. Over one year [ ]

14. What is the frequency of breastfeeding in a day?
   i. Exclusive breastfeeding [ ]
   ii. Thrice a day [ ]
   iii. Twice a day [ ]
   iv. Once a day [ ]
   v. During the night [ ]
   vi. Other (specify) .

15. Do you suffer any problems while breast-feeding?
   i. Yes [ ]
   ii. No [ ]

16. If so which ones?

____

17. Are there special foods for consumption during lactation?

i. Yes [ ]
ii. No [ ]

18. If yes which ones?

____

19. What is the reason for consumption of such foods?

____

20. What is your food source?

i. Farm [ ]
ii. Purchase [ ]
iii. Others (specify) [ ]

21. Are there foods you would like to buy but cannot afford?

i. Yes [ ],
ii. No [ ]

22. If yes which ones?

____

23. What cooking pot do you use?

i. Stainless steel [ ]
ii. Aluminium [ ]
iii. Non-Stick [ ]
iv. Earthen ware [ ]
v. Others (specify)

24. 24 HOUR DIETARY RECALL

Time/meal	Dishes	Name of ingredient	Amount of ingredients taken in household	Amount of ingredients taken in metric	iron	Vit C	Copper	Zinc	Vit A	Vit B12	Folic acid
Breakfast											
Snack											
Lunch											
Snack											
Supper											
Snack											

25. **FOOD FREQUENCY**

Food	**Daily**	**> Or 3times a week**	**Twice a week**	**Once a week**	**rarely**	**Never**
1. Meat						
2. Milk						
3. Fish						
4. Poultry						
5. Liver						
6. Kidneys						
7. Eggs						
8. Soya beans						
9. Beans						
10. Peas						
11. Greengrams						
12. Njahi						
13. oranges						
14. Paw paws						
15. Pineapples						
16. Amaranthus						
17. Spinach						
18. Kales						
19. Cabbage						
20. Managu						
21. Capsicum						
22. Tomatoes						
23. Others(tea, coffee etc)						

26. When did you take de-worming tablets last?
   i. 3 months ago
   ii. 6 months ago
   iii. 9 months ago
   iv. 1 year or more ago
   v. Never

27. Do you suffer from any illness?
   i. Yes [ ]
   ii. No [ ]

28. If yes which one?
   i. Malaria [ ]
   ii. Hypertension [ ]
   iii. T.B. [ ]
   iv. Typhoid [ ]
   v. Others (state)

29. How do you manage these complications? ______________________________

30. Are the times when you feel dizzy, fatigued or hands become pale?
Yes [ ]
No [ ]

31. If yes, how do you manage these complications? _________________________

32. How many children do you have? __________________________

33. Are there any dead?
    i. Yes [ ],
    ii. No [ ]

34. If yes how many? _________________________________

35. When was your last pregnancy?_______________________________

36. Do you use any contraceptive?
    i. Yes [ ]
    ii. No [ ]

37. If yes, what method do you use?
    i. Pills [ ]
    ii. IUD [ ]
    iii. Depo-Provera [ ]
    iv. Condoms [ ]
    v. Others (specify)

38. How long is your menstrual period in days?
    i. 2-4
    ii. 4-6
    iii. 6-8
    iv. More than 8

39. Do you take any oral iron supplements?
    i. Yes [ ]
    ii. No [ ]

40. If yes which one? _____________________________

41. What dose do you take? _______________________

42. What is the frequency of taking the iron supplement? ______________________

43. What type of toilet do you use?

i. Closet type [ ]
ii. Pit latrine [ ]
iii. Portable toilet [ ]
iv. Other (specify)

44. How do you dispose off household waste?

i. municipal garbage collection [ ]
ii. Garbage pit [ ]
iii. In the open ground [ ]
iv. Others (specify)

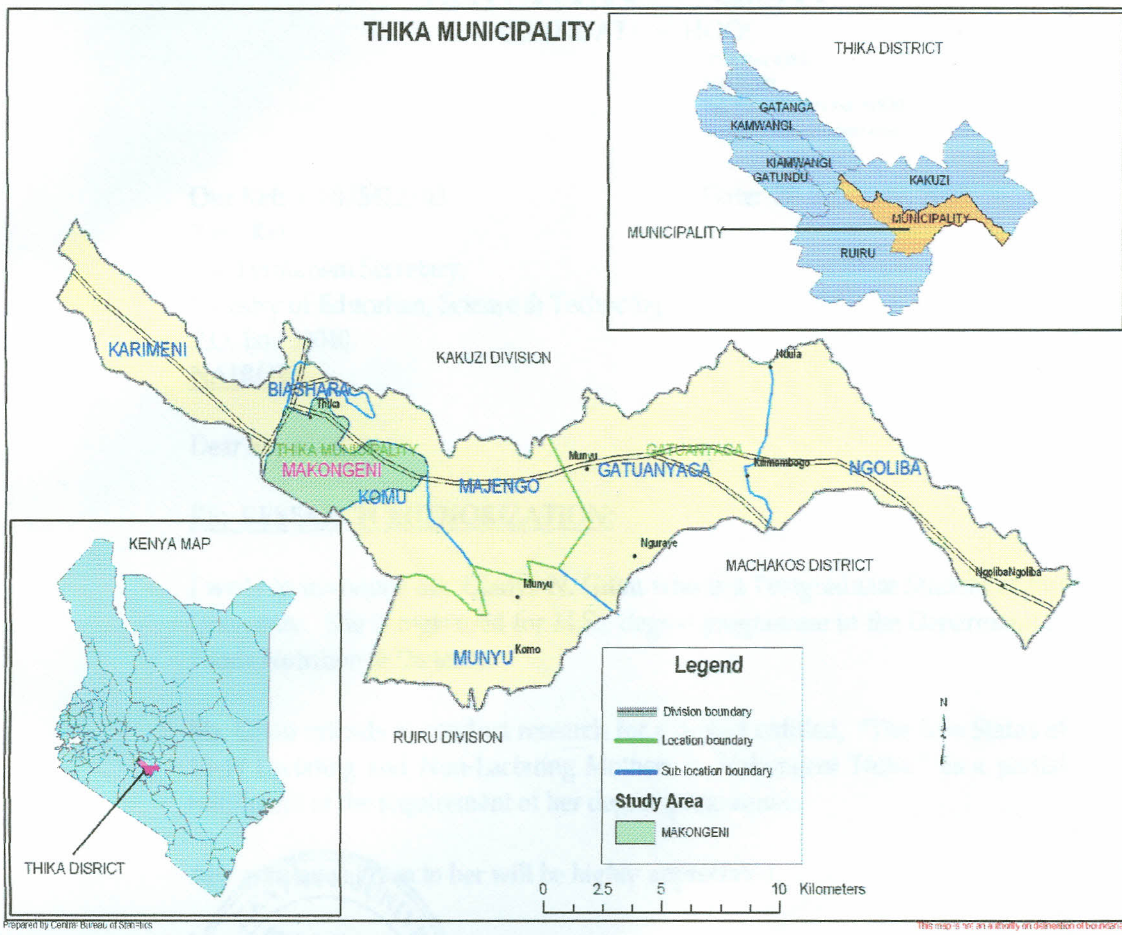
45. What is your source of water?

i. Tap water [ ]
ii. Spring [ ]
iii. Borehole [ ]
iv. Roof catchment [ ]
v. River [ ]
vi. Other (specify)

APPENDIX 4: MEASUREMENTS

ITEM	HOUSEHOLD MEASURES	METRIC MEASURES
Sugar	1 teaspoon (full)	5g
,,	1 tablespoon (full)	10g
Maize meal flour	1 glass level	160g
,,	1 medium teacup level	180g
,,	1 small soup bowl	220g
Bread	2 slices	40g
Fat	1 tablespoon (full)	20g
,,	1 teaspoon (full)	10g
Rice	1 glass level	190g
,,	1 small cup	190g
Carrot	medium	120g
,,	small	60g
Irish potato	1 big	180g
,,	1 medium	100g
,,	1 small	70g
Onions	1 big	90g
,,	1 medium	50g
,,	1 small	30g
Tomatoes	1 big	110g
,,	1 medium	70g
Spinach	5 small leaves	40g
Kales	1 bunch (6 medium leaves)	200g
Water	1 glass water	220ml
Tea	1 cup medium	270ml
Oil	1 tablespoon/1 teaspoon	8ml/2ml

APPENDIX 5: STUDY AREA MAP



KENYATTA UNIVERSITY

GRADUATE SCHOOL

P.O. Box 43844,
NAIROBI
Tel. No. 810901/9 Ext. 57530
E-mail: kubps@yahoo.com

Our Ref: H60/5422/03 **Date:** 7th February, 2005

Your Ref:

The Permanent Secretary,
Ministry of Education, Science & Technology,
P.O. Box 30040,
NAIROBI.

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION:

I write to introduce Ms. Gladys N. Gitau who is a Postgraduate Student of this University. She is registered for M.Sc. degree programme in the Department of Foods Nutrition & Dietetics.

Ms. Gitau intends to conduct research for a project entitled, "The Iron Status of 15-49 Lactating and Non-Lactating Mothers in Makongeni Thika." as a partial fulfillment of the requirement of her degree programme.

Any assistance given to her will be highly appreciated.

Yours faithfully,

KENYATTA UNIVERSITY OFFICE OF THE DEAN - 7 FEB 2005 GRADUATE SCHOOL

J.O. IFUKHO
FOR AG. DEAN, GRADUATE SCHOOL

C.C. Registrar (Academic)
Dean, GS - to see on file
Dean, School of Environmental & Human Sciences
Chairman, Department of Foods, Nutrition & Dietetics
Directorate of Personnel Management
P.O. Box 30050
00100 NAIROBI - KENYA

JOI:eww

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

Telegrams: "EDUCATION", Nairobi
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When replying please quote

Ref. No. ....
MOEST 13/001/35C 53/2

JOGOO HOUSE "B"
HARAMBEE AVENUE
P.O. Box 30040-00100
NAIROBI

15th February, 2005, 20......

Gladys N. Gitau
Kenyatta University
P.O. BOX 43844
NAIROBI

Dear Sir

RE: RESEARCH AUTHORISATION

Following your application for authority to conduct research on "Iron Status of 15-49 years lactating and Non-Lactating Mothers in Makongeni, Thika", I am pleased to inform you that you have been authorised to conduct research in Thika District for a period ending 30th May, 2005.

You are advised to report to the District Commissioner, the District Education Officer Thika, the Town Clerk Thika Municipality and the Education Officer, Thika Municipality before embarking on your research project.

It is noted that the research is a requirement in part fulfilment for the award of M.Sc Degree by Kenyatta University.
Upon completion of your research project, you are expected to submit two copies of your research report to this Office.

Yours faithfully

B. O. ADEWA
FOR: PERMANENT SECRETARY

Cc
The District Commissioner
Thika District

The District Education Officer
Thika District

The Town Clerk
Thika Municipality

The Education Officer
Thika Municipality

CONDITIONS

1. You must report to the District Commissioner and the District Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit.
2. Government Officers will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two (2)/four(4) bound copies of your final report for Kenyans and non-Kenyans respectively.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice.

GPK 6055—3m—10/2003

REPUBLIC OF KENYA

RESEARCH CLEARANCE PERMIT

(CONDITIONS—see back page)

PAGE 2

THIS IS TO CERTIFY THAT:

Prof./Dr./Mr./Mrs./Miss GLADYS N. GITAU

of (Address) KENYATTA UNIVERSITY
P.O. BOX 43844, NAIROBI

has been permitted to conduct research in

THIKA MUNICIPALITY Location,
THIKA District,
CENTRAL Province,

on the topic IRON STATUS OF 15-49 YEARS LACTATING MOTHERS IN MAKONGENI THIKA

for a period ending 30th May, 20 05

PAGE 3

Research Permit No. MOEST 13/001/35C 53

Date of issue 15th February, 2005

Fee received Shs. 500

Applicant's Signature

For: B. O. ADEWA
Permanent Secretary
Ministry of Education
Science and Technology