DIETARY INTAKE OF VITAMIN A, HOUSEHOLD FOOD SECURITY AND PREVALENCE OF UNDERNUTRITION AMONG LACTATING MOTHERS IN SINAI SLUM, NAIROBI COUNTY, KENYA

BY

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A THESIS SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, DEPARTMENT OF HEALTH MANAGEMENT, POLICY AND NUTRITION IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTERS IN PUBLIC HEALTH (MPH)

MOI UNIVERSITY

2021

DECLARATION

Declaration by Candidate

I declare this thesis to be my original work and to the best of my knowledge has not been presented for a degree in any other institution. No part of this thesis shall be reproduced without my prior permission or that of Moi University

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DEDICATION

I dedicate this work to my beloved parents, Denis Ochere and Stella Eunice Ochere My lovely wife Hilda and our children Shawn, Scott and Shelby for being there always for Dad.

My sisters, Maren, Lilian, Mereza, Isabel, and brothers, George, Polycarp and Elly for the unwavering support and encouragement during my studies.

My Uncle, Bernard for teaching me how to do things always

ACKNOWLEDGEMENT

I wish to express my sincere gratitude to those who supported me in my work, with special thanks to:

My supervisors Dr. Susan Keino for her tireless guidance and advice throughout the development of this thesis and;

Prof. Constance N. Tenge for her guidance and support in development of this thesis.

All the lecturers of the School of Public Health Moi University for their collective efforts which armed me with important skills necessary in the development of this document.

Special recognition to the lactating mothers for their valued time during the study.

Lastly, to my colleagues MPH class 2007, their critique made me realize and correct my mistakes.

ABSTRACT

Background Vitamin A deficiency is a problem of public health significance among all the family members including the lactating mothers. In Africa, about 20% of the women of child bearing age are undernourished. In Kenya, 12% of the women 15-49 years are considered thin with a body mass index (BMI) of < 18.5. During the period of lactation, nutrient needs of the lactating mother increase to cater for her needs and the breastfeeding child. Low dietary intake of vitamin A during lactation has been found to result in inadequate concentration in breast. Due to this, undernutrition is common among lactating mothers.

Objectives: The objective of this study was to determine the adequacy of dietary intake of vitamin A, prevalence of undernutrition and household food security among lactating mothers aged 16-45 years in Sinai slum, Nairobi County, Kenya. The specific objectives were to determine i) adequacy of dietary intake of vitamin A ii) prevalence of undernutrition iii) Household food security.

Methods: A cross sectional study method was employed with participants identified through consecutive sampling. A total of 384 lactating mothers from Sinai slum attending Lunga Lunga health centre participated in the study from March to April 2011. A 24-hour dietary recall and a Food Frequency Questionnaire (FFQ) were used to assess dietary adequacy of vitamin A intake. Prevalence of undernutrition was determined through anthropometric measurements; Body Mass Index and Mid Upper Arm Circumference (MUAC). Household food security was determined using food insecurity access scale and dietary diversity questionnaires. Statistical analysis was done using Microsoft excel and SPSS Version 23.0. Descriptive analysis was used to display participant characteristic while Chi-square test was used to test for associations between inadequate intake of vitamin A, maternal undernutrition, household food security, and sociodemographic factors. Logistic regression was used to determine actual predictors of adequate dietary intake of vitamin A, maternal undernutrition and household food security.

Results: A total of 225 (58.6%) lactating mothers had inadequate dietary intake of vitamin A while 120 (31.3%) had low MUAC<220mm and 53(13.8%) had low Body Mass Index (BMI). Low protein intakes correlated with inadequate vitamin A intakes and low MUAC ($p=0.043$, $p=0.035$). Energy intake had a statistically significant association with dietary intake of vitamin A and low MUAC ($p<0.001$). Food insecurity had a statistically significant association with inadequate dietary intakes of Vitamin A, low MUAC and low BMI. Food insecure households were 2 times more likely to have inadequate Vitamin A intakes ($p<0.001$), low MUAC ($p=0.002$ and low BMI ($p=0.042$). The Household Dietary Diversity Score HDDS score was 5.2(SD=2.15). Dietary diversity correlated with inadequate Vitamin A intakes ($p=0.003$). Length of breastfeeding also correlated with low MUAC ($p=0.027$).

Conclusion: Lactating women in Sinai slums have low dietary intake of vitamin A. Additionally, they are under nourished with characteristic low protein and energy intakes as well as BMI and MUAC. Food insecurity alongside limited purchasing power compromise positive nutritional outcomes for the mothers hence at risk of these multiple micronutrient deficiencies.

Recommendations: There is need for well-designed nutrition intervention programs focusing on nutrient intake of affordable foods to increase dietary diversity and food variety of lactating women in this low socio-economic setting. Concurrent nutrition sensitization, distribution of nutritional supplements and empowerment programs through income generating activities, developing policies and comprehensive approaches, integrating food-based strategies by the government to address the high prevalence of undernutrition among lactating mothers. Such interventions would improve their nutritional status as well ultimately reduce vitamin A deficiencies.

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DEFINITION OF TERMS

Anthropometry-The study and technique of taking body measurements, weight, height, MUAC especially for use on a comparison or classification basis.

Body mass index (BMI) –Also known as Quetelet's index. An index that uses the variables weight and height to measure body fat stores (weight in kilograms divided by the square of height in meters.

Household- One person who lives alone or a group of persons, related or unrelated, who share food or make common provisions for food and possibly other essentials for living; the smallest and the most common unit of production, consumption and organization in societies

Malnutrition- A nutritional disorder or condition resulting from faulty or inadequate nutrition **Morbidity**- A condition resulting from or pertaining to disease; illness.

Mid Upper Arm Circumference (MUAC)-The circumference of the left upper arm measured in centimeters at point is between the tip of the shoulder (acromion process) and the elbow (olecranon).

Mortality rate- Death rate; frequency of number of deaths in proportion to a population in a given period of time; death.

Protein-Energy Malnutrition (PEM)-Under nutrition that results in an individual not receiving adequate protein or calorie for normal growth, body maintenance, and the energy necessary for ordinary human activities

Stunting- A slowing skeletal growth that results in reduced stature or length; a condition that usually results from extended periods of inadequate food intake and infection, especially during the years of greatest growth for children

ABBREVIATIONS

BMI	-	Body Mass Index
DGLV	-	Dark Green Leafy Vegetables
FAO	-	Food and Agricultural Organization
FFM	-	Food frequency method
FFQ	-	Food frequency questionnaire
HKI	-	Hellen Keller International
IPHN	-	Institute of Public Health Nutrition
LAM	-	Lactational Amenorrhea Method
LBW	-	Low Birth Weight
MDS	-	Maternal Depletion Syndrome
MUAC	-	Mid Upper Arm Circumference
PEM	-	Protein Energy Malnutrition
RAE	-	Retinol Activity Equivalent
RDA	-	Recommended Dietary Allowance
RE	-	Retinol Equivalent
SPSS	-	Statistical Package for Social Scientists
UNICEF	-	United Nations Children’s Fund
VAD	-	Vitamin A Deficiency
WHO	-	World Health Organization

CHAPTER ONE

1.0 Introduction

In most developing countries, women spend a large proportion of their reproductive years pregnant, lactating or pregnant and lactating at the same time. It is estimated that on average, African and Asian women between the ages of 15 and 45 years are pregnant or lactating 30–48 percent of their time. Most women living in these countries experience various biological and social stresses that increase the risk of malnutrition throughout life. These include: food insecurity, inadequate diets, recurrent infections, frequent parasites, poor health care, heavy work burdens and gender inequities. Additionally, successive pregnancies and lactation have been found to have cumulative effects on specific nutrients and depending on the maternal body stores lead to maternal depletion. Of the key nutrients affected is vitamin A whose requirement is increased during lactation. Low weight in combination with low serum retinol levels lead to a risk of depletion and hence undernutrition.

Under-nutrition and poor health from preventable causes disproportionately affect the well-being of millions of people in the developing world. Factors at individual, household and community level, or a combination of these factors, may contribute to poor nutrition and health status. In particular, malnutrition among women is likely to have a major impact on their own health as well as their children's health and that more than 3.5 million women and children under age five in developing countries die each year due to the underlying cause of under-nutrition (Bitew *et al*., 2010). Women are more likely to suffer from nutritional deficiency than men for several reasons, including their reproductive biology, low social status, poverty and lack of education. In addition, socio-cultural traditions and disparities in household related to work patterns can also increase women's chance of being malnourished (Haileslassie *et al*., 2013).

Kenya Demographic Health Survey noted that the mean BMI among women aged 15-49 is 23.7 kg/m^2. Nine percent of women of reproductive age are thin or undernourished (BMI <18.5 kg/m^2). The proportions of mild thinness (17.0-18.4 kg/m2) and moderate and severe thinness (<17 kg/m^2) are 6 percent and 3 percent, respectively. Younger and rural women are more likely to be thin. Twenty-six percent of children under age 5 are stunted, 4 percent are wasted, and 11 percent are underweight. Stunting is higher among rural children (29 percent) than urban children (20 percent). Only 22 percent of children are fed in accordance with the three recommended infant and young child feeding practices. Seventy two percent of children age 6-59 months received vitamin A supplements in the past six months. Children who were still breastfeeding (77 percent) were more likely to be given vitamin A supplements than those who were not breastfeeding (71 percent). More children in urban areas received vitamin A supplements than in rural areas (75 percent and 70 percent, respectively) (KDHS 2014).

The global number of hungry people keeps rising, and in sub-Saharan Africa, estimates show that almost 690 million people went hungry in 2019 - up by 10 million from 2018. High costs and low affordability also mean billions cannot eat healthily or nutritiously. The hungry are most numerous in Asia, but expanding fastest in Africa (FAO 2020). The rapid growth of urban population has prompted concern about food security with respect to availability and accessibility. Rapid urbanization in Sub-Saharan Africa has resulted in urban poverty, which is recorded to be severe enough to put livelihoods and food security at risk. Apart from this, urban growth has also brought forth other problems such as unemployment and environmental degradation (Mugalavai *et al*., 2013). Malnutrition in urban slums is mainly attributed to the consumption of inadequate and often irregular meals, which do not meet the nutritional requirements of the various life stages including during lactation. Maternal and child under-nutrition is highly prevalent in low-income and middleincome countries, resulting insubstantial increases in mortality and overall disease burden. (Mutisya *et al.*, 2015).

1.1 Problem Statement

Vitamin A deficiency affect about one third of children aged 6 to 59 months, with the highest rates in sub-Saharan Africa (48 per cent) and South Asia (44 per cent) (UNICEF 2019). The coverage of vitamin A supplement programmes dropped by more than half, in countries with the highest under-five mortality rates. In Kenya, latest data show the prevalence of vitamin A deficiency (retinol-binding protein <0.70 μmol/l) among pre-school children at 9.4% (CI: 7.5-11.3) (MOH 2011). However, more research is needed to better measure the magnitude of the problem and identify specific sub-groups at highest risk. Low dietary intake of vitamin A during lactation has been found to result in inadequate concentration in breast milk increasing the child's risk of becoming deficient. Given that hospitals have been reporting clinical cases of vitamin A deficiency in the past years, questions have been raised about the effectiveness of the current national vitamin A deficiency reduction programs in Kenya.

Although many studies have been conducted on the nutritional status of lactating mothers in Kenya, few have described their dietary intake of micronutrients. Under-nutrition in addition to micronutrient deficiencies especially Vitamin A and iron deficiencies are among the most common nutritional deficiencies in most developing countries probably second to Protein- Energy- Malnutrition (WHO 2012). Inappropriate dietary practices characterized by poor dietary intakes, reduced number of meals and inadequate consumption of fruits and vegetables among pregnant and lactating women contribute to under nutrition (Hossain *et al*., 2013). The Kenya Demographic Health Survey provides national and sub-national coverage estimates, but does not give data on dietary intakes. Therefore, less is known about dietary intakes among lactating women who may not only be undernourished and food insecure but are also at risk of vitamin A deficiency in low socioeconomic setting.

The study focused on lactating mothers living in low socio-economic setting who may be at risk of vitamin A deficiency because inadequate intake is suspected to be a limiting factor for growth and development of infants and has been found to be higher during lactation when vitamin A concentration is essential in breast milk. It is also during this period where if the essential nutrients are not provided, infants are likely to suffer under nutrition and other health problems related to growth and development.

1.2 Justification

During lactation, mothers require approximately 500 additional kcal/day beyond what is recommended for non-pregnant women (American Academy of Pediatrics and the American College of Obstetricians and Gynecologists 2012.). This requirement is a major challenge for the mothers from low socio-economic setting like the slums. Moreover, micronutrient requirements can only be met by a diversified diet which includes animal source foods, cereals, fruits and vegetables. Unfortunately, many poor mothers do not eat adequate meals so as to gain enough weight to facilitate lactation.

Lactation is considered successful when the breast-fed infant is gaining an appropriate amount of weight (Kominiarek and Rajan 2017).

In Sinai slum, the population is mainly comprised of labour migrants working in the neighbouring industrial area. The slum is served by few public and private health facilities, and these are located far from most slum population. The slum residents depend solely on the Lunga Lunga health centre which is the only government health facility in the area for health care. Though it does not have in-patient services their maternal and child health, the clinic is always busy due to the number of mothers seeking healthcare services at the clinic. Cases of micronutrient deficiencies as per the health records at the health centre are reportedly high.

The high prevalence of undernutrition and inadequate vitamin A intakes among lactating mothers in Kenya is alarming. According to KDHS (2014), the environmental risk factors such as inadequate food intake and frequent infection have been found to be common in Kenya especially in the low socio-economic settings like Sinai slum. There are reasons to suspect vitamin A to be a limiting factor for growth and development in infants. This emphasizes the importance of addressing linear growth retardation at the earliest possible age when nutritional deficiencies occur.

Furthermore, information on dietary intake of vitamin A is lacking as a result of poor data on vitamin A content of local foods. This study seeks to identify dietary intake of micronutrient vitamin A in lactating mothers. Dietary intake of micronutrients will therefore provide valuable data to guide in policy making and to initiate programs in order to increase vitamin A concentration in food. The study will therefore aid in evaluating additional interventional strategies in order to increase vitamin A concentration in food and provide valuable data to guide in policy making and to initiate intervention programs in order to provide optimum micronutrients requirements to lactating mothers. It will further contribute to the field of knowledge in nutrition and will act as a basis for future research in this area of study.

1.3 Research Question

1. Is dietary intake of vitamin A adequate to meet the nutritional requirements of lactating mothers in Sinai slum, Nairobi County, Kenya?
2. What is the level of undernutrition amongst mothers in Sinai slum, Nairobi County, Kenya and their extent of household food security?

1.4 Objectives

1.4.1 General objective

To assess the adequacy of vitamin A dietary intake, prevalence of undernutrition and extent of household food security among lactating mothers in Sinai slum, Nairobi County, Kenya.

1.4.2 Specific objectives

1. To determine adequacy of vitamin A dietary intake among lactating mothers in Sinai slum, Nairobi County, Kenya
2. To determine the prevalence of undernutrition among lactating mothers in Sinai slum, Nairobi County, Kenya
3. To determine the extent of household food security among lactating mothers in Sinai slum, Nairobi County, Kenya

CHAPTER TWO

LITERATURE REVIEW

2.1 Sources of vitamin A and Recommended Daily Allowance (RDA) for Vitamin A

Vitamin A is an essential human nutrient; it refers to a family of similarly shaped molecules: the retinoids. In foods of animal origin, the major form of vitamin A is an ester, primarily retinyl palmitate, which is converted to an alcohol (retinol) in the small intestine. Vitamin A can also exist as an aldehyde (retinal), or as an acid (retinoic acid). Precursors to the vitamin (provitamins) are present in foods of plant origin as some of the members of the carotenoid family of compounds. Vitamin A may be found in various forms: Retinol, the form of vitamin A absorbed when eating animal food sources, is a yellow, fat-soluble, vitamin with importance in vision and bone growth. The absorption of provitamin also depends greatly on the amount of lipids ingested with the provitamin; lipids increase the uptake of the provitamin.

Dietary sources of vitamin A are of two categories: Vitamin A and retinol, also known as preformed vitamin A and provitamin A which refers to those carotenoid precursors that can be bioconverted to retinol. Preformed vitamin A is found naturally in certain foods of animal origin: liver, fish oil, egg yolk, whole milk and products with milk fat and breast milk. Provitamin A is formed by and found primarily in plant foods such as dark green leafy vegetables and yellow orange fruits. In poorer countries carotenoids are the major sources of vitamin A in the diet.

Table 2-1: Sources of vitamin A rich foods

Food	mcg RAE per serving	IU per serving	Percent DV*
Sweet potato, baked in skin, 1 whole	1,403	28,058	561
Beef liver, pan fried, 3 ounces	6,582	22,175	444
Spinach, frozen, boiled, ½ cup	573	11,458	229
Carrots, raw, ½ cup	459	9,189	184
Pumpkin pie, commercially prepared, 1 piece	488	3,743	249
Cantaloupe, raw, ½ cup	135	2,706	54
Peppers, sweet, red, raw, ½ cup	117	2,332	47
Mangos, raw, 1 whole	112	2,240	45
Black-eyed peas (cowpeas), boiled, 1 cup	66	1,305	26
Apricots, dried, sulfured, 10 halves	63	1,261	25
Broccoli, boiled, ½ cup	60	1,208	24
Ice cream, French vanilla, soft serve, 1 cup	278	1,014	20
Cheese, ricotta, part skim, 1 cup	263	945	19
Tomato juice, canned, ¾ cup	42	821	16
Herring, Atlantic, pickled, 3 ounces	219	731	15
Ready-to-eat cereal, fortified with 10% of the DV for vitamin A, ¾–1 cup (more heavily fortified cereals might provide more of the DV)	127–149	500	10
Milk, fat-free or skim, with added vitamin A and vitamin D, 1 cup	149	500	10
Baked beans, canned, plain or vegetarian, 1 cup	13	274	5
Egg, hard boiled, 1 large	75	260	5
Summer squash, all varieties, boiled, ½ cup	10	191	4
Salmon, sockeye, cooked, 3 ounces	59	176	4
Yogurt, plain, low fat, 1 cup	32	116	2
Pistachio nuts, dry roasted, 1 ounce	4	73	1
Tuna, light, canned in oil, drained solids, 3 ounces	20	65	1
Chicken, breast meat and skin, roasted, ½ breast	5	18	0

Source: U.S. Food and Drug Administration (FDA)

Reference values for retinol or its equivalents, provided by the National Academy of Sciences, have kept changing. The RDA varies in terms of sex, age and physiological status. Currently the

RDA of the lactating mother is estimated to be 900-2500 μg /day for age group of 19->50 years.

Vitamin A activity of carotenoids varies with β-carotene having the highest activity. One of the reasons is the differences in the bioavailability of carotenoids. Bioavailability is the fraction of the ingested nutrient available for utilization in normal physiological functions and storage while bioconversion is the fraction of a bioavailable nutrient (an absorbed pro-vitamin A carotenoid) converted to the form of the nutrient (retinol). Vitamin A is essential for vision acuity, maintaining mucosal surfaces of the respiratory, gastrointestinal, and genitourinary tracts and for differentiation of immune system cells; however excess preformed vitamin A exerts teratogenicity effects. The recommended dietary allowance in lactation is 850μg/day which gives a normal retinol concentration in breast milk of 485μg /liter (Ongosi, 2010).

Vitamin A status and intake can be affected by other nutrients. For example; it is dependent on an adequate dietary intake of nutrients such as fat, protein, vitamin E, and zinc. Combining vitamin A with iron has been shown to be more effective in increasing red blood cell production than giving iron alone in girls and in pregnant women. Vitamin A deficiency impairs mobilization of iron, allowing it to accumulate in the liver and spleen.

Table 2-2: Vitamin A Recommended dietary allowance during lactation

Life stage	Lower limit (ug/ day)	Upper limit (ug/day)
Lactation		
<19 years	900	2300
19->50 years	900	2500

2.2 Vitamin A Deficiency during lactation

Good nutritional status of women is important for their good health and working capacity, as well as for the health of their offspring. During pregnancy and lactation, women are more vulnerable to under nutrition than others at reproductive age, due to increased energy and nutrient requirements (Desalegn *et al.,* 2018). Low vitamin A status during pregnancy and lactation is also associated with greater risk of mild anemia, severe anemia, and lower body mass index (BMI) as well as symptoms of urinary /reproductive tract infections, diarrhea, pre-eclampsia and nausea. In Kenya, fifty four percent of women received a vitamin A dose during the postpartum period. The percentage of women receiving postpartum vitamin A was noted to be higher in urban areas (58 percent) than in rural areas (51 percent) (KDHS 2014).

Low dietary intake of vitamin A during lactation has been found to result in inadequate concentration in breast milk increasing the child's risk of becoming deficient. Nutrient requirements are considerably elevated during lactation than in any other stage of a woman‘s reproductive life. Women who are breastfeeding should increase their energy and nutrient intakes to levels above those of non-pregnant, non-lactating women. 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. By four months after birth, an infant double the birth weight accumulated during the nine-month pregnancy period. The milk secreted in one month represents more energy than the total cost of a pregnancy. Lactation is the most energy-demanding phase of human reproduction. The energy cost of milk production in the first six months of exclusive breastfeeding increases women's daily energy needs by 30% or 1260 kJ/day above the pregnancy energy requirement. An additional 500 kcal for the first six months, and 400 kcal during the next six months, are required for a lactating mother (Ongosi, 2010).

Vitamin A deficiency and iron deficiency anemia, two of the major nutritional deficiencies in lowincome countries, often coexist. This may be due to inadequate dietary intake of both vitamin A and iron (Othoo *et al.*,2014). Adequate micronutrient intake by women has important benefits for both women and their children. Breastfeeding children benefit from micronutrient supplementation that mothers receive, especially vitamin A (KDHS 2014). In a Kenyan study, a high percentage (88.4%) of lactating mothers were found to be at risk of vitamin A deficiency with serum retinol values of less than 1.05 µmol/L. The study noted that mothers with a low level of fat mass also had a high prevalence of vitamin A deficiency (Ettyang, 2003). It has also been reported that lactation has different effects on maternal nutritional status depending on its duration, intensity.

Demographic Health Survey in Kenya indicated that the prevalence of postpartum vitamin A supplementation increases with increasing education. Women in the lowest wealth quintile are less likely to receive a postpartum vitamin A dose (38 percent) than their wealthier counterparts (54 percent or higher) (KDHS 2014). More evidence related to malnutrition is often determined through anthropometric and clinical indicators as, wasting, stunting, underweight and anemia (MoH & UNICEF, 2012) and food restrictions (Barennes *et al.,* 2009).

Several studies have shown that metabolic disturbances early in life, particularly those related to nutrition, induce irreversible physiologic alterations in adulthood. Experimental and epidemiologic studies have pointed out that nutrition is vitally important during prenatal (pregnancy) and postnatal (immediately after birth) periods.

Therefore, nutrition of the lactating woman not only affects milk composition and production but also the health of the offspring in adulthood. Energy and nutrients can be obtained from a varied diet that includes foods from each basic food group. Some nutrient needs however are greater than others and they vary from lactation and pregnancy needs as they independently affect breast milk concentration. However, women in developing countries generally enter lactation with low bodily energy reserves, which makes them to be at risk of adverse nutritional consequences. How these women meet this need for additional energy has created considerable interest in terms of basic biology and policy implications. Further results show that women, who enter lactation with low bodily fat stores and fail to compensate for the additional energy needed, have substantial postpartum weight loss (Ongosi, 2010).

Vitamin A Infant liver stores of vitamin A at birth are very small even in well-nourished populations. They greatly depend on the dietary intake of the mother. On the other hand, although vitamin A in human milk decreases over the course of lactation, breast milk is a good source of vitamin A and clinical vitamin A deficiency is rare in breastfed infants during their first year of life, even in poor populations. Therefore, if mother does not consume vitamin A in her diet, she will be depleted together with her child (Ongosi, 2010). Where protein energy malnutrition exists, it is inevitable that other micronutrient deficiencies will also be present the most notable being vitamin A and iron. Vitamin A deficiency involved in the etiology of nutritional anemia and deficiency contributes to poor maternal performance during the reproductive cycle including lactation (Ongosi, 2010).

2.3 Undernutrition among Lactating Mothers in Low Socioeconomic Settings

Despite the fact that challenges of food and nutrition security are global in nature, the magnitude of the problem is immense in Sub-Saharan Africa. The prevalence of undernourishment is the highest where about 23% of the population is undernourished (FAO and ECA 2018). In Kenya, in particular, the prevalence of undernourishment in the total population stands at about 29.4 %, (FAO IFAD, UNICEF, WFP and WHO 2019). In rural areas, undernourishment is generally more pronounced than in urban settings. However, within the urban setting, undernourishment is more pronounced amongst those in the lower wealth quantiles.

A woman’s nutritional status has important implications for her health as well as for the health of her children. Malnutrition in women results in reduced productivity, increased susceptibility to infections, slowed recovery from illness, and a heightened risk of adverse pregnancy outcomes. For example, a woman with poor nutritional status, as indicated by a low body mass index (BMI), short stature, or micronutrient deficiencies, has a greater risk of obstructed labour, of having a baby with a low birth weight, of death from postpartum haemorrhage, and of morbidity for both herself and her baby (KDHS 2014).

The effects of malnutrition on human performance, health and survival have been the subject of extensive research for several decades and studies show that malnutrition affects physical growth, morbidity, mortality, cognitive development, reproduction, and physical work capacity. Malnutrition is an underlying factor in many diseases in both children and adults, and it contributes greatly to the disability-adjusted life years (DALYs) worldwide (Murray et al, 2013). Malnutrition is particularly prevalent in developing countries, where it affects pregnant and lactating mothers. The primary determinants of malnutrition, as conceptualized by several authors relate to unsatisfactory food intake, severe and repeated infections, or a combination of the two. Consequently, the assessment of maternal nutritional status is a suitable indicator for investigating the wellbeing of mothers, and as well as for examining households' access to food, health and care.

Maternal adequacy of energy and protein intake have an effect on the mother's vitamin A status. With a prolonged lactation period of >4 months, the increase in breast milk fat is at the expense of a decrease in maternal protein reserves. This affects not only the concentration of breast milk vitamin A but also the long-term preservation of maternal energy and protein reserves (Shetty, 2015). However, chronic energy deficiency and stunting among women in developing countries are the results of malnutrition during fetal development, infancy, and childhood with low energy intakes continuing into adulthood. During pregnancy and particularly during lactation, a woman's food intake helps meet the additional demands of pregnancy and lactation.

BMI is expressed as the ratio of weight in kilograms to the square of height in metres (kg/m^2). BMI is used to measure thinness or obesity. A BMI below 18.5 kg/m2 indicates thinness or acute undernutrition, and a BMI of 25.0 kg/m^2 or above indicates overweight or obesity. A BMI below 17 kg/m^2 indicates severe undernutrition and is associated with increased mortality (KDHS 2014).

Demographic and health survey conducted in Kenya in 2014 indicated that the mean BMI among women age 15-49 was 23.7 kg/m^2. Nine percent of women of reproductive age were thin or undernourished (BMI <18.5 kg/m^2). The proportions of mild thinness (17.0-18.4 kg/m^2) and moderate and severe thinness (<17 kg/m^2) are 6 percent and 3 percent, respectively. Younger and rural women were more likely to be thin. Women in the lowest wealth quintile (22 percent) were 5 times as likely to be thin as women in the highest wealth quintile (4 percent) (KDHS 2014). Low weight in combination with inadequate intakes lead to a risk of depletion and hence malnutrition.

2.4 Household Food Security among Lactating Mothers in Low Economic Settings

2.4.1 Household Food Access

In Kenya today, over 54 percent of the population live in poverty with more than 12 million living in "absolute poverty" surviving on less than one dollar per day. The poor do not have access to basic social services unlike the populations in developed nations (Mugalavai *et al*., 2013). The number of people living in urban centers continues to grow at approximately twice the rate of rural areas. The low-income households in Kenya spend more than 50-80% of their disposable income on food and still do not meet their daily dietary needs. Those with tangible assets such as freelease land and housing are more likely to survive and prosper than those without (Mugalavai *et al*., 2013).

Chronic food insecurity affects the resource-poor and may result from inadequate diet caused by the inability to acquire food due to lack of resources for buying food or producing some (USDA, 2015). Transitory food insecurity results from natural calamities which include wars, floods, climatic failures, loss of purchasing power by groups of households and market failures due to high inflation rates and grain hoarding (Mugalavai *et al*., 2013).

Most of Africa's urban population spends 80 percent of their earning on food only, as compared to the US, who spend an insignificant 2 percent only (UNDP 2016). However, food per se is not everything a human being needs in life as other social amenities such as shelter, clean water and good sanitation, clothing, transport, education and healthcare are necessary for worthy living (Mugalavai *et al*., 2013). Urbanization has a major negative impact on the nutritional health of poor populations. This is mainly attributed to limited financial resources and the cost of food is higher in cities, the urban poor lack nutritious diets – leading to illness, which contributes to loss of appetite and poor absorption of nutrients (Rahman and Kuddus 2014).

Food availability is critical for quality nutrition that leads to a balanced diet. An individual's body also has to be in the right health status, free from diseases and living in good sanitary conditions so as to benefit from the available food (Rahman and Kuddus 2014). Thus, a household is food secure when it has access to the food needed for a healthy life for all its members (adequate in terms of quality, quantity, supply, and culturally acceptable) and when it is not at undue risk of losing such access (USDA, 2015). Food must therefore be available, accessible, affordable, adaptable and acceptable to households in order for an adequate food security status to be attained (Mugalavai, 2008).

The World Health organization advocates for a healthy weight by eating roughly the same number of calories that individual body is using (WHO 2018). A well-nourished mother is one with access to adequate food supply, care and health. Such a mother will have weight and height measurements that compare very well with the standard normal distribution of heights (H) and weights (W) and body mass index as well as other anthropometric parameters of healthy adults of the same age. An old nutrition maxim that says "feed the mother, thereby the infant" will go a long way in improving the nutrition situation on both mothers and their children.

Dietary diversity may be limited by access and affordability of higher quality foods (Justine et al., 2017). Dietary quality can be affected by market prices of micronutrient rich foods and staple grains as major sources of energy. In response to rising food prices, the poor generally tend to purchase and consume smaller amounts of nutrient-dense foods, such as dairy products, eggs, meats, fish, fruit, vegetables, nuts, and pulses, while maintaining staple grain consumption despite the higher or widely fluctuating costs of the grain (Keith P. West and Sucheta Mehra 2010).

In Bangladesh, food prices, household dietary quality and SES, and child nutritional status were among factors assessed in cross-sectional population surveillance panels conducted every 2 months between 1992 and 2000. Keeping seasonality constant, rice intake per capita remained comparable despite 50% fluctuations in price. Such price inelasticity led to less money being spent, during high rice price periods, on vegetables, fruits, dairy products, eggs, and meat with liver. Vitamin A status was not followed in this instance, but it was assessed in a similar, large national surveillance system in Indonesia in the late 1990s and early years of the new millennium. Increased expenditure on plant-based foods, eggs, other animal foods, and all non-grain foods was strongly protective against risk of night blindness in non-pregnant women, whereas the risk was almost tripled in households with the highest share of food expenditure spent on grains. Odds ratios associated with the highest vs. lowest quintiles of expenditures ranged from 0.47 to 0.62, with upper 95% confidence limits of ≤0.85 for each class of nongrain, usually micronutrient-rich, foods (Keith P. West and Sucheta Mehra 2010).

Additional reports of association between food expenditures (proxy for income) and food group intakes over time (i.e., changing terms of exchange) could help inform the design and content of local food production, marketing, fortification, and nutrition education strategies seeking to improve access and dietary choice to prevent nutrient deficiencies (Keith P. West and Sucheta Mehra 2010).

In Kenya, over 80% of the population occupy 20% of arable land area, creating great pressure on the scarce arable land thus contributing to high rural urban migration and hence rapid expansion of urban slums, thus having 29% of the urban population being poor (UNICEF 2016). With annual population growth rate of 7% in Nairobi it is thus one of the cities with the fastest growth rates in Africa. A large proportion of this population (50-70%) live in informal settlements where environmental and health conditions are very poor (World Bank, 2016). The rate at which urban growth is increasing stretches the economy of a country to the extent that it cannot cope with all the populations in urban centres. This makes the urban poor to live under difficult situations, which expose them to various diseases and ill health. Moreover, the environment in which the urban poor live in influences the health of all human beings greatly. In almost all urban slums and shantytowns, the surrounding is quite unsafe because there is no adequate lighting, and garbage is not regularly collected or not at all, thus exposing the inhabitants to a precarious life. Rapid urbanization has made it difficult for urban centres to keep pace in providing the basic services like supply of adequate clean water, proper sanitation, schools, health services and decent housing, thus forcing the majority to live in poverty and squalor. Under nutrition among people in urban slums therefore is aggravated and perpetuated by rapid urbanization and more specifically more than 5 million children aged 0-14 years die each year from environment-related diseases and conditions such as diarrhoea and respiratory illnesses (APHRC, 2020). One of the goals of the Sustainable Development Goals (SDG) is to ensure environmental sustainability, which aims at increasing the proportion of populations having increased access to an improved water source and improved sanitation (APHRC, 2020). This will have positive influence on the health and nutritional status of the whole family members.

Urbanization, together with population growth and decreasing incomes, contribute to tremendous increases in food demand, the volume of food required, and to varied and dynamic changes in dietary structure. The urban poor are low-income earners, thus spent less on purchase of food. Most of these families access food mainly through purchase from the market or shops. The food available within the market may be expensive thus forcing the urban poor to cut down on their daily expenditure for food. Increased food prices force poor families to reduce both quantity and quality of their food intake (Ongosi, 2010). This has a direct impact on household food security in that the members are likely to get inadequate amounts of food of the right quality and quantity to satisfy their dietary needs throughout the year.

2.4.2 Households' Dietary Diversity

Dietary diversity has been defined as the number of different foods or food groups that are consumed over a specific reference period. According to Zainal-Badari et al., 2012, adequate nutrient intake necessary for good nutrition has often been associated with food variety and diet quality of individuals. Regrettably, literature shows that micronutrient malnutrition remains a major public health concern in developing countries due to intake of monotonous, predominantly starchy based diets that are lacking in diversity (Kennedy et al., 2007). Unfortunately, lactating women in these countries are considered most vulnerable since they have higher nutrient requirements (Mary et al., 2011).

Dietary diversity is usually measured using a simple count of foods or food groups over a given reference period. Ruel's study (2008) revealed that studies in developed and developing countries have used a variety of food and food group classification systems, different numbers of foods and food groups, and varying reference period lengths (ranging from 1 to 15 days). Ingestion of more than four different food groups per 24 hours daily is considered dietary diversity (FANTA, 2018). Four types of foods or less consumed in 24 hours are considered not diverse therefore inadequate nutrient intake requiring nutrition education or relevant interventions (FANTA, 2018).

2.4.3 Consequences of food insecurity on populations

Food insecurity and under-nutrition have strong negative effects on lactating and pregnant mothers, infants, children, the elderly, the disabled and people living with HIV/AIDS (PLWHAs). Pregnant and lactating mothers need adequate nutrient intake to meet their own nutrient needs for physiological processes in addition to those needs for the growing and developing foetus. Nutrients requirements during pregnancy and lactating increase due to physiological changes associated with the growing foetus and, infant meeting its requirements from the mother through lactation ((FSAU, 2018).). Unless the mother is severely under-nourished, the baby is likely to get its nutrient requirements at the expense of the mother. For instance, the mother might develop anaemia during pregnancy but the baby may not necessarily have iron deficiency. However, the baby inside her will be affected by maternal iron deficiency because of low oxygen supply to the placenta. This results in low-birth-weight babies (Ongosi 2010).

Under-nutrition has a direct impact on maternal and infant mortality and morbidity (FSAU, 2018). Inadequate maternal dietary intake of some vitamins such as vitamins

A and C will affect iron absorption from her diets. In addition, low nutrient intake of lipids by the mother also limits absorption of Vitamin A. One sees the importance of having dietary diversification as most nutrients affect or work in synergy each potentiating the effects of the other (Ongosi 2010).

CHAPTER THREE

METHODOLOGY

3.1 Study Design

This was a cross-sectional study where dietary intake of vitamin A was determined as well as undernutrition of the lactating mothers in the socio-economically Sinai slum, Nairobi County, Kenya.

3.2 Study Area

Sinai slum is located in Makadara Sub-County, Nairobi County. It is about 7 kilometers from the city centre covering an area of 2.02 Km^2. It has a population around 120,000 people. There are very few public health facilities serving the slum communities, and these are located on the outskirts of the slums. The population is mainly comprised of labour migrants working in the neighbouring industrial area.

Lunga Lunga Health Centre is the only public health facility offering basic health services mostly outpatient n Sinai slums. It’s located at the edge of the slum, hence far from many slum residents. Nutrition services are offered by hospital nurses who may not have adequate nutritional knowledge. The health facility has one clinical officer and 4 nurses. The health facility is attended by majority of the mothers residing in the slum.

Sinai slum lacks access roads, no adequate clean drinking water, lacking garbage and sewage disposal, having high unemployment rates, insecurity and poverty. The slum was purposively chosen for the study because there is no current available literature on any research on the adequacy of dietary intake of vitamin A, extent of food insecurity and undernutrition among the lactating mothers in Sinai slum.

3.3 Target Population

The study population were 384 lactating mothers attending the Lunga Lunga Health Centre from Sinai slums in Nairobi County, Kenya.

3.4 Sample Size Determination

There is lack of information on prevalence of dietary intake of vitamin A in Kenya, hence the proportion of the population with the characteristic of interest (P-prevalence*)* was assumed to be 0.5. Expected frequency of 50% was used because there were no similar previous studies on the same. The frequency was unknown hence the use of 50%. Using a 95% confidence interval and a sampling error of 5%, the sample size was calculated using the formula below;

$$Sample\ size\ (N) = \frac{Z^2\ (PQ)}{D^2}$$

Where N is the sample size, Z is the Z-score for a 95% confidence interval in a normal distribution table, P being the prevalence dietary intake of vitamin A, Q as the compliment of P (1-P), and D as the sampling error.

$$To\ give\ N = \frac{1.96^2\ x\ 0.5\ x0.5}{0.05^2}$$

N =384 Respondents.

3.5 Sampling Technique

Consecutive sampling was used to get the respondents. Whereby they were recruited as they came provided, they met the inclusion criteria within the specified study period from 4th March to 28th April 2011 until the desired sample size was achieved.

3.6 Inclusion/exclusion criteria

3.6.2 Inclusion criteria

- Mothers who had lived in the slums for more than three months hence were familiar with the slum in question including the social and health amenities
- The age of child being breastfed was between 0-24 months postpartum.
- Mothers were considered lactating if they reported breastfeeding their infant atleast three times a day as this was indicative of active breastfeeding.

3.6.2 Exclusion criteria

- Mothers who had serious medical complications e.g., diabetes, hypertension or disability
- Mothers with children with chronic medical conditions needing referral

3.7 Data Collection

3.7.1 Maternal dietary intake

The lactating mothers attending the clinic with their children were identified, recruited and interviewed. Through surveys of the foods available at the market, locally available plant and animal sources of vitamin A were identified. Substitutions of food items in the Hellen Keller International Food Frequency Questionnaire was made to come up with a Modified Food Frequency Questionnaire based on locally available plant and animal food sources of protein, energy and vitamin A. The survey's primary question asked was the number of times a given food item was consumed in the last one month. The study sought to determine the frequency of consumption of vitamin A food sources by lactating mothers to determine its intake. A list of all common foods was developed and their nutritional value obtained from the food composition table. To quantify, the foods were weighed and classified into three portion sizes (small, medium and large) and photographs taken. These photographs were shown to the respondents during the interview. Generally, the respondent was asked both for the frequency and amount consumed. The number of days on which dark green leafy vegetables, yellow fruits and vegetables, and foods of animal origin were consumed and the amounts were thus determined. In most cases, the purpose of an FFQ is to obtain a crude estimate of usual total daily intakes over a designated time period (Thompson and Subar 2013).

3.7.2 Household Food insecurity

A household food security and access scale questionnaire were administered to ascertain levels of food insecurity for the recall period of the last one month. The questionnaire was mainly a frequency-of-occurrence based to determine whether availability of food (food characteristic/ condition) happened rarely (once or twice), sometimes (three to ten times) or often (more than ten times) or did not happen. Each question received a minimum or a maximum score of 0 or 3. The expected range of scores for all the nine questions was 0 to 27. The Household dietary diversity questionnaire (Swindale et al, 2006) was used to determine the number of different food groups consumed by the household based on the previous 24 hours as the reference period. The 12 food groups in table 2 below were used to calculate the Household Diversity Dietary Score (HDDS) value ranging from 0-12. Food access is measured in a number of ways including quantitative food consumption surveys or income and expenditure analyses, but some of these approaches are time consuming and require sophisticated analytical methods (Saaka and Osman 2013).

Table 3-1: The 12 food groups used to calculate Household Dietary Diversity Scores (HDDS)

Cereals
Root and tubers
Vegetables
Fruits
Meat, poultry, offal
Eggs
Fish and seafood
Pulses/legumes/nuts
Milk and milk products
Oil/fats
Sugar/honey
Miscellaneous

3.7.3 Anthropometric Measurements

Weights of mothers were measured using an electronic scale (SECA scale) with the women standing barefoot with light clothing. Weights were measured to the nearest 0.1kg. The scales were tared and checked every time for proper calibration. Standing height measurements were made using height/length (Shorr) boards and a repeat of the measurements done to ascertain accuracy.

Anthropometric measurements were compared to the World Health Organization standard reference values. The cut-off point for undernutrition was then determined. BMI was measured by dividing weight in kg by height in meters squared (Kg/m^2). Mid upper arm circumference (MUAC) was measured to the nearest 0.1 cm using a non-stretchable MUAC tape. The MUAC was measured with the arm in the extended position midway between the olecranon process (elbow) and the acromion process (shoulder).

Additionally, an interviewer administered questionnaire was administered to the mothers to collect information on demographic and socio-economic information. Information on age, parity, length of lactation, and education on vitamin A rich foods was recorded. Information on background characteristics and family size was also collected. To ensure that good quality data was collected, questionnaires were cross-checked continuously. Clinical assessment was done by the clinical officer who was on duty on each day of the study and had the competency to diagnose Bitots spot and other medical complications.

Data collection tools are attached as appendices

3.8 Data Management and Analysis

The contents of the food frequency questionnaires were entered into a nutrient's calculator; a computer-based calculator locally developed using Microsoft Access program based on Kenya food composition tables. This aided in the calculation of the average amount of the daily nutrient intake.

The probability approach was used to estimate the prevalence of inadequate intakes. In this approach, nutrient intakes were classified into six classes as the individual's intake in terms of percent estimated average requirement (EAR); the number of individuals with intakes of the nutrient within each class was determined. This number was then multiplied by the appropriate probability of each class to give the number of individuals per class who were likely to have intakes below their own EAR. The sum of these numbers gave the total number of individuals in the population who were at risk for inadequate nutrient intake. The amount of protein, energy and vitamin A was then compared to the standard recommended intakes for lactating mothers to determine adequacy of intake.

To estimate number of lactating mothers who were likely to have nutrient intakes below their own estimated average requirements (EAR), probability of prevalence of nutrient inadequacy was computed as shown in Table 3-2.

Table 3-2: Probability statement for six classes of observed nutrient intakes

		Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Row A	Individual intake as % of EAR	< 54	54.1-65.5	65.6-77	77-88.5	88.6-100	> 100
Row B	Probability of Inadequacy	1.0	0.93	0.69	0.31	0.07	0.0

Source: Adapted from National Academy of Science (2002)

The prevalence of household's food insecurity was calculated after creation of HFIA category variables as follows: Food Secure (coded as category 1), Mildly Food Insecure (coded as category 2), Moderately Food Insecure (coded as category 3), and Severely Food Insecure (coded as category 4). Using the scheme in table 3-3 and the following

Formula:

$$\frac{\text{No. of households with HFIA category} \times 100}{\text{Total no. of households with a HFIA category}} = \text{Prevalence of food insecurity}$$

Table 3-3: Basis for categorizing food insecurity access

QUESTION	FREQUENCY		
	RARELY	SOMETIMES	OFTEN
1 a	##########	I I I I I I I |I	I I I I I I |I
2 a	I I I I I I I I	I I I I I I I |I	I I I I I I |I
3 a	I I I I I I I I	////////////////	//////////////
4 a	I I I I I I I I	////////////////	//////////////
5 a	////////////// /	////////////////	------------
6 a	////////////// /	////////////////	------------
7 a	-------------	--------------	------------
8 a	-------------	--------------	------------
9 a	-------------	--------------	------------

Source: Adapted from FANTA (2006)

KEY to Table 3-3

= Food secure

//////// // = Moderately Food Insecure

I I I I I = Mildly Food Insecure

---------- = Severely Food insecure

In order to determine pattern of household dietary diversity (HDD), the HDD variable was calculated for each household. The value for this variable ranged from 0 to 12.

HDDS (0-12) = sum (A+B+C+D+E+F+G+H+I+J+K+L+M+N+O). Where A-O, was a list of foods that anyone in the household ate a day before, during the day and at night. Secondly, the average HDDS indicator was calculated for the sample population as follows; Average HDDS = sum (HDDS)/ Total number of households surveyed.

Maternal anthropometric data was used to derive indices. Weight for height, Body mass index, MUAC measurements were then compared to the WHO reference standards for all the respondents.

Statistical analysis was carried out using SPSS for windows version 23.0. Results were expressed as means and standard deviations, frequencies and percentages, while Chi-square test was used to determine relationship between the socio-demographic variables, dietary intake of vitamin A and undernutrition of the mothers and household food security during lactation. A p-value of less than 0.05 was regarded as statistically significant.

3.9 Limitations

The accuracy of these estimates may have been affected by recall bias, given the unusually long recall period. Data on the prevalence of vitamin A clinical deficiency was not obtained because of the invasive nature of the process. To carry out biochemical analysis of serum and breast milk posed financial, logistical technical and time constraints for the 384 participants. Underreporting and underestimation may have been a problem with self-reported dietary intake, particularly for the women. However, the mothers who participated in the study were very committed and, because they took some degree of time, there is no reason to suspect they would deliberately misrepresent their food consumption patterns. It may also be that intake is so chronically poor among the mothers that there is little variation in their diets over the month.

The 24-hour recall did not provide enough information hence allowed generalization about the maternal food intake due to recall bias from the mothers.

Further effort was made by repetition of measurements and use of photographs to help the mothers make accurate estimations of their dietary intakes.

There was also very little literature on dietary intake of vitamin A in socio-economic settings in Kenya.

3.10 Dissemination of Study Results

Upon successful defense, this thesis will be published and the university will retain copies of the thesis in the department and in the library for reference. The findings will also be disseminated to Lunga Lunga Health Centre, MCH clinic and other relevant authorities.

3.11 Ethical Considerations

The proposal was submitted to Moi University School College of Health Sciences and Moi Teaching and Referral Hospital (MTRH) Institutional Research and Ethics Committee (IREC) for approval before the commencement of the study. Further permission and clearance was sought from the Nairobi County Department of Health to seek their permission to undertake the study at their health facility. After explaining the purpose and objectives of study, participants who agreed to participate were required to give an informed consent by signing a consent form. Identification numbers were assigned to each participant to keep their identity anonymous. A female nurse research assistant was recruited to assist in anthropometric measurements. This was due to the fact that the participants were females and would only be comfortable with a female health personnel. All the information collected from participants was treated with confidentiality. Respect and dignity were upheld while collecting data by ensuring that no part of the procedure subjected the respondent to undue psychological torture or embarrassment.

CHAPTER FOUR

RESULTS

4.1 Socio-Demographic Characteristics of the Respondents

Three hundred and eighty-four (384) lactating mothers participated in the study. The mean age of the respondents was 26.5 years old with a standard deviation (SD) of 5.67. Most (103(26.8 %) of the mothers were aged 20-24 years, 90(23.4%) were aged 15-19 years, 87(24.4%) were aged 2529, and 6(1.6%) of the respondents were aged above 45 years. Majority (257, 66.9%) of the mothers were reportedly married, 61(15.9%) were single, 42(10.9%) widowed and 24(6.3%) were separated or divorced. With respect to religion, 345 (89.8%) of the mothers were Christians while 39 (10.2%) were Muslims. Most (280, 72.9%) of the mothers had primary level of education, 84 (21.8%) had secondary/tertiary education while 20(5.2%) had no formal education.

Over half (221, 57.6%) of the mothers were self-employed or in casual employment majority of them operating small businesses *(Jua kali, selling groceries, hawking, selling clothes etc.*, 144(37.5%) were not in any form of employment and reported being housewives with no income generating activities and 19 (5%) of the respondents were formally employed. Most (258 (75.9%) of the married mothers reportedly had self-employed spouses, most of them in informal employment/sector *((Jua kali, selling groceries, hawking etc),* 46 (13.5%) were unemployed and 36 (10.6%) were formally employed.

Data on income levels indicate that 121(32%) of the mothers were earning less than Kshs 2500 per month, 187(49%) earning between Kshs 2501-5000 per month, 55(14%) reported earning between Kshs 5001-7500, 21(5%) reported earning Kshs 7001-1000. More than half (201, 52.3%) of the mothers had stayed in the slum for 2-

4 years, 140 (36.5%) had stayed for less than 2 years and only 43 (11.2%) had stayed in the slums for more than 4 years. Most (217, 56.5%) of the households had 2-5 children, 95 (27.7%) had less than 3 children while 18.8% had more than 5 children. Most (187, 48.7%) of the households had 3-5 members, 112 (29.2%) had 6-8 members, 67 (17.4%) had 2 members while only 18 (4.7%) had 8-10 members. Sociodemographic characteristics of the mothers are illustrated in Table 4-1.

Table 4-1: Socio-demographic characteristics of respondents

Variables	Categories	Frequency (N=384)	Percent
Age	15-19	90	23.1
	20-24	103	26.5
	25-29	87	24.1
	30-34	51	13.1
	35-39	30	7.6
	40-44	17	4
	45+	6	1.6
Religion	Christian	345	89.8
	Muslim	39	10.2
Education Level	None	20	5.3
	Primary	280	72.9
	Secondary/ Tertiary	84	21.8
Marital status	Married	257	66.9
	Single	61	15.9
	Widowed	42	10.9
	Separated/Divorced	24	6.3
Employment	Employed	60	15.7
	Self employed	201	52.3
	Un-employed	123	32.0
Household income (Kshs per month)	<2500	121	32
	2501-5000	187	49
	5001-7500	55	14
	7501-10000	21	5
Length of breastfeeding	0-3months	115	29.9
	3-6 months	171	44.5
	>6months	95	25.5
Household Size	2	67	17.4
	3-5	187	48.7
	6-8	112	29.2
	8-10	18	4.7
Number of own children living in the household	0-2	95	24.7
	3-5	217	56.5
	>5	72	18.8

Other factors considered during the study included length of breast feeding, maternal and child health, awareness on the types of Vitamin A rich foods, age of the youngest child and length of stay in the slums and how food is obtained by the household as illustrated in table 4-2.

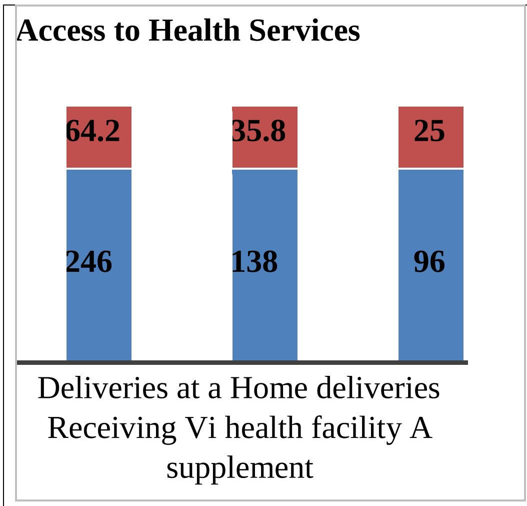

Figure 4-1: Access to health services

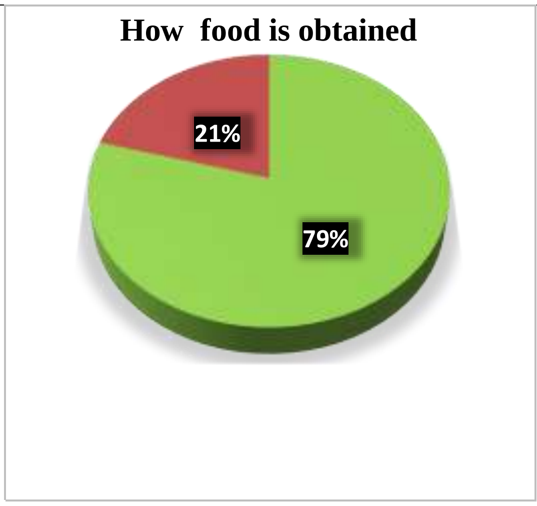

Figure 4-2: How food is obtained

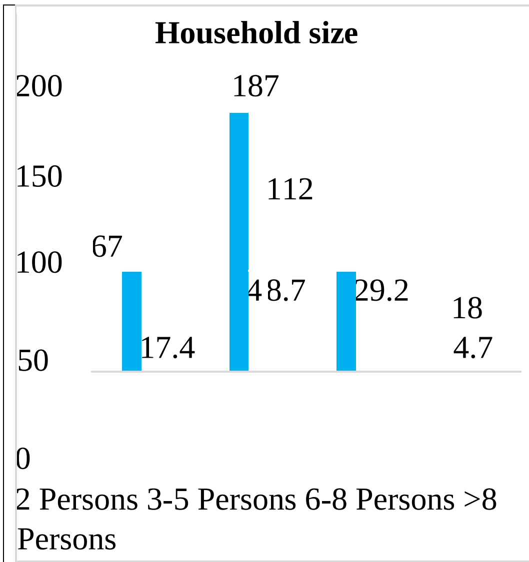

Figure 4-3: Household size

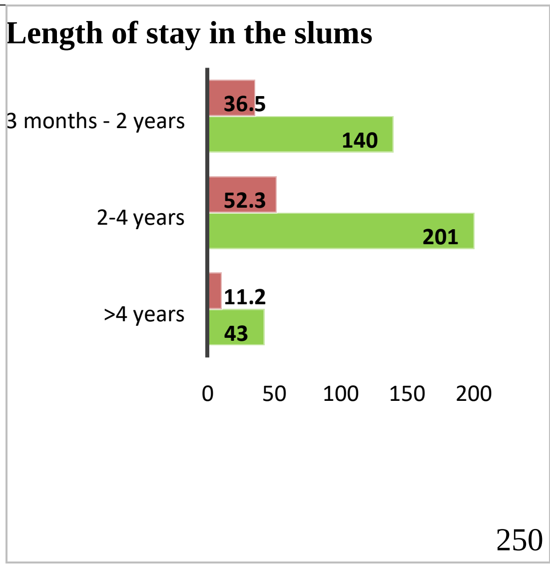

Figure 4-4: Length of stay in the slum

Nearly half (171, 44.5%) of the households had their youngest children in the age group of 3-6 months, 114(29.7%) were in the age group <3 months and only 99(25.8

%) had children older than 6 months with a mean age of 4.06 months, SD=1.03. The mean number of times the respondents sought ante-natal care services was 2.5 (SD=0.66) while the mean number of times the respondents sought post-natal care was 3.46(SD=0.68). Most of (246, 64.2%) the respondents had their deliveries at a health facility while 137(35.8%) of the deliveries occurred at home. Nearly all the home deliveries, 135 (99.3%) were facilitated by fellow women. Most (320, 83.3%) of the mothers reported that they had not received health education on the importance of vitamin A by a health professional while only 64 (16.7%) reported having received education on the importance of vitamin A. Vitamin A supplementation was received by 288 (75.0%) mothers compared to 96 (25%) who received vitamin A supplementation. Clinical assessment indicated that 39(10.1%) showed symptoms of vitamin A deficiency compared to 345(89.9%) who did not show any symptoms. While 354(92.2%) reported that they purchased food exclusively, 30(7.8%) indicated that they depended on both purchased food and donations from either government, nongovernmental organizations or relatives.

Awareness on types of vitamins A rich foods

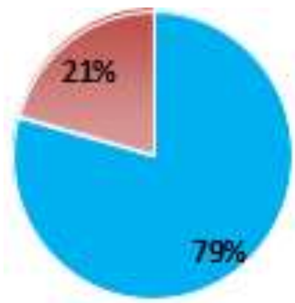

Figure 4-5: Awareness of Vitamin A rich foods

Symptoms of Vitamin A deficiency

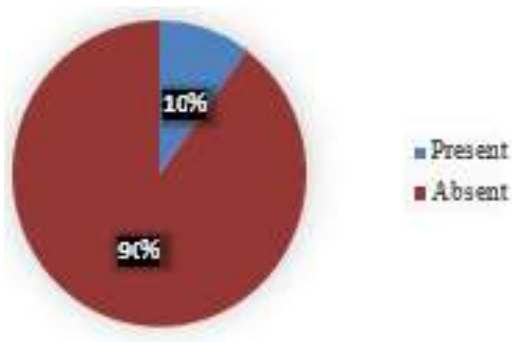

Figure 4-6: Symptoms of Vitamin A deficiency

The mean number of times the respondents sought ante-natal care services was 2.5(SD=0.66) while the mean number of times the respondents sought post-natal care was 3.46(SD=0.68)

4.2 Dietary Intakes

4.2.1 Dietary intake of Vitamin A

The mean intake of vitamin A by the respondents was 716µg standard deviation (SD) of 201. Based on this study, the extent of inadequate vitamin A intake for the 384 lactating women is shown in Table 4-2. Compared to their EAR, inadequate maternal intake of vitamin A and protein is likely to be 58.6% and 71.4% respectively.

Table 4-2: Prevalence of Dietary vitamin A intake

Individuals' intake as % of EAR	Frequency	Probability of vitamin A deficiency	Vitamin A deficient individuals
<54	114	1	119
54-65.5	52	0.93	62
65.6-77	36	0.69	28
77.1-88.5	23	0.31	11
88.6-100	49	0.07	5
>100	110	0	0
Total	384		225

Note: EAR-Estimated Average Requirement, %PINI-Percent Prevalence of Inadequate Nutrient Intake.

Slightly over half (225, 58.6%) of the respondents had inadequate intake of vitamin A while 143 (37.2%) reported adequate dietary intakes. 41(10.7%) of the respondents reported intakes below half of the recommended daily allowances.

Table 4-3: Mothers consuming Vitamin A rich food sources.

	Number of mothers consuming adequate sources	Percentage
Vitamin A source		
Dark green leafy Vegetables	102	26.6
Yellow fruits and vegetables		
Mango	51	13.3
Pumpkin	45	11.7
Papaya	32	8.3
Yellow sweet potato	89	23.2
Oranges	62	16.2
Avocado	55	14.3
Bananas	70	18.2
Carrots	33	8.6
Pineapple	41	10.7
Foods of Animal origin		
Egg	57	14.8
Small/whole fish	72	18.8
Liver	34	8.9
Meat	64	16.7
Cod liver oil	23	6.0
Chicken	18	4.7

A third (26.6%) of the mothers were reportedly consuming adequate dark green leafy vegetables, mangoes (13.3%), pumpkin (11.7%), papaya (8.3%), yellow sweet potato (23.2%), oranges (16.2%), bananas (18.2%), carrots (8.6%), pineapple (10.7%), eggs (14.8%), small/whole fish (18.8%), liver (8.9%), meat (16.7%), cod-liver oil (6.0%), chicken (4.7%). The percentages of the mothers receiving animal sources of Vitamin A were fewer despite an average lactation period of 4.7 months. Results of the percentage of mothers consuming vitamin A rich food sources are illustrated in Table 4-5.

4.2.2 Dietary intake of Protein and Energy

Protein intake was noted to be below the recommended daily intake for the mothers. Two seventyfour (71 .4%) mothers reported protein intakes below the recommended daily intake of 65mg. The mean protein intake was 41mg with a standard deviation (SD= 10.3). Notably, 110 (28.6 %) of the protein deficient respondents reported adequate intake of vitamin A. Most (277, 72%) of the mothers reported energy intakes below the recommended daily intakes of 2100kcal. The mean energy intake was 1927 kcal with a standard deviation (SD=378).

4.2.3 Dietary intake of vitamin A versus Socio-demographic and maternal characteristics

Chi Square tests indicated that the socio-demographic characteristics of the mothers that were significantly associated with inadequate vitamin A intake of the lactating mothers included: Age, Household income, awareness on vitamin A rich foods, number of children, how food is obtained, length of breastfeeding and family size. However, there was no association between vitamin A intake and other socio-demographic characteristics such as religion, educational status, employment status of the respondent, employment status of their husbands, marital status, the number of times a respondent accessed antenatal care services or post-natal care services, supplementation, presence of clinical symptoms and vitamin A intake yielded statistically insignificant results ($p>0.05$). Additionally, Protein and Energy intake, presence of symptoms of vitamin A deficiency (night blindness/Bitot’s spot), food security and Household Dietary Diversity (HDDS) were associated with vitamin A intake. The results of the association between dietary intake of vitamin A and the variables are illustrated in Table 4-4.

Table 4-4: Relationship between dietary intakes of Vitamin A to other variables including demographics

Variables	**Categories**	**Inadequate Vitamin A** Intake **(As a %) PINI)**	**Chi square**	**P-Value**
Age	15-19 20-24 25-29 30-34 35-39 40-44 45+	53(23.6) 60 (26.7) 51 (22.7) 30 (13.3) 18 (8) 10 (4) 4 (1.7)	χ^2= 7.0545 df= 5	**0.002**
Employment status	Employed Self employed Un- employed	12(5.3) 118(52.9) 94(49.3)	χ^2 = 6.880 df= 2	0.057
Household income	<2500 2500-4000 4001-6000 6001-8000 8001- 10000 >10000	55(24.4) 118(52.4) 33(14.7) 12(5.3) 5(2.2)) 2(0.8)	χ^2 = 4.158 df= 4	**0.008**
Awareness on vitamin A rich foods	Yes No	184(81.8) 41(18.2)	χ^2 = 2.552 df= 1	**0.040**
No of children	0-2 3-5 >5	43(19.1) 132(58.7) 50(22.2)	χ^2 =2.393 df=1	**0.031**
How food is acquired/got	Purchase Aid(Relatives, Government, NGOs)	208(92.4) 17(7.6)	χ^2 =3.645 df=2	**0.002**
Length of breastfeeding	<3months 3-6 months >6months	70(31.1) 103(45.8) 52(23.1)	χ^2 =5.503 df= 1	**0.019**
Family Size	2 3-5 6-8 8-10	26(11.6) 102(45.3) 82(36.4) 15(6.7)	χ^2 =3.291 df= 2	**0.001**
Protein intake	Adequate Inadequate	11(4.9) 214(95.1)	χ^2 =4.853 df= 1	**0.001**

Energy intake	Adequate Inadequate	13(5.7) 212(94.2)	χ^2 =4.749 df=1	**0.001**
Eye diseases (night blindness)	Present Absent	25(11.1) 200(88.9)	χ^2 =3.141 df=1	**0.04**
Food security	Food secure Mildly insecure Moderately insecure Severely insecure	7(3.1) 14(6.2) 82(36.4) 122(54.2)	χ^2 =4.171 df=3	**0.001**
Dietary diversity (HDDS)	Diverse Mild Less	8(44.4) 40 (59.2) 185(68.9)	χ^2 =4.381 df=2	**0.001**

4.2.4 Logistic Regression results for dietary intake of vitamin A

Factors that were significantly associated with dietary vitamin intake and under nutrition at the bivariate analysis were later included in the logistic regression model to see if they still significantly predicted the outcomes. A p value of less than 0.05 was considered statistically significant. After controlling for other factors, logistic regression indicated that household income showed significant association with dietary intake of vitamin A. Respondents who were below the poverty line/earning less than Kshs 2500 were two times likely to have low intakes compared to those who earned more than Kshs 2500 per month/ living above the poverty line($p>0.001$ at 95% C.I).

Family size had a significant association with dietary intake of vitamin A. Those who were 8-10 persons in the household were two times likely to have inadequate intake of vitamin A compared to those who were less than 3 persons in the household. ($p<0.001$, $p=0.044$ at 95% C.I for 8-10, persons in the household respectively).

Protein intake had statistically significant association with vitamin A intake. Those with low protein intakes were 83% more likely to have inadequate intakes of dietary intake of vitamin A compared to those who had adequate protein intakes ($p=0.043$ at 95% C.I). Energy intake had a statistically significant association dietary intake of vitamin A. Those with inadequate energy intakes were two times likely to have inadequate vitamin A intakes compared to those who had adequate intakes of the vitamin ($p<0.001$ at 95% C.I).

Those who did not have information on the importance of eating vitamin A rich foods were 57% more likely to have inadequate intakes of vitamin A compared to those who had information ($p=0.041$ at 95% C. I). Those who had signs of vitamin A deficiency like night blindness were 2 times more likely to have inadequate dietary intake of vitamin A compared to those who did not show the symptoms of deficiency ($p=0.004$ at 95% C.I).

The food insecure households were 2 times more likely to have inadequate intakes compared to the food secure households. Those from food insecure households were also more likely to have inadequate intakes compared to the food secure households ($p<0.001$, $p=0.057$ at 95% C.I respectively).

Those who had less diverse diets were 2 times more likely to have inadequate intakes compared to those who had more diverse diets. Those who were mildly diverse in their diets also reported inadequate intake with a 28% likelihood ($p=0.003$ and $p=0.49$ at 95% C.I respectively).

Purchase of food had a significant association with adequate intakes of the vitamin A. Those who exclusively purchased food were 2 times more likely to have inadequate intakes compared to those who got food aid and purchased as well ($p<0.001$ at 95% C.I).

Table 4-5: Predictors of vitamin A intake among Lactating mothers.

Variables	**OR**	**95.0% C.I**		**P-Value**
Income <2500	2.655	0.370	3.162	0.001
No of children >5	2.659	0.833	3.615	0.030
Protein intake Inadequate	0.839	0.307	2.297	0.043
Energy intake Inadequate	1.524	0.714	3.439	<0.001
Eye diseases (Night blindness) Yes	1.667	0.802	2.489	0.02
Information on Vitamin A foods No	0.413	0.331	1.297	0.041
Food security Food Insecure	2.488	0.291	3.545	0.001
Dietary diversity (HDDS) Low	2.042	0.655	4.111	0.003
How food is obtained Purchase	1.542	0.702	3.043	<0.001

4.3 Undernutrition among Lactating Mothers

The mean MUAC of the respondents was 22.8 with SD=3.45. A third (120, 31.3%) of the mothers had MUAC < 220 mm (low MUAC) while 264 (68.7%) had MUAC >220mm (normal). Of these, only 16(6.2%) had MUAC > 250mm. None of the respondents reported MUAC denoting severe acute malnutrition as well as moderate acute malnutrition, 243 (63.3%) mothers reported MUAC that denotes mild acute malnutrition and 141(36%) mothers were classified as normal.

Association between low MUAC and employment status, educational status, employment status of their husbands, marital status, and information on vitamin A rich foods, age of the youngest child and all other demographic variables showed no statistical significance all yielding p>0.05 at 95% C.I. The relationship between the variables and low MUAC are illustrated in Table 4-6.

Parity of the mothers had a significant association with low MUAC. Mothers with more than five children were 2 times more likely to have low MUAC compared to those who had less than three children of their own staying in the household and closely spaced. Those who had 3-5 children in the household were 49 % more likely to have low MUAC compared to those who had less than three children of their own in the household and closely spaced (p=0.025 and p=0. 045 at 95% C.I respectively).

Table 4-6: Relationship between variables and low MUAC

Variables	***Categories***	***Low MUAC***	***Chi square***	***P-Value***
Employment status	Employed	5(4.2)	χ^2 =6.381	0.056
	Self employed	53(44.2)	df=2	
Household income	Un- employed	62(51.6)		
	<2000	48(40)	χ^2 =4.525	0.083
	2000-4000	30(25.0)	df=3	
	4001-6000	24(20.0)		
	6001-8000	10(8.3)		
Marital status	8001-10000	6(38.5)		
	>10000	2(1.7)		
	Married	79(65.8)	χ^2= 4.859	0.450
	Single	20(16.7)	df=2	
	Widowed	13(10.8)		
	Separated	8(6.7)		
No of children	0-2	37(30.8)	χ^2= 3.32	**0.044**
	3-5	64(53.3)	df=1	
	>5	19(15.8)		
Length of breastfeeding	<3months	25(20.8)	χ^2= 6.582	**0.025**
	3-6 months	37(30.8)	df=2	
Family Size	>6months	58(48.3))		
Protein intake	2	21(17.5)	χ^2= 5.645	**0.002**
	3-5	45(37.5)	df=3	
	6-8	36(30)		
	8-10	18(15)		
	Adequate	39(32.5)	χ^2= 7.158	**0.001**
	Inadequate	81(67.5)	df=1	
Energy intake	Adequate	37(31.8)	χ^2= 3.204	**0.001**
	Inadequate	83(69.2)	df=1	

4.3.1 Logistic Regression results for undernutrition

Protein intake had statistically significant association with low MUAC. Those with low protein intakes were 40% more likely to have low MUAC compared to those who had adequate protein intake (p=0.035 at 95% C.I). Energy intake had a statistically significant association low MUAC. Those who had inadequate energy intakes were two times likely to have low MUAC compared to those who had adequate energy intake (p<0.001 at 95% C.I). Those who had breastfed for more than 6 months were more likely to have low MUAC compared to those who had breastfed for a period of less than 6 months as illustrated in 4-7.

Table 4-7: Logistic regression results for MUAC

Variables	***OR***	***95.0% C.I***		***P-Value***
No of children >5	2.218	0.834	3.760	0.025
Protein *Inadequate*	0.604	0.217	1.342	0.035
Energy *Inadequate*	0.492	0.114	0.801	<0.001
Length of breastfeeding *>6months*	1.272	0.180	2.430	0.0197

The mean BMI of the respondents was 21.5kg/m^2 at standard deviation (SD=2.2). Majority (306, 79.7%) of the mothers had normal BMI in the range of 18.5-25kg/m^2, 36(13.8%) respondents had low BMI while 17(6.5%) of the respondents had BMI>25 (overweight).

There was no statistically significant association between BMI and age, religion, education, employment status of the respondent, employment status of their husbands, marital status all yielding p values > 0.05 at 95% C.I.

Logistic regression results revealed that energy intake had a statistically significant association low BMI. Those with inadequate energy intakes were two times more likely to have BMI compared to those who had adequate energy intakes (p=0.033 at 95% C.I). The logistic regression results are illustrated on Table 4-8.

Table 4-8: Logistic regression results for BMI

Variable	***OR***	***95.0% C.I***		***P-Value***
Energy Inadequate	1.479	0.718	2.530	0.033

4.4 Household Food Security

4.4.1 Household Dietary Diversity Scores

One forty-two (37%) of the respondents reported consuming more than 6 types of foods from the 12 food groups. Two forty-six (64%) of the respondents consumed less than 6 of the 12 food groups. The Household Dietary Diversity Score HDDS score (SD) was recorded at 5.2(SD=2.15). Majority (73.4%) of the respondents reported that they had had not taken any cereal in their meals the previous night or day and only 102(26.6%) ate these kinds of foods. 84 (21.8%) of the respondents reported they had eaten meat which is a protein rich food while 300(78.2%) did not. Small/whole fish was consumed by 31 (8%) unlike 354(92%) who did not. Pulses were eaten by 101(26.3%) of the respondents while 283(73.7%) did not eat them. Vegetables were not eaten by 225(58.6%) while 159(41.4 %) did consume them. 326(85%) of the respondents did not consume fruits while only 58(15%) consumed them. Diverse diet is very crucial in helping the body maintain its normal physiological functions. It is particularly important to women during lactation as the quality of nutrition determines the nutrition status of the child later in life.

4.4.2 Household Food Access

Household Food Insecurity Access Prevalence was determined to ascertain food insecurity status of the households. Even though the respondents were interviewed at the health facility they recalled the patterns of eating within the household with respect to quantity and quality of the foods the household consumed during the recall period.

The HFIAS score (SD) was 7.8(2.5). 5.1% of the households reported experiencing none of the food insecurity conditions, or just experiences worry, though rarely. The 10.6% mildly food insecure households were worried about not having enough food and/or are unable to eat preferred foods. The 39.1% moderately food insecure households sacrificed quality more frequently and may have cut back on quantity by reducing size and number of meals. The 45.2% severely food insecure households were likely to often cut back on meal size and number of meals eaten, and /or go a whole day without eating, go to bed hungry, or ran out of food.

Percentages of food secure, mildly insecure, moderately and severely food insecure households are shown in Table 4-9. Households were categorized as increasingly food insecure if they responded affirmatively to more severe conditions and/or experience those conditions more frequently.

Table 4-9: Household perceptions on the ability to access food in the previous month.

Indicator	Frequency of occurrence			
	Never	**Rarely**	**Sometimes**	**Often**
Worried about insufficient food.	17(4%)	34(9%)	122(32%)	211(55%)
Not able to eat preferred foods	8(2%)	38(10%)	108(28%)	230(60%)
Ate limited variety of foods	19(5%)	35(9%)	96(25%)	234(61%)
Ate no preferred foods	7(2%)	31(8%)	127(33%)	219(57%)
Ate smaller meals	27(7%)	50(13%)	100(26%)	207(54%)
Ate fewer meals	31(8%)	54(14%)	115(30%)	184(48%)
Ate no food at all	177(46%)	61(16%)	69(18%)	77(20%)
Slept hungry	230(60%)		50(13%)	69(18%)
	254(66%)		35(9%)	
Went a whole day without food			38(10%)	61(16%)
			31(8%)	

4.4.3 Under-nutrition and food insecurity

Among the mothers who had low MUAC and low BMI, 53(44%) and 15 (50%) 13 (03.9%) were severely food insecure respectively as shown in Table 4-10. Households that were mildly food insecure had low MUAC and low BMI at 27(23%) and 6 (20%) respectively as illustrated in Table 4-10.

Table 4-10: Under-nutrition and food insecurity

	Undernutrition	
Food security	Low MUAC (n=120)	Low BMI (n=30)
Food secure	17(14%)	2 (7%)
Mild food insecure	27(23%)	6 (20%)
Moderately food insecure	23(19%)	7 (23%)
Severely food insecure	53(44%)	15 (50%)

There was a significant association between household dietary diversity scores (HDDS) and low MUAC (χ^2 = 1.694, df = 1, p =0.031; and between HDDS and low

BMI (χ^2 = 3.039, df = 1, p = 0.042). The severely food insecure households were 2 times more likely to have low MUAC compared to the food secure households (p=0.031 at 95% C.I) whereas the severely food insecure households were 2 times more likely to have low BMI compared to the food secure households (p=0.042 at 95% C.I respectively). The significant association noted could be attributed to low dietary diversity in the households. The results of the logistic regression are illustrated in Table 4-11

Table 4-11: Logistic regression results for Household Dietary Diversity Score

	OR	95.0% C.I		P-value
Low MUAC	0.836	0.402	1.694	0.031
Low BMI	1.788	0.520	3.039	0.042

CHAPTER FIVE

DISCUSSION

5.1 Socio-Demographics

Majority of lactating women had low education level, were unemployed and had large family sizes. According to Kenya Demographic and Health Survey (KDHS) these are some of the socioeconomic and demographic factors that determine dietary intakes of lactating women which ultimately affect their nutritional status (KDHS 2014). Lactating women should be empowered with nutrition education during MCH visits to help them make good food choices and meet their RDA for vital nutrients (Bryan *et al.,* 2020).

5.2 Adequacy of Dietary Intake of Vitamin A

Most lactating mothers in this study had inadequate intakes of Vitamin A. Although there is no documented data on the national prevalence of dietary intakes, consumption patterns of particular foods containing vitamin A was low and therefore insufficient to provide for recommended daily intake. Most mothers did not meet their RDAs for vitamin A. This meant that they did not consume adequate vitamin A rich foods since their diets mainly consisted of maize meal (maizemeal mush or ugali) and sardines (omena). This study is in agreement with the study done by the Kenya National Bureau of Statistics, which found that lactating women had inadequate dietary intakes for micronutrients (KDHS 2014). Adequate dietary intakes characterized by individual dietary diversity score are an essential pillar of health for the lactating mother and the infant. Adequate dietary consumption especially for micronutrients can be achieved through dietary diversity that increases chances of adequate nutrient consumption. Ministry of Health emphasizes the importance of adequate dietary consumption of vitamin A during lactation in addition to vitamin A supplementation (KDHS 2014).

The consumption of animal sources of vitamin A was low as exemplified by the following patterns; eggs (14.8%), small/whole fish (18.8%) and liver (8.9%). These consumption patterns are in agreement with to studies from Ethiopia where eggs were consumed by (16.0%), and foods of animal origin such as liver (13.9%), fish (31.9%) by the lactating mothers (Bereket *et al*., 2018). 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.

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 vitamin A.

The most frequently consumed foods were whole grains, wheat, maize and rice, green grams, carrots, dark green leafy vegetables and eggs. Most of these foods symbolize the major staples in Kenya. 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. Despite the respondents frequent, however they were not deficient of other nutrients found in frequently consumed foods. The least consumed foods were sweet potatoes, cassava and groundnuts. Sweet potatoes are rich in Vitamin A.

Daily vegetable consumption was three-fold more prevalent when compared to daily fruit intake. The higher consumption of vegetables than fruits in this study is supported by evidence from studies in South Africa and Mozambique (Padrao *et al.*, 2012, Peltzer and Phaswana-Mafuya 2012). Vegetables are a cheap relish that accompanies daily staples like ugali, rice, bread and others (Ruel *et al.*, 2005, Smith and Eyzaguirre 2007) and this may explain to a large extent, the high daily vegetable consumption. This study is also in agreement with a study done in Bangladesh that reported inadequate dietary intakes of vitamin A among pregnant and lactating women in rural and urban areas of Bangladesh (Hossain *et al.*, 2013).

Most mothers did not consume fruits (<25%) that are rich in vitamin A. Most of the mothers reported that the fruits were expensive for their daily consumption. These findings are in agreement with studies in Java which showed that fruit intake was more frequent among women in higher income groups compared to those in the low-income groups (Stoltzfus *et al.*, 2010). This is further supported by a study in Iran which also reported that fruits are consumed in low quantities because of economic restraints (Victoria *et al*., 2016).

Fruits like mangoes, papaya, oranges are seasonal and may be available for only two months in the year, they are relatively expensive for many people and the usual portion size is less than the amount needed for the estimated vitamin A requirements for a lactating mother. The months that preceded the study were months of dry season and the availability of these foods at the household level was more dependent on the purchasing power due to the high prices in the markets. This is in agreement with dietary studies in Nepal where purchase power limited the portion sizes (Hellen *et al*., 2018. Bai *et al*, 2021, further reported that animal foods as sources of vitamin A are often too expensive for low-income people. At the time of the study, food insecurity had been declared a national emergency two months before and most households especially in the slums could not afford the high prices of the foods in the market.

5.3 Prevalence of Undernutrition

Mothers aged between 15-19 years were more undernourished compared to the other age groups. This indicates the influence of age in the dietary patterns and nutritional status of the respondents. This could be explained by the fact that during adolescence, maximum growth and development has not been achieved. Additionally, during at this age, the mothers are largely unemployed. The lactation period coupled with bodily needs for growth to maximum bone mass for the mother leads to depletion of nutrients hence resulting in malnutrition. With response of the body to reduced food intake low body weight and low body mass index, there follows reduced body fat. The lactation phase of the reproductive cycle is energy demanding and maternal body composition stores are considered a proxy for adequacy of energy and protein intake.

The occurrence of a significant association between length of breastfeeding, BMI and MUAC in mothers with a lactation period more than 6 months indicates a significant depletion in maternal energy stores. This is comparable to a study among rural lactating women in Pokot County, Kenya where a prolonged lactation of more than 4 months the increase in breatmilk fat is at the expense of a decrease in maternal protein reserves. Prolonged lactation may affect not only the concentration of breastmilk vitamin A but also the long-term preservation of maternal energy and protein reserves. The data shows that in this urban Kenyan community, mothers with a low level of fat mass a proxy for BMI also had a high prevalence of low dietary intake of vitamin A although this needs to be supported by biochemical analysis of the serum retinol. On the contrary, results from an Ethiopian study in 2018 indicated that among determinant factors of nutritional status (using MUAC), lactating mothers who breast fed to greater than or equal to 6 months aged child were 54% less likely to be malnourished than those who breast fed less than 6 months aged child. This could be because mothers who breast fed less than 6 months aged child might be more at risk of being malnutrition than nursing for greater than or equal to 6 months. The reason might be because of increased nutritional requirement and rate of consumption of the child, no additional food intake more than the usual during lactation, low pre-conception and pregnancy BMI or fat storage, limited intervention on nutrition and low women empowerment by government and NGO (Bereket *et al.*, 2018).

Ability to produce breast milk that is adequate to support the normal growth, nutrient store and development of infants may be compromised when mothers consume poor quality diets that are low in protein and energy. For instance, studies in India showed that women with children who live in disadvantaged circumstances exhibit dietary intakes below recommended levels for both protein and energy (Suparna Ghosh-Jerath *et al.* 2015).

More than half of the lactating mothers had satisfactory BMI hence normal nutritional status while some had BMI <19.0kg/m^2 indicating they were underweight and at risk of malnutrition. Others had BMI more than 25.9 Kg/M^2 indicating they were overweight. Similarly, MUAC values showed that more than half of the lactating mothers had values more than 21cm indicating that they had normal nutritional status while others had MUAC values less than 21cm indicating that they were malnourished. An Ethiopian study reported on the nutritional status of lactating women using BMI and MUAC that showed almost similar values for nutritional status of the women (Haileslassie *et al.* 2013).

A national survey report on the anthropometry of adult women in Kenya in 2014 indicated that only 1% of adult women were stunted (height <1.45m), but more than one out of ten (12%) had a body mass index <18.5kg/m^2, defining chronic energy deficiency (CED). The prevalence of CED was the highest among young women aged 15-19 years, reaching 20%. Women living in rural areas were much more likely to suffer from CED than urban women (15% and 5% respectively). Food deficits were noted to be common in the North-Eastern province and this affected the nutritional status of women living in this area. There was an inverse relationship between educational level and CED: only 6% of women with secondary or higher education level were affected (KDHS 2014).

This study found that household income is significantly associated with intake of vitamin A ($p<0.001$) hence income is a major determinant of how animal source foods of vitamin A are consumed. Nevertheless, it is difficult to reverse a deficient state without the use of animal sources of vitamin A. Adolescent mothers had inadequate dietary vitamin A intake. More than half (66.7%) of those in the age group of 15-19 reported low intake of vitamin A. In a study in Maharashtra, consumption of foods such as green leafy vegetables, milk and milk products were lower than the recommended level among adolescents (16-19 years), the extent of deficit for vitamin A was 71% even though association results did not find age as a predictor of dietary intake of vitamin A.

In this study, only 16.7% of the mothers indicated that they had received information on the role of vitamin A rich foods which compares to an Indian study where about 14% of the mothers attributed clinical causes to dietary deficiency. Notably, this could be an indicator that most of the mothers were not aware of the causes of VAD.

In this study, the intakes of protein and energy are low and more than 70 % of the mothers had inadequate intakes for both protein and energy. Protein and energy intakes showed statistical significance with intake of vitamin A ($p=0.043$ and $p<0.001$ at 95% C.I respectively). This compares to a study in India where average intake of nutrients showed deficiency of protein and energy, and vitamin A deficiency of lactating mothers (Saeed *et al,* 2013).

Household size had a significant relationship with the nutritional status of the mothers as well as their dietary intake of vitamin A. Those from households with more persons reported low vitamin A intakes compared to those from households of few members (<3). This is explained by the fact that the food that is put on the table is shared among the higher numbers which may result into underfeeding of the lactating mothers.

Mothers who earned less than Kshs 2500,2501-5000 and 5001-7500 had low intakes compared to mothers whose household income was above Kshs 7500. This could have an impact on their nutritional status as well as that of their children. Household income influences the purchasing power of the mothers hence may result in compromised nutrition. This can be further explained by the fact that most of the respondents are casuals, whatever wage they receive at the end of the day or week, their first priority is food, whereas, for those on monthly wages may not sustain the provision of food throughout the month. According to FAO and WHO, the tendency of many wage earners to spend almost all their wages within a few days of receiving them often results in a family diet of varying nutritive value (FAO and WHO**,** 2016). The family eats well just after one payday than just before the next. They further stated that wages were often paid monthly, and there seems little doubt that a change to weekly payment of wages would improve the diet of wage earners and their families. The net income for the households could have an impact on the nutritional status of the breastfed infants and other children in the household. This study is in agreement by results from a Kenyan study in that found a strong significance (p=<0.019) between household income and mothers' nutritional status (Othoo *et al*, 2014). Families with higher income had better nourished children than families with low income.

5.4 Extent of Household Food insecurity

Food insecurity limits the capacity to meet nutritional needs of the lactating mothers living in low income set up. The interaction between food insecurity and dietary intake has been recognized and interventions to address this issue continue to emerge. Food availability and food cost were the factors that affected consumption of vitamin A rich foods most. Kenya. This is in agreement with Demographics and Health Survey 2014 that reported similar results on the factors that determine dietary consumptions of households with children less than five years in Kenya where most food consumption is based on food availability and market prices (KDHS 2014).

Data from this research study indicate a limited food variety and dietary diversity, the lactating women consumed diets below RDA and WHO recommendations and the majority of the households (64%) reported food insecurity. Therefore, it can be concluded that nutrient intake of the lactating woman was not adequate. Similar observations that have been made previously in the reports on the Kenya nutrition profile that undernutrition in Kenya is associated with widespread micronutrient deficiencies and more long-term strategies are needed such as fortification, dietary diversification and nutritional education (FAO 2005).

The intake of protein foods both animal and plant were reported by many to be inadequate, as over 70% reported having inadequate protein intakes. Energy and protein intakes are proxies for nutritional status and low intakes usually in the face of lactation and even pregnancy often result in protein energy malnutrition as well as depletion. A study in Ethiopia indicated that lactating mothers were malnourished BMI<18.5 kg/m^2. The study noted that the immediate causes of malnutrition were low food intake and a high prevalence of infection, which exert a synergistic effect on under nutrition and mortality (Bitew et al., 2010).

Most lactating women did not meet the recommended dietary diversity score given that their food consumption of food items in a food group was less than four times a week. Consumption of foods rich in vitamin A and iron as well did not meet the FAO recommendations for adequate/regular consumption frequency. Consumption of food items in a food group should be ensured in a day's meal so as to meet the dietary diversity which is believed to improve nutritional wellbeing of individuals (FAO 2011).

5.5 Socio-economic Factors Influencing Food Security

For persons living in urban areas, food access hinges primarily on the household's ability to purchase food. Most urban poor neither have large food stores, nor do they have access to areas for own food (Gina 2003). This is evident from the socio-bio demographic data of this research study where the market was the food sources that was reported by majority of the women. Some of the women did not actually know how much money was available for daily expenditure of food, because most of them were housewives and could only get money for food from the spouse or parents but could not calculate how much they spent in total and/or their spouses did casual work and thus bought food out of daily income. This information is in line with the findings of a survey done on urban dietary patterns by Maxwell, and co-workers (2000) that revealed that the urban poor often paid more for food purchases than did their wealthier urban counterparts, as they were obliged to buy small quantities daily because they did not have the resources or living conditions which permitted them to purchase and store large quantities of food at home (Maxwell 2000). With a near 100% dependence on the market system, income within the households was a limitation to food security within the households. It can be therefore concluded that the socio-economic status influenced the nutrient intake of the lactating mother in this study group.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 Conclusion

- Lactating mothers in Sinai slum had inadequate dietary intake of vitamin A and are under nourished. The inadequate dietary intakes of these nutrients put them at risk of these nutrients deficiencies as well as of pregnancy complications such as anaemia and maternal morbidity. Under-nutrition continues to pose a threat to the health of lactating mothers in
- Sinai slum. The most prevalent forms of under-nutrition found in the study were low MUAC, and underweight. The level of nutrient intake among the lactating mothers was low as noted by the protein and energy intakes.
- The median dietary diversity statuses of the study subjects were lower than half of FAO recommendation. Mean intake of some macro and micro nutrients of the mothers were also lower than RNI of FAO; such as, mean intake of protein, energy and vitamin A did not meet the requirement. In addition, the major source of energy needs to meet the RNI was much of plant-based food than animal-based food, since only 12% of the women took animal-based food in both residences.
- Strengthening maternal health service integrating with nutrition intervention program like CBN, multiple micronutrient supplementations for adolescent women, lactating women and engaging partners who are working in these areas for improving pre and post pregnancy BMI was recommended. Further interventional research was recommended.
- Food insecurity alongside limited purchasing power compromise positive nutritional outcomes for the mothers hence they are at risk of these multiple

micronutrient deficiencies. Household income plays an important role in the dietary intakes and nutritional status of lactating mothers residing in slums as indicated by the statistical significance. The higher the income the better the nutritional status, dietary intake and the more the food secure the household is. Mothers in Sinai maybe compromising their own dietary intakes for the sake of the family and more so the children due to low-income status.

6.1 Recommendations

- The Ministry of Health should design nutrition intervention programs including fortification aimed at enhancing nutrient intake of affordable foods to increase dietary diversity and food variety of lactating women in this low socio-economic set up.
- Both state and non-state actors in nutrition should enhance nutrition sensitization, education and empowerment programs through income generating activities simultaneously to address undernutrition and underlying causes especially food insecurity.
- The ministry of health should enhance distribution of nutritional supplements especially to the urban poor who may not be within reach of health facilities offering routine health services
- There is need to develop policies and comprehensive approaches including integrating food-based strategies by the government to address the high prevalence of undernutrition among lactating mothers.
- There is need for nutrition education on the sources and importance of micronutrients by nutrition stakeholders aimed at acquainting the mothers with

knowledge on the importance of good nutrition in order to alleviate micronutrient deficiencies.

6.1.2 Areas of further research

1. Due to the cross-sectional nature of this study, longitudinal assessment should be carried out in the study area to ascertain nutritional status of lactating women over a longer period of time.
2. A more comprehensive research is needed on the food insecurity status of the household in low economic settings.
3. Dietary intake, diversity and food insecurity studies should be conducted for all the life stages to back up the little available data.

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APPENDICES

Appendix 1: Consent Form

STUDY TITLE: Adequacy of vitamin A intake among lactating mothers attending Government Maternal and Child Health clinic in Sinai slums, Nairobi.

INVESTIGATOR:

OCHERE JOHN O. (MPH STUDENT)
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Purpose and background: Findings of this study will be disseminated to relevant authorities and other stakeholders with specific recommendations to help improve the dietary intakes of slum dwellers. The purpose of this study is to assess the adequacy of vitamin A among lactating mothers and to determine the prevalence of undernutrition in lactating mothers living in a low-income urban set up in Kenya.

In developing areas of the world, where vitamin A is largely consumed in the form of fruits and vegetables; daily per capita intake is often insufficient to meet dietary requirements. Vitamin A is one of the key nutrients whose requirements are increased during pregnancy and lactation, the lactation phase of the reproductive cycle being energy-demanding. The lactating mother in Kenya has been found to be underweight while living under the constraints of a limited food supply and the demands of hard physical work. Nutritional studies in the country have tended to concentrate on the preschool-age child and to a very small degree on the pregnant mother, but little has been done on lactating mothers, however they are equally vulnerable.

Procedure: The research involves interviews, and administration of questionnaires to the subjects and anthropometric measurements.

Benefits: There will be no direct benefit from participating in the study. However, the findings and recommendations of the study will benefit the government and other stakeholders in policy formulation and planning regarding the protection and care of the lactating mothers in future.

Risk: There is no risk involved in choosing to participate in the study.

Confidentiality: All the information given will be treated with confidentiality.

Right to refuse or withdraw: The subject's participation in the study is entirely voluntary and one is free to refuse to take part or withdraw at any stage of study without any consequences.

If you consent, please indicate so by signing this form:

For participant

I willfully agree to participate in this study:

SIGNATURE ……………………

DATE:……………

Appendix 2: Socio-Demographic and Health Related Information

DATE: ____________________ ID: __________________

SECTION 1

1. How old are you? ------------Years

2. What is your marital status?

- ☐ Single
- ☐ Married
- ☐ Divorced
- ☐ Widow
- ☐ Other (specify) ______________________

3. What is your completed educational level?

- ☐ No formal education
- ☐ Primary level
- ☐ Secondary level
- ☐ Tertiary level

4. How long have you stayed in Sinai?

5. How many children do you have? ………..State their ages…………

6. What is your religion?

- ☐ Muslim
- ☐ Christian

7. How many are you in the family?

8. What is your employment status?

- ☐ Employed
- ☐ Self employed
- ☐ (Jua kali-hawking, selling food stuffs, selling clothes etc)
- ☐ Unemployed

9. What is your husband's employment status?

☐ Employed
☐ Self employed
☐ Jua kali-hawking, selling food stuffs, selling clothes etc)
☐ Unemployed

10. What is the total household income per month (Kshs)

☐ <2500
☐ 2501-5000
☐ 5001-7500
☐ 7501-10000

11. How long have you breastfed? ----------Months

12. How old is your youngest child?

☐ 0-2 months
☐ 2-4 months
☐ 4-6 months
☐ >6 Months

13. How many times did you access ante-natal services?

☐ Not even once
☐ Once
☐ More than once

14. How many times have you accessed post-natal services?

☐ Not even once
☐ Once
☐ More than once

15. Where did you deliver your youngest child?

☐ At the hospital
☐ Elsewhere (specify)____

16. If you delivered elsewhere, who assisted you?

☐ Nurse
☐ Doctor
☐ Fellow women

- ☐ Other (specify) ____

17. Have you received any education on vitamin A rich foods since your delivery?

- ☐ None
- ☐ Vitamin A
- ☐ Iron
- ☐ Other (specify)………………………………………………………

18. Observe for Bitot's spots, and any sign of vitamin A deficiency including night blindness (Clinician)

- ☐ Present
- ☐ Absent

19. Did you receive vitamin A supplementation soon after delivery?

- ☐ Yes
- ☐ No

20. How do you get food? ❑ Purchase

- ☐ Food aid
- ☐ Relatives

SECTION II

Household Food Insecurity Access Scale (HFIAS) questionnaire

1. In the past four weeks did you worry that your household would not have enough food?

- ☐ Never
- ☐ Rarely (once or twice in the past 4 weeks)
- ☐ Sometimes (three to ten times in the past 4 weeks)
- ☐ Often (more than ten times in the past 4 weeks)

2. In the past four weeks were you or any household member not able to eat the kinds of foods you preferred because of the lack of resources?

- ☐ Never
- ☐ Rarely (once or twice in the past 4 weeks)

- ☐ Sometimes (three to ten times in the past 4 weeks)
- ☐ Often (more than ten times in the past 4 weeks)

3. In the past four weeks were you or any household member have to eat a limited variety of foods due to lack of resources?

- ☐ Never
- ☐ Rarely (once or twice in the past 4 weeks)
- ☐ Sometimes (three to ten times in the past 4 weeks)
- ☐ Often (more than ten times in the past 4 weeks)

4. In the past four weeks were you or any household member have to eat some foods you really did not want due to lack of resources?

- ☐ Never
- ☐ Rarely (once or twice in the past 4 weeks)
- ☐ Sometimes (three to ten times in the past 4 weeks)
- ☐ Often (more than ten times in the past 4 weeks)

5. In the past four weeks were you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?

- ☐ Never
- ☐ Rarely (once or twice in the past 4 weeks)
- ☐ Sometimes (three to ten times in the past 4 weeks)
- ☐ Often (more than ten times in the past 4 weeks)

6. In the past four weeks were you or any household member have to eat fewer meals in a day because there was not enough food?

- ☐ Never
- ☐ Rarely (once or twice in the past 4 weeks)
- ☐ Sometimes (three to ten times in the past 4 weeks)
- ☐ Often (more than ten times in the past 4 weeks)

7. In the past four weeks was there ever no food to eat of any kind in your household because of lack of resources to get food?

- ☐ Never
- ☐ Rarely (once or twice in the past 4 weeks)
- ☐ Sometimes (three to ten times in the past 4 weeks)

- ☐ Often (more than ten times in the past 4 weeks)

8. In the past four weeks did you or any household member go to sleep at night hungry anything because there was not enough food?

- ☐ Never
- ☐ Rarely (once or twice in the past 4 weeks)
- ☐ Sometimes (three to ten times in the past 4 weeks)
- ☐ Often (more than ten times in the past 4 weeks)

9. In the past four weeks did you or any household member go a whole day and night without eating anything because there was not enough food?

- ☐ Never
- ☐ Rarely (once or twice in the past 4 weeks)
- ☐ Sometimes (three to ten times in the past 4 weeks)
- ☐ Often (more than ten times in the past 4 weeks)

Appendix 3: House Hold Dietary Diversity Score (HDDS) Questionnaire

	QUESTIONS	CODING CATEGORIES
	Now I would like to ask you about the types of foods that you or anyone else in your household ate yesterday during the day and at night. **1=If anyone in the household ate the food in question,** **0=If no one in the household ate the food.**	
A	Any [*insert any local foods, e.g ugali, shima*], bread, rice noodles, biscuits, cookies, or any other foods made from millet, sorghum, maize, rice, wheat, or [*insert any other locally available grain*]?	A…………[__]
B	Any pumpkin, carrots, squash, or sweet potatoes that are Yellow or orange inside?	B…………[__]
C	Any white potatoes, white yams, manioc, cassava or any other foods made from roots or tubers?	C…………[__]
D	Any dark, green, leafy vegetables such as cassava leaves, bean leaves, kale, spinach, pepper leaves, taro leaves, and amaranth leaves?	D…………[__]
E	Any other vegetables?	E…………[__]
F	Any ripe mangoes, ripe papayas or [*insert any other locally available vitamin a-rich fruit?*	F…………[__]
G	Any other fruits?	G…………[__]
H	Any beef, pork, lamb, goat, rabbit wild game, chicken, duck, or other birds, liver, kidney, heart, or other organ meats?	H…………[__]
I	Any eggs?	I…………[__]
J	Any fresh or dried fish or shellfish?	J…………[__]
K	Any foods made from beans, peas, or lentils?	K…………[__]
L	Any cheese, yoghurt, milk or other milk products?	L…………[__]
M	Any foods made with oil, fat, or butter?	M…………[__]
N	Any sugar or honey?	N…………[__]
O	Any other foods, such as condiments, coffee, tea?	O…………[__]

Appendix 4: 24-Hour Recall Form

During the last 24 hours what have you eaten?

ID.		Date of Recall:		
		Time of Recall:		
NO. of the mother:		Age		

MEAL TIME 1-Morning *(4 to 9 a.m.)* 2-Midmorning *(9 to 11:30 a.m.)*	3-Noon *(11:30 to 2 p.m.)* 5-Evening *(5 to 8 p.m.)* 6-Night *(8 p.m. to 4 a.m.)*	4-Afternoon *(2 to 5 p.m.*

FOOD TYPE	**Mealtime**	**Place eaten**	**Food description/ ingredients.**	**Amou nt eaten**	**Weight equivalence (g)**

SECTION III B: Dietary intake data for the lactating mothers

Food frequency questionnaire
Abbreviation's guide P/D = Per Day P/W =Per Week P/M = Per Month N/A=Not Applicable

Appendix 5: Food Frequency Questionnaire.

During the last one month, have you taken?

FOOD TYPE	Quantity Measures & equivalence in grams	**House hold measure/ pictures**	**Amount usually eaten**			**Frequency of intake**			
			Small	Medium	Large	P/ D	P/ W	P/ M	N/ A
Boiled green bananas Green Bananas fried with fat/oil		Pictures							
Boiled Irish potatoes Fried Irish potatoes		Pictures							
Sweet potatoes boiled		Pictures							
Nduma boiled		Pictures							
Beaf stew fried beef boiled Nyama choma Sausage		Sukari nguru cut pieces							
Chicken stew soup Chicken fried		Pictures							
Tilapia fish fried Tilapia stew Omena stew		Pictures							
Matumbo/offals Stewed Fried		Sukari nguru cut pieces							
Egg boiled Omelette Fried		Food model							
Cowpea leaves/ kunde		Food model							
Pumpkin leaves		Food model							
Saga/ dek/ spider herb		Food model							
Cabbage		Food models							
Kales (sukuma wiki)		Food models							
Spinach		Food models							
Pumpkin boiled		Pictures							
Avocado		Pictures							
Ripe banana		Food models							
Mango		Food models							
Orange		Pictures							
Lemon		Pictures							
Pawpaw		Pictures							
Pineapple		Pictures							
Passion fruit		Food models							
Pears		Pictures							
Water melon		Pictures							
Ground nuts Roasted and salted		Pictures							

FOOD TYPE	Quantity Measures & equivalence in grams	House hold measure/ pictures	Amount usually eaten			Frequency of intake			
			Small	Medium	Large	P/D	P/W	P/M	N/A
Fresh milk / glass		Cups							
Milk used to cook vegetables									
Milk in beverages (tea, cocoa									
Yoghurt									
Mala									
Cream from milk used in cooking vegetables		Pictures							
All brands of solid vegetable cooking fats (kimbo, kasuku etc) All brands of liquid vegetable cooking oils (elianto) Margarine Fat made from milk or meat fat Peanut butter		Spoons							

Appendix 6: Anthropometric measurements

Readings	First Reading	Second Reading	Average
Weight			
Height			
MUAC			

Appendix 7: Approximate vitamin A content of various foods in 100grams

Foods	Grams
Liver, beef, pork, chicken, fish	6500 µg
Carrots	835 µg
Sweet potatoes	709 µg
Kale (Sukuma Wiki)	681 µg
Butter	684 µg
Spinach	469 µg
Leafy vegetables	404
Pumpkin	369 µg
Eggs	140 µg
Papaya	55 µg
Mango	38 µg
Peas	38 µg