IMPROVING NUTRITION OF LACTATING MOTHERS IN A PERI-URBAN USING TRADITIONAL VEGETABLES. A CASE OF MWANAMUKIA IN NAIROBI

BY

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DEPARTMENT OF FOOD SCIENCE, NUTRITION AND TECHNOLOGY

2017
DECLARATION

I Evayline Muthoni Nkirigacha hereby declare that this thesis is my original work and to the best of the knowledge has not been presented for an award in any other institution.

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DEDICATION

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OPERATIONAL DEFINITIONS OF TERMS

Dietary Diversity- is the sum of the number of different foods or food groups consumed by an individual or household over a specific period of time.

Food poverty – Is the ability of individuals and households to obtain an adequate and nutritious diet, often because they cannot afford healthy food or there is lack of shops in their area that are easy to reach.

Chronic food insecurity - continuously inadequate diet that is caused by the inability to acquire food

Permanent source of income- Steady monthly salaried form of employment or stabilized business.

Quantitative data- Numerical observations or measurements.

Qualitative data- Observations which are categorical rather than numerical, such as attitudes, intentions and perceptions.

Food accessibility- A condition when households have adequate incomes or other resources to purchase or barter to obtain appropriate levels of foods needed to maintain consumption of food and adequate diet/nutrition level (USAID 1992).

Food availability- A condition when sufficient quantities, necessary types of food from domestic production, commercial imports or donors are consistently available to individuals or are within reasonable proximity to them or are within their reach (USAID 1992).

Consumer unit- It is the nutrient requirement of an individual as a requirement of an individual as a ration of the requirement of an arbitrary chosen person (nominal adult male) whose requirement is equivalent to one and the rest is expressed as a fraction of it (WHO/FAO/UNU, 1985).

Coping strategy/mechanism- The methods which households employ to deal with food inadequacies in crisis e.g making greater use of wild foods, selling assets, migration
**Food security**- when all people at all times have both physical and economic access to sufficient and good quality food to meet their dietary needs for productive and healthy life (USAID, 1992).

**Drought tolerant crops**- Crops that can withstand water stress to some degree and relatively produce some yields.

**Prevalence**- the proportion of the population that has a condition of interest (e.g. stunting) at a specific point

**Vulnerability**- The extent to which an individual, household, community, socio-economic system is likely to be affected by a foreseeable bad event.

**Household**- Defined as members of the same family eating from the same pot with the same head and not necessarily blood relatives.

**Xerophthalmia**- A medical condition in which the eye fails to produce tears

**Dermatitis**- Inflammation of the skin

**Bitot’s Spots**- Buildup of keratin debris located superficially in the conjunctiva, which are oral, triangular or irregular in shape.

**Keratomalacia**- An eye disorder that leads to a dry cornea
Diet is the cornerstone for maintaining health and for the management and prevention of a wide range of medical conditions. Good nutritional intake supports the stamina, patience and self-confidence that nursing an infant demands. Among the rights to human beings is right to food and freedom from hunger. Production of food in lactating mothers’ households guarantees household food security for all populations. It plays a key role in improving their health, their offsprings health and work capacity. The concept of adequate food is fulfilled by crop production which can be a very important source of supply of fresh vegetables locally among other foods. This greatly improves access to food and dietary diversity thus improving the nutritional status of lactating mothers. Increasing food production is thus crucial to achieving major nutritional improvements.

Pregnant and lactating women are especially at high risk of deficiencies due to inadequate dietary intakes, physiological changes involved and various socio-demographic factors. Lactating mothers from low-income settings are especially considered a nutritionally vulnerable group. Due to the nursing process mothers are subjected to nutritional stresses. Frequent pregnancies followed by lactation increase the health risk of mothers resulting in a high maternal mortality. It is therefore necessary to carry out intervention on the diets of these mothers so that they can meet the nutritional requirements of micronutrients that are helpful to both the mother and the child. These micronutrients include zinc, iron and vitamin A. African traditional green leafy vegetables have been found to have high levels of micronutrients, which makes them good vehicles for micronutrient intervention. The vegetables are easy to grow and they possess familiar tastes to many African communities. This study was divided into two phases a baseline phase and an after intervention phase. During the baseline phase 260 lactating mothers 0-3 months postpartum from Mwanamukia a peri urban area of Nairobi metropolis were interviewed. Using the local administration, the population of such mothers was enumerated and from the population, the sample was randomly selected. Then
using structured and pre-tested questionnaire information was collected on socio-demographic and socio-economic characteristics. The aim of this study was to assess the foods produced and proportion consumed by lactating mothers in a peri-urban area of Nairobi. This cross sectional study was conducted on 260 purposively selected lactating women living in Mwanamukia, Nairobi Kenya. A structured, validated and pre-tested questionnaire was used to obtain information on socioeconomic characteristics, food production and consumption. Data was entered into SPSS version 20 and analyzed using descriptive statistics and Pearson correlation coefficient was used to determine associations. Majority of the respondents (61.6%) were participating in urban agriculture. In crop production, maize (26.5%) and out of this all was for home consumption, beans (28.4%) were produced and home consumption was 18.4% and 10% was sold. Amaranth was produced at 25.7%, 8% consumed at home and 17.7% was sold other crops were grown in small quantities. In the study 57.3% of the respondents owned land to practice urban agriculture. Majority of them (15.3%) had 250m² plots and 26.3% of these had inherited the land they had. Where the respondents did not own the land, they were renting (7.8%). More women (31.8%) than men (21.6%) decided on what crops to plant. More women (35.7%) provided labor for agriculture. More respondents consumed and also sold (34.1%) the produce compared to those who consumed only (27.8%). Vegetables were not a major food crop produced. Intervention programs should target on emphasizing the production and consumption of vegetable to increase availability and help meet the increased nutritional needs of the lactating woman.

Results indicate that majority of the respondents fell within the age range of 36 – 40 years. The 44.6% of the respondents had attained primary, and 16.8% had attained secondary. The household size ranged between 6 –12. In average the respondents’ households contained 6 persons. Majority of the respondents were from the lower socio-economic category. A subsample of 53 mothers was randomly selected from the main sample and this was used to
determine the dietary intake of protein, energy, vitamin A, iron and zinc in a 24-hour recall, and the nutrition status of the mothers. Most respondents had a high diverse diet, meaning that they were able to consume a wide variety of foods from each of the seven food groups, in the amounts recommended, however dietary intake of vitamin A, iron and zinc were low meaning the amount of foods consumed that are rice in the said micronutrients were low, indicating an unmet nutritional requirement. The nutritional status as determined by the BMI of majority of the respondents (47.1%) was underweight compared to (30.1%) of the respondents that had a normal BMI and (22.8%) who were overweight. In the second phase the 53 lactating mothers were used to determine the dietary intake and nutritional status after consuming three types of vegetables. A 24 hour recall was done for the respondents. This was done by asking the respondents the amount of food they had consumed during the last 24 hours preceding the study. These were converted into water in the measure used and put into measuring cylinders then measured and recorded. The vegetables were Amaranth (A. dubius), black nightshade (Solaanum nigrum) and cow pea leaves (Vignaunguiculata) which were grown as pure stands under similar conditions in either organoponics, multistorey gardens or open fields by the different mothers. The mothers each planted three pure stands of each vegetable for each planting system. The 24 hour recall data was entered into nutrisurvey then transferred to SPSS version 20 and analysed using descriptive statistics and Pearson correlation coefficient was used to determine associations. Results showed that the mean intake of vitamin A, iron and zinc increased in the lactating mothers after intervention with the vegetables. However, the mothers were still deficient of Vitamin A and Iron after the intervention. Lastly, the vegetables that were used for nutritional intervention in lactating mothers were analysed for proximate composition and micronutrient contents, so as to be able to calculate their contribution to dietary micronutrient intake. The micronutrients analysed were beta-carotene for vitamin A, iron and zinc. The analyses were done on raw, boiled and stewed vegetables sampled from the
organoponics, multistorey gardens and the open fields. Data analysis was done using one way-ANOVA at P≤0.05. Proximate analysis of the vegetables indicated that there was a statistically significant difference in beta-carotene, iron and zinc between the three vegetable groups and no statistically significant difference of the micronutrients in the method of cooking of each vegetable. Findings of this study indicate that urban agriculture is a way of providing food security and especially to vulnerable groups. This can be done even with limited space in organoponics and multistorey gardens. Interventions with foods grown in these gardens can be done for groups at risk to be able to meet their nutritional needs. Any group undergoing a dietary intervention program should be advised on proportions to feed on and the methods of preparation. It is therefore important that the proximate composition of crops being used in the intervention be determined for their nutrient composition so that their advantage to the groups using them can be determined.
CHAPTER ONE: GENERAL INTRODUCTION

1.1 BACKGROUND

Lactating mothers in their state of nursing babies require enough nutrients to enable them cope with the high demands for nutrients during this physiological state. The milk produced by the lactating mother contains the ideal amount of nutrients for the infant, and provides important protection from diseases through the mother’s natural defenses. The colostrum is rich in immunoglobulin A. The diet of a lactating mother is important in that certain substances in the mother’s diet could enter the milk and reach the child’s stomach. This necessitates a lactating mother to plan her diet in such a way that it contains vital micronutrients such as vitamin A, iron and zinc as well as protein which enables the body to produce the much need enzyme for milk production prolactin and oxytocin which is essential for milk ejection reflex and let-down to occur. Traditional green leafy vegetables are rich sources of vitamin A, iron and zinc and therefore they can be used as means of providing micronutrients in the household with lactating mothers (Capuco and Akers, 2009). Micronutrient deficiencies are more likely to affect breast milk composition, and the development and nutritional status of the infant (Capuco and Akers, 2009). Lack of diet diversity and a high prevalence of infection in many developing countries can contribute to inadequate micronutrient status (Adelman et al, 2008).

This study was based in a peri-urban area of Nairobi, which has a culture of urban agriculture. This culture was introduced in the area earlier by a project, National Agriculture and Livestock Development Project (NALEP) during the period 2009-2012. The practice of urban agriculture is not legal according to the by-laws of the City of Nairobi. However, the practice is quite rampant, especially among the lower-middle socio-economic households. Crops like maize, beans and leafy vegetables are cultivated in any available land space, including backyards, any
empty spaces in the estates, and road sides and reserves. Small animals such as goats, sheep and poultry are also kept, as lone rangers, in confined sheds or even in the dwelling houses.

Majority of the urban farmer households spend large proportions of their income on food. It has been reported that in Nairobi, over one-third of these households spend 70 -75% of their income on food (Foeken and Mwangi, 2002). This income is however usually low and sometimes unpredictable. It is usually brought in by household heads usually as wages from informal casual employment. Women therefore usually engage in urban agriculture and other informal commercial activities to supplement the income for food and other social welfare needs (Norman and Steyn, 2016). The dwelling places of these people are usually located in the overpopulated peri-urban areas. A study showed that in these areas, informal trade and food selling were the most frequent sources of income. Among the non-farming households mainly, illegal trade and practices (like manufacturing and selling alcoholic beverages, prostitution, street begging and stealing) scored high (24%) in comparison with the farmers' group (10%) (Foeken and Mwangi, 2000).

Nutritional demands of lactating mothers are high, and nutritional assessment should be carried out routinely so that when carrying out medical care, the position is known (Temple and Steyn, 2016). The nutritional status and dietary intake of micronutrients such as iron, zinc and vitamin A, should be put into account so that approaches such as planting African leafy vegetables in lactating mothers household become one of the chosen strategies to improve their micronutrients intake. Lactating mothers nutritional status depends on various factors which includes, weight gain during pregnancy, weight loss immediately postpartum, dietary intake and physical activity (Temple and Steyn, 2016). When assessing lactating mothers’ nutritional status use of BMI values are useful indicators, poor infant growth during exclusive breastfeeding are also possible indicators. For instance a child who develops infantile beriberi
is an indication of lack of the mothers ability to consume or absorb thiamine (who Expert Committee, 1995; Norman and Steyn, 2016). A BMI cut-off of <18.5 can be used to identify women at risk (WHO Expert Committee,1995; Temple and Steyn, 2016). Lactating mothers require extra macronutrients and micronutrients in order to meet their increased nutritional requirements for milk synthesis in lactation (Sharbang et al., 2005; Shabert, 2004; Norman and Steyn, 2016). They require an additional 330kcal of energy for the first 6 months post_partumin addition to the recommended RDA for non-pregnant females (Shabert, 2004). Lactating mothers’ nutrition and diet directly impact on breastfeeding. Inadequate intake of micronutrients such as iron, zinc and vitamin A, and macronutrients such as protein, carbohydrates and lipids, can decrease the volume of breast milk production and lead to breastfeeding malnutrition, or “failure to thrive”, in infants (Shabargh et al, 2005, Norman and Steyn, 2016). Lactating mothers with closely spaced pregnancies, long periods of continuous breast feeding and are from deprived socio-economic backgrounds encoupled with suboptimal diets tend to suffer from micronutrients deficiencies particularly iron leading to megablastic anaemia (Witney and Rolfers, 2016; Norman and Steyn, 2016). Excessive weight gain during pregnancy may lead to complications such as gestational diabetes, caesarean birth and macrosomia (birth weight >400 grams), may hider initiation of breastfeeding thus affecting lactation (Kjolhede, 2004; Norman and Steyn, 2016).

1.2 URBAN AGRICULTURE: GLOBAL PERSPECTIVE

Globally, between 15 and 20% of food consumed is produced by urban agriculture. Urban production varies between countries, with a greater proportion taking place in low-income countries. Vietnam has the highest participation in local production of urban food; in Hanoi, 80% of fresh vegetables and 40% of eggs are produced within city borders (Corbould, 2013).
Some of the major factors that affect urban agriculture production are legislative, landowner issues and city policies. In areas with a low acceptance for urban agriculture, production is mainly in low-price crops to avoid goods being stolen and/or destroyed (Thomas et al., 2012). Additionally, when land ownership is not clear, cultivation is mainly focused on the next harvest; issues like improving land quality and maintaining high fertility of soil are given low priority. Urban and peri-urban farmers need assurance that they can keep their harvests. (Vinnerås, and Jönsson, 2014).

The production of vegetables and fruits within urban and peri-urban boundaries provides food for millions of Africans in urban areas as well as livelihoods for thousands of urban growers. Thus, the socio-economic impact of urban horticulture is substantial (Asp and Alsanius, 2014). Urban horticulture not only provides plant-based food of high nutritional and health value, but also offers secure livelihoods. Over 70% of urban growers in the city of Tamale, Ghana, state their main occupation as vegetable growing, primarily for market and less for their own consumption (Abubakari & Mahunu, 2007).

Horticulture is ideal for conditions prevailing in urban areas as it is characterized by high turnover, high resource efficiency, high yield and good quality as well as flexible land use and production of several crops during one season. Horticultural production provides more efficient land use by allowing substantial cropping in limited areas through efficient low-tech production systems like vertical cropping. For example, production in bag gardens (cultivation in hanging bags filled with soil and manure) has become more utilized throughout Africa and helps to increase food security and eco-social capital for households (Gallaher et al., 2013).

Urban horticulture also contributes to ecosystem services other than food provisioning; it
affects ecological processes and dimensions in cities, including climatic factors such as, air quality, biodiversity and water management. Urban horticulture affects energy provision in that crops such as irish potatoes, maize and sweet potatoes can be grown using urban horticulture and these are energy giving foods in the society. Well-managed urban horticulture will be an important tool to reduce poverty, improve environmental management and further economic development in many cities of developing countries (Asp and Alsanius, 2014).

Urban horticulture cannot produce enough food for its dwellers so that they have to depend on food production from rural areas for them to be food secure. To this end, some authors have argued that a dichotomous relationship between the rural and urban economies must be rejected as the two are interlinked and dependent on each other (Baker, 2005). This is of real significance in countries like Malawi where large quantities of rural produce are sold in peri-urban and urban markets to urban residents (Mkwambisi, 2008), but whereas yet detailed research or quantification of these flows has not yet been undertaken.

The view that malnutrition results mainly from insufficient supplies of the macronutrients energy and proteins, appears to have underestimated real problems with deficiencies of critical micronutrients, problems now collectively referred to as “hidden hunger”. Iron and vitamin A and iodine deficiencies are the three micronutrient deficiencies of greatest public health significant especially in the developing world (F.A.O, 2003). Deficiencies of micronutrients like Vitamin A, iron, zinc and iodine are extremely common within urban sub-Saharan populations (Tenkouano, 2011).

The choice of crops for production in urban areas is primarily determined by whether food is being produced for household consumption, or subsistence, or for the market sale. The decision
to undertake urban agriculture is also influenced by location, resource availability, growth conditions, and market value (Cofie, 2009). Various studies indicate that a variety of vegetables are favored by urban farmers, although fruits, herbs, and other food crops are also cultivated. In Lagos and Ibadan, many farmers cultivate lettuce, cabbage, and carrots, which have very high values because of the high demand by expatriates. Similar trends exist in Dakar and Banjul, where 60% and 80% of vegetables, respectively, are supplied through urban agriculture. In addition, vegetables and fruits from urban agriculture are important commodities of export in some cities, such as Lome (Cofie, 2009).

The food needs of African cities will increase as the pace of urbanization and urban growth accelerates over the next several decades. In addition, the overall cost of supplying, distributing, and accessing food will rise as urban nutritional needs become more complex and diverse and as cities depend on food transported from distant areas, especially imported food (Argenti, 2000). These concerns raise critical questions about whether urban food systems in African cities will be able to provide adequate food supplies at affordable prices for all urban residents, especially the poor. They also raise questions about whether urban agriculture will be able to serve regional and global markets in the long term.

World-wide, Urban and Peri-Urban Agriculture (UPA) involves some 800 million people (Midmore & Jansen, 2003) and generates significant livelihood opportunities, for urban and peri-urban farmers and also for traders, input suppliers and other service providers along the value chain for domestic produce (Scott et al., 2004). According to UNDP (2002), urban agriculture is helping people with food, especially in developing countries. Peri-urban commercial cultivation is a growing food supply enterprise of high-value crops, including tomatoes, onions, green vegetables and fruit, for a number of African cities. By practicing a
diversified form of urban agriculture, poor urban workers are able to meet some of their nutritional requirements, especially those for minerals and vitamins, through the consumption of some of their produce (FAO, 2004).

1.3 URBAN AGRICULTURE IN NAIROBI

Report by the World Bank (2003) indicates that 25% of the population in Nairobi is employed in urban and peri-urban agriculture. Urban agriculture is one of the main activities used by residents to eradicate poverty and sustain themselves. Kenya’s leading development challenges today include alleviation of poverty and environmental management in the context of rapid population growth and urbanization. Kenya’s population was 28.6 million people in 1999 and is expected to reach 43 million in the year 2020. According to the government statistics, the national level of absolute poverty increased from 46.3% in 1997 to 48.5 percent in 2005 (GOK 2010).

Urban agriculture is practiced in many cities and metropolitan centers of the world. The practice involves gardening in high-density areas or unplanned settlements, and is mostly subsistence oriented and a clear survival strategy for the poorer households (Mougeot, 2005) estimated that about 35,000 farming households in Nairobi depend on peri-urban fruit and vegetable production for their income. Majority of the farmers are women, most of who are household heads. For many of these women who lack the presence of an adult man in the house and who have children to feed, farming is something of a last resort. Many of these women are also of relatively low level of education in comparison with the men. Almost one-quarter of the household heads the low-income farming households have been found to have up to secondary school education (Mougeot, 2005).
There are four major farming systems that can be distinguished in peri-urban areas. The first is the small-scale subsistence crop cultivation, which is the dominant system. The second is the small-scale livestock production, often combined with the first system. The third is the small-scale market-oriented crop production. Finally the fourth is the large-scale commercial farming (Foeken and Mwangi, 2000).

For urban agriculture in Nairobi all the four types of agriculture are practiced are. Large scale commercial farming is practiced in South-Western part of the city (Karen, Langata). In these areas, people own large pieces of land, on which they set up homes and plenty of land is left to practice commercial farming. This urban agriculture in the city is therefore not for the lower, but for the higher socio-economic category of the population, and they grow mainly high value crops and even keep dairy cattle. Some of the land parcels are the remains from the colonial period, characterized by irrigated vegetable fields, battery cage system of keeping layers and zero grazing dairy cattle (Mwangi and Foeken, 2002). Urban agriculture is practiced by low income farmers of Mwiki Kasarani, where small ruminants are kept like rabbits, poultry which provides the households with eggs, and meat. Dairy goats and daily cows are kept the farmers and these provide the farmers with milk and manure whereby milk is consumed and sold and manure is used for farming and some farmers sell the manure to farmers producing vegetables and crops like maize and beans. They also grow vegetables such as kales, spinach, amaranth and cow peas which are consumed in the household (Nkirigacha et al., 2015). In the low income areas urban farming is mainly done for food and nutrition security.

1.4 IMPORTANCE OF URBAN AGRICULTURE

Agriculture is a part of diverse livelihoods and provides a significant contribution to income (Prain and Lee-Smith 2010). Selling is quite common among the “subsistence” crop cultivators. Sales are important to meet other basic needs besides food, such as staple foods, cooking oil,
paraffin, medical services and school fees (Foeken and Mwangi, 2000). Urban and peri-urban agriculture (UPA) is undertaken for three reasons: cash (mainly vegetables and livestock); food subsistence (including savings on food expenditure); and as a survival or risk buffering strategy (Armar-Klemesu and Maxwell, 2000; Nugent, 2001). It can also act as an income generating activity as farmers produce for markets or sell surplus, which contributes to a household’s income security (Cohen & Garrett, 2010; Mougeot, 2005). Urban and Peri-urban Agriculture (UPA) is used as a strategy by many urban dwellers to improve their livelihoods and overall well-being (Magnusson et al., 2014). It improves a household’s access to food during times of shortage, instability or uncertainty (Bush, 2010; Zezza & Tasciotti, 2010). It contributes to improved health among the urban population by providing highly nutritious and fresh foods (Zezza & Tasciotti, 2010).

Increased food production and access are crucial to achieving major nutritional improvement. More foods should be produced that are rich in all the essential micronutrients, available in sufficient quantities and accessible to people all year round. Access to stable and sustainable food supplies is a precondition for the establishment of food security at the household level. Greater and more sustained yields from the farming system increase the potential access of the household to an adequate diet (FAO, 2007).

1.5 GLOBAL NUTRITION

Lactating mothers from low-income settings are nutritionally vulnerable to food and nutrition security globally. Mothers is subjected to nutritional stresses during the time they are nursing their infants. This affects mothers in such away that they are not able to meet the recommended dietary intake which is increased during lactation. Diet diversification for lactating mothers in such households globally is a challenge. Meeting the dietary requirements
of lactating mothers in micronutrients especially vitamin A, iron and zinc during lactation is yet another challenge. Malnutrition affecting such women is likely to not only affect lactating mothers but also affect their infants. In addition, socio-cultural status, poverty and lack of education are some of the factors that lactating mothers from low-socio-economic backgrounds globally (Tigray Regional Health Bureau, 2012).

Global nutrition aims to in-cooperate political, economic, cultural and social wings in achieving nutritional status of the population by having improved food and nutritional security (FAO, 2011). Nutrition is one of the critical drivers for economic growth and poverty reduction, making it a key component of promoting international stability and security, building human and economic capacity through improved learning and productivity and contributing to robust workforce (Black, 2006).

Malnutrition in all its forms continues to hamper the lives and opportunities of millions of people worldwide. An estimated 805 million people worldwide are chronically undernourished (FAO, IFAD and WFP, 2014), 161 million under 5 children are stunted (WHO, UNICEF, World Bank, 2013), while 42 million are overweight and obese (WHO, 2014).

Improvements in nutrition contribute significantly to reducing poverty, and to achieving health, education, and employment goals (IFPRI, 2014). Many countries have made significant progress towards reducing hunger and malnutrition, but much remains to be done to achieve global and national nutrition targets. Achieving the goal of optimal nutrition encompasses the prevention, control and treatment of under nutrition, micronutrient malnutrition and overweight and obesity, promoting optimal care and feeding practices (e.g. exclusive breastfeeding) and dietary diversity, and addressing food safety and quality, and ensuring access to and use of health services and a safe, hygienic environment. The co-occurrence of under nutrition,
micronutrient malnutrition and obesity and overweight poses challenges and underscores the reality that malnutrition is a global phenomenon, affecting virtually all countries (IFPRI, 2014).

The concentration of some micronutrients (vitamin A, iodine, iron, zinc, thiamin, riboflavin, pyridoxine, and cobalamin) in breast milk is dependent on maternal status and intake, so the risk of infant depletion is increased by maternal deficiency (Bhutta et al., 2008).

1.5.1 Nutrition of the Lactating Mother

Adequate nutritional of lactating mothers is important for good health and increased work capacity of themselves as well as the health of their offspring. The benefits of breastfeeding to mothers and infants are well established and the quantity of milk depends very much on the mother's diet.

Exclusive breastfeeding is the consumption of no other food or liquids except breast milk and small amounts of medicines or vitamin-mineral supplements for at least 4 and if possible the first 6 months of life (Brown, 2007). Infants should receive breastmilk exclusively from birth to 6 months after which they are introduced to nutritionally adequate and safe complementary foods while breastfeeding continues up to two years of age and beyond (PAHO/WHO, 2005). This saves one in five children (Bhutta et al., 2008). Even with optimum breastfeeding children will become stunted if they do not receive an adequate quantity and quality of complementary foods after 6 months of age (Black et al., 2008). With improved nutritional status, the risk of child mortality is reduced and development is enhanced (KDHS 2015). Prolonged breastfeeding can be detrimental by increasing the risk of micronutrient deficiency as human milk has low concentrations of iron and zinc (Wintergerst, 2007).
The main purpose of introducing complementary foods is to provide needed nutrients that are no longer supplied adequately by breast milk or formula alone. The foods chosen must be those that the infant is developmentally capable of handling both physically and metabolically. The exact timing of introduction of complementary food depends on the individual infant’s needs and developmental readiness, varying from infant to infant because of differences in growth rates, activities, and environmental condition (Whitney and Rolfes, 2013). In developing countries, early or inappropriate complementary feeding displaces breast milk and may lead to malnutrition and poor growth, resulting in stunting or wasting in childhood (Wintergerst, 2007).

Delaying the introduction of complementary food beyond the age of 26 weeks is associated with the risk of nutritional insufficiency, particularly in low-income populations, and such delays may be associated with an increased risk for disorders connected with the immune system (Przyrembel, 2012).

1.5.2 Nutrition deficiencies on lactating mothers particularly vitamin A, iron and zinc

Nutrientional needs during lactation depends on the nutritional status of the mother during pregnancy period. When the lactating mother carries out exclusive breastfeeding their energy demand exceeds that of a pregnant woman by approximately 640kcal/day. If mothers do not receive recommended dietary allowances during lactation they are likely to suffer macro and micro-nutrients deficiencies. Daily outputs of energy, vitamin A, iron and zinc in milk tend to exceed the recommended increments (Sheri et al., 2004).

Vitamin A reserves vary greatly among women and may be precariously low in women whose habitual intake of vitamin A is marginal. When a lactating mother has small stores of vitamin A in the diet, the loss of vitamin A in milk could theoretically deplete vitamin A stores within a few months (Sheri et al., 2004).
Iron deficiency is the most common nutritional disorder in lactating mothers the world over. Iron is present in all cells in the human body and has several vital functions, such as carrying oxygen to the tissues from the lungs as a key component of the haemoglobin protein, acting as a transport medium for electrons within the cells in the form of cytochromes, facilitating oxygen use and storage in the muscles as a component of myoglobin and as an integral part of enzyme reactions in various tissues. Too little iron can interfere with these vital functions and lead to morbidity and death. Iron deficiency in the diets of lactating mothers can be brought about by lack of consumption foods rich in iron or rather by lack of foods rich in vitamin C which facilitates iron absorption in the body. Iron deficiency remains one of the most common nutritional deficiencies especially in women of reproductive age whose diets are lacking in foods rich in iron. Dark green leafy vegetables are good sources of iron. Iron from non-heme sources is more readily if consumed with foods that contain either heme-bound iron or vitamin C. Adequate consumption of iron by lactating mothers from the age of 19 years and above should be 18.0mg/day (NHANES 2001-2014).

There is no accepted indicator to use for evaluating the adequacy of zinc intakes during lactation and this may lead to a deficiency of the same during lactation. The RDA increment for zinc during lactation is 4 to 13 times higher than the estimated zinc secretion in milk to allow for poor absorption of dietary zinc (estimated at 20% for unpregnant, nonlactating adults). Maternal zinc status may be jeopardized by by low intakes lower than the RDA (Sheri et al., 2004).

1.5.3 Vitamin A Deficiency

Vitamin A is transferred from mother to offspring trough the mammary gland (breast milk) during lactation. In human milk it is uniquely well-absorbed, in part because of a lipase present in milk that helps the infant digest vitamin A. Adequate transfer of vitamin A is essential.
Human lactation is well-adapted to protecting the vulnerable neonate from vitamin A deficiency. The colostrum is particularly rich in vitamin A (containing approximately 7 umol/L) and thus provides an excellent dietary source of the vitamin during the infant’s first days of life. Mature milk on the other hand of well-nourished women contains around 2.3 umol/L vitamin A, ample to meet the infant’s metabolic requirement and to accumulate safe and adequate stores of the vitamin (Mara, 2002).

It is clear that the vitamin A content of human milk is dependent on the mother’s own vitamin A status. Vitamin A deficiency in mature human milk typically contains around 1 umol/L vitamin A. The observed means range from 0.4 to1.8 umol/L. These lower levels are a direct result of maternal vitamin A deficiency, and breast milk vitamin A only increases if the mother’s vitamin A status is improved. This can be done in both supplementation and food fortification supply. Maternal vitamin A deficiency during lactation rapidly disposes the infant to severe vitamin A deficiency. Lactating mothers dietary intake rich in vitamin A helps to protect the infant against vitamin A deficiency in the first days of life. Colostrum is particularly rich in vitamin A, containing approximately 7µmol/l. However if lactating mother’s vitamin A stores are poor due to consumption of diets poor in vitamin A then the infant is likely to suffer subclinical vitamin A deficiencies (Sheri et al., 2004).

Vitamin A deficiency in lactating mothers can cause night blindness, xerophthalmia, bitot’s spot, keratomalacia, dermatitis, severe anemia, wasting, reproductive and infectious morbidity and increased risk of mortality.

Breastfed infants are largely protected from xerophthalmia, improving vitamin A stores during infancy will help to protect children from xerophthalmia during weaning. It also increases the children iron status and growth (Sheri et al., 2004).
1.5.4 Iron Deficiency

The most common micronutrient deficiency worldwide is iron which is the most important cause of nutritional anemia; it leads to impairment of health, growth, development, and performance (Sheri et al., 2004). Iron serves as a cofactor to enzymes involved in oxidation-reduction reactions that occur in all cells. Enzymes involved in making amino acids, collagen, hormones, and neurotransmitters all require iron (Whitney and Rolfes, 2016). Iron is especially required by women of reproductive age, pregnant, lactating and young children who are vulnerable to iron deficiency anemia, iron deficiency leads also to impaired mental and motor development, inflammation of the oral mucus or, increased susceptibility to infections, increased lactic acid production in muscles, muscle cramping, poorly formed nails. Vulnerable groups to iron deficiency include women at child bearing age, infants, children below five years, pregnant and lactating women. The daily requirement for women of reproductive age range between 15-18mg/100g/day and children 7-15mg/day (National academic press, 2001). Prolonged breastfeeding can also be detrimental by increasing the risk of micronutrient deficiency as human milk has low concentrations of iron and zinc (NHANES 2001-2014).

The most important tool used currently to combat iron deficiency is iron supplementation. However, a high intake of iron, especially as a supplement, was shown to be an antagonist to zinc absorption (Wintergerst, 2007).

1.5.5 Zinc Deficiency

There is currently very little information on the extent of the consequences of zinc deficiency. Assessment of an individual’s zinc status is difficult because plasma zinc concentrations do not sufficiently reflect individual zinc status due to strong homeostasis (Wintergerst, 2007). Zinc requirements vary during the life cycle, and peak needs coincide with infantile and adolescent growth spurts, pregnancy and lactation (King, 2002). The requirements for zinc during lactation are quantitatively greater than those during pregnancy, especially during the early weeks.
postpartum ((King, 2002). Zinc concentrations are quite high soon after birth but over the early weeks post-partum normally decline precipitously (Wintergerst, 2007). During lactation there is an increased maternal loss of zinc that is secreted into human milk (Wintergerst, 2007). The concentration of zinc in human milk is highest in colostrum and progressively declines with the duration of lactation.

Zinc is necessary for a wide range of immunological, biochemical and clinical functions and its present in all body tissues and fluids (Hanif et al., 2006). These biochemical functions of zinc are responsible for its unique role for growth and development. Zinc also plays a role in vitamin A and β-carotene metabolism.

Zinc deficiency manifests itself in several ways which include an increased incidence and severity of infection and impaired growth and development of children to pregnancy complications, low birth weight, and increased prenatal mortality, delayed sexual development and late puberty, impaired testicular and ovarian function, poor sperm production and disordered ovulation, impaired enzyme function and neurotransmitter and weakened immune system among others (Rolfers and Whitney, 2016).

In infants, improved growth performance after zinc supplementation is the most accurate measure of preexisting zinc deficiency but, on a population level, plasma zinc is still the most practical and reliable indicator of zinc status (Hanif et al., 2006).

1.6 METHODS OF ASSESSMENT OF NUTRITION OF LACTATING MOTHERS

Lactating women in low-income setting often consume inadequate amount of micronutrients because of resource limitations. They have a limited intake of plant and animal source foods, fruits and vegetables. Low intake of micronutrients especially vitamin A, iron and zinc less
than the recommended values increase lactating mothers risk of micronutrient deficiencies. Information on nutritional status, factors of lactating and feeding practices are urgently needed for designing, prioritizing and initiating nutritional programmes aimed to improve maternal nutrition (Black et al., 2008).

Micronutrient deficiencies are more likely to affect breast milk composition, and the development and nutritional status of the infant (Alien, 1994). Lack of diet diversity and a high prevalence of infection in many developing countries can contribute to inadequate micronutrient status (Adelman et al, 2008). With improved nutritional status, the risk of child mortality is reduced and development is enhanced (KDHS 2015).

Lactating mothers from low-income settings are considered a nutritionally vulnerable group. Due to the nursing process mothers are subjected to nutritional stresses. Frequent pregnancies followed by lactation increase the health risk of mothers resulting in a high maternal mortality (Shabert, 2004).

Nutritional assessment is done by collecting, integrating, and analyzing nutrition-related data. This includes cultural, religious and ethnic food preferences, age related nutrition issues and the need for diet counseling. The dietitian evaluates patient’s nutritional status and the extent of any malnutrition. Data gathered provides the objective basis for recommendations and evaluation of care (Black et al., 2008).

The purpose of nutritional assessment is to estimate functional status, diet intake and body composition compared to normal populations. Body composition reflects calorie and protein needs. Baseline body composition and biochemical markers determine if nutrition support is effective from the results obtained (Sharbaugh et al., 2005).
The general reasons for assessing nutritional status, as well as the tools for doing so, and their suitability for application to lactating women should provide indicators of risk of undesirable outcomes for the lactating mothers. The nutritional assessment can be done through screening height, weight, unintentional weight loss, change in appetite and serum albumin. Nutrition care indicators include, nutritional, history, Feeding modality, Unintentional Weight Loss, Serum Albumin, Diagnosis (Bokeloh, 2008).

Diet assessment evaluates what and how much persons are eating, as well as habits, beliefs and social conditions that may put person at risk. This can be done through determining usual intake that includes (24 hour recall, Food log and food frequency questionnaire to give general idea of how often foods are consumed) and compare to estimation of needs (Black, 2004).

1.6.1 24 Hour recall
A 24hour recall is a retrospective method and is preferably administered by a dietician or a trained interviewer. It requires the respondents to recall all the food and drinks that he/she consumed in the previous 24 hours. Its accuracy is dependent on the respondents’ memory and over all reliability, as well as the respondents’ ability to estimate and describe portion sizes. The respondent is expected to remember what they ate in relation to time such as morning (when they woke-up), lunch time (when they broke from work) and evening (when they arrived home from work). The portion sizes are used in connection to the household measures such as plates, cups, spoons, and/or food photographs or food models. The interviewer is expected to record all the information that is provided by the respondents. For accuracy the interviewer should request the respondent to verify all the information recorded to ascertain that what is recorded is true. Any errors and omissions are corrected (Steyn and Senekal, 2004). While using 24hour dietary recall there are various strengths and weaknesses of the tool. The strengths
include and are not limited to; low respondents burden; suitable for large scale surveys; can be used with illiterate populations; the person’s usual diet is not affected. The weakness of the tool includes and not limited to; the portion sizes are estimates; it is memory –dependent; does not capture day-to-day variations; possible bias in reporting and analysis are based on estimates obtained.

Dietary diversity measures the number of food groups consumed over a reference period, usually 24 hours. Generally, there are six food groups that the body needs to have every day that should be consumed at different proportions. The body requires higher quantities of consumption of carbohydrate source foods and only small amounts of fats and sugars. Consuming any examples of the food type from each of the six groups in 24 hours, it can be said that their dietary diversity score is six. This score is an indicator, if food consumption is adequate, of both the balance of nutrient consumption and the level of food security (or insecurity) in the household. A high dietary diversity score in a family, shows how more diversified and balanced the diet is and the more food-secure the household (Kennedy et al., 2011).

Food consumption varies widely between countries and among different cultures. As shown by the FAO and others, average caloric intake in least developed, and industrialized countries varies widely – 2,120, 2,640, and 3,430 kcal per person per day, respectively (FAO, 2011). However, in many communities in the developing world, the average intake is far lower than 2,120 kcal per person, resulting in systemic hunger and undernourishment. The health effects of chronic undernourishment are severe, especially for children, and include slowed growth, underweight, susceptibility to disease and shortened life expectancy. Populations in South Asia and Sub-Saharan Africa remain especially vulnerable to undernourishment.
Food consumption patterns are changed by the way people interact in the world caused by globalization which enable individuals and communities to get new ideas of food and change current ones.

1.6.2 Food Frequency Questionnaire (FFQS)

Food frequency questionnaires provide information that establishes usual dietary intake. At its simplest, a food frequency questionnaire consists of a list of foods and a selection of options relating to the frequency of consumption of each of the foods listed (eg. No of times per day, daily, weekly, monthly, after three months). They are designed to collect information from a large number of people (>100) and are normally self-administered, although it is important that an interviewer carry them out. This can be done either by one on one with the respondent or by phone interviews (Haraldsdottir et al, 2001). The list of foods in the questionnaires varies depending on what is being investigated. If it is a wide range of nutrients and energy values are required then a list of upto a 150 foods may be added, but if its only specific food (fruits and vegetables) or nutrients (iron, zinc and vitamin A) is required the list may contain only 11 foods (Steyn and Senekal, 2004). To calculate the nutrient intake, the reported frequency of each food is multiplied by the amount of the nutrient in a specified serving for that food. This gives dietary constituents. An estimate can be made of the amount of particular foods or of food groups if they are required (Thompson and Subar, 2001). The food frequencies questionnaires are many, and one needs to be careful when selecting the one to use so that it suites their specific clients. It should be specific to the culture, ethnic group, food brands and food preparation practices of the population being surveyed. The questionnaire should be compatible with the database that will be used for analysis (South African Medical Research Council, 2001). The FFQs have their strengths and weaknesses. The strengths include and not limited to; low respondent burden; suitable for large surveys; can be self-administered or posted inexpensive and can be used to assess association between dietary intake and disease. The weaknesses
include and not limited to; difficulty in obtaining accurate reports for foods eaten both as single items in mixtures; can take up to 60 minutes to complete; potential of misreporting; potential for inaccurate estimation of portion sizes; requires validation.

1.6.3 Body Mass Index (BMI)

BMI is usually defined as weight in kilograms divided by the square of the height in metres (kg/m$^2$). Usually calculated as Weight in kg/ (height in metres)$^2$ is also used as measure of adult nutritional status. BMI is usually categorized into underweight, normal, overweight and associations between nutrition status and intake are made. Nutritional status percentage of adults with Body mass Index (BMI) <18.5 is an indicator of nutrition insecurity. They also have low-weight for-height (underweight) and adults suffer from thinness as a result of inadequate energy intake and/or severe illness (Kennedy et al., 2011). A BMI assessment is a reliable indicator of total body fat. BMI has been directly linked to health risks and mortality in many populations. WHO has developed BMI classification aimed for international use. BMI is used to assess the weight of lactating mothers and can form the basis for designing intervention strategies. Differences in ethnic groups exist when determining BMI. For instance evidence suggests that for some Asian populations a BMI of >23 is equivalent in terms of health risks to BMIs >25 and >27 in people of European and African decent respectively (WHO, Expert Consultation, 2004). Although BMI is used to assess nutritional status it has some weaknesses such as; it tends to overestimate body fat in muscular individuals and underestimate body fat in people with decreased body muscle mass, such as the elderly and people who are severely undernourished (WHO, 2004).

Severe energy restriction may hinder milk production. This means that lactating mothers must be able to meet their energy requirement to cater for that used during milk production.
1.7 METHODS OF NUTRITIONAL INTERVENTION IN MOTHERS

Viable interventions /strategies to improve the diets of lactating mothers to avoid micronutrients deficiencies such as vitamin A, iron and zinc will include and not limited to; Fortification, Supplementation, Diet diversification and Nutrition education.

1.7.1 Food Supplementation

According to Food and Drug Administration a dietary supplement is a product intended for ingestion that contains a “dietary ingredient” intended to add further nutritional value to supplement the diet. A “dietary ingredient” may be one, or any combination, of the following substances; a vitamin, a mineral, an herb or other botanical, an amino acid, a dietary substance for use by people to supplement the diet by increasing to total dietary intake or a concentrate, metabolite, constituent or extract.

Dietary supplements may be found in many forms such as tablets, capsules, soft gels, gel caps, liquids or powders. Some dietary supplements can help ensure that you get an adequate dietary intake of essential nutrients. Others may help reduce your risk of disease as per Food and Drug Administration (Food and Drug Administration, 1996).

Many people are advised to consume foods which are rich in certain nutrients but due to lack of availability and poverty, they are not able to especially in developing countries. Supplementation remains one of the many possible intervention and strategy to curb micronutrients deficiencies. Lactating mothers are advised to consume foods that are rich in micronutrients but supplementation remains a working strategy to avoid deficiencies in micronutrients such as vitamin A, iron and zinc among others (Dietrich et al., 2004).
Nutrients supplementation is also important for pregnancy and lactating mothers whose nutritional needs are increased so as to support the fetal and infants growth and development. It also helps to enhance maternal tissue growth and metabolism. The heightened nutrient need during lactation is very unlikely to be met by use of maternal diets from natural food sources therefore supplementation becomes a necessity. Nutrient deficiencies are often predicated during reproduction therefore giving lactating mothers supplements such as vitamin A, iron and zinc among others (Dietrich et al., 2005).

Iron supplement in lactation and pregnancy is necessary to meet nutritional demands of the mother during this period (Institute of medicine, 2001). Total iron cost of pregnancy is usually 1040 in estimation, of which 200mg are retained by the woman when blood volume decrease after delivery and 840mg are permanently lost. Iron is necessary in this period for the foetus and it’s also used for the formation of the placenta, expansion of red cells mass and blood loss during delivery. Maternal anemia is associated with prenatal maternal and infant mortality and premature delivery. It is therefore recommended that iron intake during pregnancy increase by 9mg to a total of 27mg/d (12). To obtain this level from food is a natural challenge. Supplementation is needed to achieve recommended intakes (Black et al., 2008).

Vitamin A supplementation among lactating mothers is most important because it helps to curb VAD among the population group (Black et al., 2008).

Most trials have found that vitamin A supplementation help to reduce mortality rate (Semba et al., 2010). Where is vitamin A supplementation lactating mothers have shown an increase in vitamin A the milk, it also provides additional vitamin A to the breast-fed infant (WHO, 2010). Supplementation of lactating mothers with vitamin A for the first month postpartum is currently
recommended by World Health Organization as part of vitamin A capsule distribution programme (WHO, 2010).

Trials done in South Asia on neonates and pregnant women found a significant reduction in mortality (21%) in the first six months of neonates after supplementation with vitamin A and a 40% reduction in maternal mortality (Bhutta et al., 2008). A study conducted in India found that women of child bearing age suffered from night blindness, with 5% pregnant women manifesting vitamin A deficiency (Schmitz, 2012). This goal though in India was found to be thwarted by coverage and logistical complications (Bhutta et al., 2008).

In Pakistan lactating and pregnant mothers were found to suffer from low serum retinol concentration and night blindness in the area of Karach. The visual symptoms were locally named ‘Shafkour’ and ‘Chhaya’ meaning shadow and inability to see at night with vitamin A supplementation all these symptoms disappeared (Siddiq et al., 2008).

1.7.2 Food Fortification

According to US Food and Drug Administration food fortification is the process of adding vitamins and nutrients to food and drinks. The term food fortification is often used to describe one or two main processes. The first process, also referred to as food enrichment, is the adding back of nutrients to food and drinks that have been removed during processing. The second process is the addition of nutrients to foods that are either not naturally occurring in the food or are added at a higher concentration than what is naturally occurring (food and Drug Administration, 1996).

Fortification involves a program where commonly eaten foods are identified and used as vehicles for micronutrients. The commonly used foods are wheat flour, maize flours, sugars and salt among others. These foods serve as diets for most vulnerable population which include
pregnant, lactating mothers, infants and school going children and the elderly. This makes fortification one of the best intervention programs to curb micronutrients deficiencies in communities especially the poor populations (Amstrong, 2004).

Fortified foods can serve as a solution to the diets of lactating mothers and other vulnerable groups in the developing countries. These fortified foods can be provided through public feeding programs and foods which are marketed commercially and are likely to provide a positive impacts to the populations in question (Rivera et al., 2004). Fortified foods which are industrially produced are acceptable for intervention diets for the pregnant, lactating mothers and other groups world-wide. Pediatricians have also endorsed use of fortified foods for feeding the young infants since they are nutritionally sound and can meet the nutritional demands of infants (Rivera, 2004).

Cereals are seen as suitable vehicles for food fortification. Wheat and maize meal flours are known to be the best vehicles for fortification because they are staple foods in many parts of the world. These two also exist as the main ingredients in many food preparations in many parts of the world. Micronutrients deficiencies can be curbed using commonly consumed cereal flours fortified with vitamin A, iron, zinc and other vitamins and minerals (Black et al., 2003).

Folic acid has been successfully used to fortify cereal flours and it has had a remarkable impact on reducing women’s risk of having babies born with spina bifida or anencephaly (Wintergest, 2005). Food fortification is a suitable strategy used to increase blood folate levels at the critical period of pregnancy especially in the first weeks before women recognize that they are pregnant and start taking supplements. In the US for instance grain with folic acid fortification started way back in 1996. A survey done by the National Health and Nutritional Examination
on disease control and prevention realized that the average level of folic acid in the blood of US women of child bearing age had tripled in five years (Rivera, 2004).

Food fortification is not very expensive and therefore it is the best intervention strategy to curb micronutrients deficiencies in populations in developing countries. In South Africa and Nigeria wheat flour and maize flour fortification has been made mandatory (Mara, 2002). Fortification of milk and breakfast cereals with vitamin A, has been practiced in developing countries, while sugar has been used as a fortification vehicle for vitamins and minerals in the developed countries. Salt has been used to fortify salt to curb thyroid swelling (goiter) (Mara, 2002).

1.7.3 Food Production and Diet Diversification

Increased food production and access are crucial to achieving major nutritional improvement. More foods should be produced that are rich in all the essential micronutrients, available in sufficient quantities and accessible to people all year round. Access to stable and sustainable food supplies is a precondition for the establishment of food security at the household level. Greater and more sustained yields from the farming system increase the potential access of the household to an adequate diet (FAO, 2007).

World-wide, Urban and Peri-urban Agriculture (UPA) involves some 800 million people (Midmore & Jansen, 2003) and generates significant livelihood opportunities, for urban and peri-urban farmers and also for traders, input suppliers and other service providers along the value chain for domestic produce (Scott et al., 2004). According to UNDP (2000), urban agriculture is helping people with food, especially in developing countries. Peri-urban commercial cultivation is a growing food supply enterprise of high-value crops, including tomatoes, onions, green vegetables and fruits, for a number of African cities. By practicing a diversified form of urban agriculture, poor urban workers are able to meet some of their
nutritional requirements, especially those for minerals and vitamins, through the consumption of some of their produce (FAO, 2007).

Diet diversification has shown to be the most viable intervention in improving the diets of lactating mothers in developing countries (Tigray et al., 2009). This can and is done by encouraging lactating mothers to grow crops such as fruits and vegetables and keeping of small ruminants such as rabbits, poultry, and dairy goats which can be kept using minimal space especially urban areas. In Pakistan for instance studies have shown that home gardening as a food-based strategy reflected promising results (Faber and Laurie, 2011). Home gardening in South Africa revealed an efficacy of the approach by enabling significant control of vitamin A deficiency in the affected population (Faber and Laurie, 2011).

Consumption of variety of diets can help combat micronutrients deficiency. A study done in Pakistan showed that kitchen gardening helped to provide dietary diversity and control vitamin A deficiency. A campaign was launched to promote kitchen gardening in Pakistan so as to improve dietary diversity and combat micronutrients deficiency. Residents in Punjab are provided with seasonal vegetable seeds at subsidized costs on demand so that they get encouraged to participate in the growing and maintain the same thereafter. Promotion of keeping of animals and growing of crops helps to promote food security in the populations. Rearing of animals like poultry, dairy cows, rabbits and fish are some of the viable strategies to curb micronutrients’ deficiencies. Plant source of for instance vitamin A include, β-carotene (pro-vitamin) mainly derived from fruits and vegetables with relatively low bioavailability compared to retinol.
Direct indicators of food consumption in populations include food expenditure (household budget and consumption surveys), household perception of food security, and the food frequency assessments. Indirect indicators include assessment of nutritional status. Nutritional status does not always correlate with directly with food availability and access because nutritional status is a result of factors beyond food consumption (Black et al., 2003).

Nutrition education plays a big role in diet diversification since it leads to increase of knowledge and consumption of the grown foods (Kapil and Tyagi, 2011). In low income populations though it is advisable that fruits and vegetables are used as an intervention to combat micronutrients deficiencies in lactating mothers households (WHO, 2013) Educated mothers for instance are able to detect signs of micronutrients deficiencies at their early stages and this enables them to control diseases early. Knowledge on the benefits of consuming leafy green vegetables and animal products to curb micronutrients deficiencies will enable lactating mothers be safe from these incidences. Lactating mothers with primary and above education level are able to understand why children or they should be supplemented with micronutrients and also help in controlling communicable diseases to their children much better than women with low education (Khan et al, 2009, Paracha et al., 2000).

Nutrition education also helps in that lactating mothers can be educated on the environmental issues that bring about food borne illnesses in the developing countries such as high humidity and temperatures. Use of safe water, proper hygiene and food safety when cooking food is an important aspect to avoid diarrhea and typhoid. Mold and yeast proliferation in stored foods due to high humidity and high temperatures bring about food safety issues (Akhtar et al., 2008, Akhtar et al., 2012). Nutrition education will enable lactating mothers get to understand the need for them to take their children and themselves for immunization against diseases such as
diphtheria, tetanus, cholera and typhoid which when they attack can cause micronutrients deficiencies (Bethony et al., 2006).

1.8 PROBLEM STATEMENT

Micronutrient deficiencies are still a major health problem in most developing countries with infants, pregnant and lactating women especially at risk. The deficiencies of vitamin A, iron, and zinc often coexist and have independent and interacting effects on health, growth, and immune competence.

Fulfilling nutritional requirements in the diets of lactating mothers below six months postpartum is a problem in developing countries (WHO 2008; UNICEF 2009). Inadequate micronutrient status is brought about by lack of diet diversity and a high prevalence of infection in many developing countries (Adelman et al., 2008). This is particularly a severe problem among poor populations in the developing world, where diets are based predominantly on starchy staples and often include few or no animal products and only seasonal fruits and vegetables (Arimond and Ruel 2004).

Lactating mothers in Mwanamukia which is a low-income area live in households where food security is a problem and they do not grow crops and keep small ruminant animals which can provide the mothers with protein and other foods rich in vitamin A, iron and zinc. These lactating mothers find it difficult to carry out exclusive breastfeeding for the first six months due to poor economic status and lack of food to eat after breastfeeding (Nkirigacha et al., 2016, GOK, 2012)

Lack of diversification by farmers in their farming practices to produce a variety of crops that could enhance better household food and nutrition security has probably led to poor nutrition in the households affecting lactating mothers. They therefore find it difficult to practice
exclusive breastfeeding for six months as recommended by World Health Organization (WHO 2008).

1.9 JUSTIFICATION OF THE STUDY

In lactating mothers Urban and Peri-urban Agriculture (UPA) helps in nutritional improvement and poverty eradication as well as reduction of sub-clinical Vitamin A deficiency which is prevalent throughout Kenya (Mara, 2002).

A pre-intervention study can be used to determine the quality of diets of lactating mothers especially in provision of micronutrients such as vitamin A, Iron and Zinc which are especially important for healthy growth and immune competence.

Adequate nutritional status of mothers is important for good health and increased work capacity of themselves as well as the health of their offspring. Breast milk continues to be an important source of vital nutrients, fluids and offers immunological protection (Black, 2008). The benefits of breastfeeding to mothers and infants are well established and the quantity of milk depends very much on the mother's diet. Micronutrients such as vitamin A, Iron and Zinc are especially important for healthy growth and immune competence (Kramerms and Kakuma 2004). There is therefore need to carry out agricultural food production interventions as one of the ways of improving the quality of diets of lactating mothers which translates to the quality of milk produced.

The contribution of urban Agriculture to food and nutritional security in households with lactating mothers has not yet been well studied in Kenya. Knowledge on crop and animal diversity, nutrition education, farming skills in the Mwanamukia area is scanty.
There is therefore need to assess the contribution of intervened urban agriculture by doing an intervention on households of lactating mothers by growing local vegetables such as amaranthus, cowpeas and black nightshade for improved food and nutrition security of lactating mothers in Mwanamukia area a peri-urban area of Nairobi metropolis. The results of the study will be useful in helping lactating mothers get enough food which will enable them to consume enough food to provide them with Iron, zinc and Vitamin A. lactating mothers will therefore have improved nutrition to enable them increase exclusive breast feeding. The results can be used by the ministry of public health and other stake holders to carry out interventions in lactating mothers households by growing vegetables in their kitchen gardens so as to improve their nutritional status and the their stability when carrying out care giving to their infants.

1.10 GENERAL OBJECTIVE

The overall objective of the study was therefore to assess the possible improvement of nutrition of lactating mothers of a peri-urban area, using traditional vegetables.

The specific objectives of the baseline study were:-

1. To identify the amount of food produced, consumed and the way the reminder is utilized.

2. To determine socio demographic and socio-economic characteristics, food consumption patterns, dietary intake and nutritional status of lactating mothers in Mwanamukia before intervention.

The specific objectives of the longitudinal intervention study were:-

1. To carry out vegetable growing intervention and analyze vegetables used in intervention study for nutrient contents and proximate composition.
2. To determine food consumption patterns, dietary intake and nutritional status of lactating mothers in the study area after intervention.

1.11 STUDY AREA

The study area was Kasarani area

![Map of Kenya showing Kasarani sub-county showing the study area](image)

Figure 1.1: Map of Kenya showing Kasarani sub-county showing the study area

1.11.1 Baseline Study Phase

The area of study was Mwanamukia sub-ward, Kasarani ward, Kasarani sub-county. The sub-county has four Wards namely, Kasarani ward, Githurai ward, Ruaraka ward and Roysambu ward. Kasarani ward has 3 sub-wards; Mwiki sub-ward, Clay city sub-ward and Mwanamukia sub-ward. Mwanamukia has two villages namely; Maji-Mazuri village and Gitueko village. Mwanamukia Area is approximately 9 square km². The area has a total population of 61,316 with 28,637 males and 32,679 female (G.O.K 2010). The area of study was selected purposively. With the help of the Assistant chief and headmen the researcher was able to choose villages from which she made a list of households with lactating mothers.

A cross sectional study targeting lactating mothers was done. The sampling unit was households. The Fischer’s formula (Fischer et al., 1991) was used to calculate the sample size.
The calculation yielded 236 households. After adding 10% Attrition (24 households) the total became 260 households. The activities going on these households were also noted. Sample size per village was drawn purposively for each village.

1.11.2 Longitudinal Intervention Phase

This was the second phase which had a sub sample of 53 respondents randomly selected from the 260 respondents who participated in the baseline study.

1.12 THESIS LAYOUT

Chapter One: General Introduction

General introduction describes the study background including the problem statement, justification of the study, objectives and a description of the study area.

This study was organized into two phases including a cross sectional baseline study, and a longitudinal intervention study as follows

Phase I: The baseline study

In January-August, interviewing of lactating mothers commenced. Structured and previously pretested questionnaires were administered. Data on the respondents’ socio-demographics and socio-economic was obtained.

This included age, marital status, education levels, monthly income, family size, occupation, number household members, heads of households, food production, and amount produced, consumed and sold for income generation.

The baseline survey was conducted on 260 lactating mothers 0-3 months postpartum with the aim of assessing crops grown, consumed and manner of utilizing the reminder and assessing their socio demographic and socio-economic characteristic and their food consumption patterns, dietary intake and nutritional status.
Chapter Two

This chapter determines the amount of food produced, consumed and manner of utilization of
the reminder by lactating mothers in Mwanamukia before intervention.

Chapter Three

In this chapter a pre-intervention study on socio demographic and socio-economic
characteristics, food consumption, dietary intake and nutritional status of lactating mothers in
Mwanamukia area, a peri-urban area of Nairobi metropolis is evaluated.

Phase II: Intervention study

Intervention study was conducted with sub sample of 53 respondents who were from the
baseline survey. The aim was to carry out an intervention on planting vegetables then to assess
the nutritional status, dietary intake and food consumption patterns of lactating mothers 3
months postpartum after intervention. The intervention was on planting dark green vegetables
which the respondents choose from the eight domesticated African traditional vegetables.
Three vegetables were planted in multistory, organoponics and open field according to lactating
mothers’ situation. These vegetables were amaranthus (A. dubius), black night shade
(Solaanum retriflexum) and cowpeas (Vigna unguiculata). There was also analysis of the
planted vegetables for nutrient content and proximate composition.

Chapter Four

In this chapter a post-intervention study on food consumption, dietary intake and nutritional
status of lactating mothers in Mwanamukia area, a peri-urban area of Nairobi metropolis is
evaluated.
Chapter Five

This chapter looks at proximate composition and micronutrient content of three vegetables used in the intervention on lactating mothers.

Chapter Six: General Discussion

This chapter discusses the main results that were found in all the other chapters.
CHAPTER TWO: FOODS PRODUCED AND UTILIZED BY LACTATING MOTHERS’ HOUSEHOLDS IN MWANAMUKIA PERI_URBAN OF NAIROBI

ABSTRACT

Food production and utilization using urban agriculture goes a long way in fulfilling the human right to food and freedom from hunger as advocated in the International agenda as far back as 1948 that “Everyone has the right to a standard of living adequate for the well-being and health of himself and his family; including food. Food production in lactating mothers household guarantees household food security for all populations. Adequate nutritional status of women is important for good health and increased work capacity of themselves as well as the health of their offspring. Lactating mothers and other vulnerable populations are the ones who suffer most from inequalities in food distribution. This is why household food production becomes the most viable solution especially in lactating mothers’ households. This improves greatly the equation of food availability and accessibility in lactating mothers households. The concept of adequate food is fulfilled by crop production in terms of quantitative terms (i.e caloric sufficiency) and qualitative in terms of (variety, safety and acceptability). Stability of lactating mothers constant food supply is sufficient income, production and transfers of adequate food supplies on continuing basis. Majority of people who cannot meet their nutritional needs live in urban areas especially in the slums. World’s resources are adequate to produce enough food for their populations in the higher-income developed countries. The scale of food production should never be underestimated especially in African urban cities. Conservative estimates suggest that 40% of the African cities are involved in urban agriculture. Studies show that urban farmers consume more vegetables than non-urban farmers. Local food production can be an important source of supply of fresh vegetables for urban populations. Food production can greatly improve access to food and dietary diversity thus improving the nutritional status of lactating mothers. The aim of this study was to assess the foods produced and proportion...
consumed by lactating mothers in a peri-urban area of Nairobi. This cross sectional study was conducted on 260 purposively selected lactating women living in Mwanamukia, Nairobi Kenya. A structured, validated and pre-tested questionnaire was used to obtain information on socioeconomic characteristics, food production and consumption. Data was entered into SPSS version 20 and analyzed using descriptive statistics and Pearson correlation coefficient was used to determine associations. Majority of the respondents (61.6%) were participating in urban agriculture. In crop production, maize (26.5%) and out of this all was for home consumption, beans (28.4%) were produced and home consumption was 18.4% and 10% was sold. Amaranth was produced at 25.7%, 8% consumed at home and 17.7% was sold other crops were grown in small quantities. In the study 57.3% of the respondents owned land to practice urban agriculture. Majority of them (15.3%) had 250m$^2$ plots and 26.3% of these had inherited the land they had. Where the respondents did not own the land, they were renting (7.8%). More women (31.8%) than men (21.6%) decided on what crops to plant. More women (35.7%) provided labor for agriculture. More respondents consumed and also sold (34.1%) the produce compared to those who consumed only (27.8%). Vegetables were not a major food crop produced. Intervention programs should target on emphasizing the production and consumption of vegetable to increase availability and help meet the increased nutritional needs of the lactating woman.
2.1 INTRODUCTION

Increased food production and access are crucial to achieving major nutritional improvement. More foods should be produced that are rich in all the essential micronutrients, available in sufficient quantities and accessible to people all year round. Access to stable and sustainable food supplies is a precondition for the establishment of food security at the household level (Moffat, 2002). Greater and more sustained yields from the farming system, increases the potential access of the household to an adequate diet (FAO, 2011).

Food insecurity in households of lactating mothers is known to lead to poor health, poor dietary intake and poor nutrition outcomes. This consequently leads to low rates of breastfeeding (Nyaruchua et al, 2006; Hackett et al; 2009). A study carried out in Bangladesh, observed that improved household’s food security during the antenatal period resulted in poor infant feeding practices from 3 to 6 months, including providing cow’s milk, juices and other drinks (Saha et al., 2009).

Food insecurity sometimes make lactating mothers leave their infants at home to go and look for temporary employment such as washing clothes, working on construction sites, working as house helps and seeking farm laborers jobs (Moffat 2002; Mamabolo et al., 2004; Cliford et al, 2006, Otoo et al., 2009). Food insecurity can also make lactating mothers develop psychosocial distress which can make them loose self-efficacy and thus compromise with values of exclusive breastfeeding. In countries where there is high prevalence of food insecurity such as Ethiopia (Hadley et al; 2009)) and Tanzania (Hadley and Patil, 2006) and even those with rich settings as the United States (Huddler, Casas et al; 2009); Lent et al., 2009) households food insecurity was associated with higher rates of maternal depression and stress. If a lactating mother suffer distress or depression this could be a significant predictor of reduced
breast feeding self-efficacy and this affects exclusive breastfeeding significantly (Galler et al., 2006; Dennis and McQueen 2009). Food insecurity and malnutrition are associated with the causes of psychological and physiological distress and this impairs breast milk let down in quantity and quality (Dewey 2001). When lactating mothers suffer malnutrition due to lack of macronutrients and micronutrients like vitamin A, iron and zinc their milk output is affected downwards (Ettyang et al., 2005).

The contribution of urban Agriculture to food and nutritional security in households with lactating mothers has not yet been well studied in Kenya. Knowledge on crop and animal diversity, nutrition education, farming skills in the Mwanamukia area is scanty. Lactating mothers nutritional improvement and poverty eradication has led to reduction of sub-clinical Vitamin A deficiency which is prevalent throughout Kenya (GOK / UNICEF, 2000 and GOK/UNICEF, 2002). From the results of the baseline survey farmers in Kasarani Sub-County, did not diversify their farming practices to produce a variety of crops that could enhance better household food and nutrition security (Nkirigacha et al., 2015). This has probably led to poor nutrition in the households affecting lactating mothers. They therefore find it difficult to practice exclusive breastfeeding for six months as recommended by World Health Organization (WHO 2008).

In urban areas the households most at risk of food insecurity and chronic malnutrition belong to the lowest-income groups which cannot afford to purchase adequate food. Many of these households comprise families of recent migrants who have failed to find regular employment (Gupta et al., 2006). Their income levels are often so low that they can afford to purchase only the cheapest and most basic foods, and since they cannot afford to rent housing they are forced to camp in makeshift shanty towns on the periphery of cities. Such families often cultivate tiny
plots of land within their household area and keep small livestock as a basic survival strategy (FAO, 2011).

World-wide, Urban and Peri-urban Agriculture (UPA) involves some 800 million people (Midmore & Jansen, 2003) and generates significant livelihood opportunities, for urban and peri-urban farmers and also for traders, input suppliers and other service providers along the value chain for domestic produce (Scott et al., 2004). According to UNDP (2000), urban agriculture is helping people with food, especially in developing countries. Peri-urban commercial cultivation is a growing food supply enterprise of high-value crops, including tomatoes, onions, green vegetables and fruit, for a number of African cities. By practicing a diversified form of urban agriculture, poor urban workers are able to meet some of their nutritional requirements, especially those for minerals and vitamins, through the consumption of some of their produce (FAO, 2007).

A report by the World Bank (2003) indicates that, 25% of the population in Nairobi is employed in urban and peri-urban agriculture. Urban agriculture is one of the main activities used by residents to eradicate poverty and sustain themselves. Kenya’s leading development challenges today include alleviation of poverty and environmental management in the context of rapid population growth and urbanization. Kenya’s population was 28.6 million people in 1999 and is expected to reach 43 million in the year 2020. According to the government statistics, the national level of absolute poverty increased from 44 percent in 1992 to 56 percent in 2002 (G.O.K 2002).

In Nairobi alone, it is estimated that urban farmers contribute 50,000 bags of maize and 15,000 bags of beans annually and up to a quarter million chicken, about 45,000 goats and sheep, and 42 million liters of milk. This, in economic terms, means that milk alone generates up to Kshs.
800 million annually if priced at 20 Kshs. per liter. Most of it reaches the urban poor as either food or income. In 1998 there were 24,000 dairy cattle in Nairobi, worth roughly one billion shillings. In Kasarani Division, about 180,000 trays of eggs were produced, worth Kshs. 27 million. In the same year 110,000 kilograms of sukuma wiki were grown in Dagoretti, 240,000 kilograms in Langata and 260,000 kilograms in Westlands (Agaya et al., 2004).

Urban and peri-urban agriculture (UPA) is undertaken for three reasons: cash (mainly vegetables and livestock); food subsistence (including savings on food expenditure); and as a survival or risk buffering strategy (Armar-Klemesu & Maxwell, 2000; Nugent, 2001). It can also act as an income generating activity as farmers produce for markets or sell surplus, which contributes to a household’s income security (Cohen & Garrett, 2010; Mougeot, 2005). UPA is used as a strategy by many urban dwellers to improve their livelihoods and overall well-being (Magnusson et al., 2014). It improves a household’s access to food during times of shortage, instability or uncertainty (Bush, 2010; Zezza & Tasciotti, 2010). It contributes to improved health among the urban population by providing highly nutritious and fresh foods (Zezza & Tasciotti, 2010).

The objective of this study was therefore to identify the foods produced, in Mwanamukia peri-urban area, the proportion of the foods consumed and what is done with the surplus consumption.

2.2 STUDY DESIGN AND METHODOLOGY

2.2.1 Study Design

This was a cross sectional study targeting lactating mothers. The sampling unit was households. The study was divided into Phase 1 and phase 11. Phase 1 was the baseline which involved collection of data on foods produced, consumed and utilization of the remainder, socio
demographic and socioeconomic characteristics of lactating mothers and their dietary intake and nutritional status before longitudinal intervention study.

2.2.2 Methodology

2.2.2.1 Study site

The area of study was Mwanamukia sub-ward, Kasarani ward, Kasarani sub-county. The sub-county has four Wards namely, Kasarani ward, Githurai ward, Ruaraka ward and Roysambu ward. Kasarani ward has 3 sub-wards; Mwiki sub-ward, Clay city sub-ward and Mwanamukia sub-ward. Mwanamukia has four villages namely; Maji-Mazuri village, Chieko village, Gituamba and Gitueko village. Mwanamukia Area is 11.5 square km. About half of the available land is used for Agricultural production. The average size of land is 50m x 50m. The main farming system is subsistence and it is usually intensive farming. Food crops grown are mainly maize and beans and horticultural crops in small quantities along the river banks (GOK, 2002).

This study was carried out in two phases. The first phase was a baseline survey with a sample size of 260 respondents. In August, interviewing of lactating mothers commenced. A food frequency questionnaire and a 24-hour dietary recall were administered. Data on food production, amount produced, consumed and sold for income generation was collected using a structured questionnaire.

2.2.2.2 Study population

The estimated total population in Mwanamukia area is 61,316 with 28,637 males and 32,679 female (G.O.K 2010).
2.2.2.3 Sample size calculation

This was based on the formula by Fischer et al., (1991): \( N = \frac{z^2pq}{d^2} \), where N is the sample size, \( z \) is the normal deviation (1.96) corresponding to 95% confidence intervals, \( p \) is estimated food insecurity in Nairobi at 32.9% (Urban Health, 2011), \( q \) is 1-\( p \) and \( d \) is the degree of the desired accuracy at 5%. The calculation yielded 236 households, plus 10% attrition gave a total sample of 260 households.

2.2.2.4 Sampling procedure

![Diagram of sampling procedure](image)

**Figure 2.1: Sampling procedure for phase I and Phase II respondents**
2.2.3 Data Collection Tools

i) Structured questionnaire

A pre-tested structured questionnaire was used to obtain information on the social demographic, social economic characteristics of the households, agricultural practices and production, food consumption patterns and coping mechanisms employed during periods of food scarcity by the lactating mothers.

(ii) Focus group discussion question guide

A question guide was developed to help gather information on lactating mothers diet adequacy, crop production, animal production and the challenges lactating mothers face in coping with food and nutrition insecurity.

2.2.4 Data Collection Procedures

(i) Recruitment and training of field assistants.

A research assistant (not from Mwana Mukia) and two field assistants (from Mwana Mukia were trained prior to data collection. There was a baseline survey at the beginning of the project then monitoring throughout the project and lastly evaluation at the end of the project. Data was collected through interview sessions, observation and through focus group discussions.

Research assistant and two field assistants were trained on data collection techniques especially on how to translate the questions from English to Kiswahili where needed be and also the elements of confidentiality with the information gathered from the respondents.

(ii) Observation checklists.

The observation checklist was used to collect data on, household farming practices, labor providers and crops produced
2.2.5 Data Management and Analysis

(i) Development of the questionnaire

A pre-test of the interview schedule, focus group discussion guide and observation check-lists was done on households with lactating mothers focusing on the lactating mothers and their environment. The pretest was done in Ngomongo village which has similar characteristics as the study area. Vague questions were redefined or paraphrased and instruments were checked so as to measure the content that they were supposed to measure. These households had the same characteristics as those in the study but were not included in the study sample. A 24 hour recall questionnaire was used to collect data on dietary intake a food frequency questionnaire was used to collect data on dietary diversity of lactating mothers in the households. The 24 hour recall was conducted on 53 respondents was a sub-sample of the main sample of 260 lactating mothers households. It was done to provide an estimate of habitual dietary intake of lactating mothers (Gibson and Ferguson, 2008). The 24 hour subjects were first asked to mention chronologically all the foods and beverages consumed 24 hours preceding the study. They were then asked to describe the foods and beverages consumed, including ingredients and preparation methods. The quantities of all foods, beverages and ingredients were estimated either in weight, household units (volume determined by water content), or in monetary value. The proportion of what was eaten by the lactating mother was determined based on the volume prepared. The proportion was used to calculate amount of ingredients consumed. Food cooked dishes prepared outside the home, mainly food stalls, recipes and amounts of ingredients were obtained and amounts consumed determined. Conversions factors from household measures and monetary values to weight equivalent were determined (Ren’tRiet et al., 2002; Gewa et al., 2007). Food frequency questionnaire was administered to the subjects by asking them to mention the frequency of consuming the seven food groups either once dairy, once per week, once per month or rarely consumed. Height and weight of the
subjects was taken too. Weight was taken by asking the subjects to be in light clothing then stand on a weighing balance which is calibrated at 0 with legs apart at 25cm. weight was then taken to the nearest 0.1kg (Gibson, 2005). All measurements height and weight were taken twice and the mean value was used for analyses. Where the differences for the two measures were higher than 0.5cm or 0.5kg then a third measure was taken and the mean of the two closest values used in the analyses. Weight and height measurements were calculated into BMI values and lactating mothers categorized as underweight, normal weight or overweight.

(ii) Ethical consideration

The sub-county administration officer and the area chief were informed about the proposed research project. A research permit was obtained from the ministry of Agriculture, livestock and fisheries. This ensured proper coordination of the project and reduced suspicion among community members. The community members participated in the project voluntarily. They were also assured of strict confidentiality of information they provided to researchers.

2.2.6 Data Quality Control

Collection processes were discussed in the following sections.

1) Minimizing biases

Calibration of the equipments and machines used to the set standards tests were done every morning prior to field work. The respondents were informed of the study objectives and its purpose in order to reduce the respondents’ bias.

2) Reviewing of the questionnaires

The questionnaires completed each day were cross-checked for any anomalies. The principal investigator examined the questionnaires in the field to check for completeness, accuracy in recording the measurements, consistency of the answers as well as correct filling of the questionnaires. Any errors encountered during the cross checking of the
questionnaires were corrected immediately. If the questionnaires were incomplete or the
data collected look suspicious the households were revisited for clarification.

3) **Supervision**

All the activities during the study period were closely monitored and supervised. The
presence of the principal investigator throughout the study; supervising and participating
in some activities such as dietary frequency recall. These together with the availability of
the supervisors from the University of Nairobi supervised the fieldwork and also provided
technical assistance that ensured high quality data.

4) **Administering of the questionnaire**

This was done by the principle researcher and the research assistance under the supervision
of the principle researcher. The research assistance were trained on confidentiality of
information got from the respondents and interpretation of the questionnaire from English
to Kiswhahili where need be.

5) **Data Entry**

Before the data entry a data entry template was developed by the principal investigator in
consultation with a biostatistician. Data entry was then carried out using SPSS (12.0.1) by
the principal investigator immediately after data collection.

2.2.7 **Data Analysis**

The qualitative and quantitative data was analysed using the (SPSS version 20) programme to
generate frequencies, mean and standard deviations. Required coding and modification of data
was done to fit the appropriate statistical method. The statistical package for social sciences
(SPSS) was used for most analysis of this study.
The field assistants were supervised by the researcher to ensure data was accurately collected and received. The weighing scales were calibrated to ensure accuracy and precision. Cleaning of questionnaire was done daily and this involved checking on any omission or irregular information.

2.3 RESULTS

2.3.1 Urban Agriculture Participation by Households

The results show that out of 260 respondents the urban agriculture participation was 61.6% against 38.4% non-participation.

Figure 2.2: Urban agriculture participation
2.3.2 Land Ownership, Food Production and Utilization

Table 2.1: land ownership

<table>
<thead>
<tr>
<th>Ownership</th>
<th>n=260</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own land</td>
<td>66</td>
<td>25.4</td>
</tr>
<tr>
<td>Rented</td>
<td>69</td>
<td>26.7</td>
</tr>
<tr>
<td>Resettled</td>
<td>15</td>
<td>5.5</td>
</tr>
<tr>
<td>Inherited</td>
<td>110</td>
<td>42.3</td>
</tr>
</tbody>
</table>

The study found out that almost a 3\textsuperscript{rd} of the study population of Mwanamukia (67.8\%) owned land to practice urban agriculture. The study also found out that (15.3\%) had 250m\(^2\) plots. Those who lacked land cited it as a hindrance to urban agriculture participation. Most of the respondents (42.3\%) had inherited their land, 26.7\% were renting, 25.5 \% had bought their land and 5.5\% had been resettled in the land they owned.

Table 2.2: provision of labour and decision on what to plant

<table>
<thead>
<tr>
<th>Gender</th>
<th>Percentage of Provision of labour</th>
<th>Percentage of decision on planting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>37</td>
<td>28.9</td>
</tr>
<tr>
<td>Women</td>
<td>62</td>
<td>71.1</td>
</tr>
</tbody>
</table>
More women (71.1%) decided on what crops to be planted compared to men (28.9%).

Results also show that lactating mothers were producing and utilizing a variety of food stuff the highest in production being beans and lowest crotalaria.

Table 2.3: Amount produced and utilization

<table>
<thead>
<tr>
<th>Food item</th>
<th>Percentage of Mothers producing</th>
<th>Percentage of own consumption</th>
<th>Percentage of mothers selling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beans (dry)</td>
<td>28.4</td>
<td>18.4</td>
<td>10.0</td>
</tr>
<tr>
<td>Maize</td>
<td>26.5</td>
<td>26.5</td>
<td>0</td>
</tr>
<tr>
<td>Amaranthus</td>
<td>25.7</td>
<td>8</td>
<td>17.7</td>
</tr>
<tr>
<td>Cow peas</td>
<td>10.3</td>
<td>9</td>
<td>1.3</td>
</tr>
<tr>
<td>Black night shade</td>
<td>8</td>
<td>7</td>
<td>1.0</td>
</tr>
<tr>
<td>Pumpkin leaves</td>
<td>0.6</td>
<td>0.6</td>
<td>0</td>
</tr>
<tr>
<td>Kales</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Spinach</td>
<td>0.2</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>Crotalaria</td>
<td>0.1</td>
<td>0.1</td>
<td>0</td>
</tr>
</tbody>
</table>

Out of the 26.5% lactating mothers who were producing maize, all 26.5% consumed what they produced. Out 28.4% of lactating mothers produced beans 18.4% consumed the beans and 10% sold, and out of 25.7% of lactating mothers produced amaranth, 17.7% was sold while 8% was consumed. Out of 10.3% of lactating mothers produced cowpeas leaves 9% consumed and only 1.3% was sold, other vegetables were produced in small quantities and were consumed at home as shown.

Overall most of the food produced 69.9% is consumed in the lactating mothers households while 30.1% is sold.
2.4 DISCUSSION

2.4.1 Urban Agriculture Participation

The study showed that majority of the lactating mothers participated (62%) in urban agriculture production. These results are in line with a study done in Southern African cities by Frayne et al., 2014, that showed that over 60% of the respondents in Blantyre in Malawi engaged in urban agriculture. In their study those that engaged in urban agriculture participated less frequently in provision of food handouts. In Botswana, Hovorka, 2004 found that the benefits of participating in urban agriculture are primarily captured by high-income and often male-headed households. This results contrast this study in that those who participated in urban agriculture were from low-income area and more women than men participated and benefited from urban agriculture participation. In essence this means that urban agriculture participants in this study better accessed food which was readily available to them from their own farms. In this study lactating mothers who participated in urban agriculture had primary education and above and this same group was found to have normal BMI and some were overweight, compared to their counterparts who were non-participants and were illiterate who had majority who had underweight BMI. This study is in agreement with a study done by Kutiwa et al., 2010 which found a significant statistical difference in the crops yields of educated participants and non-educated participants. In their study Maxwel et al., 2000 in Kampala Uganda found the frequencies of occurrence of underweight and stunting in children more significantly lower in families that were involved in urban agriculture. This concurs with the results of this study which found a statistically significant difference in the frequencies of occurrence of underweight in lactating mothers who were non-participants of crop production ANOVA (P≤0.05).
2.4.2 Land Ownership, Food Production and Utilization

The study noted that, majority of the households’ land was 250m². Majority (57.3%) owned the land they were farming on and where they did not; they were either renting or acting as caretakers. Much more other women would like to carry out urban agriculture in the area but they are limited by space. Farming space in this area is being consumed by coming up of commercial building which are viewed to be profitable than farming. Moustier & Danso’s research (2006) contradicts these findings by indicating that home subsistence farmers have land below 100m² but concurs that they have secured land access. Three studies also observe that some urban farmers cultivate publicly (government) and privately (commercial firms, individual lease holders) owned land. The farmers generally have explicit use rights extending over an agreed time period, during which tenants also act as 'caretakers' (Woodhouse et al. 2000; Kombe, 2005; Nkurunziza, 2007). Gregory (2005) ascertains that urban agriculture contributes to food security through small plots of land.

The current study found that, maize and beans were produced more than any other crops. Lactating mothers also produced amaranth more than other vegetables. This is in line with what Mwangi & Foeken (2000) described as the first type of farming system found in Nairobi. The small-scale subsistence crop cultivation which is dominant with the most common crops cultivated being maize, beans and kales. In their study Agaya et.al. (2004) reiterate that, in Nairobi alone, urban farmers contribute 50,000 bags of maize and 15,000 bags of beans annually.

These findings are in line with what Mudzengerere (2014) ascertained in his study in Nigeria. That the growing of maize, vegetables, fruits and rearing of chickens were the main urban
agricultural activities practiced in many African cities. The findings concur with Moustier & Danso (2006) in their study in Cameroon who noted that, home subsistence farmers’ mainly grew leafy vegetables, cassava, plantain, maize, fruits, rice and kept goats, sheep and poultry. Mwangi & Foeken (2000) also noted that in Nairobi, the contribution of city farmers in the way of tomatoes, beans, cowpeas, maize among many others, makes a profound contribution to urban food consumption. This clearly indicates that these crops were widely produced and in higher quantities. These findings differ with what Nkirigacha et al., 2015, found in their study that in Mwiki Nairobi, residents did not produce enough food for home consumption but had to get the highest proportion of their foods from purchases.

Research by the Urban Harvest initiative of the Consultative Group on International Agricultural Research (CGIAR) in 2002- 2004 in Cameroon found that the majority of producers cultivated maize and traditional leafy vegetables on plots in upland areas (FAO, 2012). According to Cofie, (2009), the choice of crops for production in urban areas is primarily determined by whether food is being produced for household consumption, subsistence, or for sale.

The current study established that the farm produce was for home use and the surplus for sale. The amount sold was small and could not be counted to help pay family bills and provide money for school fees and health bills. This is because farming took place in small plots sizes. Mudzengerere’s research, (2014) concluded that women typically venture into urban agriculture as a way of supplementing their income. For women in developing countries, urban agriculture is a way of improving their income as well as a means to provide for their families (Women Watch, 2008). Moustier & Danso in their study, (2006) also note that, home subsistence farmers’ objective was mainly home consumption.
This study partially corresponds with Abubakari & Mahunu (2007), who noted that more than 70% of urban growers in Tamale, Ghana, grew vegetables primarily for market and less for their own consumption. Mudimu (2001) and Kutiwa et al., (2010), further emphasizes that 87.5% of produce from female headed families is for consumption. Smit et al., (2001) explain that production for self-consumption and barter increases food security of the poor by making it possible to obtain food they could not otherwise afford or find. As these three studies have clearly pointed out (Moustier & and Danso (2006): Cofie et al., (2003), Nugent (2000)), urban agriculture provides a large proportion of food consumed in households.

Majority of respondents preferred to plant beans and maize in larger quantities than other food stuff produced. This is due to the fact that diets of most Kenyan poor are comprised of the staples and amount of beans used is more since it can be used with many dishes in the household, beans can be used as stew for chapatis, rich and ugali and can be used by mixing with maize to produce githeri (mixture of maize and beans) a common Kenyan dish. Production of food and animals for home consumption is a responsibility which is carried out mainly by women (Franzel et al., 2002).

Most of the crops produced as shown in table 2.1 were used for home consumption and only small amount was sold. This is due to the fact that they produced in small quantities and owing to their urge families getting extra for sale was difficult. The decision on what to produce and even how the food was utilized was mainly the responsibility of women in the household, these results agree with the results of a study done in Benin and South Cameroon by Schreckenberg, 2004, Kalaba et al., 2009, where women were seen as the best managers of the farm, accorded the best freedom in decision making, however their decision making power in farming is limited to foods with low returns and those that involve less advanced technologies.
2.4.3 Decision on Crop Production

In this study, more women (72%) made decisions on what to plant in the farms than men (28%). There were also more women (62%) who provided labor in the farms than men (38%). This could be because most women were housewives and were using the farm as part of their occupation and source of food and income for the family. This also explains why lactating women gave their infants complementary feeds before six months as per WHO (2008) recommendations because they needed to go to the farm and doing other income earning activities like cleaning clothes for pay to their neighbors. This is as per observations made by the researcher in the course of research period. This study concurs with the results of the study done by Hovorka et al., (2009) that describes that women were the greater part of urban farmers worldwide. These results agree with the results of a study done in sub-saharan African cities by Bryld, 2013 which revealed that women were responsible for the cultivation of urban agriculture plots and he suggested two reasons for it namely; farming of small plots close to the home can readily be accommodated into women’s daily work routines and that men generally perceive urban agriculture as a marginal activity rather than a serious business endeavor. Another study done in Malawi by Mwambisi et al., 2011 states that women obtained more money from urban farming than men. These results agree with this study in that women reported that they participate in urban agriculture for provision of ready fresh food and since they were lactating mothers it enabled them give individualized care to their infant by frequenting breastfeeding and yet carrying out farming activities within the homestead. Some respondents were not involved in urban agriculture production they relied on food purchases for the household food consumption.

However different findings have been observed in other studies like in Kumasi Ghana, majority (98%) of the farmers practicing urban agriculture were males. Females were not so much involved in the vegetable farming (Ackerson and Awuah, 2010). Also in Gweru city,
Zimbabwe, males were 66.4% and female 33.62% (Jongwe, A. 2014). This difference between their study results and this study results could be because the kind of urban farming carried out by respondents is on small a plot which was able to produce enough food for the family and sale to cater for other family requirements like school fees, medical care and clothing among others.

This study showed that Women were the decision makers when it came to what crop to plant. They also provided the labor. This is the main domain where women are sole decision makers and they plant the crops they believe will benefit their families in terms of nutrition and food security. In 2014, Mudzengerere, concluded that women play a crucial role in sustainable urban development. He further explains that labour is provided by women although men are sometimes hired to till and weed the land. Kutiwa et al., (2010) established the same. Women provided labour, especially the middle aged and the elderly, whilst their male counterparts view urban agriculture as part of women’s household chores. In Kampala, for example, 80% of the urban farmers were women (Obuobi et al., 2004).

Labour was provided by women, this concurs with a study done Swinkels et al., 2002, which says that labour is the only resource that women have at their disposal in many parts of Africa. Simiyu & Foeken (2013) observed that in Eldoret, Kenya, 25% of women farmers’ assumed sole responsibility for land preparation. Obuobi et al., (2004) also documents that, in Kenya 56% of labour in urban agriculture is practiced by women. Studies in Nairobi by Mougeot (1994) also showed that 50% of the urban farming is carried out mainly by women who are concerned about food production for the family. Research by the Urban Harvest initiative of the Consultative Group on International Agricultural Research (CGIAR) in 2002- 2004 in Cameroon also found that the majority of producers were women (FAO, 2012). Jacobi, P et
al., (1996) found that in Dar es Salaam, women are traditionally responsible for feeding the family and also for home gardening; men hardly play a role.

2.5 CONCLUSION

Majority of the respondents participated in urban agriculture. Maize and beans were the most preferred crops and amaranth and cowpea leaves were the most preferred vegetables. More than half of the respondents owned land to practice urban agriculture and one quarter of them had inherited the land they had. More women than men made decisions on what crops to plant. They also provided labor for agriculture on the farms. More respondents consumed and also sold the produce they farmed.

2.6 RECOMMENDATIONS

Lactating mothers who are among the vulnerable groups that suffer malnutrition should be encouraged to produce more crops using current technologies on food production where space is a limiting factor such as multistory, organoponics and hanging gardens.
CHAPTER THREE: FOOD CONSUMPTION, DIETARY INTAKE AND NUTRITIONAL STATUS OF LACTATING MOTHERS IN MWANAMUKIA: A PERI-URBAN AREA OF NAIROBI METROPOLIS

ABSTRACT

Adequate nutritional status of women is important for good health and increased work capacity of themselves as well as the health of their offspring. Nutritional status of lactating mothers is important since it can influence the milk production, nutrient concentration of breast milk and health of the offspring. According to WHO and UNICEF fulfilling nutritional requirements in the diets of lactating mothers below six months postpartum is a problem in developing countries. A pre-intervention study can be used to determine the quality of diets of lactating mothers especially in provision of micronutrients such as vitamin A, Iron and Zinc which are especially important for healthy growth and immune competence. This study was designed as baseline for an intervention to assess the effect supplementation of urban agriculture by production of traditional leafy vegetables on the dietary intake of protein, energy, vitamin A, iron and zinc, and the nutritional status of mothers of 0 to 3 months postpartum. Lactating mothers are likely to be nutritionally vulnerable and their low food intake and the poor nutrition are likely to negatively impact on the nutrition of the weaning children, especially during the period of exclusive breastfeeding. A cross-sectional study was carried out among 260 of the lactating mothers living in Mwanamukia peri-urban area in the Eastern Nairobi County. Using the local administration, the population of such mothers was enumerated and from the population, the sample was randomly selected. Then using structured and pre-tested questionnaire information was collected on socio-demographic and socio-economic characteristics. A subsample of 53 mothers was randomly selected from the main sample and this was used to determine the dietary intake of protein, energy, vitamin A, iron and zinc in a 24-hour recall, and the nutrition status of the mothers including taking of height and weight of the lactating mothers as BMI indicators. Data was analyzed using SPSS version 20 for
descriptive data and Pearson correlation was used to determine associations. Results indicate that majority of the respondents fell within the age range of 36 – 40 years. On education, 44.6% had attained primary, while 16.8% had attained secondary. The household size ranged between 6 -12 with average of 6 persons. The study population was multiethnic with the Meru and Luhya constituting the majority. Majority of the respondents were from the lower socio-economic category. Most respondents had a high diverse diet, however dietary intake of vitamin A, iron and zinc were low, indicating an unmet nutritional requirement. The nutritional status as determined by the BMI of majority of the respondents (47.1% was underweight compared to (30.1%) of the respondents that had a normal BMI and 22.8% who were overweight. More than half of the respondents had achieved primary education and they had a normal BMI while those who were underweight were those with little or no education. This is because people who are literate are more likely to understand the reasons for a balanced diet for the purpose of their health and that of their infants. Majority of the respondents participated in urban agriculture and this is used to improve food access in the study population which is a slum area with majority of respondents with low income making it difficult for them to purchase food for their households from the available markets. Most of the respondents were not meeting their dietary intake for the selected micronutrients in the study. This could be attributed to the fact that in poor environments people have a tendency of consuming energy and carbohydrates rich foods which are cheap and readily available in bulk unless fruits, vegetables and protein food. The dietary intakes of energy and protein were found to be moderate as represented by mean percent RDAs for each group. The intakes of vitamin A showed there were deficiencies among the lactating women of all age groups studied as well as the intakes of iron and zinc. The nutritional status as represented by BMI was found to be unmet for majority of the mothers and comparison among the age groups showed that some women met their requirements though still at low percentages, while comparison among the
socio-economic categories showed that the nutritional status of women with low income highly affects the women and most of these women do not meet their requirements and end up being underweight. The dietary intake was found to be positively correlated with intake of minerals, carbohydrates, proteins and fats while the nutritional status was found to be correlated with occupation and education.

3.1 INTRODUCTION

Socio-economic status is a multi-factorial condition which is embedded in environmental, material and personal characteristics. These mutually interact in a complex way and often reinforce each other through self-perpetuating trickledown spirals, not only on individual level and social layer level, but also on intergenerational level (De Henauw et al., 2003). Research has shown that most Nairobi farmers belong to the group with low to very low incomes. The farmers' households spend a very large part of their income on food; over one third of them spend even 70 -75% of their income on food. This percentage would be even higher if these households were cut off from their farming activities, or otherwise they might starve from hunger. Few people in the farming households in Nairobi are employed in the formal sector (Foeken and Mwangi, 2000). Many are either unemployed or perform casual labor. In slum areas, informal trade and food selling were the most frequent sources of income. Among non-farming households, illegal trade and practices (like manufacturing and selling alcoholic brews, prostitution, street begging and stealing) scored high (24%) in comparison with the farmers' group (10%) (Foeken and Mwangi, 2000).

Urban agriculture gardening in high-density areas or unplanned settlements is mostly subsistence oriented and a clear survival strategy for the poorer households (De Henauw et al., 2003) estimated that about 35,000 farming households depend on periurban fruit and vegetable production for their income. The majority of the urban farmers in Nairobi are women. Particularly among the low-income farmers, the percentage of female-headed households is relatively high. For many poor women who lack the presence of an adult man in the house and who have children to feed, farming is something of a last resort. This has also to do with their relatively low level of education in comparison with the men. Almost one-quarter of the heads
of the low-income farming households had completed secondary school education (Foeken and Mwangi, 2000).

Agriculture is a part of diverse livelihoods and provides a significant contribution to income (Prain and Lee-Smith 2010). Selling is quite common among the “subsistence” crop cultivators. Sales are important to meet other basic needs, such as maize flour, paraffin, school fees, etc. (Foeken and Mwangi, 2000).

Increased food production and access are crucial to achieving major nutritional improvement. More foods should be produced that are rich in all the essential micronutrients, available in sufficient quantities and accessible to people all year round. Access to stable and sustainable food supplies is a precondition for the establishment of food security at the household level. A greater and more sustained yield from the farming system can increase the potential access of the household to an adequate diet (FAO, 2007).

In urban areas the households most at risk of food insecurity and chronic malnutrition belong to the lowest-income groups which cannot afford to purchase adequate food. Many of these households comprise families of recent migrants who have failed to find regular employment.

Pregnant and lactating women are especially at high risk of nutritional deficiencies mainly due to elevated dietary requirements (Silveira et al., 2007). Nutrition is vitally important during the postnatal period (Silveira et al., 2007) because breast milk has to supply the added nutrients for the infant requirements (Brown, 2008). Nutrition of the lactating woman affects milk composition and quantity (Silveira et al., 2007) and depletion of nutrient stores during lactation poses a risk of malnutrition to the mother, which in turn compromises the quality and quantity the milk by the mother and impacts negatively on the nutrition of the infant (Ukegbe, 2014).
Good nutritional intake supports the stamina, patience and self-confidence that nursing an infant requires. This emphasizes the need for continuous monitoring of the dietary intake and nutritional status of the mothers especially those among poor resource communities (Ukegbe, 2014, Brown, 2008). Adequate intake by lactating mothers of particularly protein, energy, vitamin A, iron and zinc is important as the nutrients are very crucial for health, growth and immune competence of the infant.

The contribution of urban Agriculture to food and nutritional security in households with lactating mothers has not yet been well studied in Kenya. Knowledge on crop production, nutrition education, farming skills in Mwanamukia area is scanty. This study was therefore designed to assess the food, dietary intake of vitamin A, iron and zinc, and the nutritional status of lactating mothers with children 1 – 3 months old in a peri-urban setting with an established culture of urban agriculture, with a view to establishing the baseline for an intervention project.

3.2 OBJECTIVES OF THE STUDY

1. To determine socio demographic and socio-economic characteristics of lactating mothers in Mwanamukia area.

2. To determine the dietary intake and the nutritional status of lactating mothers in Mwanamukia area.

3.3 STUDY DESIGN AND METHODOLOGY

3.3.1 Study Design

This was a cross sectional study targeting lactating mothers with children 0 – 3 months postpartum. The sampling unit was households with children satisfying the criterion of
selection. The study was carried out between January 2015 and April 2015. The study constituted a baseline for a larger intervention study on elevation of the dietary intake and nutritional status of lactating mothers.

3.3.2 Methodology

3.3.2.1 Sample size calculation

This was based on the formula by Fischer et al., (1991):

\[
N = \frac{z^2pq}{d^2},
\]

where \( N \) is the sample size, \( z \) is the normal deviation (1.96) corresponding to 95% confidence intervals, \( p \) is estimated food insecurity in Nairobi at 32.9%, \( q \) is 1-\( p \) and \( d \) is the degree of the desired accuracy at 5%. The calculation yielded 236 households, plus 10% attrition give a total sample of 260 households.

3.3.2.2 Sampling procedure

Using the local administration, the households satisfying the lactating mothers were identified and from the number, the sample of 260 mothers was selected by random sampling. The selected mothers had also to meet the inclusion criteria in the questionnaire that included the following: 1. currently breast feeding 2. Free from any chronic sickness and not on medication 3. Not pregnant at the time of study. From the sample of mothers, a subsample of 53 mothers was randomly selected for use in the determination of dietary intake and the nutritional status as Body Mass Index (BMI).

The 24 hour subjects were first asked to mention chronologically all the foods and beverages consumed 24 hours preceding the study. They were then asked to describe the foods and beverages consumed, including ingredients and preparation methods. The quantities of all foods, beverages and ingredients were estimated either in weight, household units (volume...
determined by water content), or in monetary value. The proportion of what was eaten by the lactating mother was determined based on the volume prepared. The proportion was used to calculate amount of ingredients consumed. Food cooked dishes prepared outside the home, mainly food stalls, recipes and amounts of ingredients were obtained and amounts consumed determined. Conversions factors from household measures and monetary values to weight equivalent were determined (Ren’tRiet et al., 2002; Gewa et al., 2007). Food frequency questionnaire was administered to the subjects by asking them to mention the frequency of consuming the seven food groups either once dairy, once per week, once per month or rarely consumed. Height and weight of the subjects was taken too. Weight was taken by asking the subjects to be in light clothing then stand on a weighing balance which is calibrated at 0 with legs apart at 25cm. weight was then taken to the nearest 0.1kg (Gibson, 2005). All measurements height and weight were taken twice and the mean value was used for analyses. Where the differences for the two measures were higher than 0.5cm or 0.5kg then a third measure was taken and the mean of the two closest values used in the analyses. Weight and height measurements were calculated into BMI values and lactating mothers categorized as underweight, normal weight or overweight.

3.3.3 Data Collection Methods
A pretested structured questionnaire was administered to lactating mothers. Themes of interest to this study were developed and they formed the check lists which were used in two focused group discussions and among 4 key informants. The first focused group consisted of 8 lactating mothers while the second group comprised 5 lactating mothers, then 2 area elders and 1 headman. The key informants consisted of a hospital nutritionist, the sub-county Agricultural officer and the area ward administrator. The mothers’ questionnaire was used to collect information on socio-demographic and socio-economic status, and dietary intake in a 24-hour
recall of protein, energy, vitamin A, iron and zinc and nutritional status. The nutritional status was assessed by taking the height and weight of the subjects and calculating the Body Mass Index (BMI). The BMI values were used to categorize the subjects as underweight, normal and overweight. The respondents’ consent was sought before administering the questionnaire and confidentiality was assured.

The protocol of the study was approved by the University of Nairobi Post Graduate Studies and the Ministry of Agriculture, Livestock development and Fisheries, Kasarani Sub-county.

3.3.4 Data Analysis

The questionnaires were coded and summarized according to the variables for each objective. Data was entered and cleaned using statistical packages for social sciences (SPSS version 20) for analysis. Frequencies mean, standard deviations, percentages were calculated and correlations were conducted to identify associations. Where the associations existed, chi-square was used to test their strength. Data on dietary intake was analyzed using Nutrisurvey software and the analysis was exported to Word as a report.

3.4 RESULTS

3.4.1 Socio-Demographic and Socio-Economic Characteristics of the Mothers

3.4.1.1 Age of the mothers

The age categories of the respondents are shown in Table 3.1. The minimum age of the respondents was chosen as 19 years. The maximum age was chosen as 49 years, the maximum for reproductive age. The highest number of mothers fell in the range of 36-40 years. The least
number of mothers were within the age ranges of 20 – 25 years and 46 years; this may indicate low tendencies to have children below age 25 and age above 46 - 49 years as per the study observation.

Table 3.1: Distribution of mothers by age categories

<table>
<thead>
<tr>
<th>Age categories (years)</th>
<th>Number of respondents (N=260)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-25</td>
<td>18</td>
<td>6.7</td>
</tr>
<tr>
<td>26-30</td>
<td>43</td>
<td>16.5</td>
</tr>
<tr>
<td>31-35</td>
<td>45</td>
<td>17.3</td>
</tr>
<tr>
<td>36-40</td>
<td>86</td>
<td>33.1</td>
</tr>
<tr>
<td>41-45</td>
<td>52</td>
<td>20.1</td>
</tr>
<tr>
<td>46-49</td>
<td>16</td>
<td>6.3</td>
</tr>
</tbody>
</table>

3.4.1.2 Marital status of the mothers

Majority of the mothers as shown in table 3.2 were married (62.7%), Single mothers were 25.4%. The remaining mothers were either divorced or widowed and each at less than 10%.

Table 3.2: Distribution of the mothers by marital status

<table>
<thead>
<tr>
<th>Marital status</th>
<th>Number of respondents N=260</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Divorced</td>
<td>16</td>
<td>6.2</td>
</tr>
<tr>
<td>Widow</td>
<td>15</td>
<td>5.7</td>
</tr>
<tr>
<td>Married</td>
<td>163</td>
<td>62.7</td>
</tr>
<tr>
<td>Single</td>
<td>66</td>
<td>25.4</td>
</tr>
</tbody>
</table>
3.4.1.3 Education level of the mothers

The education levels of the mothers are shown in Table 3.3. As the Results show that, 44.6% had primary and 40% had secondary education. The remaining mothers had either college diploma or university degree. There were 8.1% of illiterate mothers. That means that majority of the mothers participating in the study had at least primary level education. This means that they were all capable of accessing nutrition and health information from the common sources available. The main education level attained was primary at 44.6% which is higher than the average of 43% indicated by KDHS study (2014).

Table 3.3: Distribution of mothers by education level

<table>
<thead>
<tr>
<th>Education level</th>
<th>Number of respondents (N=260)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illiterate</td>
<td>21</td>
<td>8.1</td>
</tr>
<tr>
<td>Primary level</td>
<td>116</td>
<td>44.6</td>
</tr>
<tr>
<td>Secondary (O level)</td>
<td>90</td>
<td>34.6</td>
</tr>
<tr>
<td>Secondary (A level)</td>
<td>14</td>
<td>5.4</td>
</tr>
<tr>
<td>College</td>
<td>17</td>
<td>6.5</td>
</tr>
<tr>
<td>University</td>
<td>2</td>
<td>0.8</td>
</tr>
</tbody>
</table>

3.4.1.4 Size of the household

The distribution of household sizes is as shown in table 3.4. In this study, the maximum household size was 12 while the average was 6. The number is higher compared to 3.9 the average household size in Kenya according to KDHS (2014).

Table 3.4: Distribution of mothers by household size

<table>
<thead>
<tr>
<th>Members in the household</th>
<th>Number of households (N=260)</th>
<th>Percentage (%) of households</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>146</td>
<td>56.3</td>
</tr>
<tr>
<td>6-10</td>
<td>94</td>
<td>36.2</td>
</tr>
<tr>
<td>11-15</td>
<td>20</td>
<td>7.5</td>
</tr>
</tbody>
</table>

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3.4.1.5 Occupation of the mothers

The occupations of the mothers are shown in Table 3.5; there were many differing occupations among the respondents. Majority were running small businesses mainly in the informal sector at 28.6%, while 23.9% were housewives and 21.2% were farmers, probably practicing urban agriculture.

Table 3.5: Distribution of the mothers by occupation

<table>
<thead>
<tr>
<th>Occupation of the mothers</th>
<th>Number of mothers (N = 260)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>75</td>
<td>28.6</td>
</tr>
<tr>
<td>Housewives</td>
<td>62</td>
<td>23.9</td>
</tr>
<tr>
<td>Farmers</td>
<td>55</td>
<td>21.2</td>
</tr>
<tr>
<td>Teachers</td>
<td>20</td>
<td>7.8</td>
</tr>
<tr>
<td>Hairdresser</td>
<td>17</td>
<td>6.3</td>
</tr>
<tr>
<td>Tailor</td>
<td>8</td>
<td>3.1</td>
</tr>
<tr>
<td>House help</td>
<td>8</td>
<td>3.1</td>
</tr>
<tr>
<td>Laborer</td>
<td>5</td>
<td>2.0</td>
</tr>
<tr>
<td>Others</td>
<td>10</td>
<td>4.0</td>
</tr>
</tbody>
</table>

3.4.2 Distribution of the mothers’ households by monthly income

The monthly income levels of the households in Kenya shillings (KES)* of the households are shown in table 3.6. As the Figure shows, the largest group of households had income of KES 11000 – 20000. About 27% of the families had income of between KES 1,000 – 10,000. These figures show that at least 18% fall within the lower socio-economic group of the country considering reference for cut-off of KES 15000. Also the incomes show that 68% of the households had income of less that KES 30,000 per month, and therefore lived below the World Bank poverty line of $1 a day. It is possible that this number could go down considering that
the communities do not necessarily entirely depend on the monetary income especially for food. Much of the food consumed is usually grown by the households under urban agriculture.

### Table 3.6: Distribution of mothers’ households by income

<table>
<thead>
<tr>
<th>Monthly income Categories</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 – 10,000</td>
<td>39</td>
<td>27.2</td>
</tr>
<tr>
<td>11,000 – 20,000</td>
<td>103</td>
<td>40.6</td>
</tr>
<tr>
<td>21,000 – 30,000</td>
<td>24</td>
<td>9.4</td>
</tr>
<tr>
<td>31,000 – 60,000</td>
<td>28</td>
<td>10.2</td>
</tr>
<tr>
<td>&gt;70,000</td>
<td>25</td>
<td>12.6</td>
</tr>
</tbody>
</table>

#### 3.4.3 Food Consumption Frequency

The frequency of food consumption by the mothers is shown in Table 3.7. As the results show, the most frequently consumed grains by the mothers were maize and rice. Wheat products were consumed at a frequency of 20% daily and at 12% 3 to 6 times a week. These consumptions were probably in bread and chapattis. Root crops (potatoes, sweet potatoes and arrow roots) were consumed at average frequency of 12% daily. These foods therefore made significant contribution to energy intake. However this frequency differed with time, Irish potatoes were consumed at 18% 3 to 6 times a week compared to sweet potatoes that were consumed at a frequency of 16% 1-2 times a week while arrow roots were consumed at a frequency of 12% once a month.

Pigeon peas were commonly consumed legumes and pulses daily at a frequency of 20% followed by ground nuts at a frequency of 10% daily. It was noted that most lactating mother fed on at least one of the following 1 - 2 times a week: pigeon peas, green grams and ground nuts. These foods were probably the main source of protein and were augmented by the little products eaten. Carrots were the most frequently consumed vegetables at 24% daily while tomatoes, amaranth, night shade and cowpea leaves were taken at least 4-6 times per week. Except for tomatoes, the other vegetables are good sources of vitamin A, and the leafy
vegetables are rich sources of iron and zinc (Whitney and Rolfer, 2016). Kales and spinach are also good sources of vitamin A and minerals and were consumed at a frequency of 12% at least 1 to 6 times a week.

Eggs had the highest frequency of consumption compared to other chicken and beef. Their frequencies stood at 44% daily, 34% 3 to 6 times a week and 10% 1 to 2 times a week. Beef and chicken meats had a low consumption at 10% daily for beef. Goat meat was consumed at frequencies of 8% and 12% 3 to 6 times a week and 1 to 2 times a week respectively. Chicken and fish were the least consumed meats at a frequency of 10% once a month. That means the contribution of protein intake by meats was low.

Avocado fruit was the highest consumed at frequencies of 16% daily, 12% 3 to 6 times a week and at 10% 1 to 2 times a week.

Fresh milk was the highest consumed dairy product at frequencies of 92% daily and at 4% 3 to 6 times a week while other daily products had very little consumption. The high frequency of consumption of fluid milk was probably that used with tea daily.
Table 3.7: Frequency of food consumption among lactating mothers

<table>
<thead>
<tr>
<th>Food item</th>
<th>Frequency (%)</th>
<th>Daily</th>
<th>3-6 times a week</th>
<th>1-2 times a week</th>
<th>Once a month</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grains</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>20</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>10</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Starch roots</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irish potatoes</td>
<td>12</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweet potatoes</td>
<td>12</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arrow roots</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Legumes, pulses and nuts</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pigeon peas</td>
<td>10</td>
<td>10</td>
<td>18</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Green grams</td>
<td>20</td>
<td></td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground nuts</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Vegetables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional leafy vegetables</td>
<td>12</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>(Amaranth, night shades and cow pea leaves)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrots</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kales and spinach</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>French beans</td>
<td>8</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Meats and eggs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goat</td>
<td>8</td>
<td>12</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Fish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td>44</td>
<td>34</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fruits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avocados</td>
<td>16</td>
<td>12</td>
<td>10</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Dairy products</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh milk</td>
<td>92</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Yoghurt</td>
<td>8</td>
<td>18</td>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.4.4 Dietary Intake in a 24-Hour Recall

The results of the intake of energy, protein, and the consumption of carbohydrates and fat are presented in Table 3.8. As the results show, no group achieved a mean intake of energy of 100% or more, although within the groups, there is possibility of some individuals having done so. The group, less than 19 years of age had only one respondent who was taking very little energy, and was probably terribly underweight. Of the other groups, the intake of energy by the 20 – 25 years had the highest energy intake with mean RDA of 76.7%, while the group of 30 years and over had the lowest mean intake represented by mean RDA of 72.5%. However these mean RDAs were not significantly different from one another (P≤0.05).
Table 3.8: Energy, protein, carbohydrate and fats intake for different age groups of lactating women

<table>
<thead>
<tr>
<th>Energy (Kcal)</th>
<th>N=53</th>
<th>Minimum</th>
<th>Maximum</th>
<th>RDA for age</th>
<th>Mean intake</th>
<th>Mean RDA intake percent</th>
<th>P value</th>
<th>Degree of freedom</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-20 years</td>
<td>1</td>
<td>506</td>
<td>506</td>
<td>2037</td>
<td>506</td>
<td>24.8</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>20 - 25 years</td>
<td>15</td>
<td>856</td>
<td>2189</td>
<td>2037</td>
<td>1563</td>
<td>76.7</td>
<td>0.8</td>
<td>6</td>
</tr>
<tr>
<td>26 - 30 years</td>
<td>13</td>
<td>878</td>
<td>2153</td>
<td>2036</td>
<td>1476</td>
<td>72.5</td>
<td>0.7</td>
<td>6</td>
</tr>
<tr>
<td>31- 35 years</td>
<td>16</td>
<td>922</td>
<td>2185</td>
<td>2036</td>
<td>1506</td>
<td>74.1</td>
<td>0.8</td>
<td>6</td>
</tr>
<tr>
<td>36 -40 years</td>
<td>5</td>
<td>350</td>
<td>612</td>
<td>2036</td>
<td>517</td>
<td>67.8</td>
<td>0.1</td>
<td>6</td>
</tr>
<tr>
<td>41-45 years</td>
<td>2</td>
<td>900</td>
<td>1934</td>
<td>2038</td>
<td>1417</td>
<td>69.5</td>
<td>0.5</td>
<td>6</td>
</tr>
<tr>
<td>45-49 years</td>
<td>1</td>
<td>1523</td>
<td>1523</td>
<td>2038</td>
<td>304</td>
<td>74.7</td>
<td>0.1</td>
<td>6</td>
</tr>
</tbody>
</table>

Protein (g)

| Less than 20 years | 1 | 13.8 | 13.80 | 60.4 | 13.8 | 22.9 | 0 | 6 |
| 20 to 25 years     | 15| 20.4 | 75.40 | 60.4 | 47.4 | 78.8 | 1.0 | 6 |
| 26 to 30 years     | 13| 21.5 | 62.00 | 60.4 | 39.0 | 64.8 | 0.6 | 6 |
| 31-35 years        | 16| 20.1 | 74.10 | 60.4 | 38.4 | 63.9 | 0.7 | 6 |
| 36-40 years        | 5 | 18.3 | 67.00 | 60.4 | 32.1 | 53.4 | 0.5 | 6 |
| 41-45 years        | 2 | 23.2 | 43.40 | 60.4 | 33.3 | 55.4 | 0.3 | 6 |
| 45-49 years        | 1 | 29.4 | 29.40 | 60.4 | 29.4 | 48.9 | 0 | 6 |

Carbohydrate (g)

<p>| Less than 20 years | 1 | 84.60 | 84.60 | 290.6 | 84.6 | 29.1 | 0 | 6 |
| 20 to 25 years     | 15| 146.30| 386.30| 290.6 | 269.5| 92.7 | 0.5 | 6 |
| 26 to 30 Years     | 13| 132.60| 516.00| 290.6 | 265.0| 91.2 | 0.5 | 6 |
| 31-35 Years        | 16| 161.10| 375.80| 290.6 | 274.7| 94.5 | 0.3 | 6 |
| 36 -40 Years       | 5 | 72.40 | 289.60| 290.6 | 235.6| 81.1 | 0.7 | 6 |
| 41-45 years        | 2 | 114.6 | 316.40| 290.6 | 215.5| 74.2 | 0.8 | 6 |
| 45-49 years        | 1 | 389.9 | 389.90| 290.6 | 389.9| 134.2| 0 | 6 |</p>
<table>
<thead>
<tr>
<th>Age Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>Sex (M/F)</th>
<th>Waist (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 20 years</td>
<td>1</td>
<td>12.60</td>
<td>6.60</td>
<td>12.60</td>
<td>12.6</td>
<td>6.60</td>
<td>12.60</td>
<td>M</td>
<td>67</td>
</tr>
<tr>
<td>20 to 25 years</td>
<td>15</td>
<td>19.30</td>
<td>5.30</td>
<td>19.30</td>
<td>19.3</td>
<td>5.30</td>
<td>19.30</td>
<td>M</td>
<td>67</td>
</tr>
<tr>
<td>26 to 30 Years</td>
<td>13</td>
<td>20.10</td>
<td>5.10</td>
<td>20.10</td>
<td>20.1</td>
<td>5.10</td>
<td>20.10</td>
<td>M</td>
<td>67</td>
</tr>
<tr>
<td>31-35 Years</td>
<td>16</td>
<td>17.60</td>
<td>4.60</td>
<td>17.60</td>
<td>17.6</td>
<td>4.60</td>
<td>17.60</td>
<td>M</td>
<td>67</td>
</tr>
<tr>
<td>36-40 Years</td>
<td>5</td>
<td>9.60</td>
<td>7.90</td>
<td>9.60</td>
<td>9.6</td>
<td>7.90</td>
<td>9.60</td>
<td>M</td>
<td>67</td>
</tr>
<tr>
<td>41-45 years</td>
<td>2</td>
<td>39.60</td>
<td>5.40</td>
<td>39.60</td>
<td>39.6</td>
<td>5.40</td>
<td>39.60</td>
<td>M</td>
<td>67</td>
</tr>
<tr>
<td>45.49 years</td>
<td>1</td>
<td>62.1</td>
<td>6.21</td>
<td>62.1</td>
<td>62.1</td>
<td>6.21</td>
<td>62.1</td>
<td>M</td>
<td>67</td>
</tr>
</tbody>
</table>

Source: Dietary intake reference, 2009
Table 3.9: Dietary intake of vitamin A, iron and zinc for different age groups of lactating women

### Vitamins

<table>
<thead>
<tr>
<th>Age Group</th>
<th>N=53</th>
<th>Minimum</th>
<th>Maximum</th>
<th>RDA</th>
<th>Mean</th>
<th>Mean RDA intake percent</th>
<th>P Value</th>
<th>Degree of freedom</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-20 years</td>
<td>1</td>
<td>177.50</td>
<td>177.50</td>
<td>3000µg</td>
<td>177.5</td>
<td>5.9</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>20 to 25 years</td>
<td>15</td>
<td>18.30</td>
<td>1710.70</td>
<td>3000µg</td>
<td>520.8</td>
<td>17.4</td>
<td>0.3</td>
<td>6</td>
</tr>
<tr>
<td>26 to 30 years</td>
<td>13</td>
<td>30.50</td>
<td>1132.60</td>
<td>3000µg</td>
<td>497.3</td>
<td>16.6</td>
<td>0.2</td>
<td>6</td>
</tr>
<tr>
<td>31-35 Years</td>
<td>16</td>
<td>46.60</td>
<td>1689.50</td>
<td>3000µg</td>
<td>634.8</td>
<td>21.2</td>
<td>0.3</td>
<td>6</td>
</tr>
<tr>
<td>36-40 Years</td>
<td>5</td>
<td>113.4</td>
<td>1867.10</td>
<td>3000µg</td>
<td>537.4</td>
<td>17.9</td>
<td>0.3</td>
<td>6</td>
</tr>
<tr>
<td>41-45 years</td>
<td>2</td>
<td>384.6</td>
<td>753.2</td>
<td>3000µg</td>
<td>568.9</td>
<td>19</td>
<td>0.1</td>
<td>6</td>
</tr>
<tr>
<td>46-49 years</td>
<td>1</td>
<td>167.9</td>
<td>167.9</td>
<td>3000µg</td>
<td>167.9</td>
<td>5.6</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>

### Minerals

<table>
<thead>
<tr>
<th>Age Group</th>
<th>N=53</th>
<th>Minimum</th>
<th>Maximum</th>
<th>RDA for age</th>
<th>Mean</th>
<th>Mean RDA intake percent</th>
<th>P Value</th>
<th>Degree of freedom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19-20 years</td>
<td>1</td>
<td>3.50</td>
<td>3.50</td>
<td>18 mg</td>
<td>3.5</td>
<td>19.4</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>20 - 25 years</td>
<td>15</td>
<td>4.00</td>
<td>20.00</td>
<td>18 mg</td>
<td>8.3</td>
<td>46.1</td>
<td>0.5</td>
<td>6</td>
</tr>
<tr>
<td>26 -30 years</td>
<td>13</td>
<td>7.2</td>
<td>45.6</td>
<td>18 mg</td>
<td>6.4</td>
<td>35.6</td>
<td>0.5</td>
<td>6</td>
</tr>
<tr>
<td>31-35 years</td>
<td>16</td>
<td>6.50</td>
<td>16.70</td>
<td>18 mg</td>
<td>7.6</td>
<td>42.2</td>
<td>0.1</td>
<td>6</td>
</tr>
<tr>
<td>36 -40 years</td>
<td>5</td>
<td>3.6</td>
<td>21.3</td>
<td>18 mg</td>
<td>5.3</td>
<td>29.4</td>
<td>0.4</td>
<td>6</td>
</tr>
<tr>
<td>41-45 years</td>
<td>2</td>
<td>6.7</td>
<td>13.2</td>
<td>18mg</td>
<td>10.1</td>
<td>55.3</td>
<td>0.3</td>
<td>6</td>
</tr>
<tr>
<td>45-49 years</td>
<td>1</td>
<td>8.7</td>
<td>8.7</td>
<td>18mg</td>
<td>8.7</td>
<td>48.3</td>
<td>0.3</td>
<td>6</td>
</tr>
</tbody>
</table>

| Zinc               |      |         |         |             |      |                        |         |                  |
| 19- 20 years       | 1    | 2.30    | 2.30    | 8 mg        | 2.30 | 28.8                   | 0       | 6                |
The women were very far from meeting their Vitamin A requirements. None of them had intakes close to half for mean intake. The highest mean intake Vitamin A among the respondents was 635 µg while the lowest was 177 µg. The recommended intake is 3000 µg. The highest mean intake of Vitamin A was meeting 21% of the allowances.

The highest Iron intake among the respondents was 13.7 mg while the lowest was 3.5 mg. The recommended intake is 18 mg. The highest mean Iron intake was meeting 76% of the allowances. The highest mean Zinc intake among the respondents was 7.5 mg while the lowest was 2.3 mg. The recommended intake is 8 mg. The highest Zinc intake was meeting 94% of the allowances. Women in this study were most deficient in vitamin A.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Cases</th>
<th>Mean Intake</th>
<th>Mean Zinc</th>
<th>Mean Iron</th>
<th>Mean Calcium</th>
<th>Mean Copper</th>
<th>Mean Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 - 25 years</td>
<td>15</td>
<td>2.50</td>
<td>7.30</td>
<td>8 mg</td>
<td>3.2</td>
<td>40</td>
<td>0.4</td>
</tr>
<tr>
<td>26 - 30 years</td>
<td>13</td>
<td>3.70</td>
<td>4.1</td>
<td>8 mg</td>
<td>3.9</td>
<td>48.8</td>
<td>0.03</td>
</tr>
<tr>
<td>31-35 years</td>
<td>16</td>
<td>3.60</td>
<td>8.6</td>
<td>8 mg</td>
<td>4.1</td>
<td>51.3</td>
<td>0.4</td>
</tr>
<tr>
<td>36-40 years</td>
<td>5</td>
<td>3.4</td>
<td>7.8</td>
<td>8 mg</td>
<td>3.8</td>
<td>47.5</td>
<td>0.7</td>
</tr>
<tr>
<td>41-45 years</td>
<td>2</td>
<td>2.4</td>
<td>4.2</td>
<td>8 mg</td>
<td>3.3</td>
<td>41.3</td>
<td>0.2</td>
</tr>
<tr>
<td>46-49 years</td>
<td>1</td>
<td>4.6</td>
<td>4.6</td>
<td>8 mg</td>
<td>4.6</td>
<td>57.5</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Dietary intake reference, 2009
3.4.5 Nutritional Status of the Mothers

The nutritional status is shown in table 3.10. Majority of the respondents (47%) were underweight, while (30%) were normal and 23% of the respondents were also at risk of being obese (BMI >25). All these were found in the category of women aged above 36 years.

The mean BMI of the respondents was 18.5 at P ≤ 0.05.

<table>
<thead>
<tr>
<th>Age of the mothers in years</th>
<th>BMI Categories</th>
<th></th>
<th></th>
<th></th>
<th>P ≤ 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>&lt;18.5</td>
<td>1(1.9)</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>20-25</td>
<td>18.5-25</td>
<td>8(15.1)</td>
<td>4(7.5)</td>
<td>3(5.7)</td>
<td>0.02</td>
</tr>
<tr>
<td>26-30</td>
<td>&gt;25</td>
<td>6(11.2)</td>
<td>4(7.5)</td>
<td>3(5.7)</td>
<td>0.04</td>
</tr>
<tr>
<td>31-35</td>
<td></td>
<td>8(15.1)</td>
<td>5(9.4)</td>
<td>3(5.7)</td>
<td>0.00</td>
</tr>
<tr>
<td>36-40</td>
<td></td>
<td>2(3.8)</td>
<td>2(3.8)</td>
<td>1(1.9)</td>
<td>0.05</td>
</tr>
<tr>
<td>41-45</td>
<td></td>
<td>0</td>
<td>1(1.9)</td>
<td>1(1.9)</td>
<td>0.03</td>
</tr>
<tr>
<td>46-49</td>
<td></td>
<td>0</td>
<td>0</td>
<td>1(1.9)</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>(47)</strong></td>
<td><strong>(30)</strong></td>
<td><strong>(23)</strong></td>
<td></td>
</tr>
</tbody>
</table>

Respondents (percentage)

3.4.6 Lactating Mothers BMI and Socio-Economic Status

The association between lactating mothers BMI and their socio economic status is shown in table 3.11. The highest percentage 22.6%, of Ksh 1,000-10,000 were underweight while 15.1% of respondents with an income of Ksh >21,000 were at risk of becoming obese. This means that the association between income and nutritional status of lactating mothers is significant at P≤0.05. The highest percentage of 19% means that an income of 11,000 to 20,000 was highly associated with a normal BMI.
### Table 3.11: Association between lactating mothers BMI and socio-economic status

<table>
<thead>
<tr>
<th>Monthly income of the HH</th>
<th>&lt;18.5</th>
<th>18.5-25</th>
<th>&gt;25</th>
<th>P≤0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1,000 - 10,000</strong></td>
<td>12(22.6)</td>
<td>3(5.7)</td>
<td>1(1.9)</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>11,000 - 20,000</strong></td>
<td>10 (18.8)</td>
<td>9(17)</td>
<td>3(5.7)</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>&gt;21,000</strong></td>
<td>3(5.7)</td>
<td>4(7.5)</td>
<td>8(15.1)</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Respondents (percentage)

### 3.4.7 Lactating Mothers BMI and Household Size

The association between lactating mothers BMI and household size is shown in Table 3.12.

From the study households with 1-4 people had the highest number of lactating mothers with normal BMI at 20.8%. These same households also had a high number of mothers at risk of overweight. At the same time, households with the most number of people had no underweight mothers. Households with the least number of people had the highest percentage of them with normal BMI.

### Table 3.12: Association between lactating mothers BMI and household size

<table>
<thead>
<tr>
<th>HH Size</th>
<th>&lt;18.5</th>
<th>18.5-25</th>
<th>&gt;25</th>
<th>P≤0.005</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 - 4 People</strong></td>
<td>28(11.02)</td>
<td>48(18.89)</td>
<td>25(9.84)</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>5 -9 People</strong></td>
<td>6(2.36)</td>
<td>59(23.22)</td>
<td>47(18.50)</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>&gt;9 People</strong></td>
<td>0</td>
<td>9(3.54)</td>
<td>32(12.59)</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Respondents (percentage)

As seen from the table above, households with 5-9 people had the highest number of lactating mothers with normal BMI. These same households also had a high number of mothers at risk of overweight. At the same time, households with the most number of people had no underweight mothers. Households with the least number of people had the highest percentage of them with normal BMI.
3.4.8 Lactating Mothers’ Education and their Nutritional Status

The association between lactating mothers BMI and education is shown in Table 3.13. Lactating mothers with primary school education had the highest percentage of underweight at 30.1% than any other level of schooling. They were also had the highest percentage of lactating mothers who had normal BMI. Those with secondary school education (O level) were more likely to have normal BMI. There was a statistical significance between lactating mothers BMI and level of education $P \leq 0.126$.

<table>
<thead>
<tr>
<th>Education level</th>
<th>BMI Categories</th>
<th>p.v</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>&lt;18.5</td>
<td>18.5-25</td>
</tr>
<tr>
<td>Primary</td>
<td>3(5.7)</td>
<td>2(3.8)</td>
</tr>
<tr>
<td>Secondary</td>
<td>16(30.1)</td>
<td>11(20.7)</td>
</tr>
<tr>
<td>Tertiary</td>
<td>4(7.5)</td>
<td>2(3.8)</td>
</tr>
</tbody>
</table>

*Respondents (percentage)

3.4.9 Correlation between Some Socio-Demographic Characteristics and Dietary Intake of Nutrients

The Correlation between some socio-demographic characteristics and dietary intake of nutrients is shown in Table 3.14. There was a positive and significance relationship between occupation of the respondents and their dietary intake of iron, zinc, vitamin A, energy and protein $P \leq 0.005$. This was true in households of lactating mothers who practiced urban farming. They were able to get food from their farm to meet their dietary requirements however those who depended on income from manual labor proceeds had negative and insignificant relationship in meeting their dietary needs in this study $P \leq 0.012$.

There is also a positive correlation and significant relationship between dietary intake of iron, zinc, vitamin A, protein and energy and Age of the respondents. However, the study shows a
positive but insignificant relationship between dietary intake and income, and ethnicity of respondents. This means that, occupation and age determined a lot about the dietary intake of iron, zinc, vitamin A, protein and energy.

Table 3.14: Correlation between some socio-demographic characteristics and dietary intake of nutrients

<table>
<thead>
<tr>
<th>Variables</th>
<th>dietary intake of iron, zinc and vitamin A, protein and energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>0.126</td>
</tr>
<tr>
<td>Occupation</td>
<td>0.012**</td>
</tr>
<tr>
<td>Age</td>
<td>0.028*</td>
</tr>
<tr>
<td>Income</td>
<td>0.385</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>0.425</td>
</tr>
</tbody>
</table>

Correlation between the different characteristics is shown in Table 3.15. The results from the study shows that there is an associations among number of people living in household and occupation of mothers; number of people living in household and monthly income; number of people living in household and age of the mothers; occupation of mothers and age of the mothers. These were significant at P≤0.1. The monthly income and age of the mothers were highly correlated at P≤0.05 percent.
Table 3.15: Correlation between occupation, number of children and number of people in HH

<table>
<thead>
<tr>
<th></th>
<th>Monthly income</th>
<th>Size of HH</th>
<th>Occupation</th>
<th>Number of children</th>
<th>Children below 5 years</th>
<th>Head of the Household</th>
<th>Marital status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupation</td>
<td>N</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
<td></td>
<td></td>
<td>-.322**</td>
<td>-.303**</td>
<td>.198**</td>
<td>-.030</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
<td>.000</td>
<td>.000</td>
<td>.002</td>
<td>.630</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of children?</td>
<td></td>
<td></td>
<td></td>
<td>Pearson Correlation</td>
<td></td>
<td>.680**</td>
<td>-.271**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N</td>
<td>260</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of people</td>
<td></td>
<td></td>
<td></td>
<td>Pearson Correlation</td>
<td></td>
<td>-.196**</td>
<td>-.383**</td>
</tr>
<tr>
<td>in HH</td>
<td></td>
<td></td>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
<td>.002</td>
<td>.728</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N</td>
<td>260</td>
<td></td>
<td>260</td>
</tr>
</tbody>
</table>

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

There is a scientifically significant difference between the number of children in a household and the occupation of the mothers at p≤0.07.
Table 3.16: Correlation between age of the mothers, level of education and monthly income

<table>
<thead>
<tr>
<th></th>
<th>Monthly income</th>
<th>Size of HH</th>
<th>Occupation</th>
<th>Number of children</th>
<th>Children below 5 years</th>
<th>Head of the Household</th>
<th>Marital status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.151*</td>
<td>.498**</td>
<td>-.278**</td>
<td>.535**</td>
<td>.184**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.016</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of education</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.298**</td>
<td>-.154*</td>
<td>.208**</td>
<td>-.182**</td>
<td>-.188**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
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<td>.014</td>
<td>.001</td>
<td>.004</td>
<td>.003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td>260</td>
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<tr>
<td>Monthly income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>-.196**</td>
<td>-.199**</td>
<td>-.325**</td>
<td></td>
<td></td>
<td>-.021</td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.002</td>
<td>.001</td>
<td>.000</td>
<td></td>
<td></td>
<td>.737</td>
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<tr>
<td>N</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>House Hold size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>-.383**</td>
<td>.878**</td>
<td>.734**</td>
<td></td>
<td>-.302**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td></td>
<td>.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*, Correlation is significant at the 0.05 level (2-tailed).
**, Correlation is significant at the 0.01 level (2-tailed).
There is a scientifically significant difference between age, level of education, monthly income and household size at p≤0.3.
3.5 DISCUSSION

3.5.1 Age

The results in this study show that majority of the respondents were young people. As it appears, urban farming is not restricted to certain age groups as stated by Awuah, (2010). It is however most probable that since urban agriculture is small scale and far from having commercial drive, majority of the farmers are women.

A study in Ghana found that 63% percent of the urban farmers were in the age bracket of 21-40 years Ackerson and Awuah, (2010). In this study, the farmers in the age range 20 – 40 years were 73.6%. In Namibia as well, majority of the respondents 66.3% were young people falling in the age range of 21-40 Dima et al., (2002). A study in Eldoret, the mean age of urban farmers was 28 years Kadenyeka et al., (2013). In Gweru city, Zimbabwe, the average age was 41 years Jongwe (2014). Salau and Attah (2012 ) working in Nasarawa state Nigeria found that the mean age of the farmers was 50 years, although 35.56% were within the age range of 41–50 years followed by those within the range of 51–60 years at 24.44%. In their study Yusuf et al., (2015) found that the majority of farmers (76.1%) were aged 41-60 years. In Accra Ghana, 83% of the farmers were aged 40 years and over, only 17% were between 20-29yrs of age. None of the farmers was below 30 years Danso et al., (2004). It is however most probable that since urban agriculture is small scale and far from having commercial drive, majority of the farmers are women.

3.5.2 Marital Status

Majority were married (62.7%), Single mothers were 25.4%. The remaining mothers were either divorced or widowed and each at less than 10%. The marital status of the mothers was shown to contribute to their nutritional status. Most married lactating mothers had an overweight BMI. This could have been attributed to the fact that their partners were able to
provide them with food. Also married lactating mothers had husbands who probably were able to buy high quality and nutritious food for them compared to their counterparts who solely depended on themselves as bread winners for themselves and their family despite their lactating conditions.

Results of a study in Nigeria compare quite well with those of the current study where 90% of the respondents were married and only 7.78% were single Salau and Attah, (2012). However, a study in Namibia found that only 23.4% of the respondents were married while 58% respondents were single, 13.5% were cohabiting, 4% divorced and 6% separated Dima et al., (2002). In Samre Woreda, Ethiopia, 92.3% of the respondents were married, 5.8% divorced and 2% widowed Haileslassie et al., (2013). Again in Ibadan, Oyo states, Nigeria 90.9% of the farmers interviewed were married Yusuf, Balogun, & Falegbe, (2015).

3.5.3 Education Level

There were very few numbers of illiterate mothers contributing to 8.1% of the respondents. That means that most the mothers participating in the study had at least primary level education and that they were capable of accessing nutrition and health information from the common sources available. Most mothers with a higher education level had a normal BMI.

A study in Nigeria by Salau and Attah (2012) reported that 33.33% of the respondents had primary education, while 22.22% had secondary education. A study in Kumasi Ghana showed that 67% of the respondents had dropped out or completed basic education Ackerson and Awuah, (2010). A study in Eldoret, Kenya showed that the respondents with primary education level of education were 25% and Secondary 15% Kadenyeka et al., (2013). Another study in Nigeria showed that majority of the respondents (50.5%) had tertiary education while 25.4% had only secondary (Yusuf et al., 2015). In Accra Ghana a study showed that 33% of the respondents had primary education, 37% secondary and only 6% had Tertiary education (Danso et al., 2004).
3.5.4 Household Size

The household size in this study was higher compared to 3.9 the average household size in Kenya according to KDHS (2014). Larger households have a higher demand on family income and are thus using their resources to produce own food (Danso et al., 2004). In Ibadan, Oyo state, Nigeria, majority of the respondents (92.3%) had a household size of 4-8 (Danso, 2006). The household size affects the nutritional status of lactating mothers as seen in table 10 where lactating mothers households with the highest number of members, had lactating mothers who were underweight 29% and household whose members were less had 80% of lactating mothers with normal BMI.

In Pretoria, South Africa the average household counted 4.4 members (Averbeke, W.V 2007). In a study in Eldoret, the Mean household size was also 4 (Kadenyeka, M.V. et al., 2013). In Gweru city, Zimbabwe, the average household size was 4.62 (Admire, 2014). In a study in Namibia, majority of respondents had household sizes ranging from 3 to 8 persons. In Windhoek 76% of the respondents had family sizes of 3-8 persons, 22% had less than 3 persons per household and only 2% had members greater than 8. In Oshakati the respective figures were 71% with 3-8 persons, 11% with less than 3 persons and 18% with more than 8 persons living in their families (Dima, S.J et al., 2002).

3.5.5 Occupation

Majority of the respondents in this study were small scale business people (28.6%) in the informal sector and housewives (23.9%). These findings concur with those of Foeken and Mwangi (2000) who established that farming activities in the urban areas were mostly carried out on a part time basis by people in other livelihoods. Their participation in urban agriculture was to supplement their family food or income. These results concur with the result of a study done in Kibera a slum in Nairobi by Karanja (2013) where the respondents used sack gardening
as a source of income and home consumption. This study agrees with research conducted by the Planning Commission and the Ministry of Labor and Youth Development of Daresalaam (2006) which found that, about 30% of the urban population gains an income in the informal sector and about 6.5% of the informal urban workforce works in urban agriculture. Found (Mwangi, 2000) that, for 90% of interviewed periurban farmers, agriculture was their primary economic activity. Farming was the primary occupation of most (90%) farmers, although they all had other sources of supplementary income, such as trading, teaching, etc (Danso et al., 2004).

The results of Salau and Attah’s study (2012), showed that majority (63.33%) of the respondents were civil servants, 22.22% with trading as their major occupation while 14.45% were full time farmers. In Zimbabwe, Mudzengerere’s study (2014) showed that 55% of the respondents were unemployed whilst 24% worked in the informal sector. Only 13% were formally employed. In total, 87% of the interviewed people were unemployed and they were dependent on the informal sector for employment. In Pretoria, South Africa the contribution to mean total household income of employment was 67.1%, public welfare grants 16.0%, service provision 7.2%, trade 7.0%, transfers by kin 2.5% and agriculture 0.2% (Averbeke, 2007).

### 3.5.6 Food Frequency

The respondents in this study mainly consumed maize, rice, wheat and potatoes food items as starchy staples. Findings from this study also indicate that pigeon peas and green grams were the commonly consumed pulses and carrots were the frequently consumed vegetables. These are common foods consumed in Kenya. Their availability and accessibility are considered synonymous with food security.
Foods that were less frequently consumed include ground nuts, Green peas, arrow roots, yoghurt, Chicken and fish, probably influenced by affordability, familiarity and acceptability. For example majority of the communities in the area are not habitual eaters of fish.

According to Whitney and Rolfes (2016), wheat is rich in calcium and iron. Maize is rich in carbohydrates. Carrots are rich in vitamin A. Dark green leafy vegetables are rich in calcium vitamin A and many other minerals including zinc. Orange flesh sweet potatoes are rich in Vitamin A, Milk is rich in calcium and vitamin A. These foods were eaten frequently, and if the eaten quantities were adequate, then there was low likelihood of insufficient intake of the nutrients targeted.

Studies indicate that women can produce milk with adequate protein, carbohydrate, fat, and most minerals, even when their own supplies are limited (Whitney and Rolfes, 2016). For these nutrients milk quality is maintained at the expense of maternal stores. For calcium for example dietary calcium has no effect on the calcium concentration of breast milk, but maternal bones lose some density during lactation if calcium intakes are inadequate. Vitamins A in breast milk is likely to decline if inadequate dietary intakes are prolonged.

3.5.6.1 Vitamin A and mineral intakes

This study indicated that most respondents’ sources of Vitamin A came from dark green leafy vegetables agreeing to what Sanusi and Adebiyi (2009) reported that the diets of populations in tropical countries rarely contain large amounts of milk, eggs and liver which are rich sources of preformed vitamin A. This thus makes people depend on carotenoids particularly from leafy vegetables and palm oil as sources of vitamin A. Affordability of animal food items that contain vitamin A is also a challenge to the study population which contains majority of them who have low income since it’s a slum area.
Whitney and Rolfes (2016) state that dark green, deep orange vegetables and fruits and fortified foods such as milk contribute large quantities of vitamin A. Some foods are rich enough in vitamin A to provide the RDA and more in a single serving. Carrots and sweet potatoes are two of the best sources per kcal which the respondents took almost every day. The deficiency may have been because they were not taking enough of Vitamin A rich foods to cater for the demand of both mother and baby.

### 3.5.6.2 Energy

A study of energy requirement in exclusively breastfeeding women cited a total energy cost of approximately 623 Kcal per day assuming 750 grams of milk produced at 0.67 Kcal/g and 80% efficiency (Whitney and Rolfers, 2014). With mobilization of approximately 170 kcal per day, net energy needs were estimated at approximately 450 Kcal per day (Brown, et al., 2011). According to Whitney and Rolfes (2016), most women need at least 1800 kcal a day to receive all the nutrients required for successful lactation. The women with the lowest energy intakes in this study took 612 Kcal, while others were higher than the recommendation. This could have been contributed by the fact that most lactating mothers consumed the food they produced which were largely maize and beans in this baseline study. They also had avocado trees planted in their compounds and most of them consumed avocado and ‘githeri’ which is a mixer of maize and beans this is according to the observation by the researchers. This means they were within the recommended range. The respondents’ distribution of total calories from carbohydrate ranged from 29.1% to 134.25% kcal. This shows that carbohydrates consumption was high in this study.

### 3.5.6.3 Proteins

The mean protein intake of the lactating women was low compared to the recommended intakes by WHO/FAO/UNU (2007). The age group of less than 20 years had only one mother who had
very low intake of protein at 13.8g; this was very low compared to the recommended amount of 60g. According to Chen et al., (2012) lactating women require dietary protein for synthesis of the protein in breast milk, and for the growth, maintenance and repair of cells. With this deficiency, there is possibility of lowered protein intake by the child from the milk, leading to poor growth of the children in exclusive breast feeding.

3.5.6.4 Nutritional status

Findings from this study show that the highest percentage (47%) of the respondents had a underweight BMI. Therefore for them to have improved in their dietary intake inorder to improve on the body weight they ought to have improved on their dietary intakes. The Dietary Reference Intakes (DRIs) for normal-weight lactating women are based on the assumption that the energy spent for milk production is 500 Kcal per day in the first 6 months and 400 Kcal afterward (Butte & King, 2005). Lactating mothers require an addition of 400kcal of energy in addition to the amount of RDA recommended for their non- pregnant non-lactating counterparts (Shabert, 2004). This low energy percentage, means lactating mothers in this study were likely to suffer from energy deficiencies and this can impact negatively to themselves and the infant leading to breastfeeding malnutrition or “failure to thrive” in infants. These findings concur with those of Sharbargh et al., 2005, which showed that women with both macronutrients deficiencies suffered from breastfeeding malnutrition. Severe energy restriction may hinder milk production. The fact that 23% of the respondents were overweight could be due to the weight gained during pregnancy which they may not have managed to shed off. It could also be due to the fact that some women tend to overeat while breastfeeding (Brown, J. E. et al., 2011). In addition, the BMI recommendation for normal adults was used in classifying the lactating women in this study, since there is no recommended standard for the category. This could have positioned majority of the women in the overweight and obese categories.
Jayawardena et al., (2013) argue that diets that offer a greater variety of energy-dense foods could increase food intake and body weight. Overweight in lactation can lead to other problems that can hinder smooth running breastfeeding, like diabetes which could have graduated from gestational diabetes. A study done by Rasmussen and Kjolhede, 2004, found that overweight or obese lactating mothers had a lower prolactin response to infant suckling, which can compromise milk production and lead to early cessation of breastfeeding. Therefore mothers should be encouraged to consume vegetables in large quantities, so that these can help them not consume a lot of calorie dense foods and they also benefit from micronutrients in these vegetables, thus prolonging breastfeeding in a healthy state.

Having majority of lactating women in this study in the underweight category could have been contributed by the fact that this being a slum area with majority of them with low income it was difficult for them to generate enough money to buy food so that they can increase their food consumption in lactation (Brown et al., 2011). They were also engaged in manual labor which could have contributed to increased weight loss.

Majority of the respondents who were underweight had low levels of education and were housewives. This concurs with the results of research published by CFSVA (2005) that state that households with no education are most likely to be considered food insecure. The results of the present study do not agree with the study among a group of Brazilian lactating women which showed a high prevalence of overweight despite a lower energy intake below the recommended level (Tavares et al., 2013). Food consumption frequencies subsume that the respondents consumed larger quantities of energy foods more frequently. There is a positive and significance relationship between the nutritional status of lactating mothers and the level of income. Households with high income had majority of lactating
mothers with a normal BMI 83%, while those with low income had lactating mothers who were underweight 61%. In this study lactating mothers whose households had least members had a normal BMI 80% while those with members above nine were underweight 29%. This is supported by the fact that the study area is a slum area with most people depending on manual labor for a living making it difficult to get enough resources for food and other needs of the family such as education and health. This study concurs with the study done by Maswikaneng. J. M (2007) in Atteridgeville, Pretoria, which found a positive and significance correlation between households which participated in urban farming and their nutritional status.

Focus group discussions and key informers showed that majority of respondents started giving complementary feeds to their children between two to three months. They gave lack of food to eat after breast feeding and lack of breast milk as reasons for giving supplementary feeds before six months. Lactating mothers also gave lack of space for farming as reasons why they did not participate in urban farming. They also required advice on how to grow vegetables and fruits for own consumption and for sale. Majority of them did not keep small animals like rabbits and goats due to lack of space. Some respondents kept chicken in form of local and broilers for sale and also for consumption. The respondents also had a poor health seeking behavior since majority of them gave birth at home and did not seek advice from the local clinic especially on how to feed their infants thus failing to follow exclusive breastfeeding for six months as per WHO recommendation. Due to their low income majority of the respondents left their infants under the care of relatives and neighbors to go look for manual jobs to get money to purchase food and buy other facilities for the family.

3.6 CONCLUSION

More than half of the respondents had achieved primary education and they had a normal BMI while those who were underweight were those with little or no education. Majority of the
respondents participated in urban agriculture and this is used to improve food access in the study population which is a slum area with majority of respondents with low income making it difficult for them to purchase food for their households from the available markets. Most of the respondents were not meeting their dietary intake for the selected micronutrients in the study. This could be attributed to the fact that in poor environments people have a tendency of consuming energy and carbohydrates rich foods which are cheap and readily available in bulk unless fruits, vegetables and protein food.

The dietary intakes of energy and protein were found to be moderate as represented by mean percent RDAs for each group. The intakes of vitamin A showed there were deficiencies among the lactating women of all age groups studied as well as the intakes of iron and zinc.

The nutritional status as represented by BMI found majority of the mothers had underweight BMI and comparison among the age groups showed that some women met their requirements though still at low percentages, while comparison among the socio-economic categories showed that the nutritional status of women with low income highly affects the women and most of these women do not meet their requirements and end up being underweight. The dietary intake was found to be positively correlated with intake of minerals, carbohydrates, proteins and fats while the nutritional status was found to be correlated with occupation and education.

3.7 RECOMMENDATION

It is recommended that most urban dwellers be made aware of the importance of urban agriculture, extensive use of urban farming can help households with lactating mothers improve on their dietary intake and thus improve their nutritional status. Diversification of urban farming to fast growing crops and crops with higher nutritional benefits to vulnerable groups should be done. Further research is recommended on the impact of high-value-crops and use of irrigation in heightening food security predicaments that face slum dwellers in Kenya.
ABSTRACT

African leafy vegetables have been found to have high levels of micronutrients, which makes them good vehicles for micronutrient intervention. The vegetables are easy to grow and they possess familiar tastes to many African communities. This study was therefore designed to analyze the vegetables that were used for nutritional intervention in lactating mothers for proximate composition and micronutrient contents, so as to be able to calculate their contribution to dietary micronutrient intake. The micronutrients analyzed were beta-carotene for vitamin A, iron and zinc. The vegetables were grown and consumed by the mothers in a periurban area of Nairobi Metropolis. The vegetables included Amaranthus (*A. dubius*), black nightshade (*Solanum nigrum*) and cow pea leaves (*Vigna unguiculata*). The analyses were done on raw, boiled and stewed vegetables. The vegetables were grown as separate stands open fields owned by the mothers or in organoponics and multistoreys in case of mothers who lacked open fields. All vegetables were grown under similar conditions of soil, manure application and watering. Using random sampling between week 4 and 7 the vegetables were picked in approximately 1 kg batches in early morning, placed in black polythene bags (gage 250), then transported to the Laboratory of the Department of Food Science, Nutrition and Technology within two hours. The samples were grouped into three that is, raw, boiled and stewed, and for each sample, analysis was done in triplicate. For proximate composition, 350gms of raw edible portion was chopped, placed in a porcelain dish then dried in an air-oven at (temperature) to constant weight. The dry residues were ground using a laboratory hammer mill to a fine powder. The powder was used for analysis of proximate composition iron and zinc by AOAC methods (AOAC, 1980). Vitamin A was analyzed as beta-carotene using colorimetric method.
The boiled vegetables were prepared by placing 300g of fresh edible vegetables with 300ml water and boiled for five minutes and draining through a colander, then 250gms of the boiled sample was stewed using 15gms onion, 5ml cooking oil for five minutes. 2gms of boiled and stewed samples were used for analysis of proximate composition of iron and zinc by AOAC methods (AOAC, 1980). Vitamin A was analyzed as beta-carotene using calorimetric methods. Data analysis was done using one way-ANOVA at P≤0.05. The results showed that there is a statistically significant difference in beta-carotene, iron and zinc between the three vegetable groups and no statistically significant difference of the micronutrients in the method of cooking of each vegetable. There is a statistically significant difference in the amount of total ash, moisture, soluble carbohydrates and energy between the three vegetables; however there is no statistically significant difference in the amounts of lipids where boiled amaranth had highest at 1.7±0.02, followed by boiled cow pea leaves at 1.4±0.04 and the least was black nightshade at 1.05±0.01, crude protein was highest in boiled blacknightshade at 40.1±0.03, followed by boiled amaranth at 34.2±0.02, then boiled cowpea leaves at 26.1±0.05 and crude fibre was highest in the boiled sample cowpea leaves at 22.4±0.03, followed by boiled black night shade at 16.2±0.01, the least was amaranthus at 14.10±0.04 between the three vegetables. The three leafy vegetables were found to manifest high levels of beta carotene, iron and zinc, and the levels did not reduce very much after boiling and stewing. Amaranth contributed to the lactating mothers mean RDA intake of vitamin A, iron and zinc than any other vegetable.
4.1 INTRODUCTION

Optimal micronutrient status is essential for the health, psychological well-being, and work capacity of women (Bartley et al., 2005; Kennedy and Meyers, 2005). Micronutrients are known to be lacking in diets, particularly of the socio-economically disadvantaged sections of the population in developing countries (Seshadri, 2001). This is more so with the lactating mothers who need the nutrients in their diets for quality milk production. Among the important micronutrients today are beta carotene (which is converted to vitamin A in the body), iron and zinc whose deficiencies are rampant in women. In a mostly vegetarian diet, these nutrients are well obtainable from the commonly consumed vegetables, including green leafy vegetables (Maina and Mwangi, 2008).

Consumption of African Leafy Vegetables is quite common in households and is even on the increase. These vegetables have been found to be richer in beta carotene and minerals than their exotic counterparts such as spinach and cabbage (Maina and Mwangi, 2008). Although it is alleged that the availability of vitamin A from these vegetables is low, the manner in which they are prepared for consumption which involves stewing with oil makes the vitamin more readily absorbable by the body (Rolfers and Whitney, 2016). Amaranth provides non-negligible amount of protein. A quantity of 180g fresh, a portion that can easily be consumed with two meals, it fulfills in itself more than 90% of daily requirement of iron and almost 80% of provitamin A. Then lactating mothers can get the reminder from other food groups in the diet. A portion size of 300g from vegetables should be able to meet the daily requirement for most nutrients especially where other nutrients like animal products (meat, fish, and daily products) are lacking (Thomson and Amoroso, 2011). To satisfy the nutritional requirements of lactating mothers their diet should compose of 200g of fresh vegetables per day, or 75kg per head per year, must be included as individual dietary targets (WHO, 2004).
Home production of traditional green leafy vegetables in Africa has served as small scale enterprises that have resulted to viable business model (Besong et al., 2001). Production of these vegetables can serve as a useful tool to for reduction of poverty and hunger in African countries (Ronsmans et al., 2008). The revenue generated when these vegetables are sold can serve as an important contributor to income, that can be used to enhance nutrition security, access to family health care and consequently enable women to acquire financial independence from husbands (IITA, 2003). In Kenya many traditional vegetables have been grown for consumption, some are fully domesticated, others are semi-domesticated and majority is collected from the wild for consumption in households (Besong et al., 2001). The most commonly consumed traditional green leafy vegetables are *Amaranthus spp* (pig weed), *Vigna spp* (cowpea leaves), *Solanum nigrum* (blacknightshade), *Cleome gynandra* (cat’s whiskers), *Cucumba spp* (pumpkin leaves), *Corchorus spp* (jute). These vegetables have been reported to be rich in vitamin A, iron and zinc. The vegetables are also rich in vitamin C, protein, fiber and minerals such as phosphorus and calcium (Akindah and Salwu, 2005, Orech et al., 2005).

Production of green leafy vegetables requires very little input, save for farm yard manure which is usually available in homes where animals like dairy goats, dairy cows and exotic poultry are kept. The vegetables take a short time to mature around two months after planting. Harvesting is usually done in three methods.

1. Picking the tender branches and edible parts
2. Picking the tender branches
3. Cutting entire plants at close of the ground level or uprooting the plants.

The quantity of micronutrients in vegetables is sometimes difficult to be assessed considering the amount of water content that they portray. Some food like vegetables absorb water during cooking although in varying amounts. Dry Matter (DM) is more appropriate denominator when
comparing the nutritive value of vegetables and other foods. Losses of cooking and bioavailability of the nutrient such as vitamin A, iron and zinc from vegetables must be put into consideration when linking the scales of nutritional requirement for food composition tables (Stadlynaryy et al., 2012).

Vegetable production is practiced in peri-urban areas especially in cities so long as there is irrigation water. The areas include rivers, marshy places and road sides. These areas are near a market so production in urban areas is more linked to income generation than consumption (Fondio et al., 2007). These producers grow vegetables that take a short time to mature such as amaranth, Africa night shade, cowpeas, African kale, jews mallow, tomatoes and egg plant (Fondio et al., 2007).

Deficiencies of vitamin A, iron, and zinc often coexist and have independent and interacting effects on health, growth, and immune-competence (Tavares et al., 2013). Iron deficiency is the most important cause of nutritional anemia; and leads to impairment of health, growth, development, and performance (Stadlynaryy et al., 2012). Vitamin A deficiency has also been shown to contribute to anemia and stunting in children (Roman and Steryn, 2016). Dietary interventions or supplementation can increase the secretion of many of the micro nutrients in breast milk, and improve infant nutritional status. (Ronsman et al., 2008).

Zinc is an important nutrient. The American Dietetics Association stated that “zinc is critical to the proper function of more than 80 enzymes in the body” (Insel et al., 2004). This seemingly significant mineral is vastly important to the proper functioning of the body. Zinc is considered a trace element, yet its partnership with these enzymes makes it a nutrient which is essential for good health. Zinc is also a very important component of every cell. Zinc helps to form the
structure of the body cells, preventing them from their shape collapsing (Blake, 2008). Zinc requirements and concentrations are quite high soon after birth but over the early weeks post partum normally decline precipitously (Ronmans et al., 2008). During lactation there is an increased maternal loss of zinc that is secreted into human milk (Tavares et al., 2013). The concentration of zinc in human milk is highest in colostrum and progressively declines with the duration of lactation. There are no body stores of zinc so daily intake of zinc is needed to maintain adequate body levels. Leafy green vegetables are a good source of zinc and especially to lactating mothers 0-6 postpartum (Jaarsveld, 2006). Deficiency of zinc leads to growth restrictions (delayed bone maturation), impaired immune function, and susceptibility to infections, diarrhea, lethargy and anorexia (Mibe, 2011).

Inadequate micronutrient status is brought about by lack of diet diversity and a high prevalence of infection in many developing countries (Adelman et al., 2008). This is particularly a severe problem among poor populations in the developing world, where diets green leafy vegetables are plant species and the parts that are utilized for nutrient provision are the leaves, and the young succulent stems may be included and so are the fruits and the flowers. (Jansen et al., 2007). The production, processing and commercialization of traditional African vegetables are on the rise but the potential remains underexploited. The most commonly consumed and fully domesticated traditional vegetables in Kenya are the Amaranthus spp. (Pig weed), Vigna spp. (Cowpea leaves), Solanum spp. (Black nightshade), Cleome gynandra (Cat's whiskers), Cucurbita spp. (Pumpkin leaves) and Corchorus spp. (Jute/Bush okra) (Hanif and Rasheed, 2006).
4.2 OBJECTIVE

The objective of this study was to analyze the three vegetables amaranthus, blacknightshade and cow peas used in the nutrition intervention for iron, zinc and beta carotene, and proximate composition.

4.3 METHODOLOGY

The study targeted three vegetables these were *Vigna unguiculata*, *Amaranthus spp* and *Solanum nigrum*. The vegetables were distributed to 53 lactating mothers who grew these vegetables as pure stands. 26 mothers each used three multi-storey gardens, while 21 mothers each used three organoponics gardens and only 6 mothers each used open fields which were divided into three sections each measuring 3m*10m. Soils and manure were supplied to the mothers to create similar basal environment and reduce effects of confounding factors on the three nutrients to be determined. Soil and manure were well mixed at a ratio of 1:1. The mixture was then put in the multistory gardens (each garden was *1m* in size), organoponics each measuring (2m² base and 0.5mm height) and open fields sections.

Seeds of *Amaranthus* (*A. dubius*), blacknightshade (*Solanum nigrum*) and cowpea (*vigna unguiculata*) were bought from Kenya Seeds Company Limited shops in Nairobi. The seeds of Amaranthus (*A. dubius*) and blacknightshade (*Solanum nigrum*) were first mixed with fine soil in the ratio of 1:4 before planting, while cow peas seeds were planted 1 seed per hole In the multistory garden and organoponics garden 200 seeds of each vegetable were planted at a spacing of 25cm*25cm as pure stands. In the open fields each section was planted with pure stands of the seeds at a spacing of 30cm*30cm and a depth of 0.5cm. Between the sections was a foot path measuring 0.5m long. Each section was planted with each vegetable.
The vegetables were irrigated three days per week. Weeding was done shallowly from time to time on vegetable on open fields to ensure that no weeds grew. At week 4-7 the vegetables were harvested and sampled for analysis.

4.3.1 Sampling of Vegetables for Analysis

Sampling for analysis was done three times over the period. Usual, sampling was done from 16 mothers (2 open field, 8 multistorey and 6 organoponics) selected randomly and the vegetables from each production system were bulked for analysis. It was also assumed that during this period, the mothers were harvesting and consuming the vegetables.

Vegetables were harvested early in the morning by breaking the main shoot which consisted of the stalk and leaves at the vegetative stage. One kilo of each vegetable was harvested. They were immediately transported to the Laboratory of the Department of Food Science, Nutrition and Technology within 2 hours for analysis in black polythene bags.

4.3.2 Preparation of the Vegetables for Analysis

Raw sample

About 350g of the edible parts of each raw vegetables sample was separately finely chopped using a knife and chopping board and thoroughly mixed.

Boiled sample

300 grams of each chopped vegetable samples were separately boiled in 300mls of water for 5 minutes before analysis.

Stewed sample

250gms of each boiled vegetable sample was then separately stewed using 15gms onion, 5ml cooking oil for 5 minutes.
4.3.3 Determination of Beta-Carotene
Beta carotene was determined using Method No. 44 of International Federation of Fruit Juice producers adopted in 1972. 2g of vegetable was ground using a mortar and pestle and total carotenoids extracted completely using acetone then topped to 50ml mark. Half of this was dried in a rotary evaporator at 60°C until all the liquid evaporated and the residue deposited on the inside wall of the volumetric flask. The concentrated extract was then dissolved in 1ml petroleum spirit. The separation of beta carotene from the total carotenoids was done using a chromatographic column packed with silica gel as the fixed media and petroleum spirit as the mobile media. Beta carotene which is usually the first yellow color elute was received in a 25ml volumetric flask. The absorbance was read in Spectrophotometer (Cecil 4400, England) at 450nm wave length. The amount of beta carotene was calculated using the standard curve as - Concentration/absorbance spectrophotometer reading. All analysis was done in triplicate.

4.3.4 Determination of Iron and Zinc
Iron and zinc were analyzed at the Department of Mines and Geology, Ministry of Environment and Natural Resources laboratories. The two minerals, Iron and Zinc was determined by use of Atomic Absorption Spectrophotometer (AAS) method and each mineral has its own lamp (AOAC, 1980). The standards for each mineral were used during the determination for calibration and to ensure the readings were within the normal curves. The sample was dried at 110°C for 1 hour then ground. 1 gram was digested with 20ml concentrated nitric acid on a hot plate at 60°C until nitrogen dioxide (brown gas) disappeared and the volume was reduced. The mixture was cooled slightly then 2ml of hydrogen peroxide was added and returned to the hot plate for a few minutes when the solution cleared after any remaining solids had been oxidized. The same was filtered and topped to 50ml with distilled water then read on the Atomic Absorption Spectrophotometer. All analysis were done in triplicate.
4.3.5 Determination of Proximate Composition

Micronutrient of fresh vegetables were determined by drying 2.5g of fresh vegetables in an air oven 105°C overnight to a constant weight (AOAC, 1980). Moisture content, crude protein, crude lipid, crude fiber, total ash and soluble carbohydrates were determined by finding the differences in the samples. Energy in (Kcal/100g) was calculated using the Witwater factor. All compositions were done using references on Association of Official Analytical Chemists (AOAC, 1980). All analysis were done in triplicate.

4.4 STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS version 20 (SPSS Inc: Chicago USA). Data was entered in excel then exported to SPSS and cleaned before analysis. Analysis was by one-way analysis of variance (ANOVA) followed by Kruscal Wallis multiple comparisons per post hoc test. Results were expressed as mean #SD of triplicate samples. Differences were considered significant at 95% confidence interval (p≤.05).

4.5 RESULTS

4.5.1 Beta Carotene, Iron and Zinc Composition

The results on the composition of beta carotene Iron and Zinc of the three green leafy vegetables used by the lactating mothers are shown in table 4.1.
Table 4.1: Micronutrient contents of the fresh and cooked vegetables (mg/100g dmb)

<table>
<thead>
<tr>
<th></th>
<th>Beta Carotene mcg Retinal/100g</th>
<th>P Value</th>
<th>Iron(mg/100g)</th>
<th>P Value</th>
<th>Zinc (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cowpeas</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw</td>
<td>436 ±0.00</td>
<td></td>
<td>4.5 ± 0.10</td>
<td></td>
<td>0.63 ± 0.02</td>
</tr>
<tr>
<td>Boiled</td>
<td>988 ± 2</td>
<td>0.05</td>
<td>1.9 ± 0.10</td>
<td>0.02</td>
<td>0.27 ± 0.04</td>
</tr>
<tr>
<td>Stewed</td>
<td>1496 ± 1</td>
<td>0.05</td>
<td>9.3 ± 0.30</td>
<td>0.03</td>
<td>1.72 ± 0.01</td>
</tr>
<tr>
<td><strong>Amaranthus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw</td>
<td>490 ± 3</td>
<td></td>
<td>4.42 ± 0.02</td>
<td></td>
<td>0.82 ± 0.01</td>
</tr>
<tr>
<td>Boiled</td>
<td>1204 ± 0.84</td>
<td>0.06</td>
<td>2.1 ± 0.20</td>
<td>0.02</td>
<td>0.32 ± 0.01</td>
</tr>
<tr>
<td>Stewed</td>
<td>2467 ± 5.00</td>
<td>0.05</td>
<td>11.9 ± 0.20</td>
<td>0.04</td>
<td>2.05 ± 0.05</td>
</tr>
<tr>
<td><strong>Black Night Shade</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw</td>
<td>499 ± 4.17</td>
<td></td>
<td>3.7 ± 0.30</td>
<td></td>
<td>0.52 ± 0.01</td>
</tr>
<tr>
<td>Boiled</td>
<td>1418 ± 10.00</td>
<td>0.04</td>
<td>2.7 ± 0.20</td>
<td>0.03</td>
<td>0.33 ± 0.01</td>
</tr>
<tr>
<td>Stewed</td>
<td>1914 ± 5.84</td>
<td>0.06</td>
<td>8.5 ± 0.40</td>
<td>0.01</td>
<td>3.71 ± 0.21</td>
</tr>
</tbody>
</table>

These are means of triplicate samples (means ± SD)
Beta carotene was found to be highest in the stewed amaranth at 2466 ±5.00 µ/100g followed by the stewed blacknightshade at 1914.17 ± 5.84 µ/100g and least in the cowpea leaves at 988.33± 1.66 µ/100g. This is because they were analyzed in the dry matter content due to concentration of solutes. Analysis of vegetables shows that there is a significance difference in beta carotene contents between the three vegetables, however there is no significant difference in beta carotene levels between the three methods of cooking per vegetable.

Iron was found to be highest in the stewed amaranth at 11.9± 0.20 mg/100g followed by stewed cowpea leaves at 9.3±0.30mg/100g and least in the boiled cowpea leaves at 1.9 ±0.10mg/100g. Iron analysis on vegetables shows that there is a significance difference in iron between each of the three vegetables, however there is no significant difference between the three methods of cooking per vegetable. The P value was 0. The differences were considered significant at 95% confidence interval (p≤0.05).

Zinc was found to be highest in stewed black night shade at 3.71± 0.21mg/100g, followed by stewed amaranth at 2.05±0.05mg/100g and least in boiled cowpea leaves at 0.27±0.04mg/100g. This shows that there is a significance difference between zinc content in each of the three vegetables, however there is no significant difference in zinc content between the three methods of cooking per vegetable at 95 % confidence and P≤0.05.

4.5.2 Proximate Composition of the Vegetables

The results on proximate analysis are shown in Table 4.2. They show that there is a statistically significant difference in the amount of total ash, moisture, soluble carbohydrates and energy between the three vegetables; however there is no statistically significant difference in the amounts of lipids, crude protein and crude fiber between the three vegetables.
Table 4.2: Proximate Composition of the Vegetables - Component Content as Percent on dmb

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Moisture</th>
<th>P.V</th>
<th>Crude proteins</th>
<th>P.V</th>
<th>Lipids</th>
<th>P.V</th>
<th>Crude fiber</th>
<th>P.V</th>
<th>Total ash</th>
<th>P.V</th>
<th>Soluble carbohydrates</th>
<th>P.V</th>
<th>Energy (Kcal/100g)</th>
<th>P.V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cowpeas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw</td>
<td>86.71 ±</td>
<td>32.1 ±</td>
<td>3.23 ±</td>
<td>14.4 ±</td>
<td>20.0 ±</td>
<td>39.0 ±</td>
<td>277.8 ±</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.14</td>
<td>0.04</td>
<td>0.04</td>
<td>0.03</td>
<td>± 0.31</td>
<td>± 0.06</td>
<td>± 0.76</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boiled</td>
<td>89.06 ±</td>
<td>0.01</td>
<td>26.1 ±</td>
<td>0.01</td>
<td>22.4 ±</td>
<td>0.05</td>
<td>10.6 ±</td>
<td>0.001</td>
<td>39.4 ± 0.19</td>
<td>0.02</td>
<td>320.6 ± 3.77</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.26</td>
<td>0.05</td>
<td>0.04</td>
<td>0.03</td>
<td>± 0.03</td>
<td>± 0.13</td>
<td>± 0.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stewed</td>
<td>60.62 ±</td>
<td>0.02</td>
<td>16.5 ±</td>
<td>0.02</td>
<td>16.5 ±</td>
<td>0.06</td>
<td>7.5 ±</td>
<td>0.02</td>
<td>13.2 ± 0.22</td>
<td>0.01</td>
<td>530.3 ± 1.50</td>
<td>0.03</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>0.21</td>
<td>0.08</td>
<td>0.08</td>
<td>0.02</td>
<td>± 0.02</td>
<td>± 0.03</td>
<td>± 0.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amaranthus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw</td>
<td>80.49 ±</td>
<td>29.5 ±</td>
<td>1.2 ±</td>
<td>10.7 ±</td>
<td>18.5 ±</td>
<td>40.0 ±</td>
<td>289.3 ±</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.17</td>
<td>0.05</td>
<td>0.03</td>
<td>0.05</td>
<td>± 0.02</td>
<td>± 0.15</td>
<td>± 0.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boiled</td>
<td>86.10 ±</td>
<td>0.01</td>
<td>34.2 ±</td>
<td>0.01</td>
<td>14.10 ±</td>
<td>0.01</td>
<td>14.8 ±</td>
<td>0.001</td>
<td>35.1 ± 0.13</td>
<td>0.01</td>
<td>292.9 ± 0.62</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.16</td>
<td>0.02</td>
<td>0.02</td>
<td>0.04</td>
<td>± 0.04</td>
<td>± 0.01</td>
<td>± 0.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stewed</td>
<td>44.59 ±</td>
<td>0.02</td>
<td>16.5 ±</td>
<td>0.02</td>
<td>10.5 ±</td>
<td>0.02</td>
<td>10.7 ±</td>
<td>0.002</td>
<td>13.1 ± 0.13</td>
<td>0.02</td>
<td>560.2 ± 0.36</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.01</td>
<td>0.08</td>
<td>0.04</td>
<td>0.03</td>
<td>± 0.03</td>
<td>± 0.13</td>
<td>± 0.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Black night shade
<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>87.18 ± 0.04</td>
<td>31.4 ± 0.02</td>
<td>1.7 ± 0.02</td>
<td>9.8 ± 0.01</td>
<td>15.2 ± 0.01</td>
<td>41.8 ± 0.08</td>
<td>308.4 ± 0.06</td>
</tr>
<tr>
<td></td>
<td>88.68 ± 0.4</td>
<td>40.14 ± 0.03</td>
<td>1.05 ± 0.01</td>
<td>16.2 ± 0.01</td>
<td>10.2 ± 0.01</td>
<td>33.4 ± 0.29</td>
<td>296.2 ± 0.34</td>
</tr>
<tr>
<td></td>
<td>57.95 ± 0.2</td>
<td>19.4 ± 0.08</td>
<td>48.0 ± 0.03</td>
<td>13.2 ± 0.01</td>
<td>9.2 ± 0.05</td>
<td>10.1 ± 0.21</td>
<td>550.5 ± 0.87</td>
</tr>
</tbody>
</table>
ANOVA analysis of proximate composition in the three vegetables shows that there is no statistically significant difference in the amounts of lipids between the three vegetables however the method of cooking each vegetable showed there was a statistically significant difference in the lipids levels at P≤0.05.

4.5.2.1 Crude protein

This shows that there is no statistically significant difference in the amounts of crude proteins between the three vegetables however the method of cooking each vegetable showed there was a statistically significant difference in the crude proteins levels at 95% confidence and P ≤ 0.05.

4.5.2.2 Total ash

This shows that there is a statistically significant difference in the amounts of total ash between the three vegetables however the method of cooking each vegetable showed there was no statistically significant difference in the total ash levels at P≤0.05.

4.5.2.3 Crude fiber

This shows that there is no statistically significant difference in the amounts of crude fiber between the three vegetables however the method of cooking each vegetable showed there was a statistically significant difference in the crude fiber levels at P≤0.05.

4.5.2.4 Moisture

There is a statistically significant difference in the amounts of moisture between the three vegetables however the method of cooking each vegetable showed there was no statistically significant difference in the moisture levels at P≤0.05.

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4.5.2.5 Soluble carbohydrates

There is a statistically significant difference in the amounts of soluble carbohydrates between the three vegetables however the method of cooking each vegetable showed there was no statistically significant difference in the soluble carbohydrates levels at P≤0.05.

4.5.2.6 Energy

There is a statistically significant difference in the amounts of energy between the three vegetables however the method of cooking each vegetable showed there was no statistically significant difference in the energy levels at P≤0.05.

4.5.3 Food Consumption Frequency

Results on the consumption frequency of the three vegetables as a source of beta carotene, iron and zinc are shown in table 4.3.
Table 4.3: Frequency of vegetable consumption of beta carotene, iron and zinc

<table>
<thead>
<tr>
<th>Food item</th>
<th>Daily Frequency</th>
<th>3-6 times a week Frequency</th>
<th>1-2 times a week Frequency</th>
<th>Once a month Frequency</th>
<th>Nutrient Intake (mg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beta carotene</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amaranthus</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td>9</td>
<td>11.2</td>
</tr>
<tr>
<td>Cow peas</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>7.2</td>
</tr>
<tr>
<td>Blacknight shade</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>11.33</td>
</tr>
<tr>
<td><strong>Iron</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amaranthus</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>0.0196</td>
</tr>
<tr>
<td>Cow peas</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>0.0139</td>
</tr>
<tr>
<td>Black night shade</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>0.0216</td>
</tr>
<tr>
<td><strong>Zinc</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amaranthus</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>0.0029</td>
</tr>
<tr>
<td>Cow peas</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>0.0019</td>
</tr>
<tr>
<td>Black night shade</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>0.0026</td>
</tr>
</tbody>
</table>
The nutrient intake is based on assumption that each person is taking 200mg per meal and their daily intake is based on one meal only, either lunch or dinner. The intakes are also calculated on the basis of boiled vegetables only because it was the most popular method of preparation. The most frequently consumed vegetable is amaranth with the highest frequency being 4 times daily and at least 6 times weekly). The second frequently consumed vegetable was cowpeas at least twice daily and 3 times weekly. Black night shade was the least consumed vegetable at least once daily and twice weekly.

Mean RDA intake percent from the three vegetables.

4.5.4 Contribution of the Three Vegetables to the Dietary Intake of the Lactating Mothers

The contribution of the three vegetables to the dietary intake of the mothers in the vitamin A, iron and zinc are shown in table 4.4.
Table 4.4: Dietary intake of vitamin A, Iron and Zinc from the three vegetables (P≤0.05)

<table>
<thead>
<tr>
<th>Vitamin-A</th>
<th>n=53</th>
<th>DIETARY INTAKE</th>
<th>MEAN RDA INTAKE</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CPL</td>
<td>AMAR</td>
<td>BNS</td>
</tr>
<tr>
<td>Years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 20</td>
<td>1</td>
<td>420.0 ± 0.0</td>
<td>390.1 ± 0.0</td>
<td>520.1 ± 0.0</td>
</tr>
<tr>
<td>20-25</td>
<td>15</td>
<td>490.23 ± 40.0</td>
<td>425.6 ± 45.4</td>
<td>458.1 ± 82.2</td>
</tr>
<tr>
<td>26-30</td>
<td>13</td>
<td>595.5 ± 14.6</td>
<td>660.6 ± 60.4</td>
<td>505 ± 34.1</td>
</tr>
<tr>
<td>31-35</td>
<td>16</td>
<td>624.5 ± 45.7</td>
<td>906.4 ± 16.4</td>
<td>548.9 ± 90.9</td>
</tr>
<tr>
<td>36-40</td>
<td>5</td>
<td>380.9 ± 78.4</td>
<td>926.5 ± 62.5</td>
<td>715.4 ± 16.5</td>
</tr>
<tr>
<td>41-45</td>
<td>2</td>
<td>421.9 ± 69.1</td>
<td>875.6 ± 54.9</td>
<td>810.5 ± 79.8</td>
</tr>
<tr>
<td>46-49</td>
<td>1</td>
<td>675.9 ± 115</td>
<td>850 ± 250</td>
<td>694 ± 163.1</td>
</tr>
</tbody>
</table>

MINERALS

<table>
<thead>
<tr>
<th>IRON</th>
<th>n=53</th>
<th>CPL</th>
<th>AMAR</th>
<th>BNS</th>
<th>CPL</th>
<th>AMAR</th>
<th>BNS</th>
<th>CPL</th>
<th>AMAR</th>
<th>BNS</th>
<th>CPL</th>
<th>AMAR</th>
<th>BNS</th>
<th>CPL</th>
<th>AMAR</th>
<th>BNS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years</td>
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<td></td>
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</tr>
<tr>
<td>&lt; 20</td>
<td>1</td>
<td>2</td>
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<td>2</td>
<td>0.0</td>
<td>11.0</td>
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<td></td>
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</tr>
<tr>
<td>20-25</td>
<td>15</td>
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<td>2.5</td>
<td>14.4</td>
<td>1.5</td>
<td>69.4</td>
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</tr>
<tr>
<td>26-30</td>
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<td>5.5</td>
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<td>0.5</td>
<td>8.0</td>
<td>10.0</td>
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</tr>
<tr>
<td>31-35</td>
<td>16</td>
<td>7.05</td>
<td>1.05</td>
<td>7.5</td>
<td>1.5</td>
<td>8.6</td>
<td>0.6</td>
<td>47.2</td>
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<td>36-40</td>
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<td>1.5</td>
<td>11.5</td>
<td>1.5</td>
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<tr>
<td>41-45</td>
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<td>6.5</td>
<td>1.5</td>
<td>5.55</td>
<td>1.55</td>
<td>12.5</td>
<td>2.5</td>
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</tr>
<tr>
<td>46-49</td>
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<td>5.5</td>
<td>2.5</td>
<td>8.1</td>
<td>0.9</td>
<td>6.55</td>
<td>1.45</td>
<td>44.4</td>
<td>0</td>
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<td>0</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ZINC

| Years     |      |     |      |     |     |      |     |     |      |     |     |      |     |     |      |     |
| < 20      | 1    | 4.0 | 0.0  | 4.35 | 0.35| 3.0  | 0.0  | 50.0 | 53.8 | 37.5 | 0   | 0   | 0   |
| 20-25     | 15   | 3.65 | 0.55 | 3.05 | 0.95| 2.65 | 0.55 | 46.3 | 37.5 | 40   | 0   | 0   | 0   |
| 26-30     | 13   | 5.75 | 0.75 | 5.5  | 1.5 | 4.85 | 1.85 | 29.4 | 68.7 | 61.3 | 0   | 0   | 0   |
| 31-35     | 16   | 2.8  | 0.7  | 4.75 | 0.55| 2.9  | 0.8  | 35   | 60   | 36.3 | 0   | 0   | 0   |
| 36-40     | 5    | 6.2  | 0.8  | 3.05 | 0.35| 3.95 | 0.85 | 77.5 | 37.5 | 48.7 | 0   | 0   | 0   |
| 41-45     | 2    | 4.2  | 1.1  | 5.3  | 1.0 | 4.3  | 1.1  | 52.5 | 66.3 | 53.8 | 0   | 0   | 0   |
| 46-49     | 1    | 4.85 | 1.35 | 7.2  | 1.0 | 2.55 | 0.45 | 61.3 | 90.0 | 55.0 | 0   | 0   | 0   |

CPL: Cowpea Leaves
AMAR: Amaranthus
BNS: Black Night Shade
The vegetables the mothers consumed contributed to their RDA in percentages in various amounts. Vitamin A had highest mean RDA intake percentage of 30% from amaranth for age group of 36-40 years, followed by 27.0% from blacknightshade for the age group aged 41-45%. The least contributing vegetable was cowpea leaves at 22.5% for the age group of 46-49 years.

Iron contribution to the RDA of lactating women was highest at 80.5% by amaranthus, for the age group of 20-25 years, followed by cowpea leaves at 69.4% for the age group of 20-25 years. The least contributing vegetable was blacknightshade at 38.9% for the group aged 31-35 years.

Zinc contribution to the mean RDA intake of lactating women was highest at 90.0% by amaranthus, for the age group of 46-49 years, followed by cowpea leaves at 77.5% for the age group of 20-25 years. The least contributing vegetable was blacknightshade at 61.3% for the group aged 31-35 years.
4.6 DISCUSSION

4.6.1 Composition of Beta carotene, Iron and Zinc in the Three Vegetables

The study showed high values of zinc content in blacknightshade and low values of the same nutrient in boiled amaranth. The vegetables had highest values of iron in amaranth and lowest values of the same nutrient in the same at 0.2%. The vegetables had highest value in beta carotene in the stewed black night shade and lowest values in the stewed cowpeas. This could have contributed to the frequency of consumption of these vegetables as potential sources of beta carotene and the minerals under the study. Both amaranth and cowpea leaves are dark green vegetables that are rich in iron, zinc and beta-carotene. (Odhav et al.,2014) found values of amaranth concentration of iron at 2.36%, these values are higher than those of this study that were at 0.44%. The values in these vegetables show that there is need to optimize the nutrient content and other properties of traditional vegetables in daily food of lactating mothers. Zinc was highest in the stewed amaranth at 0.37%, this value is low than the values obtained by Gockowski et al., 2003 on traditional amaranth consumed in Kenya at 57.93%, they also found values of zinc in blacknightshade at 205.71±21.07 and iron at 41.82±17.07. Mbei (2011) reported lower values of zinc in amaranth vegetables 1.36%. However these values are lower than values obtained by Raja et al., (1997) who reported values of 4.08% for amaranth collected in various markets in Daesalaam, Onyango (2010), also reported higher values of 6.3mh/100g in Kenya. Zinc requirements vary during the life cycle, and peak needs coincide with infantile and adolescent growth spurts, pregnancy and lactation (King, 2002).

The lactating women in this study could have benefited in iron, zinc and beta-carotene by consuming the grown vegetables. This goes a long way in solving the problem of malnutrition in
the vulnerable groups of the population such as, infants below 6 months postpartum and lactating mothers.

Consumption of vegetables like amaranth, cowpeas and blacknightshade which are rich in such nutrients as, iron, zinc and betacarotene helps alleviate problems like low immunity, infertility and good vision in lactating mothers and their children (Whitney and Rolfers, 2016). In this study the values of stewed vegetables were higher than in other samples, this shows that stewing is the best method of cooking vegetables as it is able to retain more nutrients. According to an earlier study most mothers preferred growing of amaranth at 78% followed by cowpea leaves production and lastly black night shade. This could have highly contributed to the frequency of consumption of these vegetables as potential sources of beta carotene and mineral under study. Both Amaranth and Cowpea are dark green vegetables that are rich in iron, and beta-carotene.

This study reveals that indigenous African vegetables are best in nutrient content when stewed than when boiled. The high values obtained in stewed cowpea leaves are far much higher than those reported by (Kamega et al., 2013) in their study which had values of betacarotene in maranth at 77.49µg/100g. Cowpea leaves had the lowest values in the raw sample among the three vegetables evaluated in this study. Black nightshade had higher values than those reported by (Kamega et al., 2013), in their study at 100.84µg/100g on betacarotene. This means that lactating mothers can benefit from vitamin A, if they consume adequate amount of the three evaluated vegetables and their bioavailability is upright. This can go a long way in alleviating micronutrients deficiencies in lactating mothers and their infants especially those associated with inadequate intake of vitamin A. In Africa, about 30% of lactating mothers and other vulnerable populations to malnutrition are affected by vitamin A, deficiency, (Standing Committee of Nutrition, 2004).
their report, (Mason et al., 2004), highlighted that there has been numerous projects in sub-Saharan Africa and elsewhere in developing countries to address micronutrient deficiency.

According to an earlier part of the study, the socio-economic demographic showed that majority of the women are low income earners. This could have affected their preference of the vegetable choice where amaranth was highly preferred could be from the volumes it’s vended in and its availability. Amaranthus leaves were probably preferred over the black nightshade because of the yields of leaves and from the way they are vended at much higher volumes than that of the black nightshade (Onyango et al., 2008). Whitney and Rolfes (2013), indicate that ½ cup (100g) of boiled amaranth contains 1.49mg of iron, 0.58mg zinc and 91.7µg Vitamin A. 1 raw cup of amaranth comprises of 0.65 mg of iron, 0.25mg zinc and 40.9µg Vitamin A. ½ cup of boiled Cowpea leaves contains 0.92 mg of iron, 0.85mg zinc and 33µg Vitamin A. Breast milk is the only source of vitamin A during the neonatal period for the exclusively breast-fed infant, and it is the principal source for many infants from developing countries as long as breast-feeding continues. The ability to meet infant requirements, therefore, depends on the concentration and volume consumed, both of which are influenced by maternal vitamin A status and dietary intake (Underwood, 2014).

Data from the 24 hour recall indicates that the zinc mean intake was 11.2 mg. According to (Ronsmans et al., 2008), the recommended dietary allowances for men are 11 mg/day while for women its 8 mg/day. The upper Level for adults is 40 mg/day. The current study’s mean zinc intake is in accord with the recommended allowances for men. However, it is slightly higher than the recommended figures for women.
4.6.2 Proximate Composition of the Vegetables

The moisture content of the three leafy green vegetables ranged from 44.59 ± 0.01 for amaranth to 89. 06 ± 0.26 for cowpea leaves. Most of the values were within the corroborated results (60-90%) of the investigated vegetables as indicated by FAO (2006). The relatively high moisture contents reveal that the studied leafy vegetables need care for appropriate preservation as they would be prone to deterioration (Kwenin, 2011). Indeed, the high moisture content may induce a greater activity of water soluble enzymes and co-enzymes involved in metabolic activities of these leafy vegetables (Iheanacho and Udebuani, 2009).

The crude proteins content ranged between 16.5 ± 0.08 % for amaranth and 40.14 ± 0.03% for black nightshade. The proteins content of these vegetables is higher than that reported by Asaolu (2012). According to a study by Ali (2009), plant foods which provide more than 12 % of their calorific value from proteins have been shown to be good source of proteins.

The lipids content from the boiled samples of the three green leafy vegetables is low between (1.05 ± 0.01 for black nightshade to 1.72 ± 0.02 for amaranth) which concurs with the results of a study done by (Asaolu, 2012) that proves leafy vegetables are a poor source of lipids. However the lipid content in the stewed samples of the three leafy vegetables is high between 48. 0 ± 0.03 for blacknightshade and 50.4 ± 0.08 for cowpea leaves. This could have been contributed by the addition of cooking oil.

The crude fiber content in the vegetables ranged from 10.5 ± 0.03 for amaranth and 22.4 ± 0.03 for cowpea leaves. The high level of crude fibers may be advantageous for their active role in the regulation of intestinal transit, increasing dietary bulk due to their ability to absorb water, lower serum cholesterol level, diabetes, colon and breast cancer, coronary heart disease and hypertension (Ishida et al., 2000). However, consumption of vegetables with high fiber content, can cause
intestinal irritation and lower nutrient bioavailability hence larger quantities of plant vegetables have to be consumed to obtain adequate levels of nutrients (Ali, 2009).

Ash content was found to be relatively high with values ranging from 7.5 ± 0.02 for cowpeas to 14.8 ± 0.01 for amaranth. These values indicate that these vegetable species may be considered as good sources of minerals when compared to cereals and tubers whose values are low, at (2 – 10 %) as obtained by (FAO, 2007).

The soluble carbohydrates content in the three leafy vegetables ranges from 10.1 ± 0.21 for blacknightshade and 39.4 ± 1.9 in cowpeas leaves. These values could have contributed to a small portion of the recommended dietary allowance for the lactating mothers which is estimated at 210g.

The energy values from the three vegetables varied from 292.9 ± 0.62 to 560.2 ± 0.36 in amaranthus. These values compare favorably with those in a study done in Nigerian vegetables by (Antia et al., 2006). The calorific value is in agreement with general observation that vegetables have low energy values (Ali, 2009).

4.6.3 Food Consumption Frequency

Overall the most frequently consumed vegetable on daily, weekly and monthly basis was amaranth, followed by cowpeas and lastly blacknightshade. The popularity of specific vegetable is function of many factors, including availability, ease of preparation, taste, consistency and appearance. The soft, fast-cooking leaves of amaranth were preferred to the fibery leaves of cowpeas leaves which require long cooking times. This agrees with a study done by (Antia et al., 2006).
According to Vorster et al., (2002), taste is a very important factor which affects the preference of the vegetable of choice. This could have been the reason why blacknightshade was least appreciated compared to the other vegetables due to its bitter taste.

The reasons for not consuming some vegetables may be personal preference and selling of vegetables to buy other food stuffs. Like Cowpeas are primarily grown for grain but young leaves and growth points are used as a leafy vegetable.

4.6.4 Dietary Intake of Vitamin A, Iron and Zinc from the Three Vegetables

The three vegetables contributed immensely to the mean RDA intake of lactating mothers. The highest contributing vegetable in all nutrients analyzed was amaranth followed by blacknightshade and finally cowpeas leaves. The results indicate that the studied leafy vegetables if consumed in sufficient amount would contribute greatly to the nutritional requirement and food security of the lactating mothers.

4.7 CONCLUSION

From the results the studied leafy vegetables are good source of nutrients: proteins, fiber, carbohydrates, energy and lipids, carotenoids, iron and zinc. This therefore suggests that the studied leafy vegetables if consumed in sufficient amounts would contribute greatly to the nutritional requirements of the lactating mothers for normal growth and adequate protection against diseases arising from malnutrition. However they are limited sources of nutrients like protein where we have animal sources as best sources and carbohydrates where we have cereals as best sources.
4.8 RECOMMENDATION

The selected leafy vegetables of this study could be recommended in diets for reducing hidden hunger (micronutrient deficiencies) in lactating mothers. It is important to investigate the bioavailability of the nutrient contents of the selected leafy vegetables with the optimization of their functional property and nutritional value. This would probably lead to higher demand, wider cultivation and food security of population.

Further research is recommended to analyze the vegetables in their stewed and boiled forms for the presence of specific amino acids (methionine and lysine) which are the limiting amino acids in most plant proteins.
CHAPTER FIVE: DIETARY INTAKE AND NUTRITIONAL STATUS OF LACTATING MOTHERS IN MWANAMUKIA AREA POST-INTERVENTION

ABSTRACT

Diet is the cornerstone for maintaining health and for the management and prevention of a wide range of medical conditions. Good nutritional intake supports the stamina, patience and self-confidence that nursing an infant demands. Pregnant and lactating women are especially at high risk of deficiencies due to inadequate dietary intakes, physiological changes involved and various socio-demographic factors. Nutrient requirements are considerably elevated during lactation than in any other stage of a woman’s reproductive life. The dietary intake of lactating women is a major determinant of nutritional status and depletion of nutrient stores during lactation poses a risk of malnutrition to the mother whereas inadequate amounts of breast milk can be a source of malnutrition for the infant. It is therefore necessary to carry out an intervention on the diets of these mothers so that they can meet the nutritional requirements of micronutrients that are helpful to both the mother and the child. These micronutrients include zinc, iron and vitamin A. The aim of this study was to determine the dietary intake and nutrition status of the lactating mothers after intervention with vegetables. This cross sectional study was conducted on 53 purposively selected lactating women living in Mwanamukia, Nairobi Kenya. A structured, validated and pre-tested questionnaire was used to obtain information on food frequency, nutrition status and dietary diversity. 24 hour recall data was entered into nutrisurvey then transferred to SPSS version 20 and analyzed using descriptive statistics and Pearson correlation coefficient was used to determine associations. The mean energy intake range was 1896.7-2105.4 Kcal while mean protein intake was 70.1 - 72.2g. The women in this study were however deficient in Vitamin A and iron. The study showed that (36%) of the respondents had a normal BMI. The number of respondents who
were at risk of being obese was (34%). The most frequently consumed foods were whole grains, wheat, maize and rice, green grams, carrots, dark green leafy vegetables, meats and eggs. These were consumed on a daily basis. The least consumed foods were tomatoes, sweet potatoes, cassava, groundnuts. From these results we can conclude that intervention programs are useful in provision of important micronutrients to lactating mothers of groups at risk of malnutrition. This can be done using affordable, accessible and fast growing food. The respondents however need to be advised to take diverse foods like local vegetables which are natural sources of vitamin A, iron and zinc. They need to increase their intake of foods derived from animals as the richest sources of the retinoid. It is also paramount for them to include colorful fruits in their diet.

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5.1 INTRODUCTION

Diet is the cornerstone for maintaining health and also for the management and prevention of a wide range of medical conditions (WHO, 2011; WHO, 2007; WHO, 2007). Pregnant and lactating women are especially at high risk of deficiencies due to inadequate dietary intakes, physiological changes involved and various socio-demographic factors (Diallo, 2009). Nutrient requirements are considerably elevated during lactation than in any other stage of a woman’s reproductive life (Doran et al., 1997). Nutrition is vitally important during the postnatal (immediately after birth) period (Silveira et al., 2007). The requirements are greater than during the pregnancy period, since breast milk has to supply an adequate amount of all the nutrients for an infant’s needs for growth and development. The milk secreted in one month of breastfeeding represents more energy than the total cost of a pregnancy (Guthrie and Mary, 1995).

Lactating women are more likely to suffer from amalnutrition than their un lactating counterparts for the following reasons; their reproductive biology and increased body nutrient need in lactation, low social status, poverty and lack of access to food due to poor resource availability. Lactating women in low-settings often consume inadequate amount of micronutrients because of resource limitation. They have a limited intake of animal source foods, fruits and vegetables. Intake of micronutrients less than the recommended values increase women’s risk of micronutrient deficiencies. Severly malnourished mothers have reduced lactation performance contributing to the increased risk of child mortality. Nutritional requirement during lactation are greater than during pregnancy.

The high energy cost of lactation as well as the nutritional and health risk it could pose for the woman emphasizes the need for continuous monitoring of their nutritional status and dietary intake
in poor resource countries (Ukegbu, 2014). Helping women achieve appropriate nutritional status to optimize breastfeeding is important and requires consideration of energy and nutrient needs (Brown, 2008).

One of the strategies of meeting increased nutrient needs is through utilization of locally available foods including fruits and vegetables which most of the time are produced for sale (Wardlow, 2005). Monotony in diet is considered the common mark of poverty and poor nutrition. These diets supply inadequate amounts of nutrients and have poor organoleptic qualities that further diminish appetites already suppressed by physiological nutrient deficiencies (Engebretsen, 2010). The need for variety is imposed by the body’s physiological requirements. Poor diets deficient in nutrients reinforce the malnutrition–infection cycle and contribute to overall poor health and sub-optimal growth (Onyango, 2003).

Dietary diversity, assessed as the number of foods consumed across and within food groups over a reference period, is widely recognized as being a key dimension of diet quality and is reflected in food-based dietary guidelines (WHO, 1998; FAO, 2010). Dietary diversity is a simple count of food items or food groups used in households or by individuals over a certain time period. It has been considered a potential ‘proxy’ indicator to reflect nutrient adequacy (Ruel, 2002). The count serves as an indicator of the nutritional adequacy of diet in relation to growth and other health outcomes (Onyango, 2003). Dietary diversity indicators have been proposed as potential proxy indicators for diet quality (Ruel, 2003). Under ideal conditions of food access and availability, food diversity should satisfy micronutrient and energy needs of the general population. Unfortunately, for many people in the world, access to a variety of micronutrient-rich foods is not
possible (FAO, 2001). Dietary diversity may be limited by access and affordability of higher quality foods (Stewart et al., 2013).

Individual dietary diversity scores aim to reflect nutrient adequacy. Studies in different age groups have shown that an increase in individual dietary diversity score is related to increased nutrient adequacy of the diet. Dietary diversity scores have been validated for several age/sex groups as proxy measures for macro and micronutrient adequacy of the diet. Scores have been positively correlated with adequate micronutrient density of complementary foods for infants and young children (FANTA, 2006). If properly promoted, urban agriculture can play a crucial role in Africa's quest for food security, including food availability, enhancement of nutrition for residents, and dietary diversity (Arku et al., 2012). Nine food groups are proposed for the WDDS.

Food frequency questionnaire (FFQ) are the most efficient, cost-effective and practical method for the large-scale measurement of dietary intake, which also includes the measurement of micronutrients (Lucas, 1998; Piers, 1995). Dietary intakes typically obtained from FFQ or 24 h recall data have been used to calculate a diet quality score or index that provides an evaluation of the consistency of food intakes with dietary guidelines rather than comparing with nutrient reference values (Spurr et al., 2002; Dufour et al., 1997). One of the requirements for reliable dietary intake data is high-quality food composition data. Local data is preferred because of variations in growing conditions, transportation and food preparation methods, local data is preferred (Scrimshaw, 1997).
Food consumption challenges are brought about by famine which causes famine related deaths, starvation and nutritional deficiency diseases in communities affected by natural and man-made disasters. These challenges face lactating mothers especially those in slum areas leading to widespread chronic hunger which causes failure for the mothers to practice exclusive breast feeding for at least six months to their infants.

5.2 OBJECTIVE

The study was formulated to determine the dietary intake and nutrition status of the mothers after intervention.

5.3 MATERIALS AND METHODS

The study sample was a sub sample of all the lactating mothers enrolled in the study. It comprised of 20.4% which is more than the recommended 10% (Norman and Steyn, 2016) of the 260 lactating mothers which gave 53 respondents. The 53 lactating mothers were randomly selected from the 260 lactating mothers for the participation in the study. These respondents had to meet the inclusion criteria in the questionnaire that included the following: 1. Currently breast feeding 2. Free from any chronic sickness and not on medication 3. Not pregnant at the time of study.

In this phase (intervention phase) a cross-section survey was carried out between April 2015 and July 2015 in Mwanamukia, a peri urban area of Nairobi metropolis. Respondents were trained on farming methods to be involved. Training on vegetable production methods was conducted by the researcher and Ministry of Agriculture staff. After the training, in May 2015, each participant was assisted with planting materials and equipment to facilitate the planting process in their households.
The 53 respondents planted amaranthus, black nightshade and cowpeas. The vegetables were planted in multistory gardens, organoponics, and open field depending on the respondent’s situation. In July 2015, the vegetables were ready for consumption and the respondents consumed them for one month. They were then evaluated using a structured questionnaire, 24 hour dietary recall and a food frequency questionnaire.

In August, interviewing of lactating mothers commenced. A food frequency questionnaire and a 24-hour dietary recall were administered. A 24-hour dietary recall was conducted chronologically on all foods eaten 24 hours preceding the study to determine and analyse the respondents’ dietary diversity. A 24-hour dietary recall was conducted on randomly selected sub-sample (53) lactating mothers from the study area. The subjects were first asked to mention chronologically all the foods and beverages they had eaten 24 hours preceding the study (morning, mid-morning, lunch, mid-afternoon, supper and after supper before bed-time). They were then asked to describe the foods and beverages consumed, including ingredients and preparation methods. Solid food items were estimated by asking the respondents to depict the actual amount of food consumed in household measures. These volumes were then converted to food volumes using water and measuring cylinders.

The proportion of what was eaten by the lactating mother was determined based on the volume eaten and the total volume of the dish prepared. The proportion was used to calculate amount of ingredients consumed. Food cooked dishes prepared outside the home, mainly food stalls, recipes and amounts of ingredients were obtained and amounts consumed determined. Conversion factors from household measures and monetary values to weight equivalent were determined (Van’tRiet et al., 2002). The nutrient and energy content of foods consumed by the
mothers was calculated by using nutrisurvey and food conversion tables. To investigate the socio-economic and demographic factors affecting the nutritional status of the mothers, logistic regression was used. ANOVA and t-test were used to see if there was a mean difference in nutritional status among the lactating mothers. Difference was considered significance at p≤0.005.

The respondents were assured of confidentiality and anonymity of their participation. The respondents’ consent was sort before administering the questionnaire. Determination of dietary intake, food consumption patterns and nutritional status as Body Mass Index (MBI) was done on the mothers after consuming the vegetables. A food frequency questionnaire was administered on lactating mothers to determine the food consumption habits.

Anthropometric measurements was done using weights and heights of the lactating mothers. Weights of the lactating mothers were measured to the nearest 0.1kg on a battery powered digital scale (seca770, Hanover Germany) and heights were measured to the nearest 0.1cm using a wooden height-measuring board with a sliding head bar following standard anthropometric techniques ((Bruce,2001). To avoid variability among the data collectors, all the anthropometric measurements were taken by the researcher (principal investigator). Body Mass Index (BMI) of the study subjects was calculated by diving the weight in kilogram to the height in meter squared (kg/m2.

The protocol of the study was approved by the University of Nairobi Post Graduate Studies and the Ministry of Agriculture, Livestock development and Fisheries, Kasarani Sub-county, Nairobi County. The study commenced with training of all research assistants on how to interpret the questionnaire, calibrate the weighing scales and take correct measurements for height and weight of lactating mothers and take measurements of the food consumed in 24 hour dietary recall.
5.4 ANALYTICAL METHODS

Solid food items were estimated by asking the respondents to depict the actual amount of food consumed in household measures. These volumes were then converted to volumes using water and measuring cylinders. If the fruit was a slice of an orange the fruit was got sliced and the juice squeezed then the content measured in a measuring cylinder. If it was a pawpaw the size of a paw was got pulp removed and the content measured and recorded.

5.5 DATA ANALYSIS

5.5.1 Food Frequency

Data was extracted from the food frequency questionnaire. The types of foods consumed and their frequency was identified. The list of food was looking at the vitamin A, zinc and iron rich foods as well as other foods that promote and sustain exclusive breast feeding habits in lactating mothers. An extensive emphasis was laid on the foods that facilitate the achievement of dietary diversity on the seven food groups recommended by Gibson, 2005, FAO, 2014. The most frequently consumed foods were ascertained and presented.

24 hour dietary recall:

This was conducted in a sub-sample of 53 households of lactating mothers 0-3 months postpartum. The aim of the exercise was to estimate the habitual dietary intake in lactating mothers (Roman and Steyn, 2016). The lactating mothers were the main respondents. During the 24 hour recall lactating mothers were requested to mention all foods and beverages they had eaten during the preceding 24- hours to the interview day. The quantities were estimated either in household units (volume determined by water content), weight, or in monetary value. The volume eaten or the dish...
prepared where used to determine the proportion of what was consumed by lactating mothers. This was then analyzed using Nutrisurvey and food composition tables.

5.5.2 Nutrition Status

Respondent information on weight and height was compiled to obtain BMI. This was then categorized into underweight, normal, overweight. This was presented. Associations between nutrition status and intake were made.

5.5.3 Nutrition Knowledge and Dietary Intake

Diet quality scores were done to investigate the relationship between nutrition knowledge and dietary intake. The lactating mothers were asked if they knew what a balanced diet is from the three food groups and for any food group mentioned one scored 1 mark if they did not know any they scored 0.

5.6 STATISTICAL ANALYSIS

To facilitate data entry, questionnaires were coded. Data was then entered and cleaned using statistical packages for social sciences (SPSS version 20). The data was then analyzed. The variables for each objective were defined and coded for ease of data analysis. Frequencies, mean, standard deviations, percentages were determined. Correlations were conducted to identify associations. Where the associations existed, chi-square was used to test their strength. Data on dietary intake obtained from the 24 hour recall questionnaire was entered into the Nutrisurvey software. This professional nutrition software contains a food database and provides nutrient analysis and nutrient requirements for individuals. Two food composition tables were used. The analysis obtained from the Nutrisurvey software was then exported to Word as a report.
5.7 RESULTS

5.7.1 Food Consumption Frequency

Results on the respondents’ food frequency are shown in table 5.1.
Table 5.1: Frequency of food consumption among lactating mothers

<table>
<thead>
<tr>
<th>Food item</th>
<th>Daily</th>
<th>3-6 times a week</th>
<th>1-2 times a week</th>
<th>Once a month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>20</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>10</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starch roots</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irish potatoes</td>
<td>12</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweet potatoes</td>
<td>12</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arrow roots</td>
<td>12</td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Legumes, pulses and nuts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pigeon peas</td>
<td>10</td>
<td>10</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Green grams</td>
<td>20</td>
<td></td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Ground nuts</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Vegetables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional leafy vegetables (Amaranth, night shades and cow pea leaves)</td>
<td>23</td>
<td>35</td>
<td>38</td>
<td>53</td>
</tr>
<tr>
<td>Carrots</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kales and spinach</td>
<td></td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>French beans</td>
<td>8</td>
<td></td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Meats and eggs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Goat</td>
<td></td>
<td></td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Fish</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Eggs</td>
<td>44</td>
<td>34</td>
<td>10</td>
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<td>Fruits</td>
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<td></td>
</tr>
<tr>
<td>Avocados</td>
<td>16</td>
<td>12</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Dairy products</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Fresh milk</td>
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<td></td>
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</tr>
<tr>
<td>Yoghurt</td>
<td>8</td>
<td>18</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

Findings indicate that the consumption frequency of traditional vegetables increased in this phase compared to the baseline phase. At least all the homesteads in the study fed on the vegetables.
once a month compared to other foods. This compares well with baseline consumption of vegetables which was 12 times daily.

5.7.2 Dietary Intake in 24 Hour Recall

The results for 24 hour recall for energy (Kcal), protein, carbohydrates, fats and fiber are shown in Table 5.2.

Table 5.2: The 24 hour recall on Energy (Kcal), protein, carbohydrates, fats and fiber intake for the lactating mothers

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std deviation</th>
<th>RDA</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy (kcal)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 – 24 years 13</td>
<td>1896.6846</td>
<td>759.80219</td>
<td>2036.635</td>
<td>527.80</td>
<td>3601.40</td>
</tr>
<tr>
<td>25-50 years 40</td>
<td>2105.3975</td>
<td>796.99426</td>
<td>2035.8</td>
<td>420.30</td>
<td>5518.30</td>
</tr>
</tbody>
</table>

| **Protein (g)**      |            |               |          |         |         |
| 19 – 24 years 13     | 70.1231    | 40.33995      | 60.14    | 11.10   | 175.40  |
| 25-50 years 40       | 72.2125    | 32.85778      | 60.14    | 8.60    | 186.50  |

| **Carbohydrate (g)**|            |               |          |         |         |
| 19 – 24 years 13     | 294.8308   | 104.35164     | 81.70    | 458.20  |
| 25-50 years 40       | 332.4775   | 115.97573     | 290.6 g  | 74.00   | 717.40  |

| **Fat**              |            |               |          |         |         |
| 19 – 24 years 13     | 48.8846    | 43.98333      | 0.00     | 182.20  |
The mean energy intake for women aged 19 – 24 years was 1896.7 Kcal while the recommended energy for the same women was 2036.635 Kcal. The mean energy intake for the women aged 25-50 years was 2105.4 Kcal while the recommended energy for the women was 2035.8 Kcal. The mean protein intake for women aged 19 – 24 years was 72.2g while the recommended protein for the same women is 60.14g. The mean protein intake for the women aged 25-50 years was 70.1g while the recommended energy for the same women is 60.14g.

The mean for the carbohydrate in the category of women between 19 to 24 years is 294.8g. The recommended carbohydrate intake for the category of 25 to 50 years is approximately 290.6g. The average mean for the carbohydrate in the category of women between 25 to 50 years is 332.5g. The recommended carbohydrate intake for the category of 25 to 50 years is approximately 290.6g. The average mean for the fat in the category of women between 19 to 24 years is 48.9g (data from 24HR). The recommended fat intake for the category of 25 to 50 years is approximately 69.2g. The average mean for the fat in the category of women between 19 to 24 years is 56.8g. The recommended fat intake for the category of 25 to 50 years is approximately 69.2g.
5.7.3 Dietary Intake of Vitamin A

Most foods contributed to the respondents’ requirements of Vitamin A, Iron and Zinc after intervention. This can be seen in Table 5.3.

Table 5.3: Intake of Vitamin A, iron and zinc by the lactating mothers

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>S.D</th>
<th>RDA</th>
<th>Mean RDA Intake Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vit_A (µg)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 to 24 years</td>
<td>13</td>
<td>28.40</td>
<td>3562.70</td>
<td>972.94</td>
<td>0.5</td>
<td>3000µg</td>
<td>32.4</td>
</tr>
<tr>
<td>25 to 50 years</td>
<td>40</td>
<td>50.80</td>
<td>2975.90</td>
<td>727.64</td>
<td>0.5</td>
<td>3000µg</td>
<td>24.3</td>
</tr>
<tr>
<td><strong>Iron (mg)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 to 24 years</td>
<td>13</td>
<td>6.90</td>
<td>25.90</td>
<td>15.95</td>
<td>1.63</td>
<td>18 mg</td>
<td>88.3</td>
</tr>
<tr>
<td>25 to 50 years</td>
<td>40</td>
<td>1.60</td>
<td>32.00</td>
<td>16.97</td>
<td>2.74</td>
<td>18 mg</td>
<td>94.4</td>
</tr>
<tr>
<td><strong>Zinc (mg)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 to 24 years</td>
<td>13</td>
<td>3.40</td>
<td>18.30</td>
<td>10.71</td>
<td>3.32</td>
<td>8 mg</td>
<td>133.8</td>
</tr>
<tr>
<td>25 to 50 years</td>
<td>40</td>
<td>1.90</td>
<td>31.90</td>
<td>11.34</td>
<td>2.25</td>
<td>8 mg</td>
<td>141.3</td>
</tr>
</tbody>
</table>

The women in this study had an increased mean RDA intake for vitamin A compared to the figure in the baseline study however; they were still deficient in Vitamin A.

The results indicate that the respondents met the requirements for the zinc mineral at percentages exceeding 100% however iron did not reach the 100% mean RDA make but there was
improvement compared to the percentage levels before intervention. Statistical significance was considered at 95% confidence and $P \leq 0.05$.

### 5.7.4 Nutrition Status of the Lactating Mothers After Intervention

The results on the nutritional status of the respondents after intervention are shown in Table 5.4.

**Table 5.4. The nutritional status of the mothers**

<table>
<thead>
<tr>
<th>BMI Categories</th>
<th>&lt;18.5</th>
<th>18.5-25</th>
<th>&gt;25</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mothers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>1(1.9)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20-25</td>
<td>6(11.2)</td>
<td>2(3.8)</td>
<td>1(1.9)</td>
</tr>
<tr>
<td>26-30</td>
<td>8(15)</td>
<td>2(3.8)</td>
<td>1(1.9)</td>
</tr>
<tr>
<td>31-35</td>
<td>1(1.9)</td>
<td>1(1.9)</td>
<td>1(1.9)</td>
</tr>
<tr>
<td>36-40</td>
<td>0</td>
<td>2(3.8)</td>
<td>1(1.9)</td>
</tr>
<tr>
<td>41-45</td>
<td>0</td>
<td>6(11.2)</td>
<td>6(11.2)</td>
</tr>
<tr>
<td>46-49</td>
<td>0</td>
<td>8(15.1)</td>
<td>8(15.1)</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>30</td>
<td>36</td>
<td>34</td>
</tr>
<tr>
<td>(percentage)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The findings indicate that the number of respondents that had a normal BMI were (36%) and the number that was overweight was (8%).

### 5.7.5 Comparison between Nutritional Status of the Mothers Before and After Intervention

Table 5.5 shows that the nutritional status of lactating mothers improved especially the weight after intervention with the number of mothers having a normal BMI increasing.
Table 5.5: Nutritional status of the lactating mothers before and after intervention as BMI categories

<table>
<thead>
<tr>
<th>BMI Categories</th>
<th>&lt;18.5(A)</th>
<th>&lt;18.5(B)</th>
<th>18.5-25(A)</th>
<th>18.5-25(B)</th>
<th>&gt;25(A)</th>
<th>&gt;25(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mothers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>1(1.9)</td>
<td>1(1.9)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20-25</td>
<td>8(15.1)</td>
<td>6(11.2)</td>
<td>4(7.5)</td>
<td>2(3.8)</td>
<td>3(5.7)</td>
<td>1(1.9)</td>
</tr>
<tr>
<td>26-30</td>
<td>6(11.2)</td>
<td>8(15)</td>
<td>4(7.5)</td>
<td>2(3.8)</td>
<td>3(5.7)</td>
<td>1(1.9)</td>
</tr>
<tr>
<td>31-35</td>
<td>8(15.1)</td>
<td>1(1.9)</td>
<td>5(9.4)</td>
<td>1(1.9)</td>
<td>3(5.7)</td>
<td>1(1.9)</td>
</tr>
<tr>
<td>36-40</td>
<td>2(3.8)</td>
<td>0</td>
<td>2(3.8)</td>
<td>2(3.8)</td>
<td>1(1.9)</td>
<td>1(1.9)</td>
</tr>
<tr>
<td>41-45</td>
<td>0</td>
<td>0</td>
<td>1(1.9)</td>
<td>6(11.2)</td>
<td>1(1.9)</td>
<td>6(11.2)</td>
</tr>
<tr>
<td>46-49</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8(15.1)</td>
<td>1(1.9)</td>
<td>8(15.1)</td>
</tr>
<tr>
<td>TOTAL (percentage)</td>
<td>47</td>
<td>30</td>
<td>30</td>
<td>36</td>
<td>23</td>
<td>34</td>
</tr>
</tbody>
</table>

* Respondents (percentage)

A= Pre-intervention nutritional status per age group
B=Post-intervention nutritional status per age group

The results in Table 5.5 show that the overall nutritional status of lactating mothers improved after intervention. The percentage of mothers who were underweight improved from 47% to 36%, normal weight percentage was 30% in the baseline and this reduced to 23%, thus raising the percentage of mothers in the overweight from 30% to 34% after intervention.

5.7.6 Comparison between Mean RDA Before and After Intervention

Results on Table 5.6 show that intervention positively improved the mean RDA of the lactating mothers.
Table 5.6: comparison on effect of intervention on RDA of lactating mothers

<table>
<thead>
<tr>
<th></th>
<th>Pre intervention n=53</th>
<th>Post intervention n=53</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>RDA</td>
</tr>
<tr>
<td><strong>Vit_A(µg)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19-24 years</td>
<td>13</td>
<td>697</td>
</tr>
<tr>
<td>25-50 years</td>
<td>40</td>
<td>2,408</td>
</tr>
<tr>
<td><strong>Iron(mg)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19-24 years</td>
<td>13</td>
<td>11.8</td>
</tr>
<tr>
<td>25-50 years</td>
<td>40</td>
<td>38.1</td>
</tr>
<tr>
<td><strong>Zinc(mg)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19-24 years</td>
<td>13</td>
<td>5.5</td>
</tr>
<tr>
<td>24-50 years</td>
<td>40</td>
<td>19.7</td>
</tr>
</tbody>
</table>

Table 5.6 above shows the mean percentage intake of lactating mothers during baseline study and after intervention. Lactating mothers dietary intake of vitamin A improved for the age groups of 19-24 years from 23.3% to 32.4%, while there was a decline in the age group of 25-49 years from 80.3% to 24.3%.

Dietary intake of iron improved in the age group of 19-25 years from 65.5% in the baseline to 88.3% after intervention, while there was a decline in the age group of 25-49 years from 210% to 94.4%.

Dietary intake showed an overall improvement in zinc intake after intervention from 23.3% to 80.3% in the age group of 19-24 years and 133.8% to 141.8% in the age group of 25-49 years.
5.7.7: Focus Group Discussion

Results from the two focused group discussion revealed that lactating mothers from the study area suffered from food insecurity which made them give their infants complementary feeds before 6 months as per recommendation by WHO, (2000). It also came out that most of the mothers were going out to do manual jobs with infants as young as two weeks so that they could acquire money food to eat during the period they were breastfeeding. They said they did such jobs as cleaning clothes for their able neighbours, digging shambas (farms) for their neighbours and sometimes trekking long distances covering over 2 kms to go and look for jobs. Those that were saloonist before delivering went back to the jobs in two weeks time after delivery to get money to be able to buy food stuffs for themselves and the family.

The discussions revealed that, after planting the vegetables in the intervention phase they were able to consume them and sell so that they could buy food items in the households. They bought such foods as maize meal, wheat flour, rice, soughum flour, fingermillet flour, bulush milet flour and fruits. This is what they were consuming in the households together with the grown vegetables. To some extent the discussions revealed that some lactating mothers were consuming small quantities of vegetables and selling the rest in bulk. They said the vegetables become a source of livelihood for them since they were able to acquire food, and get money to pay school fees for their school going children. They also said that health care become easy since they could use proceeds from the vegetables and take themselves and their children to the hospitals. After selling the vegetables they were able to buy seeds to plant in their farms which were not occupied by vegetables especially the farms along the liver bulks and open fields away from the home steads.
They also reported that care giving became easy since they no longer went out frequently for manual labour since they had vegetables to tend and sell to get money for food.

5.7.8: Observations check list
The observations were done by the principal researcher and the research assistance. These showed that most labour in the home was provided by the lactating mothers, they also decided on what to plant in the gardens and they handled the proceeds from the farm. The households also had fruit trees especially avocado trees which they got fruits to eat from. These fruits were eaten alone and also with githeri (mixer of maize and beans) and was mixed with rice and pigeon peas during lunch time. Some lactating mothers households also kept local chicken and some though few homes had dairy cows from where they got the milk they used as a beverage in the house.

5.8 DISCUSSION
5.8.1 Food Frequency
The most frequently consumed foods were dark green leafy vegetables, whole grains, wheat, maize and rice, green grams, carrots, and eggs. These were consumed on a daily basis in most respondents’ households. Most of these foods symbolize the major staples in Kenya. These are common foods consumed in Kenya. These were the mostly grown food crops in by the lactating mothers household that prompting their frequent consumption due to availability. It was therefore not unexpected to find that the lactating women had a high carbohydrate intake. According to Whitney and Rolfes (2016), wheat is rich in calcium, iron, sodium, folate and niacin. Maize is rich in iron, folate and niacin. Carrots are rich in potassium and vitamin A. Dark green leafy vegetables are rich in calcium, potassium, vitamin A and folate. The least consumed foods were sweet potatoes, cassava and groundnuts. Sweet potatoes are rich in Vitamin A and potassium, cassava is
rich in potassium while groundnuts are rich in potassium, sodium, vitamin E and niacin. Because these foods were consumed less frequently, the respondents were likely to be deficient in the nutrients. Our findings also suggest that fruits were eaten less frequently.

The respondents’ sources of protein were mainly plant based (cereals and legumes). The most frequently consumed legumes were green grams. The consumption of beans and other legumes was low as majority of the mothers rarely consumed them at all. The digestibility of most animal proteins is high (90 to 99 percent); plant proteins are less digestible (70 to 90 percent for most, but more than 90 percent for soy and legumes). Plant based foods have also been noted to contain micronutrients with low bioavailability (Neumann et al., 2003). This means that a little of the legumes consumed was lost and did not get absorbed.

5.8.2 Dietary Intake in 24-Hour Recall

5.8.2.1 Energy

The women aged 19 – 24 years were unable to meet their recommended energy intake while women aged 25-50 years met and exceeded their recommended energy intake by 3.4%. The DRIs for normal-weight lactating women assume that the energy spent for milk production is 500 cal per day in the first 6 months and 400 cal afterward (Food and Nutrition Board, 2002). A study of energy requirement in exclusively breastfeeding women cited a total energy cost of approximately 623 cal per day assuming 750 grams of milk produced at 0.67 kcal/g and 80% efficiency. These energy demands could have been the major reason why some mothers were not able to meet their requirements.
Other studies indicate that with approximately 170 kcal per day, net energy needs were estimated at approximately 450 kcal per day (Brown, J. E. et al., 2011). Whitney and Rolfes (2016) also stated that most women need at least 1800 calories a day to receive all the nutrients required for successful lactation. Severe energy restriction may hinder milk production. The women with the lowest energy intakes in this study took 1896.7 kcal. This means they were within the recommended range.

The mean energy intake in this study was (17%) below recommendation. It was lower than standards in the 19 – 24 years category and (3%) above recommendation in the 25-50 years category.

### 5.8.2.2 Protein

The mean protein intake for women aged 19 – 24 years was 72.2g while for the women aged 25-50 years was 70.1g. The recommended protein intake for women in both categories is approximately 60.14g (Nutrisurvey, 2007). WHO/FAO/UNU (2007) recommends that macronutrients contribute the following to total energy; Fat 25-35, carbohydrates 45-65 % and proteins 10-35 %. The women in this study took above the recommended levels of proteins. WHO/FAO/UNU (2007) recommends that macronutrients contribute the following to total energy; Fat 25-35, carbohydrates 45-65 % and proteins 10-35 %. In this study, proteins provided 13-14% of the total energy recommendations. This is in line with the recommended intakes. Chen et al., (2012) indicate that lactating women require dietary protein intake for synthesis of the protein in breast milk, and for the growth, maintenance and repair of cells.
The nutritionist who was a key informer in the study also informed the researcher that majority of the lactating mothers in the study area had a poor health seeking behavior such that they do not attend nutrition sensitization meetings where they can be equipped with nutrition education to enlighten them on the importance of protein in the body during lactation. Protein is an important food component in the body of a lactating mother and her infant because it provides the body with the ability to repair and renew worn out tissues, formation of enzymes and control of alkalinity of the blood and osmotic pressure in the blood vessels. Since these lactating mothers did not consume enough protein this could jeopardize the important function of exclusive breast feeding which is regarded as one of the means that can be used as an intervention to reduce infant mortality. Studies in Ghana showed that delayed and non-exclusive breastfeeding are potential risk factors to increased risk of infectious diseases in partially breast fed infants compared to those feed exclusively on breast milk that is rich in among others protein (Edmond et al., 2007, Wandu, Bulik, 1999).

5.8.2.3 Vitamin and mineral intakes

The women in this study had tremendous improvement in their zinc dietary RDA intake in all the age groups of lactating mothers. They also had an improvement in iron and vitamin A, dietary intake in the age group of 19-24 years. There was a dietary RDA deficiency in the dietary intake of vitamin A, and zinc in lactating mothers in the age groups of 25-49 years. This is because this is the group that was not benefitting from consumption of animal products. These deficiencies identified are in agreement with the Food and Nutrition Board, Institute of Medicine which states that, vitamin and mineral intakes that do not meet recommended levels (of folate, thiamin, vitamin
A, calcium, iron, and zinc) have been reported for lactating women (Food and Nutrition Board, 2001.

According to the observation made by the researcher and reports from the key informers most of the respondents grew vegetables but they sold them to generate income to buy other food items that were not produced in the household like bread, carrots, tomatoes, sweet potatoes and wheat flour. In this study, milk was rarely consumed and when it was consumed, it was in small quantities either as part of beverages mainly tea. This in agreement with the report of Farinde and Taiwo, 2003, that said that when women carry out farming in commercial terms it helped them generate income which enables them to gain financial independence from their husbands. This could have been because lactating mothers’ households lacked in keeping of either dairy goats or dairy cows. The few respondents’ households that kept dairy cows sold most of the milk to their neighbors and some small hotels thus leaving little milk for home consumption and they consumed milk in tea.

Sanusi and Adebiyi (2009) reported that the diets of populations in tropical countries rarely contain large amounts of milk, eggs and liver which are rich sources of preformed vitamin A. This thus makes people depend on carotenoids particularly from leafy vegetables and palm oil as sources of vitamin A. This is in agreement with the current study in that the best sources of Vitamin A came from dark green leafy vegetables. However, contrary to Sanusi and Adebiyi (2009) the respondents in this study took eggs.

Whitney and Rolfes (2016) state that dark green, deep orange vegetables and fruits and fortified foods such as milk contribute large quantities of vitamin A. Some foods are rich enough in vitamin
A to provide the RDA and more in a single serving. Carrots and sweet potatoes are two of the best sources per kcalorie which the respondents took almost every day. The deficiency may have been because they were not taking enough of Vitamin A rich foods to cater for the demand of both mother and baby. Much of the vitamin E in the diet comes from vegetable oils and products made from them, such as margarine and salad dressings. Wheat germ oil is especially rich in vitamin E. Because vitamin E is readily destroyed by heat and oxidation, fresh foods are preferable sources (Whitney and Rolfes, 2016). The fact that the respondents had a deficiency might have been because they were not consuming Vit E rich products and where they did, they probably exposed the products to heat such that the vitamin was destroyed.

Intakes of 200-500mg calcium per day is typical in African and Asian countries where the consumption of animal milk is low, while average calcium consumption in Northern Europe, Northern America and Australia is in excess of 1000mg/d (Zapata et al., 2004). This partially agrees with the current study where the minimum calcium intake was 202mg while the average was 687mg. In this study, milk was rarely consumed. When it was consumed, it was in small quantities either as part of beverages mainly tea. Insufficient calcium intake has also been reported among lactating women in Italy and Spain (Savino et al., 2001; Sanchez et al., 2008).

Whitney and Rolfes (2016) indicate that, women can produce milk with adequate protein, carbohydrate, fat, and most minerals, even when their own supplies are limited. For these nutrients and for the vitamin folate as well, milk quality is maintained at the expense of maternal stores. This is most evident in the case of calcium: dietary calcium has no effect on the calcium concentration of breast milk, but maternal bones lose some density during lactation if calcium
intakes are inadequate. The nutrients in breast milk that are most likely to decline in response to prolonged inadequate intakes are the vitamins especially vitamins B6, B12, A, and D.

5.8.3 Nutrition Status

The respondents who had normal BMI were (36%) and (8%) were overweight. The fact that 8% of the respondents were overweight could be due to the weight gained during pregnancy which they may not have managed to shed off. It could also be due to the fact that some women tended to overeat while breastfeeding as per focused group discussion with lactating mothers. Also, the BMI recommendation for normal adults was used in classifying the lactating women in this study, since there is no recommended standard for them. This could have positioned majority of the women in the overweight and obese categories (WHO, 2000). The result of the present study contradicts with that carried out among a group of Brazilian lactating women which showed a high prevalence of overweight despite a lower energy intake below the recommended level (Tavares et al., 2013).

Effect of intervention on lactating mothers’ nutritional status showed an overall improvement after intervention. Lactating mothers were able to improve their nutritional status, this is because the mothers not only consumed the vegetables grown but were also able to sell them and buy other items for the household such as food. This agrees with a study done by (Tavares et al., 2013), which showed that commercial production of vegetables can serve as a tool for poverty reduction, and reduction of hidden hunger in African countries. In the study of (Faride and Taiwo, 2003), they sighted that revenue generated from growing vegetables can serve as an important contributor to income and thus enhance food security. It also enables mothers to gain financial independence from their husbands. According to the principal researchers observation these lactating mothers
used to sell the vegetables to buy food stuffs such as maize flours, beans and breakfast items. They also sighted having food security after growing vegetables because they had enough to eat and sell, thus having ample time devoted to care giving, since they no longer went for casual labour to look for money for food. Sack gardening has been found to improve social capital in the households practising it in Kibera slum of Nairobi, Kenya, (Kallacher et al., 2013). Growing of vegetables improved the lactating mothers’ food and nutrition security and so was their food dietary diversity in the household. This study concurs with a study done by (Kallacher, et al., 2013) which found the garden farming participants of Kibera, Nairobi improve their food security and helped reduce the need to sort painful coping mechanisms used in food shortages. Hampwaye’s (2008) in his study in Lusaka confirmed that urban dwellers were engaged in urban farming activities within and on the periphery of the urban area and this served as the participants as a source of nutrition security.

Effect of intervention on minerals, iron, zinc and vitamin A, dietary intake of lactating mothers, show that, lactating mothers RDA dietary intake improved in the age group of mothers aged 19-25 years. There was however no improvement found in the lactating mothers aged 25-49 years in vitamin A, dietary intake. This group of lactating mothers probably consumed diets that were only rich in macronutrients such as carbohydrates and consumed little vegetables. Tropical diets are mostly lacking in animal proteins which are main sources of vitamin A (Sanusi and Adebiyi, 2009). There was tremedious improvement on zinc RDA dietary intake in all age groups of lactating mothers. The vegetables on analysis were rich in all the three micronutrients but the amount of vegetables taken should be adequate to provide required amount. WHO, (2004), recommends dietary intake of 200g of cooked vegetables, which can be adequate distributed in three meals.
Lactating mothers who were deficient of vitamin A and iron probably did consumed much less than this recommended amount.

5.9 CONCLUSION
Dietary intervention using affordable and accessible foods is an important source of macronutrients and micronutrients to vulnerable groups like lactating mothers. From the current study findings show that lactating women were provided with some micronutrients that they were previously deficient of in the baseline study. Nutritional status of lactating, especially the weight of the mothers improved tremendously after intervention, these positive results are owed to the growing and selling of vegetables in lactating mothers’ households either in multi-storey gardens, organoponic or open field. Lactating mothers in urban areas can be encouraged to plant vegetables using any of the above methods depending on their situation in terms of space availability. Zinc was the micronutrient that showed big improvement after intervention in all age groups of lactating mothers.

5.10 RECOMMENDATION
It is important that any group undergoing a dietary intervention program be advised on proportions to feed on and the methods of preparation. It is therefore important that the proximate composition of crops being used in the intervention be determined for their nutrient composition so that their advantage to the groups using them can be determined.
CHAPTER SIX: GENERAL DISCUSSION ON MAIN FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 BACKGROUND

This study aimed at improving the nutritional status of lactating mothers a vulnerable group in the urban set up. This was to be done by intervening the diets of the mothers with traditional vegetables that are easy to grow and take a very short period of time to grow. The specific nutrient chosen were vitamin A, iron and Zinc. The study results are intended to reduce the prevalence of malnutrition and nutrient deficiencies in lactating mothers and their young ones during the period of breastfeeding. The ability to generalize the findings depends on understanding existing diet diversity among lactating mothers, individual bioavailability and proximate composition of vegetables used during intervention.

6.2 METHODOLOGICAL CONSIDERATIONS

The base line survey was used to assess the socio-demographic and socio-economic characteristics of lactating mother. Then on crops grown in the study area and how these crops were utilized. The nutritional status of the mothers and their food consumption patterns before intervention was also assessed.

Then intervention was done by growing African green leafy vegetables, these were cowpeas, blacknightshade and amaranth. The intention was to grow vegetables in lactating mothers’ household, which they consumed and were evaluated for nutritional status and food consumption frequencies.
The use of dark green leafy vegetables to improve the nutritional status and food consumption patterns of lactating mothers 0-3 months postpartum can be used by many vulnerable groups in Kenya. The prevalence of vitamin A, iron and zinc in lactating mothers is high in Kenya. These deficiencies affect infants and children (WHO, 2004). Mwanamukia area of Kasarani Sub-County Nairobi metropolis is one such area where lactating mothers did not practice exclusive breastfeeding for at least 6 months as it’s recommended (WHO, 2004, Nkirigacha et al., 2015).

African green leafy vegetables especially cowpea leaves, amaranth and blacknightshade are known to be rich in micronutrients and proximate composition, which are important for growth and development and for milk composition (Silveira et al., 2007). It was important therefore to ascertain this by carrying out rigorous laboratory procedures to help in support of the above statement scientifically. This objective was achieved by conducting necessary analysis and evaluation using appropriate procedures, using the set standards until results was achieved.

6.3 MAIN FINDINGS

More than half of the respondents interviewed were literate, married and lived in households headed by men. A quarter of them were business people and single. The highest number of people fell in the 36-40 years age category. Findings show that urban agriculture is a major practice among people either to supplement their source of income, as an occupation or as a source of food mainly on urban dwellers without any formal employment. Women in the study were the main providers of labour in their households, this is in agreement with a study done by (Chikoko, 2000), in Africa, which showed that women decision making power in farming was limited to foods consumed in the household which were produced with less use of high technologies and had low returns The
A high proportion of respondents involved in urban farming in Mwanamukia area shows the importance of this enterprise in informal settlements and high-density areas where the level of poverty is usually high. This is in agreement with the study done by Foeken and Mwangi (2000), on the slums of Korogocho in Nairobi which found that the majority of farmers grew vegetables and kept livestock for livelihoods.

More than half of the respondents had achieved primary education and they had a normal BMI while those who were underweight were those with little or no education. This agrees with a study done in Kumasi, Ghana by Ackerson and Awuah (2010). 67% of the respondents had completed basic education. This is because people who are literate are more likely to understand the reasons for a balanced diet for the purpose of their health and that of their infants. Majority of the respondents participated in urban agriculture and this is used to improve food access in the study population, which is a slum area with a majority of respondents with low income making it difficult for them to purchase food for their households from the available markets. Most of the crops produced by respondents were used for home consumption and for sale. This helped the mothers to get enough money to buy other food stuffs like maize, soughum, fingermillet, bullush millet, rice, what, and even meet for home consumption. These findings concur with those of Foeken and Mwangi (2000) who established that farming activities in the urban areas were mostly carried out on a part-time basis by people in other livelihoods. Most of the respondents were not meeting their dietary intake for the selected micronutrients in the study. This could be attributed to the fact that in poor environments people have a tendency of consuming energy and carbohydrates rich foods which are cheap and readily available in bulk unlike fruits, vegetables, and protein food.
The dietary intakes of energy and protein were found to be moderate as represented by mean percent RDAs for each group. The intakes of vitamin A showed there were deficiencies among the lactating women of all age groups studied as well as the intakes of iron and zinc. Lactating mothers require diets rich in both macronutrients and micronutrients these can come from meat and dairy products, fruits and vegetables (Huang et al., 2005). Although after intervention lactating mothers consumed the vegetables, they were deficient in iron and vitamin A, this can be associated with the fact that they consumed small amount of vegetables which they were consuming with other staples such as maize and beans, could also be associated with the methods of preparation, the presence of antinutritional factors and/or drug-diet interactions. All these factors could have compromised the amount of micronutrients content available from the consumed food. Certain trace elements such as iron are vulnerable to the influence of such factors. Another important aspect that can explain the micronutrient deficiency even after consuming the vegetables is the interaction of micronutrients at the physiological and metabolic level. For instance zinc and calcium may reduce iron absorption and therefore reduce its bioavailability (Ramakrishnan and Huffman, 2008).

The nutritional status as represented by BMI was found to be met by majority of the mothers and comparison among the age groups showed that some women met their requirements though still at low percentages in the baseline survey but after intervention the nutritional status improved in most of the age groups of mothers especially their weights. In comparison among the socio-economic categories showed that the nutritional status of women with low income highly affects the women and most of these women do not meet their requirements and end up being underweight. The dietary intake was found to be positively correlated with intake of minerals,
carbohydrates, proteins and fats while the nutritional status was found to be correlated with occupation and education. Lactating mothers were not meeting nutritional requirements for the macronutrients in the baseline but after intervention to they were able to meet their requirement due to intervention because they not only consumed the produced vegetables but sold and used the proceeds to buy other food stuffs. Nutrition of the lactating woman affects milk composition and production plus the health of the offspring in adulthood (Silveira et al., 2007). Nutritional requirements for micronutrients especially iron, zinc and vitamin A, had a few age groups meeting the recommended intake and some were not able to meet these requirements, although results of nutrients analysis show the vegetables produced and consumed were rich in these nutrients. This is attributed to individual bioavailability and the fact that lactating mothers consumed less vegetable as they were consumed with other food staples in the dish.

Lactating mothers’ nutritional status improved after intervention and they were able to meet their zinc RDA dietary requirements. They not only consumed the grown vegetables but they also sold the surplus so as to buy other food stuffs not grown and they also used the income generated for health and education. This is as per focused group discussion and also reports from key informers in the study. Commercial production of vegetables can serve as a useful tool for poverty reduction for lactating mothers as well as a tool for reduction of hidden hunger, if only the right amount is consumed (Nkirigacha et al., 2016). It is important that any group undergoing a dietary intervention program be advised on proportions to feed on and the methods of preparation. In their report WHO, 2004, recommends that cooked vegetables should be consumed at 200gm per day. It is therefore important that the proximate composition of crops being used in the intervention be
determined for their nutrient composition so that their advantage to the groups using them can be determined.

Lactating mothers consumed the vegetables but in small quantities. The three vegetables were rich in iron, zinc and vitamin A. They were also rich in fiber, lipids, protein and carbohydrates. Methods of cooking did not show significant difference in the content of micronutrients and proximate composition. Therefore whether they stewed or boiled, the differences are negligible. The vegetables were rich in iron, zinc, and vitamin A, therefore it's recommended that lactating mothers plant and consume vegetables for their growth and development and prevention of various micronutrients deficiencies. Helping women achieve appropriate nutritional status to optimize breastfeeding is important and requires consideration of energy and nutrient needs (Silveira et al., 2007).

6.7 STRENGTHS AND IMPLICATIONS OF THE STUDY

The study had several strengths, the strongest being the community where the study was done were willing to have the study undertaken in their area. The other being the participants of the study went all the way to the end of the study and were willing to undertake all activities including growing of vegetables and participating in nutritional assessment procedures. This made it possible for comparisons of nutritional status and food consumption in both phases of the study.

The fact that the vegetables used were among the eight domesticated African green leafy vegetables and were found to be rich in nutrients such as iron, zinc and vitamin A, is evident that
these vegetables can improve the nutritional status of lactating mothers and the community at large, if only they are consumed in the right quantities.

6.8 CONCLUSIONS

Dietary intervention using affordable and accessible foods is an important source of micronutrients to vulnerable groups like lactating mothers. From the current study findings show that lactating women achieved micronutrients requirements, that they were previously deficient of in the baseline study and lactating mothers in different age groups improved their zinc, iron and vitamin A intake.

6.9 RECOMMENDATION

It is recommended that most urban dwellers be made aware of the importance of urban agriculture, in relation to improving their dietary intake and nutritional status. Diversification of urban farming to fast growing crops and crops with higher nutritional benefits to vulnerable groups should be done with the aim of improving dietary intake and nutritional status of lactating mothers.
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## APPENDIX I: FOOD CONVERSION TABLE

<table>
<thead>
<tr>
<th>TYPE OF FOOD</th>
<th>SELLING PRICE</th>
<th>WEIGHT (EDIBLE PORTION)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loaf of bread</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1kg Tin of maize</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1kg Tin of Beans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1kg Tin of pigeon peas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 sack of sweet potatoes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 sack of cassava</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 sack of pumpkins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irish potatoes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irish potatoes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cassava (medium) - 1 piece</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pawpaw (medium)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ripe bananas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pumpkin (medium)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pumpkin (large)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Egg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX II: CONSUMER UNIT

Energy and protein requirements of the various age and sex group expressed in terms of consumer units. One consumer unit is the consumption equivalent in terms of energy and protein respectively of a nominal adult man. Energy requirement of 2960 Kcal of adult man (20-29 years) and protein requirement of 50 grams was used (WHO/FAO/UHU, 1985).

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Energy requirements – Kcal/cu/day</th>
<th>Protein requirements – grams/cu/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>Male: 0.3</td>
<td>Female: 0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 0.3</td>
</tr>
<tr>
<td>1</td>
<td>Male: 0.4</td>
<td>Female: 0.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 0.3</td>
</tr>
<tr>
<td>1-2</td>
<td>Male: 0.4</td>
<td>Female: 0.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 0.3</td>
</tr>
<tr>
<td>3-5</td>
<td>Male: 0.5</td>
<td>Female: 0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 0.4</td>
</tr>
<tr>
<td>5-7</td>
<td>Male: 0.6</td>
<td>Female: 0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 0.6</td>
</tr>
<tr>
<td>7-10</td>
<td>Male: 0.7</td>
<td>Female: 0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 0.7</td>
</tr>
<tr>
<td>10-11</td>
<td>Male: 0.8</td>
<td>Female: 0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 0.9</td>
</tr>
<tr>
<td>12-14</td>
<td>Male: 0.9</td>
<td>Female: 0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 1.1</td>
</tr>
<tr>
<td>14-16</td>
<td>Male: 0.9</td>
<td>Female: 0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 1.1</td>
</tr>
<tr>
<td>16-18</td>
<td>Male: 0.9</td>
<td>Female: 0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 1.0</td>
</tr>
<tr>
<td>18-30</td>
<td>Male: 1.0</td>
<td>Female: 0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 1.0</td>
</tr>
<tr>
<td>30-60</td>
<td>Male: 0.7</td>
<td>Female: 0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 1.0</td>
</tr>
<tr>
<td>&gt;60</td>
<td>Male: 0.7</td>
<td>Female: 0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male: 1.0</td>
</tr>
</tbody>
</table>
APPENDIX III: QUESTIONNAIRE

SECTION A
Demographic information

Date

Interview no:

Hh NO:

1. Gender
   a) Male   b) Female

2. What is your ethnicity?
   a) Kamba  b) Luo   c) Meru  d) Luhya   f) Embu  g) Mdama
   h) Kikuyu f) any other specify

3. What is your age in years? 

4. What is your marital status?
   a) Single  b) Married  c) Widow/widower  d) Divorced  e) Sister or aunt to child

5. Who heads this hh?
   a) Husband  b) wife   c) children  d) others  e) husband and wife  f) wife

6. How many people live in your hh you included?

7. How many living children do you have of your own?
   Male
   Female
   Total

8. How many are below 5 years?

9. What is the highest level of education that you have achieved?
   a) None  b) primary  c) secondary ‘O’ level
   d) Secondary ‘A’ level  e) diploma college  d) university

SECTION B
Social economic status of hh food security information. Hh income and asset ownership.

10. What is your occupation?
11. How much money in Kenya shillings do you receive monthly from all sources (amount in ksh.) _________________________________________________________________

12. Who decides on the use of this income?
   a) Husband       b) wife       c) husband & wife       d) children
   e) Other       f) specify       g) parents

13. How much of this money do you spend on food per month (amount in ksh.)

14. Do you own the following assets?
   a) T.V       b) radio       c) gas cooker       d) latten lamp       e) gas lamp
   f) sofa set       g) bicycle       h) motor cycle       i) motor vehicle

15. How large is your piece of land?_______________________________________

16. Is this land yours
   a) yes       b) no

17. If yes, how did you acquire it?
   a) Resettlement       b) buying       c) inheriting
   d) other       e) specify       f) N/A

18. If NO, what are the terms of usage?
   a) Caregiver       b) renting       c) N/A

19. What do you farm in you piece of land?
   a)----------------- b)----------------- c)----------------- d)-----------------
   e)----------------- f)----------------- g)----------------- e)-----------------

20. What are the uses of the farm produce from your farm?
   a) For home consumption       b) for sale       c) consumption & sale
   d) Other, specify_________________________ e) N/A

21. What are some of the farming practices that you adopt?
   a) Terracing       b) Spraying       c) Mulching       d) Irrigation

22. Where do you acquire the above practices?
   1. Agriculture extension officer
   2. School
   3. Media TV, Radio, News paper
   4. Friends
5. Parents
6. Others specify

23. How do you acquire the seed/seedling to plant?
   1. Buy from approved seed stocks certified seeds
   2. Buy from the local shops uncertified seeds
   3. Get from the previous harvest and plant
   4. Any other specify

24. Who decides on what to plant

25. Who provide labour

26. What type of tools?

27. What input do you use?

28. Do you always have enough food for all the members of your household?
   Code: 1. Yes  code: 2. No

29. (If the answer in No: 29 is No, ask ) how many months do you usually have scarcity of food in a year?

30. What are the specific months of scarcity? -----------------------------------------------

31. What measures do you take to cope with the food shortage? (Indicate in order of importance)
   Sale of assets---------------- Reduce the meal size--------- Reduce the frequency of breast feeding the baby--------- Reduce the frequency of meals --------- Others specify---------
   -----------------------------------------------

32. What are the main sources of food in order of importance in this house? (Please rank)
   Own production ------------ Purchase------------ Food aid------------------ Others specify------------

33. How many meals do you consume per day?
   Code: 1 –one  2---Two  3--- Three  4--- Four

34) LAND OWNERSHIP AND URBAN CROP PRODUCTION
35. How much land do you own?___________(acreage)
36. Do you rent any land for cultivation? _______ (acreage)
37. (If the answer is No go to question 40 if yes ask)
38. How much is under cultivation? ____________ (acreage)
39. What food crops do you grow in this household? How much was produced per crop in the last year both in the long and short rain season?

<table>
<thead>
<tr>
<th>Food crops</th>
<th>Amount produced</th>
<th>Area under cultivation (acreage)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Long rain Season</td>
<td>Short rain Season</td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Measures
1. 90 Kgs Sacks 4.2Kg Kasuku
2. 50 Kgs Sacks 5.Kgs
3. 18 Kgs-Debe 6.Others, specify

41(a) Do you know of any drought tolerant food crops? 1. Yes 2. No
42(b) (If the answer Yes Ask) which ones? (List them) ____________________________
43.(c) For what reasons are they grown? (Please rank)
Use less inputs they are drought tolerant, home consumption others, specify _______________

44. Indicate in order of importance what you do with each of the crops. (Use the codes provided below the table)

<table>
<thead>
<tr>
<th>CROP</th>
<th>IMPORTANCE (RANK)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RANKING</td>
</tr>
<tr>
<td></td>
<td>1. 2 3 4 5</td>
</tr>
<tr>
<td>1. Black night shade</td>
<td></td>
</tr>
<tr>
<td>2. Cow peas leaves</td>
<td></td>
</tr>
<tr>
<td>3. Sorghum</td>
<td></td>
</tr>
<tr>
<td>4. Bulrush Millets</td>
<td></td>
</tr>
<tr>
<td>5. Saga</td>
<td></td>
</tr>
<tr>
<td>6. Amaranth</td>
<td></td>
</tr>
<tr>
<td>7. Kales</td>
<td></td>
</tr>
<tr>
<td>8. Spinach</td>
<td></td>
</tr>
</tbody>
</table>

Code:
5. Others specify__________

45. How much was used in each category of utilization (in question 44)?
(Use the codes below or enter the quantity in kilograms. Note indicate the unit of measure in brackets)

<table>
<thead>
<tr>
<th>Field Crops/urban produce</th>
<th>(a)Amount produced</th>
<th>(b)Amount consumed</th>
<th>(c)Amount sold</th>
<th>(d)Other uses Specify………..</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Codes: Measurements

46 (a) Do you preserve the above food crops that you grow?  1. Yes  2. No.

46 (b) *(If the answer is Yes, Ask)* How they are preserved?
(A) Legumes and cereals__________ (B) Root crops________________(use code below)
5. Vegetable preservation  6. Others specify

(iv) LIVESTOCK OWNERSHIP
What types of livestock do you own?
(Use the codes below)

<table>
<thead>
<tr>
<th>Type of livestock</th>
<th>Number owned</th>
<th>Type of product</th>
<th>Uses (Please rank in order of importance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cow</td>
<td>(a)……………….</td>
<td>1………………2………………3……...</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)……………….</td>
<td>1………………2………………3……...</td>
<td></td>
</tr>
<tr>
<td>2. Bull</td>
<td>(a)……………….</td>
<td>1………………2………………3……...</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)……………….</td>
<td>1………………2………………3……...</td>
<td></td>
</tr>
<tr>
<td>3. Goat</td>
<td>(a)……………….</td>
<td>1………………2………………3……...</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)……………….</td>
<td>1………………2………………3……...</td>
<td></td>
</tr>
<tr>
<td>4. Sheep</td>
<td>(a)……………….</td>
<td>1………………2………………3……...</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)……………….</td>
<td>1………………2………………3……...</td>
<td></td>
</tr>
<tr>
<td>5. Poultry</td>
<td>(a)……………….</td>
<td>1………………2………………3……...</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)……………….</td>
<td>1………………2………………3……...</td>
<td></td>
</tr>
<tr>
<td>6. Others, specify</td>
<td>(a)……………….</td>
<td>1………………2………………3……...</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)……………….</td>
<td>1………………2………………3……...</td>
<td></td>
</tr>
</tbody>
</table>
Codes: uses
1. Home consumption
2. Sell.
3. Others, specify________________

(v) HOUSEHOLD INCOME
47. In order of importance indicate the main source of income in this household. (Please rank)
Sale of drought tolerant food crops  sale of animals  Business
Sale of labour  others specify

48. How much do you spend on the following items in your household?

<table>
<thead>
<tr>
<th>Item</th>
<th>Per day (Ksh)</th>
<th>Per week (Ksh)</th>
<th>Per month (Ksh)</th>
<th>Per year (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Food</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2  Clothing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3  Farm inputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4  Wages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5  Medical care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6  School fees</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7  Others, specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

49. Contribution of urban Agriculture to hh food consumption. What is the contribution of urban farming to your hh food consumption?
   a) Most of the food
   b) About ½ of the food
   c) Only a small portion of the food
   d) Negligible
   e) None at all
   f) N/A
SECTION C Breastfeeding practices

50. Breastfeeding practice

a) Are you breastfeeding your child?
   1. Yes
   2. No

b) When did you initiate breastfeeding?
   1. First hour after delivery
   2. Within the first day of delivery
   3. After one day
   4. One week after delivery

c) How do you decide when to breastfeed during the day?
   1. When the child starts crying
   2. When the child wakes up
   3. Timing- after some time if not asleep
   4. When the child start to look for the breast
   5. When the milk starts oozing

d) How many times do you breastfeed your child during the day?
   1. On demand
   2. 4 times a day
   3. 1-2 times a day
   4. Rarely

c) If yes, how do you decide when to breastfeed the child at night?
   1. When the child starts crying
   2. When the child wakes-up
   3. Timing- after sometimes
   4. When the child tries to look for the breast

d) If no, why don’t you breastfeed?
   1. Lack of milk
   2. Lack of time
   3. Due to hunger
   4. Fear that the breast milk can harm the child
e) Why do you breast feed?
   1. Mother’s milk is nutritious
   2. Gives immunity to the child
   3. For healthy growth and development to the child
   4. For baby to get satisfied
   5. Breast milk is only food for the baby at that time
   6. For bonding with the baby
   7. It is child right to be breastfed
   8. To avoid breast engorgement

f) Do you breastfeed you child when in public places?
   1. Yes
   2. No

g) Your answer being No, give a reason
   1. Shy
   2. Embarrassment
   3. There is no place
   4. Fear for bad omen
   5. Not applicable

h) At what age did you start giving the child something else apart from breast milk?
   1. Within the first day
   2. 1-2 weeks
   3. 1-3 months
   4. 4-6 months
   5. Not applicable

i) What was the first food/fluid given to the child?
   1. Plain water
   2. Cow’s milk
   3. Infant formula
   4. Solution of water, salt and sugar
   5. Solution of water and salt
   6. Porridge
7. Pawpaw
8. Not applicable

Complementary feeding practice
51. a) Have you started giving your child any other food apart from breast milk?
   1. Yes
   2. No

If yes, go to next question
b) At what age did you start giving the child additional food or fluid in addition to breast milk?
   1. At two weeks
   2. At 1 month
   3. At 3 months
   4. At 4 months
   5. At 6 months

c) What was your reason for introducing complementary feeding?
   1. Not having enough milk
   2. To reduce colic pains
   3. Not having enough food to eat after breastfeeding
   4. Information acquired
   5. Working mother
   6. Baby should learn how to eat
   7. Not applicable

d) Did you consult at the clinic before you start giving food/fluid to your child?
   1. Yes
   2. No

Breastfeeding knowledge
52. a) Have you had any lesson on breastfeeding?
   1. Yes
   2. No

b) Where did you get this information?
   1. Clinic/labour ward
   2. Read poster/observation
   3. Friends
   5. College
   6. Not- applicable

c) Did you have a special diet/
   1. Ante-natal yes and post-natal
2. Ante-natal yes and post-natal
3. Post-natal yes and ante-natal
4. Ante-natal no and post-natal

Interviewer: Thank the respondent for her co-operation

Section D
53. F.G.D guide for the 53 Hh in the intervention.
   Part one
   a) What are the main sources of income in your community?
   b) How do lactating mothers cope with food scarcity?
   c) What are some of the challenges you face when breast feeding you babies?
   d) What are some of the factors that affect crop production in your area?
   e) For how long do breast feed your babies before introducing complementary feeds?
   Part two
   a) What new activities did you gain from this project?
   b) What has this project helped you in the provision of food to yourself and hh members?
   c) What new knowledge did you gain from this project?
   d) How sustainable is this food source?
   e) What problem are you encountering so far in food and livestock production?
   f) What have you done and will do to impact this knowledge to the other community members?
      1. Talk to others about it
      2. Conceal the information
      3. Others specify
   i) What are the sources of vitamin A? (liver, eggs, dark green vegetable,& yellow –orange fruits, spinach, carrots, pawpaw, tomatoes)
Any three sources_________________ 3  
Any two sources____________________ 2 
Any one source_____________________ 1  
Wrong answers or don’t know_________ 0  
j) What are the source of iron? ( meat, egg, fish, whole cereals, legumes and leafy green vegetable)  
k) Why is a balanced diet important to lactating mothers  

Section E  
Observation check list: Observe the following  
I. Materials used for constructing the main house.  
   a) Roof  ii) Grass  iii) Iron sheet  iii) Tiles  iv) Others specify 
   b) Floor i) Cement ii) Tiles iii) Mud iv) Wood  v) Others specify 
2. What is used as main source of lighting?  
3. What is the main source of fuel  
   i.Gas ii. Electricity iii. Firewood iv. Others specify  
4. What type of fruit trees are in the homestead?  
   i. Avocado ii. Pawpaws iii. Mangoes iv. Others specify  
5. What type of animals are in the compound  
   i. Cows ii. Goat’s iii. Chicken iv. Rabbit’s v. Others specify  
5. What is the main source of water?  
   i. Tap ii. Water tank iii. Rain iv. Others specify  
Obervation during interview  
   1. How often is the baby breastfed 
   ii. Is the baby given anything to eat other than the breastmilk?  
   iii. Is the baby taken out for exposure to sunlight?  
   iv. The presence of toilet in the compound  
   V. Does the mother take anything to eat during break time or mid-afternoon?  

Key informant interview question guide
Name of key informant
Designation
Interviewer’s name-----------------------
Date of interview -----------------------
Time--------------------------
Place -------------------------------
General introduction to researcher/recorder----------------------

1. Food consumption habits of lactating mothers
2. Breastfeeding habits
3. What age do mothers exclusively breast feed their babies-------
4. Do mothers come to the clinic for pre and post-natal clinic-------1. Yes 2.NO
5. Do you offer nutrition education to the mothers who attend the clinic------ 1. Yes 2. No
6. What would you associate with the mothers failure to breastfed their babies exclusively

Agriculture section
1. Is urban agriculture practiced in this sub-county?
2. Who are the main participants in farming in the family set-up?
3. What are the common farm implements used?
4. Which types of crops are commonly grown?
5. Do you have a well streamlined marketing system for the crops grown?
6. Do farmers keep livestock?

54. A 24 hour dietary recall
Yesterday what did you consume for breakfast, mid-morning, lunch, mid-evening, super and after super before bed time.

<table>
<thead>
<tr>
<th>Type of meal</th>
<th>Type of food</th>
<th>Content In grams(indicate amount in grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
<td>2. Milk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Tea leaves/coffee/chocolate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Sugar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Bread/s.pota/nduma</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Margarine/jam</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. eggs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Others specify</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Foods</td>
<td>Ingredients</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>Mid-morning</td>
<td>1. Porridge/yoghurt</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Mandazi/bread</td>
<td></td>
</tr>
<tr>
<td>Lunch</td>
<td>Ugali</td>
<td>Type of veg (amaranth, managu, Kunde) others</td>
</tr>
<tr>
<td></td>
<td></td>
<td>specify</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meat type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Githeri</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Onion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cooking fat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Salt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Royco</td>
</tr>
<tr>
<td>Mid-afternoon</td>
<td>1. Tea/porridge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Cake</td>
<td>Milk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tealeaves</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sugar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flour</td>
</tr>
<tr>
<td>Super</td>
<td>1. Chapati</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Rice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Ugali</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Githeri</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Onions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Salt</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Beans/pigeon/njahi</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Maize</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. Flour</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10. Vegetables (specify type)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11. Egg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12. Green grams</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13. Potatoes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14. Chicken</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15. Mutton</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16. beef</td>
<td></td>
</tr>
<tr>
<td>After super</td>
<td>1. yoghurt</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. milk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. tealeaves/chocolate/Milo/coffee</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. sugar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. honey</td>
<td></td>
</tr>
</tbody>
</table>

55. **Dietary diversity (24 hour recall)**

Yesterday did you or anyone in the hh consume the following foods?
<table>
<thead>
<tr>
<th>FOOD (group )</th>
<th>SPECIFIED FOOD</th>
<th>YES(1)</th>
<th>NO(0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starchy(cereals)</td>
<td>Maize, rice, millet, wheat, sorghum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starchy(non-cereals)</td>
<td>Potatoes, s.p, cassava, yams, green bananas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legumes &amp; nuts (dry)</td>
<td>All beans, green grams, ground. All green leafy vegetables, carrots, kales, spinach, terere, kunde, pumpkin leaves.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legumes( fresh)</td>
<td>French beans, green peas, all types of fresh beans.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit</td>
<td>Oranges, avocados, tomatoes, passion, pawpaw, ripe banana</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td>Chicken eggs, duck eggs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat &amp; fish</td>
<td>Beef, chicken, fish, rabbit, pork, goat meat.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td>Fresh milk, low fat milk, yoghurt</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) =1-3 low diversity   2) 4-6 middle diversity   3) 7-9 high diversity

56. **Frequency of intake of some food items.**

<table>
<thead>
<tr>
<th>Food group</th>
<th>Specified food</th>
<th>frequencies</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Every day</td>
<td>3-6 times/week</td>
<td>Once or twice/week</td>
<td>Once per month</td>
<td>Once per three months</td>
</tr>
<tr>
<td>Starch(cereals)</td>
<td>Maize, rice, millet, wheat, sorghum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starch(non-cereals)</td>
<td>Cassava, sweet potatoes, Irish potatoes, arrow roots, yams</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legumes &amp; nut (fresh)</td>
<td>French beans, green peas, all types of fresh beans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legumes &amp; nuts (dry)</td>
<td>All greens, green grams, ground nuts, macadamia, cashew nuts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Vegetables | All leafy green vegetables, carrots, kales, spinach, terere, managu, cowpeas, pumpkins leaves, saget, mitoo
---|---
Fruits | Oranges, avocados, tomatoes, passion fruits, pawpaws, ripe bananas, lemons, grapes, guavas
Eggs | Chicken eggs, duck eggs, quil eggs
Meat & fish | Beef, chicken, fish, rabbit, pork, goat, sheep
Milk | Fresh milk, low fat, yoghurt

Any three sources________________ 3
Any two sources_________________ 2
Any one sources_________________ 1
Wrong answer or don’t know_______ 0

57. What problems are caused by urban agriculture?
1) Pollution  2) noise  3)diseases  4)other  5) none

Nutrition knowledge

58. Answer the following questions to the best of your knowledge.
   i.   Do you know what a balanced diet is?    Yes [ ] No [ ]
   ii.  If yes, what are the three food groups?(carbohydrate, proteins, vitamin)
Three groups___________________________ 3
Any two groups_________________________ 2
Any one groups_________________________ 1
Wrong answer or don’t know______________ 0

59. Who prepares and cooks food for the family?

How are vegetables prepared?
   1. By cleaning them before cutting
   2. By cutting them then cleaning
   3. By cleaning them with hot then rinsing in cold water

How do you cook the vegetables?
   1. By shallow frying
   2. By boiling
   3. By boiling then shallow frying

If by boiling how much water do you use for cooking vegetables?
   1.

What is amount of vegetables that you cook with that amount of water?
   1.

If by frying how much fat did you use for frying vegetables?
   1.

What is the amount of vegetables that you cook with that amount of frying fat?
   1.

61. Do you grow vegetables?
   1. Yes
   2. No

If the answer to question 61 above is Yes then ask the purpose for which they are grown
   1. For home consumption
   2. For sale
   3. Both for sale and home consumption

THANK THE INTERVIEWER.
APPENDIX IV: METHODOLOGY FOR B-CAROTENE AND MINERAL ANALYSIS

B-CAROTENE (VITAMIN “A”)

Take about 2g of the sample.

Extract the color using a mortar and pestle with a small portions of Acetone until the residual is colorless.

Combine all extracts into a 100 ml volumetric flask

Take 25ml of extract into 50 ml round bottomed flask

Evaporate it to dryness in Rotary evaporator at about 60 degrees centigrade

To the evaporated sample add 1 ml of petroleum spirit so as to dissolve the B-carotene.

Elute the B-carotene through a packed column.

Receive the elute into a 25 ml volumetric flask

Read the absorbemce at 450nm.

Calculate the B-carotene standard curve.

**B-Carotene standard curve**

<table>
<thead>
<tr>
<th>Conc.(ug/ml)</th>
<th>Absorbance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4</td>
<td>0.120</td>
</tr>
<tr>
<td>0.3</td>
<td>0.24</td>
</tr>
<tr>
<td>1.2</td>
<td>0.350</td>
</tr>
<tr>
<td>1.6</td>
<td>0.480</td>
</tr>
<tr>
<td>2.0</td>
<td>0.580</td>
</tr>
<tr>
<td>2.4</td>
<td>0.720</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

MINERALS

Methodology

Wet Digestion Method

Removal of organic matter by digestion with acid

Procedure

- Weigh 1 gram ground sample into a beaker
- Add 20mls of acid (3 parts perchloric acid and 1 part witric acid)
- Leave on the bench overnight
- Place on hot plate (sand bath) and digest until the fumes clear—white fumes (all organic matter is digested).
- Wet filler paper with water and filter beaker contents into volumetric flask- 50mls make to volume.