

**FOOD CONSUMPTION PATTERNS AND THE VITAMIN A
STATUS OF CHILDREN AGE 2-6 YEARS IN RURAL AND
URBAN POPULATIONS IN MACHAKOS DISTRICT.**

BY

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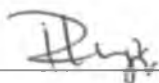
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DECLARATION

I, Immaculate Akumu Anyango, hereby declare that this project report is my original work, and to the best of my knowledge, has not been presented for a degree in any other university.



Immaculate Akumu Anyango

Date 05/09/2007

The project report has been submitted with my approval as university supervisor.



Prof. Jasper K. Imungi
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Date 05-09-07

DEDICATION

This work is dedicated to my dear husband Narkisho, my precious children Brian and Lynn for their love, patience and support.

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I do appreciate that this work has been made possible because of several people in one-way or another.

First, I would like to thank the **University of Nairobi** for admitting me to pursue **Msc. in Human Nutrition**. I also recognize my project supervisors, **Prof. J.K. Imungi** and the **late Prof. N.M. Muroki** for their guidance throughout the study.

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ABSTRACT

This study was undertaken between March and May 2003 to determine the food consumption patterns and the vitamin A status of children 2-6 years of age in a rural setting compared to those in an urban setting in Machakos district of Kenya. The study was cross-sectional in nature. Two divisions were purposively sampled namely Kalama and Central representing rural and urban settings respectively. Data on demographic and socio-economic characteristics of the population, knowledge on vitamin A, morbidity patterns and food frequency was collected using previously pre-tested questionnaires.

Results showed that a diversity of food items was consumed in the two divisions, some more frequently than others. The most frequently consumed foods were cow's milk, papaws, pumpkins, spinach and kales, which were consumed at least daily in Kalama by 82.5%, 38.8%, 54.4% and 42.2% respectively. In Central, the children consumed cows' milk, and spinach/kales at 97.5% and 71.5% respectively. Chi-square test showed significant difference ($P < 0.05$) in the consumption of cow's milk and spinach/kales between the divisions. Fats and oils were consumed in Kalama by 96.9% and in Central by 100% and there were no statistical significant differences among the level of consumption.

Clinical examination showed that 4.4% of the children in Kalama division and 6.8% in Central division suffered from severe vitamin A deficiency.

Prevalence of night-blindness in Kalama was 1.9% and Bitot's spots 3.2%. In Central, night blindness and Bitot's spots were found to have equal prevalence at 4.1%. The prevalence of vitamin A deficiency was numerically higher in males than in females in Kalama division, at 4.5% and 2.5% respectively but this difference was not statistically significant.

Consumption of vitamin A rich foods was very low except for milk, which was reportedly consumed by more than 50% of the children at least once to many times in a day in both divisions. There was little difference between rural and urban populations in terms of their consumption of vitamin A rich foods from animal origin. The major difference was noted in the consumption of green leafy vegetables like Amaranth and pumpkin leaves which was much higher in the rural than in the urban division ($P < 0.05$). There were no statistically significant differences in consumption patterns and vitamin A status of the children.

The study established that the prevalence of VAD is of public health significance in both the rural and urban areas of Machakos district studied in Kenya. The prevalence of severe forms of VAD; night blindness and Bitot's spots were above the WHO cut off points.

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OPERATIONAL DEFINITIONS

Vitamin A: This is an essential nutrient needed in small amounts for the normal functioning of the visual system, growth and development, maintenance of epithelial cellular integrity, immune function and reproduction.

Clinical signs of vitamin A deficiency: Includes Xerophthalmia (Conjunctiva xerosis and corneal xerosis) and Bitot's spots, which manifests in the eye.

Vitamin A status: The total body reserves of vitamin A, which can vary from excessive (hypervitaminosis), through adequate and marginal, to poor or evident (hypovitaminosis) states.

Index child: A child in a household whose age falls between 2-6 years and is the youngest within the age category.

Household: All the people who have lived together for the last three months (from the time research was carried out) and operate as a unit in all circumstances as sharing the household income, facilities, eating from the same pot and live in the same homestead including such members as unrelated workers and relatives who take meals together.

Household income: Household monthly cash earnings equivalent from all sources including sales, salaries and remittances.

Household head: The person (male or female) who is the major decision maker on household's income and expenditure patterns.

ABBREVIATIONS

µg / dl	- Micrograms per deciliter.
µMol/L	- Micromole per Liter.
VAD	- Vitamin A Deficiency.
ACC/SCN	- Administrative Committee On coordination / Sub committee On Nutrition.
DDP	- District Development Plan.
GoK	- Government of Kenya.
KDHS	- Kenya Demographic Health Survey.
KEMRI	- Kenya Medical Research Institute.
PEM	- Protein Energy Malnutrition.
UNICEF	- United Nations Children's Fund.
VIT. A	- Vitamin A.
WHO	- World Health Organization.
Hb	- Hemoglobin
RE	- Retinol Equivalent
FAO	- Food and Agriculture Organization of the United Nations
Lvs	- leaves

CHAPTER ONE

Introduction

1.1 Background Information

Malnutrition is an underlying cause of deaths in children. It consists of generalized malnutrition, which manifests itself as stunting, underweight, and wasting in individuals. Adequate nutrition is the intake and utilization of enough energy and nutrients together with disease control, to maintain well-being, health and productivity (WHO, 1999).

Protein-Energy malnutrition and the deficiencies of the micronutrients, zinc, iron and vitamin A are the main nutritional problems facing developing countries today. Their devastating short and long-term effects have brought these nutrients into sharp focus. Whereas much research has been carried out on Protein-Energy malnutrition, and iron and iodine deficiencies in the past, research on Vitamin A and zinc deficiencies was selective. This scenario has, however, recently changed because of the realization that vitamin A deficiency has greater effects on health and affects more people world-over than was previously perceived (UNICEF/GoK, 1999). Most symptoms of human vitamin A deficiency reflect the vitamin roles in maintaining health status of the individual.

Vitamin A deficiency (VAD) is the single most important cause of childhood blindness in developing countries and contributes significantly to morbidity and mortality from common childhood infections (WHO, 1995). According to World Health Organization, approximately 2.8 million or about 0.1% of children in the world under five years of age have clinical signs of xerophthalmia.

Urban and rural food consumption patterns in low-income countries tend to differ widely, and the nature of the differences varies with income level. Comparisons have been fairly consistent in showing that the urban poor have lower caloric intake than the rural poor. Protein and fat intakes also vary. In general, the urban populations consume increased amounts of processed foods, meats, fats, sugar, and dairy products, while the rural populations consume more coarse grains, roots, tubers and pulses. The higher intake of animal fats, preformed vitamin A, and iron in the urban areas is associated with the increased consumption of animal products in urban than the rural areas (Popkin, et al., 1988).

In Kenya, the prevalence of chronic malnutrition or stunting in children is about 30%, and about one-third of these children are severely stunted (KDHS, 2003). Although routine supplementation of Vitamin A capsule is regularly done to children below five years of age, recent research on micronutrient deficiency which was carried out established that 84% of

Kenyan children suffer from severe to moderate vitamin A deficiency (UNICEF/GoK, 1999).

The persistence of Vitamin A Deficiency in Kenya is partly due to the fact that only a small percentage of the population practices exclusive breast-feeding, diversity coupled with lack of dietary diversification. Frequent intake of foods that are naturally rich in vitamin A in addition to fortification and supplementation decreases the problem (WHO, 1999).

The government of Kenya in recognizing that vitamin A deficiency is a public health problem in the country and has recently set up several intervention programmes. These programmes include administration of high dose of vitamin A capsules to all children under the age of five years, creating enabling environment for fortification of foods, health education of the mothers, nutrition rehabilitation programs and promotion of production and consumption of high vitamin A foods.

1.2 Justification.

Scientific evidence indicates that vitamin A deficiency is a public health problem in developing countries. Food consumption patterns may affect the levels of vitamin A in the body and since it has been suggested that the rural and urban populations do not consume food rich in Vitamin A at the same levels, (Lindsay and Stuart, 2001) the research therefore, was to establish any significant differences between the two different populations. This

survey was to establish the consumption patterns of Vitamin A rich foods and compare this data with prevalence of Vitamin A deficiency between the two populations. The social characteristics that are closely associated with vitamin A status were also determined and by comparing the consumption patterns from different socio-economic status. This would facilitate the identification of high-risk households/communities to be targeted in community-based programs.

1.3 Main Objective

To study food consumption patterns and the vitamin A status of children ages 2-6 years in rural and urban populations in Machakos District.

1.4 Research Objectives

1. To determine the socio-economic and demographic characteristics of rural and urban households.
2. To determine the food consumption patterns of rural and urban populations of Machakos District.
3. To determine the morbidity experience of children of rural and urban population in Machakos.
4. To determine the prevalence of Vitamin A Deficiency among rural and urban populations in Machakos.

1.5 Hypotheses

1. There is no difference between rural and urban populations in their food consumption of vitamin A rich foods.
2. There is no difference between rural and urban populations in their vitamin A deficiency status.

1.6 Potential Benefits.

The information obtained is expected to be of use to health service providers in the Kenyan government and non-governmental organizations. The results will help in providing information for formulating guidelines to be used in planning and targeting interventions aimed at preventing Vitamin A deficiency. Consequently, the study will benefit the country, in averting deaths and disabilities, which are caused by lack of vitamin A.

CHAPTER TWO

Literature Review

2.1 Introduction

The causes of malnutrition are multifaceted as shown in the conceptual framework (**Appendix 1**). Malnutrition is a direct result of diseases and inadequate food intake. The conceptual framework shows that diseases, particularly diarrhea, acute respiratory infections, malaria and measles result from inadequate health care, insufficient water supply and poor environmental sanitation (UNICEF/GoK, 1998).

The underlying factors to malnutrition are insufficient household food security, inadequate child care systems, insufficient health services and deep rooted factors referred to as basic-related to social-economic conditions. Again malnutrition problem may only be averted if political and ideological factors such as wars and cultural issues debated and put in to consideration. Developing clear economic structures and full use of potential resources may help in alleviating the problem.

Micronutrient malnutrition is increasingly recognized as a serious threat to the health and productivity of people worldwide (Low, et al., 1997). The high prevalence and negative consequences of vitamin A, iodine and iron

deficiencies have resulted in concerted international efforts to eradicate these deficiencies.

Although consumption of macronutrients is also important, micronutrients have been given very little consideration in household, hence the deficiency disorders (also known as “hidden Hunger”).

Food consumption patterns differ considerably depending on the available and accessible foods. Comparisons have been fairly consistent in showing that the urban poor have lower caloric intake from the rural poor. Protein and fat intakes also vary. For example, in some low-income countries, urban dwellers consume more fat and protein from animal sources than rural dwellers (Bloem, et al., 2003).

2.2 Prevalence of Vitamin A Deficiency.

Vitamin A is an essential nutrient needed in small amounts for the normal functioning of the visual system, growth and development, maintenance of epithelial cellular integrity, immune function and reproduction. Vitamin A deficiency is a result of two factors. First, there is a persistent inadequate intake of vitamin A to satisfy physiological needs. This frequently exacerbated by secondary dietary circumstances such as insufficient consumption of dietary fat, which leads to inefficient absorption of this micronutrient. Second, secondary factor causing Vitamin A deficiency is high frequency of infections. Infections depress appetite, prompting an elevation in body’s vitamin A utilization and consequently the nutrients

insufficient conservation. Vitamin A deficiency occurs when body stores are depleted to the extent that physiological functions are impaired, although clinical eye signs may not be evident. Because the vitamin is fat-soluble, it is stored in the body when intake is in excess of physiological need. World Health Organization (1995) indicates that nearly 90% of that which is stored is found in the liver. Depletion of stored vitamin A occurs over time when the diet contains too little to replace that used by tissues or reduced by breast-feeding.

The main causes of Vitamin A deficiency in developing world are insufficient intake of the vitamin and the poor bioavailability of pro-vitamin A sources - vegetable and fruits (Lindsay, et al., 2001, Bloem, 2003). It is also linked to inadequate intake of precursors in relation to requirement (including increased requirements for the vitamin at certain stages in the life cycle like in early childhood, pregnancy and lactation) and frequencies of infections, which in turn result from an interaction of many underlying factors.

Vitamin A status can be grouped into four main categories: (1) deficient, (2) marginal/adequate, (3) excessive and (4) toxic depending on the retinol serum level. In deficient and toxic states, clinical signs are evident, while biochemical or static tests of vitamin A must be relied upon in the marginal/adequate and excessive states. Table 1 shows vitamin A status and the cut offs in serum levels.

Table 1: Vitamin A Status Classification in Children

STATUS	SERUM CONCENTRATIONS	
Deficient	< 10µg/dl	(0.35µmol/L)
Low	< 20µg/dl	(0.70µmol/L)
Adequate	> 30µg/dl	(1.05µmol/L)
Hypervitaminosis	> 100µg/dl	(3.5µmol/L)

Source: Lee and Neiman, 1996.

According to WHO (2000), approximately 2.8 million or about 0.1% of children under 5 years of age have clinical signs of Xerophthalmia as pointed out by Usha (2001). However, Lindsay and Stuart (2001) observe that the prevalence of clinical vitamin A deficiency is quite low. In researches, which had been carried out on children in Asia, it ranged from 0.5% in Sri Lanka to 4.5% in Bangladesh. According to WHO (1996) prevalence of > 1% indicates a public health problem.

2.3 Etiology of Vitamin A Deficiency

Since it has been estimated that over 40% of children in the world suffer from Vitamin A deficiency, the problem has been recognized as of public health significance. Etiology of Vitamin A deficiency is multifaceted (ACC/SCN 1997). It involves a combination of individual characteristics, family factors and macro-level variables (**Figure 1**).

The main causes of vitamin A deficiency are low dietary intake, especially of preformed vitamin A in animal products and beta-carotene in fruits, and effects of parasites such as *ascaris lumbricoides* & *shigella* dysentery (Guthrie, 1989).

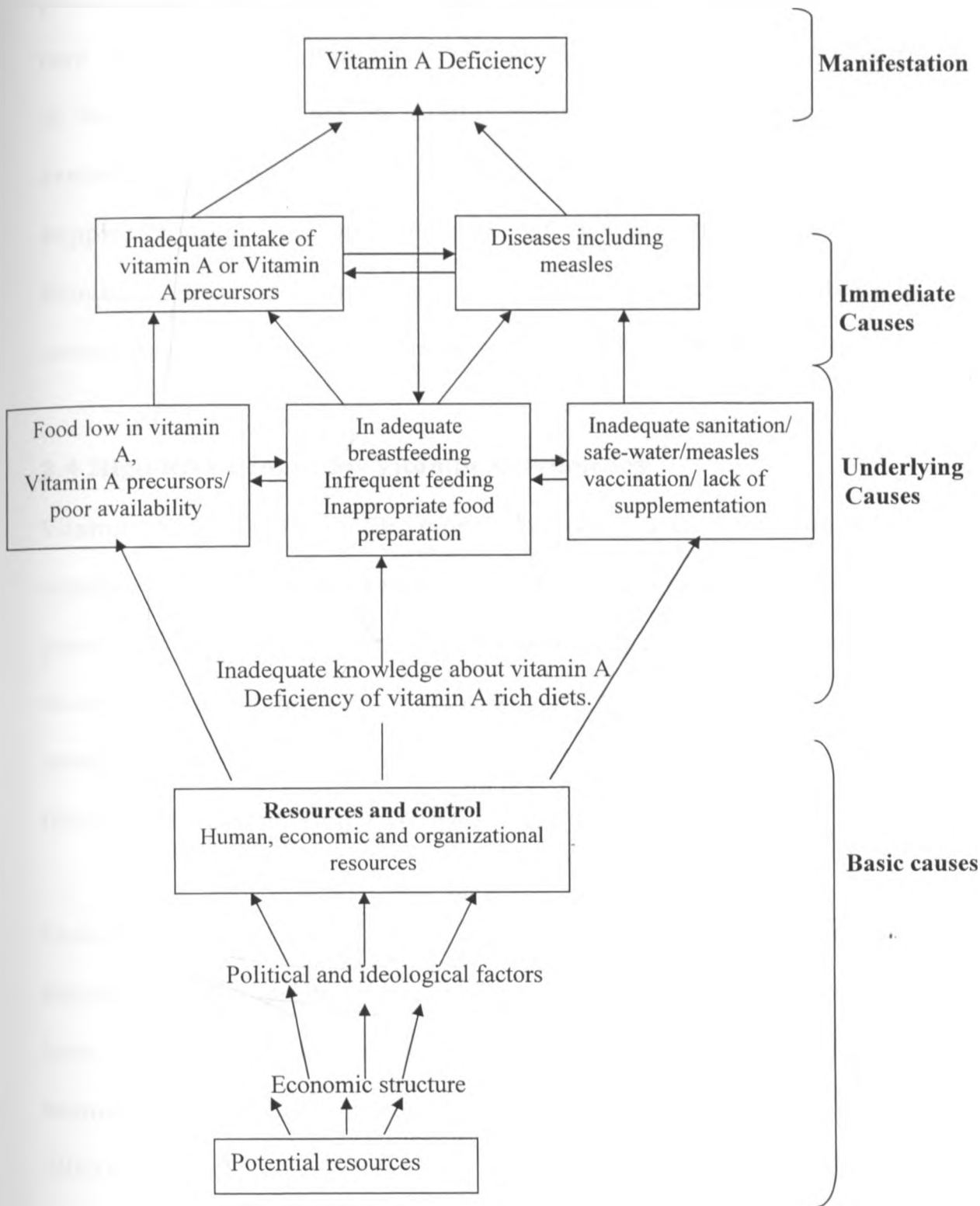
Inadequate vitamin A results from low body stores of the vitamin. This can occur for a number of reasons. There may be too little vitamin A or vitamin A may be rapidly used up and then not replaced in time to avoid damage. When body stores of vitamin A are lost, blood levels falls, damaging the immune system. Infants who are born to women who consume too little vitamin A also have low iron stores at birth. The breast milk of these women is also low in vitamin A (Kusin, 1995; WHO, 1999).

Research has proved that although vitamin A requirements are not substantially increased by pregnancy, there is an increase in clinical symptoms such as night blindness (Usha, 2001).

The mildest form of vitamin A deficiency could be simple night blindness or xerophthalmia. In its severest form, it causes destruction of the cornea in keratomalacia. Vitamin A deficiency impairs immune system, makes children vulnerable to diarrhea and measles, which kill 2.2 Million and nearly 1 Million children every year respectively (UNICEF, 1998). Relationship between measles and vitamin A has been recognized since the early 1930's and it is known that measles can bring serum concentrations of

vitamin A in well nourished children to below those observed in non-infected malnourished children (Bloem, et al., 2003).

Figure 1: Conceptual Framework on the Causes of Vitamin A Deficiency.



Source: ACC/SCN, 1997

Vitamin A deficiency is directly linked to inadequate intake of vitamin A precursors in relation to requirement and frequency of infections, which in turn results from an interaction of many underlying factors. Consumption of foods, which are low in vitamin A or its precursors, or of poor bio-availability, inadequate breast feeding, inadequate sanitation and lack of supplementation are cited as some of the underlying causes of VAD. Economic, social, and environmental deprivation limits accessibility to, and consumption of vitamin A containing foods (ACC/SCN, 1997).

2.4 High-Risk Groups for Vitamin A Deficiency

Vitamin A deficiency is the most common cause of blindness in many endemic areas. Xerophthalmia occurs almost entirely in children living in poverty. It is extremely rare to find cases in families that are affluent even where Xerophthalmia is prevalent ACC/SCN (2001). Children between 6 months and 6 years and pregnant and lactating mothers are the most at risk of Vitamin A deficiency (WHO, 1996).

Communities with high rates of infections and parasite diseases such as measles and helminthes, prolonged or severe diarrhea and other infections have reduced blood levels and stores of vitamin A. Consequently, the body immune system cannot function well without adequate levels of vitamin A (WHO, 1999).

Children who have a brother or a sister with eye signs of Vitamin A deficiency are ten times more likely to have severe Vitamin A deficiency. Mothers of these children are five to ten times more likely to have night blindness. Also, children from the same neighborhood and communities as someone with Vitamin A deficiency are twice as likely to have developed severe Vitamin A deficiency (WHO, 1999).

Families affected by land shortages, inequity and low levels of female literacy and grossly inadequate food security and health are likely to have relatively high prevalence of vitamin A deficiency depending on their nutritional status (WHO, 1999). Families living in certain environments are also at risk for Vitamin A deficiency, including communities where the availability of vitamin A rich foods is low, where infant mortality levels are high (above 100), under five mortality is high (over 75), or where there is high prevalence rates of underweight, stunting, wasting or where there are high measles case fatality (>1%) (WHO, 1999).

It is estimated that by giving adequate vitamin A, in vitamin deficient population, child mortality from measles can be reduced by 50% and child mortality from diarrhea disease by 40%. Overall, mortality in children 6 to 59 months of age can be reduced by 23% (UNICEF, 1999).

2.5 Vitamin A Deficiency in Kenya

In 1985, World Health Organization classified Kenya as a Nation where vitamin A deficiency was a public health problem, (UNICEF, 1994). A study done in South Nyanza in 1992/3 showed that Vitamin A deficiency is a significant public health problem because the prevalence of severe deficiency ($<10\mu\text{g}/\text{dl}$) was 13% and marginal deficiency ($10-19\ \mu\text{g}/\text{dl}$) was 44%. With the revelations of the adverse consequences associated with this deficiency, Kenya therefore, deemed it necessary to determine the prevalence and geographic distribution of Vitamin A deficiency in Kenya (UNICEF, 1994).

One of the first reports on clinical vitamin A deficiency in Kenya dates from the late 1920's. It observed that Vitamin A deficiency in Kenya (mainly pigmentation of conjunctiva) appeared to be present in 29.5% of all people examined (Jansen, et al., 1982). Studies carried out on food consumption revealed that in those areas, the average percentages of adequacy of vitamin A varied from 5 –44% in Central Province, 5 –30% in Eastern Province and 15 –30% in Nyanza. In Nairobi, adequacy was 34% (Jansen, et al., 1982). The researchers observed seasonal variations detected in all areas surveyed and concluded that majority of households consumed less than 60% of the recommended allowance which is below the WHO (1996) recommendation of 75% and above.

2.6 Food Sources of Vitamin A

Vitamin A exists in preformed form in animal foods, but as closely related precursors, the carotenes in plant foods. The rich animal food sources include the liver eggs, milk and milk products, which contain 25 - 8,235 RE (Latham, 1973, FAO, 2002). Consumption of animal sources among the poor communities is still low.

Plants rich in pro-vitamin A represent more than 80% of the total food intake of vitamin because of their low cost high availability and diversity. Dark green leafy vegetables yellow fruits, orange roots (mainly carrots) and the oils of palms are the main plant sources of pro-vitamin A (Laven & Frigg, 1997). Among leaves, the darker the green color, the better the vegetable as a source of the vitamin. This is because the carotene content in chloroplasts is proportional to the concentration of chlorophyll with which they are associated in photosynthesis. Because of their availability and affordability, green leafy vegetables act as the major sources of the vitamin for the poor population who consume very little of the foods of animal origin (FAO, 2002).

Vitamin A though has been added successfully to many foods through food fortification, e.g., margarine and cooking oils. These are some of the major long-term approaches to the control of the problems of Vitamin A deficiency.

2.7 Functions of Vitamin A in the Body

2.7.1. Vision:

The role of vitamin A in vision is the only clearly defined function of the vitamin. Retinol is essential for the elaboration of rhodopsin by the rods, which are the sensory receptors of the retina responsible for vision under low levels of illumination (Guthrie, 1989). Rhodopsin (Visual purple) is responsible for the ability of the eye to see in dim light. The retinol provided in the blood is oxidized to retinaldehyde. This then combines with the protein opsin to form rhodopsin, located in the rods found in the eye retinol. As light strikes the retina, the visual purple is bleached to visual yellow and retinaldehyde is separated from opsin. This action triggers stimulus from the retina through the optic nerve fibers to the brain. During the process, some vitamin A is split off from the protein and changed to retinol. Most of this retinol is converted to retinaldehyde, which in turn recombines with opsin to generate rodopsin. A small amount of the retinol is lost in this process and must be replaced by the blood otherwise vision in dim light is not possible until this whole cycle has been completed. The amount of retinol available in the blood determines the rate at which rhodopsin is generated and is available to act again as a receptor substance in the retina (Guthrie, 1989).

2.7.2. Immune Response

The body's defenses against infection and diseases partly depend on vitamin A, (Guthrie, 1989). Consequently, inadequate vitamin A may have a negative effect on the surfaces of the skin, eyes and mouth, the lining of the

stomach and the respiratory system. A child who is vitamin A deficient has more infections, which become more severe because the immune system is damaged. Vitamin A deficiency increases the risk that children will die or become blind. It is the most common cause of childhood blindness in the developing world (WHO, 1999).

2.7.3. Epithelial Cells:

The formation of epithelial cells found in the outer protective layer of the skin, in the genitourinary and respiratory tracts, is dependent on vitamin A (Guthrie, 1989, UNICEF 1998).

The epithelial cells are always lost and replaced and as such, the need for vitamin A in maintaining their health is continuous (Passmore, 1987). The author also observes that in absence of vitamin A, hardened and dry cells are produced which lack cilia and the ability to secrete mucous. Vitamin A is associated with the activation of the adenosine triphosphate (ATP), sulfuryase and sulphate transferase, which are involved in the synthesis of proteoglycans, contained in mucous. A deficiency of vitamin A will thus lead to kerratinization (Latham, 1973, Guthrie, 1989).

2.7.4 Influence of Vitamin A on Iron Absorption

Vitamin A has been shown to interact with iron absorption in a favorable way. Studies done on iron deficient (and vitamin A deficient) populations in

Indonesia showed that the response to iron therapy is improved when given concomitantly with vitamin A (Usha, 2001).

Chemical studies suggest the formation of chelate between vitamin A and iron liberated during digestion that protects the iron from being trapped by inhibitors. These findings indicated that vitamin A must be introduced as a factor in iron bioavailability studies in maize flour products (Usha, 2001).

The author observes that vitamin A deficiency predisposes to anemia. Vitamin A depletion in adult male volunteers in the United States, caused a marked fall in Hb, from about 160 to < 110 μ g per liter in a year (Usha, 2001). This was reversible with iron plus vitamin A supplements, but not with iron alone.

Supplementation of vitamin A deficient individuals with a high dose of vitamin A alone increases Hb concentrations by about 10 μ g per liter (Usha, 2001). The extent to which vitamin A deficiency contributes to the global prevalence of pregnancy anemia remains to be determined but could be substantial.

2.8 Assessment of Vitamin A Status

Measuring the vitamin A stores in the liver best assesses Vitamin A status. However, this is not feasible in evaluation of large population (Guthrie, 1989, Robert et al., 1996). Vitamin A deficiency and risk factors for vitamin A deficiency can be assessed using various methods or indicators namely, dietary, physiological, biochemical, histological, and clinical methods

(IVACG, 1993). Semi-quantitative dietary assessments of vitamin A intake can be carried out to determine populations at risk based on their consumption frequency of vitamin A rich foods or 24-hour-recall (IVACG, 1993). However, the guidelines recommend use of food frequency questionnaire results if there is an inconsistency in results derived from the two methods. The method is primarily designed to identify populations of children at risk of VAD and has been used in several studies and shown significant potential in identifying groups of young children at risk of Vitamin A deficiency (Alam, 2001).

Physiological assessment involves finding out if there are any cases of night-blindness in the study population. Biochemical assessment involves the use of either relative dose – response or modified relative dose – response or plasma retinol-binding protein response test or determination of serum retinol levels. In histological assessment conjunctival impression or impression cytology with transfer is carried out while in clinical assessment/examination for the presence of various Vitamin A deficiency clinical signs done (Matu, 2001; Usha, 2001).

Some of the various assessment methods have their limitations (Laven and Frigg, 1997). Clinical surveys do not detect mild or moderate VAD, which may still have negative effects on health. In essence, they detect the clinical VAD equally while, as the sub-clinical state may be equally detrimental. The use of night blindness may also be unreliable since this is subjective and

cannot be used in very young children (Usha, 2001). Serum retinol concentrations decrease in response to infection, and are thus unreliable indicators of Vitamin A deficiency populations with high prevalence of illness. The relative dose response test requires two blood samples taken five hours apart and is therefore impractical for use in large population surveys (Flores et al., 1984).

A recent modification of the relative dose response technique circumvents the need for two blood samples by dosing with a vitamin A analogue, but unfortunately this analogue is not yet commercially available and, even when it is, the technique will not be appropriate in large populations (Tanumihardjo, et al., 1990).

The choice of indicator to use should be governed not only by technical and financial feasibility but should also be consistent with a given demographic and cultural context (WHO, 1996). For general surveys, WHO and IVACG recommend the use of clinical signs of xerophthalmia, night-blindness, and a serum retinol value as indicators for vitamin A assessment (IVACG, 1993). Additionally the three approaches; clinical, biochemical and dietary assessment form a package whereby if used; the package provides an ideal measure of relative vitamin A and nutritional status of both population and individual (Laven and Frigg, 1997).

Using clinical and biochemical parameters, the World Health Organization has recommended minimum, prevalence criteria to assist in determining the extent to which severe Vitamin A deficiency or xerophthalmia may be considered of public health significance among children in a given community as shown in the Table 2. The prevalence ranges from >0.01% to >1% for xerophthalmia and >5% for serum retinol levels.

Table 2: Criteria for Determining Vitamin A Deficiency or Xerophthalmia as a Significant Public Health Problem.

Indicator	Prevalence
<i>Functional</i>	
Night blindness (XN)	>1%
<i>Clinical</i>	
Conjunctival Xerosis/with Bitot's spot (X1B)	>0.5%
Cornea Xerosis/Ulceration/Keratomalacia (X2/X3A/X3B)	>0.01%
Cornea Scar (XS)	>0.05%
<i>Biochemical</i>	>5%
Serum retinol less than 10µg/dl (0.35µmol/L)	

(Source: WHO, 1996)

2.9 Rural - Urban Food Consumption

Urban and rural food consumption patterns in low-income countries tend to differ widely, and the nature of the differences varies with income level. Comparisons have been fairly consistent in showing that the urban poor have lower caloric intake from the rural poor. Protein and fat intakes also vary (Bisgrove, 1988). For example, in some low-income countries, urban dwellers consume more fat and protein than rural dwellers, particularly from animal sources (Bisgrove, 1988). In general, the former consume

increased amounts of processed foods, meats, fats, sugar, and dairy products, while the latter consume more coarse grains, roots tubers and pulses. Increased consumption of animal products in urban areas is associated with higher intake of animal fats, vitamin A, and the more efficiently absorbed haem iron (Bisgrove et al., 1988).

The greater diversity of foods in urban areas may provide a wide range of nutrients; increased consumption of processed foods may contribute to a less nutrient dense diet associated with a number of chronic diseases (Bisgrove et al., 1988).

A rural society lives mainly from agriculture, whereas urban society depends on higher levels of economic diversification. This can have important consequences with respect to nutrition. Whereas the nutritional status of rural community often suffers from seasonal climatic fluctuations, particularly when there is latent lack of food, the urban community is less influenced by such changes because of its diversity. In case of drought, for example, urban populations are less affected because of their differentiated sources of income. The income of the rural population, which depends mainly on agricultural production, is affected severely by lack of rainfall (Monteiro, et al., 1989).

2.10 Relationship Between Vitamin A Deficiency and Morbidity

Mild VAD is associated with an increase rate of infections (Milton et al, 1987). Diseases such as measles, diarrhoea and respiratory tract infection influence the vitamin A status of an individual. A study on increased risk of respiratory disease and diarrhoea in children with mild VAD, demonstrated that children with mild xerophthalmia were more likely to develop respiratory disease and diarrhoea than were non-xerophthalmic children (Sommer, 1996). In a study on Ghanaian children, vitamin A supplementation reduced morbidity and mortality (Suzanne et al, 1995). Mortality decreased by 19% in the supplemented group, primarily because of decreased mortality from diarrhoea. Evidence for decreased severity of illness in supplemented children was provided by their decreased attendance at clinics admissions to hospitals.

The frequency, duration and severity of infections contribute directly and indirectly to vulnerability to VAD. Infections lessen efficiency of absorption of vitamin A since mucosal surfaces needed for absorption are damaged. Infections also influence appetite thus reducing dietary intake in addition to reducing conservation and utilization of vitamin A.

Intestinal worm infections do have an impact on vitamin A status. They may directly compete for uptake of vitamin A in addition to their general impact on health by suppressing appetite. Studies have suggested that intestinal helminthic infections impair the absorption of vitamin A. fat absorption,

which is necessary for vitamin A metabolism can also be impaired by parasitic infections of the intestines (Mahalanabis et al, 1979).

2.11 Concluding Remarks

A search through the literature revealed research gaps on Vitamin A deficiency among children in Machakos district. A survey conducted in the neighbouring Kitui district showed that VAD was a problem in that area and thus an assumption was made that a similar problem may be experienced in Machakos district because of some similarities in geographical conditions. This survey thus compared the food consumption patterns in rural and urban populations in Machakos district and investigated differences in consumption patterns and the effect on vitamin A status of preschool children.

CHAPTER THREE

Methodology

3.1 Study Site

The study was undertaken in two divisions of Machakos District of Eastern Province, Kenya. Machakos district is bordered by Nairobi Province and Thika district to the northwest, by Kitui and Mwingi districts to the east and Kajiado district to northeast. It stretches from latitude $0^{\circ} 45'$ south to $1^{\circ} 31'$ south and longitude $36^{\circ} 45'$ east to $37^{\circ} 45'$ east.

Land use and settlement pattern are based on the agro-ecological zones and are influenced by soil fertility and rainfall. High-density settlement is along the hilly masses of Matungulu, Kangundo, Kathiani, Central and Mwala Divisions. These hill masses receive moderately high rainfall and have great agriculture potential and fertile soils. Spatial settlement is found in the low plains where ranching and dairy farming is carried out. Many people settle in areas with fertile soils that support both cash and food crops. The main food crops grown include maize, beans, pigeon peas, cowpeas, sorghum and cassava.

3.2 Study Population

The study was undertaken in two divisions namely Kalama and Central. Kalama division has a population of 41,000 persons with an average

population density of 24 persons per sq. km. The population consists of predominantly the Kamba tribe. Absolute poverty is above 80% (GoK. 2002-2008). Agricultural and livestock activities contribute 70% of household income. The staple food of the Kamba is *isyo*, a mixture of boiled maize kernels and beans. Sometimes the maize kernels are decorticated; the food mixture is then called *muthokoi*.

In Central division, the study took place within an urban settlement, the Machakos municipality. Machakos municipality is a small town with a population of 3,127 persons (GoK, 1999). The population is cosmopolitan, but the dominant tribe is the Kamba. In the municipality, the study was undertaken in an area called Kariobangi, where the residents were categorized as a mixture of low to moderate-income.

3.3 Study Design

A comparative study using a cross-sectional survey was carried out in the two study areas from March - May 2003 in Machakos district. A total sample of 240 households was selected.

3.4 Inclusion Criteria

The households, which were targeted, were those with pre-school children aged 2-6 years. The respondent was the mother of the children. In cases where more than one child qualified, the youngest was chosen considering

that he/she was more vulnerable to any problem such as food inadequacy and that children give a picture of the family's economic status.

3.5 Sample Size Determination

Accurate data regarding the prevalence of severe Vitamin A deficiency among children in Machakos district were not available. However, calculation of the required sample size was based on the prevalence of severe Vitamin A deficiency in neighboring Kitui District for children aged between 6 and 72 months, which was 3.4%. This was so because Machakos District falls in the same ecological zone as Kitui. The districts are also adjacent to each other (GoK/ UNICEF 1999).

The formula, used to determine the sample size was that by Fisher et al. (1991), for testing the differences between two sub-samples viz:

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

Where:

n = desired sample

z = standard normal deviate set at 1.96 which corresponds to 95% confidence interval.

p = proportion of children with severe VAD in the target population

q = 1-p, estimated proportion of children with out severe VAD

d = degree of accuracy desired set at 0.05.

Taking the proportion of children with severe Vitamin A deficiency as 0.034, the z statistic as 1.96 and degree of accuracy at 0.05 levels, the estimated minimum sample size was: -

$$n = \frac{2(1.96^2) (0.034) (0.966)}{0.05^2} = 101$$

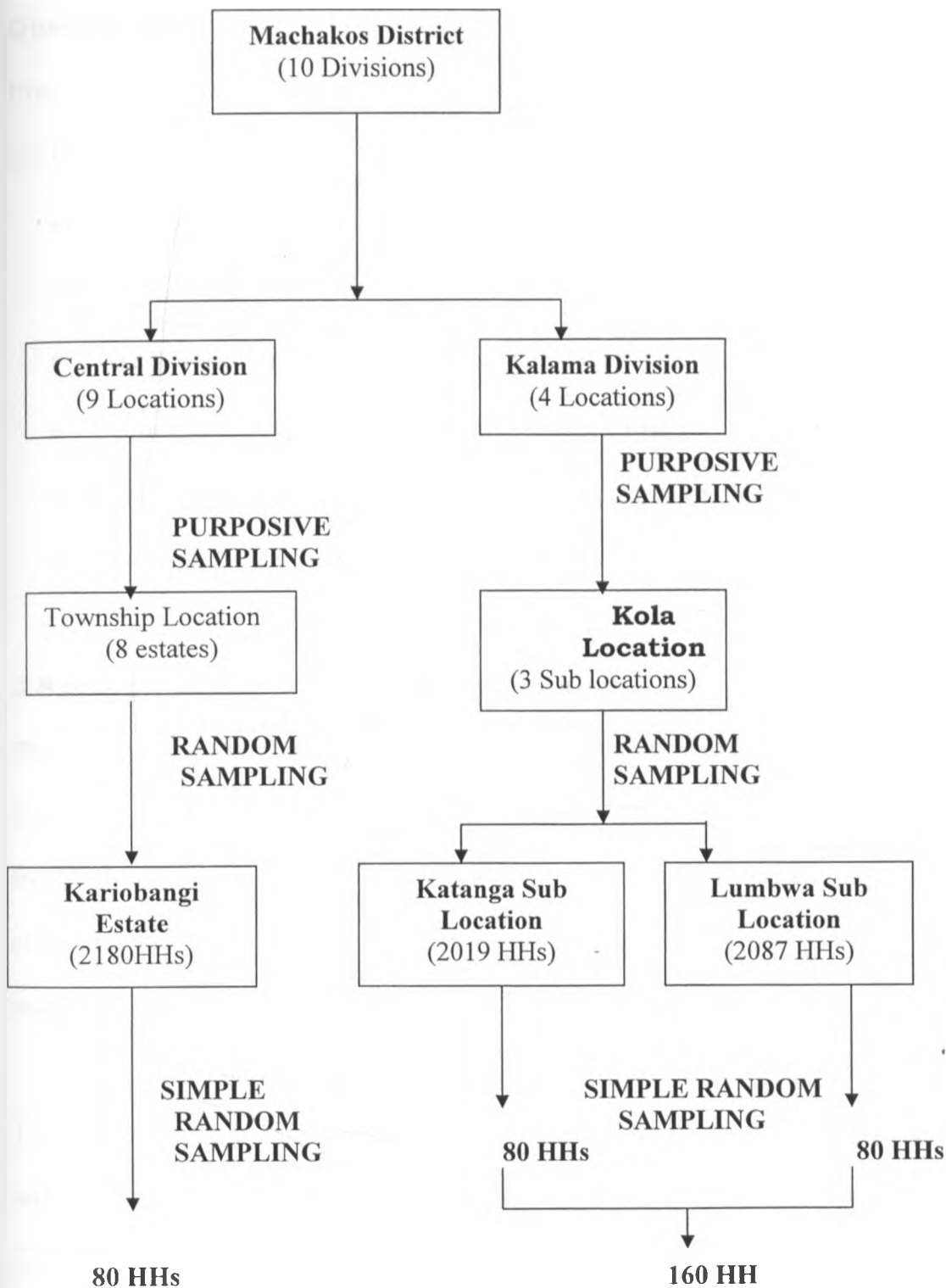
Assuming that the prevalence of severe Vitamin A deficiency in Machakos district is twice that in Kitui and considering a response rate of 20%, a sample size of 240 was taken.

3.6 Sampling Procedure

A multistage sampling was used as shown in **Figure 2**. The choice of sampling was purposive considering high poverty level (80%) and the presence of the municipality. There were 12 divisions whereby only one division fell in an urban area. Central division was chosen because of its urban environment and Kalama division was chosen to represent a rural environment.

The second choice of sampling was random which, was done at the sub - locations to come up with the number of households required. This was combined with simple random sampling on the households to be included in the study. A sample size of 80 households was selected in urban and another 160 households were selected from Katanga and Lumbwa locations each having 80 households

Figure 2: Schematic Presentation of the Sampling Procedure



HHs – Households

3.7 Study Tool

Questionnaire

Pre-tested structured questionnaires (**Appendix B**) were used for collection of the following data:

- Demographic data: household size, sex, age, educational level and occupation of household members/heads, social economic status.
- Knowledge on vitamin A.
- Demographic information of the index child.
- Food consumption. Data on food consumption was determined by use of food frequency table.

3.8 Selection and Training of Enumerators

The researcher carried out a preliminary visit in each of the study sites to find out foods frequently used. The assistant chiefs were able to identify from their communities the enumerators based on the education level, character, and responsibility. They had to be fluent in English, Kiswahili and Kikamba.

The enumerators were given detailed training on interviewing techniques with emphasis on how to correctly ask questions in a standardized manner and fill in the questionnaire. They were also trained on how to approach the mothers and were instructed to first introduce themselves and then give the purpose of their visit. They were to explain that not all the households would be visited during the survey, as some of them did not meet the criteria. The

enumerators were also to get from the mothers the road to health card, baptismal or birth certificate for age verification.

3.9 Data Collection Procedures

3.9.1 Demographic and socio-economic characteristics

The enumerators introduced themselves and clearly stated the purpose of their visit to the households. The interviewee was asked to give the number and names of all household members (those who depend on the households for their livelihood) and the household's source of income. One questionnaire was used for each household.

3.9.2 Dietary data

Dietary data were obtained using two food frequency tables; one on general foods and the second was a 7-day food frequency on selected vitamin A rich foods found in the areas (Appendix B).

3.9.3 Clinical Eye Examination

Qualified and experienced clinical officers from the Ministry of Health who accompanied the enumerators to every household carried out clinical Eye examination of the index child. The clinicians examined the children for presence of any clinical signs of Vitamin A deficiency (Appendix B).

3.10 Data Analysis

Data collected were entered and cleaned using Statistical Package for Social Sciences (SPSS). Descriptive analysis, chi – square test and estimation of the relative risk of severe VAD and the odds ratio have been used to investigate associations and relationships between variables.

3.11 Limitations of the Study

The survey was done just when the rains had started. This was a time when most household heads were busy planting. Generally some household heads whose land was away from their homesteads could not be interviewed. This necessitated visits even to homes, which had not initially been included in the sample by replacing one household with another adjacent and it slowed down the survey.

CHAPTER FOUR

Results

4.1 Demographic and Socio-Economic Characteristics

4.1.1 Introduction

Demographic and socio-economic characteristics are known to influence food consumption. The household, which is the basic unit for food production and consumption, was used as the unit for analysis. Many households in both rural and urban areas of developing countries rely on multiple sources of income for their livelihoods. Research has shown that urban dwellers acquire their income mainly from either temporary or permanent employment. However, the rural folks, who practice mainly subsistence agriculture, supplement their income with selling of their surplus farm produce (Tacoli, 2000).

Education, especially knowledge on vitamin A has been recognized as an underlying cause of Vitamin A deficiency (ACC/SCN, 1997). Impoverished women and those of low educational status tend to follow traditional ideas and practices, lack the confidence and are less likely to engage in social interactions where modern concepts and practices are promoted. Due to low education, they are also less likely to learn from the educational materials typically displayed in health centers for use in health related community activities, including those related to young child feeding practices. Moreover,

males of low education level are less likely to adopt within their household's new ideas and practices, even those related to family care and feeding.

Considering the aforementioned, it is therefore, important to study the socio-demographic characteristics of a community and relate them to the nutritional status and the general well being.

4.1.2 Characteristics of the Study Population

The socio-demographic characteristics covered in this chapter included household characteristics, sex and age distribution, education and occupation of the population. Establishing the source of income for the household and the type of residence was also used to assess the socio-economic status of the population.

4.1.2.1 Sex and Age Distribution of Study Population

Table 3 showed the distribution of the study population in terms of age and sex. In Kalama 12.5% of the children below 5 years of age were male while in Central 13.9% were male. The proportion of the under fives from the two areas were almost equivalent. For ages 15 – 24, Kalama recorded low percentage (12.5%) while central recoded higher (13.3%). The same pattern was also observed for the ages 15 – 24. Over half of the population (Kalama, 61.9% and Central, 50.5%) was between 15 years and 64 years of age.

Table 3: Age Distribution of the Population in Kalama and Central Divisions

Age in years	Kalama N=824			Central N=338		
	Male (%)	Female (%)	Total (%)	Male (%)	Female (%)	Total (%)
0-5	12.5	13.1	25.6	13.9	11.2	25.1
6-14	15.0	13.5	28.5	10.1	12.7	22.8
15-24	4.4	8.1	12.5	2.7	10.1	13.3
25-34	7.6	11.2	18.8	14.5	14.5	29.0
35-44	6.3	3.8	10.1	4.1	2.1	6.2
45-54	1.8	1.0	2.8	0.9	1.2	2.1
55-64	0.5	0.8	1.3	0.9	0.3	1.2
65 +	0.2	0.1	0.4	0	0.3	0.3
Totals	48.4	51.6	100	47.0	53.0	100

4.1.2.2 Household Size

The mean household size was 4.2 persons (within the range 1 – 6) in Kalama division and 5.1 persons (within the range 2 – 13) in Central division (Table 4). This finding contradicted that reported by KDHS (2003), where the urban mean household size (3.5 persons) was reported to be lower than that of the rural (4.7 persons) nationally.

The dependency ratio of the study population was 1:1.3 (Table 4) in Central and Kalama respectively. The result showed a higher ratio in rural than in urban areas.

Table 4: Mean Household Size and Dependency Ratio.

Division	N	Mean household size and S.D.	Dependency Ratio
Kalama	160	5.1 ± 1.9	1.3
Central	80	4.2 ± 1.7	1

4.1.2.3 Distribution of Household Heads by Sex

Majority of the households in Kalama (81.9%) and in Central (85%) were male-headed while minority 18.1% and 15% were female headed in Kalama and Central respectively. A chi-square test showed no significant differences between the male and female-headed households in the two divisions ($P > 0.05$). Additionally 85% of the respondents in both divisions were wives to the household heads while the remaining percentage was either child, widowed or separated mothers (Table 5).

4.1.2.4 Level of Education of Household Heads

The proportion of household heads with college education was higher (45%) in Central as compared to Kalama (16%). Those with lower primary education in Kalama were 1.9% while in central division were 2.5% ($p > 0.05$). In Central division, 1.3% of the household heads had attained university level of education while Kalama there was none (Table 5).

Table 5: General Characteristics of Study Population (%)

Characteristics	Kalama	Central
Sex distribution of household members	N=824	N=338
Male	48.4	47.0
Female	51.6	53.0
Sex of household head	N=160	N=80
Male	81.9	85.0
Female	18.1	15.0
Educational level of hhh*	N=160	N=80
None	4.4	5.0
Lower primary	1.9	2.5
Upper primary	33.3	23.8
Secondary	44.0	22.5
College	16.4	45.0
University	0	1.3
Education of study population	N=824	N=338
Not attended	1.2	1.2
Lower primary	21.8	11.8
Upper primary	29.0	23.4
Secondary	4.4	18.0
College	19.4	13.9
University	0	0.6
Under age	24.2	31.1
Occupational status of hhh*	N=160	N=80
Farming	82.8	0.0
Employed	0.8	68.8
Business	2.2	13.8
Casual laborer	15.0	17.4
Occupation of study population	N=824	N=338
Farming	23.4	0.0
Employed	7.0	30.1
Business	2.3	4.4
Casual laborer	7.2	12.1
Student/pupil	35.3	21.3
Under age	24.8	31.7
House wife	0	9.3

*hhh -household head

4.1.2.5 Occupation of the Household Heads

The main occupation for the head of households in Kalama was farming (82.8%), while in Central it was formal employment (68.8%). Only 0.8% of the household heads in Kalama were in formal employment while in Central there was no farming. Housewife (9.3%) as an occupation was reported only in Central while in Kalama it was non-existence (Table 5). This difference was statistically significant ($p < 0.05$)

4.1.3. Characteristics of the Study Children

A total of 160 children in Kalama division and 80 from Central were included in the study of which 51.2% were females while 48.8% were males. The children's ages varied from 2-6 years and made 28.5% of the total population from the two divisions. Results indicated that in Kalama female children studied were 10.2% of the total population while males were 9.2%. In Central, males were 12.1% and males 11.5% of the total population surveyed. Table 6 shows the distribution of children by division.

Table 6: Distribution of the Proportion of the Study Children by Sex and Division

Sex	Kalama (%) N=824	Central (%) N=338
Male	9.2	12.1
Female	10.2	11.2
Total	19.5	23.8

4.1.4 Education Level of Study Population.

With reference to education of the general population, Table 5 showed that in Kalama, 52% had attained a maximum of upper primary level and 23% had post primary level of education, while in Central division, 36% had attained upper primary and 32.5% had post primary. These differences were statistically significant ($p < 0.05$). Nobody was reported to have attained university education in Kalama while in central a small proportion (0.6%) had attained university level of education. It was observed that Kalama division had 24.2% and Central division 31.1% of children who had not attained the age of going to school thus not significant ($p > 0.05$).

4.1.5 Sources of Income by Division

In Kalama division, 75% of the households reported that their main source of income was from sale of crops grown, 39% from casual employment and only 8% from business. However in Central division, the source of income for the majority of the population was permanent employment (71%), 36% from casual employment and 18.8% from business (Table 7). These data were analysed by categorising regular income (casual employment, permanent employment and business) and irregular (sale of food crops/animals or donations from relatives). There were no significant differences in the sources of income between the divisions.

Table 7: Major Sources of Household Income (%)

Source	Kalama N=160	Central N=80
Sale of food crops grown	75.0	1.3
Sale of animals/ products	15.0	0.0
Casual employment	39.4	36.3
Permanent employment	30.6	71.3
Given by children/relative	5.6	2.5
Business	8.2	18.8

4.1.6 Type of Materials used in Constructing Houses

Variables consisting of properties owned, source of fuel and general lighting of the house, type of roofing, floor and wall materials of the main house and the number of rooms were analyzed as proxy indicators of the socioeconomic status of the population. In Kalama, majority (94.4%) of household had iron sheet roofs while only minority (5.6%) had grass-thatched roofs. In Central division, all (100%) the households surveyed had iron sheet roofs. This showed no significance difference ($p>0.05$) (Table 8). Households from both divisions were living in 2-roomed houses. In Kalama the mean was 2.9 (with SD = 1.1) and Central mean was 2.1 (with SD = 0.9).

Table 8: Materials Used in Constructing the Houses in Percentages

Roof, Wall, Floor types	Kalama (%) N=160	Central (%) N=80
Roof		
• Thatched	3.8	0.0
• Iron sheets	62.9	100
Wall		
• Mud	1.3	17.5
• Plastered	18.3	36.3
• Bricks	46.7	13.8
• Stones	0.4	32.5
Floor		
• Mud	22.1	16.3
• Plaster	44.6	83.8

4.1.7 Source of Lighting

All households in Kalama used kerosene for lighting and fuel wood for cooking food. In Central the major sources of lighting were kerosene and electricity (Table 9). There was no significant difference on usage of kerosene between the divisions ($p>0.05$).

Table 9: Source of Lighting in the Households

Lighting Options	Kalama	Central
Fuel wood	20.6	0.0
Electricity	0.0	45.0
Kerosene (Hurricane lamp)	95	52.5
Kerosene (Wick lamp)	92.5	22.5
Pressure lamp	1.9	2.5
Solar	0.6	3.8

4.2 Patterns of Consumption of Vitamin A Rich Foods

4.2.1 Introduction

Under nutrition, lack of education and ill health are some of the basic characteristics common to the rural population throughout the developing countries. In these rural areas, land is the basis of food production, income and employment, which also helps to determine the household's access to adequate food, shelter, and health services and to educational services. However, it has been observed that, there are sometimes marked differences in attainment of good nutrition, health and education services (FAO, 1986). Chronic type of malnutrition is a result of low energy intake primarily due to low energy intake as a result of insufficient food consumption.

The food frequency checklist aims at assessing the frequency within which certain food items or food groups are consumed during a specified time period for example, daily, weekly, monthly or yearly and hence facilitates collection of qualitative, descriptive information about usual food consumption patterns (Gibson, 1990). The food frequency checklist consists of a list of foods that may focus on specific groups of foods (in this case vitamin A) and a set of frequency of usage. After administering the checklist, if the foods rich in vitamin A were not consumed by more than 75% of the households at least three times a week, this indicates an inadequacy of the nutrient in that community (WHO, 1996).

4.2.2 Frequency of Consumption of Vitamin A Rich Foods

As indicated in Table 10, some food items were consumed more frequently than others, while some were not consumed at all. The most frequently consumed foods were cow's milk, papaws, pumpkins spinach and kales. These were consumed at least daily in Kalama by 82.5%, 38.8%, 20.4% and 54.4% respectively. While in Central, cows' milk, and spinach/kales was the most consumed by children at 97.5% and 71.5% respectively. Fats and oils were consumed in Kalama by 96.9% and in Central by 100%. A chi-square test showed no significant difference in the level of consumption of fats and oils in the two divisions ($p>0.05$).

Consumption of dark green leafy vegetables (kale/spinach, amaranth, pumpkin leaves) was high (consumed daily), but higher in Kalama than in Central. About 33.8% and 36.3% of the households in Kalama frequently consumed amaranth and pumpkin leaves respectively, but amaranth was not consumed at all in Central, while only 2% of households frequently consumed pumpkin leaves.

Animal products were not very commonly consumed except eggs (51.3%) in Kalama. while in Central about (37.5%) reported consuming eggs and 0.4% liver frequently. The consumption of fats and oils were reported consumed by the majority (96.9% and 100%) in Kalama and Central divisions respectively. There was no significance difference in the divisions ($P<0.05$).

Table 10: Frequency (%) of Consumption of Vitamin A Rich Foods by Study Population and Significance Difference

Food	A		B		C		D		E		X ² test
	K	C	K	C	K	C	K	C	K	C	
Cows' milk	82.5	97.5	13.0	2.5	1.3	0.0	0.0	0.0	3.1	0.0	s
Eggs	51.3	37.5	40.0	40.5	4.4	5.0	1.3	8.8	3.1	3.8	s
Carrots	1.3	26.3	35.0	36.3	23.1	20	6.3	8.8	34.4	8.8	s
Papaws	33.8	7.5	46.3	25.0	14.4	36.3	3.8	27.5	1.9	3.8	s
Cod-liver oil	0.0	0.0	0.2	0.9	5.0	6.7	6.3	5.0	80	58	s
Cow peas lvs*	35.6	21.3	53.8	33.8	5.6	8.8	3.8	20.0	1.3	16.3	s
Amaranth	33.8	45.0	0	10.0	15.0	10	1.9	31.3	4.4	48.8	s
Pumpkin	36.3	1.3	43.1	38.8	12.5	13.8	5.6	23.8	2.5	22.5	s
Liver	0	0.4	29.2	15.0	14.6	2.1	2.9	5.4	16.7	10.4	s
Pumpkin lvs*	20.4	2.1	42.9	9.6	3.3	5.0	7.9	7.9	0	8.8	ns
Spinach/kales	54.4	71.5	44.4	25.0	1.3	13.0	0.0	1.3	0.0	1.3	s
Fats/oils	96.9	100	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ns

K represents Kalama division, C represents Central division, * =Leaves, ns =not significant, n=significance

A- Frequently consumed (at least once daily)

B- Less frequently consumed (once to twice a week)

C- Not frequently consumed (not more than twice a month)

D- Occasionally (once a month)

E- Not consumed / never

4.3 Vitamin A Status

4.3.1 Introduction

The main causes of vitamin A deficiency in developing countries include, insufficient intake of vitamin A foods and poor availability of Provitamin A. Communities where diets, which contain no carotene and where little fruit, green leafy and yellow vegetables or animal products are consumed, often have low vitamin A status. Several studies done in different countries have shown significant relationship between prevalence of xerophthalmia and dietary intakes of vitamin A rich foods (Ramana et al., 1991; Mahboob et al., 1991; Wilma et al., 1991, cited by Matu 2001).

The ability of food sources to prevent vitamin A deficiency depends on the content of vitamin A compounds in different foods, the amount of vitamin A that can be absorbed and utilized, and the vitamin A status of the person consuming the food. Provitamin A carotenoids are found in fruits and vegetables. Dark green leafy vegetables are a good source of provitamin A carotenoids, but orange/yellow fruits (mango, papaya) and yellow/red vegetables (pumpkins, sweet potatoes) are twice as effective in enhancing serum vitamin A levels as those found in dark green leafy vegetables (Linkages 1999).

Since vitamin A and its precursors are fat soluble, it can be more fully utilized when fruits and vegetables are mixed or eaten with a fat source,

thus enhancing their absorption and increasing the energy density of the foods without sacrificing nutrient density (Dewan 2001). However, many of these carotenoids are seasonal foods, and this limits the frequency of intake over long period.

In most low-income populations, carotenoids constitute 80% or more of foods eaten that contain vitamin A (IVACG, 1989). Additionally, it has recently become evident that the bioavailability of Provitamin A from plants foods, especially from green leafy vegetables and to some extent from fruits and tubers, is much lower than what has been assumed (Martin et al, 1998). According to the same author, an intervention study in Indonesia among school children found that the apparent vitamin A activity of leafy vegetables and carrots was 23% of what had been assumed.

Dietary assessments that accurately reveal usual intakes of vitamin A are difficult to conduct even among literate, highly educated individuals (IVACG, 1989). Such surveys may not indicate accurately the level of preformed vitamin A and carotenoids as the biochemical and clinical methods, but they can be used as supportive evidence to point out inadequacy of the nutrient.

Existing approaches that can help in assessing the inadequacy of vitamin A are food frequency checklist and twenty-four-hour recall of dietary intake. However, the guidelines recommend using food frequency checklist results if there is an inconsistency in results derived from the two methods. This

method is primarily designed to identify populations of children at risk of VAD and has been used in several studies and shown significant potential in identifying groups of young children at risk of VAD (Dewan, 2001).

Normal vitamin A status implies that an individual is free of physiological or pathological consequences of vitamin A deficiency and has sufficient liver stores to provide protection against the increased metabolic demands in disease, reduced absorption as a result of diarrhoea or parasitic infection, or significant variations in dietary intakes.

The body's immune system cannot function well without adequate levels of vitamin A. Lack of vitamin A damages the surfaces of the skin, eyes, and mouth, the lining of the stomach and the respiratory system. A child with vitamin A deficiency has more infections, which become more severe because the immune system is damaged (Milton et al, 1987 and Sommer, et al, 1984). Vitamin A deficiency increases the risk that children will die or become blind. It is the most common cause of childhood blindness in developing world (WHO, 1999).

In general xerophthalmia is confined to children from the lowest social classes though this general rule is not always apparent especially in homogenous, peasant social class societies, which account for the bulk of the populations in the developing countries (James and Alfred, 1984). Families in lower social classes tend to have both poor access to preformed

vitamin A rich foods and poor understanding of the role of proper nutrition in the well being of their children.

Considering the observations stated above it is important to establish vitamin A status from different populations like the rural and the urban and compare their vitamin A levels.

4.3.2. Vitamin A Status of the Children Assessed

Clinical examination (Bitot's spot, Conjunctival xerosis and Corneal xerosis) was carried out on 231 of the 240 children. Examination was not carried out on the remaining 9 children due to child and/or parent refusal. Bitot's spot, Conjunctival xerosis and Corneal xerosis were the symptoms being examined. The latter two were signs of Xerophthalmia and the former, a sign of night blindness.

Results indicated that in Central division, 6.8% of the children were severely vitamin A deficient (Bitot's spots 4.1% and Xerophthalmia 4.1%), while in Kalama division, 4.4% of the children were severely vitamin A deficient (Bitot's spots - 3.2% and Xerophthalmia -1.9%). However, there was no significant difference in the level of severe VAD between Kalama and Central divisions ($p>0.05$) as shown on Table 11.

Table 11: Vitamin A Status of the study children within Divisions (%)

<i>Division</i>	<i>Bitot's Spot</i>	<i>Xerophthalmia*</i>	<i>Night blindness</i>	<i>Total severe VAD</i>
Kalama N=160	3.2	1.9	2.5	4.4
Central N=80	4.1	4.1	6.3	6.8

* *Xerophthalmia (conjunctiva xerosis and corneal xerosis)*

4.3.3 Correlates of Vitamin A Status

4.3.3.1 Vitamin A Status by Sex of the Children

The result showed a significance difference in prevalence of Vitamin A deficiency between the sexes ($p < 0.05$). Both night blindness and Bitot's spots are more prevalent in male than in female children. In Kalama division, 4.5% of the male severely vitamin A deficient (representing 62.5% of the affected children), while 2.5% were severely deficient, representing 37.5% of the affected. In Central, males at 4.5% affection represented 100% of the children with severe vitamin A deficiency. No cases of females with this condition were reported in the division. These results are shown in the table below.

Table 12: Distribution of Vitamin A Status by Sex of Study Children

<i>Sex</i>	<i>Severe VAD</i>	
	<i>Kalama (%) N=8</i>	<i>Central (%) N=5</i>
Male	62.5	100
Female	37.5	0.0

4.3.3.2 Vitamin A Status by Age of Children

The results indicated that the prevalence of severe vitamin A deficiency as assessed by clinical signs in Kalama division between the ages of 24 – 29 months, 37.5% of children were affected while in Central no child of the same age was affected. Again in Kalama, ages 36 – 41 months 25% children were affected and ages 66 – 71 months, 25% children were affected.

Central divisions, 30 – 47 months old, 60% children were affected and between 66 – 77 months again 40% children were affected. The summary of the findings is presented in Table 13.

Table 13: Distribution of Severe VAD and Age of Children

<i>Age range in months</i>	<i>Kalama n=8</i>	<i>Central n=5</i>
24 – 29	37.5%	
30 – 35		20%
36 – 41	25%	20%
42 – 47	12.5%	20%
48 - 53		
54 - 59		
60 - 65		
66 – 71	25%	20%
72 – 77		20%
78 – 83		
84 - 100		

4.3.3.3 Vitamin A Status and Morbidity

Based on a two week recall to the time of study, 77% of the children severely vitamin A deficient were found to suffer from one disease or another. In Kalama, 75% reported diseases such as malaria, cough/colds, and stomach pains. All of them reported that they suffer from eye diseases. While in Central, 80% were found to have suffered from different illnesses. An Odds Ratio analysis showed that those with VAD had higher chances of falling ill; 2.2 times more than those with no VAD in Kalama while in Central they were 1.33 times more likely to fall sick.

4.3.3.4 Vitamin A Status and Nutritional Status

The nutritional status of the children found to be Vitamin A deficient were falling between severe to moderately malnourished. Results indicated that, underweight -weight -for - age Z-score were 8 (62.5%), 6 (46.1%) were wasted and 4 (30.7%) were stunted. Correlations_ (0.05) showed an association between VAD and nutritional status.

4.3.3.5 Vitamin A Status and Source of Income in the Household

From the study, result showed that the proportion of children with severe vitamin A deficiency was high in households whose income was derived from casual employment in Central division and in Kalama division, sale of food crops. Chi-square analysis showed significant differences in the two divisions ($p < 0.05$) Table 14.

Table 14: Distribution of Severe VAD and Source of Income in the Households

<i>Income source</i>	<i>Kalama N=160</i>	<i>Central N=80</i>	<i>X² test</i>
Sale of food crops grown	42.9	0.0	significant
Casual employment	42.9	80.0	significant
Given by children/relatives	14.3	20.0	significant

4.3.3.6 Vitamin A Status and Properties Owned by the Household

Within the household interviewed and found to have children with severe Vitamin A deficiency in Kalama, the properties owned were mainly radio (83.3%) and bicycle (16.7%). In central 50% owned sofa-set while 50% owned radio. Among the households who had severe vitamin A deficient children in Kalama, results indicated that (62.5%) of them use kerosene (hurricane lantern) as their first option of lighting form while 3 (37.5%) use kerosene (tin and wick). In Central 21.3% use electricity, 76.3% use kerosene (hurricane lantern) as their form of lighting and the remaining 2.4% were reported to be using other forms like solar, tin and wick and pressure lamp. In Kalama, 100% of the household use firewood as cooking fuel while Central 20% use kerosene and 80% use charcoal as the first option in the household.

4.3.3.7 Vitamin A status and mother's knowledge

Mothers were asked to name the vitamins they know, their importance and the food sources. The result in table 15 showed that in Kalama 83.8% were aware of vitamins found in food, while in Central 80% were not.

In Kalama 16.3% mentioned at least four vitamins while in Central 12.5% mentioned at least four. Majority (52.3%) of mothers interviewed were able to mention two to three vitamins and their food sources from the two-divisions. There was no significant difference between the divisions ($P < 0.05$) in this respect.

Table 15: Distribution of the Responses on Knowledge on Vitamins and VAD (%).

Knowledge on vitamins	Idea on vitamins		Idea on vitamin A	
	Kalama N=160	Central N=80	Kalama N=160	Central N=80
Have some idea	83.8	80.0	72.5	76.3
Have no idea	16.3	20.0	27.5	23.8

4.3.3.8 Vitamin A Status and Maternal Education

Results indicated that in Kalama division, about 50% of the severe vitamin A deficient children came from households where the mothers had no formal education, 35% from households where the mothers had lower primary level and 14.8% from households where the mothers had upper primary level of

education. In Central division 80% of the severe vitamin A cases were from households where the mothers had no formal education and 20% from households where the mothers had attained only d lower primary level. However, the association between vitamin A status of the study children and the categories of maternal education levels was not significant ($p < 0.05$).

Table 16: Mothers Level of Education and Vitamin A Status of Children

<i>Education level</i>	<i>Kalama (%) N=8</i>	<i>Central (%) N=5</i>
Not attended	50.2	80.0
Lower primary	35.0	20.0
Upper primary	14.8	0.0
Secondary	0	0.0

4.3.3.9 Vitamin A Status and Maternal Occupation

In Kalama Division, all children found to have severe vitamin A deficiency were from mothers whose occupation was farming (100%) while mothers who responded that they were housewives in Central had children who were vitamin A deficient (100%). Chi-square test showed significant difference between the divisions ($p < 0.05$) as presented on Table 17.

Table 17: Distribution of Severe Vitamin A Deficient Children and Mothers Occupation (%).

<i>Mother's occupation</i>	<i>Kalama N=7 Central N=5</i>	
Farming	100	0.0
Employed permanently	0.0	0.0
Business	0.0	0.0
Casual laborer	0.0	0.0
Housewife	0.0	100

CHAPTER FIVE

Discussions

5.1 Demographic and Socio-Economic Characteristics

The average household size of 5.1 persons in Kalama (rural) and 4.2 persons in Central (urban) is comparable to average of rural 3.5 persons and urban 4.7 persons respectively, as established in other studies (KDHS 2003). The survey revealed that the rural area seemed to have larger household sizes than the urban. This could be because the urban population has access to social amenities including family planning.

In most parts of Kenya, we find that most houses are male-headed. This was evident in the study area where 81.8% were male-headed while only 18.2% were female-headed in Kalama division. While in Central (urban), female-headed was 15% while male-headed was 85%.

There was a significant different between the two divisions on the percentages of female headed households and this could be because mostly men are able to seek employment at higher rate than women. Therefore, those female without male as household head would opt for rural area than urban. Again several studies have shown that houses headed by females are disadvantaged in that children are at greater risk of malnutrition and hence vitamin A deficient.

Female heads of households are important in reference to vitamin A deficiency because it is believed that the heads as mothers have to spend a lot of time away from the child in the process of trying to survive. Being away from the child has adverse effects on the child's nutrition and vitamin A status because while the mother is away, the child is likely to get inadequate care. This means that the child may miss proper care and may also be exposed to dirty environments resulting in illnesses like diarrhea.

The family size has an effect on the quantity and quality of food available in the household whether in a rural or urban setting. It affects the availability of other economic resources that play a major role in the health and well being of household members. The high dependency ratio of 1.3 in Kalama and 1 in Central could possibly affect the vitamin A status of the study children since many persons are depending on a smaller economic active population.

The research revealed a low education level of household head in both divisions. Majority of the household heads in both areas have attained only up to upper primary level of education in Kalama, and only in Central where college and university make 46%. This is true because those who have attained upper level of education do go to town to seek for employment. The result also can be related to what had been reported in Kenya that most of the Kenyans attend school, only a small proportion are able to continue to higher level of education (KDHS, 2003).

The impact of house type on vitamin A status was not analyzed in this study. However, there exist indirect relationships between house type and Vitamin A deficiency. A study carried out in Uganda in 1995, showed that children living in houses with cemented floors have a better nutrition than those who live in houses with mud floors as quoted by Mugambi, (2001). The reason for the association could be a) a cemented floors are easy to keep and hence infections are kept away, b) households that are able to have cemented floors are expected to be better off economically than those with mud floors.

In rural areas, households whose houses are roofed with corrugated iron sheets and cemented floors are likely to be better off than those of mud and grass thatched roofs. It is assumed therefore that well off households are able to purchase vitamin A rich foods and their precursors, which aid in absorption, hence prevent Vitamin A deficiency.

5.2 Patterns of Consumption of Vitamin A Rich Foods

From literature, it is evident that fat intake is vital in metabolism of vitamin A. Results indicated that over 90% in both divisions, the children consumed fats/oils on daily basis. This shows that the population would be able to absorb most of the consumed vitamins holding other factors constant.

Micronutrient deficiencies in Kalama and Central divisions are likely to be low during wet seasons and high during dry seasons because most of the sampled dark green leafy vegetables were reported to be available only in wet seasons. Kusin *et al.* (1985) studied vitamin A status of pregnant and lactating women in Machakos district. He observed that serum vitamin A values showed a seasonal pattern, reaching peak in April-June. This is the period when green leafy vegetables are widely available.

It was noted that in Central, kales and tomatoes probably irrigated were available for sale. These are likely to be beyond the reach of many households, especially during dry periods when prices are high.

This study showed the consumption of vitamin A-rich foods in Machakos district and therefore, this explains the severe vitamin A status in the district. On the contrary, a study carried out in Mbeere showed an inverse relationship between the frequency of consumption of vitamin A rich foods and xerophthalmia (Matu, 2001).

The consumption of animal protein like liver was noted to be very low in Central (0.4%) and non-existent in Kalama. Carotenes were the main form of vitamin A consumed. Consumption of the vegetables was seasonal (only during rainy season) and generally low. Therefore, it is important to consider the types of foods consumed. In cases where carotenes are the main vitamin A source, then the quantities of these being consumed is crucial. Carotenes

are less biologically active than retinol; less efficiently processed and absorbed in the gut e.g. an individual needs to ingest up to six times as much provitamin A beta-carotene (by weight) as retinol for a similar effect (Sommer, 1982). So we may conclude that both Kalama and Central divisions, vitamin A available to the children's body could be quite limited considering that carotenes are their main source of vitamin A.

5.3 Vitamin A Status

The proportion of the population in both divisions who had consumed highly rich vitamin A sources like cod-liver oil, carrots, and liver was quite low and far much below the average cut-off point set by World Health Organization in both divisions. WHO (1996) recommends that a given vitamin A rich food should be eaten by more than 75% of the vulnerable group at least three times a week. Food that was consumed above this cut off point was only milk. This could be due to the fact that milk is known to be the first food for a child. No statistically significant association was analyzed between vitamin A status and food frequency consumption.

The study results indicated that VAD is prevalent in both the urban (Central) and rural (Kalama) divisions. The prevalence for Bitot's spots and for night blindness among the study children is well above the World Health Organization cut-off point of 1% for the VAD to be declare a public health problem in an area (ACC/SCN 2001).

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The study showed a significant difference in prevalence of severe VAD between the sexes. Both night blindness and Bitot's spots were more prevalent in male than in female children. This is in line with observations made by Sommer (1995), who reported that boys have a higher risk of night blindness and Bitot's spots when compared to girls. Similarly, in the state of Paraiba, North East Brazil, Bitot's spots occurred twice as frequently in males as in females (Christian *et al*, 1998, cited by Matu, 2001). Males are always more affected than females, a consistent characteristic which is not yet fully explained.

Mother's knowledge on vitamin A has an impact on vitamin A status as observed by Matu, 2001. However, it was observed that mother's knowledge on food sources of vitamin A and the importance of the vitamin depended on the educational level. The higher the level of education, the more knowledgeable the mothers were on vitamin A.

The study observed that night blindness and Bitot's spots were prevalent among the children of illiterate to semi-literate mothers whose occupation is either farming or housewife in Kalama and Central respectively. This is also in line with other study findings such as that cited by Matu (2001) that found lower prevalence of night blindness among literate families who somehow knew from radio about the importance of vitamin A and dark green leafy vegetables for a child's vision.

CHAPTER SIX

Conclusions and Recommendations

6.1 Conclusions

- The study established that the prevalence of VAD is of public health significance in rural and urban areas of Machakos district in Kenya.
- The research established that consumption of vitamin A rich foods were low and especially those from the animal source in both divisions. This may partly explain the high level of VAD in the district in addition to morbidity, which was associated with vitamin A status.
- Maternal level of education and occupation were related to vitamin A status of the children.

6.2 Recommendations

- Moderate vitamin A status, using biochemical indicators of Vitamin A Deficiency should be undertaken as this study determined VAD using clinical signs and thus reported only severe signs of Vitamin A Deficiency.
- It is recommended that other studies be carried out to assess the extent of other factors such as worm infestation in Machakos district and their impact on vitamin A status of the children with a view to implementing appropriate interventions.

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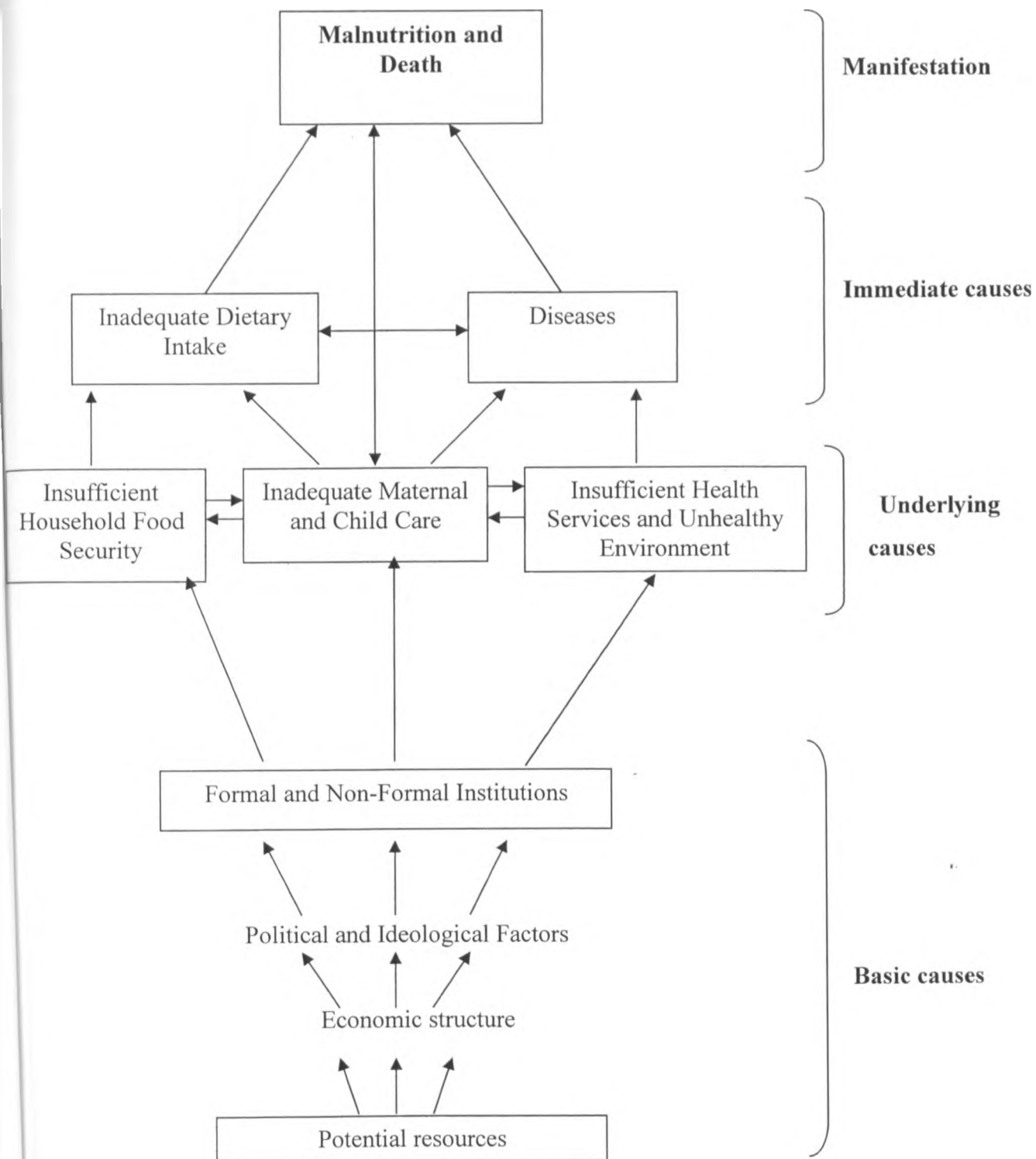
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APPENDICES

APPENDIX A: Framework on the Causes of Malnutrition.



Source: UNICEF/GoK (1998). A Situation Analysis of Children and Women in Kenya.

APPENDIX B: STRUCTURED QUESTIONNAIRE

Name of interviewer _____ Qsno. _____

Date of interview _____ Division _____

Location _____ Sub location _____

Household No. _____

SECTION A

Demography and social economic status

1. How many people are there in your household, that is those who depend on the household for their livelihood, you have cooked and eaten together from the same pot for the last 3 months?

Please give me their names, ages, relationship to the household head, their level of education, occupation, and sex. {Fill in the table below and remember to include the respondent}.

(List of household members)

Sno.	Name	Sex	Age	R/ship to HHH	Education	Occupation
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Sex

- 1=male
- 2=female

Relationship to HHH

- 1=household head
- 2=wife
- 3=child
- 4=grand child

Education

- 1=Not attended school
- 2=lower primary
- 3=upper-primary
- 4=secondary

5=college

- 6=university
- 7=not applicable

Occupation

- 1=farming
- 2=herding
- 3=employed
- 4=business

5=casual laborer

- 6=student
- 7=not applicable
- 8=other (specify

SECTION B

HOUSEHOLD INCOME AND PROPERTIES OWNED

2. a) What is or are the sources of income for the household?

b) Of these sources please rank them from the one that gives you the highest to the lowest amount of money. (Circle appropriately)

	sources (rank)	contribution
1= sale of food crops grown	_____	_____
2= sale of animals/their products	_____	_____
3= casual employment	_____	_____
4= fishing	_____	_____
5= permanent employment	_____	_____
6= cash crops grown (specify)	_____	_____
7= given by children/relative	_____	_____
8= others (specify)	_____	_____

3. Do you own any of the following items? (Circle those owned)

- | | | |
|-------------------|-------------------------|-------------------|
| 1. Television Set | 3. Sofa Set | 5. Water Tank |
| 2. Bicycle | 4. Cow chart | 6. Radio Cassette |
| 7. Pressure lamp | 8. Gas/ electric cooker | |

4. What do you usually use for lighting in the house? (Rank ones used).

- | | | |
|----------------|---------------------------------|------------------|
| 1. Fuel wood | 3. Kerosene (Hurricane lantern) | 5. Pressure Lamp |
| 2. Electricity | 4. Kerosene (Tin with wick) | 6. Solar |

--	--	--	--

5. What cooking fuel do you use?

1. Kerosene 3. Gas 5. Firewood
 2. Electricity 4. Charcoal 6. Others (specify)

--	--	--	--

6. What is the number of rooms of the main house?

7. What materials have been used to build the main house? (Fill in the table accordingly)

Roof (circle)		Wall (circle)		Floor (circle)	
Thatched	1.	Mud	1.	Mud	1.
Tin	2.	Plastered	2.	Wood	2.
Iron sheets	3.	Bricks	3.	Cemented	3.
Tiles	4.	Stones	4.	Titles	4.
Other (specify)	5.	Others (specify)	5.	Other (specify)	5.

8. Do you own any livestock? (Circle appropriately).

1=yes 2=no

9. (If yes) which livestock, and how many? (Fill appropriately)

LIVESTOCK	No. (INDIGENOUS)	No. (EXOTIC)
1.cows		
2. Goats/sheep		
3.chickens /ducks		
4.donkeys		
5.Rabbits		

SECTION C
GENERAL KNOWLEDGE ON VITAMIN A

10. Have you ever heard of vitamins found in food? (Circle).

1=yes 2= no (if no go to Q. 14).

11. (If yes) which vitamins have you heard? _____

12. What do vitamins do to our body? _____

13. Which foods do you know of to provide vitamins? _____

14. Have you ever heard of vitamin A? (Circle).

1=yes 2=no (If no, go to question no. 17).

15. (If yes) what is the importance of vitamin A? _____

16. What are the food sources of vitamin A? (List). _____

17. Among your children, aged 2-6 years are there some you feel do not see well in dim light? (Circle).

1= yes 2=No (if yes, then circle their name/s in the list on the first page and ask question No, 18, 19, 20, 21, if no move to question 22).

18. What indicators or reasons make you feel that these children (child) do not see well in dim light? (Circle).

1=falling down

2=cannot see colors

3=do not play

4=other (specify)

19. What is the possible cause of this failure to see in dim light?

20. Have you done anything to assist the child as far as this problem / issue is concerned? 1=yes 2=no

21. (If yes) what have you done? _____

22. Have any of your children received vitamin A capsules supplementation? (Circle) 1=yes 2=No (If yes, ask question No.19).

23. Where was the supplementation given? (Circle).

1=health center/dispensary/clinic

2=hospital

3=school

4=at home during polio campaigns

5=other (specify).

SECTION D

INDEX CHILD INFORMATION

(All questions in this section refer to the index child)

Date of Birth _____ means of verification _____

Codes: 1=Birth certificate 3= Clinic card

2= Memory

4= Baptism card

5= other (specify) _____

24. For the past two weeks, has (mention name of the index child) had any illness?

1=Yes

2= No (if no go to Q 2; if yes fill in the table below)

Illness	Where treated	Got well
1. Malaria / fever		
2. Skin diseases		
3. Mouth sores		
4.boils		
5.Cough/cold		
6.Earache/discharge		
7.Diarrhoea		
8.Stomachache/headache		
9.Eye diseases		
10. Wounds		
11.Vomiting		
12. Others (specify)		

Where treated

Got well

1=hospital

2=health center/dispensary/clinic

3= at home

4=other (specify)

1=yes

2=no

25. How many times (a day, a week, a month) is (mention name of index child) fed on the following foods?

FOOD	FREQUENCY	SOURCE
1.cows milk		
2. Eggs		
3.Carrots		
4. Papaws		
5. Cod liver oil/seven seas		
6. Cowpeas leaves		
7. Mangoes		
8. Amaranth		
9. Pumpkin		
10.fish		
11. Liver		
12. Pumpkin leaves		
13. Kales/spinach		
14. Fats and oils		
15. Other (specify)		

Frequency

- 1 = Not consumed / never
- 2 = frequently consumed (once-many times a day)
- 3= less frequently consumed (once-twice a week)
- 4=Not frequently consumed (Not>twice a month)
- 5=occasionally consumed (once a month)

Sources

- 1= Harvested by family
- 2= Bought
- 3= Harvested+ bought
- 4= Not applicable

SECTION E
FOOD CONSUMPTION IN THE HOUSEHOLD

26. Food frequency

Below is a list of foods, please indicate how often this household feeds on the foods listed down. (Fill in the box).

Food item/its products	Daily	Once a week	> Once - <7 times a week	Occasionally	Never
Maize					
Millet					
Sorghum					
Finger millet					
Cowpeas					
Dengu					
Beans					
Meat					
Milk					
Eggs					
Vegetables					
Fruits					
Fish					
Bread					
Margarine					
Oil/Fats					
Cassava					
Irish potatoes					
Sweet potatoes					
Rice					
Bread					
Peanuts					
Other (specify)					

INDIVIDUAL CHILD (ANTHROPOMETRY)

Measure the youngest child within the age's of 2-6 years in the household.

Name of the index child _____

Age _____ Years.

Date of Birth (D/M/Y) _____

Sex _____ 1=male 2=female

Take the following measurements and fill in the table.

Units cm, mm, kg	First	Second	Mean
Height (cm)			
Weight (kg)			
MUAC (mm)			

5. Age verification

1= Child health card 2=Birth certificate 3= Memory 4=other

(specify) _____

CLINICAL EXAMINATION

(To be filled by a clinician)

Codes; 1 = Yes 2= No

Oral mucosa; lesions present _____ Bleeding gums _____ Abscess _____

Physical abnormality _____

Pallor. _____

Jaundice _____

Skill abnormality _____

If yes, specify _____

Bitot's spot _____

7. Conjunctiva xerosis _____

8. Corneal xerosis _____

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