NUTRITIONAL AND MICRONUTRIENT (VITAMIN A, IRON, AND ZINC) STATUS OF CHILDREN AGED 9-59 MONTHS

A COMPARATIVE STUDY OF KITCHEN AND NON-KITCHEN GARDENING HOUSEHOLDS IN NGONG DIVISION, KAJIADO DISTRICT, KENYA

By

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A DISSERTATION SUBMITTED TO THE DEPARTMENT OF FOOD TECHNOLOGY AND NUTRITION IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN APPLIED HUMAN NUTRITION IN THE UNIVERSITY OF NAIROBI

2004

DECLARATION

I **Laura Wangui Kiige** hereby declare that this dissertation is my original work and has not been presented for a degree in any other university.

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DEDICATION

To my God above,

my husband James Kiige Mwangi

and our children Mwangi and Mugure

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ABBREVIATIONS

ANP	Applied Nutrition Program
ACC/SCN	Administrative Committee on Co-ordination/Sub-Committee on Nutrition
dl	Decilitre
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussion
GOK	Government of Kenya
IDA	Iron Deficiency Anaemia
ID	Iron Deficiency
IU	International Units
KEFRI	Kenya Forestry Research Institute
KEMRI	Kenya Medical Research Institute
KG	Kitchen Gardening
MCH	Mother Child Health
MOH	Ministry of Health
MUAC	Mid-Upper Arm Circumference
NHEECP	Ngong Household Energy and Environment Conservation Project
NKG	Non-Kitchen Gardening
PEM	Protein Energy Malnutrition
RBP	Retinol-Binding Protein
RDA	Recommended Daily Allowance
RDI	Recommended Daily Intake
UNICEF	United Nations Children's Fund
µg	Microgram
VAD	Vitamin A deficiency
Vit A	Vitamin A
VITAA	Vitamin A for Africa
WHO	World Health Organisation

OPERATIONAL DEFINITIONS

Anaemia	Abnormally low haemoglobin level due to pathological condition(s). In children, when the serum ferritin concentration falls below 12μg/L, the iron store is totally depleted
Bioavailability	The fraction of an ingested nutrient that is available for utilization in normal physiological functions and for storage
Double dug garden	A kind of kitchen garden where a shallow wide pit is dug, filled with manure, covered with soil and then dug again to mix the soil and manure.
Fireless cooker	A container such as a basket stuffed with heat insulating material with space in which hot food in a saucepan is placed to keep hot or continue cooking
Household	People living together for at least three months sharing food from the same pot and other essential facilities
Household head	The person who is the main decision-maker on household income and expenditure
Household income	Monthly cash earnings equivalent from all sources including sales, salaries and remittances
Index child	A child aged between 9 and 59 months that was selected for this study. This is the older child in households with two children within the range and the second child in households where there were three. Hereafter referred to as the children
Intensive kitchen gardening	Modern kitchen gardening where lots of vegetables are produced in highly fertile soil in a small area using kitchen wastewater. The kitchen garden provides enough vegetables for the household all year round. This includes *mandalla*, double dug and multi-storey gardens
Iron deficiency	Functional tissue iron deficiency and the absence of iron stores with or without anaemia
Iron deficiency anaemia	A kind of anaemia caused by severe iron deficiency
Kitchen gardening	Production of vegetables and other foodstuffs mainly for household consumption within or near the homestead
Maendeleo liners	Fuel-efficient firewood ceramic stove fixed in the fireplace in which firewood is put from one side opening
Mandalla garden	A kitchen garden in which a rubbish pit, where wastewater and

	other organic material are thrown, is dug and the crops/vegetables are planted on the sides
Multi-storey gardens	Vegetables planted at the top and on the sides of a big bag filled with soil mixed with manure
Peri- urban area	An unplanned settled area outside the original city boundary. It usually has no planned roads, no sewerage system and has a haphazard water supply. Building structures are rarely according to the public health act by-laws
Permanent house	Stone/brick wall house with corrugated iron sheets/tiles roof and cemented/wood floor
Retinoids	Compounds either natural or synthetic with vitamin A-like structure or activity
Retinol equivalent	The amounts of a substance having biological activity equivalent to that of 1μg retinol
Semi-permanent house	Mud/timber walls with tin roof or stonewall with thatch/iron sheets roof
Temporary house	Mud/paper or cardboard walls and thatch.
Vitamin A status	
• Adequate vitamin A status	When serum retinol levels are greater or equal to 20 μg/dl. It is considered as a level in which physiological functions of vitamin A are satisfactorily taking place
• Marginal status	When serum retinol levels are between 10 and 20 μg/dl. It is considered as a level in which physiological functions of vitamin A are not satisfactorily taking place
• Deficient status	When serum retinol levels are less than 10μg/dl. It is considered as a condition in which physiological functions of Vitamin A cannot satisfactorily take place
• Vitamin A deficiency	Includes xerophthalmia but has much wider application relating to any state in which vitamin A status is abnormal.

ABSTRACT

The study sought to assess the potential of kitchen gardening on improving the nutritional and micronutrient status of the study population. The specific objective was to compare the nutritional and micronutrient status of children aged 9-59 months in the households practising kitchen gardening and those without kitchen gardens.

Both qualitative and quantitative data were collected from a sample of 221 households, of which 80 had kitchen gardens. Qualitative data was collected using key informant interviews, focus group discussions and observation. Quantitative data was collected using a pre-tested structured questionnaire and biochemical analysis of blood. Information was collected on demography, social-economic characteristics, mothers' nutrition knowledge, production and utilization of foods produced in kitchen gardens, food consumption patterns of the households and pre-school children, anthropometry, micronutrient status, morbidity and sanitation. The data was analysed using statistical package for social sciences program and EPI-info available at Applied Nutrition Program.

The study results indicated that the kitchen gardening and non-kitchen gardening households were similar in demography and social-economic characteristics. Kales, spinach, 'enderema' *(Basela alba),* black nightshade, amaranth, spider plant and tomatoes among others were grown in the kitchen gardens. Vegetables produced in the kitchen gardens were consumed at home. Kitchen gardening households more frequently consumed legumes (p=0.044), fruits (p=0.042) and vegetables (p=0.005) than non-kitchen gardening households. There was

more variety of vegetables (p=0.026) and roots and tubers (p=0.000) in the diets of kitchen gardening households than non-kitchen gardening households.

The study children in kitchen gardening households consumed green leafy vegetables more often (three times a week for those under three years and four times a week for those above three years), (p=0.000) than those in non-kitchen gardening households (two times a week for both the children under three years of age and above three years). The consumption of calorie was inadequate in both kitchen gardening and non-kitchen gardening households. Study children in kitchen gardening households had significantly higher mean intake of vitamin A (p=0.000) and Zinc (p=0.001) per day as compared to the children in non-kitchen gardening households.

Multiple regression analysis showed that the diversity of vegetables, fruits, animal proteins, and cereals consumed was positively associated with both social-economic status and kitchen gardening. Kitchen gardening influenced the diversity of vegetables more (beta =0.261, p=0.048) than the social-economic status (beta =0.113, p=0.05).

Nutritional status in the children aged 18-24 months, 48-54 months and 54-59 months was better among those in kitchen gardening households compared to those in non-kitchen gardening households. Fewer children were severely stunted (3.9%, n=80 as compared to 15%, n=133) and no child was severely wasted among kitchen gardening households. Morbidity experience two weeks prior to the study among children in the kitchen gardening

households (53.8%) was lower compared to those in non-kitchen gardening households (69.9%).

Vitamin A and iron deficiency was lower in the children in kitchen gardening households compared to those from non-kitchen gardening households (p=0.001 and 0.021 respectively). The mean serum retinol, serum ferritin and serum zinc level were also higher for children in kitchen gardening households (p=0.000, 0.039 and 0.002 respectively).

Spearman's correlation showed a significant positive relation between kitchen gardening and serum retinol (r=0.503, p=0.000), serum ferritin (r=0.346, p=0.010) and serum zinc (r=0.449, p=0.001) levels. Serum retinol level was also positively correlated with the vitamin A supplementation. Multiple regression analysis showed that serum retinol (beta=0.381, p=0.003), Serum ferritin (b=0.341, p=0.010) and serum zinc, (b=0.116, p=0.047) levels were positively associated with kitchen gardening.

From the study results it is evident that kitchen gardening leads to improved dietary diversity and nutrient intake which in turn leads to decreased morbidity and improved nutritional and micronutrient status of pre-school children.

The study therefore recommends that kitchen gardening be taught, demonstrated and encouraged in urban and peri-urban communities.

1.0 INTRODUCTION

1.1 Background Information

Nutrition is essential for growth and development, health, and well being of mankind. Proper nutrition contributes substantially to the prevention of illnesses and premature deaths. Nutrition or dietary factors are associated with five of the ten leading causes of deaths in the developing countries. These are coronary heart disease, some types of cancer, stroke, diabetes mellitus, and osteoporosis (FAO, 1999).

Improper nutrition leads to malnutrition, which may manifest itself in form of protein-energy malnutrition (PEM) and/or micronutrient malnutrition. PEM is by far the most lethal form of malnutrition in the world. Children are its most visible victims. Malnutrition, "the silent emergency," is an accomplice in at least half of the 10.9 million child deaths each year (WHO, 2003). These young lives are prematurely – and needlessly – lost. PEM affects every fourth child worldwide: 150 million are underweight (26.7%) while 182 million are stunted (32.5%). Geographically, more than 70% of PEM children live in Asia, 26% in Africa and 4% in Latin America and the Caribbean (WHO, 2003)

Vitamin A deficiency (VAD), iron deficiency (ID), iodine deficiency and zinc deficiency are the four major micronutrient deficiencies in the world. Relatively few persons are clinically affected by these deficiencies, but sub-clinical deficits -- "hidden hunger" -- are more pervasive.

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The consequences of malnutrition extend beyond individuals and families to whole communities and nations. These include consequences of compromised immune function, cognitive development and performance, growth, reproduction and work capacity. The affected individuals become less resourceful and this can even affect the overall development of the country.

Early in the 1990s, the World Health Organization (WHO) estimated that deficiencies of iron, iodine, and vitamin A influenced the health of 2000 million, 1500 million, and 250 million persons, respectively (Food and Nutrition Board, 2003). VAD exists in an estimated 60 countries of the world (WHO, 1996), while iron deficiency (ID) with or without anaemia is believed to be the most prevalent nutritional deficiency in the world.

Vitamin A, iron and zinc are of special interest in Kenya. The 1999 Kenya National Micronutrient Survey revealed that VAD, iron deficiency anaemia (IDA) and zinc deficiencies were of public health concern (Mwaniki *et al*., 1999). Iodine deficiency in Kenya is being addressed through salt fortification and as reported by UNICEF (2004), fortified salt is being used by 91% of the households in Kenya.

Interventions that include food supplementation and fortification have been put in place to curb micronutrient malnutrition. These however, have their drawbacks. Food supplementation has been found to be "nutritionally counter productive". This is because the beneficiaries tend to depend on supplements and therefore stop food production. The costs of administration, storage and transportation also consume a large financial chunk of the budget (Caliendo, 1979), which makes the intervention highly unsustainable.

Food fortification with some micronutrients does not contribute to caloric density needs of the individual. It is only done to the foods that are centrally processed. Fortified foods, formulated foods and food mixtures do not reach those who do not participate in the market economy and are thus out of reach to the poor (Caliendo, 1979).

Nutritional intervention strategies based on accessing food, which include kitchen gardening, have many advantages. They are likely to be sustainable and are more appealing because they can address calorie and multiple nutrients simultaneously. They also have the uncontested advantage of allowing for the natural interactions of micronutrients within the same food or meal. Kitchen gardening has an advantage of requiring little input. It is therefore within reach for the low social-economic populations. It is also an intervention that allows community participation.

1.2 Statement of the Problem

In Kenya VAD, ID and zinc deficiencies are unacceptably high. The prevalence is reportedly higher than PEM (GOK, 2000). The 1999 Kenya National Micronutrient Survey revealed that more than a third (35.7%) of the children had retinol levels below 20 μg/dl. The estimated prevalence of anaemia among children less than 5 years old was reported as greater than 84% at the coast, 13.4% - 38.4% in the midlands, 2.1% -11.5% in the highlands and 44% in the lake basin and the adjacent highlands (Mwaniki *et al.*, 1999). Slightly less than half (40%) of the cases of anaemia were attributed to iron deficiency (Mwaniki *et al.*, 1999). The prevalence of moderate anaemia in Kenya is 54%, while almost 70% of pregnant women in Kenya are anaemic (US Census Bureau figures for Kenya, 1999). The proportion of the population with low zinc status (less than 65 μg/dl) in 1999 in Kenya was 50.8% (Mwaniki *et al.*, 1999).

Malnutrition affects the development of the community. It compromises the immune function leading to high morbidity and mortality. It affects cognitive development leading to impaired school performance and mental achievement. It can also lead to impairment of growth, reproduction and work capacity. Some of these effects are irreversible and therefore the community is permanently affected. It is therefore important to assess ways in which PEM and micronutrient deficiencies in Kenya and their debilitating effects can be averted. Sustainable and low input strategies should be given an upper hand as they are within reach of the low social-economic populations who constitute the greater part of the population.

1.3 Justification

Irungu, (2004) states that Kenya is only likely to achieve a modest economic growth rate in 2004. Nation team, (2004) also states that only 10% of the people in Kenya control the countries wealth, leaving the rest to subsist in poverty or just above the poverty line. GOK, (2000) states that chronic malnutrition among Kenyan children, aged below five years, results from poor economic status. There is, therefore, need to know where and who are suffering nutritional and micronutrient deficiencies and to explore cheap and sustainable ways of addressing micronutrient deficiencies in the country.

People of low social-economic status inhabit Mathare and Gichagi villages of Ngong Division. Among low social-economic households kitchen gardening is seen as one of the priority interventions to alleviate micronutrient deficiency. This is mainly because of its sustainability. Kitchen gardening (KG) is expected to increase small-scale production of micronutrient rich foods and to improve the diets of the poor, which tend to lack in diversity.

Ngong Household Energy and Environment Conservation Project (NHEECP) whose main aim was to educate people on energy conservation included kitchen gardening as an auxiliary activity. No assessment of the contribution of KG was carried out. It is therefore important to assess the extent to which kitchen gardening can contribute in the struggle to curb nutritional and micronutrient deficiencies in Ngong. Ngong division was also never covered during the 1999 micronutrient survey.

These observations, coupled with the nation-wide level of hidden hunger provided sufficient motivation to assess the nutritional status and the magnitude of Vitamin A, iron and zinc deficiencies in Ngong, and to compare KG and non-kitchen gardening (NKG) households.

Infants and young children are the most susceptible to PEM's characteristic growth impairment and also micronutrient deficiencies. This is because of their energy and nutrients needs and their vulnerability to infection. High energy and nutrients needs arise due to their rapid growth. They are therefore used to assess the nutrition situation of household.

1.4 Research Objective

The aim of this study was to assess the potential of kitchen gardening in nutritional and micronutrient status of low-income peri-urban populations.

The main objective was to compare the nutritional and micronutrient (Vitamin A, iron, and zinc) status of children between 9-59 months in KG and NKG households in Ngong Division.

Specific objectives

1. To determine the demography and social-economic characteristics of the two study groups.
2. To determine the level of knowledge on PEM, vitamin A, iron, anaemia, zinc and worms among the study mothers.
3. To determine the types of micronutrient rich foods produced in the kitchen gardens, methods of production and utilisation in the study area.
4. To determine food consumption patterns of households and pre-school children aged 9 - 59 months in the two study groups.
5. To determine nutritional, vitamin A, iron and zinc status of pre-school children aged between 9-59 months.
6. To determine morbidity patterns among the study children and general sanitation in the study households.

1.5 Null Hypothesis

- There is no significant difference in energy and nutrient intake and dietary diversity between kitchen gardening and non-kitchen gardening households.

- There is no significant difference in nutritional and micronutrient status of children aged 9-59 months in kitchen gardening and non-kitchen gardening households.

1.6 Expected Benefits

The study was expected to: -

- Generate additional information on the nutritional and micronutrient situation in Kajiado District.
- Show the potential of kitchen gardening in improving nutritional and micronutrient status of the pre-school children.
- Provide information that can be used by policy makers and development agents in their efforts to curb nutritional and micronutrient deficiencies in a sustainable way among the vulnerable groups.
- Be of use to future food-based intervention projects aiming at prevention and control of micronutrient deficiencies and to improve household food security.
- Show another benefit that NHEECP may have brought to the community.

2.0 LITERATURE REVIEW

2.1 Introduction

Malnutrition is an enormous problem through out the world (ACC/SCN, 1997). It often occurs as a result of poverty (lack of purchasing power), seasonality of food production and lack of nutritional knowledge (GOK, 1981). Globally children who are malnourished suffer up to 160 days of illness in a year. Malnutrition magnifies the effect of every disease. It leads to many sorts of deficiencies among them Protein-energy malnutrition (PEM), Vitamin A, iron, zinc and iodine deficiencies (WHO, 2003). Infants and young children are the most susceptible to PEM's characteristic growth impairment because of their energy and protein needs and their vulnerability to infection.

PEM can do harm to the immune system, making it difficult for the affected children to combat potentially damaging diseases, such as tuberculosis and malaria. Such diseases can worsen the deficiencies. Vitamin A deficiencies can cause loss of eyesight, ranging from deteriorating night vision to complete blindness. Many persons blinded die within the following year (WHO, 2003). Iron deficiencies may lead to anaemia. This can cause haemorrhaging in instances of childbirth, as well as physical productivity reductions. Zinc deficiency can undermine children's learning capacity (WHO, 2003).

Malnutrition can also heighten the effects of toxic chemicals on human, and various deficiencies can influence the body's absorption of substances such as lead, leading to more dangerous health hazards (WHO, 2003).

Food based approaches are a sustainable strategy in control of nutritional and micronutrient deficiencies. The food production knowledge is often not new to the user (household) and the skills, learnt on a practical basis, are left with the household. This increases the chances of the information passing from one generation to the next. Most of the foods used need not be new since most communities in Africa will have some micronutrient rich foods in their surrounding. Most households require knowledge on what nutrients are contained in foods to be able to articulate food combinations that will supply their family members with sufficient nutrients to prevent deficiencies.

2.2 Protein Energy Malnutrition

Protein Energy Malnutrition (PEM) is a major problem in developing countries. It has been reported to be the most widely spread disorder in tropical and sub-tropical areas (Mclaren and Frigg, 1997). PEM among children is usually coupled with high episodes of infections that result in lots of disability and high mortality. It also causes higher vulnerability to infection and results in retarded growth and development and therefore decreased work output (Food Security Assessment Unit of Somalia, 2003).

PEM results in increased retardation of physical dimensions, mental development, and subscribes to the morbidity in children and finally culminate in deaths. This is because energy and protein (amino acids) metabolism interact at various levels of biological complexity. Changes in energy intake will give rise to complex patterns of response in amino acids and protein metabolism, depending in part upon overall nutritional background and host conditions involved (Scrimshaw and Schurch, 1991). Severe forms of PEM are manifested as marasmus and kwashiorkor. Children in early life are the most affected by nutritional deficiency due to their rapid growth that is accompanied with high nutrient requirements. The best indicator of adequate food intake of a young child is growth (Scrimshaw, 1981).

A study on the nutritional status of the Kenyan population showed an unsatisfactory situation of health, nutrition, and educatability of children from birth to six years of age (World bank, 1996). About 34% of children in this age group were underweight, and the trend of decreasing malnutrition rates seen in the 1980s appeared to be reversing (World bank, 1996)). Morbidity levels were extremely high, with an 80% prevalence of infestation with worms.

2.3 Micronutrient Status

Micronutrient status can be grouped into five categories: deficient, marginal, adequate, excessive and toxic (Robert and Nieman, 1996). In deficient and toxic states clinical signs are evident while biochemical or static tests are relied on for marginal, adequate and excessive states (Robert and Nieman, 1996). The types of indicators for assessing micronutrient status are selected on the basis of their suitability in achieving the desired objective as shown in Table 2.1 (WHO, 1996). Biological indicators such as retinol level, ferritin status and zinc level are the most specific and useful for risk assessment, targeting programs and evaluating effectiveness (WHO, 1996).

Table 2. 1: Types of indicators useful for achieving broad surveillance objectives

Objective	Useful indicator
Vitamin A status, iron status, zinc status	Biological
Ranking area/Population at risk	Nutritional, illness, social-economic
Selecting priority area/ Create mix of intervention strategies	Demographic, ecology.

Source: WHO, 1996

2.3.1 Vitamin A

Table 2.2 shows the estimated prevalence of VAD in Kenya.

Table 2. 2: Estimated prevalence of VAD in Kenya

Group	Prevalence % (Indicator is serum retinol < 20mg/ dl)
Children 2-72 months	84.4
Mothers	50.7
Adult males (age 25 – 34)	42.2

Based on US Census Bureau figures for Kenya, 1999

Vitamin A is a generic term used to designate any compound possessing biological activity of retinol (Blomhof, 1994). In animals it occurs as retinyl palmitate (storage form) or sometimes as fatty ester retinyl acetate and retinyl stearate which both occur in all-trans configuration. The 11-cis retinol is very specific for the normal functioning of the rod cells of the retina (Blomhof, 1994). In plants Vitamin A exists in the form of precursor compounds carotenoids. Beta-carotene is the most abundant carotenoid. There are about 50 naturally occurring carotenoids with Vitamin A activity (Blomhof, 1994).

Biological activity of Vitamin A is measured in Retinol equivalents (Latham, 1997). Retinol is one of the most active or ustable form of vitamin A and it is found in animal foods such as liver and eggs. Retinal is often called pre-formed vitamin A and it can be converted to retinol and retinoic acid (Ross and Stephensen, 1996). One international unit is defined as 0.3 μg of all-trans retinol. The better term Retinol Equivalent (RE) is used to convert all sources of Vitamin A and carotenoid in the diet into a single unit (Blomhof, 1994). Recommended daily allowances for most countries vary between 600-1500 μg. For children under 5 years the recommended daily allowance is 350-500 μg (Vitamin Information centre, 2003)

Vitamin A plays the following roles in the human body: -

Vision. It is a component of rhodopsin which when bleached allows regeneration of rhodopsin from opsin, a process that enables dark adaptation

Cell differentiation. It plays a hormone-like key role in cell differentiation through out the tissues and organs of the body.

Regulation of proliferation of many cells. Some nuclear receptors have been discovered to be specific to retinoids. These receptors are turned off by retinoids and they regulate gene expression by binding to short sequences in the vicinity of target DNA (Blomhof, 1994). In embryogenesis, deficiency or excessive vitamin A or retinoic acid results in malformation of the embryo in many vertebrate species although it is not conclusively demonstrated that Vitamin A Deficiency (VAD) causes congenital malformation (Mclaren and Frigg, 1997).

Integrity of immune system. Epithelial cells are important barriers to infection and VAD impairs this functioning in a non-specific way (Mclaren and Frigg, 1997). In VAD the epithelial cells undergo squamous metaplasia and are flattened and heaped one on top of another instead of normal single layer. The result is keratinization. Squamous membranes release hydrolyses and enzymes that break down the cells causing cell death.

Growth. Normal growth, normal functioning of mucosal epithelium is dependent on vitamin A. Adenosine tri-phosphate (ATP) sulfurylase and other enzymes involved in the synthesis of proteoglycans contained in the mucous are vitamin A dependent. VAD causes incomplete synthesis of proteoglycans leading to scaling (flattening) of epithelial membrane.

Antioxidant. Oxidative stress is an important physiological reaction to situations such as infections and cancer (Kamau, 2004). Vitamin A acts as an antioxidant.

Clinical signs of VAD

Ocular manifestation (Xerophthalmia) ranges from mild uncomplicated eye signs such as night blindness to blinding, keratomalacia. They include in an increasing order of severity (name and WHO code) Night blindness (XN), conjunctival Xerosis (XIA), Bitot's spots (XIB), corneal xerosis (X2B), corneal alceration/keratomalacia (X3B), corneal scars (XS) and Xerophthalmia fundus (XF). Vitamin A also appears as a persuasive but preventable determinant of morbidity and mortality (Blomhof, 1994).

Night blindness (XN): Night blindness is the earliest manifestation of VAD. It results from impaired functioning of rod cells, where by there is a reduced rate of regeneration of rhodopsin in the outer segments of the rods following exposure to light i.e. dark adaptation (DA) (Blomhof, 1994). Night blindness can be sensitive to seasonal variation in VAD.

Conjunctiva xerosis (XIA): The term applies to any stage of xerotic changes in the conjunctiva. It can range from abnormal impression cytology, dryness to keratinization and heaping of materials as in Bitot's spots (Mclaren and Frigg, 1997).

Bitot's spots (XIB): Bitot's spot is the final stage of xerosis affecting the bulbar conjunctiva. It consists of a heap of desquamated cells, keratinized epithelial cells which form a slightly raised visual area that may be readily wiped away leaving uneven eroded base in the superficial epithelium lining on which abnormal cells may accumulate over a few days (Mclaren and Frigg, 1997).

Corneal xerosis (X2): Corneal xerosis is an indication that the process of xerosis spreads from conjunctiva to the cornea. It is evident when the cornea has a distinct hazy appearance. It tends to last for a day or two before advancing to further deformation of cornea (keratomalacia). Up to cornea xerosis prompt treatment with large doses of vitamin A can result to full preservation of sight without any residual impairment (Mclaren and Frigg, 1997).

Corneal alceration/ keratomalacia (X3A) and (X3B): Keratomalacia is the softening of the corneal substance in addition to increasing xerosis of the epithelium. Ulcers or holes may form on cornea if not treated early. Corneal softening is due to unique pathological process termed as colliquative necrosis. Sometimes colliquative changes also occur in the skin (dermomalacia).

Corneal scars (XS): It is a situation where the cornea is white and one can see light through it. Scaling of the cornea can also result from a wide range of diseases. There is therefore need to gather sufficient history.

Xerophthalmic fundus (XF): This is the final stage that leads to blindness that further leads to death. Xerophthalmia, meaning drying of the eyes (from Greek word *xeros* meaning dry), is now the term used to cover all eye manifestations resulting from Vitamin A deficiency (Latham, 1997).

Serum retinol levels

Serum retinol level is the most common biochemical measure of vitamin A status (Robert and Nieman, 1996). Under normal conditions about 95% of serum vitamin A is in form of retinol and bound to retinol binding-proteins and about 5% is unbound and in form of retinol esters (Robert and Nieman, 1996). Normal serum level is 30-50 μg/dl plasma. This can drop to low deficient level of less than 20 μg/dl. Children with Xerophthalmia will usually have a level below 10μg/dl (Table 2.3). Ocular manifestations seldom occur before serum levels are deficient (Latham, 1997).

Table 2. 3: WHO classification codes, indicators and minimum prevalence criteria for assessing public health significance of Xerophthalmia, and Vitamin A deficiency in pre-school aged children.

WHO code	**Indicator**	**Minimum prevalence**
XN	Night blindness	1.0%
X1A	Conjunctival xerosis	Not used
XIB	Bitot's spots	0.5%
X2	Corneal xerosis	0.01%
X3A	Corneal alceration/keratomalacia <1/3 corneal surface	0.01%
X3B	Corneal alceration /keratomalacia ≥ 1/3 corneal surface	0.01%
XS	Corneal scars	0.05%
XF	Xerophthalmia fundus	Not used
Biochemical indicators	Serum retinol <0.35 micromoles. Abnormal impression cytology (both eyes)	5.0%

(Adapted in parts from WHO, 1996 and Blomhof, 1994)

Consequences of Vitamin A deficiency

Irreversible blindness is among most dramatic consequences of vitamin A deficiency (Latham, 1997). Increased mortality and morbidity occur at levels of vitamin A deficiency less severe and chronic than those required for night blindness and Xerophthalmia. Measles generally takes a more serious form in children suffering vitamin A deficiency, resulting into more complication and higher death rates. This is because measles depletes vitamin A reserves by increasing its requirement at a time when the intake and absorption of nutrients are generally decreased because of the disease (Basu and Dickerson, 1996). Vitamin A deficiency also affects epithelial cells. The effects may be elaborate and are normally associated with increased risks of cancers (Shepherd, 1999).

2.3.2 Iron

A cross-sectional study conducted in a peri-urban health centre in Nairobi Kenya, to determine the prevalence of iron deficiency anaemia (IDA) and its risk factors among 403 children aged 6 months to 6 years revealed a 14.6% prevalence rate in infants. The study also found that age was positively associated with IDA. The prevalence of IDA among the children was 7.4% and was predominantly mild. The prevalence however, was likely to be higher among those who did not seek services from health facilities (Murila *et al.*, 1999).

Iron is present in the body as part of haemoglobin, myoglobin and tissue iron. The storage iron is found in liver, spleen and bone marrow. Transport iron (transferin) is about 0.1% (Guthrie and Picciano, 1995) while serum ferritin is 1%. The Recommended Daily

Allowance (RDA) for children under five years is 6.1-8.1 mg of iron (Guthrie and Picciano, 1995).

Iron plays the following roles in the body: -

- *Carrier of oxygen and carbon dioxide*- As part of myoglobin and haemoglobin iron permits the transfer of oxygen and carbon dioxide from one tissue to another.
- *Blood formation*- Iron plays a role in the formation of haemoglobin, which is a major constituent of blood.
- *Anti-infective agent*- Iron deficient people are less able to fight diseases. Lactoferrin, an iron containing substance is effective against *Escherichia coli* in the gastro intestinal tract.

Other body reactions in which iron is involved include: Catalysis of the conversion of Beta-carotene to vitamin A, synthesis of collagen, anti-body production, and detoxification of drugs in the liver.

In people without genetic defects, that increase iron absorption, there is no report on iron toxicity from foods other than long-term ingestion of home brews made in iron vessels (WHO, 1998).

Development and indicators of iron deficiency

One half of the iron in the body is present in red blood cells in form of haemoglobin. Development of iron deficiency anaemia takes stage-wise progression in absence of acute haemolysis and blood losses. It goes through three main stages:

- Early stage: - Iron depletion, which refers to a decrease of iron stores, measured by a reduction of serum ferritin concentration.
- Intermediate stage: - Iron deficiency erythropoiesies, when storage iron is depleted and there is insufficient iron absorption to counteract normal body losses. At this time haemoglobin synthesis starts to become impaired and haemoglobin concentration falls.
- Late stage: - Iron deficiency anaemia, the most severe degree of iron deficiency, which ensues if the haemoglobin concentration falls below a statistically defined threshold lying at two standard deviations below the median of a healthy population of the same age, sex, and stage of pregnancy.

For every case of iron deficiency anaemia found in a population, there are thought to be at least two cases of iron deficiency. Table 2.4 shows the biochemical indicators of progressive iron deficiency.

Table 2. 4: Biochemical indicators of progressive development of iron deficiency.

Indices of iron status	Early stage: Depleted iron stores.	Intermediate stage: iron deficiency without anaemia	Late stage: iron efficiency anaemia
↓ Serum ferritin	→	→	→
↓ Transferrin saturation		→	→
↑ Transferrin receptor		→	→
↑ Erythrocyte protophorphyrin		→	→
↓ Haemoglobin			→
↓ Mean corpuscular volume			→

Source: Mwaniki *et al.*, 1999.

KEY:
↓-Depressed **↑ - Elevated**

Serum ferritin

The serum ferritin concentration provides a quantitative estimate of the size of the iron store in the healthy individuals and those with uncomplicated iron deficiency. In children, one μg/L in serum ferritin indicates an iron store of about 0.14μg/kg. When the serum ferritin concentration falls below 12μg/L, the iron store is totally depleted (Ramakrishnan, 2001). Low serum ferritin concentrations are highly specific for iron deficiency.

Consequences of iron deficiency

Iron deficiency leads to anaemia, which is characterised by a reduction of the mass of circulating haemoglobin, decreased concentration of serum iron and complete absence of iron reserve. When haemoglobin concentration falls, oxygen supply to vital organs decline and the person begins to feel general weakness, tiredness, dizziness, and headaches. Pallor of the skin and of the mucous membrane as well as the nail beds and tongue, becomes noticeable when the haemoglobin level drops to 7g/dl or below (UNICEF, 1998)

2.3.3 Zinc

Zinc is the second to third most abundant intracellular cation. Its' deficiency affects many systems. Research on zinc over the past 40 years has shown its essentiality in development and that zinc deficiency is relatively common, affecting all social groups. The prevalence of zinc deficiency is greatest among the poor (Harold, 2002). Primary deficiency from dietary inadequacy is the common form (Morris and Zidenberg, 2002).

There are no reported cases of excess intake of zinc occurring from consuming natural foods. Excess occurs from fortified foods. The effects include: suppression of immune response, decrease in high-density lipoproteins and reduced copper status. Acute adverse effects include loss of appetite, epigastric pain, nausea, vomiting, abdominal cramps, diarrhoea and headaches (Prassad, 1976, Samman and Roberts, 1987).

Functions of zinc

Zinc plays essential roles in many aspects of metabolism including the activity of more than 300 enzymes, the structure of many proteins, and control of genetic expression. Zinc status affects basic processes of cell division, growth, differentiation, development, performance and ageing through its requirement for synthesis and repair of D eoxy-ribonucleic Acid (DNA), Ribo-Nucleic Acid (RNA), proteins, and for many other aspects of metabolism. Possibly because of its role in differentiation, zinc is associated with protection against certain nitrosamine carcinogens, and recent findings suggest that zinc deficiency, by itself, increases tumour formation in oesophagus (Harold, 2002). Effects of zinc deprivation on the developing testis illustrate the essentiality of zinc in the reproductive cell differentiation.

To verify that mild zinc deficiency can impair child development and performance, a study was carried out involving 740 apparently healthy, 6-9 year old children from low income households was carried out in three cities namely Shanghai, Chongqing and Qingdao in China. The study children were divided into two groups. One group was supplemented with zinc and other micronutrients while the other one received only the other micronutrients for one year. Major outcomes were change in knee height, and change in neuropsychological performance, measured by a computerised battery of tasks. Zinc with other micronutrients induced the most growth and had the greatest effect on neuropsychological performance while other micronutrients alone had the least effect (Harold, 2002)

Another study involving 375 apparently healthy, 6-8 year Mexican-American children from Brownsville, Texas, showed that zinc improved thymus function. Analysis found that changes in lean body mass measured by bioelectrical impedance; knee height, neuropsychological performance and cell-mediated immunity and weight were greatest in children who were treated with zinc plus micronutrients. Changes in children treated with micronutrients or iron plus micronutrients were similar (Harold, 2002).

Clinical signs of zinc deficiency

Clinical signs of zinc deficiency include acrodermatitis, low immunity, diarrhoea, poor healing, stunting, foetal growth failure, abortion, other abnormalities of pregnancy, liver failure in alcoholic cirrhosis, and neuropsychological abnormalities. The essentiality of zinc for differentiation, development and performance is exemplified by abnormalities that occur in zinc deficient pre-implantation embryos and the prevention of spermatogenesis in low zinc nutriture among males (Harold, 2002).

Probability estimates for risk of zinc deficiency can be calculated quantitatively from dietary intake alone. This can be assessed using the modified interactive 24-hr dietary recall (Kenneth *et al.*, 2001). Once the daily intake is known, the total zinc intake can be estimated by multiplying the amounts of each of the foods that are consumed by their zinc content. However to determine the severity of zinc inadequacies, dietary information needs to be combined with biochemical indices (Gibson, 1997).

2.4 Sources of Micronutrients: Vitamin A, Iron and Zinc

Vitamin A

Good sources of vitamin A or retinol are pre-formed vitamin A in liver, fish liver oils, eggs, and dairy products. Plant foods rich in beta-carotene include: -

Green leafy vegetables: These usually contain 1800 to 6000 IU per 100 grams. Leafy vegetables represent one of the richest sources of biodiversity in Africa food systems and a potential rich source of beta-carotene (Timothy, 2003).

Fruits: These contain between 1000 to 4700 IU per 100 grams. They include mangoes and papaya of which darker varieties have higher levels of beta-carotene, passion fruit, avocado, persimmon, and loquat (FAO, 2003).

Tubers: They contain about 6400 international units per 100 grams. They include the orange-fleshed sweet potato (FAO, 2003)

Other Plant Sources include: carrot, pumpkin, red pepper, red sorrel, red palm oil and leaf protein concentrate. (FAO, 2003)

Iron

The best source of easily absorbed iron is haeme iron from animal products, such as blood (blood sausage, blood pudding), meat, liver and fish (Tylor *et al.*, 1986). Breast milk (when fed during the first 6 months of life) is also a good source of iron (FAO, 2003).

Non-haem iron is got from seeds, legumes such as lima bean and other plant products. They contain 3 to 12 milligrams per 100 grams. Iron from leafy greens, fruits, grains and supplement is unavailable for the body to absorb. However, when some lean meat, fish, or poultry is mixed with some dark green leafy vegetables at a meal, the vegetable sources of iron can be improved up to 3 times (FAO, 2003).

Vitamin C-rich foods including amaranth leaves, black nightshade, beet greens, lotus root, spinach, broccoli, Chinese cabbage, green pepper, red pepper, bean sprouts, taro leaves and many varieties of wild fruits and berries enhance absorption of iron from plant foods (FAO, 2003)

Zinc

Red meat is the best common source of bioavailable zinc. Therefore individuals who do not consume this food on a regular basis are at risk of zinc deficiency, just as they are of iron deficiency. In addition similar factors affect the bioavailability of zinc and iron. Therefore it seems likely that dietary zinc and iron deficiencies might be associated. Dairy products, grains and grain products have significant amounts of zinc while fruits, and vegetables contain fairly low amounts of zinc.

In developing countries most people get their vitamin A, iron and zinc, from plant foods. Diversity is therefore necessary to improve intakes especially of fruits and vegetables. Kitchen gardening would stimulate changes in production and availability of these plant sources of micronutrients.

2.5 Common Causes of Micronutrient Deficiencies

Vitamin A, iron, and zinc deficiencies have many causes. Food poverty, inadequate availability, accessibility and affordability of health care services, inadequate knowledge and skills to reduce the risk of developing micronutrient deficiency in the general population may be fundamental issues in the causation of these deficiencies (GOK, 1981). Host factors such as infection, sicknesses that results to anorexia and those that use up the body supply of micronutrients all contribute to micronutrient deficiency (Martin et al, 1998).

VAD can result from inadequate protein needed for vitamin A carrier protein and lack of fat important for absorption of vitamin A. Severe PEM, diarrhoea and measles can predispose

VAD. Parasitic infestation may result into ingested nutrients not being absorbed. This is especially observed in the case with *Ascaris lumbricoides* and *Giardia lamblia,* which have been associated with VAD. Seasonality also causes lack of vitamin A during the dry seasons.

Infants are born with iron that lasts about 6 months. Their additional iron needs are met by breast milk. A non-breast fed infant's iron needs, if not met by the solid foods or iron supplement, can lead to deficiency. Toddlers between one and four years are at risk of developing iron deficiency because of rapid growth and lack of sufficient iron in their diets. Intake of iron absorption inhibitors including calcium, phytates and phenolics can result to iron deficiency. Acute bacterial, parasitic and viral infections, which affect catabolism and food appetite, are also causes of iron deficiency.

Diseases and other conditions may also lead to anaemia, which may not necessarily be associated with iron deficiency. Malaria, diarrhoea, acute respiratory infection, HIV/AIDS, Tuberculosis and hepatitis B and C may enhance the development of anaemia. Parasitic diseases like helminthes, schistosomiasis, trypanosomiasis and amoebasis are known to cause anaemia. Inflammatory conditions like tumours and chronic renal failure are associated with anaemia directly or indirectly. Genetic conditions affecting haemoglobin like sickle cell contribute to anaemia (Mwaniki *et al.*, 1999). Heavy metals like lead, copper, aluminium and cadmium interfere with haemoglobin formation through substitution of the iron in the haeme molecule.

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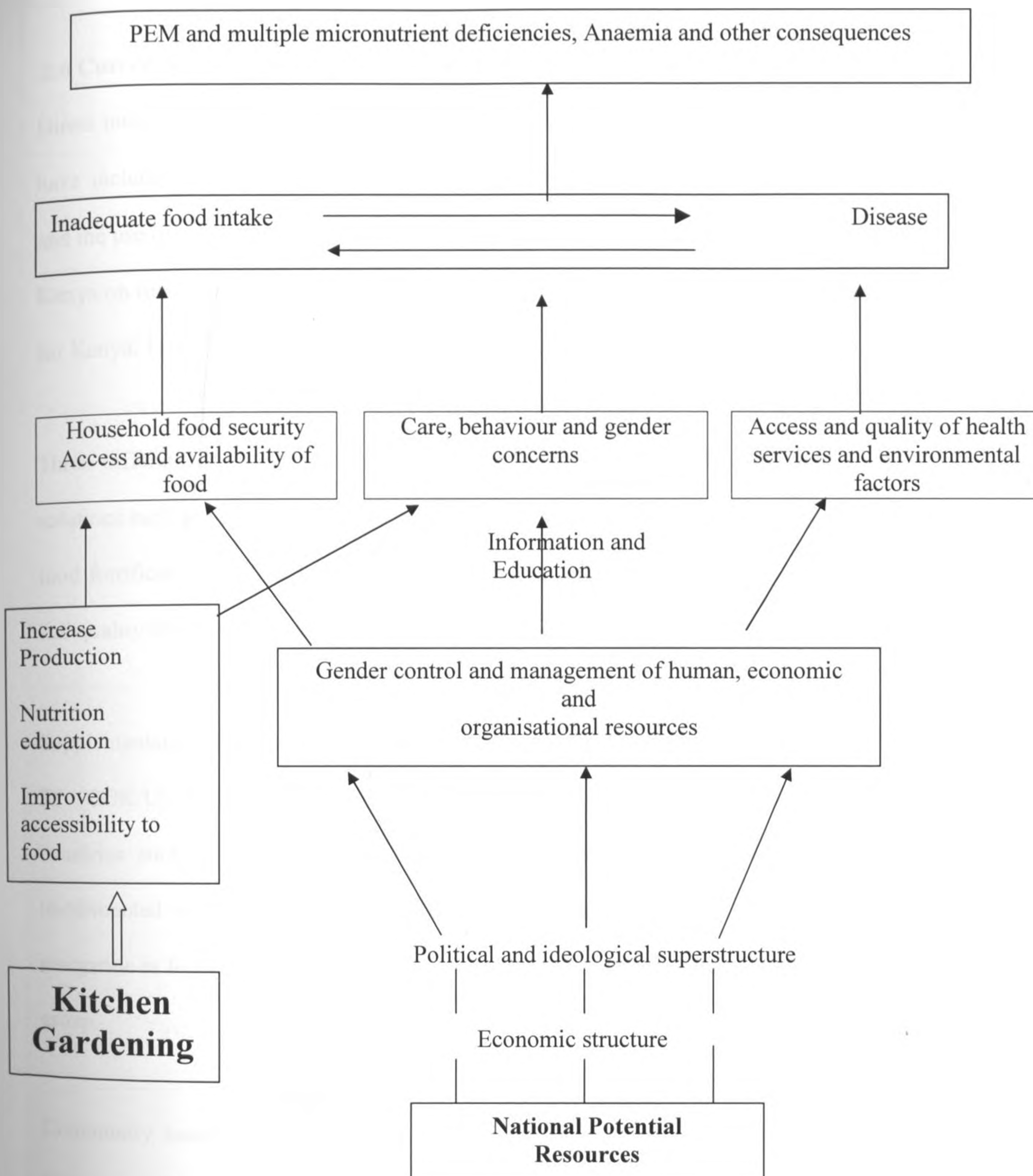
Zinc deficiency is commonly caused by low dietary intakes and low bioavailability. Mild zinc deficiency is more common than severe deficiency, but less well understood (Harold, 2002). Mild deficiency is not obvious, but because of zinc's essential functions, is a potential cause of morbidity. (Harold, 2002)

Interactions occur at tissue level between the three micronutrients. Vitamin A deficiency has been shown to inhibit mobilisation of depot iron (Benjamin, 1988). Although zinc supplementation improves scores in dark-adaptation tests, it inhibits iron absorption. Non-haeme iron administration decreases inorganic zinc absorption (Kenneth *et al.*, 2001). A decreased level of mean corpuscular volume slows the rate of zinc absorption (Harold, 2002). Large amounts of iron in supplements (greater than 25 mg) decrease zinc absorption. It would therefore be advisable to take iron rich foods other than supplements. Inhibiting and enhancing ingredients make sufficient contribution to the iron and zinc transfer from the intestines.

Figure 2.1 shows the conceptual framework of the causes of PEM and multiple micronutrient deficiency. The conceptual framework illustrates the causes of malnutrition, and their interactions, at three levels, immediate, underlying and basic. The synergistic interaction between the two immediate causes (inadequate dietary intake and disease) fuels a vicious cycle that accounts for much of the high morbidity and mortality in developing countries.

Three groups of underlying factors contribute to inadequate intake and infectious diseases: household food insecurity, inadequate maternal and childcare, and poor health services in an unhealthy environment. These underlying causes are, in turn, underpinned by basic causes that relate to the amount, control and use of various resources.



Adopted and modified from: (Mwaniki *et al*., 1999).

FIGURE 2. 1: Conceptual framework on aetiology of PEM and micronutrient deficiency

2.6 Current Interventions to Control PEM and Micronutrient Deficiency

Direct interventions have been used to reduce hunger and malnutrition. These interventions have included supplementary feeding, food aid, food fortification, nutrition rehabilitation and the use of formulated food mixtures. There are however currently no national policies in Kenya on iron deficiency, supplementation, or food fortification (US Census Bureau figures for Kenya, 1999).

Three different approaches have been adapted to control VAD. They include short-term solutions such as supplementation-using vitamin A capsules, medium term interventions like food fortification or food enrichment and long-term interventions such as dietary diversity and quality improvement (GOK/UNICEF, 1994).

Supplementation has been given in form of high dose capsules or oral dispensers of 200,000 IU (GOK/UNICEF, 1994). Food fortification has been implemented in a number of countries such as Guatemala in South America. Monoglutamate fortification was first implemented in the Philippines and later in Indonesia (GOK/UNICEF, 1994]. In Kenya margarine is fortified with vitamin A, but it may be economically out of reach for the risk group.

Community based trials have shown the effectiveness of vitamin A supplementation in reducing child morbidity and mortality. Mortality was reduced by 50% in Tamil Nadu among children under five years old and by 23% among children aged between 6-72 months in Sudan (Mclaren and Frigg, 1997). Dramatic reduction in mortality rates in hospitalised cases of measles has been repeatedly demonstrated, where treatment included vitamin A supplementation.

Food supplementation and fortification have their limitations. Supplementary feeding takes about a half of the budget in food cost, plus unacceptable quantity of staff-time (Kenneth *et al.*, 2001). This makes the intervention not likely to be sustainable. The money may otherwise be allocated to help people become self-sufficient in their food production (Caliendo, 1979). Food supplementation may not help the most vulnerable groups who are the pre-school children, pregnant and lactating mothers since it is usually done in established institutions. The free food given away may pave way for bad food habits (Caliendo, 1979). Supplementation does not allow the good dietary interactions that are provided by the natural food.

Food fortification posses a major challenge in quality control at the points of production, storage and consumption. Suitable food 'vehicles' to fortify and the technical matters of stability and acceptability are still a problem in most parts of the world (Kenneth *et al.*, 2001).

Dietary diversification should therefore be the ultimate goal of every country as a strategy of solving micronutrient malnutrition. This entails stimulating the production and consumption of micronutrient rich foods. In Kenya current programs include promotion of vitamin A rich orange-fleshed sweet potato by Vitamin A for Africa (VITAA) and general nutrition education by ministries of Health and Agriculture (GOK/UNICEF, 1994). Kitchen gardening also falls within this strategy.

2.7 Kitchen Gardening

Kitchen gardening is a term given to production of vegetables, mainly for household consumption within or near the homestead. Kitchen gardens have different names such as home mixed, back yard, home, farmyard, compound or homestead gardens. In Kenya there are various types of kitchen gardens such as multi-storey, double dug, and *mandalla* depending on how they are set up. Kitchen gardening may be the oldest production system known and its persistence is proving that there is intrinsic economic and extrinsic merit associated with it (WHO/FAO, 1998)

Potential benefits of kitchen gardening

FAO states that "the kitchen garden is an important land unit for households as it is often the centre of family life; a well developed kitchen garden is a complete farming system. The kitchen garden is the most direct means of supplying families with most of the non-staple foods they need year round" (FAO, 1995). The close proximity of the gardens ensures freshness of the produce reduces transportation costs, storage losses and facilitates harvesting. Madaleno, (2001) also states that growing and increasing consumption of vitamin A rich foods is one of the best and sustainable way of preventing VAD. Marie (2001) states that food based approaches are an essential component of a long-term global strategy for the fight against micronutrient malnutrition.

In an effort to improve dietary diversity and solve the problem of food insecurity even as they controlled vitamin A deficiency in Vietnam, horticultural interventions combined with extensive nutritional education were recommended as a long-term measure to eliminate micronutrient deficiency. Many Vietnamese families had kitchen gardens, in which they planted different species of vegetables, beans, legumes, roots, tubers and fruits in multi-layered, mixed cropping and inter-cropping cultivation systems (Khan *et al.*, 2002).

A study carried out in north east Thailand showed that the nutritional status of children residing in kitchen gardening households was relatively better off than of children residing in non-kitchen gardening households (Schipan *et al.*, 2002). The proportion of children with haemoglobin levels of 11µg/dl or less was higher for non-kitchen gardening households than for kitchen gardening households (Khan *et al.*, 2002).

Kitchen gardening contributes to household food security by providing direct access to food in an affordable way. It can also provide income and sometimes this may be the only source of independent income for the woman. It provides fodder for household animals and supplies for other needs such as fuel wood, furniture and baskets (Bendley, 1988). The trees and shrubs growing near the homestead shade the soil, reduce evaporation from the soil, conserve organic matter in the soil and provide support for climbing species of vegetables that are used in cooking (Goode, 1989).

Kitchen gardening is low input, and has few "barriers to entry". The poor can therefore easily adopt it because it is simple technology that can be done with little or virtually no economic resources. It makes use of locally available planting materials, green manure, live fencing, kitchen wastewater and indigenous pest control methods (Madaleno, 2001). Kitchen gardening may become the principle source of household food in the dry season, harvest failure, prolonged unemployment, health or disability suffering of family members. This was so in Kampala, Uganda after the civil war (Madaleno, 2001). Gardening has been practised by the landless on vacant lots, roadside, edges of fields and containers (Madaleno, 2001)

The technology of kitchen gardening remains among the populations and has chances of being transmitted from generation to generation, a key way to sustainable development (Johnson, 2001).

2.8 Ngong Household Energy and Environmental Conservation Project

Ngong Household Energy and Environmental Conservation Project (NHEECP), hereafter referred to as the project was an initiative of a group of women from the Kenya Forest research Institute (KEFRI). The main objective of the one-year project was to make firewood available and accessible to the women of Ngong and enable them to save on fuel and increase income by sale of energy saving devices.

An evaluation carried out after the first phase (six months) of the project activities, revealed that the energy saving devices, which had been promoted by the project, had enhanced household cleanliness and some women generated income from sale of the devices (Njuguna, 2000). Women had also experienced considerable energy, time, and money savings from their energy bills.

The second phase of the project involved training the women on making *maendeleo liners* (energy-saving jiko), establishing *mandalla,* multi-storey and double dug gardens as well as tree nurseries. *Mandalla,* multi-storey and double dug gardens are example of modern/intensive kitchen gardens. KG was expected to improve vegetable consumption and to be a source of income. Regular consumption of the vegetables translates into improved nutritional and micronutrient status (Howes, 1995).

The *maendeleo* liners enabled women to cut on fuel costs to a third of what they used to use (Njuguna, 2000). The money saved in such cases could be used to improve the quality of food taken. Improved income levels particularly when accessible to women, has been shown to result to higher quality food intake. This in most cases turns out to be food of animal origin, which are better sources of vitamin A, haeme iron and zinc (WHO, 1996). The maendeleo liners freed time for women, leading to increased time for childcare. This could lead to reduction in children's risk of being malnourished from insufficient feeding and can also reduce their likelihood of contracting diseases from the environment.

2.9 Gaps in Knowledge

Data on nutrition and micronutrient status of low social-economic urban and peri-urban in Kenya is at best scanty. These communities are likely to be at risk of micronutrient deficiency mainly because of their low purchasing power that limits their ability to purchase variety of foods. The information gathered will contribute significantly to the existing database.

In Kenya, information on contribution of kitchen gardening to improving nutritional and micronutrient status is at best scanty. Kitchen gardening has proved to be an appropriate technology in other parts of the world. In a country like Kenya where micronutrient malnutrition is increasing (Central Bureau of Statistics, 1998), household food production remains a viable option in the prevention of micronutrient deficiency especially among people of low-social economic status.

The comparative study assessed the contribution of current kitchen gardening activities to dietary diversity, food consumption patterns, micronutrient and nutritional status. This is additional information needed to strengthen the necessary background for promoting accessibility and consumption of micronutrient rich foods at all possible levels in the fight against micronutrient deficiency.

3.0 STUDY SETTING AND METHODOLOGY

3.1 Study Area.

The study was conducted in Ngong, one of the six divisions of Kajiado District in Rift Valley province, Kenya (Appendix 9 and 10). Ngong Division has four locations namely Ololua, Ngong, Nkaimuranya and Rongai, with its administrative centre at Ngong town. It is 3,698.1 sq. Km with 450,118 people. It has 85,680 children less than five years old. Of these, 43,324 are males and 42,356 are females (GOK, 2000).

Ngong division is a sub-urban area of Nairobi, located at about 30Km South West of Nairobi. It receives an annual rainfall of between 800 and 1200 mm, which is bimodal. The long rains fall from March to May (GOK, 2000). The short rains fall from October to December. The average annual temperature ranges from 16^0C to 20^0 C.

The proximity of Ngong to Nairobi has led to influx of many low-social economic status people in search of cheaper housing. This has put a lot of pressure on land. Pieces of land, which had hitherto high potential for agricultural development, have been used for residential and commercial purposes. This has led to a deficit in food availability that has resulted in severe cases of malnutrition (GOK, 1997). Infant mortality rate is also high (90:1,000) and is highly associated with measles, malaria, malnutrition, and acute respiratory infections (GOK, 2000). Measles is by far the leading cause of infant mortality.

3.2 Study Design

The study was comparative, cross sectional and descriptive with an analytical component. It sought to establish the potential of kitchen gardening in influencing food intake, dietary diversity, nutritional and micronutrient status of children aged 9-59 months.

3.3 Study Subjects

All households with pre-school children aged 9-59 months were eligible and constituted the sampling frame for the study. These households were divided into two groups based on whether a household owned a kitchen garden of any form or not. The children aged 9-59 months were the study subjects for nutritional and micronutrient status.

3.4 Sample Size Determination

The sample size was determined using the Fisher *et al.*, (1991) formula for comparative studies as shown below

$N = 2Z^2pq/d^2$ Where:

N = the desired sample size

P = proportion of the population with low Zinc status as per 1999 micronutrient survey carried out in Kenya which was 50.8%. Prevalence of zinc deficiency in Kenya was chosen because it gave the largest sample size. VAD, Iron deficiency or PEM would have given a smaller sample size.

Q = 1-P = 1-0.508 = 0.492.

Z = Standard normal deviation set at 1.96 (for 95% confidence interval).

Degree of accuracy desired was set at 0.1

$N = 2 \times 1.96^2 \times 0.508 \times 0.492 / 0.1^2 = 192 + 15\%$ attrition = 221.

Attrition was set higher (more than the usual 10%) because of the expected mobility of people in peri-urban areas.

3.5 Sampling Procedure

Multi-stage sampling procedure was used. Non-probability sampling was done in the initial stages since the study setting pre-determined purposive sampling. The Ngong location where NHEECP had been operating was chosen for the study. Two villages Mathare and Gichagi were selected because they were the areas where occupants had small or no plots of their own. They could therefore not practice any form of major farming except kitchen gardening.

For each of the selected villages the following were under taken: -

- Registration of all households in the cluster that had children aged 9-59 months.
- Classification of households according to whether they practised kitchen gardening or not.

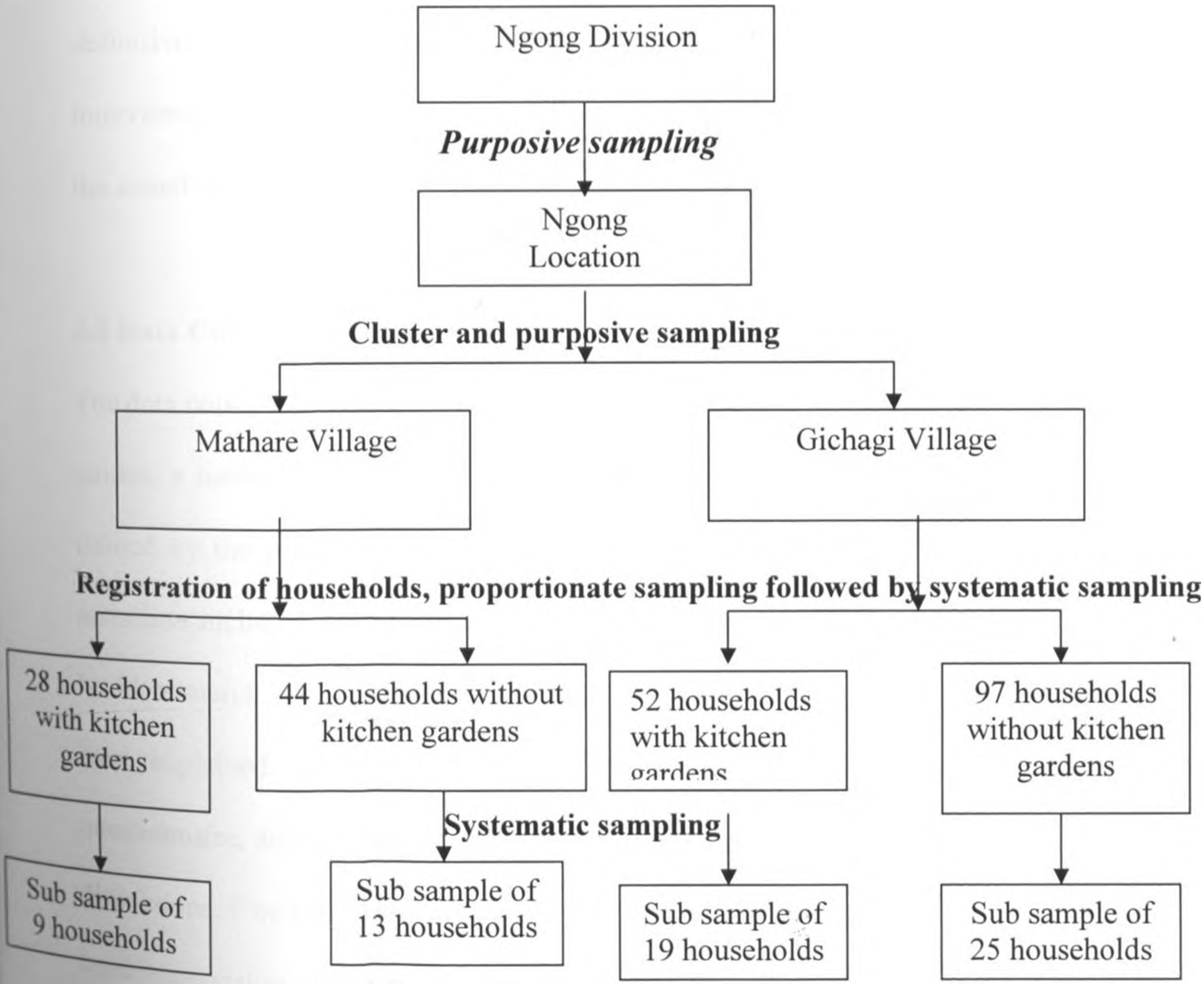
This helped to divide the household into two sampling frames: -

1 Households with kitchen gardens and children aged 9-59 months.

2 Households without kitchen gardens and with children aged 9-59 months.

In cases where more than one sibling qualified, only one was admitted in the study. If they were two the older one was admitted in the study as the older one has higher probability of being neglected due to arrival of the younger one. If three the middle one was admitted because he/she is more likely to suffer negligence due to the fact that the older one is likely to fed for themselves and the younger one is receiving maximum attention. The households with kitchen gardens and children aged 9-59 months were 80 only. They were all included in the study. The remaining households were systematically selected from the non-kitchen gardening households to make up the required sample for the study.

A total of 221 households, (141without kitchen gardens and 80 with kitchen gardens) were selected. A sub-sample of 30% of the households (28 among kitchen gardening and 38 among the non-kitchen gardening) was then systematically selected for the biochemical analysis of blood, and the 24-hour recall dietary assessment. Figure 3.1 shows the sampling frame used for the study.



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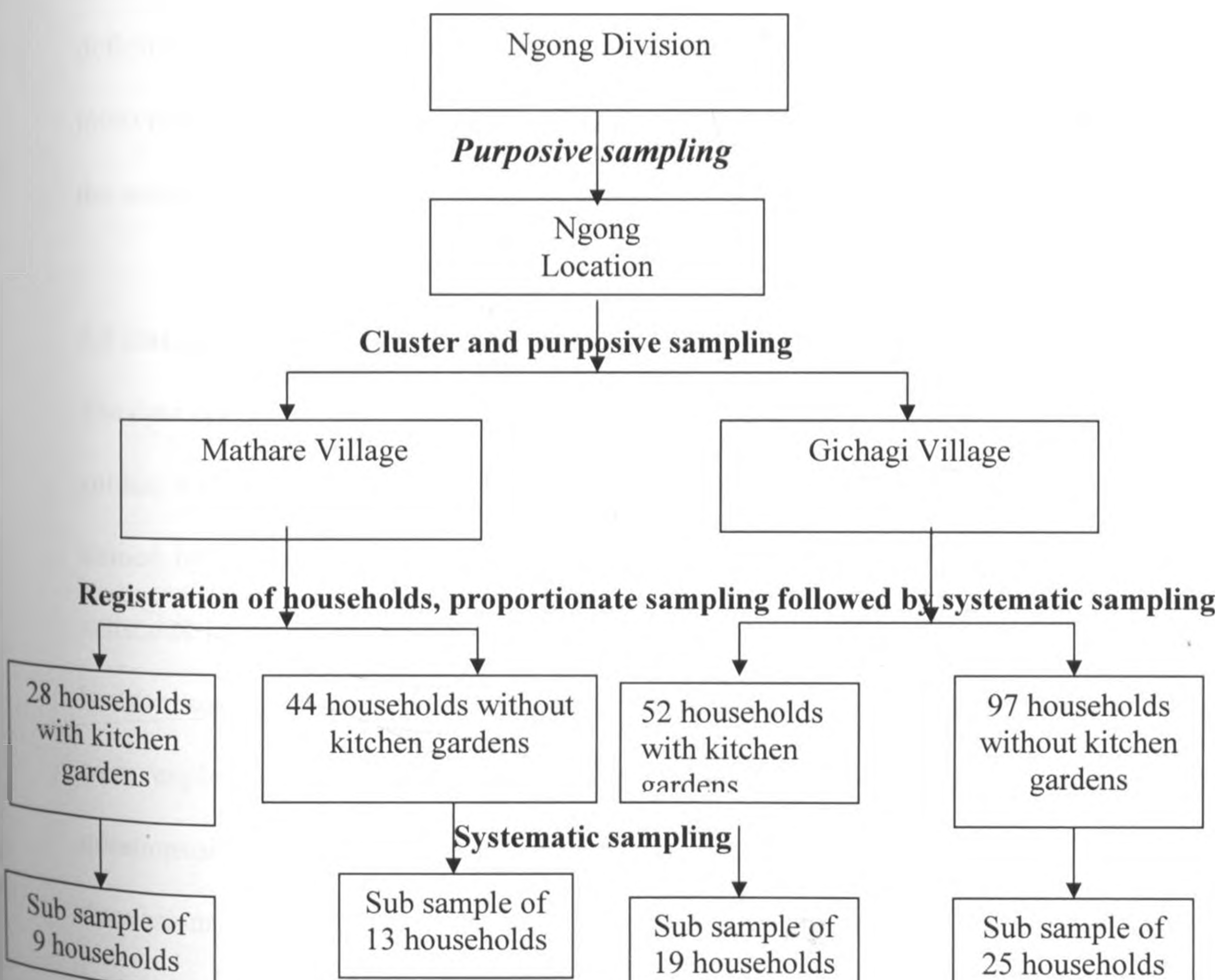

Figure 3. 1: Sampling chart

3.6. Study Instruments

Both qualitative and quantitative data were collected during the study. Quantitative data were collected using a structured questionnaire (Appendix 1) and biochemical analysis of blood samples. Qualitative data were collected using focus group discussions, key informant interviews and observation.

3.7. Pre-testing of the Study Instruments

The structured questionnaire was pre-tested in ten households that were not included in the study. Changes were made appropriately and the corrected questionnaire was used for the definitive data collection. Qualitative data collection tools were pre-tested through informal interviews with a few women in the village and key informants who were later not included in the actual study.

3.8 Data Collection Team

The data collection team was composed of the principal investigator, two field assistants, field guides, a haematologist and laboratory technicians. Two field assistants were recruited and trained by the principal investigator to assist in data collection. Selection criteria for field assistants included having attained at least a C+ (plus) in O'level and prior participation in health research. The purpose and general procedure of the study and its expected duration were explained. The training covered the sampling methodology, administration of the questionnaire, anthropometric measurements, interview skills and conducting of focus group discussions. The field assistants were also given an opportunity to measure children under keen supervision of the principal investigator. The measurement results were compared to minimise the inter-observer errors. Although the questionnaire was in English it was administered in both *Kikuyu* and *Kiswahili*. Time was spent in translating the questionnaire into *Kikuyu* and Kiswahili and back into English to make sure the meaning was the same. The training lasted four days.

3.9 Data Collection Procedures

Research clearance was obtained from the research co-ordination section, Ministry of Education, Science and Technology, Nairobi Kenya. The ethical clearance was obtained from the Kenyatta National Hospital Ethical and Research Committee.

Prior to the actual data collection phase, the principal researcher made several visits to the study area to familiarise herself with the study area and population. During the visits the researcher had a chance to explain the research to the study population during a chief's Baraza in an effort to inform the people of the intended research, its importance and what it was to involve. This enabled the participants to make informed decision on whether to take part in the study or not. On visiting their homes during the data collection phase, the participants were also informed about the on-going research, its importance and their expected participation and gave verbal consent before the interview.

The data collected included: demographic and social economic characteristics, mothers' nutritional knowledge, food production situation, dietary intake, nutritional and micronutrient status as well as morbidity experience of children aged 9-59 months and household sanitation.

3.9.1 Demographic and social-economic characteristics

Household demographic information sought included the names of the people living in that household for the last three months, their ages, sex, marital status, relationship to the household head, education level, occupation and contribution to the household in terms of money or labour.

Durable consumer goods owned by the households were recorded to serve as proxy measures for social economic status (Central Bureau of Statistics, 1999). The assets recorded included: bicycle, sofa set, television, gas cooker, cars, motor cycle/scooter, sewing machine, television and wardrobe/cupboard. Livestock and land ownership, type of housing and the household sources of energy for cooking and lighting were also recorded.

3.9.2 Mothers nutritional knowledge

Mothers' knowledge on nutrition and malnutrition, vitamin A, iron and anaemia, Zinc and worm infestation was sought. This was carried out using focus group discussions, key informant interviews and a structured questionnaire.

Focus group discussions (FGD)

Two FGD were held: one in Gichagi and one in Mathare. They were used to augment quantitative data obtained through structured questionnaires. They sought community knowledge on PEM, micronutrients, iron deficiency anaemia (IDA), vitamin A supplementation and their perception of nutrition and good diets. They also sought to identify nutrition related programs and activities that had been going on in the study area, why some vegetables were produced but not consumed and why the community did not give emphasis to some micronutrient rich foods.

The team facilitating the FGD was composed of four persons who included the principal investigator as the facilitator, the divisional nutritionist and a research assistant as the recorders and a field guide who registered the participants and on whom the team depended on mobilization of the participants. The field guides were instructed on how to randomly select 10-12 mothers with children aged 9-59 months from the village to take part in the FGDs. On the day of the meeting, the mothers' were registered and details such as their names, age and marital status noted.

Although the requirement of a FGD is 6-12 people, more mothers attended the meeting in Mathare since the invitation was by the word of mouth, and it was not prudent to send a voluntary participant away. A total of seventeen mothers attended the discussion in Mathare and ten in Gichagi.

Pre-prepared questions (Appendix 6) and probing was used to collect data after briefing of the participants. During the discussion both tape recording and writing of the notes went on simultaneously. The discussion was concluded after allowing participants to ask questions (Scrimshaw and Hurtado, 1987). Each session lasted about 60 minutes.

Key informant interviews

The key informant interviews included community leaders and the community nutritionist. The information sought included vitamin A supplementation and people's attitude towards it, presence of programmes involved in micronutrient and nutrition related issues such as food preparation demonstrations in the division, promotion of certain foods and issuing of pamphlets. This aimed at documenting the already existing information on nutrition in the study area. The interviews were also used to rank the assets owned by respondents interviewed in the order of their value as viewed by the study community.

3.9.3 Food situation

The data collected included food production, utilisation, food intake of the households and the study children and dietary diversity.

Food production and utilisation

Information was sought on the types of kitchen garden (indigenous and modern) owned, types of crops produced, the adequacy of the food produced and how the food was utilised and prepared for consumption. Special emphasis was laid on micronutrient rich foods. For the foods that were not produced information was sought on their sources.

Food intake and dietary diversity

The data on food intake by the household was collected using the food frequency questionnaire (Appendix 1). This was modified to include the frequency of consumption of the various food items over the last seven days prior to the study and the sources of the foods.

Frequency of consumption over the last seven days allowed for computation of the dietary diversity scores. A special food frequency was also designed to determine the frequency of consumption of selected foods by the study children. Food intake by the study children was assessed using the 24-Hour recall dietary assessment procedure (Appendix 1).

3.9.4 Determination of dietary diversity and food intake

Food consumption pattern for the household and its relation to dietary variety was determined. Dietary variety was assessed using a food frequency questionnaire, composed of a listing of foods commonly consumed in the households. For each food item the respondent was asked to recall the usual frequency the food was consumed in the household, and the number of times the food had been consumed over the week preceding the study (Appendix 1). This included the brands of certain types of oils and ready to eat foods such as margarine (WHO, 1996).

A 24-hr recall dietary assessment was also done on all children from the selected sub-sample to determine the food intake of the index child. The method has been regarded as suitable for estimating current food intakes (Hartog *et al.*, 1995, and Hartog and Staveren, 1985). The respondents were asked to recall the time the food was eaten, the name of the dish (foods, snacks and beverages) and the ingredients that were used. They were then asked to estimate the total volume of the dish and the amount of the food the child took including the leftovers. Detailed descriptions of all meals eaten within the period and ingredients were recorded in a table designed for this purpose (Appendix 1).

The dietary recall was done in different days of the week representing both weekdays and weekends food consumption pattern. The actual amount of the food consumed by the child plus total amount of the dish was used to compute the amount of ingredients taken by the child. For example, 30 grams of sugar was used to make 300 grams tea, in which the child took 150 grams, and then the actual intake of sugar was 15 grams. Then the conversion of volumes of food to grams was carried out as described in Mitzner *et al.*, (1984) before further analysis.

3.9.5 Data on nutritional and micronutrient status of the study children

nutritional status

Anthropometric measurements of weight, height, and MUAC were taken. A fourth variable, age, which was necessary for computing height-for-age and weight-for-age, was given by the mothers/caretaker and verified using baptismal cards, growth monitoring cards or family records. The fifth variable sex was determined through observation.

Weight: - It was taken using a salter scale, which was calibrated in kilograms and grams. Each child was undressed and put in the pants that were hang on the salter scale which was suspended from a beam using a strong sisal rope. The weight of the child was read and recorded twice to the nearest 100 grams (0.1kg) (Scrimshaw and Hurtado, 1987).

Older children, 25 to 59 months old were weighed dressed with inner cloths, but no shoes, on a bathroom scale. The scale was calibrated in kilograms and grams as recommended (Scrimshaw and Hurtado, 1987). The measurements were read and recorded twice to improve accuracy. The indicator pointer of the scale was zeroed before every child was measured and the readings were taken from an angle of 90 degrees.

Height: - The height/length of the index child was taken using a height/length board. Children between 9-24 months or who were shorter than 85cm were measured lying on their back. The head of the child was held by the mother/caretaker to ensure that it touched the board. The top of the head was pressed firmly against the fixed end of the measuring board, the knees were held straight and footboard moved firmly against the heels so that the heels were at right angles. The person measuring held the legs together and took the measurements The older children (25-59 months) were measured standing on the height board with their feet flat together on the base of the board, knees straight, heels, and head touching the back of the board and the head board firmly on the head as well as on the board. The height board was always placed on a flat surface and against the wall. Two readings were taken for each child (Scrimshaw and Hurtado, 1987).

Mid-upper arm circumference: The mother was requested to uncover the child's left arm as far as the shoulder and bend it such that the lower arm was placed at 90^0 across the stomach. The tip of the bone at the back and top of the shoulder was found using fingers and marked with a pen. The 2nd spot was marked at the tip of the elbow. The distance between the two marked spots was measured while standing behind the child and divided into two. MUAC tape was wrapped around the arm at the midpoint between the shoulder and the elbow tips while comfortably crossing over from zero mark and readings were taken twice.

micronutrient status

Ethical considerations

Ethical clearance was obtained from the Kenyatta National Hospital Ethical and Research Committee (Appendix 2). This was necessary because the study was intrusive. Children were enrolled in the study only after the parents/guardians had given informed consent to participate and signed a consent form (Appendix 4). In the consent information the entire study was explained (Appendix 3) and any questions raised were addressed.

All laboratory personnel who handled biological specimens wore gloves. Similar bio-safety precautions were applied during detailed laboratory analyses. Single use disposable needles and syringes were used. All used expendable materials were incinerated while glass wear was soaked in high-level disinfectant overnight before cleaning as it is recommended by WHO (1996). Outside temporary discomfort associated with venipuncture, the index children experienced no other pain or discomfort. Within limits of the study all participants considered to be ill were referred to Ngong health centre for follow up.

Blood collection and analysis

Serum retinol, serum ferritin, and zinc levels were determined for the study children through blood sample analysis. A qualified haematologist from Kenya Medical Research Institute (KEMRI), Nairobi, did the venipunctures and blood collection. Using a single use sterile syringe and needle and standard clinical procedures, 5 Ml of venous blood were drawn from the child and transferred to an amber coloured or foiled acid-washed screw-capped tube. Each *micronutrient status*

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High Pressure Liquid Chromatography (HPLC) technique was used in the analysis of serum retinol levels at 325nm. Mini vidas was used to analyse serum ferritin levels while Flame Atomic Absorption spectrophotometer was used to analyse serum-zinc. The results were recorded in a blood sample analysis form (Appendix 5). Children confirmed to have VAD were referred to Ngong health centre for vitamin A supplementation.

3.9.6 Morbidity and sanitation

The guardian/caretaker was asked to recall any form of illness that the index child had suffered within the two-week period prior to the study. Common practises were also sought especially on health seeking habits of the households. Information on sources and methods of treating water were sought. Observation was done to note the presence of a toilet facility.

3.10 Data Quality Control

The quality of the data was ensured through proper training of the field assistants and their regular supervision during the process of data collection. The questionnaire was checked for completeness and errors at the end of each day of the actual survey. In cases where an individual respondent was unwilling to take part in the study, the interviewer moved to the next household that had been registered but not sampled. The data was cleaned through running of frequencies and cross tabulation after entry to check for mistakes that could have occurred during entry.

3.11 Data Analysis

All open-ended responses were manually coded. The instructions for coding were prepared after data collection to incorporate all the ideas that had come up. Data was analysed using statistical package for social sciences (SPSS) and EPI-info programs available at ANP.

Proportions, frequencies, means, standard deviations and correlation coefficients were computed (Munro and Page, 1993). The Chi-square test was used to determine the presence of an association between the independent variables. T-test was used to compare the mean caloric, protein, vitamin A, iron and zinc intake. Linear and simultaneous multiple regression analysis were also carried out to determine the factors influencing micronutrient status of the study children. The kitchen gardening, social-economic status, dietary variety and mothers' level of education were entered as independent variables while micronutrient statuses were entered as dependent variables. In determination of factors influencing dietary variety, kitchen gardening, social economic statuses of the household were considered as independent while dietary variety was considered dependent.

The difference between the two study groups were considered statistically significant when P<0.05. Descriptive statistics using tables and figures such as bar charts, pie charts and line graphs were used to describe the demography, nutritional knowledge and nutritional status.

Social-economic status index

The different types of livestock owned were converted into livestock units (appendix 7). The assets owned were then weighted as in appendix 8 to allow for the calculation of the social-economic status index of each household. The weight of each asset was based on information generated from key informant interviews on the community's perception of households of high, medium or low social economic status. With the help of key informants, the average value of the commonly used items in the market was then used to assign each asset a specific weight (Appendix 7). The sum the weights allocated to assets owned represented the social-economic status index of the household. Based on the index, the households were classified into three social-economic status groups, high (16-24), middle (8-15) and low (0-7).

Household dietary diversity, energy and nutrient intake by the study children

Household dietary variety within food groups was assessed in the following manner. First six food groups were formed as an initial basis on which to combine food types listed. The six food groups and the food types within each group are shown in table 3.1 along with representative food types in each group. Dietary variety was then calculated as the percentage of different food types consumed fromµg each food group within the last seven days prior to the study, regardless of the frequency with which they were consumed (Megan *et al.*, 1999).

Dietary variety was then computed as the number of food types consumed divided by all possible food types in the food group and was converted into a percentage.

Table 3. 1: Food group descriptions

Food group	Number of food types	Food types
Cereals	5	Maize and maize products, sorghum and sorghum products, millet and millet products, rice, wheat and wheat products.
Legumes	6	Beans, peas, Green grams, chickpea, ground nuts, pigeon peas.
Fruits	8	Banana, lemon, oranges, avocado, passion, mangoes, sugarcane, pawpaw.
Vegetables	10	Amaranth, cabbage, kales, carrots, tomatoes, cowpea leaves, pumpkin leaves, French beans, fresh peas, 'enderema' (*Basela alba*).
Roots and tubers	4	Sweet potato, Irish potato, arrowroots and yams.
Animal products	5	Eggs, beef, chicken, milk and fish.

The index child's daily food intake was calculated from the 24-hour recall. The estimated amounts of food intake were converted from household measures to grams. This was done using the graduated measuring cylinders to estimate food volumes and/or kitchen scales to estimate food weights. The food models were also used in cases where there were no left over ingredients to obtain the weight of the ingredients that were used. In cases where the respondents gave the ingredients in terms of their money worth in the market, samples of such foods were bought and weighed to estimate their weights.

The estimated intake of energy and nutrients was then calculated using food composition tables (Sehmi, 1993 and Kenneth, 2001). Syntax was made based on the composition of each food that the child had consumed over the 24-hours prior to the study. This took into account the calorie, protein, vitamin A, iron and zinc content of each individual food ingredient consumed. Using SPSS the quantities of the energy and nutrients consumed in the 24-hours were estimated and compared with the recommended daily intake (RDI). The RDI used are as shown in table 3.2. Based on Harper (2001), who states that the amount of nutrients most people require is below RDA, and about half the population would require less than 75% of the RDA, the proportion of children consuming less than 75% of the RDA was also determined.

Table 3. 2: Recommended daily intake by age group

Age in years	Energy (Kcal)	Vitamin A (R.E)	Proteins (g)	Iron (mg)	Zinc (mg)
<1	820	300	13.50	6.10	5.0
1 - <2	1150	250			
2 - <3	1350	550	15.50	7.0	
3 – 5	1550	300	17.5	8.1	6.5

Based on Sehmi, 1993 and Kenneth *et al.*, 2001

Nutritional status

U.S National Centre for Health Statistics (NCHS) reference values, which have been adopted by WHO, facilitated comparison among and within population subgroups and allowed classification of groups into varying levels of nutritional status. The WHO has set up cut off points on these indices based on implied exposure to risk when children fall below specified limits.

The cut-offs for nutritional status used in this study were: -

- < - 2 Z score: reflects global malnutrition. Children falling below this cut-off point were considered to have a deficit in their nutritional status while those whose values were above that value were considered to be normal.
- -2 SD - 3 Z scores: the children were considered to have moderate/mild malnutrition.
- < 3 Z scores the children were considered to be severely malnourished.

The cut-off point for Mid-Upper Arm Circumference (MUAC) was set at <12.5 cm. A child whose MUAC fell below this cut-off was considered to be nutritionally at risk.

3.12 Problems Experienced

- Delay in acquisition of ethical clearance. The study had to be delayed as ethical clearance was awaited.
- A few children did not turn-up for blood collection. This however did not affect the eligibility of the data for statistical analysis or the representative ness of the sample.

4.0 RESULTS

A total of 755 households in the study population had children aged 9-59 months and therefore met the selection criteria for inclusion in the study. In Gichagi, there were 503 households, of which 67 had kitchen gardens and 436 did not. In Mathare there were 252 households of which 13 had kitchen gardens and 239 did not. A total of 80 households with kitchen gardens and 141 households without kitchen gardens were interviewed. This made the required sample size of 221 households. There were eight dropouts as a result of incompletely and wrongly filled questionnaires. This resulted in a sample of 213. For the blood collection, 87.8%, n=66 of the children turned up. Out of these, one sample was insufficient and therefore 86.4%, n=66 of the planned sample size was analysed.

4.1 Demographic and Social Economic Characteristics

4.1.1 Social-demographic characteristics of the study population

Majority (92.8%) of the households had settled in the area for at least one year by the time the study was carried out. There were a total of 983 persons in the households with 333 belonging to kitchen gardening (KG) and 650 to the NKG households. Of the total number of persons, 468 (47.6%) were males and 515 (52.4%) females. The KG and NKG households were similar in terms of household headship, household size, number of pre-schoolers and parents age and education (Figure 4.1 and Table 4.1). More than three-quarters (80%) of the mothers were aged between 20 and 34 years (Figure 4.2). Most (80 % n=213) of them were married.

More than two-thirds (68.1%) and slightly less than a quarter (23.4%) of the household heads had obtained primary and secondary education respectively. Illiterate household heads and those with tertiary education accounted for 4.2% and 2.4% of the households respectively. Although there were more mothers who had attained secondary education among KG households than among NKG households (Figure 4.1), the difference was not significant. Pearson correlation however, showed a negative correlation between the mother's level of education and age in years (r =-0.36, p=0.000).

Table 4. 1: Some demographic characteristics of the study population

Characteristic	**Overall**	**House hold with kitchen garden**	**House hold without kitchen garden**	**P-value**
	N=213	(%), n=80	(%), n=133	X^2–test
Male headed households	171	78.8	81.2	0.663
Female headed households	42	21.3	18.8	0.663
Proportion of pre-school children	277	28.8	27.8	0.745
	Mean ± standard deviation			t- test
Fathers age in years	33.8 ± 8.64	34.4 ± 9.48	33.7 ± 8.2	0.077
Mothers age in years	28.6 ± 8.11	28.5 ± 8.36	28.7 ± 8.03	0.653
Fathers years in school	8.4 ± 2.78	8.3 ± 2.84	8.5 ± 2.76	0.311
Mothers years in School	7.3 ± 2.46	7.7 ± 2.4	7.1 ± 2.46	0.104

There was no difference in household size between the two study groups. The average household size was 5±2 and the mean number of children in each nuclear family was 3±2 in both study groups.

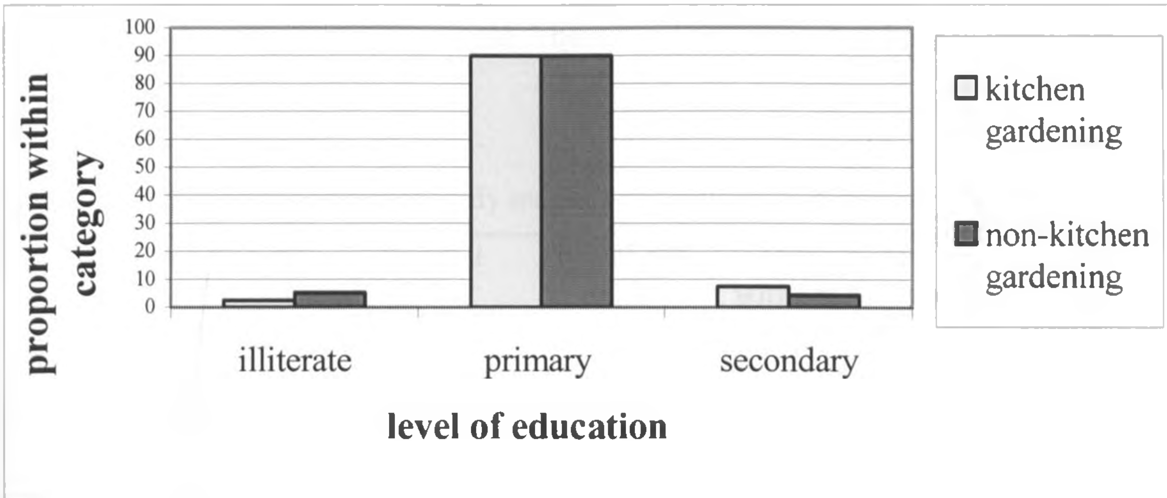

Figure 4. 1: Distribution of the study mothers by level of education and study group

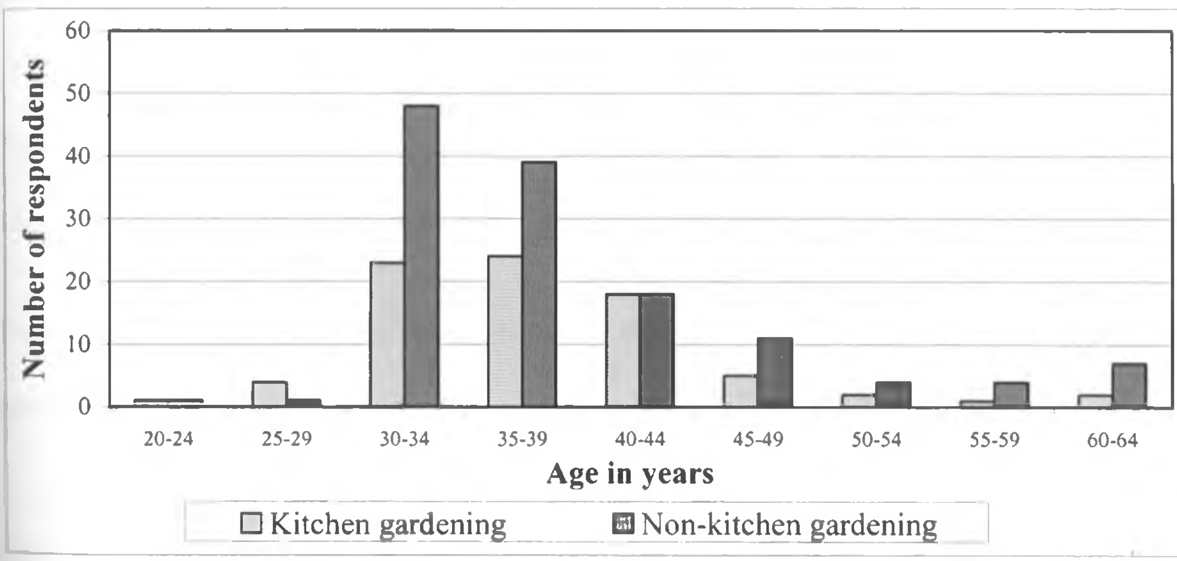

Figure 4. 2: Distribution of the respondents by age groups and household category

Occupation of the parents

There was no significant difference between the KG and NKG household as far as the parents' occupation were concerned. More than half of the fathers and a tenth of the mothers were casual labourers (Table 4.2). About three-quarters (72.9%) of the mothers contributed both labour and income to the household. The rest contributed only labour in the household.

Table 4. 2: Percent distribution of study mothers and fathers by occupation

Characteristic	Overall	Households with kitchen garden	Households without kitchen garden	P- value (X^2– test)
Fathers occupation	**N=171**	**N=63**	**N=108**	
Small scale traders	33.3	25.4	37.9	0.071
Casual labourers	57.3	65.1	52.8	0.104
Formally employed	9.35	9.5	9.3	0.872
Mothers occupation	**N=213**	**N=80**	**N=133**	
Small scale traders	23.0	21.25	24.1	0.637
Casual labourers	11.7	15	9.8	0.806
Formally employed	1.0		1.5	
House wives	64.3	63.75	64.7	0.893

Dependence ratio

The dependence ratio was calculated as: - $\frac{\text{total persons below 15 years + those over 65 years}}{\text{Total persons between 15 and 65 years}}$

There was no significant difference between the dependence ratios (DR) of the kitchen gardening (DR=1.11) and non-kitchen gardening households (DR=1.13).

4.1.2 Social-economic characteristics of the study households

Land and house ownership

In total only 6% (n=213) of all the households studied owned land. The land size ranged between one-quarter acre and two acres. Three-quarters of those w ho owned land had less than one acre. Renting of land was significantly more common among KG households than among NKG households. KG was practised more among households that lived in their own houses than among households renting houses (p=0.013) (Table 4.3).

Temporary and permanent types of housing were rare (2.8% in total, n=213) as the area was mainly covered with semi-permanent houses (97.2%). The mean number of rooms per house was 2 ± 1 and the mean rent per month was 516 ± 250 shillings.

Table 4. 3: Distribution of kitchen and non-kitchen gardening households by ownership of land and house

Characteristic	Total number of households	HH with kitchen gardens	HH without kitchen gardens	P- value (X^2–test)
N	%, n=213	%, n=80	%, n=133	
HH owning land	6.1	6.3	6.0	0.858
HH renting land	45	66.3	32.3	0.000**
Owner occupier	60.6	71.3	54.1	0.013**
Rental house	39.4	28.8	45.9	0.013**

** Significant at p<0.05 HH- Households

Social-economic status

The vast majority (92.5%, n=213) of the households were of low social-economic status while only 1.9% were classified as high social economic status. The proportion classified as middle social-economic status was 5.6%.

Means of lighting and cooking

Means of lighting and cooking did not differ between the KG and NKG households. The proportion of households using hurricane lamps, tin lamps and solar power as means of lighting were 73.7%, 23.5% and 1% (n=213) respectively. For 51.2%, 30.5%, and 18.3% of the households the main source of energy for cooking was charcoal, paraffin and wood respectively. Most of the households had an alternative source of energy for cooking.

Study findings therefore indicated that both KG and NKG households were similar in demographic and social-economic status.

4.2 Mothers Nutritional Knowledge

There was no significant difference between the KG and NKG households as far as the mothers' knowledge on nutritional issues were concerned.

4.2.1 Protein-energy malnutrition

The mothers knew that food is important in the body as it provides energy needed for growth and to do work. They also knew that the food also keeps the body healthy by providing protection against diseases. They classified foods into three groups: body building foods, energy giving and protective foods. They identified kwashiorkor as a disease suffered if the child does not take enough food for some undefined length of time. Mothers said that kwashiorkor is manifested as extended stomach, brown hair instead of black and thin legs. They had no idea about the quality of the food that should be given to the children nor the frequency with which a child should be fed

4.2.2 Vitamin A

Less than half of the study children (42.3%) had received vitamin A supplement within the last six months prior to the study (45%, n=80 from the KG and 40%, n=133 from NKG households). The difference in the proportion of the children who had received vitamin A supplementation was not significant. For most (83.7%) of the children who had not been supplemented with Vitamin A in the same period, their mothers had no knowledge of the on-going vitamin A supplementation programme. The rest either did not see the need (11.5%) or were prohibited by religious reasons (5%). About three-quarters (72.2%) of the mothers did not know why their children received the vitamin A supplementation while the rest had their children supplemented because they thought that vitamin A was necessary for prevention of disease (8.8%, n=90) or it helped the child to gain appetite (18.8%).

More than half of the mothers (52.1%, n=213) knew that food was an alternative source of the vitamin. The majority associated fruits and vegetables with all the vitamins in general. A few however (4.5%, n=111) reported that basking under the sun also provided vitamin A.

Periodic use of vitamin supplements such as cod liver oil, fish oil and haliborange was recorded in a few households (11.2%, n=213). The main reason as to why these were used was for prevention and treatment of cough/cold and pneumonia.

4.2.3 Anaemia

Overall more than a half (56.8%, n=213) of the mothers had knowledge about anaemia. There was no significant difference between the KG and NKG households as far as the knowledge was concerned (p=0.105). Table 4.4 shows the distribution of the mothers who reported they knew about anaemia by the signs and symptoms they associated with it. The local names generally described anaemia as lack of blood. The names included: anaemia, Kwaga thakame (kikuyu language), ndetema (Kamba language) and enyamorea (Kisii language).

Table 4. 4: Signs and symptoms of anaemia as given by mothers with knowledge about the disease

Description	Proportion (%) n=92
Fainting	31.5
Eyes turn white	29.3
Tiredness	21.7
Turning yellow	17.4

The perceived leading causes of anaemia included inadequate food intake, pregnancy and overworking (Figure 4.3). Figure 4.4 shows the mothers' sources of information about anaemia. Mothers rely more on their friends for information about health than they do to the health workers. Information from the health workers included the regular counselling at mother child health (MCH) clinics. A few of the mothers (4.2%) had suffered from anaemia.

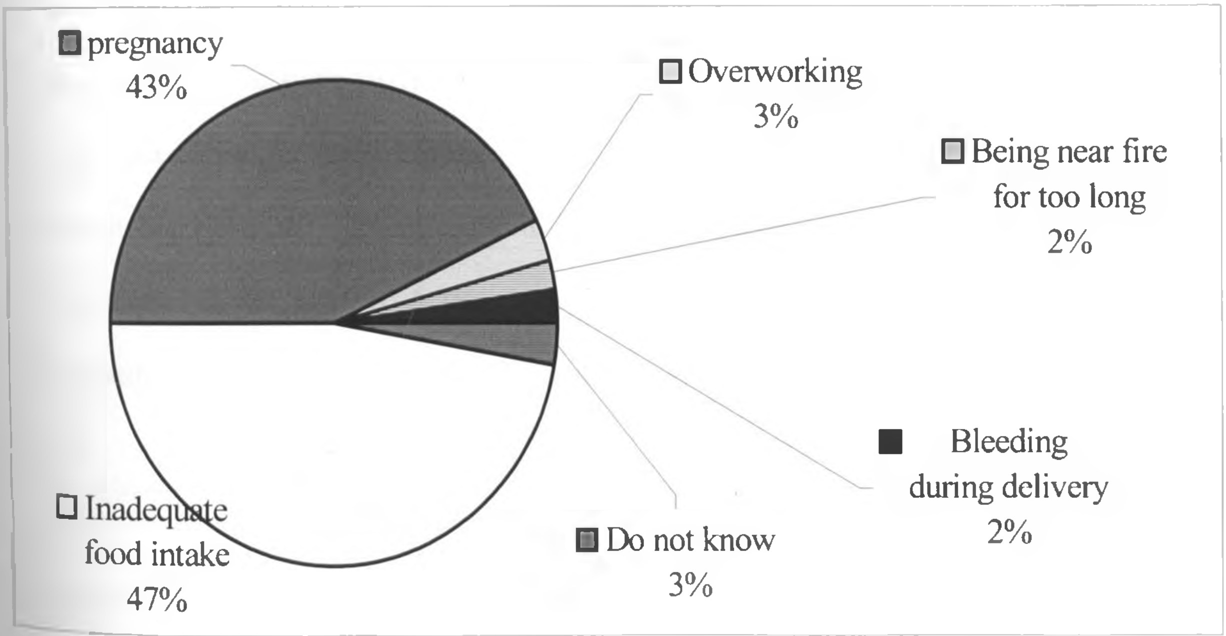

Figure 4. 3: Distribution of study mothers (n=141) by perceived leading causes of anaemia

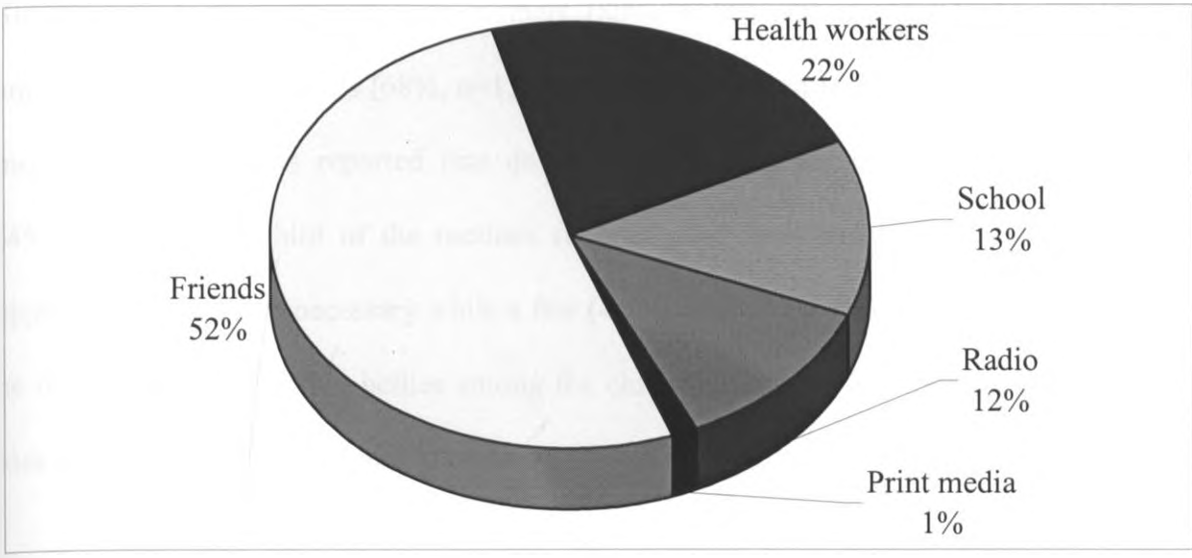

Figure 4. 4: Distribution of respondent mothers (n=141) by the sources of information about anaemia

The mothers did not know anything on zinc deficiency or zinc as a nutrient.

4.2.4 Intestinal worms

Majority of the mothers (91.1%, n=213) reported that they knew about worms. Significantly higher proportion of mothers among the KG households knew about worms than in NKG households (p=0.047). Eating of soil/dirt was perceived to be the main cause of worm infestation (92.5%, n=194). A few mothers reported that drinking of untreated water (2.5%) and eating of cold foods (5%) could also lead to worm infestation.

There was no significant difference between the number of mothers who knew the cause of worms in the KG households and the NKG households. Though most of the mothers (90.2%, n=195) who knew about worms felt that there was need to have their children de-wormed, only less than half of them (41%, n=194) had their children de-wormed within the three months prior to the study.

Significantly higher proportion of mothers (80%, n=80) among the KG households than among the NKG households (68%, n=133) knew that de-worming should be done every three months. Most mothers reported that de-worming enabled the child to grow as required (45.4%, n=192). A third of the mothers reported that de-worming makes a child to gain appetite, and therefore necessary while a few (4.7%, n=192) reported that de-worming should be done so as to avoid big bellies among the children. Some of the mothers (7.3%) had no idea as to why de-worming should be done.

4.3 Vegetable Production and Utilisation

The prevalence of KG in the study area was 10.6%, n=755. The majority (82.5%) of the households used small plots for vegetable production (traditional KG) while a few (12.5%) grew their vegetables on double-dug gardens. Only 3 (3.75%, n=80) of the kitchen gardening households had *mandalla* gardens. The mothers used the traditional (indigenous) kitchen gardening method because they did not know about the intensive (modern) methods of kitchen gardening.

Of the 80 households with kitchen gardens only one produced enough for the household vegetable needs all year round. The rest complimented what they produced in their kitchen gardens by buying more from the market.

The producing households most commonly consumed vegetables grown in the kitchen gardens. The most commonly grown vegetables were kales and spinach (Table 4.5) and were usually cooked mixed. Although *'enderema' (Basela alba)* was common in most of the kitchen gardens, it mainly served as a live fence (75%, n=19), except for a few households (21%, n=19), where it was also consumed. *'Enderema'*, spider plant and cowpea leaf had the lowest number of households consuming them (5.5%, 9.9% and 42.7% respectively).

Table 4. 5: Production and utilisation methods of vegetables from the kitchen gardens

Vegetable	Total number of Kitchen gardens producing the vegetable	Production method			Utilisation method	
		Double dug gardens	Small plots	Mandalla gardens	No of KG whose vegetables were consumed at home	No of KG whose vegetables were sold
Kale	77	10	66	1	76	1
Spinach	48	7	41		48	
'Enderema'	19		19		4	
Black night shade	9		8	1	5	4
Amaranth	8	1	6	1	8	
Spider plant	5		5		5	
Tomato	4	1	3		4	
Cowpea leaves	1		1		1	
Pumpkin leaves	1		1		1	

Most of the kitchen gardens were lacking in variety. Only 12.5% of them had more than two varieties (3-4) of vegetables. The rest had either one or two varieties. In addition to vegetables, 10% of the kitchen gardens had other crops such as maize, sweet potatoes, irish potatoes and beans.

4.4 Food Consumption Patterns

4.4.1 Household food consumption frequency

The most commonly consumed foods were the starchy foods as either cereal or roots tubers followed by green leafy vegetables and animal proteins. Legumes and fruits were rarely consumed.

Cereals were consumed about four days in a week. Maize, the staple cereal was consumed on daily basis by about a quarter of the households. There was a significantly higher frequency of maize consumption among the KG (p=0.000) than the NKG households. However, when all the cereals were put together this was not so (Table 4.6). Roots and tubers were consumed approximately two times per week while animal proteins were consumed only about once per week on average.

There was a significant difference in the numbers of times that legumes, fruits and vegetables were consumed between KG and NKG households. KG households consumed the food groups more often than the NKG households (Table 4.6). About three-quarters of the households (73.3%, n=213) consumed fruits any time they were available, a quarter (23.3%) consumed fruits with or immediately after a main meal. A few households (3.4%) took fruits at breakfast.

Table 4. 6: The mean frequency of consumption, per week, of different food groups by household category.

Food type	**All**	**KG households**	**NKG households**	**P – value** (For t-test)
	Mean ± SD number of times consumed per week			
Cereals	4.31 ± 1.8	4.4 ± 1.77	4.15±1.8	0.187
Roots and tubers	1.58 ± 0.81	1.62 ± 0.88	1.56 ± 0.76	0.636
Animal protein	1.14 ± 1.08	1.18 ± 1.1	1.13 ± 1.07	0.734
Legumes	0.78 ± 0.66	0.84 ± 0.035	0.62 ± 0.074	0.044*
Fruits	0.84 ± 0.69	1.03 ± 0.059	0.81 ± 0.057	0.042*
Green leafy vegetables	1.88 ± 0.56	2.11 ± 0.054	1.81 ± 0.057	0.005*

* Significant at p<0.05

Dietary variety within food groups

Household dietary variety was based on table 3.1 on the various food groups and the food types within the food groups and it varied widely. Information on the usual dietary variety consumed within each food group expressed as a percentage of total possible food variety is shown in table 4.7. The mean dietary diversity score ranged between 30.4% and 75.9% for the six different food groups. In all the food groups there was substantial variability among subjects with some individuals consuming little variety and others consuming a much greater variety. KG households had a higher variety than the NKG households for the six food groups, but the difference was only significant for vegetables and roots tubers.

Table 4. 7: Dietary variety by household category

Food group	**KG households**	**NKG households**	**P-value (t-test)**
	% (± SD) of foods within food group	**% (± SD) of foods within food group**	
Cereals (n=5)	75.94 ± 19.66	70.45 ± 17.44	0.896
Legumes (n=6)	35.00 ± 12.16	31.81 ± 9.21	0.257
Vegetables (n=10)	53.75 ± 2.04	50.00 ± 1.72	0.026*
Roots and tubers (n=4)	43.33 ± 12.9	19.68 ± 9.37	0.000*
Animal protein (n=5)	57.90 ± 12.58	52.52 ± 13.23	0.211
Fruits (n=8)	41.43 ± 1.64	30.41 ± 9.12	0.136

* Significant at p<0.05

Simultaneous multiple regression analysis showed that the diversity of vegetables, fruits, animal proteins, and cereals consumed was positively associated with both social-economic status and kitchen gardening. Kitchen gardening influenced the diversity of vegetables more (beta =0.261, p=0.048) than the social-economic status (beta =0.113, p= 0.05). However, the diversity of fruits, animal proteins and cereals consumed was more associated (beta =0.225, p= 0.020, beta =0.255, p= 0.013 and beta=0.415, p=0.071 respectively) with the social-economic status than with the kitchen gardening (beta =0.15, p= 0.063, beta = 0.241, p= 0.037 and b=0.147, p=0.070 respectively). The diversity of legumes consumed was positively associated with kitchen gardening (beta = 0.141, p= 0.044) and negatively with the social-economic status (beta = -0.09, p=0.36).

4.4.2 Food consumption by the children aged 9-59 months

Frequency of consumption of selected foods

More than half of the children (56%) consumed animal protein only once a week while a few (9%) hardly consumed animal proteins in a week. Less than a fifth (17.3%, n=213) of the children consumed animal proteins at least three times in a week. On average most common animal protein consumed by the children was milk. It was consumed at an average of two times per week (Table 4.8). Other animal proteins consumed but at lower frequency were meat and eggs. Fruits and beans were consumed on average once per week.

Table 4. 8: Mean frequency of consumption, per week, of selected food items by the study children and household category.

Food type		**All households**	**KG Households**	**NKG Households**	**p- value (t-test)**
		Mean number of times consumed in a week (SD)			
Animal protein	Milk	2.02(2.54)	2.05(1.5)	2.3(2.74)	0.247
	Meat	1.13(1.6)	1.44(1.56)	1.23(2.0)	0.274
	Eggs	0.73(0.93)	0.73(0.82)	0.71(0.99)	0.883
Fruits		1.23(1.58)	1.26(1.49)	1.21(1.64)	0.779
Beans		1.31(1.31)	1.42(1.14)	1.1(1.45)	0.051
Unfermented Porridge		2.52(2.88)	2.64(2.93)	2.44(2.87)	0.407
Fermented porridge		0.08(0.69)	0.21(1.12)	0.00	
Tea		6.08(2.2)	6.17(2.13)	6.03(2.24)	0.505
Green leafy Vegetables		2.44(0.16)	2.97(0.20)	2.14(0.68)	0.000*

SD - Standard deviations. * Significant at p=0.000.

Only 13.1% of the children consumed porridge. The porridge was made of maize flour, sorghum flour and millet flour. In a few cases Soya flour, ground silver fish and green grams were also added. The children rarely consumed fermented porridge (Table 4.8). They consumed tea on average about six days in a week. Two thirds of them consumed tea at breakfast while more than a quarter (28.2%, n=213) consumed tea both at breakfast and with or immediately after meals. Consumption of green leafy vegetables among children from KG Households was significantly higher than among children from NKG households (p=0.000). More than a quarter of the children (27.3%, n=213) consumed nothing in between the meals.

The consumption of milk and enriched porridge was higher among younger children than among children aged 3 years and above as shown in table 4.9. Consumption of meat, eggs, fruits and beans was similar for the two age groups. The older children consumed fermented porridge, tea and green leafy vegetables more often. The children above three years in KG households consumed green leafy vegetables more often (p=0.033) than those below three years. Children above three years in KG households consumed green leafy vegetables more often than their age mates in NKG households (p=0.000).

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Table 4. 9: Mean frequency of consumption, per week, of selected food items by age of the study children and household category

Food type		Kitchen gardening households		Non-kitchen gardening households	
		Less than 3 years	Three years and above	Less than 3 years	Three years and above
Animal proteins	Milk	2.81 ± 0.81	1.26 ± 0.88*	2.48 ± 0.74	1.37 ± 0.98*
	Meat	1.11 ± 0.70	1.61 ± 0.7	1.22 ± 0.59	1.12 ± 0.42
	Eggs	0.5 ± 0.14	0.92 ± 0.81	0.66 ± 0.9	0.85 ± 0.91
Fruits		1.28 ± 0.54	1.11 ± 0.28	1.73 ± 0.15	0.96 ± 0.76
Beans		1.41 ± 0.4	1.31 ± 0.93	1.09 ± 0.46	1.17 ± 0.96
Enriched porridge		2.91 ± 0.18	0.38 ± 0.22*	2.5 ± 0.19	0.35 ± 0.11*
Fermented porridge		0.08 ± 0.06	0.23 ± 0.02	0	0
Tea		5.69 ± 0.68	6.71 ± 0.55	5.67 ± 0.54	6.7 ± 0.96
Green leafy vegetables		2.54 ± 0.81*	4.05 ± 0.99*	1.94 ± 0.78	2.2 ± 0.85*

* Significant at p<0.05, independent sample t-test.

Food types consumed by the study children as revealed by the 24-Hour recall

The 24-Hour recall showed no significant difference (p>0.05) in consumption of cereals, animal products, legumes/pulses, fats/oils and fruits between children in KG and the NKG households (Table 4.10). However, significantly higher percentage of children from KG households consumed both Roots and tubers and green leafy vegetables. Almost all the study children and slightly less than two thirds consumed cereals and tubers respectively. The most common animal product consumed was milk. A relatively low proportion of the children had consumed meat. Meat was hardly consumed among the NKG households

Almost three-quarters of the KG households had consumed vegetables during the 24-hour period preceding the study. Majority of these (85.7%) had consumed vegetables from the kitchen gardens. The most commonly consumed vegetables were the kales and cabbages. Cooking fats/oils were consumed by more than 90% (n=66) of the children. A third had consumed fruits. The fruits mainly consumed were ripe bananas (16.7%) followed by mangoes (9.1%).

Table 4. 10: Percent distribution of the study children by household category and food types consumed as revealed by the 24-hour recall.

Group	N	Food types								
		Cereals	Tubers	Animal products			Pulses /legumes	Vege-ables	Cooking fat/oils	Fruits
				Milk	Meat	Others*				
KG	28	100	69.9	62.9	10.7	17.9	64.3	73.5	92.9	32.1
NKG	38	94.7	56.2	62.1	5.3	15.8	68.4	60.5	92.1	31.6
P – value[X]			0.048[S]	0.99	0.11	0.744	0.483	0.043[S]	0.84	0.88

* Includes fish, eggs, poultry and sausages. [S] significant at P<0.05 [X] - X^2–test

4.4.3 Energy and nutrient intake by pre-school children

There was no significant difference in caloric, protein and iron intakes between children in KG household and those in NKG households. There was however significantly higher intake of vitamin A and zinc among study children in KG than in NKG households in the preceding 24-Hour period (Table 4.11).

On comparison of proportions of children whose energy and nutrient intake over the 24-hours was less than the RDI; there was no significant difference between the KG and NKG households (p>0.05).

Majority of the children 88% (n=66) and 83.3% (n=66) of the children consumed inadequate calories and vitamin A respectively as noted from the 24-hour recall. The proportion of children who consumed inadequate protein, iron, and zinc was 11%, 20%, and 36% respectively.

Table 4. 11: Energy and nutrient intake of children aged 9-59 months among KG and NKG households.

Energy/Nutrient	HHs with Kitchen gardensN=28	HH without KG, n=38	P- value (t-test)
	Intake per day (mean ± SD)		
Calorie (Kcal)	1038.6 ± 61.08	1043.0 ± 51.31	0.418
Protein (g)	30.45 ± 3.44	28.83 ± 6.62	0.101
Iron (g)	10.44 ± 1.51	10.83 ± 2.07	0.458
R.E	98.41 ± 7.489	68.22 ± 22.25	0.000**
Zinc (g)	10.76 ± 1.30	8.44 ± 1.06	0.001**

** Significant at p<0.05   R.E = Retinol equivalents.

In figure 4.5 dietary intakes of the study children are presented as a proportion of their RDI. The figure shows that children from the KG households generally consumed more calorie and nutrients than those from NKG households. However, only vitamin A and zinc intakes were significantly higher (p=0.024 and p=0.021 respectively) for children from KG households than those from NKG households. The intake of protein was satisfactory especially for children in KG households. The consumption of vitamin A was far below the RDI with the children in NKG households consuming on average less than a quarter of the RDI. The mean consumption of iron was in both cases higher than the RDI (100%).

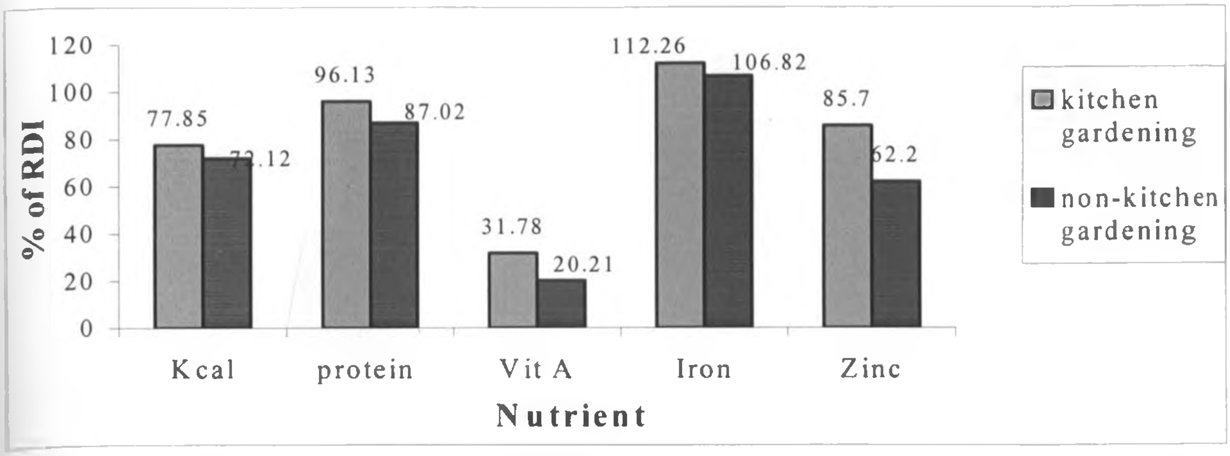
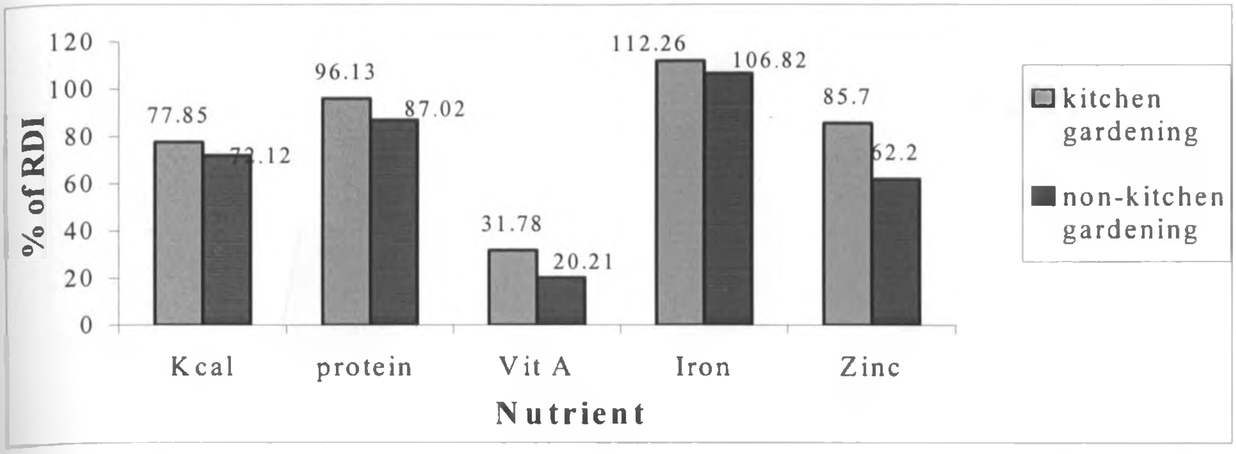


Figure 4. 5: Mean daily intake of energy and some nutrients as a proportion of the RDI for children aged 9-59 months by household category.

Figure 4.6 shows that there were a higher proportion of children who consumed less than 75% of the recommended daily intake among the NKG households than among the KG households. Significantly higher proportion of children consumed less than 75% of the RDI for vitamin A (p=0.020), calorie (p=0.041), and zinc (p=0.032) among the NKG households as compared to the KG households. The difference in protein and iron consumption between the two categories was not significant.



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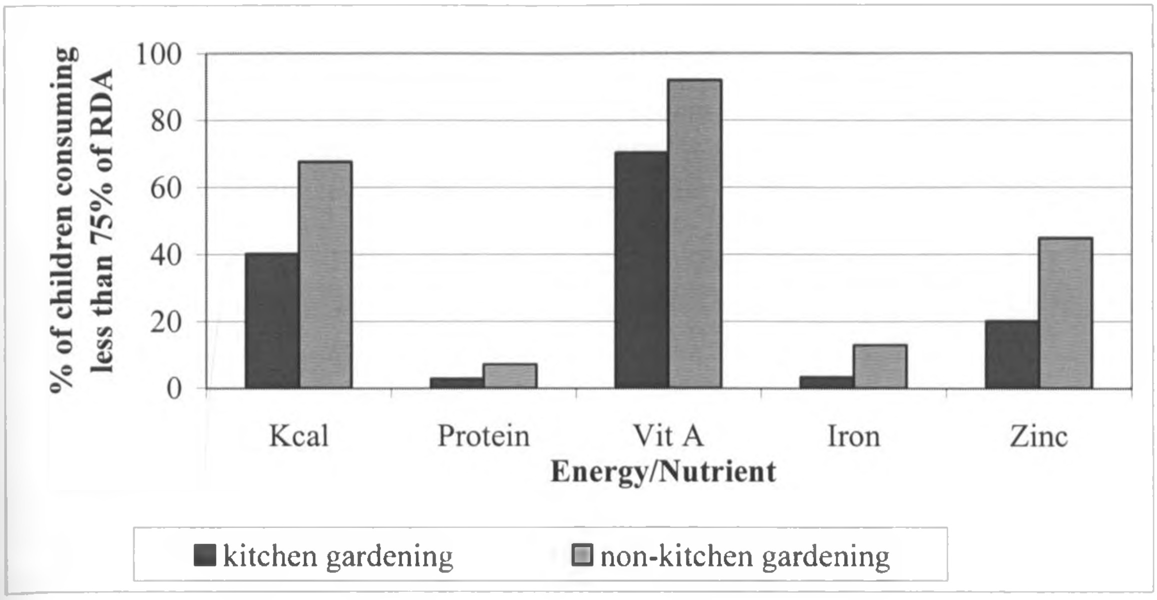

Figure 4. 6: Proportion of children consuming less than 75% of the RDA by household category as revealed by the 24 – Hour recall.

4.5 Nutritional and Micronutrient Status of the Study Children

4.5.1 Nutritional status

More than three-quarters of the dates of birth (76.3%, n=213) used in calculation of the nutritional status were confirmed using clinic cards or baptismal cards, which normally indicate the date of birth.

A) Stunting

The mean Z-score for height-for-age is shown in Table 4.12. About one third of the study children were stunted (< -2 z-score). There was however no significant difference between study children from the KG and the NKG households in both overall mean z-score and proportion stunted.

Table 4. 12: Distribution of mean height-for-age, weight-for-age and weight-for-height Z-scores and the prevalence of malnutrition among the study children.

Cluster	n	HAZ scores (Stunting)			WAZ scores (Underweight)			WHZ scores (Wasting)		
		Mean	SD	<-2Z%	Mean	SD	<-2Z%	Mean	SD	<-2Z%
KG	80	-1.56	1.42	30	-1.12	0.95	15	-0.28	0.91	3.8
NKG	133	-1.44	1.3	34.1	-1.18	1.07	22	-0.29	1.03	3.0
Overall	213	-1.51	1.34	32.4	-1.16	1.02	19.2	-0.29	0.98	3.3

A comparison of the mean z-scores for the various age groups showed that the mean was significantly higher among the KG households for the ages 18-24 months (p=0.046), 48-54 months (P=0.020) and 54-59 months (p=0.019) (Figure 4.7).

Overall, 15% (n=133) of the children in NKG households were severely stunted compared to 4% (n=80) in the KG households (Figure 4.8). The difference in severe stunting between NKG and KG households was significant (p=0.011). Severe stunting was highest among the children aged 18-24 months. The trend lines showed the stunting was more severe among the older children in NKG households. In the KG households the opposite was observed with younger children being more stunted than the older children.

Table 4. 12: Distribution of mean height-for-age, weight-for-age and weight-for-height Z-scores and the prevalence of malnutrition among the study children.

Cluster	n	HAZ scores (Stunting)			WAZ scores (Underweight)			WHZ scores (Wasting)		
		Mean	SD	<-2Z%	Mean	SD	<-2Z%	Mean	SD	<-2Z%
KG	80	-1.56	1.42	30	-1.12	0.95	15	-0.28	0.91	3.8
NKG	133	-1.44	1.3	34.1	-1.18	1.07	22	-0.29	1.03	3.0
Overall	213	-1.51	1.34	32.4	-1.16	1.02	19.2	-0.29	0.98	3.3

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Overall, 15% (n=133) of the children in NKG households were severely stunted compared to 4% (n=80) in the KG households (Figure 4.8). The difference in severe stunting between NKG and KG households was significant (p=0.011). Severe stunting was highest among the children aged 18-24 months. The trend lines showed the stunting was more severe among the older children in NKG households. In the KG households the opposite was observed with younger children being more stunted than the older children.

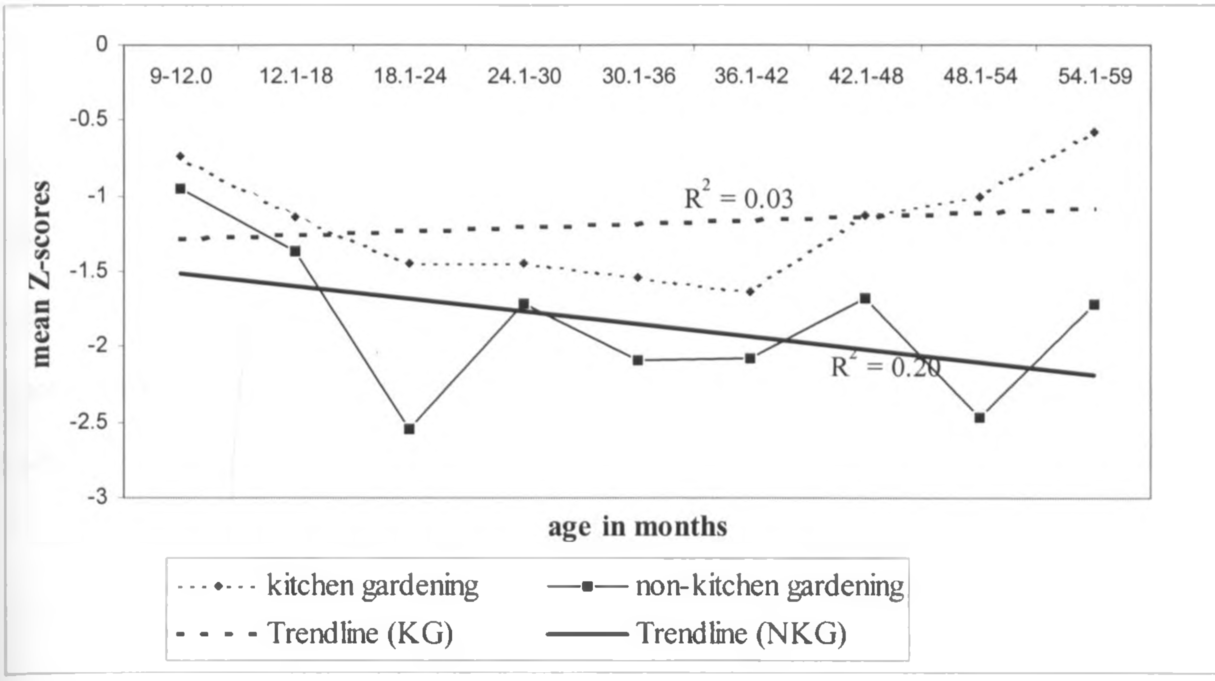

Figure 4. 7: Distribution of mean height-for-age z-scores (stunting) among the study children by household category

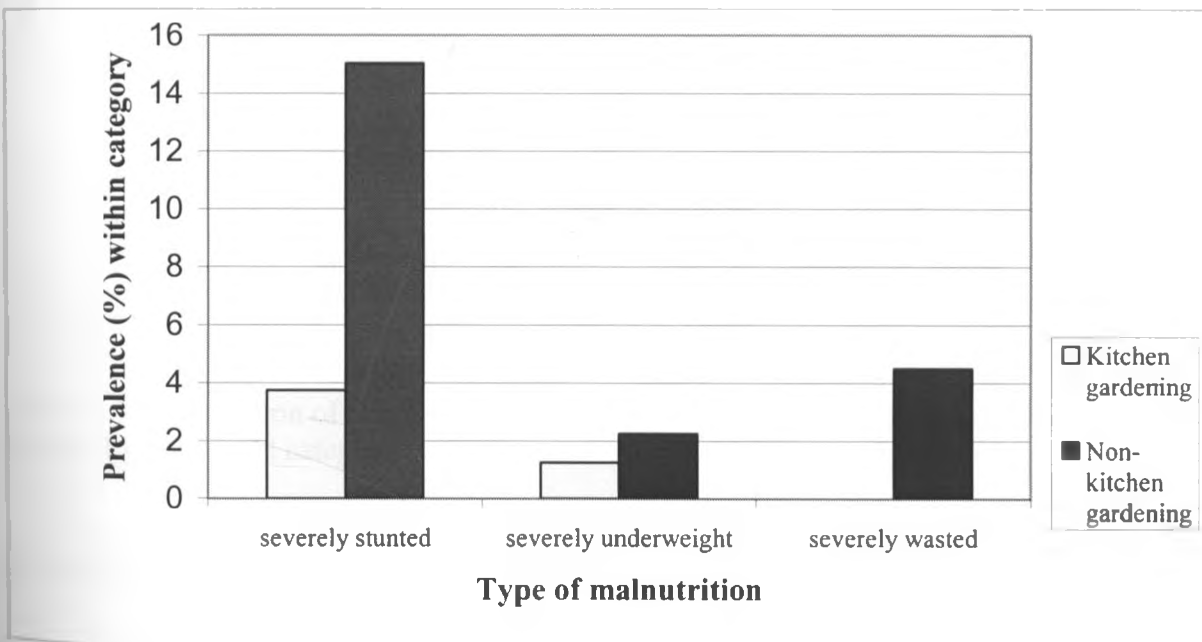

Figure 4. 8: Prevalence of severe stunting, underweight and wasting by household category

B) Underweight

The mean z-score for weight-for-age is shown in Table 4.12. A fifth of the children were underweight (< -2 z- score). There was no significant difference between the KG and the NKG households in both overall mean score and proportion underweight. A comparison of the mean z-scores for the various age groups showed that the mean was significantly higher among the KG households for the ages 18-24 months (p=0.031), 48-54 months (P=0.022) and 54-59 months (p=0.042) (Figure 4.9).

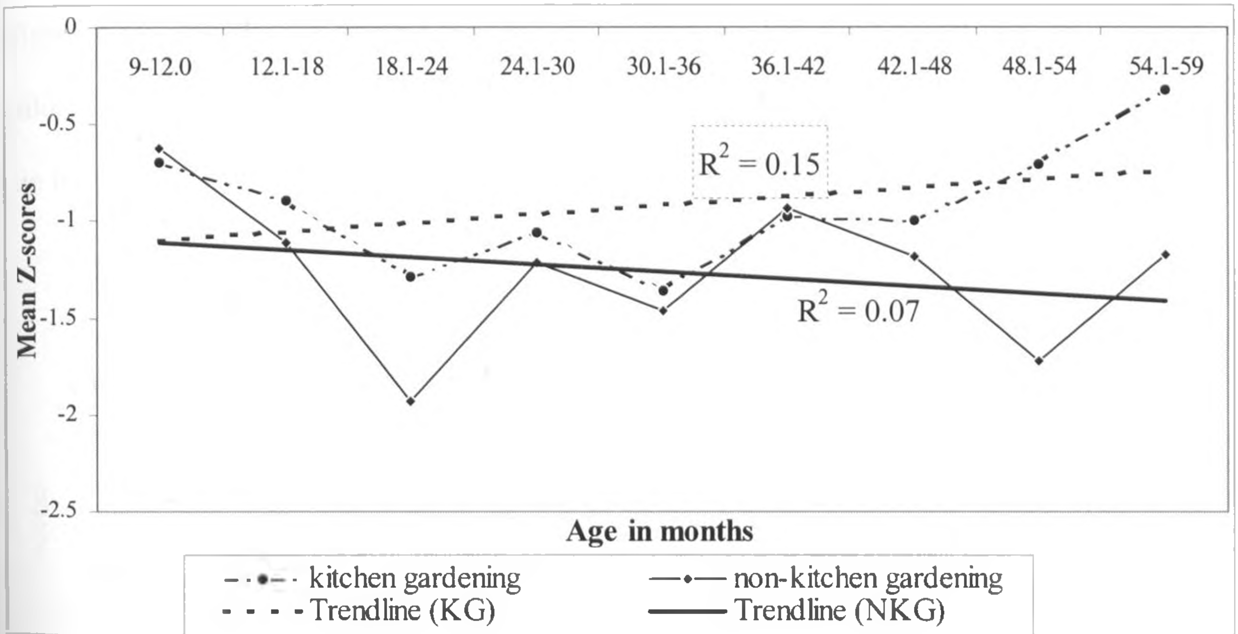

Figure 4. 9: Distribution of mean weight-for-Age z-scores (underweight) among the study children by household category.

Overall 2.3%, n=133 of the children in the NKG households were severely underweight compared to 1.3%, n=80 in KG households (Figure 4.8). The difference in the prevalence of severe underweight in NKG and KG households was not significant. Trend line showed that in the KG households, the older children were less affected by underweight as compared to younger children. In NKG households the older children were more affected by underweight than the younger children.

C) Wasting

The mean z- scores for weight-for-height is shown in Table 4.12. A few children (3.3%, 213) of the study children were wasted (< -2 Z score). There was no significant difference between the KG and NKG households in both overall mean scores and proportion wasted. Comparison of the mean z-scores for the various age groups showed that the mean was significantly higher among the KG households for the ages 18-24 months (p=0.028), and 48-54 months (P=0.037) (Figure 4.10). For the age group 54-59 the P-value for the difference was 0.052. The younger children in KG households were more wasted than the older children and the opposite was true for NKG households.

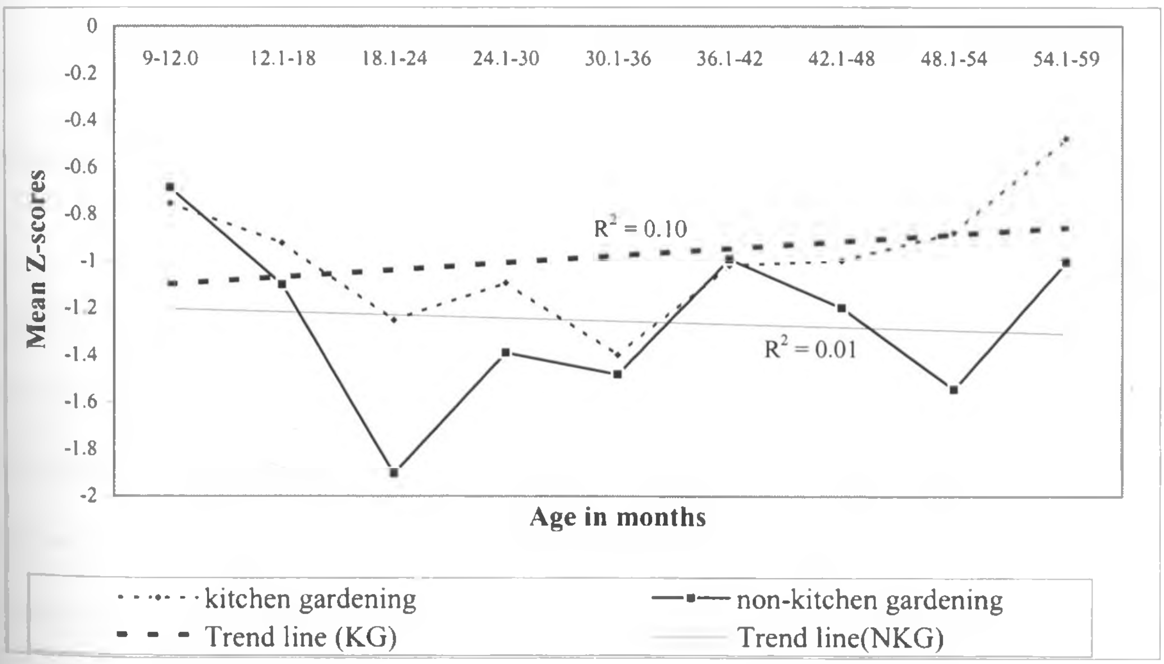

Figure 4. 10: Distribution of mean weight-for- Height z-scores (wasting) among the study children by household category.

Overall in the NKG households 4.3 % (n=141) of the children were severely wasted while there was no severely wasted child in the KG households (Figure 4.8).

Trend lines showed a tendency for the study children in KG households to have better nutritional status with increased age (figure 4.7,4.9 and 4.10). The children in NKG households were tending to become worse in nutritional status with increased age.

Pearson correlation showed that there was no correlation between the age of the mothers and the level of wasting (p=0.744), underweight (p=0.648) or stunting (p=0.226). This was the case in both KG and NKG households. There was also no correlation between the mothers' level of education and the nutritional status of the children. Point-biserial correlation however showed a significant positive correlation between kitchen gardening and weight-for-height (r=0.182, p=0.008). There was also a positive correlation between sickness in the two weeks preceding the study and both weight-for-age (p=0.34) and weight-for-height (p=0.015).

4.5.2 Micronutrients status

Blood samples were obtained from 25 (86.2 %) children of the 29 who had been selected from the KG households and 32 (91.4%) children of the 35 from the NKG households. Table 4.13 shows the prevalence of serum retinol, serum ferritin and serum zinc deficiencies among the study children.

Table 4.13 shows that the prevalence of deficiencies of vitamin A, iron and zinc was higher among study children in NKG households than among those in KG households. However, only serum retinol and Serum ferritin were significantly different. Only one child had severe deficiency in vitamin A (serum retinol less than 10µg/dl). The child was in a NKG household.

Table 4. 13: Prevalence of micronutrient deficiencies among study children by household category.

Indicator	% in all households (n=55)[a]	% in kitchen gardening households (n=25)	% in non-kitchen gardening households. (n=30)[b]	P - value (X^2 – test)
Serum retinol (less than 20µg/dl)	56.1	32	75	0.001*
Serum ferritin (less than 12µg/ L)	36.4	20.0	50.0	0.021**
Serum Zinc (Less than 65µg/dl)	69.5	54.2	80.6	0.055

*Significant at p= 0.001. ** Significant at P < 0.05. [a]n=57 for serum retinol level. [b]n=32 for serum retinol.

The mean serum retinol, serum ferritin and serum zinc was significantly higher among children from kitchen gardening households than those in non-kitchen gardening households as shown in table 4.14.

Table 4. 14: Mean serum retinol, ferritin and zinc levels of study children in kitchen gardening and non-kitchen gardening households.

Indicator	All households	Kitchen gardening households	Non-kitchen gardening households.	P – value (For t-test)
	Mean ± Standard deviation			
Serum retinol (µg/dl)	19.33 ± 5.73	22.55 ± 3.27	16.01 ± 3.16	0.000*
Serum ferritin (µg/ L)	21.26 ± 22.47	28.74 ± 10.63	15.03 ± 7.82	0.032**
Serum Zinc (µg/dl)	58.71 ±19.41	67.71 ± 15.31	51.74 ± 10.61	0.002**

*. Significance at p<0.001level **. Significance at p< 0.05level

Figure 4.11, 4.12 and 4.13 shows a comparison of the serum retinol, serum ferritin and serum zinc status of the study children in KG households with those in NKG households. Figure 4.11 and 4.13 shows that there was a wide range in serum retinol and serum zinc levels of the study children in both the kitchen gardening and non-kitchen gardening households. Study children in KG households were however better off than those in NKG households. The range in serum ferritin levels of the study children was small. There were however a few outliers, most of them being in kitchen gardening households, with high levels of serum ferritin.

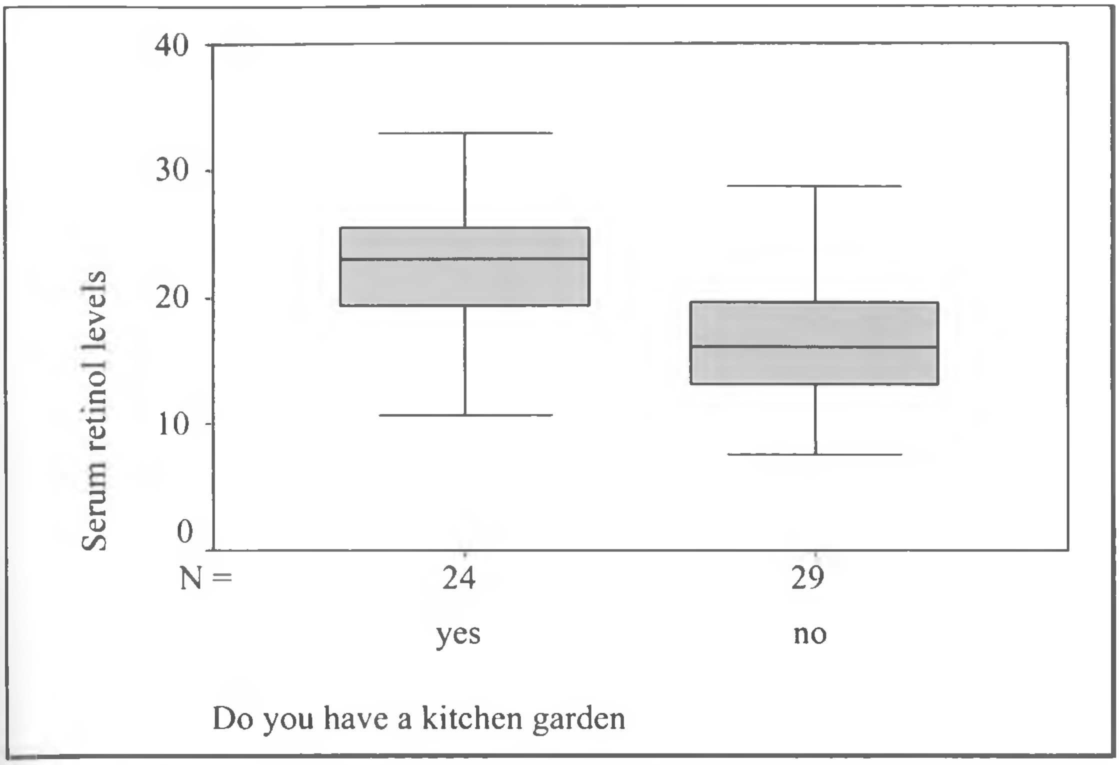

Figure 4. 11: Comparison of serum retinol levels of the study children in KG and NKG households

Figure 4. 12: Comparison of serum ferritin levels of study children in KG and NKG households

Figure 4. 13: Comparison of serum zinc levels of study children in KG and NKG households

Iron deficiency in presence of vitamin A deficiency was observed in a quarter (25.4%, n=55) of the study children. More than three quarters (79%, n=14) of the cases were in non-kitchen gardening households.

Pearson correlation showed a positive correlation between serum retinol levels and serum zinc levels (Table 4.15). Serum ferritin was positively correlated to serum zinc. Serum retinol, ferritin and zinc levels were positively correlated with weight-for-height. Spearman's correlation showed a positive correlation between KG and the serum retinol, ferritin and zinc levels. There was also a positive correlation between serum-retinol level and vitamin A supplementation (Table 4.15).

Table 4. 15:Variables significantly correlated to micronutrient levels as shown by Pearson correlation.

Variable	Serum retinol		Serum ferritin		Serum zinc	
	r	p-value	r	p-value	r	p-value
Serum zinc	0.285	0.036	0.179	0.046		
Kitchen gardening*	0.503	0.000	0.346	0.010	0.449	.0.001
Weight-for-height	0.322	0.014	0.382	0.048	0.690	0.000
Vitamin A supplementation	0.447	0.023				

* Spearman's correlation r correlation coefficient.

Simultaneous multiple regression analysis showed that the serum retinol level was positively associated with mothers' level of education, vitamin A supplementation, the diversity of fruits consumed and kitchen gardening, (Table 4.16)

Table 4. 16: Contribution of the various variables to serum retinol, ferittin, and zinc levels of the study children.

Variable	S-retinol		S-ferritin		S-zinc	
	Beta	Sig.	Beta	Sig	Beta	Sig.
Constant	6.53	.000*	.66	.005*	1.29	.011*
Mothers' level of education	.372	.010*	.055	.102	-.001	.997
Dietary diversity (Animal proteins)	.149	.299	.031	.062	.224	.043*
Vit.A supplementation	.563	.004*	.783	.072	.442	.059
Social-economic status	.011	.942	.319	. 034*	.458	.003*
Dietary Diversity (vegetables)	.335	.052	.582	.001*	.005	.979
Dietary Diversity (legumes)	.021	.883	.197	.198	-.172	.257
Dietary Diversity (fruits)	.284	.048*	-.041	.049*	.284	.126
Kitchen gardening	0.381	.003*	.314	.010*	.116	.047*
Is your child sick	0.008	0.159	0.481	0.065	0.343	0.101
Deworming	0.115	0.482	0.142	0.401	0.179	0.290

S- Serum *Significant P<0.05

The serum retinol level could therefore be predicted using the model: Serum retinol = 6.53 + 0.372 (mothers' level of education) + 0.563 (Vitamin A supplementation) + 0.284 (diversity of fruits consumed) + 0.381 (kitchen gardening)

Serum ferritin levels were positively associated with diversity of vegetables consumed, social economic status and kitchen gardening. It was negatively associated with diversity of fruits consumed (Table 4.16). Serum ferritin level can therefore be predicted using the model: Serum ferritin = 0.66 + 0.122 (social-economic status) + 0.582 (diversity of vegetables consumed) + 0.314 (kitchen gardening) – 0.041 (diversity of fruits consumed). Serum ferritin status did not seem to be significantly influenced by de-worming.

Serum zinc was positively associated with diversity of animal proteins consumed, social-economic status and kitchen gardening (Table 4.16). Serum zinc level can therefore be predicted using the model: Serum zinc = 1.29 + 0.458 (social-economic status) + 0.224 (diversity of animal proteins consumed) + 0.116 (kitchen gardening).

4.6 Morbidity and Sanitation

4.6.1 Morbidity

Slightly less than two thirds (63.8%) of the index children had suffered illnesses within the two weeks preceding the study. About a half (53.75%, n=80) and two thirds (69.9%, n=141) of the children from KG and NKG households respectively had suffered illnesses. The proportion was significantly higher among children in the NKG than KG households.

Cough/cold was reported as the leading illness and perceived to be of great health concern. Of the children who had suffered illnesses 52% had suffered from a cough/cold. Diarrhoea (16.9%) and pneumonia (7.7%) were the 2nd and 3rd commonest. Spearman's correlation showed a significant relationship between morbidity experience and nutritional status (weight-for-height) of the study children (r=0.114, p=0.047). Most of the mothers (88.2%) took their children to the health centre when sick while a few took them either to private clinics (7%) or gave them home care (3.8%). Home care entailed giving the children multivitamins, fish liver oil and/or Haliborange, when suffering from colds/coughs. Only 1% (n=213) of the respondents consulted spiritual healers.

4.6.2 Hygiene and sanitation

Water: source and treatment

The main source of water was borehole (98.7%, n=213), the remaining 1.3% obtained their water from a spring. All the households used less than 30 minutes to get water from the source. Only about a third (36%) of the households treated their water. Out of these 99% treated their water by boiling and 1% by filtration.

Latrine facility

Among the KG households, 41% had their own toilet while only 23% of NKG households owned toilets. The difference was significant (p=0.044). More than two thirds of the households shared the toilets between two or more families.

4.7 Results Summary

The study results indicate that the KG and NKG households were similar in both social-demographic and social-economic characteristics. This made the comparison of the two study groups less biased.

The mothers/caretakers had a few ideas about nutrition, PEM, vitamin A and iron. Zinc to them was however, unheard of. A few of the mothers had witnessed their children receive vitamin A supplement but were not certain about its importance. Mothers were also not aware of the vitamin A supplementation programme. They knew that vitamins were in general got from fruits and vegetables. According to the mothers, anaemia was a disease that affects women of reproductive age. There were a few misconceptions about its causes. The main source of information was friends who included relatives and neighbours.

A large proportion of the mothers knew about worms. Significantly more mothers knew about worms in the KG than the NKG households. However, there were a few misconceptions about the causes of worms, recommended duration between one de-worming and the next, and the reasons for de-worming.

The most prevalent form of KG was the traditional kitchen garden where vegetables were grown in a small plot in the homestead. However, a few modern KG in form of *mandalla* and *double-dug* gardens were also present. Vegetables especially kales, spinach and *'Enderema' (Basela alba)* were produced in the kitchen gardens. A few other crops such as maize, beans, sweet potatoes and Irish potatoes were also produced. The vegetables produced though mainly consumed at home were hardly enough for the household needs all year round.

KG households consumed legumes, fruits and vegetables more frequently than NKG households. The KG households and their children also consumed a greater variety of vegetables and Roots and tubers than the NKG households. Fruits were mainly consumed any time when available. Tea in both KG and NKG households was mainly consumed with meals or immediately after meals. Children under three years of age in both KG and NKG households also consumed milk and porridge in addition to other foods.

Intake of vitamin A and zinc though inadequate was significantly higher in the KG than NKG households. Significantly higher proportion of children in NKG households consumed less than 75% of the RDI for vitamin A, calorie and zinc compared to those in the KG households.

Results of nutritional status showed that mean of height-for-age, weight-for-age and weight-for-height were higher among study children in KG than NKG households. This difference was significant for ages 18-24 months and 48 months and above. Severe stunting was significantly more prevalent in NKG than KG households. No severe wasting was recorded among study children in KG households.

Although the prevalence of micronutrient deficiency was high, study children in KG households were better in micronutrient status than those in NKG households. Micronutrient statuses were positively correlated to the social-economic status, kitchen gardening and dietary diversity. Serum retinol level was also positively correlated to vitamin A supplementation. The prevalence of iron deficiency in the presence of vitamin A deficiency was higher in NKG households than in KG households. Micronutrient deficiency was positively correlated to morbidity experience.

Cough/colds and diarrhea were the common illnesses suffered by the study children. The proportion of children who had suffered illnesses two weeks preceding the study was higher for NKG than KG household. In a similar manner, ownership of latrines was more common in KG than NKG households.

5.0 DISCUSSION

The study sought to assess the role of kitchen gardening (KG) in nutritional and micronutrient status of low-income peri-urban populations. It therefore involved comparison of KG and non-kitchen gardening (NKG) households in Ngong division. The prevalence of KG in the study population is quite low and this could be associated with low level of both nutritional knowledge and knowledge on intensive KG. This is in agreement with Goode (1989) who noted that lack of nutritional knowledge and shortage of water are key factors that would discourage urban agriculture.

5.1 Demography and Social Economic Characteristics of the Study Population

The similarity of the study households in both demographic and social-economic characteristics including: the gender of the household head, education level of the mothers, household sizes, mothers' age, occupation of the mother and father, the dependence ratio, and low social-economic status makes the comparison of other factors less biased.

Demographic characteristics and nutritional status

It has been documented that female-headed households are disadvantaged in that children are at a greater risk of malnutrition and micronutrient deficiencies (Miamba and Ubomba, 2000). This is because while the mother is away, the child is likely to get inadequate care. The child may miss meals and also may be exposed to dirty environment resulting in illnesses especially diarrhoea.

The lack of correlation between the gender of the household head and nutritional and micronutrient status of the study children could be attributed to the fact that married women are also contributing to household income. They are therefore spending time away from the child trying to survive. Being away from the child can have adverse effect on the child's nutritional and micronutrient status (Oswani, 1997)

The lack of relationship between the level of education of the mothers and the nutritional status of the study children contradicts literature (ANP, 2000, Mwadime, 2000, Mbithe, 2002). This could be attributed to the low level of education among the mothers and to the fact that there was little difference in the educational levels of individual mothers. Most of the mothers therefore earn their income through casual labour and small-scale trading leading to similarity in their income levels. Casual labour in most cases is seasonal. This means that the households suffer periods of inadequate food during the labour off-season.

The study households are composed of small young families, with young children. This means that the children cannot provide adequate care for one another when the mother is away trying to earn a living. Contrary to what would be expected, that large families are unmanageable and are at risk of malnutrition and hence micronutrient deficiencies (GOK/UNICEF, 1994), it has been suggested that large families (more than five children) are able to accord more care to children than small families (Sharma, 1999, Kigutha, 1994). Studies have also shown that large households have a positive impact on the children's nutritional and micronutrient status (WHO, 1996). The older children can take care of the younger ones. Inadequate care, which includes feeding, is a risk factor for malnutrition.

Social economic status and nutrition

Living in semi-permanent house structures as is the case in the study area, is an indicator of low social-economic status. A direct relationship between the social-economic status of the household and the nutritional and micronutrient status of the children could be the reason behind high prevalence of malnutrition in the study area. Children from households that are better off economically have better nutritional status than children from households of low social-economic status (Ahn and Shariff, 1995). It is assumed, therefore that those well-off households are able to purchase adequate and quality food, which prevents malnutrition.

The problem of landlessness as noted in the study population commonly means casual labour livelihood and as a consequence, poverty (WHO, 1996). Studies have reported an increase of prevalence of underweight among the landless than those with access to land (Alderman, 1996, Piechulek *et al.*, 1999, HKI, 1998). It is expected that once a family is self-employed on the land it will have basic income. In addition, such a family will meet all the nutritional requirements meaning that malnutrition would be unlikely. Underweight is an indicator of malnutrition and malnourished children are at risk of micronutrient malnutrition (WHO, 1996).

The households that rent land also own kitchen gardens. This could be associated with the knowledge of the importance and benefits of household food production. The households are therefore trying to make use of every available space. The association of owner-occupier with KG can be as a result of the tenure security accompanying land ownership that may act as an incentive to developing their plots as opposed to insecurity accompanying renting of residential houses.

5.2 Mothers Nutritional Knowledge

The lack of difference between the KG and NKG households as far as nutritional knowledge of the mother/caretaker is concerned, could be as a result of their similarity in demography and social-economic characteristic. Mothers who are primary school graduates have limited knowledge in nutrition. They may also not be in a position to acquire knowledge from publications because of the high unemployment rates and low wages they get from casual labour. Anything else besides the basic requirements for survival could be therefore not a priority. This makes them dependent on one another and to a lesser extent on the MCH for information about health and childcare.

Protein energy malnutrition

Mothers' knowledge on PEM is limited to the basic knowledge that is taught in primary level education. The little more that they know could have been learnt from the other mothers or have been taught in maternal child health clinic (MCH). It is evident that the nutrition knowledge is inadequate. This commonly means poor nutritional choices. This supports GOK (2000)[b] that states that chronic malnutrition among children below five years in Kenya can be associated with intake of food of poor nutritional value due to poor nutritional choices, prolonged consumption of inadequate food and/or the presence of chronic poor health.

Vitamin A

The Kenya national policy on vitamin A requires that the children who are less than 5 years old, be given vitamin A supplementation at nine months of age or any time the child comes into contact with a health worker after nine months and at an interval of six months thereafter (Muga, 2001). This is an effort to try and reduce the high prevalence of vitamin A deficiency among preschoolers in Kenya. The capsule can also be given every 3-6 months when necessary (Muga, 2001). Surprisingly, about half of the mothers have no knowledge of the existence of the programme, hence the low vitamin A supplementation coverage.

The respondents know that vitamins are found in fruits and vegetables, the so-called protective foods as they protect children against diseases. However, the mothers do not feed their children on vegetables often probably due to their low levels of education. They also cannot identify vitamin A sources, its various roles in the body, the signs of its deficiency or the best methods of cooking vegetables to conserve vitamins.

Anaemia

The descriptions of anaemia reported by the respondents refer to domains that describe perceived causes, blood loss or presentation following blood loss or actual blood insufficiency. The knowledge is however insufficient because a lot of misconceptions on the causes and the symptoms are evident. Unreliable source of the information is therefore in use and the extent to which the knowledge would trigger action against anaemia is unclear. The fact that very little is known about minerals and especially zinc is a clear indication of the lack of nutrition knowledge in the study population.

Though the mothers have some idea about worms, this has not triggered the desire to have their children de-wormed. This can be associated with the notion among the mothers that de-worming increases a child's appetite. With problems of food shortage, mothers may not de-worm their children until such a time when they loose appetite. The consequence of this is food wastage and malnutrition. Another reason for lack of care could be that the mothers are too busy enhancing livelihood and have little time to care for the children.

5.3 Vegetable Production and Utilisation.

The association of KG with the ownership of land implies that traditional (indigenous) form of kitchen gardening, which requires one to own land, is being practised. KG knowledge could have been passed on from friends, relatives or the previous generations. This means that the kitchen gardening practice has a chance of being transmitted from generation to generation, a key way to sustainable development (Johnson, 2001). This also agrees with WHO/FAO (1998) view that KG may be the oldest production system known and that its persistence bears intrinsic economic and extrinsic merits.

The traditional kitchen gardening, though a source of vegetables has its demerits. It requires a reliable supply of a lot of water and therefore cannot be practised in areas with water shortages. Hence it is only feasible during wet seasons. The outputs of such gardens are also low as the spacing of the vegetables and other foods is large due to the low fertility of the soil. In this context, the household therefore requires a large piece of land to meet its vegetable needs all year round.

The prevalence of kitchen gardening in the community could be associated with the fact that the community considered their plots to be too small for any meaningful farming, as it clearly came out from the focus group discussions. Lack of knowledge on intensive KG also leads to the community believing that there is shortage of water and therefore KG is only possible during the wet season. The need for proper fencing to keep off neighbours' livestock (e.g., chicken, ducks, sheep and goats), as is the case in the study population, is also a hindrance to KG (Goode, 1989).

Absence of intensive KG and the poor utilization of the kitchen gardens present may be associated with the mothers' limited knowledge on intensive methods of KG. It is also possible that the mothers do not know the nutritional importance of the vegetables in their KG. This agrees with ACC/SCN, (2001) which states that for significant progress to be achieved in food-based approaches, integrating production, nutrition education and behavioural changes should be considered.

Lack of variety in the kitchen gardens could be desirable to some extent. Goode (1989) states that under conditions of extreme poverty, it is better to grow only one of the local vegetables in the kitchen garden as they provide a useful component of the diet especially for young children. The vegetables produced are utilized at home. This means that KG has the potential to improve nutritional and micronutrient status of the study population when properly carried out (William, 1997).

5.4 Food Consumption Patterns of the Household and Pre-schoolers.

Consumption of most of the crops grown in the kitchen gardens within the household is comparable with what Mwangi (1995) found. The higher frequency of consumption of vegetables, fruits and legumes among KG households also agrees with Bendley (1988) view that KG contributes to household food security by providing direct access to food in an affordable way. This can be because, with the presence of kitchen gardens, vegetables are within reach to the caretaker/mother. Money that would have otherwise been used to buy vegetables is used to buy fruits, animal products and legumes as stated in the FGDs.

It is worthy noting that although KG households have higher levels of consumption of fruits and vegetables, the frequency of consumption of these foods is generally low in the study area. This could be explained by lack of nutrition knowledge. This is in line with a study carried out in Vietnam that showed that horticultural interventions combined with extensive nutritional education were a long-term measure to eliminate micronutrient deficiency (Khan *et al.*, 2002). It therefore means that kitchen gardening interventions should also be combined with nutrition education interventions. The other reason as to why the consumption is low could be as a result of low productivity due to lack of knowledge of intensive kitchen gardening.

The consumption of meat only once per week could mean that the women have little if any independent income. Studies have shown that increased income, especially when accessible to women, often results to higher quality food intake that in most cases tend to be food of animal origin (WHO, 1996). Such foods are better sources of vitamin A, iron and zinc.

Fat and/or oil intake on daily basis by a vast majority of the households in both KG and NKG households, suggests sufficient intake to ensure adequate absorption of vitamin A in children. Evidence from literature reveals that protein and fat intake is vital in the metabolism of vitamin A (WHO, 1995). To ensure adequate intake, foods containing fat or oil should be consumed daily.

The consumption of vitamin A rich foods less than three times in a week by more than three quarters of the households, as is the case in the study population, is an indication of vitamin A deficiency according to WHO, (1996) and Sommer (1982). Sommer (1982) notes that in addition to dietary intake of vitamin A, it is important to consider the types of food being consumed. In cases where carotenes are the main vitamin A source the quantities being consumed are crucial. Carotenes are less biologically active than retinol and less efficiently processed and absorbed in the gut.

It is probable that the inadequate caloric and vitamin A intakes in the study children is due to the reduced access to food and inadequate childcare practices due to demand placed on mothers in circumstances where they provide both income and labour (Yohannes *et al.*, 1992). As in Maxwell *et al.*, (2000) the protein intake of the study children is rather satisfactory despite low energy intake. The consumption of phenols (iron absorption inhibitors) in the form of beverages (tea mainly) with meals, as is a common practice in the study population, has an effect on the bioavailability of the iron.

According to literature more than 70% of vitamin A in developing countries is derived from plant sources (Alson, 1996). The long periods of cooking of the vegetables, as is the case with the study population, commonly means a low potential for vitamin C intake. Vitamin C enhances the absorption of iron from plant foods and hence zinc (FAO, 2003). Long cooking of vegetables causes destruction of vitamin C (Imungi, 1996). The Uganda Government Nutrition Rehabilitation Unit in Goode (1989) recommends that green leafy vegetables should be steamed or boiled 4-5 minutes in a covered vessel.

5.5 Nutritional and Micronutrient Status of the Study Children

Nutritional status

The findings that the study children from KG households have better nutritional status than those from NKG households agrees with findings of a study carried out in North East Thailand that showed that three anthropometric measures taken in children residing in KG households had an inclination to have better overall nutrition status than children residing in NKG households (Schipan *et al.*, 2002).

The availability of vegetables and other foods in kitchen gardens means that the families have access to food that is unlikely to be contaminated in an affordable way. This allows the caregivers to provide nutrient dense food frequently to the infant. The consumption of vegetables coupled with supplementation with vitamin A by the children from KG households means that their vitamin A status is better than those in NKG households. They are therefore able to resist infection. Vitamin A plays a role in immunity.

The high prevalence of infection among study children in NKG households could have seriously affected their nutritional status. Morley and Woodland (1985) states that there is a direct correlation between the age of the child and the effect of infections on their nutritional status. Malnutrition could also lead to infection as it affects the cellular immunity necessary in the body's defence against diseases (Morley and Woodland, 1985). This tends to increase the severity of an infection. It is therefore a vicious cycle.

In a study carried out in India by Devi and Geervani (1994) it was found that a child's current and past nutritional status is significantly affected by the number of diarrhoeal episodes and caloric adequacy of the diet. The number of diarrhoeal episodes was highly correlated with the social-economic status of the household. Low social-economic status households, as is the case in this study population, had higher episodes of diarrhoea. The number of upper respiratory infection and other infections also had negative effect on growth status.

Mothers' participation in market activities could also have led to the poor nutritional status of the study children. Rafiqul (1986) states that the participation of women in market activities is detrimental to the health and nutritional status of the household. This is because women spend their time purchasing items rather than using time to produce them. A woman working outside the home may resort to non-nutritive convenience food to the detriment of the health of the family members. The money that she earns does not always meet nutritional needs (Rafiqul, 1986). Mother's nutritional knowledge, hygiene in food preparation, skills and acceptance and use of health facilities also determine nutritional status of the household (Gutierrez *et al.*, 1996).

Philip and Shawkey (1999) states that children between 6 and 18 months, and sometimes up to 24 months, tend to benefit from a combination of breast milk and complementary foods. However, two studies carried out in Kenya have shown that children are breast fed up to the age of 15-18 months (Mirie, 1989, Ellamass, 1997). This could be the probable reason as to why, though malnutrition was common, there was no significant difference between the study children from KG and those from NKG households of this age group. The children also have limited stomach capacity and therefore consume very small quantities of food. This therefore means that even when the quantity of food given is adequate, children may not receive enough calories and nutrients because the feeding practices are poor (Brown, *et al.*, 1995). The study children receive less than the recommended number of meals per day. Brown, *et al.* (1995) states that it is important to counsel such mothers to ensure that their children receive age-appropriate quantities of food and numbers of feeding and that they are actively encouraged to feed at appropriate times.

Poor nutritional status of children aged 18-24 months could be associated with termination of breast-feeding. A study in Kenya has shown that children are breastfed up to the age of 15-18 months (Mirie, 1989) The significant difference in nutritional status of the study children aged between 18 to 24 months between the KG and NKG households is a clear indication that apart from breast milk, children from KG households take more appropriate quality and quantity of food than those in NKG households. This is in line with what Brown, *et al.* (1995) states that introduction of animal foods, fats, oilseeds, nuts, legumes and varied fruits and vegetables to the staple diet can improve nutritional status. Philip and Shawkey, (1999) also state that the food given to such children should be nutrient dense and the caretaker should ensure that the food eaten is utilized by reducing infections from contaminated foods. KG ensures that vegetables that are fresh and free from contamination are accessible.

The poor nutritional status and lack of significant difference in nutritional status between the study children in KG and NKG households in the ages 2 and 3 years could be as a result of poor weaning practices. Jelliffe, (1985) states that second and third years of life are often marked by long periods with poor growth, or even no growth, or loss of weight. This is due to the numerous infections that often occur such as measles, diarrhoea, malaria, chest infection and intestinal worms (Jelliffe, 1985). It is also during these years, that children move out of the houses and are likely to be affected by the poor sanitation that is evident in the study area leading to intestinal worms. Gutierrez *et al.*, (1996) state that diarrhoea diseases reduction was associated with improvement in environmental sanitation. The poor weaning practices, illnesses and poor sanitation could have affected both KG and NKG households.

Among the study children aged 4 years and above, children from the KG households show better nutritional status than those from NKG households. This means that despite the poor weaning practices and the poor sanitary conditions of the area, children from KG households are better able to meet their nutritional needs due to presence of food. The immunity of children at this stage is also boosted and the children are better able to resist infection. This is manifested in better nutritional status among study children in KG households. Cases of severe stunting, wasting and underweight are also higher in NKG households than in KG households. This is evidence that KG improves the nutrition in the households.

Micro nutrient status

The results reveal significantly higher mean serum retinol, serum ferritin and serum zinc levels among children from KG households. Other results indicated that the difference between the KG and NKG households in the proportion of children who had received vitamin A supplementation was not significant. This implies better vitamin A, iron and zinc status in children from KG households as compared to those from NKG households. This supports Ruel and Levin, (2000) who suggested that food-based interventions that aim at increasing the production, availability and access to vitamin A and iron rich foods through the promotion of home production could be an essential part of the long term global strategy to alleviate vitamin A and iron deficiencies.

The significant association between the micronutrient status and both the KG and dietary diversity is prove that KG influences the micronutrient status of the study children. KG influences the dietary diversity that in turn influences the micronutrient status causing the study children from KG households to be better off than those from NKG households. Apart from providing direct access to food in an affordable way, KG could also be freeing money for purchase of other foods. Animal products that are better sources of vitamin A, iron and zinc now use the money that would have been used to buy vegetables. The money can also be used to meet health needs of the children and therefore prevent loss of nutrients due to infection.

The proportion of study children suffering iron deficiency and at risk of zinc deficiency in NKG households is higher than the findings of the 1999 Kenya national micronutrient survey by Mwaniki *et al.* However, the proportion of study children in KG households is lower for iron but higher for zinc when compared to the 1999 survey findings. This is in agreement with a study carried out in Thailand that showed that the proportion of children with haemoglobin levels of 11 μg/dl or less was higher for NKG households than for KG households (Khan, *et al,* 2002).

High prevalence of micronutrient deficiency as observed in the study children could be due to lack of knowledge of infant nutrition which leads to less optimal choices for the infants at the age of weaning. Low maternal education and low social-economic status characterise the study population. Oelofse, (2001) states that low social-economic communities with low maternal education are the most vulnerable to micronutrient deficiencies and its grave consequences.

Seasonality of production of the vegetables, which is evident in the study area, could also lead to deficiencies. FAO (1997) states that to improve micronutrient status, gardening must lead to increased consumption (demand) and production (supply) of micronutrient rich foods. To achieve this practical food preservation and processing methods such as sun drying should be adopted to avoid shortage during low production seasons. Intensive kitchen gardening could also be adopted to provide vegetables all year round.

The fact that more than a third of the study children are deficient in iron, contradicts the results of the 24-hour recall that shows that the consumption of iron in the study population is adequate. This could be associated with the low bioavailability of iron from plant sources.

Howes, (1995) states that iron and zinc fall in the category of nutrients with low bioavailability. He however notes that certain traditional home processing methods such as fermentation can increase their availability.

The long cooking of vegetables that is evident in the study population could also have led to destruction of vitamin C that enhances the absorption of the iron.

High risk of zinc deficiency could be associated with the low frequency of consumption of animal proteins (on average about once per week) both in KG and NKG as shown by the food frequency checklist. FAO, (2003) states that red meat is the best source of bioavailable zinc. Individuals, who do not consume this on a regular basis, as is the case in the study population, are therefore at risk of zinc deficiency. Bhutta (2003) states that high rates of sub clinical zinc deficiency occur among children with frequent and recurrent bouts of diarrhoea, as was the case in the study population.

A quarter of the study children suffer iron deficiency (ID) in presence of vitamin A deficiency (VAD) indicates physiological interaction between VAD and ID. The significant associations between serum retinol, serum ferritin and serum zinc confirms this. This also agrees with what Mwaniki, *et al*., (1999) stated, that the VAD is associated with an increased risk of anaemia. Bowley, (2002) also states that to prevent ID anaemia the body also needs vitamin A and C among other vitamins as well as zinc and copper.

5.6 Morbidity and Sanitation

Morbidity

The high prevalence of upper respiratory tract infection among the study children could be associated with vitamin A status. A prospective study carried out in south central India among pre-school children showed that children with mild xerophthalmia were twice as likely to develop upper respiratory tract infections as were the non-xerophthalmic children (Milton et al, 1987). The study children could therefore be at different stages of vitamin A deficiency mainly the pre-symptomatic stages.

The 16.9% prevalence of diarrhoea among the study children is slightly lower than WHO cut-off. WHO suggests that a 2 weeks prevalence of diarrhoea disease >20% in the selected population may identify a population at risk of VAD (WHO, 1996). WHO also states that if >30% of the under five years children are stunted then there is a high risk of Vitamin A deficiency. This is the case in the study area where about a third of the children are stunted. This therefore indicates a population at risk of VAD

Dewaal (1989) in Diskin (1995) states that the health condition may be more constraining than the food intakes on the nutritional well being. According to research carried out in Darfur during the 1984-85 famine, the researcher concludes that if safe water, better sanitation and measles vaccination had been provided, most or even all of the famine deaths could have been prevented. The high prevalence of morbidity in the study children could therefore have led to malnutrition, or could be as a result of malnutrition.

Hygiene and Sanitation

Although a number of mothers from both KG and NKG households reported that they boiled their water, personal experience and key informant interviews showed that very few did boil their water. The main reason as to why drinking water is hardly boiled could be due to shortage of cooking fuel. Most of the mothers are also very busy trying to earn some income for their families, which means that they have little time for childcare practices. There is also a popular believe that water from boreholes is pure/clean and therefore requires no treatment.

The findings that the few latrines present are poorly made and maintained could be associated with land tenure insecurity, as the occupants of the areas have no land title deeds. The occupants could therefore be unwilling to make good but temporary latrines. Sharing of the facilities could also be encouraging carelessness. Lack of latrine facility is a health hazard. Yohannes *et al.*, (1992) states that children under six years of age, analysed to examine the patterns of childhood illnesses, showed that children who lived in a house with a latrine and defecated in a latrine had the lowest morbidity rates.

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The study was carried out to determine the role of kitchen gardening in nutritional status of children aged 9-59 months in low-income peri-urban populations. To achieve this the demography and social-economic characteristics, mothers nutritional knowledge, food production, food consumption patterns of the study households and preschoolers, the nutritional and micronutrient (vitamin A, iron and zinc) status of the study children, morbidity and sanitation of the study area were determined.

Based on the study findings, the following can be concluded

- The KG and NKG households in Ngong area were similar in demography and social-economic status. The level of education and nutritional knowledge of the mothers is low.
- Production of vegetables and other foods in the kitchen gardens leads to
    - ✓ Improved access to food in an affordable way and to reduced expenditure on vegetables and other foods produced. This in turn avails money for purchase of foods that are not produced
    - ✓ Contribution of food to the total diet and results in improved food intake and dietary diversity.
    - ✓ Better nutritional status of the children.
    - ✓ Better micronutrient status of the children.

The findings indicate that kitchen gardening together with nutrition education has the potential to alleviate protein energy malnutrition and micronutrient malnutrition.

6.2 Recommendations

There is need to reduce the prevalence of PEM and micronutrient malnutrition or eradicate it all together. From the study findings, it is recommended that: -

1) Intensive kitchen gardening be taught, demonstrated and encouraged in urban and peri-urban communities.
2) Nutrition education should be taught even in basic education. Special emphasize should be laid on micronutrients.

Other recommendations include:

- There is need for the government to enforce planned housing, roads, water supply, sewage and drainage, public toilets and promotion of preventive health facilities. During such an intervention, the government can ensure provision of some land where the members of the community can be leasing and using it for vegetable production.
- Non-governmental organizations need to be encouraged to mobilize communities to incorporate KG component into community based development programmes.
- Further research should be carried out to determine factors that affect childcare practices in the study area.

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APPENDICES

Appendix 1: Research questionnaire

Nutritional and micronutrient status of children aged 9-59 months in Ngong Division, kajiado District.

Fill in the spaces with the required information, and circle the suitable answer where applicable.

DEMOGRAPHY

Household No Date……dd/……mm/……..Yr.

Sub-Location…………………………… village…………………………

Name of interviewer……………………...Name of respondent……………………

When did you move in to live in this area?………..….mm/………..Yr.

Household profile

[Fill in the table] Please let me know the people who have lived in your household for the **last three months.**

SERIAL NO	NAME	AGE (YRS)	SEX	MARITAL STATUS	RHHH	EDUC	OCCUPATION	CONTRIBU TO HH

Contribution to household labor is by members above 15 yrs of age.
Education level will be indicated by the number of years spent in school.
Serial numbers should start with household head as no 001.

SEX
1 Male
Female

CONTRIBUTION TO H/HOLD
1 Money
2 labor
99 Nothing

MARITAL STATUS
1 Married
2 Divorced
3 Separated
4 Widowed
5 single
99 Not applicable

RHHH (RELATIONSHIP TO HOUSEHOLD HEAD)
1 Household head
2 Wife
3 Son
4 Daughter
5 Grand child
6 Parent to HHH
7 Others: specify
7(a)…………………
7(b)……………………

OCCUPATION
1 Farmer
2 Small scale trader
3 Business man/woman
4 casual labourer
5 Formally employed
6 house wife
7 others: specify
7(a)……………………
7(b)……………………
99 Not applicable

SOCIAL ECONOMIC STATUS

[Observe or ask] Do you own the following assets?

	Assets	Owned **Tick where applicable**	No owned/number of acres/ No of sets.
2.1	Car		
2.2	Motorcycle/scooter		
2.3	Sewing machine		
2.4	Television		
2.5	Gas cooker		
2.6	Bicycle		
2.7	Wardrobe/cupboard		
2.8	Sofa set/ easy chair		
2.9	Land		
2.10	Cows		
2.11	Goats		
2.12	Sheep		
2.13	Rabbits		
2.14	Ducks		
2.15	Chicken		
2.16	Others (specify)		

3 Do you rent land? 1 yes 2 no

4 **[If yes]** How much land do you rent? ……………acres.

5 How much do you pay per rented land? Ksh……………

6 Is the house you live in your own or rented? 1 owned 2 rented

7 How many rooms does your house have? […..]

8 **[If rented]** How much do you pay per month? Ksh…………..

9 How many rooms does the house have [……]

10 **[Observe]** what material has been used to construct the main house?

10.1) **Roof**

1 Makuti 2 iron sheets 3 tiles 4 grass/thatch

Others (specify)……………………………………..

10.2) **Wall**

1 mud 2 plaster 3 wood 4 brick/block/stones

5 iron sheets 6 others(specify)………………………………..

10.3) **Floor**

1 mud 2 cemented 3 wood 4 brick/tiles/stones

others (specify)…………………………………………….

SOCIAL ECONOMIC STATUS

[Observe or ask] Do you own the following assets?

	Assets	Owned **Tick where applicable**	No owned/number of acres/ No of sets.
2.1	Car		
2.2	Motorcycle/scooter		
2.3	Sewing machine		
2.4	Television		
2.5	Gas cooker		
2.6	Bicycle		
2.7	Wardrobe/cupboard		
2.8	Sofa set/ easy chair		
2.9	Land		
2.10	Cows		
2.11	Goats		
2.12	Sheep		
2.13	Rabbits		
2.14	Ducks		
2.15	Chicken		
2.16	Others (specify)		

3 Do you rent land? 1 yes 2 no

4 **[If yes]** How much land do you rent? ……………acres.

5 How much do you pay per rented land? Ksh……………

6 Is the house you live in your own or rented? 1 owned 2 rented

7 How many rooms does your house have? [.....]

8 **[If rented]** How much do you pay per month? Ksh……………

9 How many rooms does the house have [……]

10 **[Observe]** what material has been used to construct the main house?

10.1) **Roof**

1 Makuti 2 iron sheets 3 tiles 4 grass/thatch

Others (specify)……………………………………..

10.2) **Wall**

1 mud 2 plaster 3 wood 4 brick/block/stones

5 iron sheets 6 others(specify)………………………………..

10.3) **Floor**

1 mud 2 cemented 3 wood 4 brick/tiles/stones

others (specify)…………………………………………

11 What are the two main sources of energy for lighting?

1st	
2nd	

1 wood 2 tin lamps 3 hurricane lamps 4 pressure lamps 5 gas
6 Electricity

12 What are the two main sources of energy you use for cooking?

1st	
2nd	

1 wood 2 charcoal 3 paraffin 4 gas 5 electricity
others: (specify)…………………………………..

FOOD PRODUCTION AND UTILIZATION.

13 Do you have a kitchen garden? 1 yes 2 No

14 **[If yes]** Is what you produce usually sufficient for the household needs?
1 yes 2 No

15 For the vegetables that are consumed in your house explain how they are produced, how they are utilised and the method of preparation.

Crop	**Vegetable produced 1 yes 2 No**	**Production method**	**Utilization**	**Preparation method**
Tomatoes				
Kales				
Carrots				
Amaranth(Terere)				
Cowpeas leaves				
Pumpkin leaves				
'Enderema' (Basela alba)				
Spinash				
Black night shade(managu)				
Others (specify)				

Production method	**Utilization**	**Preparation method**
1 Mandalla gardens	1 Consumed at home	1 cooked for 15 min & more
2 Multistorey gardens	2 Sold	2 Cooked slightly(<5min)
Double dug gardens	3 Gifts	3 Consumed raw
4 Small plots	4 Fence	4 Others: specify
5 Others: specify	5 Others: specify	4 (a)……………………
5 (b)………..	5 (b)……………	4 (c)…………………..

16 When are fruits usually taken? 1 breakfast time 2 with or after a snack
3 With or immediately after main meal 4 Any time when they are available
5 others (specify)……………….

FOOD CONSUMPTION PATTERNS.

[Where applicable] How often do you usually consume the following foods?
How many times did you consume the following foods within the last seven days?
[Fill in the table below]

FOOD EATEN	No. of times consumed										No. of times consumed in the last one week	Source of the food
	No. of days consumed in a week							After fortnight	Monthly	Never (less than once a month)		
	1	2	3	4	5	6	7					
CEREALS												
Maize/products												
Rice												
Chapati												
Others: specify												
Legumes												
Beans												
Green peas												
Kunde												
Dengu												
Njahi (pigeon peas)												
FRUITS												
Banana												
Lemon												
Oranges												
Avocado												
Passions												
Mangoes												
Pawpaw												
Others: specify												
SOURCE 1 garden/farm 2 shop/kiosk 3 market 4 others (specify)………..												

FOOD EATEN	No. of times consumed										No. of times consumed in the last one week	Source of the food
	No. of days consumed in a week							After fortnight	Monthly	Never (less than once a month)		
	1	2	3	4	5	6	7					
VEGETABLES												
Amaranth												
Cabbage												
Sukuma												
Carrots												
Tomatoes												
Cowpea leaves												
Pumkin leaves												
'Enderema' (Basela alba)												
Others: specify												
ROOTS AND TUBERS												
Sweet potato												
Arrow roots												
Irish potato												
OTHERS: SPECIFY												
ANIMAL PRODUCTS												
Eggs												
Meat												
Milk												
Fish												
SNACKS												
Bread												
Sugar												
Cakes												
FATS & OILS												
Veg oil/fat												
Animal fat												
Others												
SOURCE 1 garden/farm 2 shop/kiosk 3 market 4 others (specify)…………												

INFORMATION ON INDEX CHILD

Name of the child.. Sex [...]1 male 2 female

Date of birth...........dd/............mm/...........yr.

Date of birth verified by [...] 1 Birth registration 2 Birth certificate 3 Baptism card 4 Family records 5 Clinic card 6 none

19 What do you usually give the child in between the main meals?

1 fermented porridge 2 porridge fortified with fish and pulses 3 Tea 4 porridge fortified with pulses/soy 5 Fruits 6 nothing 7 others (specify).....................

20 Please let me know all the foods and drinks the child consumed from the time he/she woke up yesterday morning to the time he/she went back to bed. Let us start with the first food item he/she ate after waking up.

Fill in the table below:

Period	Dish		Name of ingredients	Amount of ingredients In Household Measures		Amounts In Standard Units (Grams)	Amounts Served To Index Child (Volume In Ml)	Amount Leftover By Index Child (Volume In Ml)	Amount Consumed By Index Child
	Name	Volume		No	Units				
BREAKFAST									
MID MORNING									
LUNCH									
AFTERNOON									
DINNER									
AFTER DINNER									

SOURCE 1 Kitchen garden 2 shop/kiosk 3 market 4 others (specify)...........

How often does the index child consume the following.

FOOD EATEN	No. of times consumed									
	No. of days consumed in a week							After fortnight	Monthly	Never
	1	2	3	4	5	6	7			
Milk										
Eggs										
Meat										
Fish										
Fruits										
Beans										
Green vegetables										
Fortified porridge										
Fermented porridge										
Tea										

21 When is tea /coffee/cocoa usually taken? 1 Breakfast time 2 with snacks
3 with or immediately after meals 4 others (specify)……………………………………

MORBIDITY

22 What are the two main sources of water that you use?

1st	
2nd	

1 dam 2 pipe water 3 bore hole 4 spring 5 roof catchment
6 others (specify)……………………………

23 How long does it take you to get water from the source you use?
1 water within the house 2 less than 30 minutes
3 30min-hour 4 1hour to 2 hours 5 2 hours and more

24 Do you treat your drinking water? 1 yes 2 No

25 **[If yes]** how do you treat your water before drinking? 1 boil 2 filter
3 use chemicals 4 others (specify)………………………..

[observe or ask] Is the toilet you use your own or shared? 1 owned
2 shared between families

27 Has your child been sick over the last two weeks? 1 yes 2 No

28 **[If yes]** what illness did the child suffer from? [Tick where appropriate]

Disease	Suffered	Action
28.1 Cough/cold		
28.2 Stomach ache		
28.3 Fever		
28.4 Tonsils		
28.5 Diarrhea		
28.6 Skin disease		
28.6 Wounds		
28.7 Malaria		
28.8 Eye problem (specify) ……………………		
28.9 Others (specify)…………		

1 gives home care 2 private clinic 3 health center 4 hospital 5 herbalist
6 traditional healers 7 spiritual healers 8 others (specify)……………………… …

When your child is sick/unwell whom do you usually consult?
1 gives home care 2 private clinic 3 health center 4 hospital 5 herbalist
6 traditional healers 7 spiritual healers 8 others (specify)……………………… …

30 Do you know about worms? 1 yes 2 No

31 **[If yes]** what causes worm infestation? 1 eating soil
2 drinking un-treated water. 3 eating faeces
4 others (specify)…………..

32 Have you ever de-wormed your child? 1 yes 2 No

33 **[If yes]** when did you last de-worm your child? 1 last 3 months
2 last 6 months 3 more than 6 months ago

34 Do you think it is important to de-worm children? 1 yes 2 no 3 don't know.

35 Why?……………………………………………………

36 How often should children be de-wormed? 1 Every 3 months 2 Every 6 months
3 Don't know 4 Others (specify)……………………..
37 Have you ever heard of someone suffering from little or no blood ?

1 yes 2 No

38 **[If yes]** what is the local name and description of the disease?.................

....

39 Who are usually affected by this condition of little or no blood? 1 children 2 women 3 Men 4 Anybody 5 Others (specify)...................

40 Do you know what causes the disease? 1 intestinal worm infestation
2 over- working 3 malaria 4 Inadequate food intake 5 pregnancy
6 don't know 7 other (specify)..

41 Where and from whom did you learn about this disease? 1 friends 2 school
3-health worker 4 neighbors/relatives 5 through radio/ television
6 reading magazines/ news papers 7 traditional birth attendants
others (specify)...

42 Has your child received Vitamin A supplementation in the last six months?
1 Yes 2 No

43 **[If no]** why? 1 Do not see the need 2 I have never heard of it
3 Religion 4 Others (specify)............................

44 **[If yes]** Why do you think children should be given Vitamin A supplementation?

....

....

45 Do you know if there is any other way of combating the problem that Vitamin A supplementation usually addresses? 1 Yes 2 No

[If yes] How?..

....

47 Apart from food what else do you give your child regularly? 1 none
2 cod liver oil 3 multivitamin syrup 4 Haliborange
5 Others(specify)..
49 **[If any]** Why?..

....

ANTHROPOMETRY

50 Fill in the anthropometric measures of the index child.

Reading	Height (to the nearest 0.01cm)	Weight (to the nearest 0.1 kg)	Oedema present 1 yes 2 no	Mid-upper arm circumference (MUAC)
1st				
2nd				
Average				

Appendix 2:Ethical Clearance

KENYATTA NATIONAL HOSPITAL
Hospital Rd. along, Ngong Rd.
P.O. Box 20723, Nairobi.

Tel: 726300-9
Fax: 725272
Telegrams: "MEDSUP", Nairobi.
Email: **KNHplan@Ken.Healthnet.org**

Ref: KNH-ERC/01/2240 **Date: 5 May 2004**

Laura Wangui Kiige
Dept. of Food Science Technology & Nutrition
University of Nairobi

Dear Laura

RESEARCH PROPOSAL "NUTRITIONAL AND MICRONUTRIENT STATUS (VIT A, IRON, AND ZINC) OF CHILDREN AGED 9-59 MONTHS IN NGONG: A COMPARATIVE STUDY OF KITCHEN GARDEN PRACTISING AND NON-PRACTISING HOUSEHOLDS IN NGONG, KAJIADO DISTRICT, KENYA" (P14/2/2004)

This is to inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and **approved** the revised version of your above cited research proposal for the period 5 May 2004 – 4 May 2005. You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given.

On behalf of the Committee, I wish you fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of database that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely,

PROF. A N GUANTAI
SECRETARY, KNH-ERC

Cc Prof. K Bhatt, Chairperson, KNH-ERC
The Deputy Director (C/S), KNH
The Dean, Faculty of Medicine, UON
The Chairman, Dept of Paediatrics,UON
Supervisors: Dr A M Mwangi, Dept. of Food Science & Technology, UON
Prof. S K Mbugua, Dept of Food Science & Technology, UON
Prof. R N Musoke, Dept of Paediatrics, UON

Appendix 3: Consent Information

Nutritional and Micronutrient Status [Vitamin A, Iron, and Zinc] of Children Aged 9-59 Months in Ngong

Nutrition is essential for growth and development, health, and well being of mankind. It is therefore important for children to build a foundation for well-being by practising healthy eating behaviours.

Protein-energy malnutrition (PEM) is by far the most lethal form of malnutrition. The Kenya National Micronutrient suevey by MOH and UNICEF in 1999 also showed that VAD, IDA and zinc deficiencies were of public health concern.

The main objective of this is to determine the nutritional and micronutrient [Vitamin A, iron, and zinc] status of children between 9-59 months in households practising kitchen gardening and those without kitchen gardens.

The expected benefits of the study are: -

- Contribution of kitchen gardening to improved nutritional and micronutrient status of children in Ngong area will be established.
- The participants will benefit in that the study will act as a baseline study for a kitchen gardening promotion intervention that is intended for Ngong area.
- The study will also be of use to the study participants, health facilities in the study area and the government as it will assess the extent to which the ongoing vitamin A supplementation is reaching the under fives in Ngong.

- The policy makers and development agents will be able to understand a viable way of improving the nutritional and micronutrient status in the country among the vulnerable groups.
- The results will be useful to future intervention projects wishing to use food-based intervention in the control of micronutrient deficiency and household food security.
- The research will generate additional information on Kajiado district that was not captured in the previous micronutrient survey.

The study does not pause any risk to the index child.

Data will be collected for this research using: - a) a structured questionnaire, b) collection of blood and measuring serum retinol levels, serum ferritin levels and serum zinc levels and c) taking anthropometric measurements.

5mls of blood will be drawn from the index child and this will be used for assessment of vitamin A, iron and zinc status. The blood will be drawn by a qualified haematologist using single use sterile syringe and needle using standard clinical procedures and transferred to an acid-washed screw-capped tube. There is therefore no risk of blood being drawn from a child at risk. The assessment will be done in KEMRI, Nairobi laboratories. Biological indicators such as retinol level, ferritin status and zinc levels that are to be used in this study are recommended by the World Heath Organisation and are the most specific and useful for risk assessment, targeting programs and evaluating effectiveness (WHO, 1996).

Appendix 4: Consent Form

Nutritional and Micronutrient status of children aged 9-59 months in Ngong Division, kajiado District.

Que. No.......... **Location....................................**

Village..

I (Mimi)..

Parent of (Mzazi wa)...

Do agree to take part in the above study (Nimekubali kuhusika kwa huu utafiti)

Signature.............................Date..

........................*Cut here*..

Nutritional and Micronutrient status of children aged 9-59 months in Ngong Division, kajiado District.

Name of child ....

Name of parent..

Village...

Household number..

Appendix 5: Blood Sample Analysis Form

Questionnaire no ……………… Date…….dd/…….mm/………yr

location……………………… village………………………

Name of the child ……………………………………………………..

Sex 1 male 2 female Age……………..yrs

Is the child sick? 1 yes 2 No

[If yes] explain……………………………………………………………
…………………………………………………………………………………….
……………………………………………………………………………………..

Date of specimen collection ………dd//…………mm/………yr

Date of analysis………dd/…mm/…………yr.

<u>Results</u>

Serum retinol level……….µg/dl

Serum β-carotene level…………µM/l….

Serum ferritin level………..µg/dl

Serum zinc level…………..µg/dl

Clinician's comments

……………………………………………………………………………………
……………………………………………………………………………………
…………………………………………………………………………

Signature………….

Rubberstamp

Appendix 6: Focus Group Discussion Guide

Name of the moderator................................ Date.........dd/........mm........yr.

Name of the observer/recorder.......................... Place (village)..............

	Name of participant	Age	Occupation	Marital status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

OCCUPATION
1 Farmer
2 Small-scale trader
3 Business man/woman
4 casual labourer
5 Formally employed
6 others: specify
99 Not applicable

MARITAL STATUS
1 Married
2 Divorced
3 Separated
4 Widowed
5 single

Guideline questions

1. Are there organisations that have been or are there in this area that are teaching, demonstrating or giving/selling educational materials on nutrition?
2. What did they/are they teaching, demonstrating, or giving/selling?
3. What do you know about the role of food in the body especially for children?
4. What about minerals and Vitamins?
5. Which Vitamins do you know about and what are their roles in the body?
6. What about Vitamin A? What foods contain it?
7. What causes people not to see in the dim light?
8. What is the local name for that condition?
9. Which minerals do you know about? What food contains them?
10. Do you know about iron and anaemia?
11. How do people in this area perceive kitchen gardens?
12. What crop do you commonly grow in the kitchen gardens?
13. Are there times when you suffer vegetable shortages? What do you do then?
14. Why don't you consume some of the vegetables that you grow?

Appendix 7: Conversion of livestock to livestock units

Animal	Equivalent of livestock units
Cow	1
Goat	0.2
Sheep	0.2
Donkey	1.2
Chicken	0.01
Pig	0.4
Rabbit	0.01
Ducks	0.01

Based on Kinuthia, 2004.

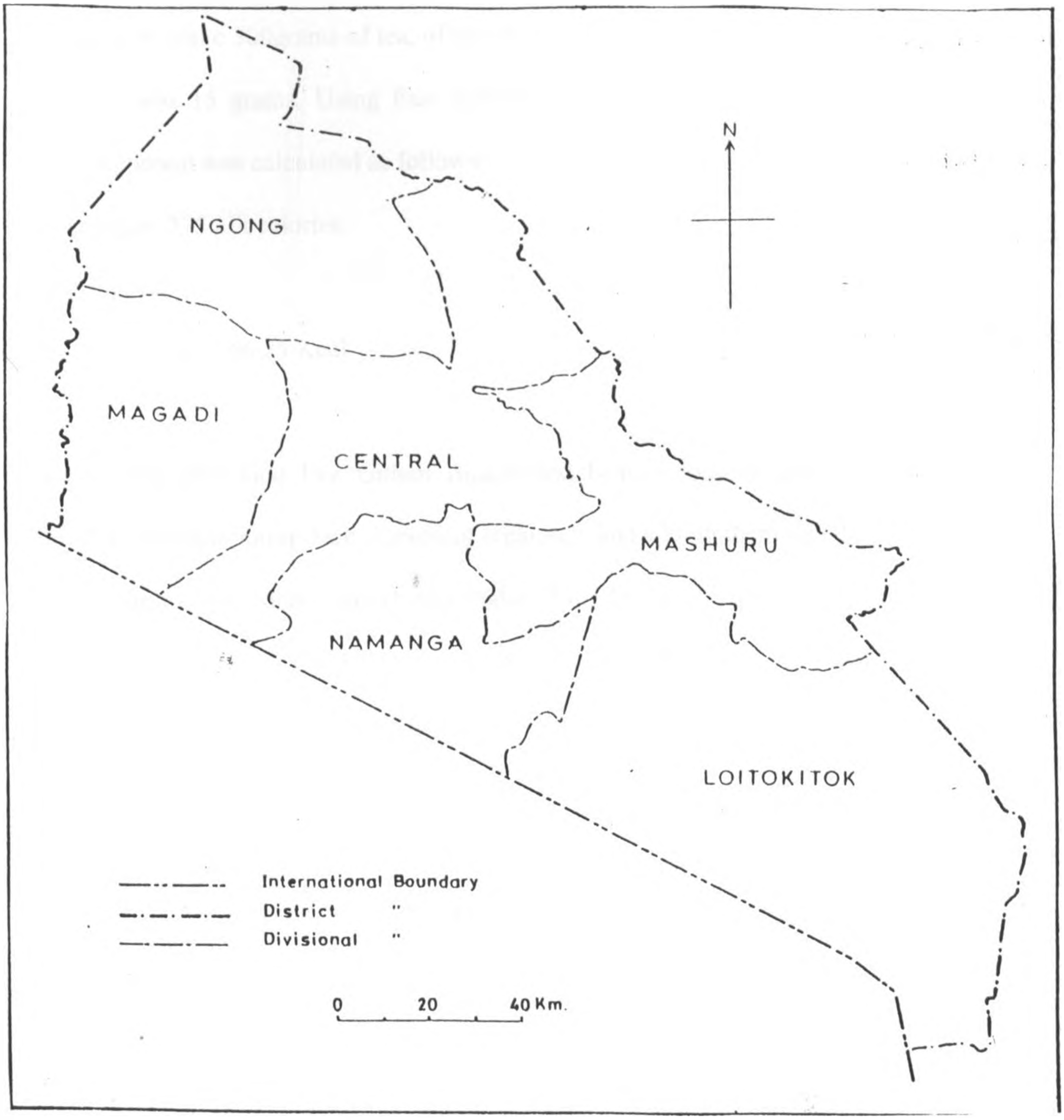
One livestock unit is equivalent to one mature cow.

Appendix 8: Weights assigned to assets owned

Asset	Weight
Car	15
Motorcycle/scooter	10
One livestock unit	7
Sewing machine	5
Television	5
Gas cooker	3
Bicycle	3
Sofa set/easy chair	1
Wardrobe/cupboard	1

Appendix 9: Location of Kajiado District

Appendix 10: Kajiado District administrative boundaries



Appendix 11: Quantitative analysis of food intake (24-hour recall)

The ratio of the family's as well as index child's foods consumed were used to derive the amount of ingredients taken by the index child. For example; if 30grams of sugar was used to make 300grams of tea, of which the child took 150 grams, the actual intake of sugar was 15 grams. Using East African conversion figures, the kilocalories and protein content was calculated as follows:

100g sugar=375 kilocalories

15 g sugar=?

$$\frac{15g \times 375 \text{ Kcal}}{100g} = 56.25 \text{ Kcal}$$

For a composite food like Githeri (maize and beans), total nutrients intakes were calculated by computing each ingredient separately and adding them together.

For example Githeri made from1000g maize, 500g beans, 200g potatoes, 20g cooking fat and 120 g onion (0.54: 0.27: 0.11:0.011 and 0.06) and salt. From this food, kilocalories and protein were calculated as follows:

Kilocalories

100g maize=335 kcal; 1g maize=3.35 kcal

100g beans=320 kcal; 1 g beans=3.2 kcal

100g irish potatoes=81 kcal; 1g irish potato =0.81 kcal

100g onion = 38 kcal; 1 g onion = 0.38 kcal

cooking fat 100g = 900 kcal; 1g = 9 kcal

Protein

100g maize=8g ; 1g maize=0.08g

100g irish potatoes = 2.01g; 1 g Irish potatoes =0.0201g

100g beans = 22 g 1 g beans = 0.22g

100g onion = 1.2g; 1 g onion =0.012g

Cooking fat does not contain protein. Similar procedures were followed for vitamin A, iron and zinc consumed by the index child.

For instance if the child ate 105 gram of Githeri, this amount was used to compute the amount of kilocalories, protein, Vitamin A, iron and zinc consumed.

Since Githeri is prepared by the ratio of 0.54:0.27:0.11:0.0011and 0.06 of maize, beans, potatoes, cooking fat and onion respectively; this is equivalent to:

Maize – 0.54x105g Githeri =56.7g maize
56.7g of maize x 3.35 kcal =185.945 kcal
56.7g of maize x 0.08g protein = 4.536g protein

Beans -0.27x105g Githeri = 28.35g beans
28.35 g of beans x 3.2 kcal = 90.72 kcal
28.35g of beans x 0.22 g protein = 6.237g protein

Irish potatoes- 0.11x105g Githeri = 11.55g Irish potatoes
11.55g of Irish potatoes x .81 kcal = 9.356 kcal
11.55 g of Irish potatoes x 0.0201 g protein = 0.2322g protein

Cooking fat = 0.0011x 105g Githeri = 0.1155g fat
0.1155g cooking fat x 9 = 1.04 kcaloreies

Onion – 0.06 x 105 g Githeri = 6.3g onion

6.3g onion x 0.38 kcal = 2.394 kcal

6.3g onions x 0.012 = 0.0756g protein

Total kilocalories and proteins were 289.455kcal and 11.08g respectively.

Therefore, 105 g GItheri provides 289.455 kcal and 11.08g proteins. Similar calculation was carried out for Vitamin A, iron and zinc content of the food.