FACTORS THAT DETERMINE THE USE OF FOOD BASED STRATEGIES IN THE PREVENTION AND CONTROL OF VITAMIN A DEFICIENCY IN MARIGAT DIVISION, BARINGO DISTRICT, KENYA.

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By

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A Master's Thesis submitted to the Graduate School in partial fulfilment for the requirement of Masters of Science Degree in Nutritional Sciences of Egerton University.

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This Master's Thesis has been submitted for examination with our approval as University supervisors.

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DEDICATION

To mum, Florence Kipkorir, and Dad, Dr. John Kipkorir for believing in me. I thank you both for your support. To Cherobon, Cheruto, Chelagat, Kibet, Kimaru and Kimalel the journey has just begun.

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ABSTRACT

Vitamin A deficiency (VAD) is recognised as a public health problem in most developing countries. Arid and semi-arid areas have been identified as areas with high risk of VAD. The purpose of this study was to investigate the factors that determine the use of food based strategies in the prevention and control of VAD. This work uses a cross-sectional survey conducted in two sub-locations, Yatoi (without irrigation) and Perkerra (with irrigation) of Marigat division. A total sample of 206 mothers with children under the age of five years were interviewed. A sub sample of 30% (64 mother-child pairs) were purposively selected for dietary assessment. A questionnaire was used to collect information on food production, demographics, food preparation, preservation, processing, knowledge, attitudes and practices. A Helen Keller Food Frequency Questionnaire (FFQ) and a 24-Hour Food Recall were used to assess dietary intake. Focus Group Discussions were held with community leaders. Statistical Package for Social Scientists version 11.5 and Nutri Survey were used for analysis of data. The findings of the study indicate that vitamin A rich foods were not available in the main farmland and kitchen gardens. Vitamin A rich foods were however available in the market place. Only 2% of the mothers interviewed grew fruits and vegetables in the main farmlands. A further 80.6% did not have kitchen gardens. Significant differences were observed when comparing the types of crops grown in the main farmlands in the Yatoi and Perkerra ($P = 0.002$). However no significant differences were observed when comparing types of crops grown in kitchen gardens and those bought in the market place ($P = 0.299$). Over 70% of the women purchased food during months of scarcity and most of them (50%) did not consume key vitamin A rich foods. At least 94.7% of women used cooking fat when preparing vitamin A rich foods. A majority of the women did not preserve their foods mainly because food was bought and consumed. The frequency of consumption of preformed vitamin A was very low (2.89 ± 1.24 and 2.85 ± 1.27 days per week) for mother and children respectively. This is low compared to 4 days per week recommended by the Helen Keller FFQ method. A high proportion of mothers (59.7%) gave incorrect responses when asked what the signs and symptoms of VAD were. The results indicate that food based strategies are a neglected frontier in combating VAD in Marigat Division. This information can provide a base for sustainable solutions such as production, preservation and consumption of vitamin rich foods. This information will be useful to policy makers, programme planners and other stakeholders.

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LIST OF ABBREVIATIONS AND ACRONYMS.

ACC	Administrative Committee of Coordination of the United Nations.
FAO	Food and Agriculture Organisation of the United Nations.
FBS	Food Based Strategies
FNB	Food and Nutrition Bulletin.
HKI	Helen Keller International.
IFNDC	International Nutrition Foundation for Developing Countries.
IU	International Units
KAP	Knowledge Attitudes and Practices
MOA	Ministry of Agriculture.
MOH	Ministry of Health.
PEM	Protein Energy Malnutrition
RDA	Recommended Dietary Allowances
RNI	Recommended Nutrient Intakes.
RE	Retinol Equivalents
SCN	Standing Committee on Nutrition of the United Nations.
UNICEF	United Nations Children Fund
VAD	Vitamin A Deficiency
VADD	Vitamin A Deficiency Disorders
WHO	World Health Organisation

µg	Microgram
mg	Milligram

CHAPTER ONE
INTRODUCTION

1.1 Background information.

Vitamin A is a fat-soluble vitamin that is essential for effective immune system functioning, growth and development, cellular differentiation, reproduction, bone development and the protection of the integrity of epithelial cells (Basu & Dickerson, 1996; Olson, 1991 ; WHO/FAO, 2004). Deficiency occurs when the body's reserves are depleted to the extent that the physiological functions mentioned above are impaired (McLaren & Frigg, 2001; MOH, 2004). Vitamin A deficiency (VAD) is a major public health problem in most developing countries (FAO/WHO, 1995; MOH/UNICEF, 1999).

In Africa, 52 million children of preschool age are at risk of developing VAD (FAO/WHO, 1995). The 1999 National Micronutrient Survey showed that in Kenya, 7% of the children had severe VAD (< 0.35 μmol/L) and 32.9% had marginal VAD (0.70 μmol/L). It is the single most important cause of preventable blindness among children in developing countries (MOH/UNICEF, 1999).

The immediate cause of VAD is inadequate intake of vitamin A rich foods. Other causes of VAD are underlying disease conditions such as diarrhoea and worm infestations. The presence of such infections impair absorption of vitamin A. Age is a risk factor to VAD. Children under the age of five are at high risk of VAD due to increased need to support rapid growth during this period. Nutrient interactions can also lead to VAD (Olson, 1991; WHO/FAO, 2004). Increasing poverty levels, lack of vitamin A rich foods of animal origin and seasonal fluctuation of vitamin A rich fruits and vegetables also leads to VAD (MOH, 2004; WHO/FAO, 2004). In order to control and prevent VAD, several strategies have been developed. These strategies include the promotion and protection of breastfeeding, dietary diversification, food fortification, production of vitamin A rich foods through home gardening, public health measures and vitamin A supplementation.

Vitamin A supplementation was introduced to Kenya by the Ministry of Health (MOH) in collaboration with the United Nations Children's Fund (UNICEF) as a short term measure of controlling VAD. Vitamin A capsules are supplied to postpartum mothers and children under the age of five. Sick children get additional doses of vitamin A capsules because diseases accentuate VAD (MOH, 2004). UNICEF estimates that

between the years 1998 and 2001, as many as 1.5 million children deaths may have been prevented because of the global progress in supplementation (FAO/WHO, 1995). However, Kenya is yet to realise such success because of many logistical problems that prevent effective distribution of vitamin A capsules to health facilities across the country. A major shortcoming of supplementation as a strategy is it is a short-term measure heavily reliant on donor support. Consequently, other strategies to complement the supplementation programme are needed. Nutrient availability is primarily a function of an agricultural system's food output as well as the accessibility and consumption at household level. Plant foods especially, provide most nutrients to feed the developing world (Welch, 2002). A large proportion of the African population depends on plant foods for vitamin A needs.

The Home Economics Extension Programme in the Ministry of Agriculture (MOA) promotes Food Based Strategies such as, dietary diversification, kitchen gardening and improved utilisation of traditional foods. Food Based Strategies such as these could be important in the control of VAD on a long-term basis. In spite of this, Food Based Strategies are not being given due attention. Bioavailability of vitamin A from fruits and vegetables may be lower than previously thought, however it varies depending on the way food is handled, processed and the quantity ingested (Britton & Lietz, 1999). Some studies have shown that Food Based Strategies, when used effectively may help in preventing and controlling VAD (Bloem *et al.*, 1996; Hulthe, 2000; Takyi, 1999; Delisle, Zagre, Bakari, Codjia & Zendony, 2003).

1.2 Statement of the problem

The National Micronutrient Health Survey done in 1999 found that arid and semi-arid areas in Kenya such as Mandera, Garissa, Kitui and Baringo had inordinately high incidences of VAD. Furthermore, prevalence of sub clinical VAD remains high in Marigat Division, Baringo District. The most vulnerable populations include women and children under the age of five. A diet rich in vitamin A is vital to prevent VAD. Research has shown that vitamin A rich fruits and vegetables are in most times available in areas with high prevalence of VAD and may be affordable to the poor. Marigat Division is classified as a semi-arid area and it is characterised by erratic rainfall, long dry spells and short cropping seasons. Yatoi sub-location is dependent mainly on livestock farming and occasional crop farming that relies on rainfall. Perkerra sub-location is dependent on crop

farming supported by irrigation. The potential of Food Based Strategies has not been fully explored in Kenya. Although the Ministry of Agriculture supports food based interventions, it still receives little focus and fewer resources. Supplementation continues to be the more popular strategy, but despite its introduction in 1995, VAD is still highly prevalent. There is need to develop Food Based Strategies that could complement supplementation. Many factors affect adoption and use of Food Based Strategies in Marigat Division.

1.3 Purpose of the study.

The purpose of this study was to investigate the factors that determine the use of Food Based Strategies in preventing and controlling VAD in Marigat Division.

1.4 Objectives of the study.

1. To determine availability and accessibility of food sources of vitamin A to mothers and their children under the age of five.
2. To identify food preparation, processing and preservation methods in the preparation of foods containing vitamin A.
3. To determine intake of vitamin A rich foods using a Helen Keller Food Frequency Questionnaire and a 24 Hour Food Recall.
4. To assess knowledge, attitudes and practices on vitamin A and VAD among women with children under five years of age.

1.5 Hypotheses

The objectives of the study were achieved by testing the following hypothesis at 0.05 alpha level.

1. Ha: There are adequate sources of vitamin A rich foods available and accessible to mothers and their children under five years of age.
2. Ha: The food preparation, processing and preservation methods used are good and favourable to vitamin A intake.
3. Ha: There is adequate dietary intake of vitamin A rich foods.
4. Ha: There is adequate knowledge, positive attitudes and good practices favourable to vitamin A nutrition.

1.6 Significance of the study.

The study findings demonstrated that several factors determine the use of Food Based Strategies in the prevention and control of VAD in Marigat Division. The information collected from the study will help initiate strategies that will influence behaviour change in terms of dietary habits, attitudes, food preparation, processing and preservation methods. It will also lead to improved knowledge and practices with regard to vitamin A. Additionally, it will improve the production, utilisation and consumption of locally available vitamin A rich foods. Further, it will provide a platform for policy makers, programme planners and other stakeholders to design suitable intervention programs to improve vitamin A status in Marigat and other areas deficient in vitamin A in Kenya. Lastly, the information is a basis for sustainable solutions to VAD that will complement supplementation.

1.7 Scope of the study.

The study included children under the age of five and their mothers. This is because studies have shown that women and children are most vulnerable to VAD. A total of 206 mothers with children under the age of five years were interviewed. They were selected from Yatoi and Perkerra Sub-locations of Marigat Division. A sub sample of 30%, 64 women with children under the age of five years, were selected from the total sample of 206 to participate in dietary assessment.

1.8 Limitations of the study.

A list of households was not available at the Central Bureau of Statistics office. Thus, the researcher obtained a list from records kept in the chief's office that was not up to date. It however helped in determining the sample. There were a few cases of attrition (15.6%) during follow up for dietary assessment. This was overcome by the large sample which had been selected, therefore those who opted out were replaced. Vitamin A deficiency is best detected through laboratory assessment but this could not be achieved due to financial constraints. Instead, the researcher determined the risk of VAD using the Helen Keller International threshold values (Rosen, Haselow & Sloan, 1993).

The 24 Hour Food Recall was not representative of day-to-day food intake as respondents were asked to recall all food consumed in the previous 24 hours. As a result,

nutrient intakes reported may not give a true picture of daily dietary intake of the population.

1.9 Operational definition of terms.

Food Based Strategies: These strategies encompass the whole food chain. From the production of vitamin A rich foods in gardens or fields, or small livestock to procurement from local or centralised markets, to processing domestically in preparation of meals, to consumption within or outside the homes. In this study, it means promoting and protecting breastfeeding, increasing production of vitamin A rich foods through home gardening and livestock. It also includes increased intake of vitamin A rich foods, dietary diversification and food fortification. It also entails improved knowledge, attitudes and practices and good food preparation, processing and preservation methods with regard to vitamin A.

Availability: It refers to the presence of vitamin A rich foods. In the study, it means the presence of these foods within the vicinity of the area under study, either from the market place, farm or the surrounding environment.

Accessibility: Accessibility refers to the ease at which individuals can obtain, use and consume vitamin A rich foods. In the study, it refers to access in terms of cost, seasonality and cultural inhibitions.

Frequency of food intake: The number of times particular food groups are eaten by individuals over a specified period. In the study, it means the number of times vitamin A rich foods are eaten by children under the age of five and their mothers for seven days preceding the study.

Twenty four hour food recall: A food recall of all foods and beverages including sweets and alcohol consumed by an individual in the 24 hours preceding the study. In the study, it means a recall of all foods and beverages consumed by children under the age of five and their mothers in the 24 hours preceding the study.

Food preparation, processing and preservation methods: Preparation includes, cutting, peeling, trimming and washing foods in preparation for cooking or eating (for raw foods). Processing involves the actual cooking process such as boiling, frying, steaming and baking. Preservation is the process of drying, salting, smoking and refrigeration of foods containing vitamin A in order to retain its nutritive value and enhance its keeping quality.

Households: The prime units within which food is acquired, stored, shared, and consumed. For the purposes, this study it means people who eat together from one 'pot'.

Dietary diversification: The art of including a variety of foods in a meal, with the aim of getting adequate nutrients through complementation. In this study, it means including a variety of vitamin A rich foods in the diet.

The risk of vitamin A deficiency: This is when 70% of surveyed community members do not meet the Helen Keller FFQ threshold values for vitamin A intake. VAD is then considered a public health problem in the community.

Staple food: It is the food that is consumed by mothers and their children on a daily basis. In this study, the foods were stiff porridge (ugali) with green leafy vegetables for supper and maize mixed with beans (githeri) over lunch.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter provides a synopsis of literature reviewed. Prevalence of vitamin A deficiency (VAD) is examined at global level. A more specific focus is accorded to Africa while Kenya, particularly the study area get a highly nuanced evaluation. Factors that affect vitamin A status, food sources of vitamin A and strategies to alleviate VAD are reviewed. A detailed explanation of food based strategies such as food fortification, home gardening and consumption patterns is given. The effect of food preparation, processing and preservation methods and knowledge, attitudes and practices on vitamin A has also been examined. The conceptual framework guiding the study is included.

2.2 Vitamin A

Vitamin A belongs to structurally related compounds called retinoids (preformed vitamin A) from animal food sources and carotenoids (pro-vitamin A) normally found in vegetables and fruits (Olson, 1991). Vitamin A is an essential micronutrient for the functioning of the visual process, cellular differentiation, growth and development, immune response, reproduction and bone morphology. It is also important for the protection of the integrity of epithelial cells lining the skin, the surface of the eyes, mucosal lining of the mouth, alimentary canal and respiratory tract (Basu & Dickerson, 1996; Olson, 1991; Mclaren & Frigg, 2001; WHO/FAO, 2004). A diet adequate in vitamin A rich foods is essential to prevent deficiency, yet most diets are poor in vitamin A rich foods.

2.3 Vitamin A deficiency.

Vitamin A deficiency (VAD) is a major cause of preventable severe visual impairment and blindness in children. Impact of VAD begins before it induces blindness: sub-clinically deficient children are three times more at risk of illness and four to twelve times more at risk of death than well-nourished children (Ngare, Muttunga & Njonge, 2000; WHO/FAO, 2004). VAD also causes high severity to infections (Basu & Dickerson, 1996). The most vulnerable population for VAD are preschool children and women of childbearing age in developing countries (FAO, 2001; WHO/FAO, 2004).

Prevalence of VAD is on the increase, it is therefore imperative that there be sustainable and feasible methods of prevention.

2.3.1 Prevalence of vitamin A deficiency globally and in Africa.

Globally, Europe, United States of America and most of the developed world have little evidence of VAD. However, in developing countries, it is a major problem with evidence of sub clinical deficiency of vitamin A evident in parts of Asia and South America and clinical deficiency seen in the African region and India (Mclaren & Frigg, 2001). An estimated 251 million children of preschool age are at risk of VAD globally and 2.8 million are clinically deficient (FAO, 1997).

A more recent report shows that 140 million preschoolers and 7 million pregnant women globally suffer from VAD every year. At least 1.2 to 3 million children and a significant number of women die unnecessarily due to VAD. Another 44 million children and 6.2 million women suffer from xerophthalmia (West, 2002). In specific regions of the world, the vitamin A situation for children under five years of age is as follows; In the Eastern Mediterranean 21.2% of children have VAD and 0.85% have xerophthalmia. In South East Asia 33% of children have VAD and 1.2% have xerophthalmia. In the Western Pacific, about 14% of the children have VAD and 0.18% have xerophthalmia. In the America's 17.3% of children, have VAD and 0.16% xerophthalmia (SCN, 2004).

In Africa, 52 million children are at risk of VAD, and an estimated 1.04 million of these have clinical signs of deficiency. Every year 250,000 – 500,000 children lose their sight because of VAD. Two thirds of these children are likely to die within a few months of going blind (FAO, 1997). Many more children are at risk in terms of survival (ten to twenty times more) as VAD impairs resistance to infections. A new report shows that 32.1% of children under five years of age in Africa are Vitamin A deficient, 1.53 % have xerophthalmia and 4.4% of women have night blindness (SCN, 2004).

2.3.2 Prevalence of vitamin A deficiency in Kenya.

Vitamin A deficiency is of public health importance in Kenya. Areas identified as having high prevalence included Kwale, Mombasa, Kitui, Baringo, Kisumu, Kisii, Bungoma, Garissa and Mandera (MOH/UNICEF, 1999). It noted to be most prevalent in arid and semi-arid areas. In Baringo 20% of the population has severe VAD (MOH/UNICEF, 1999). Children less than five years of age and women are the most affected. Men reportedly have moderate prevalence of 27% compared to 61% of women

(MOH/UNICEF, 1999). Among children under five years of age, 40.6% were reported to have VAD and 2% had xerophthalmia. Furthermore, 2.2% women had night blindness (SCN, 2004). This is despite the fact that interventions such as supplementation are already in place. Therefore, to reduce the problem of VAD, more sustainable interventions are needed.

2.4 Factors influencing vitamin A status.

Factors that influence vitamin A status includes: bioavailability, VAD itself and underlying disease conditions. According to ACC/SCN (1994) and Waudo, Tuitoek, Msuya & Kikafunda (2005) the immediate cause of VAD is low intake of vitamin A and dietary fat. The amount of dietary fat required to ensure carotenoid absorption is as low as 3-5 g per meal (Britton & Lietz, 1999). Presence of fat stimulates absorption of carotenoids and vitamin A (Olson, 1991; WHO/FAO, 2004). Other physiochemical characteristics that can reduce carotenoid bioavailability are un-absorbable fat-soluble compounds and interaction among carotenoids (Van Het Hof, West, Westrate & Hautvast, 2000). Consumption of a low fat or high fat meal enriched with vitamin E, α-carotene and ß-carotene, or lutein esters enhanced the plasma concentrations of these antioxidants (Roodenburg, Leenen, Van Het Hof, Westrate & Tijburg, 2000). It was therefore important to find out in this study the amount of fat used in preparing foods rich in vitamin A.

Underlying disease conditions such as chronic diarrhoea and severe protein malnutrition reduces absorption of vitamin A. The situation is worse in sick children under the age of five. Children with severe protein energy malnutrition (PEM), measles and persistent diarrhoea are most affected (McLaren & Frigg, 2001). This may be explained by metabolic unavailability due to low vitamin A carrier proteins as shown in diabetes and PEM (Tuitoek, Ritter, Smith & Basu, 1996). Allen and Gillespie (2001) also found that severe PEM causes impaired retinol binding protein synthesis, and zinc and iron deficiency interfere with the utilisation and storage of vitamin A. Acute PEM directly affects vitamin A metabolism by reducing carotenoid di-oxygenase and decreases the retinol binding protein (Olson, 1991).

Vitamin A deficiency in itself exacerbates susceptibility to infection and adequate vitamin A reduces risk of respiratory and gastrointestinal infections (WHO/FAO, 2004). Vitamin A deficient children were more likely than non-vitamin A deficient children to

exhibit respiratory symptoms and visible BCG vaccine scars (Jason *et al.*, 2002). In contrast, trials was done to investigate the effect of vitamin A supplementation on the incidence and severity of respiratory infections in low birth weight show that vitamin A supplementation was neither associated with improvement in neonatal or post-neonatal respiratory problems nor reduction in incidence or severity of respiratory infections (Coutsoudis, Adhikari, Pillay, Kuhn & Coovadia, 2000). In children deficient of vitamin A, supplementation alone significantly increases blood iron levels (Olson, 1991).

Presence of parasites influences plasma retinol values and overall vitamin A status (Olson, 1991). Systemic and parasitic infections reduce carotenoids absorption. Significant increases in mean serum beta-carotene concentrations was seen in Bangladeshi children treated for *Ascaris lumbricoides*, after consumption of dark green leafy vegetables and sweet pumpkin (Persson, Ahmed, Gebre & Greiner, 2001). *Ascaris lumbricoides* lowers serum retinol levels (Allen & Gillespie, 2001) and causes impaired absorption of vitamin A (Olson, 1991). Hookworm and liver fluke lower plasma retinol levels by a quarter. Intestinal schistonomiasis and malaria parasitemia lower serum retinol levels in children and exacerbate VAD in rats (Olson, 1991). Several studies have shown correlation between presence of parasites and low serum retinol it is therefore controlling parasites is important in fight against VAD.

Younger children are more sensitive to deficiency of vitamin A, probably because new borns, have low stores of vitamin A (Olson, 1991). Low maternal stores may cause this (Olson, 1991; Vinutha, Mehta & Shanbag, 2000). Thus, vitamin A supplementation to post partum women has been found to have a positive impact on breast milk retinol and serum vitamin A of infant (Ross & Harvey, 2003; Vinutha *et al.*, 2000, Ettyang *et al.*, 2004). This led to the introduction of the policy of supplemental vitamin A to post partum mothers in developing countries including Kenya (MOH, 2004). A teaching hospital in India conducted a prospective random single blind controlled study on pregnant women. Postpartum vitamin A supplementation had a beneficial impact on the infant serum retinol and the breast milk retinol level; however, it had no effect on infant growth (Vinutha *et al.*, 2000). Nevertheless, in New Delhi, early postpartum maternal vitamin A supplementation had no impact on serum retinol levels and growth of their infant (Bhaskaram, Balakrishna, Nair & Sivakumar, 2000). Early cessation of breastfeeding is another factor; a study done in Thailand among lactating women showed that the mean serum retinol and breast-milk retinol were highest during the first 3 months of lactation.

A significant increase in serum and breast-milk retinol values was seen in women who breastfed for 6 months or longer. Breast-milk retinol levels declined significantly from 4 to 12 months after delivery (Panpanich, Vitsupakorn, Harper & Brabin, 2002). Breast milk is an important source of vitamin A to growing infants.

VAD is prevalent among children under six years of age because of high requirement to support rapid growth in children especially during the first two years of life (Olson, 1991; ACC/SCN, 1994; WHO/FAO, 2004). The transition from breastfeeding to complementary foods makes children less than six years of age vulnerable, hence the increased need for vitamin A (WHO/FAO, 2004). Consequently, it is not surprising to find that blindness due to VAD is almost exclusively limited to children aged between six months to six years of age (Olson, 1991). Mother's duration and frequency of breastfeeding is an important factor in prevention of VAD in infants, thus breastfeeding patterns and adequacy of the mother's diet was a critical factor in this and related studies.

Dietary preformed vitamin A (retinol) from animal sources is absorbed efficiently in the intestinal tract. It is not affected by its food source or amount ingested because substantial amounts are absorbed even during gastrointestinal infections (WHO/FAO, 2004). When the amount of pro vitamin A ingested is small, most of it is converted to vitamin A in the intestine. However, with larger amount ingested, the absorbed carotenoid is found in the plasma and in tissues unchanged (Olson, 1999). Frequency of consumption of such animal and plant sources of vitamin A did help to determine the adequacy of vitamin A in diet.

Some Pancreatic enzymes in the intestinal lumen such as lipo-oxygenase enzymes can be particularly damaging. Carotene is a co–substrate of lipid peroxidation by lipo-oxygenases and is almost instantaneously bleached due to oxidative destruction (Britton & Lietz, 1999). Enzymatic activity also depends on level of protein in diet (Scott & Amaya, 1996) with high protein in diet resulting in increased activity of intestinal mucosal carotene deoxygenase (Bender, 1995). Carotene deoxygenase is the enzyme needed to break down carotene to retinol; its activity is relatively low. Principal site for attack by the enzyme carotene deoxygenase is 15`15`, evidence exists of asymmetric cleavage at 8`,10`,12` resulting to production of apocarotenals which when oxidised cannot be reduced to retinol (Bender, 1995). Intestinal beta-carotene cleavage activity is shown to be higher in vitamin A deficient rats than in rats with a high intake of either

vitamin A or beta-carotene (Van Vliet, Van Vlissingen, Van Schaik & Van den berg, 1996). VAD enhances absorption while protein deficiency reduces the conversion of beta - carotene to vitamin A. Nutrient interactions also affect vitamin A status, vitamin E protects vitamin A from oxidation (Olson, 1991) while presence of dietary fibre may be partly responsible for low bioavailability of carotenoids from food. The bioavailability of beta-carotene, lycopene and lutein given within a mixed supplement is reduced markedly by different kinds of dietary fibre (Riedl, Linseisen, Hoffmann & Wolfram, 1999).

Underlying causes of VAD include low production of vitamin A rich foods, poor health infrastructure, poor storage, marketing, distribution and preservation of vitamin A rich foods and intra household food maldistribution (ACC/SCN, 1994). Most vitamin A rich foods especially from animal sources may be neither available nor accessible to people from lower socio economic classes. According to King and Burgess (1995) areas of high risk of VAD include arid and semi-arid areas. They often have difficulty in getting vitamin A rich foods. It is for this reason that Marigat, being a semi-arid area and having a high prevalence of VAD was chosen for the study. Basic causes of VAD include poverty, poor economic or physical access to the market place, environmental considerations and cultural barriers (ACC/SCN, 1994). Seasonality influences availability of fresh fruits and vegetables, therefore during lean times such as prolonged drought there is high risk of VAD (ACC/SCN, 1994; King & Burgess, 1995; WHO/FAO, 2004). Yatoi Sub-location is characterised by erratic rainfall while, Perkerra Sub-location is supported by irrigation. The two were selected, as they are representative of Marigat division.

2.5 Food sources of vitamin A

The best sources of vitamin A are animal-based and include liver, egg yolk, and whole milk and its products, such as butter and cheese. Fowl, including chicken, guinea fowl and duck, is a significant source of vitamin A in Africa. Organ meats and flesh of goat, sheep, camel, and cow also contribute to preformed vitamin A in African diets (Codjia, 2001). Food sources of pro-vitamin A are numerous in Africa. Plant foods, for example, dark-green leafy vegetables, orange-yellow sweet potatoes, carrots, squash, pumpkin and red palm oil, contain substantial pro-vitamin A activity (Codjia, 2001). Traditional green leafy vegetables such as amaranthus and black nightshade also contribute significantly to vitamin A (Sehmi,1993). Mango, papaya, tomato, passion fruit, loquat, orange and watermelon have pro-vitamin A and can be found in Africa (Sehmi,

1993). Pro-vitamin A foods sources are cheap and readily available to the poor who are most affected by VAD. Availability and accessibility of vitamin A rich foods was determined in this study.

2.6 Strategies developed to alleviate vitamin A deficiency.

Several strategies have been developed to control vitamin A deficiency. These include supplementation, public health measures and food based interventions.

2.6.1 Supplementation of vitamin A.

Supplementation was introduced in Kenya by the MOH in collaboration with the United Nations Children's Fund (UNICEF) as a short-term measure of controlling VAD. Vitamin A capsules are supplied in 200,000 IU for lactating mothers within four weeks post partum (MOH, 2004). Children are supplied with 100,000 IU and 200,000 IU to children 6-11 months and 12-59 months respectively. This is done once for mothers and children 6-11 months and every six months for children 12-59 months. Additionally, some diseases are targeted during supplementation. Such would include measles, chicken pox, severe PEM, acute persistent diarrhoeas lasting more than 14 days, tuberculosis and HIV/AIDS. Others include acute lower respiratory tract infections, malaria, anaemia, schistonimiasis and heavy worm infestation. All children admitted to wards are also targeted. For children suffering from these diseases 100,000 IU is given for those 6-11 months and 200,000 IU for those 12-59 months. These capsules are given at time of first contact with health unit with each episode of illness (MOH, 2004).

There is an increasing recognition that many of these vitamin A supplementation programmes do not maintain adequate coverage for children most in need. It has been established that they are rarely sustainable without outside financial support (FNB, 2000). It hence follows that there is need to promote Food Based Strategies in order to reduce reliance on supplementation.

2.6.2 Public health measures.

This involves collaborative approaches in primary health care. Such approaches include environmental sanitation, routine immunization and school health programmes that comprise de-worming and supplementation. It also includes improving community knowledge and skill sets in management of minor ailments as well as prompt referral of complicated childhood diseases (MOH, 2004).

Table 2.1: Vitamin A content in main animal and plant sources.

Animal Sources	Vit A (µg RE/100 g edible portion)*	Vit A (µg RE/100 g edible portion) †
Fresh whole milk (goat, cow, sheep, camel)	25-95	25-27
Eggs	90.5	
Dairy butter (cow)	130	1000
Cheese	297	30
Cow liver	810	2673
Goat liver	7,490	
Chicken liver	8,235	
Beef kidney	800	
Cow's milk	30-40	27
Chicken's egg	260	
Cod fish	8-12	
Breast milk, human	35-50	137
Plant Sources	Approximate Amount. Range RE/100g *	Carotene (RE/100 g edible portion)†
Spinach	450	580
Amaranth	1000	2300
Kale	1000	900
Coriander leaf	900	
Pumpkin leaf	166	
Drumstick; tree leaf	3300	
Pumpkin	200	1200
Cabbage		1000
Black Nightshade(Managu)		50
Pumpkin leaves		3600
Cassava	1-6	
White potato	3	
Sweet potato, yellow	50-700	
Carrots	600-3500	10,500
Yellow maize	20-60	
Millet	4	
Papaya	50-400	666
Mango	100-400	400
Banana	10-100	390
Avocado		400
Loquat		559
Orange		730
Guavas		145
Water Melon		126
Seed oils, various	2- 100	
Red palm oil	2.000-24,000	25,000
Fish oil, various	40,000-300,000	140,000
Margarine(fortified)	680	
Hydrogenated oil(Fortified)	2500	

Source (* INFDC, 1997a; †Sehmi, 1993)

2.7 Food Based Strategies.

The magnitude or impact of curbing VAD is insignificant despite efforts put into formulating tablets, capsules and injection over the past decades. Although this approach has been effective in many countries, its original conceptualization was as an interim measure to be replaced over time by improved diets (FNB, 2000). For sustainable control and prevention of VAD short term supplementation should be replaced by diet-based strategies (Delisle *et al.*, 2003).

Large amounts of funds have been expended on vitamin A food fortification. However, the full implementation of food diversification approaches lags behind (Delisle *et al.*, 2003). Green and yellow vegetables and fruits with pro-vitamin A activity are found in all developing countries according to FNB (2000) and they are affordable by the poor (Delisle *et al.*, 2003). Research shows efficacy of interventions that improve production, supply and consumption of vitamin A rich foods (Delisle *et al.*, 2003). Improved dietary intake, even when most vitamin A activity comes from pro-vitamin A carotenoids can help alleviate VAD. Further improvements can be seen with increased production of vitamin A rich food products, improved nutrition education and continued monitoring of vitamin A status (Underwood, 2000; Vuong, 2000).

Food Based Strategies are described as sustainable because they empower individuals and households to take responsibility over diet in terms of quality by producing and consuming nutrient rich foods (Oluoch & Chadha, 2003). It is an advantage because it addresses multiple nutrients simultaneously. Existence of ongoing interventions even when short term, in practice can often detract governments or individuals from considering other longer-term approaches needed for sustainability (ACC/SCN, 1994).

While more than 80% of dietary intake of vitamin A in Africa comes from plant foods. Animal foods are the best sources of vitamin A, about 90% of ingested preformed vitamin A is absorbed (WHO/FAO, 2004). In many cases however, vegetables and fruits are often the only reliable and available source of micronutrients in the family diet for poor households (Talukder, Kiess, Saskia de Pee, Darton-Hill & Bloem, 2000). The consumption of plant foods for their vitamin A activity has many advantages not only are they accessible to low-income groups but also more adaptable to local food habits (Codjia, 2001). The existence of commonly consumed fish in Bangladesh having very high vitamin A content offers a great-unexploited potential for food-based strategies

(Roos, Leth, Jakobsen & Thilsted 2002). Compared to supplementation, little emphasis has been placed on Food Based Strategies in Kenya. Given its potential benefits, it was important for the researcher to determine its workability, especially in the VAD prevalent Division of Marigat.

2.7.1 Food fortification.

Fortification of a widely consumed food "vehicle" with vitamin A offers a second major intervention strategy after supplementation. It can be relatively inexpensive and effective in increasing vitamin A intake throughout the year, reflected by sustained elevations in serum vitamin (SCN, 1987). A number of necessary preconditions must exist before fortification can be considered a viable intervention. These include identifying a food vehicle which is consumed in adequate amounts by the "at risk" population, is technically fortifiable, is manufactured or processed in only a few locations, and retains its potency and acceptability after being fortified. Further, the range of intake should be relatively narrow to minimize the risk of vitamin A toxicity. Fortification can offer both a medium and long-term solution for improving vitamin A nutritional status in a chronically deficient population.

An experiment was carried out to develop a stable, efficacious, salt fortified with iodine, iron and vitamin A. Potassium iodate, micronized ferric sulphate and retinyl palminate was packaged into microcapsules and added to salt making it triple fortified salt (TFS). Effectiveness of TFS was compared to iodized salt in a 10 month double blind trial of goitruos, vitamin A and iron deficient school children in Morocco. TFS was found to be highly stable and effective in reducing iron, iodine and VAD in school children (Zimmermann *et al.,* 2004). A study was conducted to document changes in vitamin A status of a cohort of children, during first year after initiation of Nicaraguan national program of fortification of sugar with vitamin A. Children 5 – 9 years were measured for total body stores of vitamin A and liver concentration of vitamin A. Vitamin A status was seen to have improved during the year after initial distribution of vitamin A fortified sugar (Ribaya – Mercado *et al.*, 2004).

A randomised, double blind, control trial was carried out among children in India. The objective was to determine the efficacy of a premix fortified with iron and vitamin A and added to a mixture of rice and dal, in increasing iron and vitamin A stores and reducing prevalence of VAD and iron deficiency. The premix was found to be effective

in both (Varma *et al.,* 2007). Food fortification has been seen to be effective for school children or other individuals fed from an organised food distribution system. In South Africa, a biscuit fortification programme included about half of RDA of vitamin A and the biscuits given to children in schools. It proved successful in ensuring sufficient daily vitamin A intake that might not be met under regular food intake. VAD prevalence dropped from 45% to 20% of the children over the period of a school year (IVACG, 2003). In Kenya, foods fortified with vitamin A are mainly fats and margarines. According to Sehmi (1993), they provide substantial amount of pre formed vitamin A, however majority of the population cannot afford these foods. It was important in this study to find out which of these fortified foods are available and accessible to mothers with children under the age of five in Marigat Division.

2.7.2 Home gardens.

Home gardens in Africa are an established tradition, apart from being an important source of household food supplies, they also supplement food needs during the lean seasons and in some instances is a source of income (FAO, 2001). Solutions to micronutrient deficiencies focusing on locally available resources and foodstuffs offer long-term solutions for elevating the health status of disadvantaged people (Talukder *et al.*, 2000).

Regular monitoring data obtained in 1997 and 1998 from a Bangladeshi home gardening programme showed increased production and consumption of fruits and vegetables in areas where home gardens were established. Children in households with developed gardens were compared with children in households without a home garden. Results showed that children with established home gardens consumed vitamin A rich foods, such as green leafy vegetables and orange-yellow fruits, more frequently than children in households without a garden (Talukder *et al.*, 2000).

A home gardening programme was integrated into a community based growth-monitoring programme. Cross-sectional data was collected at baseline and 20 months after implementation. Dietary intakes, serum retinol concentrations, growth of 2-5 year old children and maternal knowledge regarding vitamin A was determined. Production of yellow and dark-green leafy vegetables in home gardens showed increased serum retinol concentrations of children. (Faber & Benade, 2000). Bloem *et al.* (1996) had similar results in their study, in which baseline census of a community monitoring system was

analysed. The study's objective was to track progress and measure impact of home gardening activities. Results showed that home gardens made valuable contribution to vitamin A among women in rural Bangladesh, diversity of diets was widest in families with households producing a variety of fruits and vegetables. By examining availability of vitamin A rich foods in home gardens and its accessibility and use in Marigat, the researcher was able to predict potential success of Food Based Strategies.

2.7.3 Consumption of vitamin A rich foods.

Consumption of foods rich in vitamin A is a sure way of preventing vitamin A deficiency, even if they are from plant sources. Breastfeeding is the main source of vitamin A for infants, and it has been shown that clinical symptoms of VAD are rare in an infant. However, poor maternal vitamin A status and subsequent low breast milk content or early cessation of breastfeeding are risk factors for early onset of VAD (Allen & Gillespie, 2001). A study investigating the effect of papaya and carrots on the vitamin A status of lactating women with two to twelve month old infants in Zimbabwe concluded that pureed papaya and grated carrots could improve the vitamin A status of lactating women (Ncube, Greiner, Malaba & Gerbre, 2001).

An experiment was conducted to do a comparison of changes in plasma concentration of alpha, beta carotene and synthetic beta carotene following consumption of palm oil carotenoids in humans. This study concluded that supplementation of both palm oil carotenoids and synthetic beta carotene improves beta carotene status substantially (Karin,Van, Wiersma, Tijbury & Westrate, 1999). A study done in Tanzania analysed green leafy vegetable to determine the total content of beta-carotene and their bioavailability with an in vitro method. Vegetable dishes were fed to children (1-12 years old) and adults. The study revealed that it is possible to cover the basal requirements for vitamin A with an optimal green leafy vegetables diet when the vegetables dish is served twice per day and supplemented with dietary fat (Hulthe, 2000). A trial was done to test the effectiveness of mango supplementation among Gambian children aged 2 to 7 years. Supplementation of carotene-rich mango, with and without fat proved to be effective and a sustainable approach in preventing VAD (Drammeh *et al.*, 2002).

Kasturiba, Naik, Sathyanarayana & Reddy (2002) drew similar results in a study conducted in rural schoolchildren in Karnataka, India, who had low serum retinol levels. Significant improvement was seen in serum retinol level after supplementation of

carotenoid rich foods. In another study, the effect of a biscuit with red palm oil as a source of beta-carotene was compared with the effect of a biscuit with beta-carotene from a synthetic source on the vitamin A status of primary school children in South Africa during a randomised controlled trial. Mean serum retinol increased significantly compared to baseline survey, with the red palm oil incorporated in a biscuit being accepted by the schoolchildren (Stuijvenberg *et al.*, 2000). An experiment was conducted to assess the impact of feeding of dietary palm oil supplements on plasma vitamin A profile in four-week-old Wistar albino rats. Concentrations of plasma beta-carotene and vitamin A was high in rats fed red palm oil based diets than in rats fed refined palm olein and control diets. The results indicate consumption of palm oil in moderate amounts enhances growth of tissues and bioavailability of beta-carotene (Edem, Eka & Umoh, 2002).

A double blind, cluster randomized, placebo-controlled study assessed of the impact of mortality related to pregnancy. Women of reproductive age were supplemented each week with a recommended dietary allowance of vitamin A. Results showed that the risk of death related to pregnancy was lowered by about 40% among women routinely given supplements of vitamin A or beta-carotene (West *et al.*, 1999). A study was conducted to determine whether the consumption of leafy vegetables by preschool children would enhance their vitamin A concentrations to acceptable levels. Serum retinol levels were significantly enhanced when consumption of leafy vegetables was supplemented with fat (Takyi, 1999).

The *Marmodica Cochinchinensis* (gac) is an indigenous Vietnamese fruit that has high ß-carotene content. It is mixed with rice in a preparation called the *xoi gac.* A study assessed this carotene rich rice mixture as a source of vitamin A for children. The supplementation trial with *xoi gac* for 30 days showed a significant increase in plasma ß-carotene concentrations in children. This indicates that *gac* fruit should be considered as part of a sustainable, food-based strategy for reducing the incidence of VAD in Vietnam (Voung, Dueker & Murphy, 2002). Vitamin A status was evaluated among a cohort of preschool children in rural Egypt. Children from high socio-economic class had significantly higher mean vitamin A intake compared with the respective mean intake obtained with poor children. Serum vitamin A concentrations correlated significantly with the respective vitamin A intakes (El Arab, Khalil & Hussein, 2002). While examining the effects of an income generating policy and preschooler macro and micro

nutrient consumption, a study found that though increased income resulted in improved vitamin A consumption at household level it was not significantly associated with dietary intake by preschoolers. There is need for other interventions to ensure consumption at individual level within the households (Kennedy & Oniango, 1993).

Orange fleshed sweet potato is a cheap source of vitamin A. In addition to other health enhancing features, has led to promotion of its consumption and use. A 100g portion of the sweet potato, depending on the variety can provide enough beta carotene to produce from zero to 100% of suggested daily vitamin A requirements, which is at 350 micrograms per day (Vita Project, 2004). In a study, promoting orange fleshed sweet potato in household diets through nutrition education showed improved vitamin A status particularly for pregnant women and mothers of children under ages of 5 years (Mukherjee, Ilangantileke & Ames, 2002). A trial was conducted to determine the efficacy of daily consumption of boiled and mashed Orange Fleshed Sweet Potato (OFSP). Children 5-10 years were divided into two groups, treatment group (OFSP) and control group (white sweet potato). Consumption of OFSP was seen to improve vitamin A status, it can play a role in developing countries as a viable long term Food Based Strategy (Jaarsveld *et al.,* 2005).

In Siaya Kenya, the Kenya Agricultural Research Institute established a garden and planted high beta carotene rich sweet potato and its initial research showed it was acceptable to men, women and children (Oyunga, Nga'nga & Oudia, 2001). Availability and accessibility of vitamin A rich food does not always translate to consumption. Consumption of vitamin A rich foods can significantly improve vitamin A status. Consumption patterns and adequacy of diets of mothers and their children under the age of five in Marigat was an important predictor of success of Food Based Strategies.

2013/97208

2.8 Preparation, processing and preservation of vitamin A rich foods.

New research now shows that bio-availability of carotenoids from fruit and vegetables may be lower than earlier thought (WHO/FAO, 2004). Carotenoids and retinol are affected by pH, enzymatic activity, light, and oxidation associated with the conjugated double bond system (INFDC, 1997b). The preformed and pro-vitamin A content of the raw form of a food item may be reduced because of food preparation. This is because fresh plant tissue does contain enzymes that are activated during and following processing. The most dramatic example of this has been found in red palm oil, which in

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its raw form is considered one of the richest sources of pro-vitamin A (INFDC, 1997b). Foods boiled in an open container have been shown to have the greatest losses. Dehydration significantly reduces the carotene content in vegetables, which has implications for storage of seasonally available foods (Renquist, DeVreeze & Evehuis, 1978; Park, 1987).

Khachik *et al.* (1992) however had different results. Their study controlled for complete extraction of carotenoids in raw samples their results indicated no significant changes in the β-carotene content in several green vegetables, after microwaving, steaming, or boiling. Likewise, the carotenoid content of tomatoes did not change when they were dehydrated. Traditional processing methods, including preservation, induce formation of the cis-isomer of carotenoids from the all-trans form (O'Neil & Schwartz, 1992). With increased temperature, the presence of light and catalysts such as acid, isomerization from the trans form to the cis form of carotenoids increases (Chandler & Schwartz, 1988). While processing and cooking of vegetables causes trans and cis to isomerise, the cis isomer has lower vitamin A activity. Studies have also suggested that absorption of carotenoids from raw vegetables is less than 10% but increases to about 50% when cooked (Scott & Amaya, 1996). Fermentation with moulds and bacteria of pro-vitamin A rich foods such as sweet potatoes seems to increase the amount of beta-carotene converted to vitamin A. Further, the amount of free fatty acids seems to increase which is necessary for the absorption and metabolism of vitamin A (Kiplamai, Tuitoek & Ethangatta, 2008).

A study was done to evaluate β-carotene in foods, the serum β-carotene response to single ingestion of various sources of β-carotene in 10 healthy men. The relative bioavailability of beta-carotene from stir-fried and deep-fried vegetables was about one-third to one-fourth that of the purified beta-carotene beadlets (Huang *et al.*, 2000). Losses of up to 40% in fish sources rich in vitamin A have been reported following boiling (Burt, 1988). In a study on the traditional food system of the Sahtú Dene/Métis, there were no consistent trends in retinol levels between raw and cooked forms of various food samples probably due to biological variation. Smoking fish and mammal meat did not appear to reduce retinol levels (Morrison & Kuhnlein, 1993). An individual may consume vitamin A rich foods in adequate amounts, however the food preparation, processing and preservation processes also determine bioavailability of the nutrient. This is especially true for plant sources of Vitamin A.

2.9 Knowledge, attitudes and practices on vitamin A.

Food habits and taboos often restrict consumption of potentially good sources of vitamin A. Knowledge, attitudes and practices on vitamin A, causes of VAD and food sources of vitamin A can significantly affect vitamin A intake. An evaluation carried out to determine whether positive changes indicated by a social marketing campaign project were sustained. The results showed cumulative improvement in knowledge, attitudes, and practice with respect to intake of vitamin A and fat (Smitasiri *et al.*, 1999). A sustained improvement in the consumption of vitamin A rich foods and fat towards fulfilment of the recommended dietary allowance was clearly demonstrated among pre-school children. Improvement in serum retinol levels among schoolgirls was shown in the intervention group, while no significant change was observed in the control group (Smitasiri *et al.*, 1999). A home gardening program was integrated with community-based growth monitoring system. An experimental village with established home gardens was compared with a control village. Increased intake of dietary vitamin A intake was evident in experimental the village. This improved both maternal knowledge about vitamin A and vitamin A status (Faber, Phungula, Venter, Dhansay & Benade, 2002). In a study to determine the vitamin A status and nutritional intake of carotenoids in Nigerian children, the highest prevalence of serum retinol deficiency was in the 6-12 months age group, most of who were breastfeeding, even though they had a high consumption of carotenoid-containing food. VAD was attributed to the low consumption of locally available sources of pro-vitamin A and pre-formed vitamin A rich foods, and overcooking (Oso, Abiodun, Omotade & Oyewole, 2003). This was probably due to lack of knowledge or bad attitudes and practices towards vitamin A rich foods.

During an evaluation of the long-term effects of a horticultural and nutrition education intervention in rural Tanzania, intake of retinol-rich foods by children was recorded, stools examined for helminths and serum samples analysed for retinol. Results showed that knowledge and practices were more favourable to increasing retinol intake (Kidala, Greiner and Gebre, 2000). An increased frequency of intake of green leaves was associated with higher serum retinol values. Children with helminths had a lower mean serum retinol level than those without. The study concluded that food-based retinol programmes can make sustainable improvements in knowledge and dietary practices but these may not necessarily be reflected in increases in serum retinol (Kidala *et al.*, 2000).

Poor knowledge, attitudes and practices may affect the choice of food consumed. Consequently, in this study it was important to examine these parameters with regard to vitamin A.

2.10 The conceptual framework

UNICEF (Bloem, Pee & Darnton-Hill, 1998) developed a conceptual framework showing the causes of VAD. The original model shows factors contributing to VAD such as infection, protein-energy malnutrition and the increased requirements for vitamin A at certain stages in the life cycle (early childhood, pregnancy, and lactation). Coexisting health status affects vitamin A status both by affecting the metabolic processes and by reducing intake. It brings into focus the leading cause of VAD in the developing world, insufficient intake of vitamin A and poor bioavailability of pro-vitamin A sources.

On this basis, the study determined factors affecting use of Food Based Strategies. As figure 2.1 illustrates, homestead food production can lead to increased income that ensures availability and accessibility of vitamin A rich food. Consumption patterns are determined by availability and accessibility of vitamin A rich foods as well as food processing and preservation methods. Knowledge, attitudes and practices (KAP) on vitamin A determine choice of food consumed; its preparation processing and preservation of food as well as how diseases associated with VAD are managed. Furthermore, bioavailability is predicted on the same set of parameters, including the presence of disease associated with VAD. All these factors determine the risk of VAD.

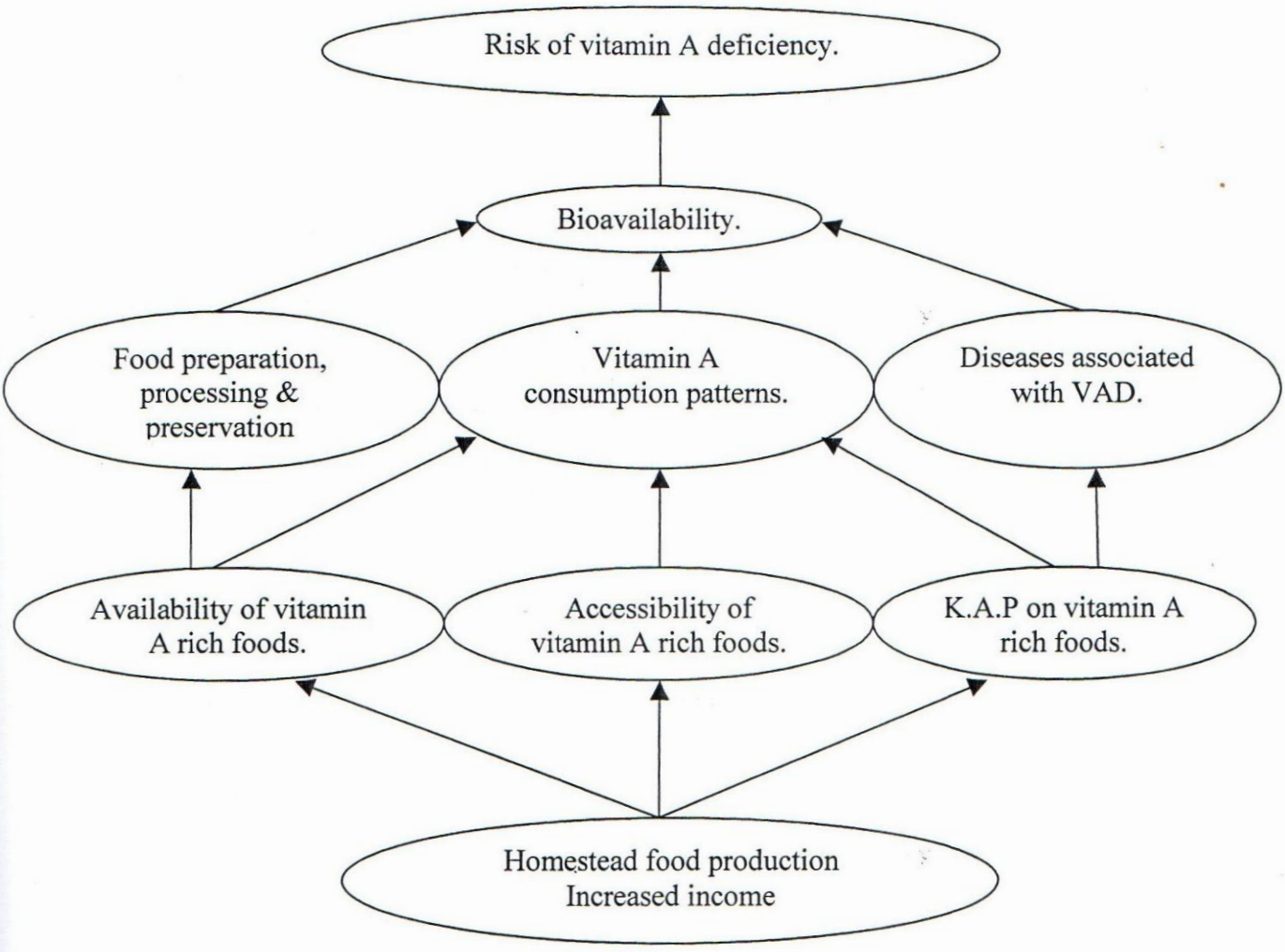


Figure 2.1: Conceptual framework

The independent variables for the study are availability and accessibility of vitamin A rich foods. More independent variables are shown in Figure 2.2. The dependent variable is the risk of vitamin A deficiency, which was determined using Helen Keller International threshold values. Extraneous variables for this study were underlying malnutrition and poor health services.

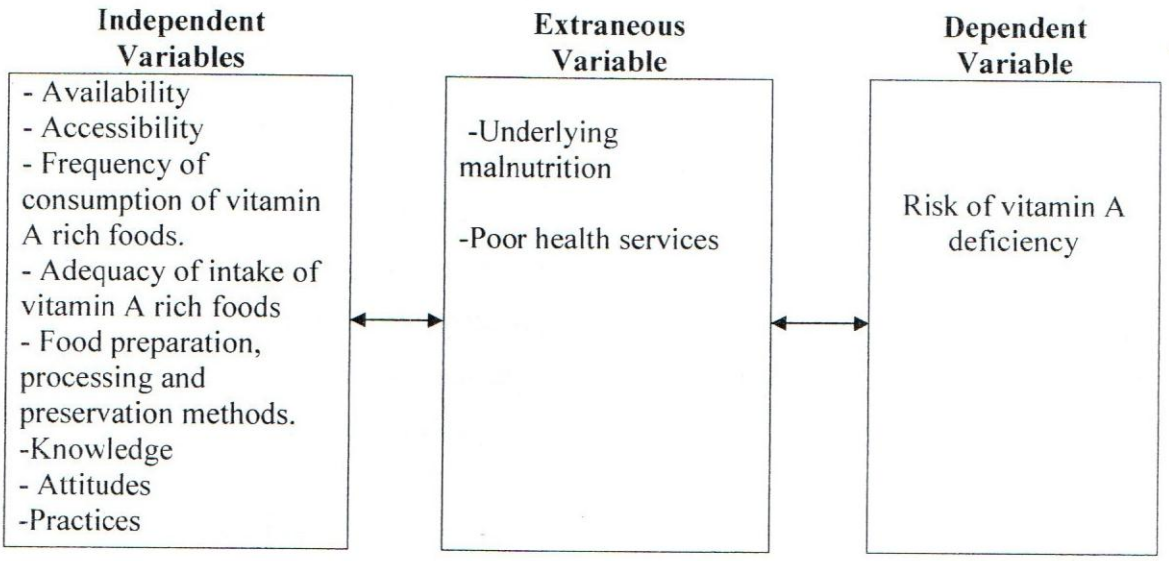


Figure 2.2: Variables of the study.

CHAPTER THREE
RESEARCH METHODOLOGY.

3.1 Introduction

The purpose of this study was to investigate the factors that determine the use of Food Based Strategies in preventing and controlling VAD in Marigat Division of Baringo District. This chapter examines the procedures for the research process. This includes the research design, location of study area, population, description of sampling and sampling procedures and the instrumentation. It also explains how reliability and validity was determined and processes of data analysis. A description of the Helen Keller Food Frequency Questionnaire method is given.

3.2 Research design

A cross-sectional survey was used for this study. This research design was suitable because the researcher covered a large area and the data was collected at one point in time. This research design has also been used in other research of similar nature (Faber & Benade, 2000; Ngare *et al.*, 2000).

3.3 Location of study area

The 1999 National Micronutrient Survey (MOH/UNICEF, 1999) identified Baringo District as having a high risk of vitamin A deficiency. Marigat Division is within Baringo District and is located in the northern part of the Rift Valley. Baringo covers an area of 641 km^2, with 9 locations and 18 Sub-locations (Appendix VI). Average annual rainfall is 1200 mm/year and average annual temperature is 25°C (Republic of Kenya, 2002). Marigat Division lies in the lower agro-ecological zones classified as semi-arid. Most parts of the Division are covered with acacia, cactus, woods and shrubs with pronounced soil erosion (Republic of Kenya, 2003). The researcher examined two sub locations, Yatoi and Perkerra. Yatoi sub-location is characterised by drained soils that are not favourable for farming. The main economic activity is livestock farming (zebu cows, goats and poultry), and a very low level of subsistence crop farming. On the other hand, Perkerra has an irrigation scheme and its main economic activity is crop farming (Republic of Kenya, 2003). The two representative locations provide clearer picture on

the effect of water on availability, accessibility and eventual utilisation of vitamin A rich foods.

3.4 Population.

Marigat Division has a population of about 29,923 in 6,356 households with a population density of about 56 persons per km^2. Yatoi Sub-location has a population of about 2168 persons in 704 households and it covers 21.8 km^2. The population density is 31 persons per km2. Perkerra covers and areas of 21.8 km^2 with a population of about 4931 in 1284 households. It has a population density of 22.6 persons per km^2 (Republic of Kenya, 2001).

3.5 Samples and sampling frame.

The sampling frame, a list of households in Marigat division was availed by the chief. Households with children under the age of five were identified in each of the two sub locations.

3.5.1 Sample size.

The total sample was determined by using the following formula by Fisher *et al.*1998.

$$N = \frac{Z^2pqD}{d^2}$$

Where N=sample size

Z= normal standard deviation corresponding to 95% confidence interval (i.e. 1.96)

P = Proportion of target population estimated to have a particular characteristic, in this case the proportion of population of under fives(15%) (Republic of Kenya, 2001).

d= degree of accuracy desired (0.05)

q= 1-p (1 – 0.15 = 0.85)

D= design effect = 1

$$N = \frac{1.96^2 \times 0.15 \times 0.85 \times 1}{0.05^2}$$

Equals = 196

Sampling Procedure.

Proportionate sampling was carried out to determine percentage of population coming from Yatoi and Perkerra sub-locations.

Proportionate sample.

Total number of households in Yatoi = 704

Total number of households in Perkerra = 1284

Percentage of households with children under five years of age = 15%

15% of 704 =107

15% of 1284 = 193

107 + 193 = 300

$\frac{107}{300}$ X 100 = 35% 35% of 196 = 68

$\frac{193}{300}$ X 100 = 65% 65% of 196 = 128

Systematic random sampling method was used to select the households. A total of 68 mothers from Yatoi and 128 from Perkerra were interviewed, which totalled to 196 households. An additional 10 households were included in order to take care of attrition. Two hundred and six mother-child pairs participated in the study. A sub sample of 30% was drawn from the 206 households to carry out dietary assessment. The sub sample comprised of 64 mothers and 64 children under five years of age with 22 and 42 respondents coming from Yatoi and Perkerra respectively. Other studies have used subsamples in their research such as Ramakrishnan *et al.* (1999).

3.5.2 Inclusion and exclusion criteria.

A major criterion for inclusion in the sample was mothers with children under the age of five. If a mother had more than one child under the age of five, the child who is most likely to suffer from malnutrition was selected. For example if a household had three children under the age of five, the middle child (index) would be included in the study as he/she was most likely to suffer from malnutrition. Children born with shorter birth intervals and those who stopped breastfeeding before the age of 2 years are considered at risk of malnutrition (Roy, 2000). Women of reproductive age and children under the age of five are most vulnerable to vitamin A deficiency. Transition from breastfeeding to complementary feeding places a child at risk of VAD (WHO/FAO, 2004). During the process of data collection, some of the sampled mothers were not present at time of interview. In such cases the neighbouring household, not in the sample,

with children under the age of five would be interviewed. The interviews would then continue as scheduled.

3.6 Instrumentation

Data was collected by use of questionnaires for children under the age of five and their mothers. A pre - test was done in Mogotio Division, which is similar to study area but located in the neighbouring Koibatek District. A checklist was prepared and used to guide the Focus Group Discussions that were held with community leaders. Before the study began, the researcher obtained a permit from the Ministry of Education Science and Technology (MOEST).

3.6.1 Questionnaires

The questionnaires were designed for the study population (for mothers with children under the age of five) (Appendix I). Questionnaires were interviewer administered and interviews were conducted in Kiswahili or in the local language in cases where Kiswahili was not understood. Section A of the questionnaire covered socio-demographic indicators. This enabled the researcher to describe the population. In order to determine availability and accessibility of vitamin A rich foods, section B of the questionnaire addressed food production. Questions on acreage, home gardens and months of food scarcity featured. In describing vitamin A intake, a modified Helen Keller Food Frequency Questionnaire was used (Appendix III). The questionnaire enabled the prediction of the risk of VAD in Marigat Division. Women were asked to recall how often they and their children consumed a particular food in the 7 days preceding the study. Food models for portion size estimates were used to facilitate recall. A 24 Hour Food Recall was also used to determine vitamin A intake. Participants were asked to recall all the foods and beverages consumed 24 hours prior to the study (Appendix II).

Food processing and preservation methods were determined in Section D of the questionnaire (Appendix I). Questions on preparation, processing and preservation methods and precautions taken during those procedures were asked. This helped the researcher predict loss of vitamin A through food preparation, processing and preservation methods. In assessing the community's knowledge, attitudes and practices with regard to vitamin A, section C had questions targeting perception about Vitamin A rich foods, night blindness, malnutrition, symptoms of VAD, breastfeeding and introduction of complementary foods.

3.6.2 The Helen Keller Food Frequency Questionnaire method.

The ability of a Food Frequency Questionnaire to determine relationships between foods and disease have been established by research. The Helen Keller Food Frequency Questionnaire is a tested tool used to determine risk of VAD in a population. To determine whether VAD is a public health problem in an area. Values were determined as follows;

Four days per week for mean frequency of consumption of animal sources of vitamin A or Six days per week for mean frequency of total consumption of animal and plant sources of vitamin A (weighted by source). To calculate weighted by source scores the following equation is used;

$$A + B/6 = \text{Weighted by source scores}$$

Where A is the sum of the number of days per week that animal foods were consumed. B is the sum of number of days per week that vitamin A rich plant food sources were consumed divided by 6. VAD is likely to be a public health problem if at least 70% of surveyed community members do not meet the threshold values (Rosen *et al.,* 1993). Ettyang *et al.* (2004) also used Helen Keller methodology to determine risk of vitamin A in Nandi District, Kenya.

3.6.3 Focus Group Discussions

The Focus Group Discussions provided more information on each of the specific objectives. Focus Group Discussions were held with community leaders (village elders, women group leaders, health care providers, home economists and agricultural extensionsist). A checklist addressed questions on types of food based strategies available, seasonal crops, hardships experienced by farmers, common problems affecting the community and VAD awareness (Appendix IV).

3.7 Reliability and validity

3.7.1 Validity

The validity of the instrument was obtained through consultations with research supervisors and other research experts at the Foods Nutrition and Dietetics Department and the Faculty of Health Sciences. These experts reviewed items in the instruments and modified them accordingly.

3.7.2 Reliability

A pre-test was carried out in one location in Mogotio Division of Koibatek District. At least twenty (20) people were interviewed which was 10% of the sample (Mugenda & Mugenda, 1999). The questionnaire was considered adequate for collection of data required. Reliability for the questionnaire was also determined by use of the internal consistency technique. In this case, a score from one item was correlated with another score from other items in the questionnaire. The result, a coefficient of 0.75 was considered sufficient to legitimize the reliability of the questionnaire.

3.8 Data analysis.

Statistical analysis for quantitative data was performed using SPSS version 11.5. Frequency of commonly consumed vitamin A rich food was determined by use of frequencies. Risk of vitamin A deficiency was determined as described in the Helen Keller Food Frequency Questionnaire method. Descriptive statistics were used to define demographic profiles, and the accessibility and availability of vitamin A foods by the various groups and frequency of VAD and associated diseases. Comparisons between proportions of the variables under study used chi square (χ^2) test statistics. Significance was tested at $p \leq 0.05$. To asses knowledge attitudes and practices, frequencies and percentages were used. The 24 Hour Food Recall data was analysed using Nutri Survey, a computer programme, to determine total kilocalorie, macro and micro nutrient intake. The data was later transferred to SPSS and descriptive statistics used to analyze the data. The summary of data analysis procedures is shown on Table 3.1.

Table 3.1: Summary of statistical procedures and data analysis.

Hypotheses	Independent Variable	Dependent Variable	Statistical Procedures and Data Analysis
Ha: There are adequate sources of vitamin A rich foods available and accessible to mothers and their children under five years of age.	Accessibility (cost, seasonality, culture) Availability (enviroment, farm, market)	Risk of vitamin A deficiency.	Descriptive statistics Inferential statistics Chi square (χ^2)
Ha: The food preparation, processing and preservation methods used are good and favourable to vitamin A intake.	Preparation (cutting, time) Processing (use of fat) Preservation.	Risk of Vitamin A deficiency.	Descriptive statistics
Ha: There is adequate dietary intake of vitamin A rich foods.	Adequacy of intake Frequency of consumption Vitamin A status	Risk of Vitamin A deficiency.	Descriptive statistics NUTRI SURVEY. Inferential statistics Chi square (χ^2), t-test
Ha: There is adequate knowledge, positive attitudes and good practices favourable to vitamin A nutrition.	Knowledge Attitudes Practices	Risk of Vitamin A deficiency.	Descriptive statistics

CHAPTER FOUR

RESULTS AND DISCUSSION.

4.1 Introduction

The chapter begins by reporting results on socio - demographic characteristics of the population. All the variables under study are then examined, relationships determined, results reported and then discussed. The variables of the study are availability, accessibility, food preparation processing and preservation, knowledge, attitudes, practices and dietary assessment.

4.2 Socio - demographic characteristics of the respondents.

A total of 206 mother - child pairs were interviewed in this study. The average age of the mothers interviewed was 27.09 ± 6.0 years and 32.6 ± 15.2 months for children. The children aged between 25 to 36 months accounted for 29.7%. Of all the children interviewed, 54.9% were male and 45.1% were female (Table 4.1). Majority of the households in the study area were male-headed (81.6%) and only 18.4% were female headed. Married and single women consisted 81.1% and 15.5% respectively. A high proportion of the women (64.7%) were educated to primary school level and 23.8% were educated to secondary school level (Table 4.1). At least 46.6% of the women lived in temporary homes made up of mud walls and iron roofing. Main source of livelihood for the women was casual work, sale of animal products and food crop production. Very few households had salaried employees (12.1%).

Main characteristics of the study population show that majority of the women were low-income earners. This is exhibited by the fact that very few mothers and household heads had salaried employment. The type of housing was of poor quality and majority of the mothers had low levels of education. Poverty is the major cause of malnutrition in sub-Saharan Africa. Poverty breeds malnutrition and in turn, malnutrition increases poverty, a vicious cycle. Poverty is one of the basic causes of VAD; poor households are unable to afford most of the vitamin A rich foods especially those from animal sources (ACC/SCN, 1994).

Table 4.1: Socio - demographic characteristics of mothers and children under the age of five in Marigat Division.

Characteristic	Respondent (%)	Household head (%)
Occupation (Salaried employment).		
No occupation	50.5	32.5
Professional	7.3	16.5
Skilled	18.9	36.4
Unskilled	23.3	14.6
Level of education		
No education	6.8	
Primary	64.7	
Secondary	23.8	
Special training	4.9	
Type of housing		
Permanent	8.3	
Semi permanent	45.1	
Temporary	46.6	
Main source of livelihood		
Cash crop production	3.4	
Food crop production	9.2	
Sale of animals and animal products	8.3	
Employment	12.1	
Casual work	31.6	
Sale of animals products and food crop production	34.5	
Self employment	1.0	
Marital Status		
Married	81.1	
Single	15	
Widowed	2.4	
Separated	1.5	
Children		
1 – 12 months	11.7	
13 – 24 months	21.8	
25 – 36 months	29.7	
37 – 48 months	22.5	
49 – 60 months	14.3	
Male	54.9	
Female	45.1	
Mean age of mothers (years)	27.09 ± 6.0	
Mean age of child (months)	32.6 ± 15.2	
Mean acreage of land cultivated	0.65 ± 0.97	

4.2.2 Availability and accessibility of vitamin A rich foods.

Availability of vitamin A rich foods was determined through finding out which vitamin A rich foods were available in main farm lands, kitchen gardens, surrounding environment and market place. Availability determines what food is accessible to the respondents; accessibility was therefore examined in terms of seasonality, cost and cultural practices.

4.2.2.1 Availability of vitamin A rich foods

Average acreage of land cultivated in the two Sub-locations Yatoi (without irrigation) and Perkerra (with irrigation) was 0.65 ± 0.97 acres. At least half of the mothers (52.9%) did not cultivate land. Among those mothers who cultivated land however, 56.7% came from Perkerra Sub-location and 27.8% came from Yatoi Sub-location. Pearson's chi square test showed significant differences when comparing cultivation of land between the two Sub-locations (P = 0.002). The results of the study also show that 42.7% of the women owned the land they cultivated, 23.8% had the land on lease and 33.5% did not have land to cultivate. An almost equal number of women 42.5% and 43.1% owned land in Perkerra and Yatoi respectively. A higher proportion of women in Yatoi did not have any land (43%) compared to 26.1% in Perkerra. The poor cultivation of land could be attributed to unpredictable rainfall patterns. Marigat is a semi-arid area according to the Republic of Kenya report (2003). This was further confirmed after examining that Perkerra had a significantly higher number of people cultivating land compared to Yatoi (P = 0.002) (Table 4.2). According to King and Burgess (1995) areas of high risk of VAD, include arid and semi-arid areas. The National Micronutrient Survey of 1999 also identified arid and semi-arid areas as being most vulnerable to VAD (MOH/UNICEF, 1999).

Maize and beans (35%) were the most common crops grown in the main farmlands. Significant differences were observed when comparing types of crops grown in the main farmlands between the two Sub-locations (P = 0.002). Vegetables and fruits were hardly grown in the main farmlands, only 10.2% of all the women grew these crops. The main reason for this was that staple food crops such as maize and beans were grown in place of vegetables and fruits. Significant differences were observed when comparing types of crops grown in main farmlands this, shows that different types crops were grown in Perkerra and Yatoi.

The results of the study also indicated that a majority of the women (68%) kept animals, mostly goats (38.3%). In spite of this, animals were hardly used as source of meat. This is considering that 87.4% of women bought meat for consumption. A study with similar results found that although many households may own cows, goats and poultry, they are hardly consumed at household level (Bwibo and Neumann, 2003). This is probably because animals are used as a source of income; animals are considered more valuable when sold than when consumed.

Table 4.2: Availability of vitamin A rich foods in Marigat Division.

Variable	Yatoi %	Perkerra %	Total %	Persons χ^2 P value
Types of crops grown in the main farmland				
Maize and beans	22	41.9	35	0.009
Fruits	0	0.8	0.5	
Vegetables	0	2.2	1.5	
Maize, beans, fruits and vegetables	7.1	11.9	10.2	
No crops grown	70.8	43.2	52.9	
Types of crops grown in kitchen gardens				
Green leafy vegetables	13.8	14.2	14.1	0.412
Orange Yellow fruits	0	3	1.9	
Orange yellow fruits and green leafy vegetables	1.4	3	2.4	
Other types of crops	0	1.4	1	
No crops grown	84.8	78.3	80.6	
Types of food bought in the market place				
Green leafy vegetables	22.2	11.9	20	0.299
Orange yellow fruits	2.8	2.2	2.4	
Orange yellow fruits and green leafy vegetables	45.8	47.8	47.1	
Maize and beans	5.6	11.3	9.7	
Orange yellow fruits, green leafy vegetables, maize and beans	23.6	26.8	24.8	
Types of food gathered in the environment				
Black night shade	1.4	4.5	3.4	0.004
Amaranthus	12.5	20.9	18	
Spider Plant	1.4	3	2.4	
Black night shade, Amaranthus and Spider plant	18	33.6	28.2	
No crops gathered	66.7	38	48.1	

The results of the study show that very few women had kitchen gardens (18.9%) with 15% and 20.8% of the women in Yatoi and Perkerra respectively (Table 4.2). Crops grown in kitchen gardens include kales, spinach, tomatoes, melons and pawpaw. No significant differences were observed when comparing types of crops grown in kitchen gardens ($P = 0.412$). The fact that very few women owned kitchen gardens indicates that vitamin A rich foods were not available in the farm. Community leaders attributed the

occurrence to erratic rainfall patterns. Kitchen gardens can act as a source of household food supplies, complement food needs in lean times and act as a source of income (FAO, 2001). Studies have shown that presence of kitchen gardens greatly influence intake of vitamin A rich foods. Talukder *et al.* (2000) reported that children living in households with developed home gardens had increased consumption of vitamin A rich fruits and vegetables compared to children in households with no home gardens.

Dietary intake of yellow and dark green vegetables improved with a home gardening program, consequently improved serum retinol concentration in children (Faber *et al.*, 2002). Production of fruits and vegetables through home gardens made valuable contributions to vitamin A among women in rural Bangladesh (Bloem *et al.*, 1996). In Mozambique, effectiveness of introduction of orange fleshed sweet potato (OFSP) was assessed in an integrated agricultural and nutrition intervention study. Children with an average age of 13 months participated in the study and were compared to a control group. Intervention children were more likely to eat OFSP, had higher vitamin A intake and had higher serum retinol levels than control children (Low *et al.*, 2007). Because no significant differences were observed when comparing types of crops grown in kitchen gardens it would be safe to conclude that availability of water for irrigation did not play a major role. A comparative retrospective survey done in Central Kenya had different results. The objective of the study was to investigate the role of irrigation on improvement of nutritional status of children 6-59 months (Kirogo, 2007). Children from the irrigation scheme were compared to children from non-irrigation scheme. Irrigation was seen to contribute to increased food availability resulting in high-energy intakes and enabling households to safeguard young children against chronic malnutrition (Kirogo, 2007). It is also worth noting that despite availability of water in Perkerra most women did not develop kitchen gardens. This could be attributed to water rationing in the irrigation scheme as reported by community leaders during the Focus Group Discussion.

Orange yellow fruits together with green vegetables were the most frequently bought food (47.1%). Person's Chi Square Test showed no significant differences when comparing the types of foods bought in the market place ($P = 0.299$). According to community leaders, erratic rainfall patterns cause inconsistent, unreliable and insufficient agricultural yield. As a result, most of the residents have to source food from the market. This is confirmed by results indicating that most households in the area buy foods. No

significant differences were observed between Yatoi and Perkerra in terms of types of foods bought in the market place. This shows that the same types of food commodities were bought in both Sub-locations.

The only foods gathered from the environment were traditional vegetables that include black nightshade, amaranthus and spider plant. Almost half (48.1%) of the mothers did not gather food from the environment compared to 51% who did. More mothers in Yatoi did not gather vitamin A rich foods (66.7%) compared to Perkerra (38%). Amaranthus was gathered by 18% of the respondents indicating that it was the most available wild vegetable in the environment. There were significant differences when comparing types of crops gathered in the two Sub-locations ($P = 0.004$). This is further confirmed by the fact that more women gathered vegetables in Perkerra than in Yatoi. Even though some women gathered food, it was clearly not enough, as a large proportion of the mothers still had to buy food for daily consumption. Traditional green leafy vegetables and wild fruits contribute significantly to vitamin A (Sehmi, 1993).

Through the Focus Group Discussions, it was revealed that several types of vitamin A rich foods were available in the market place. These include animal products such as goat meat, beef and organ meats. Fruits and vegetables include: pawpaw, melon, bananas, carrots, black nightshade, cowpeas leaves, spider plant, spinach and tree tomato fruit. These foods were available in the market place at reasonable prices. Other types of foods available were maize, beans and millet. This occurrence could be explained by the insufficient agricultural produce characteristic of the area, as well as more women having sat out the previous crop season due to the unreliability of the rainfall. As a result, most mothers bought staple foods instead of vitamin A rich fruits and vegetables, this was corroborated by Ettyang, Oloo, Litchtenbelt & Saris (2004) in similar findings. The study investigated maternal and infant intakes of locally available vitamin A rich foods in Nandi, Kenya. The aim was to establish the community risk of VAD and to assess whether breast milk is adequate to maintain and build retinol reserves of the breastfeeding children. In this study, vitamin A rich foods were seen to be available in the market place but this did not result in increased consumption at the household level.

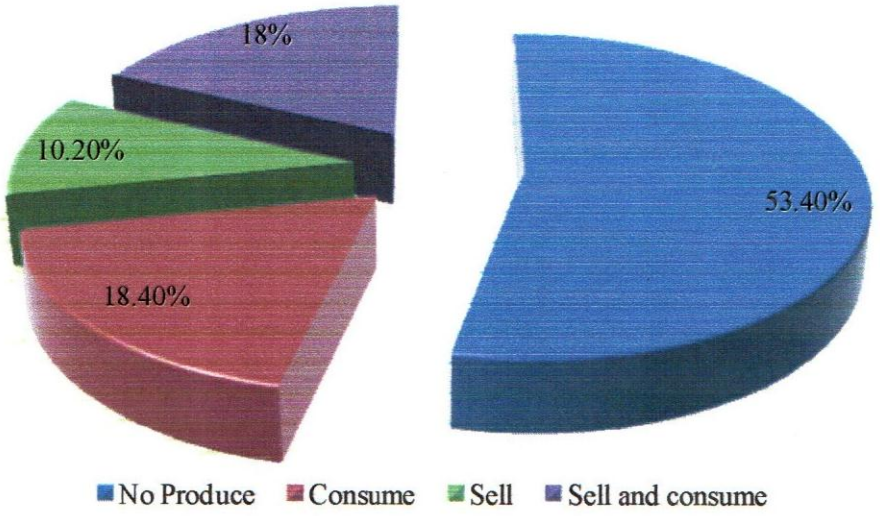


Figure 4.1: Utilization of farm produce

The proportion of women who did not cultivate land in the previous planting season or cultivated land but had no crop produce the previous planting season were 53.4%. At least 18.4 % of the women consumed all farm produce compared to 18% who sold some of the produce and consumed some of it. At least 10.2% of the respondents sold their produce. Significant differences were observed when comparing utilisation of farm produce between the two areas (P = 0.002). Figure 4.1 shows overall utilization while Figure 4.2 shows that a lot more people in Perkerra sold their produce compared to Yatoi.

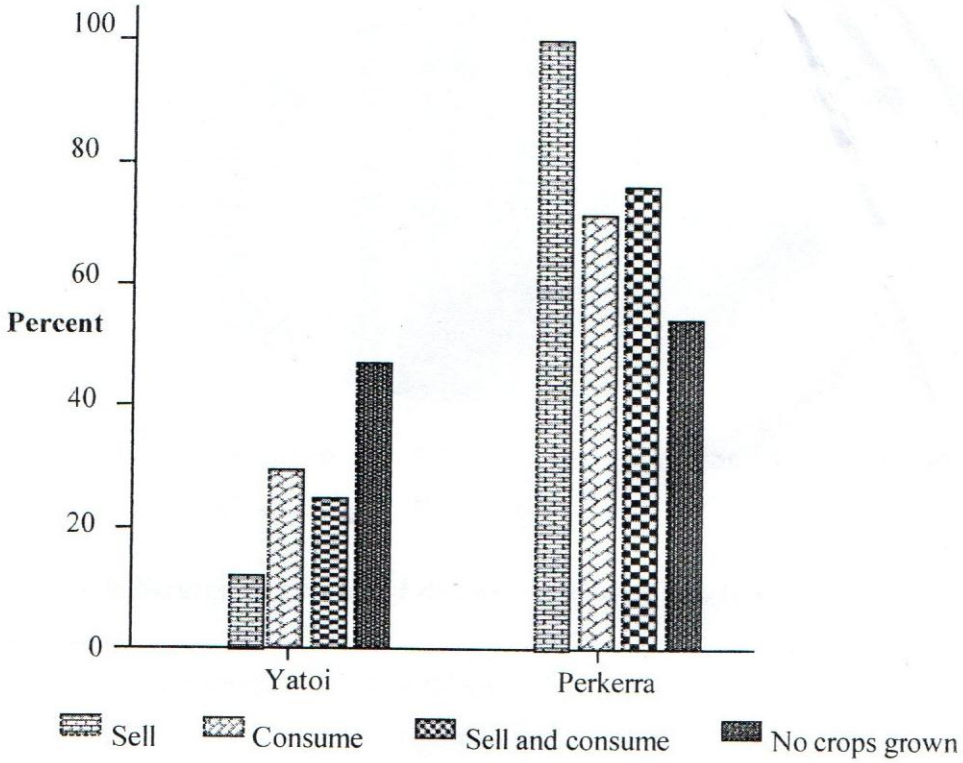


Figure 4.2: Utilization of farm produce in Yatoi and Perkerra Sub-locations.

The first hypothesis stated that there are adequate sources of vitamin A rich foods available and accessible to mothers and their children under five years of age. The above results indicate that vitamin A rich foods were not available in the main farmlands and in the kitchen gardens. Some women could access vitamin A rich foods from the environment but it was not enough. Vitamin A rich foods were found to be available in the market. However, most women did not buy them. The hypothesis is therefore rejected.

4.2.2.2 Accessibility of vitamin A rich foods.

Accessibility of vitamin A rich food was measured in terms of seasonality, cost of food (affordability) and cultural practices. Months of scarcity in Marigat Division were reported to be between January and April (89.8%), the study was conducted in the month of January and February during the dry season. This was important because the risk of vitamin A deficiency increases during lean times (King & Burgess, 1995; Rosen *et al.*, 1996).

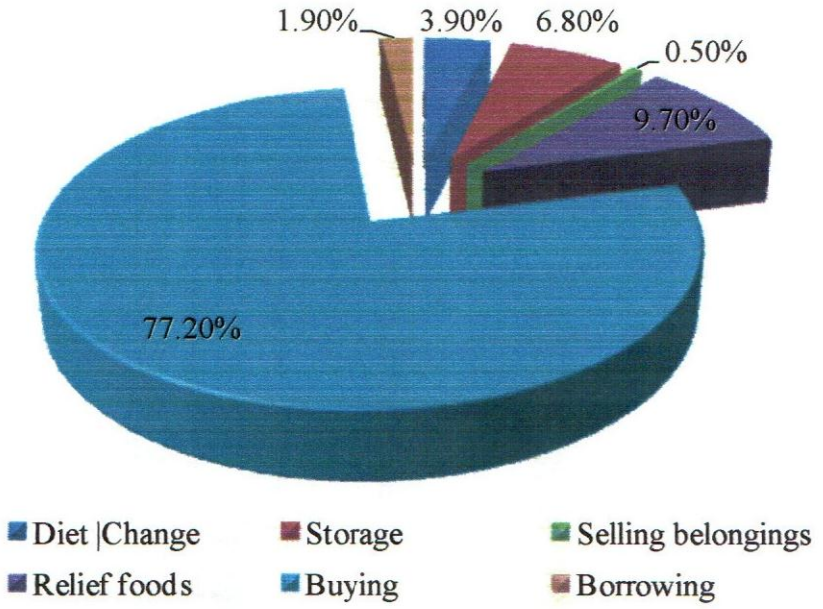


Figure 4.3: Strategies employed during months of scarcity

Several strategies were employed during this time to counteract food shortage. Figure 4.3 shows that a large proportion of the women bought food during this months (77.2%). Pearsons Chi square value showed significant differences with regard to strategies used during months of scarcity in the two Sub-locations (P = 0.00). This implied that mothers in the two Sub- locations used different strategies. It could be that foods available one Sub-location was unavailable in the other Sub-location, thus the differences.

In about half of the households interviewed (48.5%) both women and men made decision on what food was to be bought in the household (Figure 4.5). When women make decisions on type of food consumed they are more likely to buy a variety of foods thus ensuring nutrition security in the household. The results shown earlier (Table 4.2) further demonstrate inaccessibility of vitamin A rich food in the farm. A majority of the women (80.1%) did not own kitchen gardens while (32%) did not keep livestock. Additionally only 2% of the respondents grew fruits and vegetables in the main farmlands and more than half of the respondents, (53.4%) did not had no produce the previous planting season. This indicates that not only were vitamin A rich foods unavailable and inaccessible but there was also a food shortage in the Division. Consequently, most of the food consumed in the household had to be bought. Even then,

preference was given to staples such as maize and beans. As a result, vitamin A rich foods were rarely bought.

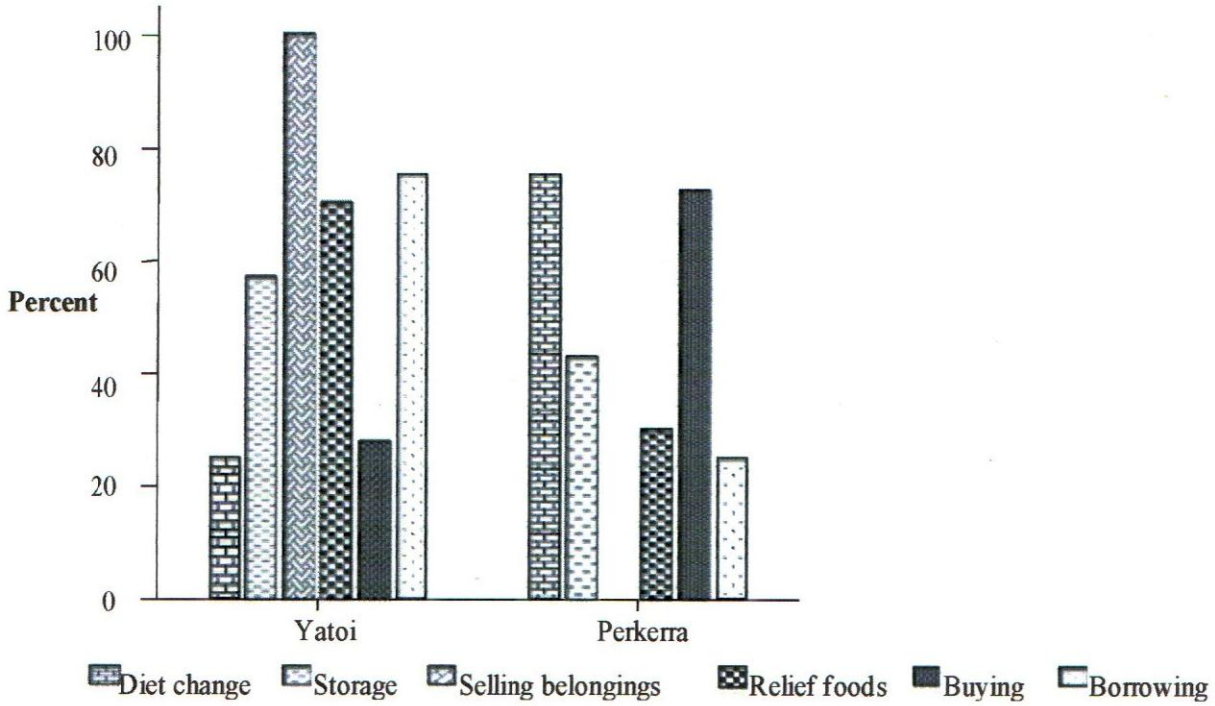


Figure 4.4: Strategies Employed during months of scarcity in Yatoi and Perkerra Sub-locations.

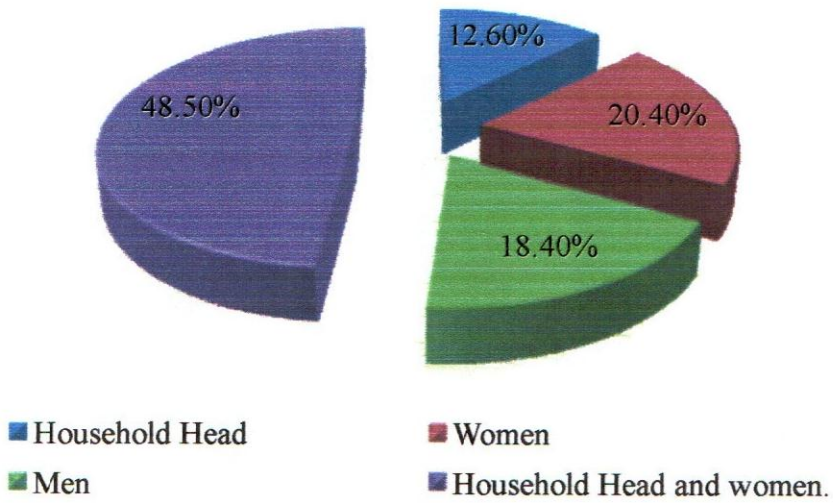


Figure 4.5: Decision making on type of food to be bought within the household.

At least 43.2% of the mothers reported that they would consume more meat if they had more money. Some of the women (41.3%) preferred a combination of milk, meat, rice, legumes, fruits and vegetables (Figure 4.6). No significant differences in food preferences were observed (P = 0.427). The food preferences indicate that money was a

constraint in buying vitamin A rich foods. Since there were no significant differences between Sub-locations on food preferences, it shows that mothers in both Sub-locations had same preferences for food.

Data on source of food used during food preparation, processing and preservation was collected and used to further analyse accessibility. It was found that 85.2% and 87.4% of the women bought green leafy vegetables and meat respectively (Table 4.3). Pearson's chi square showed significant differences when comparing source of traditional vegetables, other vegetables and fresh legumes in the two sub locations. However, no significant differences were observed in green leafy vegetables, fruits, meat, dry legumes, root tubers and nuts.

The Food Frequency Questionnaire also had data on source of foods specific to listed vitamin A rich foods (Table 4.4). The results show that most of vitamin A rich foods listed were never consumed though they were found to be available in the market in the area. Examples of foods that were never consumed include goat liver (75%), chicken liver (96.9%), chicken (85.9%), pumpkin leaves (85.9%), yellow sweet potato (89.1%), pawpaw (76.6%) and pumpkin (87.5%). The foods that were most commonly purchased were Irish potatoes (81.3%), tomatoes (95.3%) and kales (70.3%).

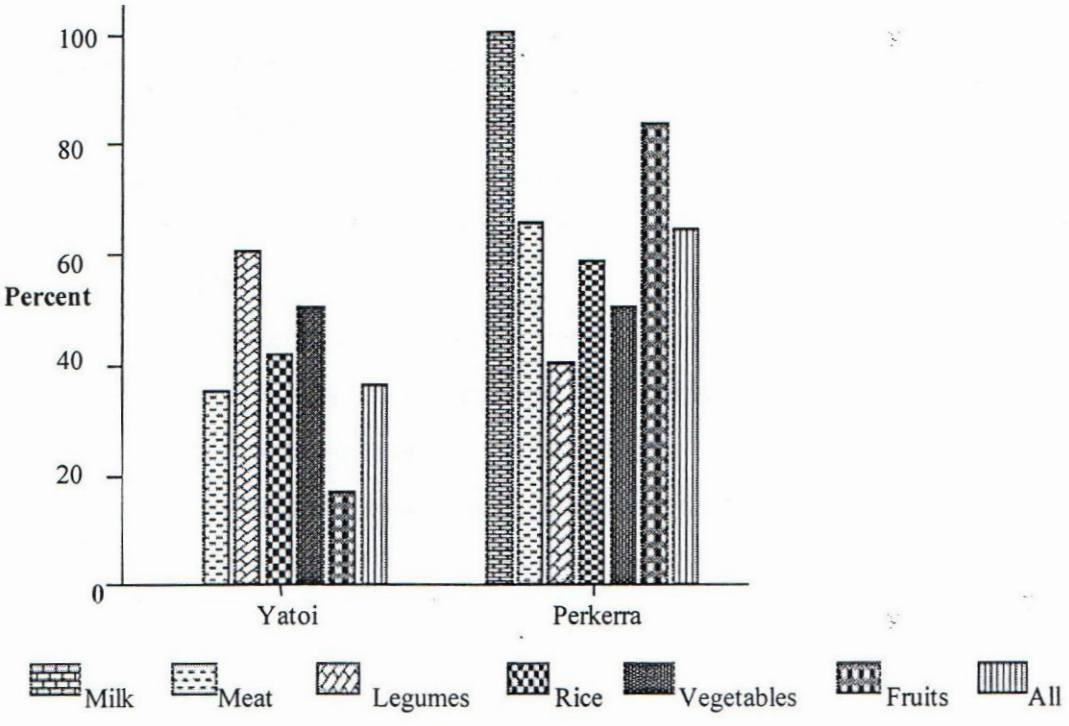


Figure 4.6: Food accessibility in terms of preference for food.

The results demonstrate that most vitamin A rich foods were not accessible to the women despites their availability in the market place. The fact that most of the food sources were bought shows a household deficit, this indicates that there was food shortage in the area. Many studies have shown vitamin A rich foods to be available in the areas where VAD is prevalent (Delisle *et al.*, 2003). For example, a food ethnographic study was conducted in Burkina Faso among children ages 6 months to 3 years. The purpose was to identify locally available and acceptable pro-vitamin A rich foods to be included in a dietary intervention programme. Findings indicated that the children's diets were low in diversity, energy and vitamin A intakes. Numerous vitamin A rich foods were rarely consumed due to financial reasons, seasonality and beliefs. Intervention strategies could improve vitamin A intake and status of children (Nana, Brouwer, Zagre, Kok & Traorè, 2005). Reasons given in Focus Group Discussions for poor accessibility of vitamin A rich foods were high cost of seeds, lack of enough rainfall, water rationing in irrigation fields and poverty. Community leaders named seasonal crops to be maize, beans, green grams, fruits and vegetables. Seasonality of crops affects accessibility of fruits and vegetables such that during lean times there is an increased risk of VAD (King and Burgess, 1995).

Most women were unable to afford foods rich in vitamin A. Poverty, poor economic or physical access to the market place are some of the other basic factors that contribute to the incidence and prevalence of VAD. Low production of vitamin A rich foods and intra household food mal-distribution are underlying causes of VAD (ACC/SCN, 1994). Production of vitamin A rich food products, nutrition education, monitoring of vitamin A status can help alleviate the problem of VAD (Underwood, 2000; Vuong, 2000).

Vitamin A rich foods were inaccessible in the Division. Most of the foods consumed by the mothers were purchased and preference was given to staple foods. Vitamin A rich foods were rarely purchased due to their related prohibitive costs. Seasonality had a great influence of accessibility of vitamin A rich foods, as Marigat is a predominantly semi-arid.

Table 4.3: Source of food used during food preparation, processing and preservation.

Type of food	Own produce (%)	Bought (%)	Available in environment (%)	Begging (%)	None (%)	Pearson's χ^2 value.
Green vegetables (total)	10.2	85.2	1.9	1.9	0.5	0.098
Yatoi	2.8	93.1	2.8	1.3	0	
Perkerra	14.2	81.3	1.5	2.2	0.7	
Traditional vegetables (total)	8.3	35.4	52.4	1.5	2.4	0.00
Yatoi	1.4	54.2	38.8	2.8	2.8	
Perkerra	11.9	25.4	59.8	0.7	2.2	
Other vegetables (total)	6.8	66.1	12.6	1.0	13.6	0.012
Yatoi	1.4	79.2	6.9	0	12.5	
Perkerra	9.7	59.0	15.6	1.5	14.2	
Fruits (total)	3.4	78.2	2.9	1.0	15	0.769
Yatoi	2.8	81.9	2.8	0	12.5	
Perkerra	3.7	75.3	3.1	1.5	16.4	
Meat (total)	8.7	87.9	0.5	0.5	2.9	0.585
Yatoi	6.9	88.9	0	1.4	2.8	
Perkerra	9.7	86.6	0.7	0	3.0	
Dry legumes (total)	14.1	82.5	0	0	2.9	0.260
Yatoi	9.7	86.1	0	0	4.2	
Perkerra	16.5	81.3	0	0	2.2	
Fresh legumes (total)	9.7	82.6	0	1.5	7.8	0.95
Yatoi	2.8	80.5	0	1.4	15.3	
Perkerra	9.1	86.7	0	1.5	2.7	
Root tubers (total)	3.9	84.5	0.5	1	9.7	0.004
Yatoi	1.4	83.3	0	1.4	13.9	
Perkerra	5.2	85.8	0.8	0.7	7.5	
Nuts (total)	1	78.7	0	3.9	20.4	0.404
Yatoi	1.4	69.4	0	2.8	26.4	
Perkerra	0.7	77.6	0	4.5	17.2	

Table 4.4: Source of vitamin A rich foods used in the Food Frequency Questionnaire.

Vitamin A rich Food	Own produce (%)	Purchase (%)	Food that was never consumed (%)
Meat	3.1	87.5	9.4
Goat liver	0	25	75
Chicken liver	3.1	0	96.9
Chicken	6.3	7.8	85.9
Eggs	34.4	15.6	50
Kales	26.6	70.3	3.1
Spinach	10.9	40.6	48.4
Amaranthus	26.6	43.8	29.7
Pumpkin leaves	10.9	3.1	85.9
Cow pea leaves	12.5	48.4	39.1
Black night shade	6.3	26.6	67.2
Yellow sweet potato	4.7	6.3	89.1
Irish potato	0	81.3	18.8
Carrots	3.2	26.6	70.3
Bananas	3.1	75	21.9
Mangoes	10.9	56.3	51.6
Pawpaw	17.2	31.3	51.6
Avocado	4.7	18.8	76.6
Melons	15.6	39.1	45.3
Guavas	1.6	4.7	93.8
Orange	4.7	76.6	18.8
Pumpkin	0	12.5	87.5
Tomatoes	1.6	95.3	3.1
Margarine	0	34.4	65.6
Oil	0	12.6	87.5
Fat	0	93.8	6.3
Margarine	0	34.4	65.6

4.2.3 Food preparation processing and preservation

Methods of food preparation, processing and preservation were examined. Use and amount of fat used during cooking was also examined. These processes play a big role in determining the bioavailability of vitamin A from pro vitamin A sources.

4.2.3.1 Food preparation and processing.

The study results showed that most women washed, cut and cooked (83%) their green leafy vegetables. A few women (15.5%) cut washed and cooked green vegetables (Table 4.5). There was no preparation done for fruits except washing. The importance of food preparation and processing of vitamin A rich foods on bioavailability of carotenoids cannot be over emphasised. Carotenoid and retinol content may be reduced or enhanced

because of food preparation (IFNDC, 1997b; Rock et al., 1998). Processing methods that result in disruption of food matrix such as heating, pureeing, juicing or grating greatly enhances bioavailability (van het Hof *et al.,* 2000). A majority of the women (90%) cut their green leafy vegetables during cooking. This is important as it breaks the food matrix in vegetables thereby improving bioavailability. A trial was done and serum concentrations of carotenoids were examined after consumption of vegetables juice, cooked and raw vegetables. Vegetables juice produced significantly higher serum concentration of carotenoids than raw or cooked vegetables (McEligot *et al.,* 1999).

A large proportion of respondents (69.4%) fried green vegetables and 50% fried traditional vegetables (Table 4.6). Most legumes were boiled (76.7%) while meat was either boiled (25.7%), stewed (39.3%) or steamed (23.3%). Cooking of pro-vitamin A food has been seen to substantially improve its bioavailability. A study done to examine pro-vitamin A carotenoid bioavailability showed that daily consumption of processed carrots and spinach produced an increase in plasma beta-carotene compared to consumption of these vegetables in the raw form (Rock *et al.,* 1998). Scott & Amaya (1996) reported similar results where it was found that absorption of carotenoids seemed greater in cooked than raw vegetables.

The study results also show that most women (94.7%) used fat during cooking and the average amount of fat used was 19.4 g in a pot for approximately five people. This amount of fat is negligible. It could also be observed from the 24 hour recall that percentage of fat in food (14.9% and 19.7% for mothers and children respectively (Tables 4.9 and 4.11) was very low. Presence of fat also plays a vital role in ensuring bioavailability of carotenoids, studies have shown that intake of fat enhances carotenoid absorption (Olson, 1991). Amount of fat sufficient to ensure carotenoid uptake is reported to be between 3-5 g in a meal. Unabsorbable fat components also affect digestibility of food (Van Het Hof *et al.,* 2000). WHO/FAO, (2004) reports and even higher amount of 5-10 g required in a meal. A trial to whose objective was to quantify appearance of plasma chylomicrons after ingestion of fresh vegetable with fat free, reduced fat and full fat dressing was conducted among ten men and women aged 19 – 28 years. Results showed that there was a substantially greater absorption of carotenoids when salads were consumed with full fat than with reduced fat salad dressing (Brown *et al.,* 2004). A study was done to assess whether addition of avocado as a lipid source enhanced carotene absorption in humans (Healthy adults aged 21 – 42 years). Results showed that

absorption of lycopene and beta-carotene was really enhanced with addition of avocado oil and salsa (Unlu *et al.,* 2005). To measure *in vitro* accessibility (available for absorption) of α – carotene and ß – carotene, a study prepared vegetables relishes with or without oil. Results showed that when green leafy vegetables were cooked in sunflower or red palm oil, 39-94% of beta-carotene became bio available compared to 8-29% of green leafy vegetables cooked without oil (Hedren *et al.,* 2002).

A majority of the mothers interviewed (85.4%) reported that they took precautions during cooking to avoid nutrient loss. Of those who took precautions, 45.1% cooked food for shorter periods and 39.3% covered food during cooking. Studies have shown foods boiled in open containers showed greater losses on carotenoids (Park, 1987).

Table 4.5: Food preparation of vitamin A rich foods.

Type of food	Cut-wash-cook	Wash-cut cook	Cut-cook	Wash-cook	No preparation
Green vegetables	15.5	83	1.0	0.5	0
Traditional vegetables	12.6	47.6	1.5	36.4	1.9
Other vegetables	14.1	57.8	1.5	6.8	19.9
Fruits	0	0	0	0	100
Meat	32.5	19.4	31.1	10.2	6.8
Dry legumes	2.9	5.3	2.4	85	4.4
Fresh legumes	3.4	3.4	0.5	80.1	12.6
Root tubers	24.8	24.3	1.9	34.5	14.6
Nuts	1.9	20.9	1.9	7.8	67.5

4.2.3.2 Food preservation

The most commonly preserved foods were grain and legumes that were sun dried and stored in airy places (49.5%), and others were stored in granaries (35.9%). A considerable proportion of women had knowledge on food preservation; this was evident as 45.1% of women reportedly preserved green leafy vegetables. These preservation processes involved short term precooking and drying. The preserved foods therefore lasted less than a week. A very high proportion of women (94.2%) said they would like to know more about food preservation. It is important to note that most traditional vegetables (52.9%), fruits (76.3%) and other vegetables for example cabbage (63.6%) were not preserved. The method mostly used in preserving meat was salting (73.8%) and was done for short periods of time (Table 4.6).

Findings of the study indicate that vitamin A rich foods were rarely preserved and if they were, the preservation processes were short term. Food preservation is important as it ensures availability of vitamin A rich foods during lean times. Food preservation could also improve food and nutrition security if vegetables and fruits were preserved. A study by Drammeh *et al.* (2002) revealed that it was possible to maintain vitamin A status of children by supplementing them with dried mango and fat.

In conclusion, the results indicate that most of the foods that were consumed were from pro-vitamin A sources. Although fat was used during cooking, it was not enough. In addition, preservation of vitamin A rich foods was rarely practised.

Table 4.6: Food processing and preservation of vitamin A rich foods.

Type of food					
Food Processing					
	Boil	Stew	Fry	Steam	Bake
Green vegetables	2.9	23.8	69.4	1.0	2.4
Traditional Vegetables	24.3	21.4	50	1.0	1.9
Other vegetables	21.4	20.4	41.7	0.5	0
Meat	25.7	39.3	0.5	23.3	1.0
Dry legumes	76.7	12.1	2.9	3.4	0
Fresh legumes	76.7	9.7	1.9	1.9	0.5
Root tubers	43.7	33	1.5	2.4	1
Food Preservation					
	Sun dried	Dried in shade	Smoked	Salted	No preservation
Green vegetables	26.7	20.4	1	1	51
Traditional Vegetables	23.3	21.8	1	1	52.9
Other vegetables	15	20.4	1	0	63.6
Fruits	4.4	12.6	1	5.8	76.3
Meat	5.3	3.4	1	73.8	16.5
Dry legumes	58.7	18.4	1.5	3.4	18
Fresh legumes	51.5	22.8	1.9	0	23.8

4.2.4 Knowledge, attitudes and practice with regard to vitamin A.

Findings of the study showed clearly that there was poor knowledge on vitamin A, VAD and VADD. Though the women had a positive attitude towards vitamin A rich food, they had poor practices with regard to vitamin A.

4.2.4.1 Knowledge and attitudes on vitamin A.

In assessing knowledge, a number of questions concerning vitamin A and vitamin A deficiency were asked. Most women gave incorrect responses when asked what malnutrition was and what caused it, 77.7% and 76.7% respectively. A majority of the women (80.6%) also gave incorrect responses when asked what a vitamin was. A high proportion of women (60.2%) did not have any idea what caused night blindness in children. Some of the women (68.9%) reported that VAD could be prevented while 31.1% said it could not. When asked how VAD can be prevented the women responded in the following way: 31.1% gave a correct response, 38.3% did not know and 23.4% gave incorrect responses (Table 4.7).

The results indicate poor knowledge on vitamin A and vitamin A deficiency. Lack of enough home economists and health workers were some of the reasons attributed to this poor knowledge from the Focus Group Discussions. Several studies have shown improvement in knowledge attitude and practices after intervention programmes focusing on nutrition education and diet-based approaches were carried out (Jones *et al.,* 2005). A follow up of the social marketing of vitamin A rich food project was done in communities in northeast Thailand. Intervention group was compared to a control group. Cumulative improvement in knowledge, attitudes, and practice with respect to intake of vitamin A and fat was seen. Serum retinol levels had increased in intervention group and the difference was highly significant when compared to the control group (Smitasiri *et al.*, 1999).

A study whose objective was to increase vitamin A and iron intake was conducted in rural Nepal. The experimental group was introduced to kitchen gardens, nutrition education and agricultural training sessions. A control group with no form of training was used for comparison. The study showed that there was significantly more nutritional knowledge in the kitchen garden group compared to control group. This group was more likely to feed special complementary foods, more likely to preserve food and consumed more than 16 types of home produced micronutrient rich vegetables (Jones *et al.,* 2005). Kidala *et al.* (2000) evaluated the long-term effects of horticultural and nutrition education in Tanzania. An experimental area that had been introduced to kitchen gardens and nutrition education showed more knowledge and practices favourable to vitamin A food groups than control area that had no training. There was also increased frequency of intake of green leafy vegetables associated with higher consumption of retinol values. A

different study evaluated the effectiveness of a health education program in promoting consumption of vitamin A rich foods. Different mediums used to inform the public were examined. Entertainment education program delivered messages to a wider audience. However, interpersonal communication was found to be a crucial factor in the promotion of vitamin A rich foods (Hussain, Aaro & Kvale, 1997).

A poor attitude towards nutrition affects the type of foods consumed by an individual. When asked if they agreed with the statement, traditional green leafy vegetables should not be fed to children, 37.4% disagreed. At least 30.1% of the women strongly disagreed and 27.2% agreed. The general agreement was the children should drink milk as an accompaniment. About 40.3% of the women disagreed when they were told that vitamin A and other vitamins have the same functions. When told that regular consumption of meats does not improve vitamin A status, 28.6% disagreed and 28.2% strongly disagreed. When asked if fruits were snacks, 42.7% disagreed and 35% strongly disagreed. Half of the respondents (51%) disagreed on whether women and children should consume organ meat (Table 4.7).

Results of the study indicate that attitudes did not negatively affect intake of vitamin A rich foods for most mothers. At least 70% of the responses given were correct in all questions regarding to attitudes (Table 4.7). This could be because of periodical nutrition and agricultural education provided by home economists and agricultural extension workers in the area. A study in Burkina Faso had similar results where positive attributes were identified with vitamin A rich foods among caretakers of children 3 months to 3 years. Vitamin A rich food was identified with health strength and vitamin richness (Nana *et al.*, 2005). This however is clearly not enough, as some pastoralist communities seem to have beliefs that could potentially reduce intake of vitamin A rich foods. Focus Group Discussions revealed that pastoralists in the area have low regard for vegetables; consequently, they were not consumed. Organ meats such as liver, heart and kidney go to men with less valuable parts of the carcass going to women and children in such communities. These beliefs are potentially harmful especially because organ meat are very good sources of vitamin A (Codjia, 2001; Nana *et al.*, 2005).

Table 4.7: Knowledge and attitudes of mothers on nutrition.

Proportion in percentage of knowledge of mothers on nutrition.				
Question	Incorrect response	No idea	Almost right	Correct response
What is the main cause of night blindness in children?	29.1	60.2	8.7	1.9
What is malnutrition?	77.1	17.5	4.4	0.5
What is the main cause of malnutrition?	76.7	18	4.9	0.5
What is a vitamin?	80.6	16	2.4	1
What are the signs and symptoms of VAD?	59.7	19.4	12.6	8.3
What food are the best sources of vitamin A?	41.3	18	33.5	7.3
How is VAD prevented?	24.3	38.3	6.3	31.1

Proportions in percentage of attitudes of mothers towards nutrition.					
Statement	Strongly agree	Agree	Don't know	Disagree	Strongly disagree
Traditional green leafy vegetables are not fed to children.	5.3	27.2	0	37.4	30.1
Vitamin A and other vitamins have the same functions.	2.4	22.3	15.5	40.3	19.4
Regular consumption of meats does not help improve your vitamin A status.	2.9	21.8	18.0	28.6	28.2
Fruits are snacks that are only fed to children.	1.0	16.5	4.9	42.7	35
Women and children should not consume organ meats	1.9	6.8	2.4	37.9	51
Regular consumption of vegetables by men is not important.	1.9	7.8	1	46.1	43.2

4.2.4.2 Practices with regard to vitamin A.

The findings of the study show that only 6.3% of the mother practiced exclusive breastfeeding. Majority of the mothers introduced their children to complementary feeding at the age of 4-6 months (78.1%). The common food for complementary feeding was mashed potatoes or ugali with a little soup (44.7%). A considerable proportion of mothers (29.6%) introduced a mixture of the same foods enriched with milk and fruits (Figure 4.7). Most of the mothers stopped breastfeeding their children at the age of 10-16 months (65.5%) and some at 16-24 months (20.4%) (Figure 4.8). The percentage of women who exclusively breast-fed was close to the national figure at 5% (SCN, 2004) which is very low. Studies have showed that exclusive breastfeeding is rarely practiced. A cross sectional study was carried in Kenya, Tanzania and Uganda to assess food consumption patterns among women and children under five years old. Exclusive breastfeeding was rarely practised among women in Kenya (Waudo *et al.*, 2004).

Similarly, a study in south India assessed vitamin A intake using a quantitative FFQ in a vitamin A intervention study. Mother with children of preschool aged participated in the study. Exclusive breastfeeding was also rarely practised and it declined with age (Ramakrishnan, Martorell, Latham and Abel, 1999). Breastfeeding is seen as an important source of vitamin A for younger children especially where intake of pre-formed vitamin A is low. However low breast milk retinol is often a result of inadequate intake and this together with early cessation of breastfeeding are risk factors for early onset of VAD (Allen & Gillespie, 2001). Most of the mothers in this study had inadequate intake of vitamin A rich foods.

A study was done to provide information strategies for improving maternal vitamin A status and increasing the consumption of breast milk in infant's ages 1-24 months. Significant increase in vitamin A status of children was seen after maternal supplementation of high dose of vitamin A during delivery (Ross & Harvey, 2003). Vinutha *et al.* (2000) had similar results where increase in infant serum retinol and the breast milk retinol was seen after postpartum vitamin A supplementation. A trial was conducted among lactating Bangladeshi women. The women were grouped into three and given vitamin A supplements (60,000 RE), ß-carotene or placebos. Results showed increase in breast milk vitamin A after supplementation of 60, 000 RE, however these improvements were not sustained over time (Rice *et al.,* 1999). Ncube *et al.* (2001) showed that Pureed papaya and grated carrots greatly improved the vitamin A status of lactating mothers after supplementation. For breastfeeding to make a significant contribution on vitamin A status, it should go hand in hand with dietary intake of vitamin A. Ettyang *et al.* (2004) reported a significant percentage of mothers had breast milk that was deficient of vitamin A and had marginal levels of serum retinol. Most of the mothers had inadequate intake of vitamin A rich foods.

Study results show that complementary foods were introduced as early as 1-3 months and most mothers introduced complementary foods at 4-6 months. These foods lacked variety, especially vitamin A rich foods and they were mostly rich in carbohydrate. Early introduction of complementary foods (approximately 3 months) and cereal based complementary foods (stiff porridge, potatoes and bananas) were seen in the Lake Victoria region, Nandi community and India (Waudo *et al.,* 2004; Ettyang *et al.,* 2004; Ramakrishnan *et al.,* 1999). A study done in Kwa Zulu Natal, South Africa assessed the nutritional and dietary practices of 4-24 month old children from a rural

South African community. Results showed high intake of carbohydrate rich foods and irregular intake of fruit and vegetables especially those rich in vitamin A. Food of animal origin were rarely consumed (Faber & Benade, 1999). El-Arab *et al.* (2002) did a study among preschool children in rural Egypt. Results showed that breast-fed children younger than one year had significantly more vitamin A consumption compared to children older than 24 months. Early introduction of complementary feeding, and lack of variety in complementary foods can place a child at risk of VAD.

The above results indicate that there is poor knowledge on vitamin A and VAD in Marigat. There was generally a positive attitude towards vitamin A however, some beliefs practised by pastoralist communities could affect vitamin A intake. There were poor breastfeeding and complementary feeding practices that are risk factors to VAD.

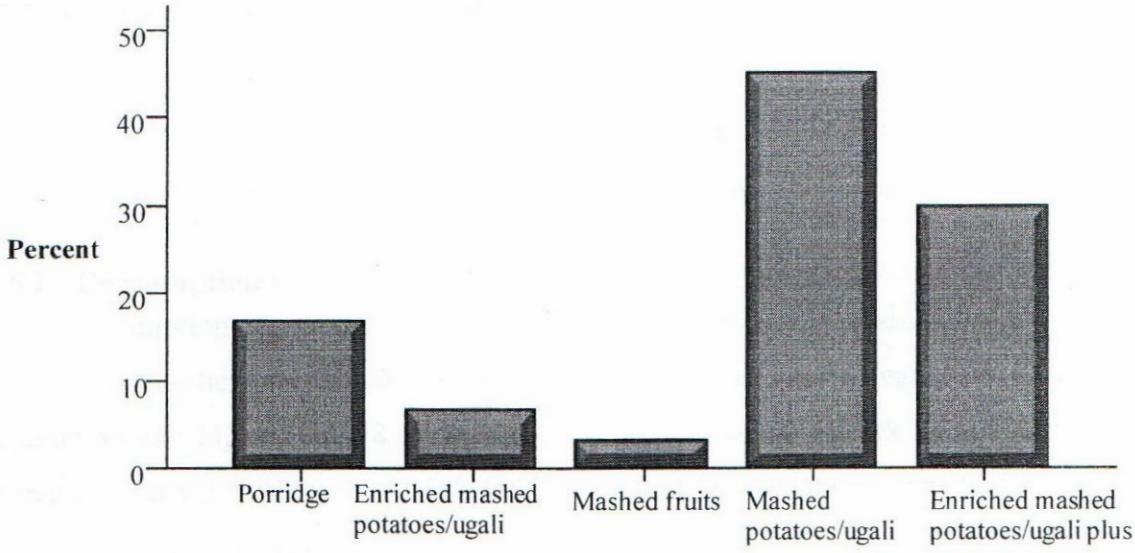


Figure 4.7: Types of food introduced during complementary feeding

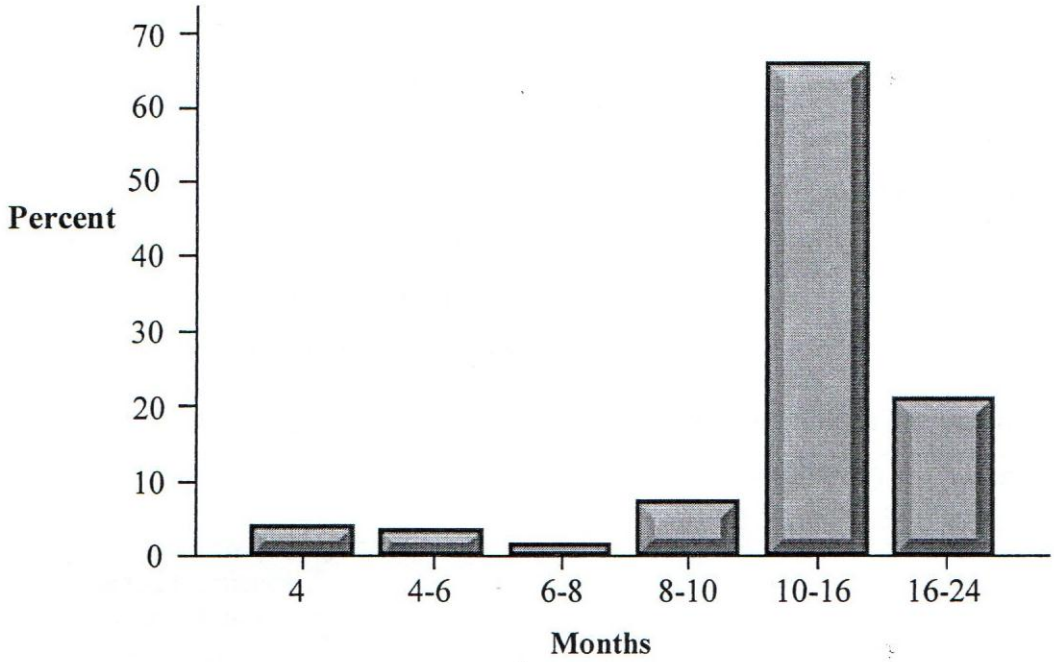


Figure 4.8: Time of cessation of breastfeeding

4.2.5 Dietary assessment.

The major source of protein in Marigat Division includes beans and goat meat. Staple food in the area included ugali, milk, porridge, green vegetables and meat.

4.2.5.1 Consumption of vitamin A rich foods.

Consumption of pre-formed vitamin A was low (2.89 ± 1.24 and 2.85 ± 1.27 days per week) for mothers and children respectively. Dark Green Leafy Vegetables (DGLV) consumption was highest (10.28 ± 3.4 and 10.59 ± 4.09 days per week for mothers and children respectively). Vitamin A rich fruits consumption was approximately 5.5 ± 2.5 days per week for mothers and 5.0 ± 2.1 days for children (Table 4.8). There was very low consumption of orange-fleshed sweet potatoes, carrots and pumpkins. The mean consumption was 1.03 ± 1.52 and 1.29 ± 2.2 days per week for mothers and children.

A relatively high proportion of mothers (71.9%), and children (70.8 %) had inadequate intake of vitamin A rich foods from animal sources (less than 4 days in a week). When vitamin A rich foods were weighted by source, the proportion of respondents with inadequate intake reduced considerably (Table 4.8). At least 29.7% and 34.4% of mothers and children respectively had inadequate intake (less than six days a week). This result is further confirmed by mean weighted frequency (6.6 ± 1.8 and 6.6 ±

1.95 for mothers and children in that order). Weighted frequency combines intake of both plant (divided by 6) and animal sources therefore mean frequency of weighted intake is usually higher than when each food source is calculated separately. Foods that are fortified with vitamin A in the area included fats and oils. Among those who used oil in their cooking, 10.9% used Elianto cooking oil and 1.6% used Golden Fry cooking oil. Type of fat used during cooking was Kimbo (35.9%), Chipsy (59.4%) and Tilly (3.1%). Most of the women did not use margarine (71.9%).

Table 4.8: Consumption of vitamin A rich foods (Helen Keller FFQ method).

Variable	Mothers (n=64)	Children (n=64)
	Mean (number of days)	
Un-weighted frequency. ‡	25.6 ± 6.1	25.8 ± 7.06
Weighted frequency. #	6.6 ± 1.8	6.6 ± 1.95
Frequency of animal sources of vitamin A. *	2.89 ± 1.2	2.85 ± 1.27
Vitamin A rich fruits. *	5.5 ± 2.5	5.0 ± 2.1
Dark green leafy vegetables *	10.3 ± 3.4	10.59 ± 4.09
Yellow sweet potato, carrots and pumpkin. *	1.03 ± 1.52	1.29 ± 2.2
Fats and oils. *	6.2 ± 2.4	6.4 ± 2.5
Adequacy of intake. +		
Animal source foods (%)	28.1	21.9
Plant source foods (%)	1.6	4.4
Plant and animal source foods (%)	70.3	65.6

‡Sum of the number of times in which animal and plant sources (divided by six) of vitamin A was reported to be consumed in the past 7 days.
#Sum of number of days in which animal sources plus plant sources (divided by six) of vitamin A was reported to be consumed in the past 7 days.
*Sum of the number of days in which food item was reported to be consumed in the past 7 days.
+ Percentage of mothers with adequate intake of vitamin A rich foods from animal source, plant sources or plant plus animal source (weighted) using Helen Keller International threshold values.

Vitamin A from animal sources is the best as about 90% of ingested preformed vitamin A is absorbed. Absorption of vitamin A from plant sources varies depending on plant source and amount of fat in the meal (WHO/FAO, 2004). Studies show that pro vitamin A rich foods are more commonly eaten than preformed vitamin A rich foods in developing countries (Talukder *et al.*, 2000) and this is because they are more accessible and cheaper (Codjia, 2001). Overall, dietary intake of vitamin A was low in this study and the bulk of vitamin A intake was from plant sources.

Similar studies done in other developing countries have shown this to be true. One such study was done to examine the validity of a FFQ method to identify areas with high risk of vitamin A deficiency in Philippines, Guatemala and Tanzania. Results showed that FFQ showed mean frequency of intake of animal source foods to be 3.8 ± 3.0, which is much higher compared to 2.89 ± 1.24 and 2.85 ± 1.27 days among mothers and children found in this study (Sloan *et al.,* 1997). Ramakrishnan *et al.* (1999) also found similar results in a study assessing dietary intakes of preschool children in southern India. Animal products such as milk, meat and eggs were consumed less frequently (45% consumed meat 1-3 times in a month). This is lower than the minimum 4 days per week recommended by the Helen Keller FFQ method (Sloan *et al.,* 1993). A study conducted in Nepal to assess how night-blind women adapt to darkness. The study noted significantly higher plasma retinol among women who consumed liver than those who consumed fortified rice (Haskell *et al.,* 2005).

In this study, the most commonly consumed plant sources of vitamin A were vegetables, more specifically green leafy vegetables that is a common staple food. Fruits and root tubers were rarely consumed by the mothers. Despite this high consumption, the bioavailability of carotenoids from vegetables has been seen to be lower than from other plant sources. A study was conducted among breast feeding women in rural area in West Java, Indonesia. The aim was to examine the extent to which an additional daily portion of local dark green vegetables can improve vitamin A status. Study results showed that consumption of dark green leafy vegetables did not improve vitamin A status in women with low haemoglobin concentrations (de Pee *et al.,* 1995). However, chopping, pureeing, grating and cooking can greatly enhance bioavailability of vegetables (Huang *et al.,* 2000; McEligot *et al.,* 1999).

Yellow sweet potato, carrots and pumpkin were rarely consumed, approximately once a week (Table 4.8). These results agree with another study done in Egypt where pumpkin was consumed once weekly (El-Arab *et al.,* 2002). This could be due to unavailability and high cost of these foods in the study area. Frequency of consumption of fats was also relatively high (approximately six times for both mothers and children). Even though most mothers used fat in cooking the average amount of fat used was very little (19.4 g in a pot). This results agree with Sloan *et al.*(1997) and Waudo *et al.* (2004) where fat and oil consumption among preschoolers in Tanzania was approximately 8 times in a week and over 60% of children under five years of age in the Lake Victoria

region consumed fats or oils daily respectively. High frequency of fat consumption is because of mothers using fat in cooking. However, total fat intake only contributed to 14.9% in women and 19.7% in children (Table 4.10). This is far below the levels required by an individual (WHO, 2003). This could contribute to poor absorption and metabolism of vitamin A in the body. Kimbo and Chipsy, fats used by majority of the women are fortified with vitamin A. Margarine, also fortified with vitamin A, was rarely consumed probably due to its prohibitive cost.

Table 4.9: Adequacy of intake of vitamin A rich foods by Sub-location.

	Mothers (%)		P value	Children(%)		(χ^2) P value
Adequacy	**Yatoi**	**Perkerra**		**Yatoi**	**Perkerra**	
Adequacy of intake of animal sources of vitamin A	18	32	0.262	11.8	17	0.43
Adequacy of intake of plant sources of vitamin A.	0	2.1	0.544	0	6.4	0.286
Adequacy of intake of plant and animal sources of vitamin A (weighted by source)	64.7	72.3	0.555	58.8	68.1	0.49

According to the Helen Keller FFQ method, the surveyed Sub-locations are at risk of VAD. This is because at least 70% of the mothers and their children had inadequate intake of animal sources of vitamin A (less than four days per week). However, the proportion of mothers and children with inadequate intake from plant and animal sources combined (weighted by source) was much lower (≈ 30%). Nevertheless, the figure is still high. When comparing the two Sub-locations in terms of adequacy of intake of animal sources of vitamin A, a relatively higher percentage of mothers and their children had higher intake in Perkerra (32% and 17%) compared to Yatoi (18% and 11.8%). The same findings were recorded when comparing intake of plant and animal sources foods combined (weighted by source). Perkerra Sub-location recorded higher intakes at 72.3% compared to Yatoi at 64.7% (Table 4.9). No significant differences were observed when comparing adequacy of intake in both Sub-locations ($p \geq 0.05$). VAD can have dire consequences in an affected community (Ngare *et al.*, 2000; WHO/FAO, 2004). It is therefore important to prevent it before it occurs. Several studies have shown improved vitamin A status after consumption of vitamin A rich foods especially from plant sources (Stuijvenberg *et al.*, 2000; West *et al.*, 1999; Takyi *et al.*, 1999). Promoting consumption of vitamin A rich food will greatly reduce risk of VAD.

4.2.5.2 Macronutrient and micronutrient intakes.

The average intake of energy and Vitamin A for children 0-6 months of was 544 Kcal and 445 µg respectively. Children aged 7-12 months had an average intake of energy and vitamin A of 849.4 Kcal and 482.5 µg respectively. Average intake of energy for children 1-3 years and 4-5 years was 1256.07 Kcal and 1157.46 Kcal respectively. Intake of vitamin A for the same age groups was 561 µg and 558 µg respectively (Table 4.10). The age group with the highest number of children was between 1-3 years (87.9%). Average intake of energy for all children was 1256 Kcal and average vitamin A intake of 562 µg. Children aged 0-6 months did not meet RNI requirements for energy, vitamin E, iron and zinc. However, RNI requirements for protein, vitamin A vitamin B6, Folic acid and vitamin C were met (WHO/FAO, 2004).

Table 4.10: Mean intakes of macronutrients and micro nutrient intakes of children.

Age Group	0-6 months	7-12 months	1-3 years	4-5 years	Total
Macronutrients					
Energy(Kcal)	544.5 ± 88	849.5 ± 3.4	1256.1 ± 3.9	1157.5 ± 19.9	1155.4 ± 306. 3
Protein(g)	14.9 ± 3.4	22.6 ± 8.4	32 ± 7.5	30 ± 7.8	29.7 ± 8.6
% of protein	11.2	10.5	10.1	10.3	10.2
Fat (g)	24.4 ± 3.9	31.1 ± 6.5	25.5 ± 11.3	20.7 ± 5	23.9 ± 9.3
% of fat	39.8	32	18.3	16.3	19.7
Carbohydrate (g)	67.5 ± 19.9	120.8 ± 4.1	228.4 ± 62.2	214.7 ± 56.6	207.9 ± 72.5
% of Carbohydrate	49	57	71.56	73.4	69.9
Micronutrients					
Vitamin A (µg)	445.5 ± 47.7	482.5 ± 267.7	561.9 ± 277.2	558.1 ± 213.4	549.1 ± 306.3
Carotene(mg)	0.26 ± 0.19	1.1 ± 0.31	2.0 ± 1.35	2.3 ± 1.2	1.9 ± 1.3
Vitamin E (mg)	1.34 ± 0.55	2.1 ± 0.26	2.6 ± 1.38	2.9 ± 1.4	2.6 ± 1.4
Vitamin. B1 (mg)	0.29 ± 0.95	0.62 ± 0.007	1.05 ± 0.27	1.06 ± 0.3	0.98 ± 0.4
Vitamin B2 (mg)	0.61 ± 0.23	0.81 ± 0.57	0.89 ± 0.24	0.75 ± 0.19	0.82 ± 0.3
Vitamin B6 (mg	0.4 ± 0.2	0.82 ± 0.38	1.1 ± 0.3	1.1 ± 0.32	1.07 ± 0.4
Total folic acid(µg)	60.1 ± 10.9	72.8 ± 26.3	86.1 ± 24	90.5 ± 28.2	85.1 ± 25.6
Vitamin C (mg)	38.7 ± 9.15	25.1 ± 6.8	28.5 ± 21.6	32.6 ± 19.5	30.6 ± 20
Iron (mg)	1.41 ± 0.8	3.1 ± 1.2	7.0 ± 2.0	6.8 ± 2	6.4 ± 2.5
Zinc (mg)	2.2 ± 0.56	4.2 ± 1.2	6.3 ± 1.8	6.1 ± 1.9	5.8 ± 2.1

Table 4.11: Mean intake of macro and micronutrients of children between Sub-locations.

Sub - Location	Vitamin A (µg)	Carotene (mg)	Energy (kcal)	Protein (g)	Fat (g)	CHO (g)
Yatoi	480.49 ± 208.9	1.7 ± 1.3	1124.8 ± 278.8	29.7 ± 8	25 ± 13.5	199.3 ± 70.3
Perkerra	576 ± 253.5	2.1 ± 1.3	1167.4 ± 318.58	29.9 ± 8.9	23.6 ± 7.2	211.37 ± 73.8
Total	549.1 ± 244	2 ± 1.3	1155.4 ± 306.3	29.7 ± 8.6	23.99 ± 9.32	207.98 ± 72.48

For children aged between 7 and 12 months, RNI requirements for the following were met: Protein, Vitamin A, Vitamin B1, Vitamin B6, Folic acid, Vitamin C and Zinc. Children of this age group did not meet RNI requirements for energy. Children in the age group of 1-3 years met most of their RNI requirements except for Vitamin E. Children aged between 4-5 years did not meet RNI requirements for energy, fat, vitamin E and Vitamin B2 (WHO/FAO, 2004). Except for fat intake, average intake of energy, protein, carbohydrate, vitamin A and carotene was higher for children in Perkerra (with irrigation) Sub-location than for children in Yatoi (without irrigation) Sub-location.

Average intake of energy in kilocalories for mothers was 1985 Kcal. Average intake of protein was 56.51g and 32.7g. Percentage of energy coming from carbohydrate, protein and fat was, 73%, 11.4% and 14.9% respectively. Average intake of vitamin A was 1171µg and for carotene was 5.2 mg. Average intakes for iron and zinc was 11mg and 12 mg respectively (Table 4.11). RNI requirements for energy and fat were not met by mothers, 1985.7 Kcal and 32.7 g respectively (WHO/FAO, 2004). However, RNI for protein was met (56.5g). In micronutrients, women met RNI requirements for vitamin A (1171 µg). Consumption of Vitamins B1, B2, B6 and C met RNI requirements; however, consumption of Vitamin E and Folic acid was below RNI. In terms of mineral requirements, zinc consumption (12.3 g) met RNI but iron requirements were below RNI (11.3 mg) (WHO/FAO, 2004). When comparing the two Sub-locations, energy, protein, fat, carbohydrate, vitamin A and carotene intakes were higher in Yatoi (without irrigation) Sub-location compared to Perkerra (with irrigation) . The 24-hour recall results showed that mothers had low energy and fat intakes. This could be attributed to the low intake of food.

Interestingly the results show adequate intake of protein and vitamin A for both mothers and their children. High protein intake could be attributed to beans that were frequently consumed and to a lesser extent goat meat. High intake of vitamin A recorded in this study may be attributed to the high consumption of dark green leafy vegetables. However, the bioavailability carotenoids are determined by the food matrix, processing of food, amount of dietary fat and interaction between carotenoids (Van Het Hof *et al.*, 2000).

The fourth hypothesis of the study stated that there is adequate dietary intake of vitamin A rich foods. According to the Helen Keller methodology either of the two threshold values is used to determine risk. The findings of the study clearly show that frequency of intake of animal sources of vitamin A rich foods was low (70% of the respondents took animal sources foods less than four times a day). This means that the respondents did not meet one of the threshold values therefore they are at risk of getting VAD. The results of the 24 Hour recall indicate that RNI for both mothers and children for vitamin A were met. Nevertheless, this intake is not representative of daily intake as the recall was done for only one day, the Helen Keller method requires at least four days intake (Rosen *et al.*, 1993). The hypothesis is therefore rejected on that basis.

Table 4.12: Mean intakes of macronutrients and micro nutrient intakes of mothers.

Macro nutrient intake	**Mean**
Energy (Kcal)	1985.7 ± 635.8
Protein (g)	56.5 ± 18.4
% of Protein	11.4 ± 1.5
Fat (g)	32.7 ± 11.6
% of Fat	14.9 ± 4
Carbohydrate (g)	365.1 ± 128.9
% of Carbohydrate	73.7 ± 4.7
Micro nutrient intake	
Vitamin A (µg)	1171.8 ± 383.8
Carotene (mg)	5.2 ± 1.8
Vitamin E (mg)	6.8 ± 2.2
Vitamin B1 (mg)	1.9 ± 0.63
Vitamin B2 (mg)	1.3 ± 0.45
Vitamin B6 (mg)	2.15 ± 0.5
Total Folic Acid (µg)	165.5 ± 46.2
Vitamin C (mg)	52.7 ± 21.8
Iron (mg)	11.3 ± 3.9
Zinc (mg)	12.3 ± 4.1

Table 4.13: Mean intakes of macro and micronutrients of mothers between Sub-locations.

Region		Energy (kcal)	Protein (g)	Fat (g)	CHO (g)	Vitamin A (µg)	Carotene (mg)
Yatoi	Mean	2076.6 ± 327.3	58.5 ± 11.7	34.9 ± 10.5	379.9 ± 62	1229.8 ± 348.4	5.5 ± 1.7
Perkerra	Mean	1950.2 ± 721.7	55.8 ± 20.5	31.9 ± 11.9	359.3 ± 147.3	1149.1 ± 398.1	5.1 ± 1.9
Total	Mean	1985.7 ± 635.8	56.5 ± 18.4	32.7 ± 11.6	365.1 ± 128.9	1171.8 ± 383.8	5.2 ± 1.8

4.2.6 Diseases associated with vitamin A deficiency and supplementation of vitamin A.

Common infections among children as reported by their mothers were Malaria (30.6%) and Respiratory Disease (40.8%) (Figure 4.9). Secondary data on incidences of various diseases associated with VAD and VADD were gathered from the all public health centres. A total of 7341 cases of malaria, 2744 cases of respiratory infections, 360 cases of tuberculosis, 220 cases of measles and 108 cases of eye infections were reported in the health centres (Table 4.14).

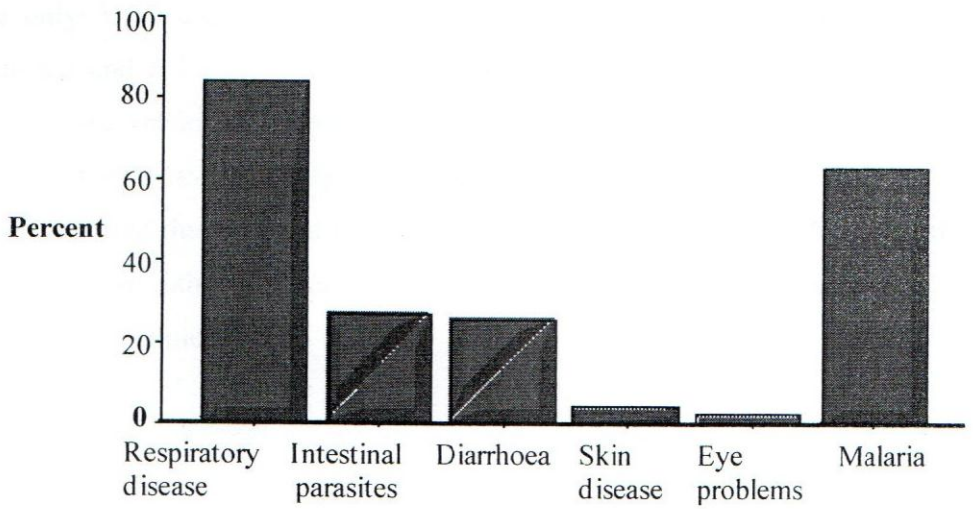


Figure 4.9: Ailments affecting children in Marigat Division.

The results indicate high incidences of respiratory disease, measles, eye infections and tuberculosis. This is shown in both secondary data and data collected during the interview. The Ministry of Health recognises presence of these diseases as a serious problem since they exacerbate VAD. Because of this, additional vitamin A

supplementation is given to those suffering from these diseases (MOH, 2004). Underlying disease conditions have been shown to reduce absorption of vitamin A (Mclaren and Frigg, 2001). Presence of parasites influences plasma retinol values and overall vitamin A status (Olson, 1991). A study was conducted to determine the long-term effects of a horticultural and nutrition education intervention in rural Tanzania. The experimental area that had been trained in nutrition and horticultural education was compared to a control area. Children aged 12-71 months had their stools were examined for helminths and serum samples were analysed for retinol and C-reactive protein. It was found that children in experimental area had lower mean serum retinol concentrations compared to children in control area. The reason for this unusual outcome was that there was higher helminth infestation in experimental area compared to control area (Kidala *et al.*, 2000). A diet adequate in vitamin A reduces risk of respiratory and gastrointestinal infections (WHO/FAO, 2004). A study showed that serum retinol and pro vitamin A as well as non-pro vitamin A carotenoid concentrations were lower in children with acute infections compared to healthy controls (Cser *et al.*, 2004). Reduced rate of infections therefore will possibly improve vitamin A status of residents of Marigat.

A high proportion of women visited the clinic after birth of index child (96.6%) while only 3.4% did not visit the clinic. Most of the children (91.3%) were fully immunised and 8.3% were partly immunised. It is important to note that some of the children were yet to finish immunization. A large percentage of mothers (73.8%) and children (86.4%) received vitamin A capsules when they went for clinic visits. Most mothers reported that they did not use any vitamin supplements (96.6%). For those who reported use of other vitamin supplements, majority used folic acid that was also provided in the clinics.

Table 4.14: Prevalence of diseases associated with vitamin A in Marigat Division

Health facility Type of Infections.	Marigat HC	Marigat PHC	Ngambo	Loboi	Kampi samaki	Kimalel	Kokwa	Totals
Malaria	2406	91	895	1559	1421	895	74	7341
Respiratory infection	595	131	201	465	253	933	166	2744
Worm infestation	4	0	4	1	11	74	3	97
HIV AIDS	17	11	0	13	8	0	0	49
Tuberculosis	349	2	0	9	0	0	0	360
Measles	61	46	32	32	49	0	0	220
Eye Infections	54	3	8	16	20	6	1	108
Kwashiorkor	1	1	0	0	5	2	1	10
Marasmus	0	6	0	2	0	2	0	10
Other Infections.	0	39	0	0	0	1	0	40
Vitamin A coverage rates								
Vitamin A Coverage's	39	0	0	0	0	0	0	39
Under 1yr(100,000IU)	304	338	50	67	92	76	1	928
Above 1yr(200000IU)	55	129	10	12	10	30	1	247
Lactating Mothers(200000IU)	340	228	17	9	77	5	3	679

HC – Health centre PHC – Public Health Centre

In terms of coverage of vitamin A supplementation, 928 children under one year and 247 children above one year were given vitamin A supplements in Baringo District. Among lactating mothers, at least 679 were given vitamin A supplements (Table 4.14) (MOH unpublished health records for Baringo District). The Focus Group Discussions further revealed that there are many problems experienced by health care providers during service delivery in health care centres. Lack of adequate medical supplies, lack of enough staff and lack of drugs are some of the major problems. It was further revealed in the Focus Group Discussion with health workers that during clinic visits sometimes health workers forget to give vitamin A supplements to mothers and children. In some cases, health care workers gave out the vitamin A supplements without supervising. Therefore, they are never sure if the mothers and/or the children took the supplements.

Clinic visits are very important, as it is during this time that most vitamin A capsules are given. Lactating mothers within four weeks post partum are supplied with vitamin A capsules of 200,000 IU. Children under one year of age and children above one year but below five years of age are given 100,000 IU and 200,000 IU respectively

(MOH, 2004). At least 70% of both mothers and their children received vitamin A supplementation in this study. A study conducted to assess impact of postpartum vitamin A supplementation found that it has a beneficial impact on the infant serum retinol and the breast milk retinol level but no effect on infant growth (Vinutha *et al.*, 2000).

Community leaders interviewed in the Focus Group Discussions said they were aware that VAD is a problem in the Division. The community leaders have awareness creation campaigns, capacity-building workshops, field days and exchange visits within the communities to make them aware of the problem. However, the campaigns are not specific to VAD, rather to solve many other problems affecting the community such as insufficient water. This could be an opportunity for relaying nutritional messages.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Food based strategies are an ignored frontier in the fight against VAD in Marigat Division. Results show that vitamin A rich foods were rarely grown in the main farmlands (2%) and very few women (18.9%) had kitchen gardens in their homes. Traditional green leafy vegetables are readily available in the environment. Despite the availability of vitamin A rich food at the market place, consumption of these foods at household level was low. The results also show that more than half of the mothers (53.4%) did not have any farm produce from the immediate previous planting season. Staple foods such as maize and other foods such as vegetables and fruits that consumed in the household had to be bought. Priority was given to staple foods and not vitamin A rich foods when buying. The results show an unexplored potential in food based strategies.

Marigat being a semi-arid area experiences long dry spells. This is demonstrated by the lack of farm produce. Seasonality of crops therefore greatly affected accessibility of vitamin A rich foods. As a result, most of the women bought food commodities because they were not available from the farms. Costs of some of the vitamin A rich foods were prohibitive therefore fruits, meat and root tubers were rarely consumed. Cultural practices may interfere with intake of vitamin A rich foods and in this study; it was restricted to pastoralist communities as revealed in the Focus Group Discussions. These communities had low regard for vegetables and believed that organ meat should only be consumed by men.

Methods used in food preparation and food processing showed that the mothers had a little knowledge on the importance of taking precautions when preparing and cooking food. However, the knowledge was not specific to vitamin A rich foods. Food preservation was rarely practised especially preservation of fresh produce. Taking into consideration that Marigat is a dry area, preservation of vitamin A rich foods could go a long way in alleviating VAD.

Consumption of vitamin A rich foods was low (less than four days a week) and more especially food from animal source. Immediate cause of VAD is inadequate consumption of food rich in Vitamin A. Low consumption may be attributed to

unavailability and inaccessibility of these foods in individual households. The 24-hour recall showed adequate consumption of vitamin A. However, these results represent intake of only one day. Intervention programmes focusing on improving availability, accessibility and eventual consumption of vitamin A rich foods should be introduced.

Poor knowledge and practices on vitamin A and vitamin A rich foods showed low nutritional knowledge. Although the women had generally positive attitudes towards vitamin A rich foods, more needs to be done. Nutrition education alone could greatly improve consumption of vitamin A rich foods as studies have shown substantial improvement in KAP after nutrition education and introduction of home gardens.

The Ministry of Agriculture helps promote Food Based Strategies such as kitchen gardening in which residents are encouraged to grow kales, spinach and traditional vegetables. They are also encouraged to grow sweet potatoes, cassava, pawpaw tomatoes and melons. The home economics unit teaches them how to cook and preserve foods and best ways to avoid loss of nutrients. The impact of this food based strategy need to be assessed to ascertain gains made.

In general, Food Based Strategies were hardly used in the prevention of VAD in Marigat Division. Vitamin A rich foods were not available and accessible. No differences were found in the two Sub Locations therefore availability of water in Perkerra did not play a major role. There was poor dietary intake of vitamins A rich foods, poor food preparation, processing and preservation practices and poor knowledge attitudes and practices.

5.2 Recommendation.

Intervention programmes focusing on production and supply of vitamin A rich foods should be established in Marigat Division. The Ministry of Agriculture already has work being done on the ground, however based on the results of the study this is not enough. Production of vitamin A rich foods in main farmlands and kitchen gardening could improve availability and accessibility. Vitamin A rich crops that can be grown in the area include kales, spinach, traditional vegetables, orange-fleshed sweet potatoes, pawpaw tomatoes and melons. These foods when sold could act as an alternative source of income thereby economically empowering individuals.

The Marigat community should be made aware of the VAD problem in the area. Results show that there is lack of awareness. Nutrition education should be conducted to improve mother's knowledge of vitamin A, best food sources and how prevent VAD. This empowers the mothers to take responsibility over their diets. They should also be taught on the importance of cooking all vitamin A rich foods with fat. Since seasonality of vegetables and fruits greatly affects accessibility, it is important to teach mother how to preserve fresh produce of vitamin A rich foods. These food could be consumed when out of season or during lean times. It is also important to make mother aware of other strategies they might use to cope during dry spells, such as using hunger gap foods and diversifying the diet.

Community leaders could help promote income-generating activities in the Division. There are many NGO's and CBO's in the area working together with the government to improve lives of the people. Integrating Food Based Strategies into such community projects, to help control VAD should be encouraged.

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APPENDIX I: QUESTIONNAIRE FOR WOMEN AND THEIR CHILDREN UNDER AGE FIVE.

Questionnaire no._____ Date of interview_____Code_____

For supervisor.
Are all questions filled?_____Are the women reasonable?_____
Is the questionnaire ready for keying?_____

Section A. Demography and socio-economic status.

1. House hold head gender____ 1 = male 2 = female
2. Occupation___I= none 2 = professional 3 = skilled worker 4 = unskilled
3. Occupation of respondent____ 1 = none 2 = professional 3 = skilled worker 4 = unskilled
4. Marital status___ 1 = single 2 = married 3 = divorced 4 =separated 5 = widowed
5. Age of respondent____level of education ____
   1 = no education 2 = primary 3 =secondary 4 = special training
6. Age of child(in months)___sex____ 1 = male 2 = female
7. (Observation) Type of housing ___1 = Permanent 2 = Semi-permanent 3 = Temporary
8. What is the main source of livelihood for this household? _____
   1 = selling animals and animal products 2 = food crop production 3 = selling animals and animal products &food crop production 3 = cash crop production 4 = employment (salary) 5 = self employment 6 = casual work 7=other (specify)____
9. Please indicate how much you earn from the following.

Sale of animal of animal products (specify)	
Food crop production (Indicate crop and no. of bags)	
Cash crop production (Indicate crop and no. of bags)	
Salaried employment	
Other (please specify)	

10. What common Infections afflict your child? Please tick where appropriate.
    ☐ Respiratory disease ☐ Intestinal parasites/worms ☐ Diarrhoea
    ☐ Skin diseases ☐ Eye problems ☐ Other (specify)_____
11. Did you visit the clinic after birth?_____ 1 = Yes 2 = No
12. Was child immunized?_____ 1 = Fully immunised 2 = Partially immunised 3 = Not immunised.

13. Were you given vitamin A capsules?____and your child?_____1 = Yes 2 = No

14. Are you taking any other vitamin and mineral supplements?____ 1 = Yes 2 = No

15. If yes, which ones?_____

Section B. Food production.

16. What acreage of land did you cultivate last season?_____

17. What did you grow on that land?

_____

_____

_____

18. What do you do with the produce?____1 = Sell 2 = Traded 3 = Consume 4 = Sell and consume

19. Do you own that land?_____ 1 = Own 2 = Lease 3 = Other (specify)_____

20. Do you keep any animals?_____1 = Yes 2 = No

21. If yes please indicate which type of animals and number

Type of Animal	Number of Animals

22. What are the months of food scarcity?_____ 1 = Yes 2 = No

1 = January – April 2 = May – August 3 = September – December

23. What coping strategies do you employ during months of scarcity? (Please tick where appropriate)

Strategy	Tick	Strategy	Tick
Diet change		Buying	
Storage		Borrowing.	
Selling belongings.		Preserving	
Hunger gap foods		Migration	
Relief food.			

24. Do you have a kitchen garden? 1 = Yes 2 = No

25. If yes what food is grown in the gardens?

_____

_____

_____

26. What foods do you buy from the market place?

_____

_____

_____

27. Approximately how much did you spend on food last month?_____

28. If you had more resources what food would you and your family like to eat more often?

_____

_____

_____

29. Are there foods, fruits or vegetables that you gather from surrounding environment?

_____1 = Yes 2 = No. If yes which ones?

_____

_____

_____

30. Who controls the buying food?_____1 = Household head 2 = Women 3 = Men 4 = Household head and women 5 = Other

Section C. Knowledge, attitudes and practices on vitamin A rich foods

31. What is the main cause of night blindness especially in Children?

1 = Food that we eat 2 = Water 3 = I don't know 4 = Other (specify)_____

32. What is malnutrition?

_____

_____

_____

33. What causes it?

_____

_____

_____

34. What is a vitamin?

_____

_____

_____

35. What are the signs and symptoms of vitamin A deficiency?

_____

_____

_____

_____

36. Which foods do you think are best sources of vitamin A?

_____

_____

_____

_____

_____

37. Is Vitamin A deficiency preventable ? _____1 = Yes 2 = No. If yes, how?

_____

_____

_____

(State the degree to which you agree or disagree with the following statements)

38. Traditional green leafy vegetables are not fed to children_____
39. Vitamin A is not different from other vitamins as they all have the same functions_____
40. Regular consumption of meats can does not help improve your vitamin A status_____
41. Fruits are snacks that are only fed children_____
42. Women and Children should not consume organ meats and eggs_____
43. Regular consumption of vegetables is not important especially for men_____

1= strongly agree 2=agree 3= don't know 4= disagree 5= strongly disagree

44. When did you introduce complementary food into the infant's diet?_____

1= 1-3 months 2= 4-6 months 3= After 6 months.

45. What foods did you introduce?_____
46. Did you exclusively breastfeed your child? 1 = Yes 2 = No _____
47. Up to what age did you continue breastfeeding your child? ___ 1 = 4months 2 = 4-6 months 3 = 6-8 months 4 = 8- 10 months 5 = 10 – 16 months 6 = 16-24 months.
48. Do you always use fat in your cooking? _____1 = Yes 2 = No
49. If yes approximately how much fat do you use?_____
50. Do you cover your foods when cooking?_____ 1 = Yes 2 = No
51. How is food distributed during mealtime? _____

    1 = Eat together on central plate 2 = Males eat first 3= Children eat first 4= Women eat first

Section D. Food preparation and preservation

Food	Preparation	Processing	Preservation	Source
Green vegetables				
Traditional Vegetables				
Other Vegetables				
Fruits				
Meats				
Dry legumes				
Fresh legumes				
Root tubers				
Nuts				

Preparation: 1=cut-wash-cook 2=wash-cut-cook 3=cut-cook 4=wash-cook 5=other
Processing: 1=boil 2=stew 3=fry 4=steam 5=bake 6=other
Preservation: 1= dried in sun 2= dried in shade 3= smoked 4= salted 5= other
Source: 1=own produce 2=bought 3=available in the wild 4=traded 5=begging 6=other

52. Do you take any precautions when preparing and preserving this foods to ensure that nutrients are not lost?____ 1 = Yes 2 = No
53. If yes what precautions?_____
54. How are preserved foods stored?_____

    1= granary 2= air tight containers 3=in an airy place 4=other (specify)_____
55. Do you have any training or knowledge of food preservation?____ 1 = Yes 2 = No
56. Would you like to add more knowledge?_____ 1 = Yes 2 = No

APPENDIX II: 24 HOUR RECALL

For mother.

1=Time/Meal	2=dish	3=Ingredients	5=Description	6=Preparation Method	Amount consumed	Qnty (g)

For child

1=Time/Meal	2=Dish	3=Ingredients	5=Description	6=Preparation Method	Amount consumed	Qnty (g)

Method of preparation: 1 = Eaten raw 2 = Boiled 3 = Steamed 4 = Deep fried

APPENDIX III: FOOD FREQUENCY QUESTIONNAIRE

Food	Mother	Child	Source of food
1. Meat			
2. Goat liver			
3. Cow liver			
4. Chicken liver			
5. Chicken			
6. Eggs			
7. Kales			
8. Spinach			
9. Amaranthus(terere)			
10. Pumpkin leaves			
11. Cowpeas leaves(kunde)			
12. Black nightshade (managu)			
13. Yellow sweet potato			
14. Irish potato			
15. Cabbage			
16. Carrots			
17. Bananas			
18. Mangoes			
19. Pawpaw			
20. Avocado			
21. Melons			
22. Guavas			
23. Oranges			
24. Pumpkin			
25. Tomatoes.			
26. Bread			
27. Oils (specify type)			
28. Fat (specify type)			
29. Margarine type			
30. Organ meats			
31. Beans/other pulses			
32. Eggs			
33. Potatoes			
34. Maize flour			
35. Rice			
36. Sugar			
37. Milk			
38. Fish			

Source: 1 = Own 2 = Purchased 3 = Donated 4 = Own produce 5 = Other

APPENDIX IV: CHECKLIST FOR FOCUS GROUP DISCUSSIONS

1. Can name all vitamin A rich foods available in this area ?

2. What are the major sources of fats, oils and protein rich foods in his area?

3. Are this foods available and accessible to everyone? ____1=yes 2=no. If not why?(List reasons)

4. Are there any cultural beliefs about these foods?

5. Are there any food based strategies being promoted in this area ? __1=yes 2=no. If yes which ones?

6. Would you say they are a success?_____1=yes 2=no

7. What are the staple foods in this Division?

8. How is this food acquired in this particular locality?

1 = Purchased 2 = Home-grown 3 = Collected from the wild 4 = Donated 5 = Other

9. Are there periodic markets in this area?____1= yes 2= no. If yes when are the market days?_____

   1= once a week 2= twice a week 3= more than two times 4= all the days

10. What food is available in the markets?

11. Are here any seasonal crops in his area ? ____1=yes 2=no. if yes Which ones?

12. Are you aware there is a problem with VAD in this area?_____1=yes 2=no

13. If yes what are the health care professionals, community doing about it?

14. What common problems are encountered during the delivery of health services?

15. What are the common problems are experienced by women and children in this community?

16. What is the community doing to alleviate such problems?

17. What problems are experienced by farmers?

18. What intervention strategies have been put by the government/NGO's to address the above problems?

APPENDIX V: CROSS TABULATION TABLES

Table 1: A cross tabulation showing types of crops grown in the main farmlands.

Region	Maize	Beans	Fruits	Vegetable s	All	None	Total
Yatoi	16	0	0	0	5	51	72
Perkerra	55	1	1	3	16	58	134
Total	71	1	1	3	21	109	206

Chi square = 0.009, p≤0.05

Table 2: A cross tabulation of utilization of farm produce in Yatoi and Perkerra.

Region	Sell	Consume	Sell and consume	No crops grown.	Total
Yatoi	1	11	9	51	72
Perkerra	20	27	28	59	134
Total	31	38	37	110	206

Chi square = 0.002, p≤0.05

Table 3: A cross tabulation for types of crops grown in kitchen gardens.

Region	Green leafy vegetable s	Orange yellow fruits	Orange yellow fruits and green vegetable s	Other types of crops	No Crops	Total
Yatoi	10	0	1	0	61	72
Perkerra	19	4	4	2	105	134
Total	29	4	5	2	166	206

Chi square = 0.412, p≥0.05

Table 4: A cross tabulation for the types of food bought in the market place.

Region	Green leafy vegetable s	Orange yellow fruits	Orange yellow fruits and green vegetable s	Maize	Beans	All
Yatoi	16	2	33	4	0	17
Perkerra	16	3	64	11	4	36
Total	32	5	97	15	4	53

Chi square = 0.299, p≥0.05

Table 5: A cross tabulation for types of food gathered from environment

Region	Black night shade	Amaranthus	Spider plant	All	No crops gathered	Total
Yatoi	1	9	1	13	48	72
Perkerra	6	28	4	45	51	134
Total	7	37	5	58	99	206

Chi square = 0.004, p≤0.05

Table 6: A cross tabulation for strategies employed during scarcity

Region	Diet change	Storage	Selling belongings	Relief foods	Buying	Borrowing	Total
Yatoi	2	8	1	14	44	3	72
Perkerra	6	6	0	6	115	1	134
Total	8	14	1	20	159	4	206

Chi square = 0.00, $p \leq 0.05$

Table 7: A cross tabulation for respondent's food preferences.

Region	Milk	Meat	Legumes	Rice	Veges	Fruits	All
Yatoi	0	31	3	5	1	1	31
Perkerra	6	58	2	7	1	5	55
Total	6	89	5	12	2	6	86

Chi square = 0.427, $p \geq 0.05$

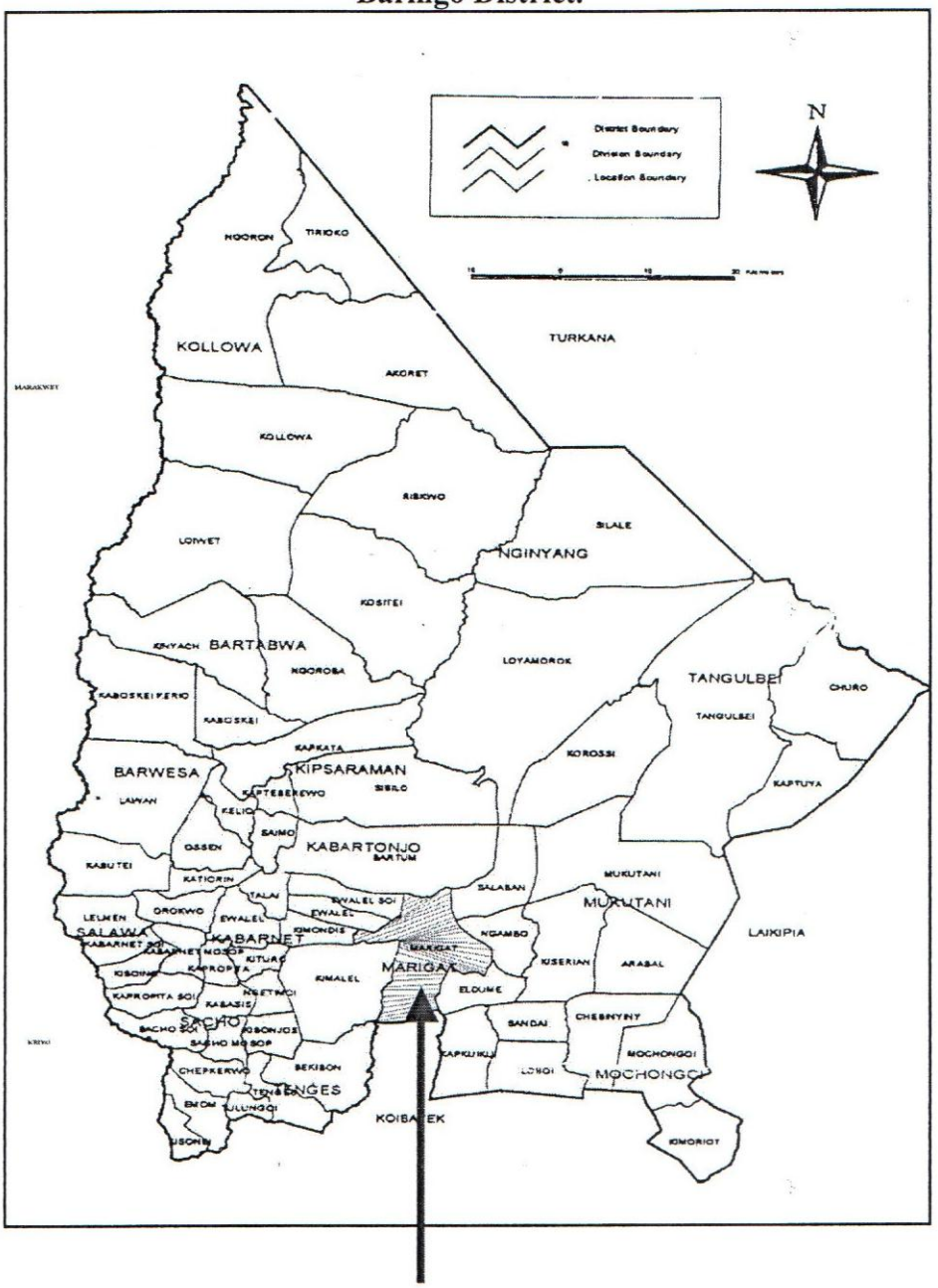
Table 8: Cross tabulation for Decision making.

Region	Household head	Women	Men	Household head and women	Total
Yatoi	15	16	14	27	72
Perkerra	11	26	24	73	134
Total	26	42	38	100	206

Chi square = 0.03, $p \leq 0.05$, df =3

APPENDIX VI: MAP OF STUDY AREA

Baringo District.



Marigat Division.

Source: Central Bureau of Statistics

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