VITAMIN A AND NUTRITIONAL STATUS OF CHILDREN AGED 24-72 MONTHS IN NAMBALE, BUSIA DISTRICT, KENYA. (A COMPARATIVE STUDY OF HOUSEHOLDS WITH AND WITHOUT HOME GARDENS)

BY

WANJOHI PAULINE MUTHONI

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DECLARATION

I **Wanjohi Pauline Muthoni**, hereby declare that this dissertation is my original work, and to the best of my knowledge, has not been presented for a degree in any other University.

Wanjohi Pauline Muthoni
Date 12-06-2006

This dissertation has been submitted for examination with our approval as university Supervisors:

PROF. WAMBUI KOGI-MAKAU
Department of Food Science, Nutrition and Technology
University of Nairobi.
Date 19 June 2006

19/6/06

PROF. E.G. KARURI
Department of Food Science, Nutrition and Technology
University of Nairobi.
Date ____________

DEDICATION

This work is dedicated to my mother, Esther Wangui Muraya, who has sacrificed so much for my education and also gave me invaluable encouragement.

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OPERATIONAL DEFINITIONS

Adequate vitamin A status	This is the situation when serum retinol levels are ≥ 1.05μmol/L and is considered to be a level at which physiological functions of Vitamin A are satisfactorily taking place.
Animal score	The total number of days a child consumed any vitamin A rich food of animal origin or a a vitamin A fortified food source in the period of seven day before the interview day.
Bioavailability	It is the proportion of a nutrient ingested which become available for utilization by the body.
Bioefficacy	It is the efficiency with which an ingested nutrient is absorbed and converted to the active form of the nutrient.
Community vegetables score	The mean frequency of consumption of plant sources of vitamin A rich food of study households in the period of seven days before the interview day.

Deficient vitamin A status	Refers to that condition where a child has very low Vitamin A values of serum retinol < 0.7μmol/L
Education level	Refers to the number of years a respondent attended formal education.
Functional bioefficacy	The proportion of an ingested nutrient that carries out a given metabolic function.
Dietary diversity score	The number of different food groups consumed by an index child over a period of seven days before the interview day.
Home gardening	Term given to production of vegetables mainly for household consumption within or near the homestead
Household	All people who have lived together for at least three months sharing food and other essential facilities regardless of their blood relations.
Household head	Refers to the person who is the major decision maker on household income and expenditure as reported by the respondent.
Household income	Refers to monthly cash earnings in the household equivalent from all sources including sales, salaries and remittances.

Index child	This refers to a child aged between 24 and 72 months who was sampled for study
Retinol Equivalents	The amount of a substance having biological activity equivalent to that of 1 μg retinol.
Retinol activity equivalent	is the proportion of β-carotene in a mixed diet converted to retinol. One(1) retinol equivalent activity(RAE) is eqivalent to 12 μg β-carotene.
Retinoids	Compounds either natural or synthetic with Vitamin A-like structure or activity
Xerophthalmia	The general term applied to all the ocular manifestations of impaired Vitamin A status ranging from night blindness to complete corneal ulceration
Vegetable score	Refers to the total number of days an index child consumed Vitamin A rich food of plant origin in the period of seven day before the interview day.
Vitamin A Deficiency	Includes xerophthalmia but has much wider application relating to any state in which Vitamin A status is abnormal.

Vitamin A Status This is the total reserve of vitamin A as indicated by amount of retinol in the blood (serum retinol levels test).

ABBREVIATIONS

ACC	- Adminstrative Committee on Coordination
ALBH	-Association of better husbandry
ANP	- Applied Nutrition Programme
ANSC	- Animal sources
AVRDC	-Asian
CBNP	- Community Based Nutrition Programme
CTA	-Technical Centre for Agricultural and rural cooperation
DAO	-District Agricultural Office
DEB	-District Education Board
DVDB	- Division of Vector-Borne Diseases
DGLV	-Dark green leafy Vegetable
DYOF	-Dark yellow/orange fruits
DYOR/V	- Dark yellow/orange roots or vegetables
ECSA	-East, central and southern Africa
EPI-Info	-Database and statistical programme for Epidemiological and Nutritional data.
FAO	- Food and Agriculture Organization
FANB	-Food and nutrition bulletin
FFQ	- Food frequency questionnaire
FGD	- Focus group discussions
FTC	- Farmers Training Centre
GIT	-Gastro-intestinal parasites
GOK	- Government of Kenya

HAZ	-Height for age z-scores
HEB	- Home Economics Branch
HEE	- Home Economics Extension
HG	- Home gardening
HKI	-Helen Keller International
HPLC	- High pressure liquid chromatography
IDA	-Iron deficiency Anemia
IDD	- Iodine deficiency disorders
IFPRI	- International Food Policy Research Institute
IU	- International units
IVACG	-International Vitamin A Consultative Group
JEEP	-'Jardins et Elevages de Parcelle'
KARI	- Kenya Agricultural Research Institute
KCSE	- Kenya certificate of secondary education
KDHS	- Kenya demographic health surveys
KEMRI	- Kenya Medical Research Institute
LM	-Low marginal
MCH	- Martenal Child Health
MOA	- Ministry of Agriculture
MOARD	-Ministry of Agriculture and Rural Development
MOH	-Ministry of Health
MSG	-Monosodium glutamate
MUAC	- Mid upper arm circumference

NHG	-Non-home gardening
NGO	-Non- Governmental organization
PDA	-Provincial Director of Agriculture
PDALE	-Provincial Director of Agriculture and Livestock Extension
PEM	- Protein energy malnutrition
RBA	- Raised bed agriculture
RBP	-Retinol Binding Protein
RDA	- Recommended daily allowances
ROP	-Republic of Kenya
SCN	- Subcommittee on Nutrition
SD	-Standard deviation
SPSS	- Statistical package of social sciences
μg	- Micrograms
Vit A	-Vitamin A
VAD	-Vitamin A Deficiency
VADD	-Vitamin A Deficiency Disorders
VITAA	-Vitamin A for Africa
WAZ	-Weight for age z-scores
WHO	- World Health Organization
WHZ	- Weight for height z-scores

ABSTRACT

This study compared vitamin A status, nutritional status and food diversity of children aged between 24 and 72 months, of households possessing home gardens and those without home gardens, in Nambale Division of Busia District, Western Province, Kenya.

The study was meant to document the extent to which home gardening contributes to vitamin A status, nutritional status and households' diet diversification. This was a cross-sectional, descriptive, analytical and comparative study.

A total of 376 households comprised the study sample, of which 138 were all households that had home gardens in the study area and 238 households without home gardens. These households were selected from three out of five locations of Nambale division using purposive, stratified and systematic sampling. A sub-sample of 82 households, 35 with home gardens and 48 without were selected for 24-hour dietary recall. Biochemical serum retinol tests, stool test for gastro-intestinal parasites and clinical observations were done on 29 children of gardeners and 48 of non-gardeners.

A structured questionnaire covering aspects of socio-demographic, socio-economic, crop production, home gardening activities, food consumption, dietary intake, vitamin A supplementation and morbidity was administered to respondents. Biochemical test for serum retinol levels was done using high

performance liquid chromatography method, while presence of gastrointestinal parasites was investigated using concentration method at research-oriented laboratories of the Kenya Medical Research Institute.Dietary data for assessing food consumption and dietary diversity was collected using the Helen Keller International food frequency questionnaire method, while the twenty-four hours recall was used to collect data on dietary adequacy.

The two study groups showed no significant difference in socio-demographic and socio-economic characteristics investigated in this study.

Vitamin A status of children from households with home gardens was low-adequate with a serum retinol mean of 1.03μmol/L and 9.1% vitamin A deficient cases while their counter parts had a serum retinol mean of 1.15μmol/L and 8.3 vitamin A deficient cases, however the difference was not significant.

Both study groups depicted a vitamin A public health problem since they consumed Vitamin A rich foods below the recommended adequate level of mean frequency score of 6, Children of home gardeners had a score of 5.98(SD 4.08) while that of non-home gardeners was 5.29 (SD 3.79) by the Helen Keller food frequency questionnaire method. In comparison to those of gardening households, children of non-gardeners had consumed significantly higher animal sources of vitamin A rich foods that could have maintained higher serum retinol levels in this group. The most commonly consumed vitamin A rich food in both study groups were dark green leafy vegetables, though the consumption was insignificantly higher in the gardening group.

Diets of both study groups provided adequate protein intake but were deficient in both calories and vitamin A. Caloric intake was significantly higher for the home gardening group and was associated with stunting within the group implying that gardening contributed to reduced stunting(both rate and severity) in study group. The children of gardeners consumed a slightly more diversified diet with an average dietary diversity score of 3.69 compared to a score of 3.35 among their counterparts.The difference was not significant leading to accepting of the hypothesis that 'there was no difference in the dietary diversity of households practicing and those not practicing home gardening'.

Very few mothers, 35.5 % gardeners and 32.4% non-gardeners, knew the importance of vitamin A to their children while only 22 mothers from both study groups considered a vitamin food as part of an ideal meal for their child.

A higher percentage (34%) of the children of households without home gardens were infested by gastrointestinal parasites compared to 25% infestation among their counterparts.

A significantly higher morbidity (53.9%) was found among children of home gardeners as compared to 43.6%. among their counterparts.

There was no significant difference in nutritional status of children from the two groups although stunting was insignificantly higher (36.4%), among the non-home gardeners compared to 27.8% among gardeners. The prevalence of both wasting and underweight were higher among the children of gardeners (4% and 15.1%), compared to 2.6% and 13% among the non-gardeners respectively. This led to acceptance of the hypothesis that ‘there is no significant difference in vitamin A and Nutrition status of household that practice or don’t practice home gardening’.

The presence of a home garden had not improved vitamin A status of study children significantly although the children of gardening households had higher caloric intake, more diversified diet and were less stunted compared to their counterparts. Off-farm income and consumption of vitamin A rich animal products had contributed to sustainable and improved vitamin A status among children of households without home gardens.Low nutritional knowledge among mothers of study children contributed to ommion of vitamin A food in the children’s’ meals. Gardening efforts should include nutrition education and activities that increase households’ income to enable adequate consumption of animal sources to vitamin A that have significant effect in improving vitamin A status.

INTRODUCTION

1.1 . BACKGROUND INFORMATION

Vitamin A Deficiency (VAD) is one of the three major micronutrient deficiencies of global concern; the others are iron deficiency anemia (IDA) and iodine deficiency disorders (IDD) (FAO, 1997). The 1995 and 1998 estimates indicate that Vitamin A deficiency exists in an estimated 78 countries of the world, affecting 140 million people out of which 4.4million have Xerophthalmia (ACC/SCN, 2000; West, 2002). Developing countries have higher prevalence of VAD, where it is associated with deaths of 1.2 – 3 million children (Sommer and Davidson, 2002).

In Kenya results of two national surveys by Ministry of Health (MOH) in collaboration with Kenya Medical Research Institute (KEMRI) and UNICEF in 1994 and 1999 show that VAD is a significant public health problem among preschool children. Using serum retinol, results of the two surveys indicate that Kenya's VAD prevalence levels were 59.4 % and 75.9% in 1994 and 1999 respectively (GOK/UNICEF, 1994; Mwaniki et al., 1999).

According to the 1999 survey, very high levels of VAD rates, 60.5%, 56.2% and 44.75% were reported in Nyanza, Western and Coast provinces respectively. More than 50% of the population in five out of the fourteen districts surveyed, (Bungoma, Kisumu, South Nyanza, Kisii and Garissa) had retinol levels below 20 μg/dl (equivalent to 0.70μMol/L), that indicates severe to moderate VAD. Residents of Six districts had severe VAD as indicated by mean serum retinol levels below 10μg/dl (equivalent to 0.35μMol/L) in more than 5% of their sampled population. The rates of severe VAD prevalence in the worst hit districts were; Kisii 21.5%, Bungoma 18.4%, Kisumu13.4 %, South Nyanza 12.8%, Mombasa 10.8% and Kwale 8.4% (GOK/UNICEF1994; Mwaniki et al., 1999). These levels are higher than the WHO cut-off point indicating that VAD is an important public health problem in the six districts. As per WHO classification, a community is said to have VAD public health problem when more than 5% of the sampled population has serum retinol levels below 10μg/dl, which is equivalent to 0.35μMol/L.

VAD is controlled through high-dose supplementation, food fortification and dietary diversity. Diet diversification is the most preferred as well as the most sustainable solution to VAD (Bloem et al, 2002; Ramakrishnan and Darnton-Hill, 2002; Sommer and Davidson, 2002). One strategy of preventing and controlling VAD through dietary diversity is by maintaining an adequate consumption of vitamin A rich foods, most of which can easily be produced in the home garden. Home gardening is likely to increase availability and accessibility to vitamin A rich foods as shown in figure 1 on page 14 (Dotted Illustration).

Best dietary sources of vitamin A are animal products such as liver, fish, eggs and dairy products. Vitamin A in plants is found in form of a vitamin A precursor known as beta- carotene. Good sources of beta-carotene include, dark green leafy vegetables, yellow fruits, orange roots and oils of palms.

Causes of vitamin A deficiency have been classified into three levels, direct, underlying and basic causes. Direct or immediate causes include inadequate dietary intake and frequent illnesses. Direct causes arise as a result of underlying causes that include, inadequate access to food, inadequate care of mothers and children and insufficient health services and unhealthy environment. Underlying causes are themselves a result of basic causes, which include political ideological superstructure, economic structure, resources and control.

1.2 PROBLEM STATEMENT

VAD continues to be a big challenge in Kenya despite the many interventions put in place to curb it. In Kenya micronutrients malnutrition (hidden hunger) based on VAD, iodine, iron and zinc deficiencies are unacceptably high and the prevalence is reportedly higher than that of protein energy malnutrition (PEM). Data from the 1999 micronutrient survey indicate that the VAD situation had worsened from 59.4% in 1994 to 75.9%. The high risks regions in Kenya include the Lake region (in which Busia district falls), Coastal region, Semi-Arid lands and Eastern Province (Mwaniki et al., 2001; Kuria et al., 2004).

Dietary diversity strategies have been cited as a sustainable method of controlling VAD as opposed to high dose supplementation that is a short-term strategy. Although food fortification is a food-based method of controlling VAD, the method has a limitation vested in the high cost of the resultant food that the VAD at risk group may not afford.

It has been shown that diets of the poor tend to consist of foods of plant origin, which are relatively cheaper than animal products(Timmer et al., 1984; Lantham, 1997). About 56% of Kenyans are poor and therefore it is necessary to assess the contribution of produce from home garden to the vitamin A status since gardening may a viable sustainable intervention of alleviating micronutrient deficiencies including VAD in such communities.

In Kenya despite home gardens have been promoted by the Ministries of Agriculture and Health since 1963, there lacks evaluation data showing the contribution of the home gardens to food diversity, vitamin A or nutritional status. This study compared vitamin A, nutritional status and dietary diversity in house holds with and those without home gardens in Nambale.

Dietary factors investigated in this study were establishing the types of vitamin A rich foods produced in the home gardens, frequency and nutrient adequacy of vitamin A foods consumed by households. Investigation sought to establish any infestation with gastrointestinal parasites that are known to compete for food in the gut thereby reducing the amount of ingested vitamin A food that is finally available for utilization of in the human body. Morbidity and clinical signs of VADD and were investigated since they influence vitamin A status, while serum retinol levels was included in the study because it is a direct indicator of vitamin A status.

Broad project purpose

The purpose of this study was to establish the contribution of home gardening in improving vitamin A and nutrition status of study population and subsequently assess the influence of home gardening on food diversity in the diets of children from Nambale.

1.3 OBJECTIVES

1.31 Main objective

To determine vitamin A, nutrition status and food diversity of children aged 24-72 months of households practising home gardening and those without home gardens.

1.32 Specific objectives.

1. To determine and compare household socio-demographic and socio-economic factors namely income, age, education, marital status, household size and dependency ratio of household members in the two study groups.
2. To determine the difference in types of vitamin A rich foods consumed by children of households that had home gardens as compared to those of households without home gardens.
3. To determine the types of vitamin A rich foods produced in the home gardens.
4. To determine the difference in dietary adequacy in terms of calories, vitamin A and protein intake of the two study groups.

5. To determine and compare mothers' knowledge in the types food that contribute to vitamin A and nutrition .status in the two categories of households.
6. To compare children's morbidity in terms of common illnesses and their respective frequencies in the two study groups.
7. To compare the prevalence of gastro intestinal parasites in children of house holds with and without home gardens.
8. To determine and compare vitamin A (blood serum retinol levels), and nutritional status of children among households that had or did not have home gardens in Nambale Division.

1.4 HYPOTHESES

1. There is no significant difference in dietary diversity of children of households practising and those not practising home gardening.
2. There is no significant difference in vitamin A and nutritional status among children of households that practice and those that do not practice home gardening.

1.5 JUSTIFICATION

Vitamin A deficiency is a public health problem in Kenya. Periodic and area specific assessments are necessary so as to regularly monitor effects of ongoing programmes, to redirect efforts on more effective sustainable interventions and to update the national database. Severe health consequences due to VAD have been found to occur even at mild or moderate vitamin A deficiency. When there exists a public health problem of even mild importance, immediate intervention is called for so as to prevent any health consequences, especially now in the advent of HIV AID'S pandemic (WHO/NUT, 1996). Recent intervention studies have shown that providing vitamin A can reduce child mortality.

There is no documentation of any study on vitamin A status carried out in Busia district although localized studies have been done in other areas of the country. Busia District was not included in the last two National Micronutrient Surveys therefore it is necessary to asses vitamin A status (MOH & UNICEF, 1991; Mwaniki et al., 1999).

Household vegetable production is important because it is established that the principal sources of vitamin A in the diets of people in developing countries are generally carotenoids, coming from fruits, green leafy vegetables and yellow Vegetables (Basu and Dickerson, 1996). This investigation focused on home gardening because it is a common household practice in Kenya and it increases household access to food.

Children aged 24months to 72 months, were selected study subjects of this study because they have been shown to be at risk of vitamin A deficiency, mainly because of being in a rapid growth stage that has increased demand for nutrients. It has also been established that night blindness is not apparent in younger children while bitot spots in the older children are remnants of previous deficiency. Most children of this age have stopped breastfeeding therefore do not access vitamin A from breast milk (Sommer and Davidson, 2002). Socioeconomic factors were investigated in this study because is established that children afflicted by VAD are mainly from low socioeconomic status, whose access to health facilities is limited (GOK/UNICEF, 1994).

Fats, and protein were investigated because they are among some of the dietary factors that affect assimilation of vitamin A in the human body, thereby indirectly influencing vitamin A status (Basu and Dickerson, 1996). In order to be absorbed from luminal phase to the mucosal phase of the small intestines dietary vitamin A requires solubilization into micellular solution that is formed from bile salts (Basu and Dickerson, 1996). A diet very low in fats or an obstruction in the bile duct seriously impairs the uptake of vitamin A (Basu and Dickerson, 1996). Vitamin A absorption, transport and metabolic availability are processes that depend upon several enzymes and specific proteins, which are synthesized in the body using protein. Dietary intake of protein therefore was investigated in this study as an important determinant in vitamin A metabolism (Basu and Dickerson, 1996). This study investigated whether gardening improved dietary intake of vitamin A because it has been established that most people in developing countries get their vitamin A from plant foods.

A biological indicator such as retinol levels, used in this study is among the most specific and useful indicators for determining risk assessment, targeting programmes and evaluating effectiveness of improving vitamin A status (WHO/NUT, 1996). It has also been established that serum retinol is more reliable as biochemical criterion at the age of two to five years (Sommer and

Davidson, 2002).The use of HPLC is preferred in this study because it has advantage of high specificity and makes assay very sensitive and so far is the only method able to distinguish between retinol and retinyl ester in serum (Chaunderey and Nelson, 1996). The study investigated morbidity because it is established that increased morbidity and mortality occur at sub clinical levels of VAD. These are levels of vitamin A deficiency less severe and chronic than those at which night blindness and Xerophthalmia are evident (Mclaren and Frigg, 1997). It is therefore necessary to establish populations at risk and intervene in good time because vitamin A deficiency is preventable and responds to treatment at early stages.

This study investigated whether the presence of home gardens had improved vitamin A, nutritional status or food diversity because household food production and increasing consumption of vitamin A are recognized as some of the best and sustainable ways of preventing VAD (FAO, 1998; FAO 2001).

The study also assessed the nutritional knowledge of the mothers in relation to vitamin A and food intake, to find out the extent to which such knowledge influenced the choice of food items that mothers included in meals of the children.

1.6 EXPECTED BENEFITS

1. The contribution of home gardening to improving vitamin A and nutrition status and dietary diversity in Nambale area was established.

2. Policy makers and development agents got information which can guide them in designing programmes of improving the vitamin A status using gardening in the country.
3. Results of this study provide a reliable base for future interventions wishing to use food based interventions in the control of VAD and household food insecurity.
4. The results provide baseline information for future research in related field of study.
5. The research project generated additional information on Busia District for the national micronutrient surveys database.

LITERATURE REVIEW

2.1 DEFINITION AND BIOLOGICAL ACTIVITY OF VITAMIN A

Vitamin A is the generic term used to designate any compound possessing biological activity of retinol (Blomhof, 1994; and Shankar, 1998). Vitamin A occurs in nature largely as retinol in its all-*trans* form but in the pure state exists as pale yellow crystals soluble in most organic solvents and in fats (Basu and Dickerson, 1996). In plants vitamin A exists only in the form of precursor compounds known as Beta-carotene or carotenoids. There are about 50 naturally occurring carotenoids with vitamin A activity (Blomhof, 1994). Most cooking methods have very little effect on the loss of vitamin A because the vitamin is stable in heat, acid and alkali (Basu and Dickerson, 1996).

Biological activity of Vitamin A is now measured in retinol activity equivalents (RAE), shifting from earlier retinol equivalents (RE) and international units (IU) (West and Eilander, 2001 Latham, 1997 and Blomhof, 1994). This was necessitated by recent research results, which indicate that the conversion of β-Carotene to vitamin A is poorer and more variable than previously assumed (Burri, 2001). Due to this the U.S. Institute of Medicine in January 2001 to revised the proportion of β- carotene in a mixed diet converted to retinol from 1:6 to 1:12. This recommendation was based on studies carried out in developing countries, which were published in reviewed journals (West and Eilander, 2001). 12 μg of β-carotene are regarded as 1 retinol activity equivalent (RAE). The term "Retinol activity equivalent replaces the 1967 FAO/WHO concept of 6μg of β-carotene being regarded as 1 retinol equivalent. The bioavailability of β-Carotene in the experimental cases of high vegetable diet was calculated to be 14% (West and Eilander, 2001). Most countries have set the a recommended daily allowance (RDA) for vitamin A between 600- 1500 μg, based on vitamin A status as determined by serum retinol levels or by dark adaptation (Blomhof, 1994).

2.2 VITAMIN A FUNCTIONS AND DEFICIENCY EFFECTS

Vitamin A has important functions in vision, cell differentiation, integrity of epithelial tissue, immune system, growth, reproduction, embryogenesis and is an important anti-oxidant (Basu and Dickerson, 1996; Blomhof 1994; Mclaren and Frigg, 1997)

Vitamin A deficiency results in devastating effects, irreversible blindness being the most dramatic consequences (Mclaren and Frigg, 1997). Others include increased morbidity and mortality, more severe and complicated measles. VAD is also associated with increase in cancers (Latham, 1997; Mclaren and Frigg, 1997).

Vitamin A deficiency has been associated with accelerated HIV progression, increased mortality, high rate transmission of HIV from mother to child, child growth failure, increased HIV load in breast milk and birth canal (Calder and Jackson, 2000).

2.3 VITAMIN A STATUS AND DEFICIENCY

Based on serum retinol levels vitamin A status can be grouped into five categories of deficient (hypovitaminosis), marginal, adequate, excessive and toxic

(Hypervitaminosis) as shown in Table 1 (Sommer and Davidson 2002; Lee and Niema, 1996). Clinical signs are mostly evident in deficient and toxic states of VAD. Retinol levels used in this study have been established as the most specific and useful indicator for determining risk assessments, targeting programmes and evaluating effectiveness in control of vitamin A deficiency (WHO/NUT, 1996).

Vitamin A deficiency disorders (VADD) are physiologic disturbances secondary to VAD that can be either sub-clinical (e.g. impaired iron mobilization, disturbed cellular differentiation, depressed immune response) or clinical (increased infectious morbidity and mortality, growth retardation, anemia, and xerophthalmia). VADD begins long before the onset of xerophthalmia (Saskia and Dary, 2002)

Table 1. Classification of vitamin A deficiency.

Serum retinol levels	Vitamin A status
<0.35μMol/L (10μg/dL)	Severe VAD
0.35-0.70μMol/L (10-20μg/dL)	Moderate VAD
0.7-1.05μMol/L (30μg/dL	Low Adequate
>1.05 μMol/L (30μg/dL)	Adequate
>3.5 μMol/L (100μg/dL)	Toxic

Information from Sommer and Davidson 2002; Lee and Niema, 1996

Definition of Vitamin A deficiency (VAD)

This is a state of inadequate vitamin A, and is widely accepted to begin when liver stores of vitamin A fall below 20μg/g (0.7μmol/L) and conventionally it is when Blood Serum Retinol, levels fall below 20μg(0.70μmol/L for children aged between 6-71months (Saskia and Dary, 2002). In most well nourished populations, "Adequate" stores or levels of vitamin A occur at average serum retinol levels that generally exceed 30μg/g equivalent to 1.05μmol/L (Flores et al, 1991; Sommer and Davidson, 2002).

Serum retinol levels

Serum retinol level is the most common and recommended biochemical measure of vitamin A status (Lee and Niema, 1995; Pee and Dary, 2002). Under normal conditions about 95% of serum Vitamin A is in form of retinol and bound to retinol-binding protein (RBP) and about 5% is unbound and in form of retinol esters (Lee and Niema. 1995). A normal serum retinol level is 30-50 μg per 100ml plasma. This can drop to deficient retinol levels of less than 20 μg/100ml. Children with xerophthalmia will usually have retinol levels below 10 μg/ 100ml (0.35 μMol/L). Ocular manifestations seldom occur before serum levels are deficient (Latham, 1997). Serum retinol level is measured by high-pressure liquid chromatography (HPLC) that is postulated to be the best biochemical indicator for VADD especially on population level (Juegen, 2003).

After reviewing 40 data sets and the original rationale for proposed cut- offs, Pee and Dary proposed a cut-off point at 0.70 μmMol /L (20 μg/dl). A community is said to have a vitamin A public health problem when 15% or more of the sampled population has serum retinol levels below 0.70 μMol/L (Pee and Dary, 2002).

2.4 PREVALENCE OF VITAMIN A DEFICIENCY

There are 127.2 million preschool children with vitamin A deficiency (by serum retinol) in the world, while 4.4 million suffer from clinical xerophalthamia. This translates to 25% of all pre-school aged children globally being vitamin A deficient. A big proportion, 45% of VAD children and women live in South and South East Asia, while three fourths of the women with VAD live in India (West, 2002). Africa accounts for 25-35% of all global cases of child and maternal VAD (ACC/SCN, 2000;West, 2002). About 10% of all deficient persons live in east Mediterranean, 5-15% in the western Pacific and 5% in the Americas (West, 2002).

The third report on the world nutrition situation showed that there has been a downward trend that may indicate deteriorating vitamin A content in the diets in Africa (ACC/SCN, 1997). The downward trend may also be as a result of improved database. Prevalence data is based primarily on preschool children although there are increasing number of reports, which indicate that the prevalence of night blindness in pregnant and breastfeeding women is similar to, or may exceed that of children (ACC/SCN, 1997). Pre school children have greater susceptibility to infection due to increased demand for micronutrients needed to support their rapid growth (WHO, 1996).

Kenya has a VAD and Xerophthalmia prevalence of 61.2% (6,752,000) and 4.8 %(530,000) respectively (West, 2002).

2.5 CAUSES OF VITAMIN A DEFICIENCY

The causes of vitamin A deficiency can be described using the UNICEF conceptual framework that delineate three layers of causality as immediate or direct, underlying and basic. The three immediate causes of VAD in children include low vitamin A in breast milk or lack of breastfeeding, inadequate dietary intake of vitamin A rich foods and frequent illnesses. Lack of dietary diversity and inability to consume foods that promote absorption (e.g. fats) and bioavailability of vitamin A, all contribute to inadequate intake of vitamin A. Inadequate consumption of protein which is essential for synthesis of vitamin A carrier proteins, the retinol binding proteins (RBP) results to inadequate dietary intake. Similarly gastrointestinal parasites prevent ingested carotene from being absorbed in the body also results inadequate vitamin A. This parasitic impact has been found to be greater on carotenoids than on preformed vitamin A (Mclaren and Frigg, 1997). Matu also observed this especially in the case of Ascaris *lumbricoides* and *Giardia Lamblia* that showed direct association with VAD. Matu also found a significant correlation between vitamin A status and *Endolimax nana* (Matu, 2001).

The presence of diarrheal disease, infection and intestinal parasites increases vitamin A needs (WHO, 1998) and may result in VAD. Sicknesses that results to anorexia and sicknesses that use up the body supply of Vitamin A all contribute to VAD. Severe PEM and measles are common diseases that predispose VAD (Blomhof, 1994)

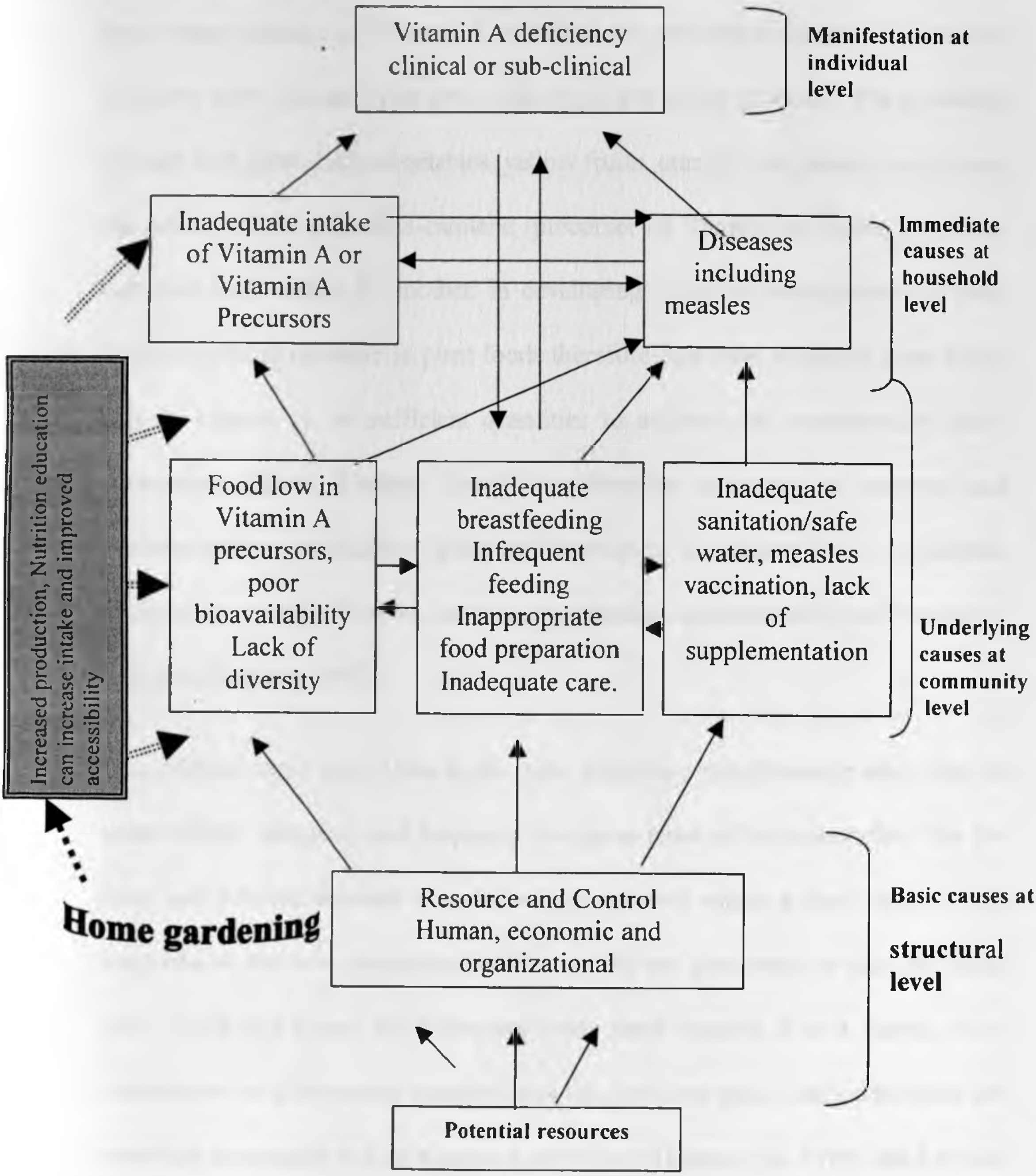
The immediate causes of VAD emanate from underlying causes, which are inadequate access to food, inadequate care for mothers and children and insufficient health service and unhealthy human environment. Inadequate education has a direct influence on these underlying causes.

The underlying causes are themselves caused by basic causes that include resources control that is determined by political and ideological superstructure which govern the potential resources both human and economic (Bloem et al., 2002).

Household food production programs including home gardening influence VADD by increasing access to food thereby alleviating an underlying cause of VAD (Bloem et al., 2002). It has also been shown that most effective interventions are those that address underlying rather than immediate causes of a problem (FAO, 1983)

Homestead food production (e.g. home gardening) and food policy can influence VADD by increasing access to food at the underlying level which is considered more sustainable as compared to food fortification that intervenes at the immediate level or capsule supplementation which increases intake of vitamin A at the manifestation level.

Figure1. Conceptual framework for vitamin A deficiency



Source; Bloem et al., 2002

2.6 DIETARY SOURCES OF VITAMIN A

Best dietary sources of Vitamin A or retinol are preformed vitamin A in animal products such as liver, fish liver oils, eggs and dairy products. Plant sources include dark green leafy vegetables, yellow fruits, orange roots mainly carrots and the oils of palms. The Beta-carotene (precursor of Vitamin A) levels vary from one food crop variety to another. In developing countries most people get their Vitamin A from carotene in plant foods therefore they need to access plant foods rich in vitamin A, in sufficient quantities to achieve the recommended daily allowances (RDA). Dietary diversity is therefore necessary to improve and increase intakes, especially of fruits and vegetables. To achieve this it is important to stimulate changes first by increasing production and availability of vitamin A rich food (Latham, 1997).

The 24-hour recall and Helen Keller food frequency questionnaire were used to assess dietary adequacy and frequency of consumption of the households. The 24-hour was selected because it could be administered within a short time, it was inexpensive, has low respondent burden and did not give room to alter the usual diet. The Helen Keller food frequency was used because it is a simple, non-quantitative food frequency questionnaire that has been specifically developed for assessing community risk of vitamin A deficiency (Rosen et al, 1994; and Lee and Niema, 1996)

2.7 CURRENT INTERVENTIONS TO CONTROL VAD

Three different approaches have been adapted to control VAD. Vitamin. A capsule supplementation is short term and is an intervention at manifestation level. Food fortification or food enrichment is a medium term intervention at the immediate level. Dietary diversification and genetic quality improvement are long-term interventions at the underlying level and have a higher likelihood of reducing the problem in a sustainable approach (GOK/UNICEF 1994, Bloem et al., Kuria et al., 2004).

Vitamin A supplementation was shown to be effective in reducing mortality (by 50%) and morbidity (by 23%) in children aged 6-72 months in studies carried out in Sudan and Tamal Nadu (Mclaren and Frigg, 1997). Vitamin A Supplementation is given to children aged 6-59 months in form of a high dose capsule (200,000 IU or oral dispensers once every six months during contacts with the clinics (GOK/UNICEF 1994, GOK 2004). In Kenya vitamin A supplements are also given during polio and measles immunization campaigns (MOH 2001, GOK/UNICEF 1994).

Food fortification has successfully been implemented in many countries; some examples are Guatemala and South America (Arroyave et al., 1981). Monoglutamate (MSG) fortification was done first in the Philippines and later in Indonesia. Evaluation results from food fortification programs have reported significant reductions in vitamin A deficiency and vitamin A status improvement among the target populations (MOH, 1994). In Kenya margarine and some cooking oils are fortified, but the poor who at risk of VAD may not afford to buy these foodstuffs.

Dietary diversification should actually be the ultimate goal of every country as a strategy of solving VAD. A first step in increasing access to vitamin A rich food is by stimulating the production and consumption of vitamin A rich foods (MOH, 1994). Home gardening falls within this strategy and has been shown to improve micronutrient status in many countries; a good example is in the Jeep project in Zaire (FAO, 1998). Current programmes involved in controlling vitamin A deficiency by diet improvement in Kenya include promotion of Vitamin A rich foods especially orange fleshed sweet potato by Vitamin A for Africa (VITAA), promotion of Orange fleshed sweet potatoes by KARI and general nutrition education by ministries of Health and Agriculture (Hagenmana, et al. 1999). A more diversified diet is an important outcome in itself and it is also associated with improved outcomes in birth weight, nutrition status improved hemoglobin levels (Swindale and Bilinsky, 2005). A more diversified diet also highly correlates to caloric and protein adequacy, percentage of protein from animal sources and household income Swindale and Bilinsky, 2005). Dietary diversity was derived from the Helen Keller International food frequency questionnaire (HKI FFQ) because the food frequency questionnaires have been shown to provide a more accurate picture of the proportion of consumers of a given food (WHO, 1998).

2.8 HOME GARDENING

Home gardening is a term given to production of fruits and vegetables mainly for household consumption within or near the homestead. Kimiywe defines it as a small area of cultivated land surrounding the house (Kimiywe, 1991). Gardening may be the oldest production systems known and their very persistence over the years is proof of their intrinsic economic and nutrient merit (FAO, 1998). Home gardens are an affordable way to household vegetable self-sufficiency. The poor can easily adopt home gardening because it is a cheap and simple technology. Different names such as, home garden, mixed garden, backyard garden, kitchen garden, farmyard garden, compound garden or homes stead gardens (FAO, 1998) are used when referring to this practice worldwide.

A home garden contributes to household food security by providing direct access to food. It is a technology done with virtually little or no 'economic' resources by using locally available planting materials such as green manures, life fencing, kitchen wastewater and indigenous pest control methods. Gardening has been practiced by the landless on vacant lots, roads sides, on the edges of fields or in containers (FAO, 1998; FAO, 2001; FAO, 1995).

Potential benefits of home gardening

Home gardening increases food production at the home level. In the 'Jardins et Elevages de Parcelle'(JEEP) project of Kinshasa, Zaire, (a project that paid attention to poorest families with malnourished cases of relapse-rehabilitated child), it was found out that of the 6235 families monitored, 4339 (70%) grew and used kikalakasa (*Psonphoccarpus scandens*). It was also found out that 30% of the families visited in 1995 improved their quantity and quality of their weekly menu (FAO, 1998; Kabeya and Paulus, 1995).

Gardening is low input technology with few "Barriers to entry" and can be afforded by poor households. Home gardening also provides other benefits like income through the sale of produce, or home processed products.

In Kampala, Uganda after the civil war it was found that very small mixed gardens provided a significant percentage of RDA of (10-20%) protein, (20%) iron, (20%) calcium, (20%) vitamin A and (100%) vitamin C (FAO, 1998). Home gardening may become the principle source of household food in the lean season, harvest failure, prolonged unemployment, health or disability suffering of family members (FAO, 1998).

The technology of home gardening remains among the populations and has chance to be transmitted from generation to generation, which is key to sustainable development (Kabeya and Paulus, 1995).

FAO has implemented many projects in Africa to increase production and promote consumption of locally produced Vit A rich foods (Bayani, 2001; FAO, 1998). It has been learnt that food consumption practices, food habits and cultural aspects represent essential factors to be taken into account for successful implementation of these approaches (FAO, 1998).

In Kenya, kitchen (home) gardening is done in different ways such as multistorey, raised bed agriculture (RBA), Balcony farming, double digging, and Mandalla (MOA, 2005; Bunch, 2000 and Njuguna, 2000). The Ministry of Agriculture (MOA) has been promoting kitchen gardening within the Home Economics Extension (HEE). Three Home Economic Assistants who had undergone a refresher course at Egerton College were the first to introduce the Home Economics Extension in the existing syllabus of Farmers Training Centers (FTC's) in 1963 (ROP, 1963). More training was done in farmers homes after it was reported that farmers were demanding follow up of the technologies after the FTC courses (ROP, 1963). The HEE has ever since been promoting kitchen gardening as one of its core activities in various methodologies, one of them is setting model kitchen gardens at the FTC's that serve as practical demonstrations for farmers whenever they attend any trainings at the centers (Owindi, 1991). As an example the HEE reported that 4513 home gardens were adopted in 2003 during routine extension (HEB, 2003).

The ministries of health and culture and social services also promote home gardening through the maternal child health clinics (MCH) and the community based nutrition programme (CBNP) respectively (GOK, 1994).

Other smaller organizations and NGO's such as Manor House Agricultural Center and ALBA promote.different methods of gardening for increasing food access and availability (Bunch, 2005)

The MOA has been promoting kitchen gardening in Busia district by carrying out demonstration to farmers in the field and passing messages even during world food day celebrations. The MOA, reported that 440, 661, 548, 260 and 478 home gardens had been adopted in Busia district in 1996,1997, 1998, 2002, and 2003 respectively (DAO, 1996; DAO, 1997; DAO, 1998, MOALD, 2000;PDA, 2002 and DAO, 2003). There were 240 home gardens adopted in Namabale division, while 14 demonstrations on kitchen gardening were done through combined efforts of MOA and CBNP (DAO, 2003). Despite these many gardening programmes being implemented, there is no documentation of any evaluation or measure of success in improvement of nutritional or vitamin A status in Busia district.

2. 9 VITAMIN A POLICY IN KENYA

The Ministry of Health released a national schedule for vitamin A supplementation in October 2000 through which it directed that children of age 12-59 months are given vitamin A supplements every 6 months during any contacts with the clinics (Muga, 2000). The policy also directed on the use of other methods of controlling vitamin A deficiency as follows;

- Exclusive breastfeeding for the first six months and continued breastfeeding up to 2 years.

- Starting to feed child with other foods at 6 months and including vitamin A rich food in all five meals fed to the child in a day with a list highlighting some examples of such animal and plant products.
- Vitamin A rich food be included in every family meal.
- Production and utilization and preservation of vitamin A rich food.
- Inclusion of oil in food preparation especially oils fortified with vitamin A (Muga, 2000).

2.10 NUTRITIONAL STATUS

Nutritional status was assessed using anthropometric measurements of weight, height and arm circumference taken together with age. It is established that body weight is subject to genetic influences as well as to past and present energy balance influences (Beaton et al. 1990). The balance between energy intake and energy expenditure is influenced by internal factors (e.g. regulation of intake and tissue metabolism) and environmental factors such as amount of food consumed, infections, and physical activity among others (Beaton et al. 1990). Interpretation of anthropometric measurements such as length and height varies a lot with the age of child. The length for age after 2yrs of life reflects a state of having failed to grow which is a risk of detrimental outcomes such as morbidity, mortality and physical development (Beaton et al. 1990). The weight for height (WHZ) reflects the magnitude of body energy stores or reserves and is taken as a measure of the current influences on the state of the body (Beaton et al. 1990).

By combining, linking and comparing data from food intake, weight, height and age together with questions occurrences of illnesses in the past two weeks, it was possible to gain an overall picture of the nutritional status of the study households. Such information enables one to predict to a certain degree whether the basic problems are related to feeding practices, illnesses or to general food shortages (WHO, 1998 and Beaton et al. 1990)

2.11 GAPS IN KNOWLEDGE

Home gardening has been shown as an appropriate technology in other parts of the world. In Kenya micronutrient malnutrition is on the increase (CBS, 1998; CBS, 2004), and household food production is a viable option in the prevention of VAD and other deficiencies especially among the lower socioeconomic populations. There is no documentation on the contribution home gardening activities in improving micronutrients specifically vitamin A in Kenya. There is need to know the impact of the home gardening promotion programmes that have been in place from as early as 1963. Busia district lies in the high-risk areas of vitamin A deficiency yet there is neither record of vitamin A assessment nor evaluation of ongoing programmes that target VAD. It is not documented the extent to which continuous availability of home garden produce ensures adequate consumption thereby leading to better outcomes in vitamin A, nutritional status and dietary diversity of the Nambale population.

CHAPTER THREE

3.0 METHODOLOGY

3.1 STUDY DESIGN AND SETTING

This was a comparative, cross sectional, study with a descriptive and analytical component seeking to establish vitamin A status, nutritional status and dietary diversity in house holds with and without home gardens. Investigations were done to compare how dietary and other factors considered to have influence on vitamin A status were presenting in the two household types.

The study was carried out in three locations, Nambale Township, Bukhayo East and Walatsi . The locations were all rural areas growing a variety of crops although it was during planting or low season period. There was one market day per week in each small market centers including Nambale Township. The sub-sample for which stool and biochemical analyses were done was selected from Nambale township location so as to combine with a parallel on-going study on "the effect of processed orange fleshed sweet potatoes on Vitamin A status" was being undertaken. The main reason for combining was to cut down the high cost of serum retinol analysis.

3.2 INCLUSION CRITERIA

All children aged 24-72 months in Nambale division were eligible for the study. In cases where two or more siblings qualified, one of them was randomly selected for admission in the study by tossing a coin.

3.3 ETHICAL CLEARANCE AND RESEARCH PERMIT

A copy of research proposal was submitted to the Ethics and Research Committee at Kenyatta National hospital who approved the protocol and procedures for the study while a research permit was granted by the Ministry of Education.

3.4 STUDY AREA AND POPULATION

The study was conducted in Nambale Division, Busia District of the Western province in Kenya. Busia District is divided into six administrative divisions namely Matayos, Funyula, Butula, Township, Nambale and Budalangi. Nambale Division is further sub-divided into five locations with a total of fourteen sub locations covering an area of 232.2 sq km. The maps (Appendices 5,6 and 7) show the study location within the division, district and the country.

Busia District is in the low midland (LM) zone and is divided into four agro-ecological zones LM1, LM2, LM3, and LM4 which are the sugarcane zone, marginal sugarcane zone, cotton zone and marginal cotton zones respectively (GOK, 2001). Nambale division lies in the LM1, LM2 and LM3 agro ecological zones. The District experiences two rainy seasons with most of the district receiving between 1270mm and 1790mm and a mean of 1500mm (GOK, 2001). The dry spells are from December through February and from June to July. The district has two main cropping seasons per year in line with the rainfall pattern, although crops are grown all the year round (GOK, 2001).

Most soils in the district are moderately deep, generally rocky and stony, consisting of well-drained red clay and have low natural fertility (GOK, 2001). In some parts of Nambale and Butula divisions the soils that are well drained, deep, brownish and sandy with moderate water holding capacity. This relatively good soil together with the higher rainfall promotes production of a variety of crops.

The main food crops grown in the area are maize, sorghum, sweet potatoes and cassava. The main cash crops are sugarcane, cotton and tobacco (GOK, 2001). Kales are mainly grown in LM2 while other vegetables are grown in LM2, LM3 and LM4 (ROP1997).

The main vegetables grown in the district are tomatoes, onions, kales, cabbages and local vegetables that comprise spider plant, amaranthus, blacknightshade and jute plant. According to Ministry of Agriculture reports, local vegetable covered an estimated acreage of 400Ha in 2002, a drop from 209Ha in 2001 (GOK, 2003)

The district has two main rivers Nzoia and Sio, which drain, into Lake Victoria in the southwest region. Vegetables are also grown on numerous streams, spring and dams in the district. Nambale division falls in the area with good ground water potential in the district (GOK, 2001).

Vitamin A supplements are given to children of 6-59 months at the government child welfare clinic once every 6 months and also during polio and measles eradication campaigns (MOH 2003).

The main inhabitants of the study area are from two major ethnic groups, the Bakhayo (Luyha) and the Teso. Nambale division is one of the three areas with high immigration in the district due its high agricultural potential and accessibility by road (GOK, 2001).

3.5 SAMPLE SIZE DETERMINATION

The prevalence of vitamin A deficiency for Bungoma District of 56.2% was used since there was no specific prevalence available for Busia district .The two districts lie in the same ecological zones and have similar consumption habits.

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

$$N = \frac{2 Z^{2 pq}}{(d^2)}$$

Where N =desired sample size for each category when population is greater than 10,000.

- p = vitamin A deficiency by serum retinol levels prevalence as per 1999 national micronutrient survey for Bungoma District(Mwaniki et al, 1999) = 56.2% ≈ 0.562
- q = 1-p = 43.81%≈0.438

- z = standard normal deviate set at 1.96 which corresponds to the 95 percent confidence interval level.
- d = Degree of accuracy desired usually set at 0.1

$$N = \frac{2x\ 1.96^2\ x0.562\ x\ 0.438}{(0.1)^2} = 189$$

189 + 10% attrition = 207 in each group x2 =414

During the pilot phase only 10 out 32 households interviewed had home gardens indicating that majority of households in the area did not have home gardens, a proportion of approximately 1: 2 was adopted instead of the intended 50:50 of households with home gardens to those without the home gardens. This ratio was applied when sampling households throughout the main study. The decision also considered that the Ministry of Agriculture had reported reaching 400 home gardens in the whole district the pervious year against a total of 13,911 households. A decision was made interview all home gardening households that qualified for the study and then march each of them to two non gardening households who were majority in the study area. One research assistant who was dropped out during the study was found incapable of taking correct anthropometry and dietary data measurements. All the questionnaires (38) she had done supervision were left out reducing the number of households considered to 376 instead of the intended 404.

Sub sample

A sub sample of 81 children was selected for more detailed investigations of serum retinol levels, presence of gastrointestinal parasites, and clinical signs. Out of 81 children who brought stool samples, clinical signs were observed on 79 children while only 77 children went through the biochemical test as some (mothers) declined. Since the twenty four hour recall procedure did not require much additional money like the biochemical tests, 10 and 7 twenty four-hour recalls were done in Bukhayo East and Walatsi locations respectively. In total 82 twenty four-hour recalls were achieved in the three study locations.

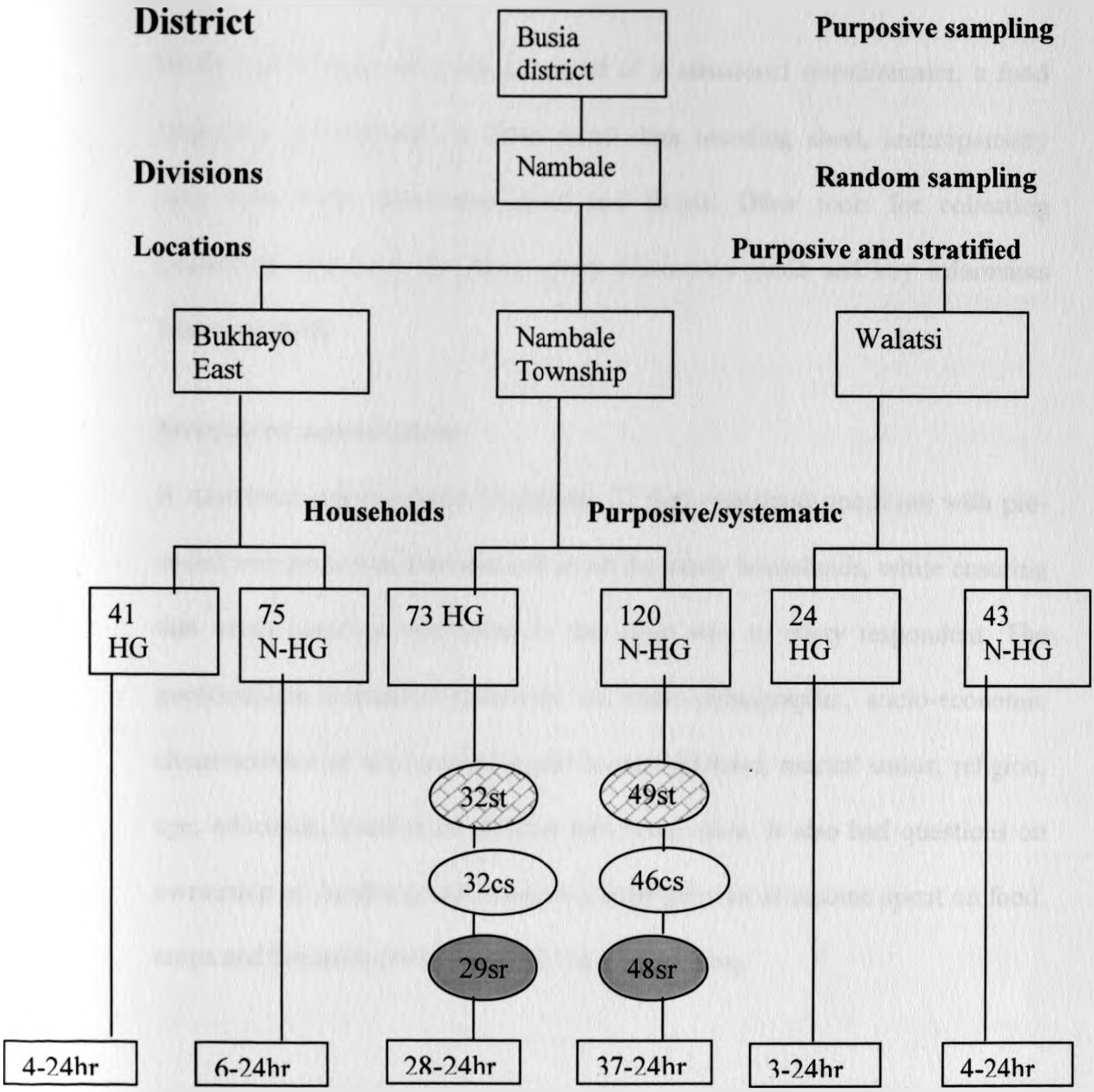
3.6 SAMPLING PROCEDURE

Multistage sampling was carried out, where purposive sampling was used to select Busia District because it lies within areas classified as vitamin A deficient as per the 1999 micronutrient survey (GOK, UNICEF 1999). Random sampling was employed at the division level from which Nambale was selected out of the six divisions in the District. Due to limited time and funding, Nambale location was purposively selected because the sub sample had to be drawn within the area where the study on orange fleshed sweet potato was taking place, to reduce cost especially serum retinol levels. Simple random sampling was applied to select the other two study locations (Bukhayo East and Walatsi) out of the other four locations of Nambale division.

For each Location selected sampling began from a central place (a primary school) to the four compass directions by tossing a coin to determine which direction to take first. Every household with a home garden and had a child aged 24-72 months was interviewed. Incase a selected household did not have such a child, the next household to meet the criteria was selected. The next sixth household without a home garden and with a child of 24-72 months was interviewed and an interval of six households was given before selecting the next household without a home garden. This selection criterion was followed in each direction till the desired sample size was achieved regardless of the sub-location boundaries.

Sample sizes from each location were proportional to the population as per 1999 census. A total of 376 households, 116 households from Bukhayo East, 193 from Nambale Township and 67 from Walatsi location. The sample achieved comprised 137 households with home gardens and 238 households without. This is as shown in Figure 2.

Figure 2. Sampling procedure chart



HG =Home gardening households st =Stool test sr = Serum retinol
N-HG =Non home gardening house holds cs= Clinical signs
24hr=24-hr recall house holds

3.7 STUDY INSTRUMENTS

Study instruments and tools consisted of a structured questionnaire, a food frequency questionnaire, a 24-hr recall data recoding sheet, anthropometry data entry form, stool and blood test forms. Other tools for collecting qualitative data were the focus group discussion guide and key informants interview guide.

Structured questionnaire

A structured questionnaire (Appendix 3) that contained questions with pre-coded responses was administered in all the study households, while ensuring that every question was asked in the same way to every respondent. The questionnaire contained questions on socio-demographic, socio-economic characteristics of the household and household head, marital status, religion, age, education, number of children and occupation. It also had questions on ownership of durable goods, sources and proportion of income spent on food, crops and livestock production and home gardening.

3.8 THE FIELD STUDY TEAM

The field study team comprised of the researcher, laboratory technicians, clinician, research assistants and field guides. The clinician and laboratory technicians were qualified and experienced personnel from Nambale Health Center, KEMRI Alupe Research Station and National Research Center for Public Health, Nairobi. The clinician examined the children for the presence of clinical signs of vitamin A deficiency disorders (VADD) such as oral mucosa, bleeding gums, abscess, ,pallor, Jaundice, skin abnormalities bitot spots and night blindness. Laboratory technicians collected and analyzed blood and stool samples.

Six research assistants were recruited from among secondary school leavers from the study Locations. The one with highest academic qualification was KCSE grade B while four had KCSE grade C. They were selected on basis of possessing good command of English, Kiswahili and were fluent with the Local languages of Bakhayo and Teso.

Training research assistants

The principal researcher thoroughly trained research assistants for two days on the survey implementation. Topics covered included: Purpose and objectives of the study, organization of the study and responsibilities of research assistants, sampling and household selection procedures, correct taking of anthropometric measurements, 24hour dietary recall method, instructions on interviewing, recording and crosschecking. The training involved a detailed question-by-question review of the whole questionnaire, while making clarifications where necessary. The study team read through each question at a time and the researcher emphasized on the importance of coding and data recording accurately. The pre-coded responses for each question were read through, clarified and modified before the assistants were showed how to circle correct response for each question. Demonstrations on taking anthropometric measurements were carried out among the research assistants who also role-played the interviewing scene as shown by the figures 4,5 and 6 on pages 55 and 56. The principal researcher conducted one interview in a household while the enumerators observed, to serve as a practical for questionnaire administration especially in anthropometric measurements and 24-Hr recall.

3.9 PILOT PHASE

A pilot study was conducted in Bukhayo North Location, at Lupida and Esidende sub locations. This location has similar field conditions to study the locations, but was a distant from the main study area as shown in the division map appendix F. During the pretest, the study questionnaire was administered to 32 households 5 or 6 questionnaires per research assistant to test whether the mothers understood the questions and were able to answer them usefully for ease of analysis. The principal researcher supervised the research assistants to assess their competence in asking questions and recording data. The whole research team held a retraining session in which some changes to the questionnaire were proposed. Appropriate changes and modifications were made and the corrected questionnaire used for the final data collection.

3.10 COMMUNITY MOBILIZATION

Community meetings with parents of 2-6 years old children were held in collaboration with the local leaders and provincial administration in five primary schools in the study area. Parents were informed of the objectives and procedures of the study after which they asked questions which the principal researcher responded to. The parents later gave a verbal approval for the study to be carried out in their area, figure 3 on page 55 shows one such meeting held at Manyole Primary School. A total of five meetings were conducted with 428 parents in attendance.

3.11 PROCEDURES OF DATA COLLECTION

Households selection and interviews

All research assistants and principal researcher used to gather in a central point (primary school) in a sub location every morning where each assistant was given the questionnaires for the day. Each enumerator was randomly assigned a direction by a rotary, in which they went interviewing all households with home gardens and marched each with two non-gardening households.

On entering a house the interviewer introduced themselves as well as the study, and then sought the consent of the respondent for child's admission into the study group. For those children selected in the sub sample for determination of serum retinol, examination for gastrointestinal parasitic infection and clinical examination, parents were requested to give written consent if they were able to write or to consent verbally if they were not able to write. Parents were also requested to assist in collecting the stool and accompany the children during the day for drawing of blood.

Helen Keller International Food frequency questionnaire

The Helen Keller International food frequency questionnaire (HKI FFQ) was used to find out the types of vitamin A rich food and the number of days each food item had been consumed by the index child in the previous week (Rosen et al, 1993). The HKI FFQ was appended to the questionnaire. The HKI FFQ consists of one question that was asked repeatedly for all the listed foods. The question was; "In how many days did (name of the child) index child consume (name specific food) in the last one week?" (Rosen et al, 1993). The HKI FFQ was adopted and modified to include few other common foods rich in vitamin A that were identified as common in diet of the study population during the pilot phase. The source of each food was also recorded as indicated in the food frequency questionnaire in Table 2.

All vitamin A rich foods consumed in each household was classified either as dark green leafy vegetables (DGLV), dark yellow/orange fruits (DYOF), dark yellow or orange roots or vegetables (DYOR/V) or from animal sources (ANSC) (Rosen et al, 1993).

1. The number of days an index child consumed each food type of certain food group was summed up to form the frequency of consumption for that particular food group.
2. The frequency of consumption of vitamin A food of plant sources or vegetable score was the total number of days an index child consumed vitamin A foods of plant origin (indicated in squares).
3. The total in (2) above i.e. consumption of plant sources was then divided twelve to adjust for bioconversion of carotenoids to retinol. The result was taken to be the adjusted plant/ vegetable sources score.
4. The number of days a child consumed a vitamin A rich animal product or a product fortified with Vitamin A was summed up to get the total consumption of vitamin A rich product from animal sources, also referred to as Animal score(ANSC).
5. The total weighted score was calculated by adding the ANSC (4) and the adjusted plant sources score (3).
6. If the animal score was above four (4) or the total weighted score was above six (6) the household was considered to have consumed adequate Vitamin A rich food according to HKI food frequency method.

Table 2. The Helen Keller international food frequency questionnaire

Item	**Frequency** 0= not consumed 1=Not more than 4times per week. 3=4or more times per week	**Source** 1=Home garden 2=bought 3=both 4=Other (specify)	**Proportion for those bought** 1=all 2=50%/50% (HG/B) 3=25%/75% " 4=75%/25% " 5= None
Maize (Ugali/Uji)			
Pepper			
Amaranth	□		
Avocado			
Banana			
Beans			
Blue band	○		
Carrots	□		
Cowpeas	□		
Eggs	○		
Groundnuts			
Kales			
Liver any type	○		
Mango	□		
Maize			
Meat			
Milk			
Onion			
Papaya	□		
Pumpkin	□		
Spinach	□		
Orange fleshed sweet potato	□		
Tomato	□		
Others (specify)			

□ *-Indicates Plant sources of vitamin A* ○ *-indicates vitamin A rich animal sources*

HG/B = ratio of home garden produce to that of vegetable bought in a household

Adapted from Rosen et al 1993

Dietary Diversity

Dietary diversity was the number of different food or food grôups consumed over the period of seven days prior to the study (Swindale and Ohri-Vachaspati, 2005). The HKI FFQ contained all food items consumed in the community and these were grouped into groups so as to reflect the overall quality of the diet (Swindale and Ohri-Vachsspati, 2005 and WHO, 1998).

1. Frequency of consumption of food type or group was determined by summing the number of days a given food/food type was consumed by an index child in the week prior to the study was calculated and is also referred to as the
2. The mean of consumption for a food group was average of number of days a given food group was consumed by all study children in each study category.
3. The dietary diversity score was arrived at by adding the mean consumptions for all food groups consumed in house holds of each study category as shown below.
4. Average diversity score was obtained by dividing the diversity score by 7(no of study days considered)

Table 3. Determination of dietary diversity

Household type	**Mean of consumption (Frequency score) of each food group**	**Diversity score (sum of means)**
	DGLV+DYOF+DYOR/V+FATTY+ANSC+LEGMS	**Max=42**
HG		
NHG		

Dietary diversity considered only the food groups considered by the HKI food frequency questionnaire as recommended by Swindale that the number of food groups used is determined with respect to the programme objectives (Swindale and Ohri-Vachsspati, 2005).

Twenty-Hour Dietary Recall

The 24-hour dietary recall consisted of all foods and beverages consumed in 24 hours from the time the index child woke up the previous day to the time the child woke up the day of the recall interview and as shown in appendix A. The amount and types of ingredients in each food taken by index child were indicated using household measures and weighing scales.

1. Each index mother was asked to mention all foods and snacks that the index child consumed for 24 hrs, from the time the child woke up the previous day to the time they woke up on the interview day.
2. For each food item mentioned and using common household measures, the mother was asked to estimate amounts of each ingredient used for cooking, total volumes of dish cooked, amounts served to and left over by the index child.
3. Foods available were measured using new kitchen scales to the nearest 0.1kg and all measurements were entered in the space provided in the 24- hour recall survey questionnaire.

4. Where actual food items were not available as was the case in most homes, volume of water was used to estimate actual food amounts using the calibrated measuring jugs and spoons.
5. By estimating average conversion of ingredient that converted to a given food item (e.g. ugali from maize flour) from households that had the ingredients and the cooked food, actual amounts of each ingredient were calculated.
6. The information on food items was later converted into individual components, then ingredients of each were converted to the respective nutrients, using the Kenyan food composition tables, CTA/ECSA, IPGRI and unpublished data from Imungi (Imungi 2003, Sehmi 1993, West & Malentnlema 1997, FAO 2003). The sum of specific nutrients consumed in a day was summed up as total nutrient consumed.
7. The total sum of dietary calories, protein and Vitamin A and was compared to the RDA for age of child to asses the dietary adequacy of food intake. (Maundu et al 1999, Guarino 1997)

Anthropometric measurements

Anthropometic measurement (weight, height and the mid-upper arm circumference MUAC) of each index child were measured and recorded in the form that also contained the date, questionnaire number, sub/location and location for ease of identification.

Weight of each index children was taken with the help of the mother. The mother assisted to remove heavy clothing from the index child who remained with vests and shorts/trousers. The index child then stood on the bathroom scale and the reading taken to the nearest 0.1Kg. Two measurements were taken and the average taken as the weight of the child. If the difference was more than 0.5kg, the measurement was repeated for accuracy, always ensuring the pointer was at Zero before taking the weight. The scales were calibrated every morning using a 2kg rice packet.

Height measurement was taken using a Microtoise manufactured by Stanley in France and readings were read to the nearest 0.5 cm. Measurements were taken twice and an average taken. If the difference between the two readings exceeded 0.5cm measurements readings were repeated.

Two measurements for the mid upper arm circumference (MUAC) were taken. This was done by first placing the MUAC at tip of the child's left shoulder and stretching the MUAC to the child's elbow to get the upper arm length. The mid-point position of the upper arm length was established and marked with a pen on the child's arm. The MUAC was then tied round the arm along the marked point on child's arm and the reading taken to the nearest mm. The process was repeated for a second reading and average taken as the MUAC of the child. If the difference of two readings exceeded 2mm, the measurements were repeated again before an average was calculated.

Focus group discussions

Focus group discussions (FGD) were conducted using the FGD guide which was an itemized list of questions covering topics related to vegetable production, home gardening, vegetable consumption by children and on vitamin A sources, deficiency diseases and Vitamin A supplementation. Four focus groups discussions for mothers of under-five years old children not included in household interviews were conducted, so as to obtain qualitative that would augment quantitative data obtained through structured questionnaires. Each FGD was conducted in a primary school nearest to all the participants.

The participants and facilitators sat in a round table arrangement to stimulate free discussion. FGD discussion began by introductions of all members in the research team as well as the mothers before briefing participants on the purpose and topic of discussion. The facilitator explained the discussion instructions and tested participants by asked a few questions to check whether they understood the instructions. Participants were also asked to consent to tape recording. The FGD moderator (Principal researcher or District Nutritionist) guided the discussion by probing on pre-determined topics.

The moderator allowed and motivated all participants to give and exhaust their opinions on every sub topic before moving to the next. Each FGD took approximately forty-five minutes after which the participants were thanked and served with refreshments.

Key informant interviews

Six in-depth interviews were conducting by asking open-ended questions to key persons involved in vitamin A activities in their daily work. The key persons selected were professionals(nutritionists, community health workers and teachers) with knowledge on gardening and vitamin A policy working in the study area. They were probed on vitamin A activities and community programmes that address vitamin A issues. They were asked on whether there were nutrition education packages put any emphasis on micronutrients, whether there had been any monitoring and evaluation undertaken. The aim of the key informant interview was to document vitamin A activities in Nambale division.

Stool collection

Stool samples were collected from 63 index children. The enumerators were given instructions, labeled poly pots and tissue paper which they passed on to mothers of the selected children a day before the stool collection day. Mothers were instructed as follows:

- To scoop a small amount of stool using the wooden rod from the first stool of the index child the following morning
- Open the sterile poly pots and put the scooped stool sample in the poly pot. Then replace the lid firmly and throw the used wooden rod and remaining stool in the toilet.
- Deliver the stool sample to the research team at St Mary's DEB primary school as soon as possible.

At the school the labels were crosschecked as shown in figure 7 before packing specimens in a cool box for transportation to the Laboratory. The stool samples were taken to the Division of Vector-bone Diseases (DVBD) laboratory, KEMRI, Alupe Station. In the laboratory stool samples were examined for presence of cysts and or ova of gastro–intestinal (GIT) parasites using the concentration method.

Analysis of Gastro-intestinal parasites

At the laboratory, the stool samples were prepared and examined for the presence of cysts or ova of any gastrointestinal parasites using the following procedure:

- 4 ml formaldehyde, normal saline was added to each sample.
- Each sample was sieved using a clean filter with new gauze.
- Applicator sticks were used to extract out most of the filtrate from each sample into a clean centrifuge tube.
- 4 ml ether was added to each tube
- The tubes were then fitted in the centrifuge and spun at 5000 revolutions per minute for 3-5 minutes to separate any cysts or ova in the specimen.
- After settling, the bottom most decant was put on a slide and observed under the microscope each sample at a time to identify any ova or cysts present.
- Any cysts or ova observed were recorded in the stool collection form,see Appendix 1.

Clinical examination

Clinical examination was carried out by a clinician who observed each selected child for symptoms such as oral mucosa lesions, bleeding gums, dental carries, abscess, physical abnormality, pallor, jaundice, skin abnormalities, bitot spot, conjunctiva xerosis and corneal xerosis. This information was entered in the clinical examination form in Appendix 1.

Biochemical determination of vitamin a status

Drawing of blood was done at the St Mary Primary School, which was easily accessible to all each index child, mother or caretaker. While being held by the mother or caretaker blood was drawn from each index child by a qualified medical technician from KEMRI as follows:

- The mother was asked to sit down and then hold the child's' left arm as shown in figure 8.
- 5ml blood was withdrawn from each child's arm and the blood collected into a tube covered with aluminum foil, which was thereafter labeled with a code.
- The coded label on each tube was confirmed before arranging the specimen in a cool box for transportation to Alupe Division of Vector-Borne diseases (DVBD) laboratory.
- In the laboratory the samples were centrifuged at 3000 revolutions per minute for ten minutes to separate different proteins.
- Each specimen was flushed with pure nitrogen gas to replace oxygen that causes oxidation or destruction of retinol.
- The specimens were then stored in liquid Nitrogen at -40^0 C in a nitrogen cylinder and were later transported to the Center for Public

Health Research at Nairobi (KEMRI), laboratories where analysis for blood retinol levels was done.

Serum Retinol Analysis

High Performance Liquid Chromatography (HPLC) was used to determine serum retinol levels. This method was preferred because of its high specificity (ability of test to identify correctly those who did not have a condition) and sensitivity (ability of test to identify correctly those who had the condition) (Fidanza 1991,WHO/NUT, 1996). The method entailed, deprotinising the serum and extracting retinol using HPLC grade hexane. Each reconstituted extract was then manually injected into a reversed phase of HPLC column, where the sensitive detector recorded retention time and peak area curves. Retention time and peak area curves were read against a known standard curve and the results used to predict the concentration of the sample by linear regression.

Procedure used in serum retinol analysis

a) Preparation of Standard curve

1. The frozen samples were thawed to room temp (25°c).
2. Various compounds at the concentrations shown below were used to prepare a standard curve.

Table 4. Composition of the standard curve

Retinol conc (μg/ml)	0	0.1	0.2	0.4	0.6
Vitamin A deficient plasma (μl)	250	250	250	250	250
Retinol(2μg/ml) standard (μl)	0	25	50	100	150
Retinyl acetate (2μg/ml) std (μl)	62.5	62.5	62.5	62.5	62.5
Methanol (HPLC grade) (μl)	187.5	162.5	137.5	87.5	37.5

Retinyl aceate was used as an internal standard due to its similarity to retinol and would be affected by factors such as light in the same way. The objective was to control for such external factors so as to obtain more accurate final results. The extracts above were subjected to vortex mixing intermittently every 15 seconds for 1 minute and analyzed in the same way as retinol samples and results plotted in a standard curve.

b) Sample extraction

3. 250μl of each samples' homogenized serum was pipetted into aluminum foil covered centrifuge tube (with a telfon-sealed screw cap).
4. To it was added 250μl of 0.5μg /ml retinyl acetate standard and vortexed intermittent intervals of 15 seconds for 1 minute.
5. 1.5 ml of HPLC grade hexane was added and vortexed intermittent intervals of 15 seconds for 1 minute as above.
6. The mixture was centrifuged at 3000 rpm for 2 minutes.
7. The upper layer was removed with a pasture pipette and saved into a second aluminum foil covered tube.

8. The lower phase was re-extracted (as in steps 5-7) and the two extracts pooled together.
9. The extract was evaporated under gentle nitrogen a water bath at 37^{0}c. The purpose of nitrogen was used to replace oxygen.
10. Residue was reconstituted in 100µl of the mobile phase (methanol: distilled water 95:5).
11. 30ml of the extract was manually injected into HPLC reverse phase column using Hamilton syringe and needle.
12. Readings were recorded based on retention time and peak area or peak length.
13. Retention time, peak area and peak length were used to predict the concentration of the sample against the known standard curve by linear regression.

c) HPLC conditions

14. UV HITACH L-4000H detector at 325µm or nanometers, the wavelength at which retinol has maximum absorbency.
15. Column- µbondapak with 5µm C18 (silica) particles.
16. C 18 guard column placed immediately before the analytical column.
17. Hitachi L-6000H Pump
18. Hitachi D-2520 integrator
19. Flow rate set at 2ml per minute.
20. Mobile phase 95:5 (Methanol: distilled water)

21. Rheodyne (Cotati) Manual injector.

22. 50µl Hamilton syringe and needle.

3.12 ETHICAL ISSUES

Informed consent

Informed consent was sought by the researcher clearly explaining the objectives and activities of the study to the community in preliminary community mobilization meetings. The detailed consent information (Appendix 4) was read and explained to individual parents during household interviews, after which those who agreed to participate in the study signed a consent form. Respondents were assured of confidentiality of information. Mothers were made aware of weighing procedures and their fears arrayed by being asked to assist in undressing and weighing the index child, similar to what they do in routine growth monitoring clinics. The children were weighed dressed with light clothing such as vests and pants.

3.13 DATA QUALITY CONTROL

The weighing scales were standardized using a two kg rice packet every morning. The principal research supervised the research assistants every day to monitor interviewers work and to help with difficult situations. A repeat of the 24 hour recall procedure was done by principal researcher (while enumerators watched) in one household before starting data collection after observing that enumerators lacked competence even after the training and pretesting. Few repeat questions were included to check consistency of responses. The principal researcher checked all completed questionnaires every day, and respondents were revisited the following day to correct any errors, discrepancies or omissions observed (Fisher et al., 1983).

3.14 CONFOUNDERS

This study considered socio-demographic and socioeconomic factors such as mothers' education and income as confounders. Other confounders considered were vegetables consumed in the households from the main garden or bought. Serum retinol levels indicator was considered despite the study area having been covered during vitamin A supplementation campaigns of Ministry of health, because results would reveal the effect of dietary vitamin A when children also received vitamin A supplements. After running cross tabulations and chi-square the confounders were found to influence both study groups the same way.

3.15 METHOD OF DATA ANALYSIS

Data was coded and progressively entered into the computers. The data was then cleaned, screened by running frequencies and analyzed using Statistical Package for Social Sciences (SPSS) program available at ANP. Descriptive frequency means were used to determine the type and distribution of vitamin A rich food grown in home gardens. Cross tabulation and chi-square was used to determine the relationship between variables, F value having $p<0.05$ was considered significant and $p>0.05$ was regarded insignificant. The t-test was used to compare means of variables in the two study categories. Mean nutrients intake of community was calculated from the food intake data and food composition tables. Recommended Daily Allowances (RDA) for different age groups were used in determining the dietary adequacy for each index child. Mean consumption scores of vitamin A rich food were calculated using the Helen Keller International food frequency method. Food groups used in Helen Keller International food frequency method were used to calculate dietary diversity scores.

Nutrition status data was analyzed using EPI-info programme. The cut-off points for stunting, underweight and wasting were set at two standard deviations (2SD's) below of the NCHS standard for each indicator (Beaton et al., 1990 and Gillespie and Mason, 1991). The cut-off point for retinol levesl was 0.7μmol/L below which a child was considered deficient. A retinol level 0.7μmol/L-1.05μmol/L was regarded low-normal, while above 1.05μmol/L was regarded as adequate (Saskia and Omar, 2002).

Regression analysis was used to describe relationships between retinol levels and nutrition status with, home garden sizes and the number of years an index child's mothers had attended formal education. The welfare index was developed by assigning points to the type of roof, floor and wall in line with the population perception of wealth. A grass-thatched roof was assigned score of 1, iron roof score 2 and brick roof 3. A mud floor was assigned 1 and concrete floor 2.Mud wall was assigned 1 while a brick wall was 2 and a stonewall 3. The sum of points scored by the household from the three variables was taken to denote the welfare index, a high score depicted high socio-economic status. A second welfare index was derived by assigning 1 score each in possessing any durable household items among a radio, sofa set or bicycle. A score of 0-2 indicate low while a score of above 2 was an indication of high welfare index.

The frequency of consumption (Score) was the number of days a food item(s) from a particular food group had been consumed in the previous seven days as reported by respondents. Vitamin A rich food of plant origin in each food group were adjusted by dividing by 12, the Number of μg Beta carotene in 1 Retinol Activity Equivalent (RAE), before adding the corresponding figure to the frequency of animal products and fortified products to get the weighted total consumption or total weighted score for a household.

Households that attained a score of 4 in consuming vitamin A rich animal products or a weighted score of 6 of both plant and animal products was considered to be consuming adequate vitamin A. The mean frequency of consumption of a food item, was calculated by adding all specific frequency scores and dividing the sum by the total number of questionnaires.

Descriptive figures of bar charts were used to describe the prevalence of gastrointestinal parasites, morbidity, occupation and types of vitamin A rich food produced in the households.

Figure 3. Parents are informed of intended study at Manyole DEB

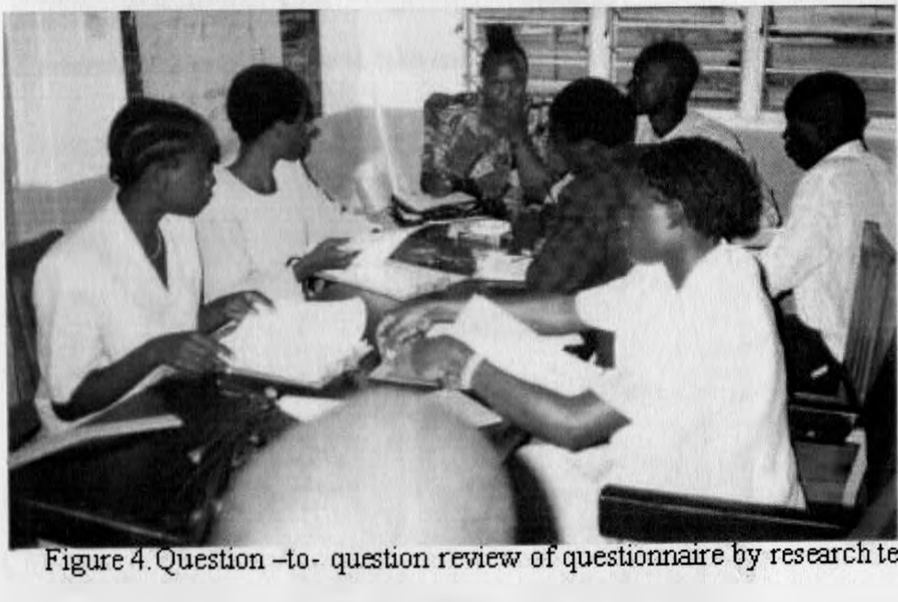


Figure 4. Question –to- question review of questionnaire by research team

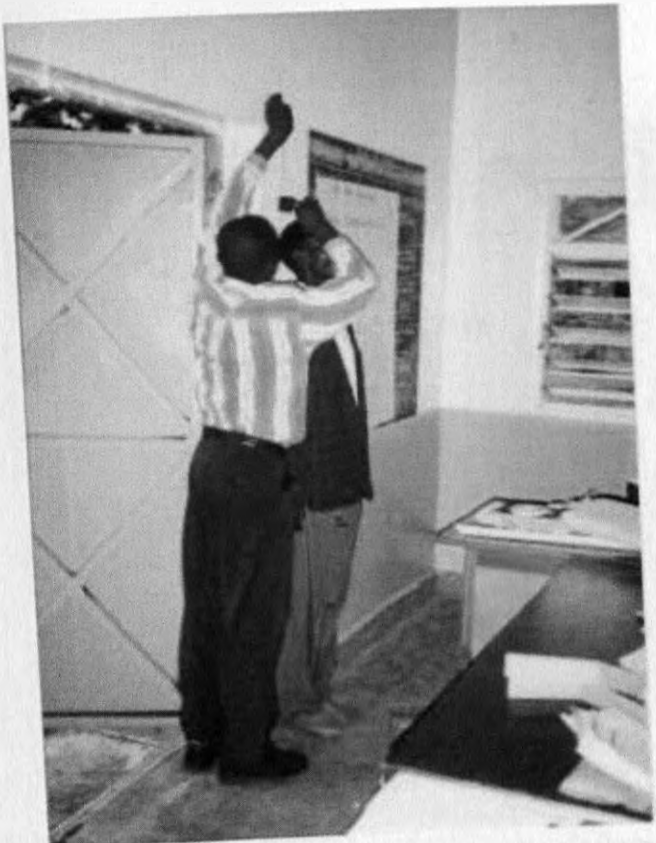


Figure 5.Research assistants practice to take and read height measurements

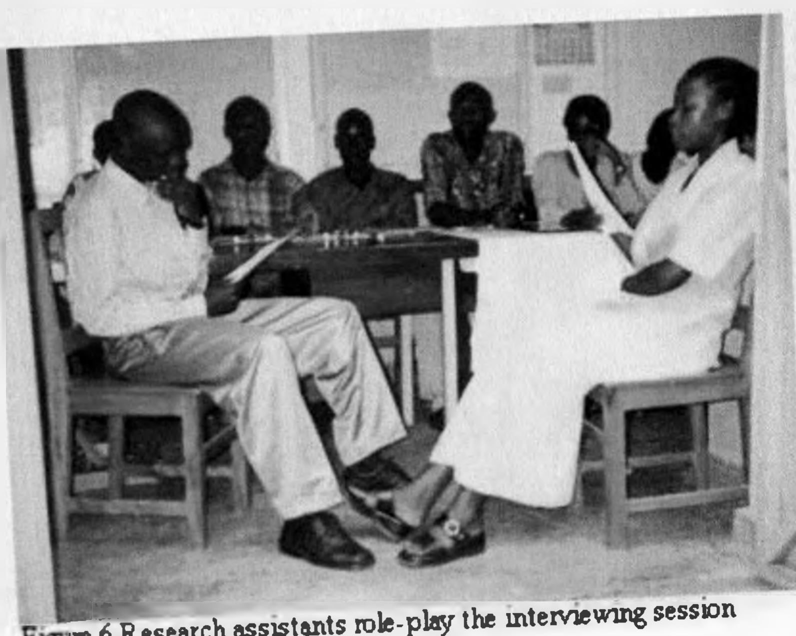


Figure 6.Research assistants role-play the interviewing session

Figure 7.Research team cross checking stool samples for proper labeling

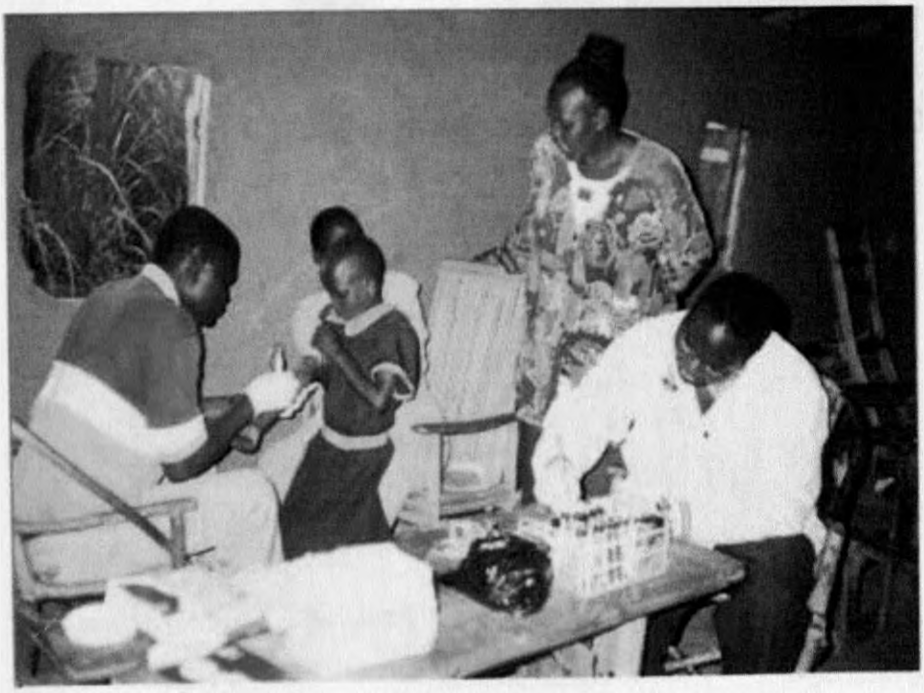


Figure 8. Mr. Omondi drawing blood from an index child

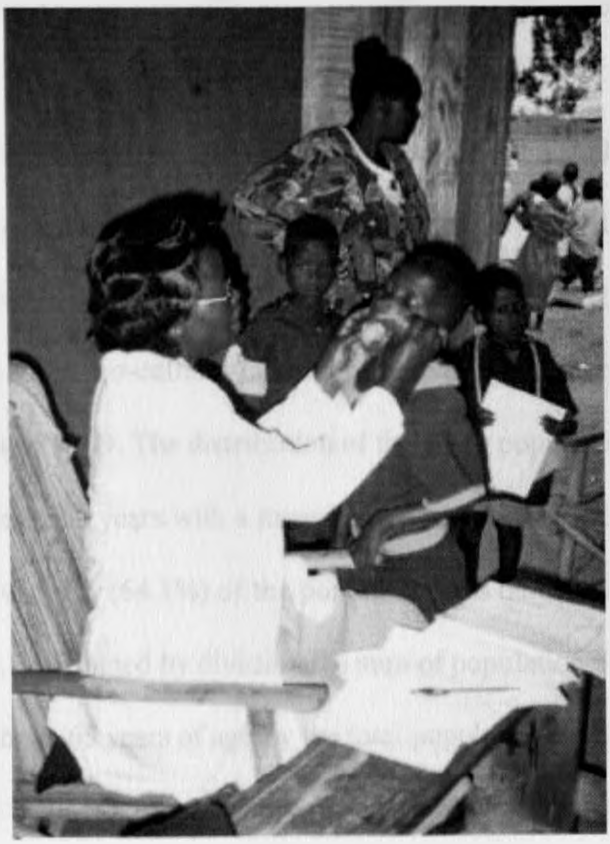


Figure 9. Ms Taphoza examines an index child for clinical signs of VADD

RESULTS

4.1 DEMOGRAPHIC CHARACTERISTICS

Data was collected in 376 households, 138 with home gardens and 238 without home gardens and not in the intended equal sampling ratio, because these comprised all households with home gardens in the study area. The total study population was 2242 people composed of 50.6% (1134) males and 49.4 (1108) females, majority of them from households without home gardens as shown in Table 3. Socio-demographic and socio-cultural factors were investigated as being among the underlying causes of VAD. The distribution of the study population by age ranged from 0 (new-born) to 80 years with a mean age of 15.9 (SD=13.71) years, a median of 11years. Majority (64.1%) of the population was below 20 years. The dependency ratio, determined by dividing the sum of population below 15 years of age and that of above 65 years of age by the total population between 15 and 65 years of age was 1:1.38. There was no significant difference between the two study groups as far as sex and age composition were concerned (Table.5)

Table 5. Distribution of household members by sex and age

	With home garden N=489	Without home garden N=1753
Study households in each location		
Bukhayo east	41	75
Nambale township	73	120
Walatsi	24	43
Sex of household members P=0.893		
Males n=1134	50.7%(248)	50.5%(886)
Females n=1108	49.3%(241)	49.5%(867)
Mean age of household members(years) P=0.873	15.91(SD=13.83)	15.84(SD=13.68)
Mean household size (persons) P=0.645	5.97 (S.D = 2.25)	5.84 (S.D = 2.25)
Age of household members P =0.873		
0-5 years	25.79%(127)	25.3%(441)
5-15years	30.9%(150)	32.4%(563)
16-65years	42.89%(208)	42%(731)
Above 65years	0.6%(3)	0.3%(5)
Mean age of study children in months	45.41(SD=12.25)	45.34(SD=12.40)

Figures in parenthesis indicate the actual numbers (n), while P values are of chi-square test between the two study groups. SD represents standard deviation.

Age of study children by months

There was no significant difference (chi-square of P=0.790) between the ages of the study children in the two groups as shown by in Figure 12.

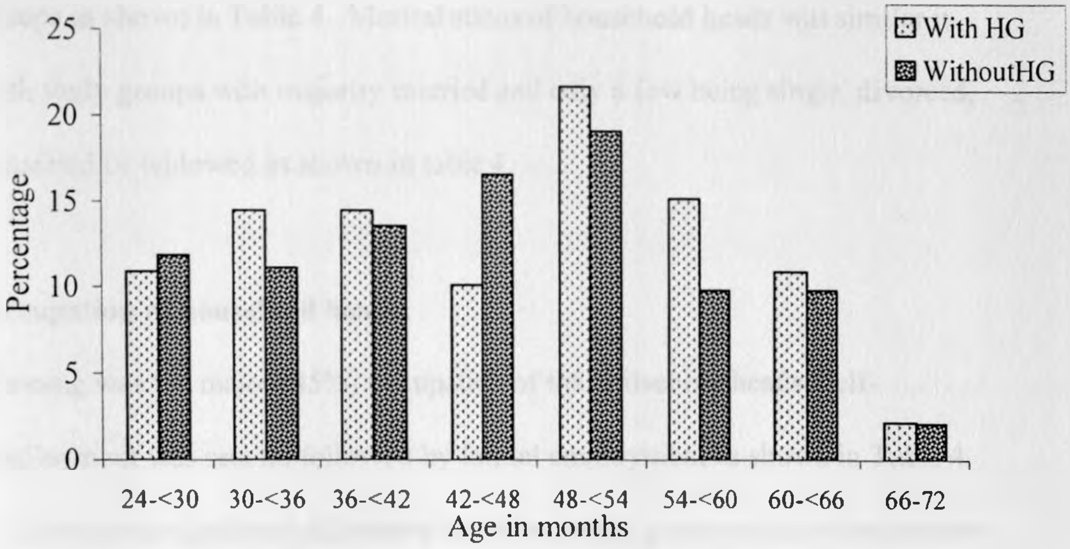


Figure 10. Distribution of study children by age in months

4.2 HOUSEHOLDS AND HOUSEHOLD HEADS CHARACTERISTICS

The total number of people in a household in the study area ranged from 2 people to 14 people, with a mean of 5.9 (S.D=2.19) and a variance of 4.80.There was no significant difference in the mean household size of the two comparison groups as shown in table 4. Mean household size was negatively correlated to consumption of vitamin A rich food with a Pearson's co-efficient of –0.288 and Pearson's P=0.012. This meant that the larger the households size the lesser the consumption of vitamin A rich food.

Gender and Marital status of household heads

Out of the 376 households, the majority of the households (92.3%) were male headed and only 7.1% (27) were female headed. There was no significant difference in the distribution of household heads by gender between the two study groups as shown in Table 4. Marital status of household heads was similar in both study groups with majority married and only a few being single, divorced, separated or widowed as shown in table 4.

Occupation of household heads.

Farming was the major (45%) occupation of the household heads. Self-employment was second followed by formal employment as shown in Table 4. There was no significant difference in the two study groups as far as occupation was concerned. The most common occupation among female household heads was farming.

Only 17.2% (386) of the population earned some money for income. Among them 69.2% (267) were men and the rest were women. The association between gender of an individual and earning was very significant with a chi-square P-value of 0.000.

Education level of household heads

Education level of households' heads indicated a similar trend as the total population with most heads having attended upper primary (28.3%) and completed primary (21.8%) school. There was no significant difference in the education level between household heads of the two groups as shown in Table 4.

Table 6. Characteristics of household heads and mothers' education level.

Characteristic	With home garden N=138	Without home garden N=238
Marital status of household heads P=0.730		
Married	95.6(131)	95.4(226)
Single, divorced, separated/window	4.4(6)	4.6(15)
Occupation of household heads P=0.028		
Farming	45.2(62)	45.1(107)
Housewife/farming	5.5(7)	5.2(13)
Employed	19.3(26)	13.1(31)
Self employed (Artisans, business)	12.6(17)	24.9(59)
Casual laborers	15.6(21)	9.7(23)
Education level of household heads P=0.067		
No education (0yrs)	1.2(1)	2.1(6)
Lower primary (1-3yrs)	2.4(2)	2.1(6)
Upper primary (4-7yrs)	26.5(22)	28.9(82)
Completed primary (8yrs)	26.5(22)	20.4(58)
Attended secondary school (9-11yrs)	13.3(11)	21.5(61)
Completed secondary school (12yrs)	22.9(19)	19.0(54)
Had post secondary education	7.2(6)	6.0(17)
Mothers years' of formal education P=0.47		
No education (0yrs)	10.9 (15)	13.8 (33)
Lower primary (1-3yrs)	3.6(5)	3.8(8)
Upper primary (4-7yrs)	34.8(48)	38.8(93)
Completed primary (8yrs)	26.8(37)	20.5(49)
Attended secondary school (9-11yrs)	13.8(19)	15.9(38)
Completed secondary school (12yrs)	7.2(10)	5.9(14)
Had post secondary education	2.9(4)	1.3(3)
Mean mothers years of formal education P=0.47	6.99	6.67

Figures show percentages while those in parenthesis indicate actual numbers (n). Chi-square P values indicate comparison between the two study groups.

Mothers education levels

Some mothers (12.7%) of the study children had not had any schooling at all, while the highest educated mothers had attained post-secondary (college) education. Mother's education level was determined by the number of years a mother had attended formal Education. Mothers with home gardens had slightly higher but not significant mean of years in attending formal education of 6.99 (S.D 3.41) as compared to mothers who did not have home garden with a mean of 6.67 (S.D 3.44). There were more mothers (13.8%) without any formal education among the non-home gardens compared to 10.9% home gardeners. This difference was not significant as shown in Table 4. Mother's years of formal education was significantly associated to consumption of plant sources of vitamin A rich food among gardeners as indicated by a Pearson's P =0.012.

Socio-economic status of households

The two groups of households were similar without depicting any significant difference in socio-economic characteristics. More males than females were earning in both study groups. The difference was very significant with a chi-square p-value of 0.000.Major sources of income in both groups were from on-farm as well as off-farm sources and depicted no significance difference in the two study groups. On farm income included sale of farm produce, casual labour, food for work, item by item exchange, and ploughing on hire. Off- farm income sources included permanent employment (1 case in each study group), salaried, gifts and business. However it was found that more households relied on on-farm income alone compared to those relied on off-farm income alone. Indicators of socioeconomic status considered included, the different types of roofs, walls and floors. There was no significant difference in the two study groups based on these socioeconomic indicators as shown by the p-values in Table 5. A welfare index was computed from scores assigned to possessing one or more valuable item among a radio, sofa set or a bicycle. No significant difference was indicated by Welfare index as shown in Table 5.

Table 7. Socio-economic status of households

Socio-economic indicator	With home gardens N=138	Without home gardens N=238
Members earning income (P=0.000)		
Males	44.20(61)	86.55(206)
Females	10.4(25)	11(94)
Sources of income (P=0.739)		
On-farm	30.9(42)	27.6(66)
Off-farm	9.6(13)	8.8(21)
Both on-farm and off-farm	59.6(81)	63.6(152)
Socio economic status indicators		
Roof types (P=0.915)		
Grass roof types	69.6(96)	69(165)
Iron sheets roof types	30.4(42)	31(74)
Type of floor (P=0.735)		
Bare ground	84.1(116)	85.4(204)
Cement	15.9	14.6
Type of wall (P=0.386)		
Mud	85.5(118)	90.0(215)
Brick	12.3(17)	8.8(21)
Stone	2.2(3)	0.8(2)
Welfare index (radio, sofa set, bicycle P=0.938)	69.1(96)	69.5(166)
Low welfare index	30.4(42)	30.5(73
High welfare index		
Proportion of income spent on food P=0.396		
30% or less	21.01(29)	18.49(44)
50% or less	18.48(44)	33.61(80)
70%-100%	5.07(7)	12.18(29)
Mean land size in Ha, P=0.642	2.77	5.07
Mean home garden size in m^2	20	0
Keeping Livestock P=0.086	94.5%(131)	98.0%(233)

Figures show percentages while those in parenthesis indicate in actual numbers (n), chi square P values indicate comparison in the two study groups.

4.3 LAND OWNERSHIP AND LAND SIZES

Few (1.6%) of respondents produced food in their own land, 78% in land owned by their husbands and 17.4% in land owned by the parent of the household head. Five (5) respondents rented land for food production, while one (1) used her brother's land. Land under agricultural production ranged from 0.1Ha to 11.2Ha. The mode was 1.2Ha and was in 56 households. Land size was not significantly associated with having a home garden (Chi-square P-value 0.642). Gardeners had lower mean landsize than their counterparts as shown in Table7.

Home garden sizes

Home garden sizes ranged from $0.5m^2$ to 7200 m^2, the most common size being $20m^2$ with a frequency of 13 households, the median was 20.5 m^2. The size of home garden had a positive association with retinol levels (vitamin A status) as indicated by a regression R-value of 0.156 and chi-square P value of 0.0437.

4.4 AGRICULTURAL ACTIVITIES

The most popular agricultural activities in the study population was farming and livestock keeping 47% (175), followed by livestock keeping and home gardening 25.1(95), farming 20.3% (77) and farming and home gardening 6.1%(23).

4.5 VITAMIN A RICH FOOD PRODUCED IN THE HOME GARDENS

The most common types of vitamin A rich foods produced in the home garden were dark green leafy vegetables (DGLV's). Households reported to be producing different types of DGLV's in their home gardens for 409 times. Pumpkin in the dark yellow orange vegetable's (DYOV's) group was reported 17 times while dark yellow orange fruits (DYOF's) were reported 11 times. Cowpeas leaves were the most commonly grown among the dark green leafy vegetables, followed by kales, amaranths, spider weed, sun hemp and pumpkin leaves respectively as indicated in Table 8. Households without home gardens were producing more of vitamin A rich foods in the main gardens in comparison with their counterparts. This higher production was not reflected in sources of vitamin A rich food consumed for non-gardening households because they reported consuming more of bought than own production. This shows that producing vitamin A rich food in the main garden did not translate in improving consumption of the same foods in the household.

Table 8. Vitamin A rich crops produced by households

Type of crop	Home garden produce only N=138	Main farm with HG N=138	Main farm witho HG N=238
Kales	55.1(75)	31.16(43)	42.44(101)
Jute plant (mrere)	34.1(47)	0	1.26(3)
Cowpeas leaves	76.8(106)	55.80(77)	92.44(220)
Sum hemp (miro)	36.2(50)	35.51(49)	50(119)
Spider weed	56.9(51)	0	0
Amaranthus	42.02(58)	2.17(3)	1.26(3)
Pumpkin	12.3(17)	34.78(48)	52.10(124)
Black nightshade	2.17(3)	0	0
Pineapples	3.62(5)	13.04(18)	30.67(73)
Tomatoes	2.17(3)	1.44(2)	0.42(1)
Bananas	1.44(2)	0	0
Others (spinach, lettuce.)	5.07 (7)	4.34(6)	0.84(2)

Figures show percentages; those in parenthesis are actual number of households (n)

4.6 SOURCES OF DARK GREEN LEAFY VEGETABLES CONSUMED IN THE HOUSEHOLDS

More households (87.6%) among the home garden category significantly consumed their own vegetables either from the home garden or main farm compared to households without home gardens (36.1%) as shown by chi square of P=0.000. Only one household among the non-gardeners reported to have consumed vegetables solely from their own production in the main farm compared to 55 households among the gardeners. Among households that consumed vegetables from both buying and own production (either in the home garden or main farm), the home gardeners reported that they ate lower proportions of bought vegetables and more of their own produce compared to non-gardeners. The difference was significant with Chi square P=0.000 as shown in figure 11.

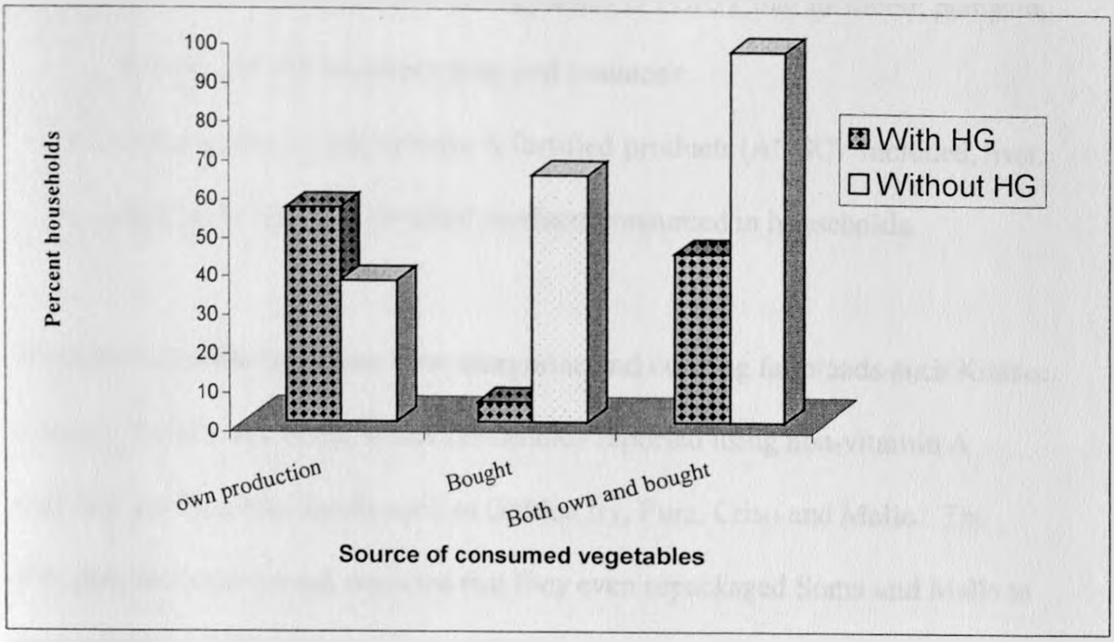


Figure 11. Sources of Dark green vegetables consumed in households

4.7 TYPES OF VITAMIN A RICH FOODS CONSUMED BY THE HOUSEHOLDS

Vitamin A rich foods consumed in the household were determined using the Hellen Keller International food frequency questionnaire (HKI FFQ) method. Vitamin A rich foods were classified into four groups.

1. Dark green leafy vegetables (DGLV) that included: kales, amaranthus, jute plant, spider plant, pumpkin leaves, sun hemp, cowpeas leaves and black nightshade.
2. Dark yellow/orange fruits (DYOF) that included: Mangoes, passion fruits and paw paws etc.

3. Dark yellow/orange roots or vegetables DYOR/V that included: pumpkin. orange- fleshed sweet potatoes and tomatoes.
4. Animal sources and vitamin A fortified products (ANSC) included, liver. eggs and vitamin A fortified products consumed in households.

Vitamin A fortified products were margarine and cooking fat brands such Kimbo, Chipsy, Yellow and Soma. Other households reported using non-vitamin A fortified cooking fats brands such as Golden fry, Pura, Criso and Mallo. The shopkeepers interviewed, reported that they even repackaged Soma and Mallo to one spoonful quantities weighing of 7-10g,which they sold at Ksh. 5.

Households with home garden had a higher but not significant mean consumption of DGLV as compared to household without home gardens. Households with home gardens consumed DGLV, DYOF, and DYOR/V in more days than households without home gardens. At the same time there were higher numbers of households without home gardens not consuming DGLV and DYOF as compared to households with home gardens, in fact no household with a home garden missed to consume DGLV in any day of study period.

The mean animal score was significantly higher in households without home gardens compared to their counterparts as indicated in Table 7. The mean vegetable score was higher in gardening households than the non-gardeners as shown in Table 7. The weighted score incorporating both vitamin A sources from plant and animals was significantly higher in households without home gardens than those with home gardens as shown in table 7.

The animal score was significantly associated to sources of income with a chi-square P value of 0.01. Households whose main source of income were from off-farm or both on-farm and off-farm had a higher score of consumption than households who depended on on-farm income only. Similarly the vegetable score had an association though insignificant with sources of income with a chi-square P-value of 0.08. It was reported during the FGD's that one major reason for not having a home garden (Sirundu as commonly called) was a way of getting male household heads to buy stew to go with ugali. FGD participants reported that men usually bought meat or any other animal product as the stew for ugali.

Table 9. Mean Consumption Frequency Scores of Vitamin A rich foods.

Food group	With HG N=138	Without HG N=238	Chi-square P-Value
Animal Score (ANSC)	4.20(3.71)	5.00(3.98)	0.001
Vegetable score (adjusted by 1:14)	1.09(0.43)	0.98(0.46)	0.08
Weighted score	5.30(3.79)	5.94(4.05)	0.028

Figures in parenthesis indicate standard deviation

Using the weighted score 57.1% households without home gardens consumed adequate levels of vitamin A as compared to 45.7 % among those with home gardens. This difference was not significant as indicated by a chi-square P value of 0.31. Figure 12 shows the number of households adequately consuming each vitamin A rich food type.

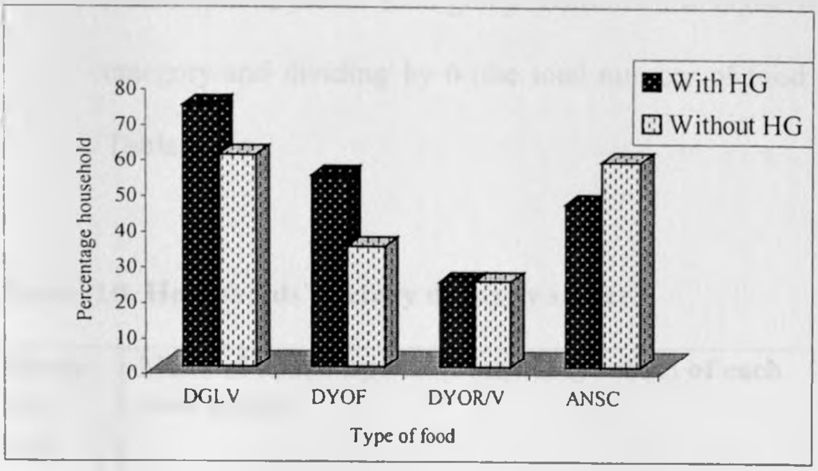


Figure 12. Households' consumption of different types of vitamin A rich foods.

4.8 DIETARY DIVERSITY

Dietary diversity was the number of different types of food groups consumed by an index child over the period of seven days prior to the study (Swindale and Ohri-Vachaspati, 2005) . The HKI FFQ contained all food items consumed in the community and these were grouped into groups so as to reflect the overall quality of the diet (Swindale and Ohri-Vachsspati, 2005 and WHO, 1998).

1. The number of days a given food was consumed by an index child in the week prior to the study was calculated and was also referred to as the frequency of consumption of food group.
2. The mean of consumption for a food group was average of number of days a given food group was consumed by all study children in each of the two study group.

3. The average diversity score was arrived at by adding the mean consumptions for all food groups consumed in house holds of each study category and dividing by 6 (the total number of food groups) as shown Table 10.

Table 10. Households' dietary diversity scores

House hold type	Mean of consumption (Frequency score) of each food group	Diversity score (sum of means)	Average diversity score
	DGLV+DYOF+DYOR/V+FATTY+ANSC+LEGMS		
HG	5.97 + 5.04 + 3.72 + 3.37 + 2.16 + 2.41	22.67	3.78
NHG	5.42 + 4.17 + 2.92 + 2.43 + 2.67 + 2.20	23.492	3.30

HG-With home garden NHG-With no home garden

4.9 DIETARY ADEQUACY

The majority of the study population 94.11% and 88.89% for gardeners and non-gardeners respectively, were was consuming above safe level of protein, with the means far above cut-off level. Most children in both study groups consumed inadequate amounts of dietary calories and vitamin A as shown by their means of consumption in comparison with the respective RDA's as shown in Table 11. The older children, 60-72 months in both groups were consuming adequate vitamin A, but the levels were higher in households without home gardens. There was no significant difference in dietary intakes in terms of calories, protein and vitamin A in the two study groups as shown by chi-square P values in table 11.

Table 11. Mean nutrient adequacy by age group

Nutrient	RDA (cut-off points)	With HG N=35	Without HG N=47
Calories in Kcal, P=0.375			
24-59.9 months	1550Kcal	1426.31(731.92)	1328.98(44.48)
60-72 months	1850Kcal	1344.29(731.92)	1344.29(966.41)
Protein in g, P=0.375			
24-59.9 months	17.5g	53.58(34.11)	55.21(44.44)
60-72 months	21g	64.33(41.05)	44.84(25.97)
Vitamin A in RE, P=0.450			
24-59.9 months	400RE	235.14(297.03)	190.00(449.48)
60-72 months	400RE	425.49(662.46)	643.93(954.36)

P values are of chi-square test between the study groups while figures in parenthesis indicate standard deviation.

Population consuming more than 75% of recommended amounts

Only 40.74%, 90.12% and 24.69% of the study population consumed more than 75% of RDA for calories, protein and vitamin A respectively. Children of gardeners had higher caloric and vitamin A intake than their counterparts. The difference was however only significant in caloric intake with a chi-square P value of 0.037. Dietary caloric intake was also significantly correlated to consumption of Vitamin A rich food of animal origin among the gardeners with a Pearson's correlation coefficient of –as 0.370 and shown in Appendix 2a.

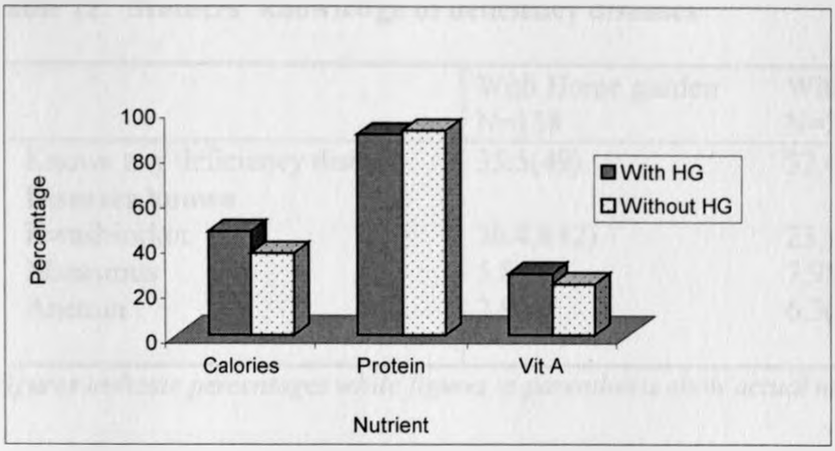


Figure 13. Population consuming more than 75% RDA

4.10 MOTHERS KNOWLEDGE ON FOODS AND DEFICIENCY DISEASES

More of gardening mothers 35.5% mentioned at least one deficiency disease associated with lack of food as compared to 32.4% among mothers with no home gardens, the difference was however not significant (chi-square P=0.534). Main deficiency diseases mentioned were kwashiorkor, marasmus and anemia as shown in the Table 12.

Table 12. Mothers' knowledge of deficiency diseases

	With Home garden N=138	Without home Garden N=238
Knows any deficiency disease	35.5(49)	32.4(78)
Diseases known		
Kwashiorkor	30.43(42)	23.11(55)
Marasmus	5.8(8)	7.98(19)
Anemia	2.9(4)	6.3(15)

Figures indicate percentages while figures in parenthesis show actual numbers

Mother's ideal meal for index child

When each mother was asked to mention the food they considered ideal for the index child, only 22 of the mothers mentioned any vitamin A rich food alone or among food combinations. The major ideal foods for study children according to their mothers are as shown in Table 13.

Table. 13. Mothers' ideal meal for index child

Ideal meal for index child	With home gardens N=138	Without home gardens N=238
Porridge	16.0(21)	11.5(26)
Beans and rice	9.9(13)	14.6(33)
Rice	7.6(10)	3.5(8)
Uji and ugali	4.6(6)	4.4(10)
Beans	4.6(6)	4.0(9)
Ugali omena	4.6(6)	3.5(8)
Ugali vegetables	2.3(3)	2.2(5)
All foods	3.1(4)	1.3(3)

Figure show percentages while those in parenthesis indicate actual numbers (n)

4.11 VITAMIN A SUPPLEMENTATION

A total of 87.5%(308) of the study children had received Vitamin A capsule supplements (200,000 IU) during Ministry of health polio and measles campaigns, 5 or 10 months before the study. Vitamin A supplementation had coverage of 87.6% among the gardeners and 87.4 % among those without home gardens. There was no significant difference in the two study groups as far as coverage and period after supplementation were concerned as shown by chi square P value of 0.967.

4.12 MORBIDITY OF STUDY CHILDREN

Almost half, 47.1%(181) of the study children had been sick in the period of two weeks prior to the survey. Prevalence of morbidity was higher 53.9(76) among children of gardeners than among their counterparts who had a morbidity prevalence of 43.6(106). The difference was significant with a chi square P Value of 0.05. An index child of gardening household had a higher likelihood of being sick as indicated by the odds ratio of 0.47 (at 95% confidence interval) than an index child from a household without a home garden. Most common diseases and disease conditions are shown in figure 14.

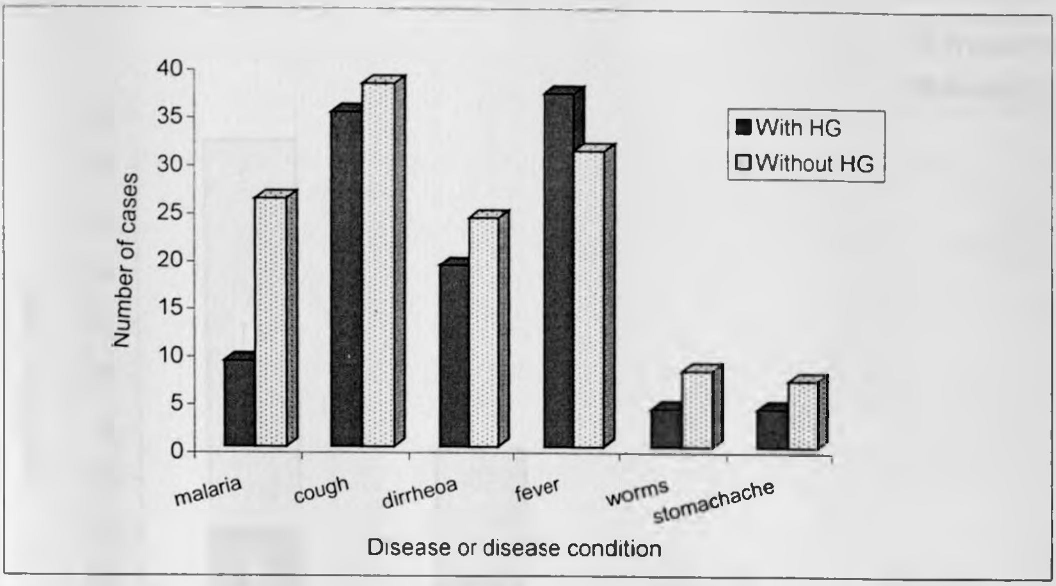


Figure 14. Prevalence of diseases among study children.

4.13 PREVALENCE OF GASTROINTESTINAL PARASITES

Gastrointestinal parasites were present in stools of 30.4% out of the 79 children tested. There was lesser 25.0% gastro-intestinal parasites infestation among children of gardeners compared to 28.6% among children of non gardeners .The difference was not statistically significant as indicated by Chi Square P value=0.657. The most common parasites were hookworms, *Ascaris lumbricoides*, *and T. tricturius* with prevalence's shown in figure 15.

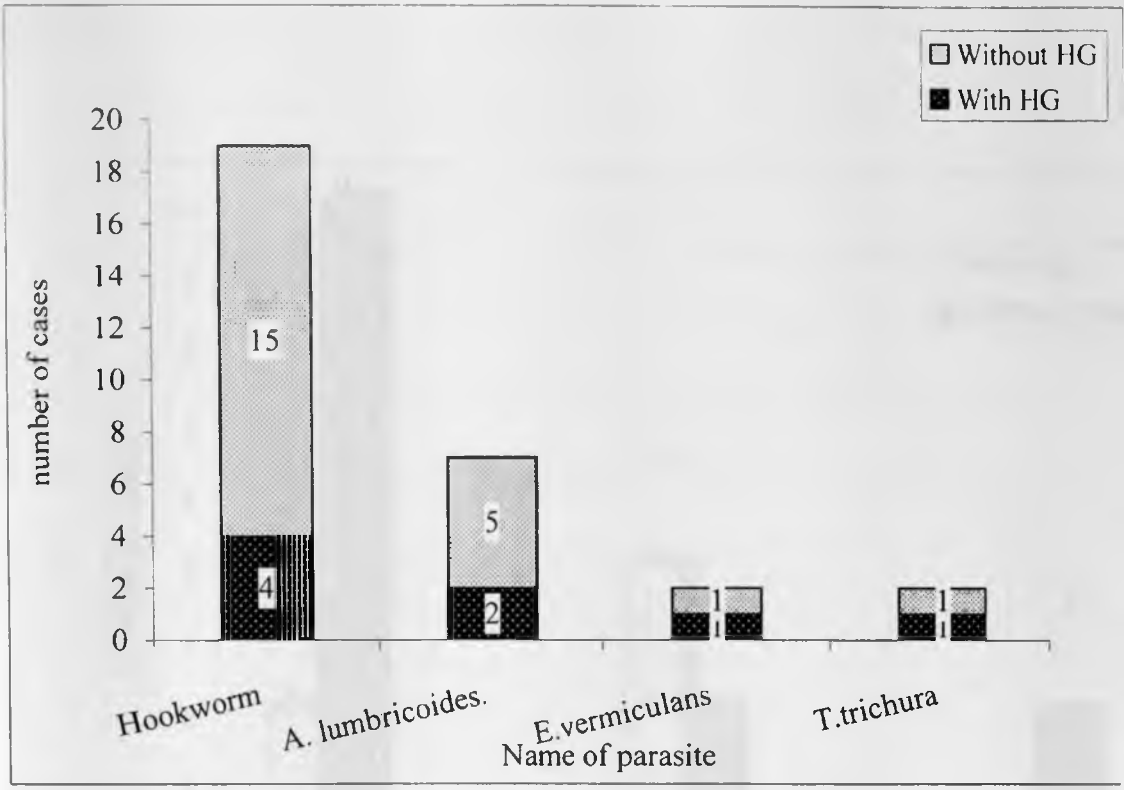


Figure 15. Prevalence of gastro intestinal parasites.

4.14 CLINICAL SIGNS OF VADD

Vitamin A deficiency disorders (VADD) clinical examinations were done on 79 children out of whom 41.8 % among gardeners and 58.1 of non-gardeners showed symptoms of VADD. In total 79 children were clinically examined. The most common clinical sign of vitamin A deficiency disorders (VADD) seen were, dental carries, septic wounds and fungal infections. Other signs observed were two (2) cases each of bleeding gums, oral mucosa lesions, ringworms and protein energy malnutrition (PEM). There was a single case each of eye discharge, ottitis media, stomatitis and bitot spot. Clinical signs of VADD were more prevalent among non-gardeners as shown in figure 16. The cases were too few to perform any significance tests.

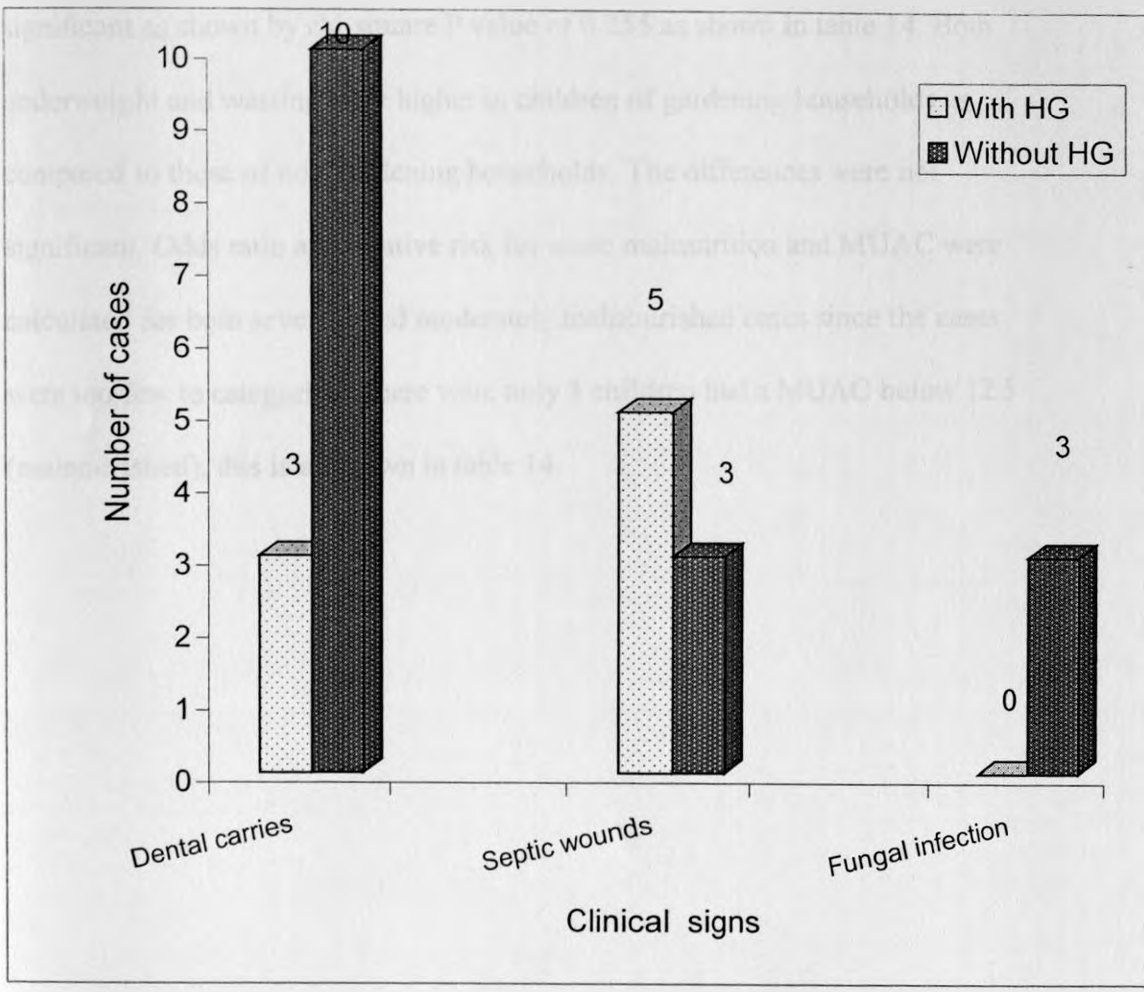


Figure 16. Clinical signs of vitamin A deficiency disorders (VADD).

4.15 NUTRITIONAL STATUS OF STUDY CHILDREN

Nutritional status was determined and reported as wasting, underweight and stunting based on weight for height Z-score (WHZ), weight for age Z-score (WAZ) and height for age Z-score (HAZ) respectively. Mid upper arm circumference (MUAC) was also determined. Stunting (in both prevalence and severity) was higher in children of non-gardening household as compared to among their counterparts as shown in figure 17. The difference was not significant as shown by chi-square P value of 0.255 as shown in table 14. Both underweight and wasting were higher in children of gardening households as compared to those of non-gardening households. The differences were not significant. Odds ratio and relative risk for acute malnutrition and MUAC were calculated for both severely and moderately malnourished cases since the cases were too few to categorize. There were only 3 children had a MUAC below 12.5 (malnourished), this is as shown in table 14.

Table 14 Nutritional status of study children

Indicator	With Home garden	Without HG	Odds ratio (95% confidence interval)	Relative risk	P-value
Underweight					
Severe	2.9%(4)	2.1% (5)	0.28	0.29	0.055
Moderate	12.2% (17)	10.9%26)	0.96	0.96	0.883
Stunting					
Severe	10.6% (13)	14% (30)	1.33	1.29	0.69
Moderate	17.1% (21)	22.4% (48)	1.00	1.15	0.403
Wasting			0.36	0.37	0.10
Severe	1.6% (2)	0	-	-	-
Moderate	2.4% (3)	2.6% (6)	-	-	-
MUAC	1	2	1.12	1.12	0.927
Below 12.5cm	0.7(1)	0.8(2)			

Figures indicate percentages while those in parenthesis show actual numbers

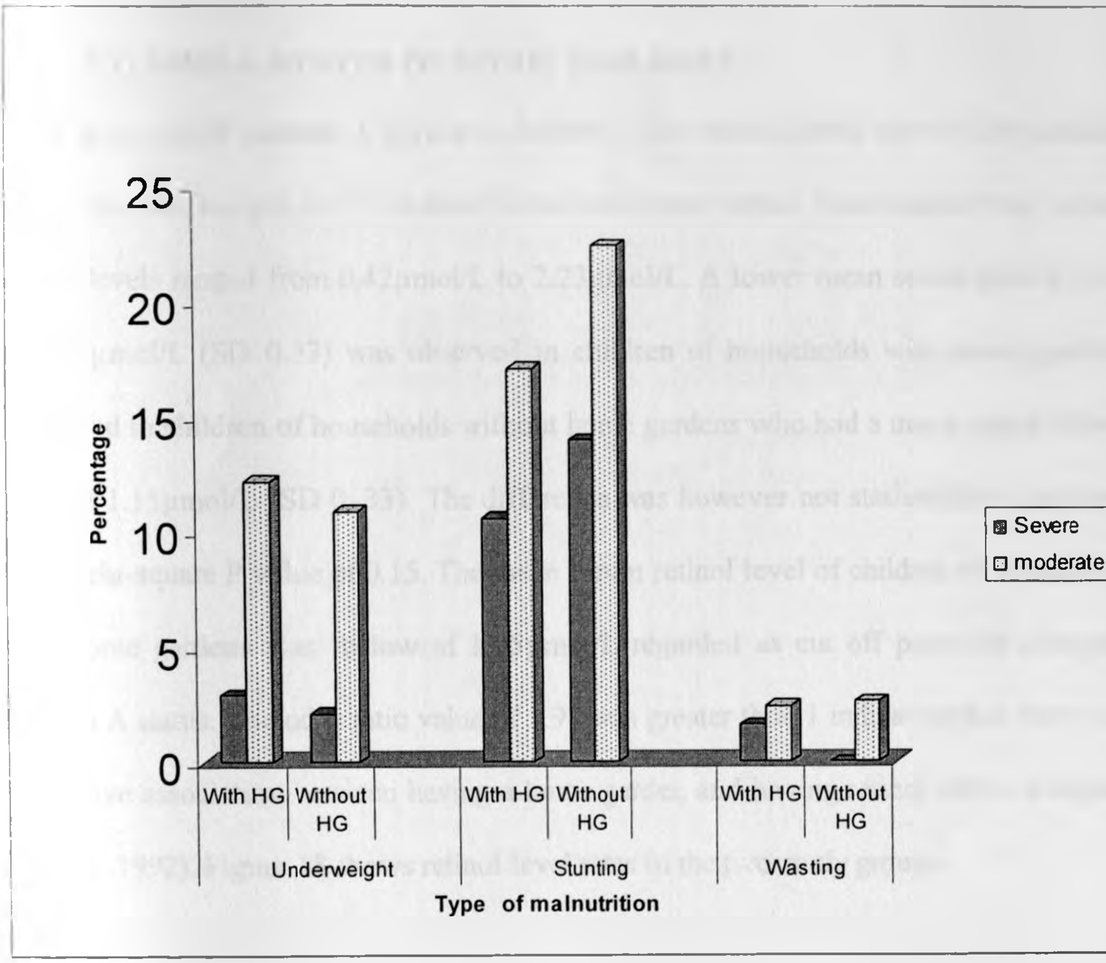


Figure 17. Nutritional status of study children.

Stunting and underweight were observed only in younger children below 48 months. Age of an index child was significantly associated with stunting as indicated by chi-square of p=0.045 and p=0 .000 for the gardening and non-gardening households respectively. Age of index child was also significantly associated with underweight (P=000) in the non-gardening group.

4.15 VITAMIN A STATUS OF STUDY CHILDREN

There were only 8 vitamin A deficient children (with retinol levels below 0.70(μmol/L) out of the sub sample of 77 children who underwent retinol biochemical test. Serum retinol levels ranged from 0.42μmol/L to 2.23μmol/L. A lower mean serum retinol level of 1.03μmol/L (SD 0.33) was observed in children of households with home gardens compared to children of households without home gardens who had a mean serum retinol level of 1.15μmol/L (SD 0. 33). The difference was however not statistically significant with a chi-square P value of 0.15. The mean serum retinol level of children of households with home gardens was below of 1.05μmol/L regarded as cut off point for adequate vitamin A status. The odds ratio value of 1.98 was greater than 1 indicating that there was a negative association between having a home garden and having retinol below adequate (Gordis, 1992). Figure 18 shows retinol level rates in the two study groups.

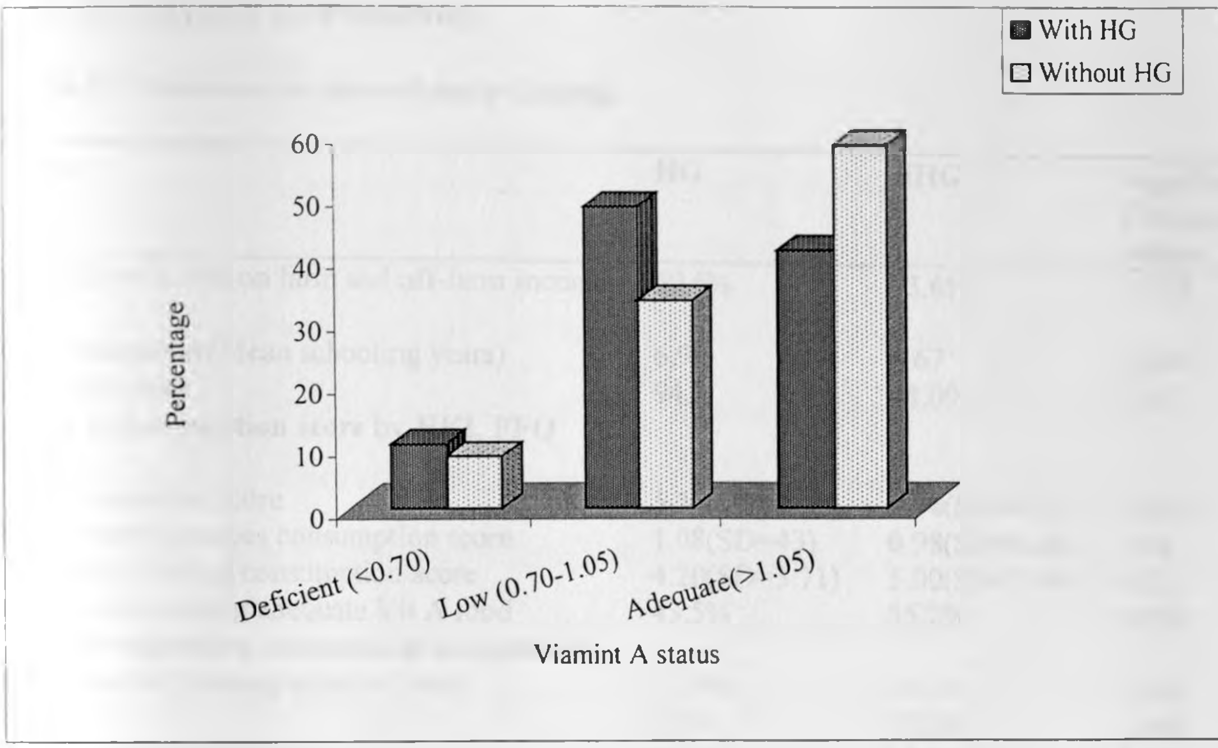


Figure 18. Serum retinol levels of study children

4.17 SERUM RETINOL LEVELS OF MALNOURISHED CHILDREN

There were more cases (10), of combined malnutrition and below adequate retinol levels (<1.05μg/mol) in households with home garden in comparison to those in households without HG (6). In both cases of stunting and underweight, the odds ratio was greater than one (1) indicating a negative association, where by presence of home garden HG could have increased the likelihood of having lower retinol levels. The difference was not significant as shown by the chi square P values of 0.161 and 0.26 for stunting and underweight respectively.

4.18 SUMMARY OF FINDINGS.

Table 15. Summary of selected study findings

Findings	HG	NHG	Significance Chi-square values
Household with both on farm and off-farm income	59.6%	63.6%	0.739
Mothers education (Mean schooling years)	6.99	6.67	0.086
Keeping livestock	94.5	98.09	0.47
Vitamin A consumption score by HKI, FFQ method			
Mean consumption score	5.30(SD=3.79)	5.94(SD=4.05)	0.028
Mean vegetable sources consumption score	1.08(SD=43)	0.98(SD=0.46)	0.08
Mean animal sources consumption score	4.20(SD=3.71)	5.00(SD=3.98)	0.01
Population consuming adequate Vit A food	43.5%	55.2%	0.036
Sources of vegetables consumed in households			
Own production (home garden or farm)	54.7%	35.7%	0.000
Bought	2.9%	19.1%	0.000
Bought and own production	40.1%	44.8%	0.000
Average diversity score	3.69	3.35	0.028
Nutrient adequacy (consumption >75% of RDA)			
Calories (Kcal)	45.94%	36.30%	0.037
Protein (g)	89.18%	90.12%	0.396
Vitamin A (RAE)	27.27%	22.72%	0.230
Mothers aware of deficiency diseases	35.5%	32.4%	0.534
Adequate Serum Retinol levels (<0.70μmol/L)	1.05(SD=0.401)	1.13(SD=0.37)	0.15
Total morbidity prevalence	53.9%	43.6%	0.05
Total GIT parasites prevalence	25.0%	28.60	0.657
Nutritional status			
Wasting	4%	2.6%	0.10
Underweight	15.1%	13.0%	0.820
Stunting	26.7%	36.4%	0.255

Figures in parenthesis indicate numbers(n) while chi-square P values indicate comparison in the two study groups.

CHAPTER FIVE

5.0 DISCUSSION

Vitamin A status of children in Nambale division was marginally adequate for households without home gardens but adequate for non-gardeners. Presence of a home garden had not significantly contributed to improved vitamin A status of study children but the size of the home garden size was associated with consumption of vitamin A rich vegetable sources and vitamin A status by retinol levels. Increased availability of income from non-farm sources and higher frequency of consuming animal sources of vitamin had contributed to improved vitamin A status of the non-gardening group. Home gardeners bought fewer vegetables than their counterparts. Children of gardening households had slightly more diversified diet and a bigger number of them consumed adequate calories compared to their counterparts. Only few mothers of both groups knew of any deficiency diseases but at the same time most mothers did not consider vitamin A rich food as ideal meal for their children.

5.1 DEMOGRAPHY

Family size, age distribution, education of house hold members, and occupation of household heads was similar in both study groups and therefore did not have much effect to vitamin A status of children. Though both study groups had similar sources of income and livelyhood, off –farm income sources, land sizes and keeping livestock were higher in households without home gardening and was associated with serum retinol levels. This contributed to the higher serum retinol levels in the non- gardening group. This further indicated that the non-gardening group was economically better off compared to their counterparts.

5.2 HOME GARDENING.

The presence of home garden contributed to the higher consumption of vitamin A rich food, higher caloric intake and also the low buying of dietary vegetables in the home gardening group in comparison with their counterparts. A home garden of $20.5m^2$ that was the mean size of home garden in this study, can improve micronutrient status of a household as shown in one project of the Asian vegetable research and development center study. The findings of the Asian (AVRDC) study showed that a garden measuring 16 m^2 in Indonesia, Thailand or Philippians, could supply a family of five; two adults and three children with significant RDA of dietary protein, calcium, iron, vitamin A and vitamin C (FAO, 2003). On the contrary home gardening did not improve vitamin A status (Retinol levels) in this study, a factor that was attributed to the masking effect of vitamin A supplementation, low bioavailabilty of carotenoids and low socio – economic level of the gardening households.

Home gardens can improve household income as shown by 44.9% of households with home gardens in this study, which also sold their home garden produce in addition to household consumption. Research on market gardens by AVRDC study showed that a plot of 10m X 20m using only family labor increased income by approximately 30% for small farm families (FAO, 2003). Additional income from the home garden did not improve the socio-economic status of gardeners in Nambale. This could be attributed to the transitory food shortage or that the sales from home gardens were too low to make any difference.

5.3 VITAMIN A RICH FOOD PRODUCED IN HOME GARDENS

The most common Vitamin A rich food produced in home garden was dark green leafy vegetables. Very few households had dark yellow roots and vegetables and fruits. This indicates lack of diversity in vitamin A rich food production in the home gardens and could have contributed to the study group having lower serum retinol levels

5.4 CONSUMPTION OF VITAMIN A RICH FOOD

Non-home gardening household reported to have been producing higher vitamin A rich food in the main garden than their counterparts but this did not translate in improved consumption of their own produce. On the contrary the non-gardeners consumed more of bought than their own vitamin A rich foods. There is therefore higher likely hood of vitamin A rich food produced in the home garden being consumed in a household than when the similar food is produced in the main farm. This therefore implied that the garden increased vitamin A food of plant origin consumed in the household, this is similar to what was found out in Ndinakuzi study where the home garden project had increased intake of DGLV and DYOR/V (FAO, 2003). Findings in this study agrees with the statement in the fourth report on the world nutrition situation which suggests that the low bioconversion of pro-vitamin A, in dark green vegetables is a major reason why home gardening *per se* is seldom found to be directly associated with improved vitamin A status (ACC/SCN, 2000).

Non gardening household consumed more vitamin A rich food of animal origin, had more off-farm sources of income and kept more livestock compared to their counterparts which contributed to the higher retinol levels in children. This was because animal sources have high bioavailability of vitamin A than plant sources. Households without home gardens bought most of their vitamin A food as compared to their counterparts indicating that they were economically better off and implying that more men participated in purchasing food in this group. During focus group discussions, male household heads were reported to buy animal products whenever they participated in purchasing food for the family. These further indicated that men are an important entry point for increasing consumption of Vitamin A rich foods especially animal products. This was further supported by the fact that more men than women in the study households were earning.

5.5 FOOD CONSUMPTION BY DIVERSITY

A bigger proportion of households with HG consumed a wider variety of foods as shown by the slightly higher dietary diversity scores as compared to their counterparts with no home gardens. This was in agreement with a study carried out by Food and Nutrition Institute whose results showed that, preschool children of households with home gardens consumed more fruits and vegetables consequently gaining higher intakes of Vitamin A, C and iron compared to those of households without home gardens (Bayani, 2000). This is similar to what was observed in the Ndunakazi study where the home gardening added variety to the diet without replacing major components of fruits and Vegetables previously consumed. There was no significant difference between the two groups in food diversity. This was therefore le to accepting the null hypothesis that 'There is no significant difference in dietary diversity of households with home garden and those without home garden'. Lack of significance was associated with general food shortage since the study area was experiencing a transitory food shortage that is common during the planting season. Gardeners could have lacked sufficient food in their diets due to their inability to buy caused by their low socio-economic status. This further suggests that the gardening could have shielded the study group from adverse consequences of malnutrition, an issue that was beyond the scope of investigations of this study. This however implies the importance of home garden as major source of food during off-season periods.

5.6 DIETARY ADEQUACY.

Dietary caloric and vitamin A intake were very low but protein was sufficient. Caloric intake was 45.94% among the home gardeners and much lower (36.3%) among the non-home gardeners. This was very low depicting a deficiency in caloric intake. This could be a result of transitory food shortage. Dietary vitamin A was lower in younger children suggesting intra-household food distribution inequality or it may have been caused by poor vegetable consumption in the age group, an issue that requires further investigation. Caloric intake insufficient among non-gardens contrary to their higher vitamin intake and adequacy, this could have been by transitory food shortage. The non-gardeners may have lacked enough money to buy every food consumed in the house since this group relied more on buying food as opposed to producing their own. This also indicates that food from main garden was not sufficient and that a home garden is necessary to increase consumption of own produced food.

5.7 MORBIDITY AND GIT PARASITES.

There was high morbidity in both study groups that could have been caused by setting of the long rains. Children of home gardeners were more affected by coughs and fever(could be a symptom of malaria) than their counterparts implying that they had less mechanisms of copying with cold and increased mosquitoes due to the rains. This was further suggestive of the low socio-economic status of the home gardeners imply their inability to acquire protective clothing or mosquito nets.

Children of households without home gardens were more infested by gastro intestinal parasites. This did not have any effect on vitamin A status since the same group had higher serum retinol levels.

5.8 NUTRITIONAL STATUS

Children of home gardening households were less stunted than their counterparts. The lower stunting rates in gardening group showed that the group had relatively lower past food shortages, while the higher wasting and underweight in the same group was a reflection of current food shortages at the time of study (WHO, 1995b). Non-gardeners children showed an opposite trend with higher stunting indicating past food shortages and lower wasting and underweight that indicated that had less food shortages at the time of study. This shows that non-gardeners had a higher risk of long-term nutritional problems such reduced mental capacity and underdevelopment.

The stunting, underweight and acute malnutrition for the area was 33.3%, 13.8% and 3% respectively. Compared to the western province statistics for 2003, Nambale division had higher stunting, but lower wasting and underweight than provincial rates, which were 30.2% stunting, 19.0 underweight and 4.5% wasting (NCPD, 2004). However acute malnutrition was higher in children of home gardeners' indication that they were more vulnerable to transitory food shortages than their counterparts.
There was no significance difference between the two study groups, therefore led to accepting of the hypothesis that 'There is no significant difference in nutritional status of children from households with home gardens and those without home gardens'.

The lower stunting rates among children from gardening household in Nambale depicted a trend similar to that found in the IFPRI-UNICEF study (Haddad, 2000). The study showed that children from households of families with non-commercial garden plots were had lower stunting rates than their counterparts in families without gardens, after controlling for income, assets and education (Haddad, 2000). Similar to this current study another study by Aziz had shown that kitchen gardening was an effective intervention program, where the under fives of households with kitchen garden were 83% well nourished while their counterparts of households without kitchen gardens had a well nourished rate of 66%(Aziz, 1989). This suggests home gardening had contributed to the continuous availability of food in the household. This was further supported by higher caloric intake found in this group despite the group low-income status.

5.9 VITAMIN A STATUS

Children from home gardening households had lower serum retinol levels as compared to the non-home gardeners though not significant. This could be attributed to the lower consumption of animal rich sources of vitamin A as compared to their counterparts. They also had fewer sources of income outside the farm indicating they could be poorer. This therefore led to accepting of the hypothesis that 'There is no significant difference in vitamin A status of children from households with home gardens and those without home gardens'. This is similar to the findings in the study on the impact of the HKI Gardening programme in Bangladesh, where gardening was shown to have a significant impact on both retinol levels and iron status of Mothers but no impact on retinol and hemoglobin ferritin levels that of children (Fuchs et al 2002). Similarly to this study the Bangladesh children had also received Vitamin A capsule supplementation in a period within 3-6 months prior to the study (Fuchs et al 2002).

Both study groups had similar vitamin A supplementation coverage and though there had been high coverage of vitamin A supplementation, serum retinol levels had not been sustained and had reached a low-adequate level requiring another dose of supplementation especially in the gardening group. Findings of this study imply that consuming higher animal sources of vitamin A of had an impact on improving the serum retinol levels in the non gardening group. The low-adequate (0.70-1.052 μMol/L) retinol levels in both groups indicate the low body reserve of vitamin A and showed that most children were at risk of getting VAD in case of any slight exposure to predisposing situation despite having received vitamin A supplements. This further suggests that adequate dietary vitamin A especially from animal sources was a more sustainable approach of maintaining adequate vitamin status, especially for the study children in Namable. This further supports the need for more off-farm or higher sources of income to increase consumption of animal products that had sustained adequate vitamin A status in the non-gardening group. This implies that income had a greater role than either gardening or capsule supplementation in terms of improving and sustaining adequate vitamin A status of the study population. This further confirms that improved income levels would improve vitamin A status of children.

There was high morbidity in the two study groups which was more manifest in the home gardening group. This could have contributed to depressing serum retinol concentration rendering the children at risk of VAD(Basu and Dickerson,1996). Infestation by gastro-intestinal parasites coupled with poor intake of vitamin A food all contributed to depleting serum retinol levels.

5.10 MOTHERS KNOWLEDGE

Very few mothers 35.5% home gardeners and 32.5% non-gardeners knew of any deficiency disease. Even among those that knew deficiency diseases, only 1 gardener and 2 non-gardeners mentioned night blindness. This showed that the study population was not aware of the importune of vitamin A, VAD nor its consequences. Only 22 mothers mentioned a vitamin A rich food in what they considered ideal food for index child further supported this. This indicates mothers' ignorance of importance of vitamin A to children. This suggests that mothers may not have put any effort that children consume the vitamin A foods available in the homes. It was therefore implied that low nutritional knowledge of vitamin A was a big problem in children's' dietary intake in addition to inaccessibility of the vitamin A food to the households.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

Home gardening did not improve vitamin A status (by retinol levels) in this study a factor that can be attributed to the masking effect of vitamin A supplementation, low bioavailabilty of carotenoids and low socio – economic level of the gardening household. Higher off-farm income, keeping livestock, bigger land sizes and high consumption of animal sources of vitamin A all contribute to improved vitamin A status of non-gardening households. Dietary consumption of animal sources of vitamin A has more sustained impact on vitamin status than gardening alone or a general one-time vitamin A supplementation campaign.

Dark green leafy vegetables comprised the bulk of crops grown in home garden there by indicating lack of diversity that contributed to low Vitamin A status in the gardening group. Gardening had improved caloric intakes, consumption of dark green leafy vegetables and offered a more diversified diet to the home gardening group.

Gardening contributed to controlling stunting by supplementing household food in a period of transitiory food shortages. Gardening also contributed to reducing the amount of vegetables bought while maintaining a higher consumption. This indicates that home gardening increases access to food.

Men's participation in purchasing of household food and more off farm sources of income resulted in increasing consumption of animal products.

There exists very low awareness of vitamin A, it importance, deficiency diseases and VAD severe consequences among mothers in both study groups. Most mothers in the study area do not consider vitamin A rich foods as part of the ideal meal of an index child.

6.2 RECOMMENDATIONS

1. Study finding indicate that vitamin A deficiency was low adequate and below adequate for the non-gardening and gardening group respectively despite above 87% in both study groups. It is therefore recommended that nutritional education be incorporated in all vitamin A capsule supplementation programmes to ensure that improved Vitamin A status as result of supplementation is be maintained in a sustainable way through improved dietary consumption of vitamin A.

2. Findings of this study show that men bought animal products whenever they purchased the sauce to go with ugali. Men should therefore be targeted for empowerment in nutrition knowledge with an aim to increasing their involvement in provision of vitamin A rich food especially animal products.

3. Most mothers' were not aware of importance of Vitamin A and consequences of vitamin A deficiency to children. Mothers should be provided with adequate

nutrition knowledge to enable them put efforts in ensuring children's diets always have vitamin A.

4. Study findings indicate an association between kitchen garden size and Vitamin A status. It is therefore necessary to promote an appropriate size of kitchen garden.

5. Findings indicate that most crops grown in the Home garden were green leafy vegetables. It is therefore recommended that household diversity the type of vitamin A rich food grown order to achieve higher consumption of vitamin A food. Diversity in the home gardens should be encouraged to include dark yellow and orange-fleshed root crops and fruits that are commonly grown in the main farms. However to achieve improved vitamin A status small animals must be incorporated with gardening mainly for household consumption.

6. Study findings indicate a relationship between off-farm income and consumption of Animal sources of vitamin A. This further implies the need to provide employment and income generation activities in the area.

7. Study findings show that Home gardening contributes to acquisition of income to sizeable population and this can explored as a window of opportunity in increasing incomes of this study group.

8. This study found high morbidity in the study population which may depress vitamin A levels especially for the poorer gardening group. It is therefore important to control malaria, other sickness and gastrointestinal parasites.

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APPENDICES

Appendix 1. Population consuming more than 75% dietary adequacy

NUTRIENT	RDA	WITH HG	WITHOUT HG
Calories	24-36 months =1350 36-59.9 months= 1550 60-72 months= 1850	45.94	36.3
Protein	24-36 months =15.5g 36-59.9 months= 17.5g 60-72 months= 21.0g	89.18	90.12
Vitamin A	24-36 months =400RE 36-59.9 months=400 RE 60-72 months= 400 RE	27.27	22.72

Appendix 2A. Pearson correlation coefficients of some selected variables with direct or indirect effect on the study findings for the home gardeners.

Independent variable	Consumption of vitamin A rich foods			Wasting	Under weight	Stunting	Retinol levels
	Vegetable	Animal	Both				
Mothers education	0.214* *0.012*	0.105 *0.222*	0.147 *0.087*	0.101 *0.264*	0.165 *0.056*	0.055 *0.526*	-0.220 *0.270*
Size of household	-0.288* *0.012*	0.105 *0.222*	0.147 *0.087*	-0.054 *0.548*	-0.023 *0.797*	-0.045 *0.606*	-0.010 *0.959*
Size of home garden	-0.259** *0.02*	-0.055 *0.527*	-0.086 0.326	0.004 *0.962*	-0.002 *0.980*	-0.005 *0.956*	-0.083 *0.681*
Dietary Vitamin A	0.335 *0.061*	-0.040 *0.826*	0.000 *0.998*	-0.365 *0.051*	-0.099 *0.608*	0.005 *0.980*	0.097 *0.778*
Dietary proteins	0.065 *0.724*	-0.303 *0.092*	-0.278 *0.123*	-0.127 *0.511*	0.207 *0.282*	-0.029 *0.886*	0.085 *0.805*
Dietary calories	0.075 *0.681*	-0.370* *0.037*	-0.347 *0.052*	-0.233 *0.224*	-0.196 *0.307*	0.116 *0.565*	0.240 *0.477*

The figures in italics represent P values. The others figures represent Pearson coefficients of independent variables while the * indicates a significant association of the variables.

Appendix 2B. Pearson correlation coefficients of some selected variables with direct or indirect effect on the study findings for the non home gardener

Independent variable	Consumption of vitamin A rich foods			Wasting	Under weight	Stunting	Retinol levels
	Vegetable	Animal	Both				
Mothers education	-0.028 *0.663*	0.072 *0.269*	0.069 *0.288*	-0.040 *0.548*	0.028 *0.668*	0.101 *0.119*	0.198 *0.140*
Size of household	0.026 *0.691*	-0.060 *0.356*	-0.058 *0.375*	-0.057 *0.396*	-0.033 *0.612*	-0.037 *0.568*	-0.071 *0.600*
Dietary Vitamin A	0.071 *0.640*	0.093 *0.540*	0.097 *0.521*	-0.230 *0.123*	-0.131 *0.376*	0.015 *0.920*	-0.244 *0.262*
Dietary Proteins	0.200 *0.183*	-0.170 *0.258*	-0.138 *0.359*	0.075 *0.620*	-0.043 *0.788*	-0.115 *0.436*	0.041 *0.851*
Dietary Calories	0.074 *0.627*	-0.101 *0.503*	-0.088 *0.561*	0.005 *0.974*	-0.180 *0.221*	-0.244 *0.095*	-0.084 *0.794*

The figures in italics represent P values. The others represent Pearson coefficients of independent variables, while the * indicates a significant association of variables.

Appendix 3: RESEARCH QUESTIONNAIRE

SECTION 1: SOCIO DEMOGRAPHIC

NAME OF INTERVIEWER ____________________________
DATE OF INTERVIEW________________DISTRICT____________________
DIVISION _________LOCATION ___________SUB-LOCATION
____
VILLAGE ________________ CLUSTER________________
QUESTIONNAIRE NO.________ HOUSEHOLD NO_______ CHILD NO.
____

What is your name [respondent Mother] _________________________ Age ________Yrs
Who is the Head of household Name _________________ Sex____________ 1=M 2=F
Marital status of household head [Circle]
Codes 1= Married 2= single (Never married) 3=widowed 4=separated/Divorced

1. What religion do you belong to? **[Circle]**
   Codes 1= Catholic 2= Protestant
   3=Muslim 4=other (specify)
2. How many people do you have in your household (those with whom you have cooked and eaten together from the same pot for the last three month)? For each of them please tell me their sex, age, marital status, and relationship to the household head, religion, education level, occupation and illnesses **[Fill in the table below corresponding codes starting with the respondent who should take serial No.1]**

List of household members

Serial No	Name	Sex	Marital status	Age	Relationship to HHD	Education	Occupation	Illness
1	(Respondent)							
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								

CODES

SEX
1= Male
2=Female

Relationship To HHH
1=Head of HH
2= Wife
3=Child
4= Grandchild
5=Parent to HHH
6= other relative
7=Servant
8=other (specify)

Education
1=Completed 1-4 of primary
2=Completed 5-8 of primary
3=Attending Primary
4=Attended Secondary school
5=Completed Sec. School
6=tertiary Education
7=Adult/Informal Education
8= Pre-school child
9=Not attended school

Occupation
99= pre school
1=Housewife/Farming
2=Herding
3=salaried/employed/civil servant
4=Farming
5=Artisan/Business
6=Student/pupil
7=Casual labourer
8=others specify

Marital Status
1=married
2=Single
3=Separated/divorced
4=Widowed parent
5=Single
6=other (specify)

Illness
1=Yes
2=No

[Observe and record type of house [Circle]

Type of roof 1=grass 2=Iron sheets 3=tiles 4=Other (specify)

1. Type of floor 1= bare ground floor 2 =concrete floor 3=Other (specify)

2. Type of wall 1=Mud walls 2=brick walls 3= stone wall 4=Other (specify)

3. Do you own the following 1=Radio 2= Sofa set 3= Bicycle

   4=Other (Specify)

4. Who owns the house? **[Circle]**
   1=own 2= Husband 3=HHH parent(s) 4=Rented 5=Squatter
   6=other (specify)

SECTION B: AGRICULTURAL PRODUCTION (HOME GARDENING)

5. Do you do any agricultural production? **[Circle]**
   1=yes 2=No
6. **[If Yes]** on whose land **[Circle]**
   1=own 2= Husband 3=HHH parent(s) 4=Rented 5=Squatter
   6=other (specify)

7. What is the size of land ________________acres

8. What agricultural activities do you carry out? **[Circle]**

   1=Home gardening 2= Farming 3=Farming and home gardening 4= Livestock 5= Farming, Home gardening &Livestock 6= Others (specify)

9. Please tell me all the crops you grow **[Circle]** 1= maize 2=beans 3=cowpeas 4=millets 5=sorghum 6= Lentils 7=groundnuts 8= cassava 9=bananas 10=kales 11=cabbages 13= simsim 14=others (specify)

10. **[For those with home gardens],** ask to visit the Home garden and observe or probe for the following information. **[For Those without home gardens go to question 28]**

11. What type is the home garden? **[Circle]** 1=Double dug 2=Multistorey 3=Mandalla 4=Small plot 5=other (specify)

12. What size is the home garden? ____ meters by ____meters=_____M^2**[Use tape measure to estimate]**

6=Other (specify)

13. Does the home garden also have a Plant nursery **[Circle]** 1=Yes = No

14. [If yes] Which plants are grown in the nursery **[Circle]** 1=kales (local name) 2=Amaranthus 3= spinach 4=spider weed (saga) 5=mrere 6=Other (specify)

15. Of the foods grown which ones does (does not) the home garden supply adequately? For those not adequate how does the family cope and how often is this done

Crop	Adequacy 1=adequate 2=Not adequate	Coping mechanism 1=buying 2= Other vegetable 3=Other type of food, alternatives (specify) 4=skips (omissions)

16. How do you use the produce from the home garden? **[Circle]**
1=Household food consumption- 2=Sales --------------
3= Household consumption and sale 4= Other (specify)

23. What are some of the things produced in home garden for sale?

1= 2= 3= 4=

5= 6= 7= 8=

24. Who works on the home garden? **[Circle]**
1=Household head 2=Wife 3=children
4= Others (specify)

25. Give three main reasons starting with the most important that make the home garden important to the household.

1st = **2nd =** **3rd =**

1. Starting with the most important tell me three important problems you have in producing sufficient vegetables for your family in the home garden. **[Circle]**

1st=

2nd =

3rd =

2. Do you keep any livestock? **[If yes]** Which ones 1=Cow (Commercial dairy) 2= Cow (local/Other) 3=sheep/Goat 4=Chicken (hybrid) 5=Chicken (local) 6= Other(specify)

28. Is any member of the family employed? **[Circle]**
1=Yes 2=No
29. How do you acquire your main income **[Circle]**
1= on farm 2= off the farm
30. How much income is spent on food **[Circle]**
1=Less than 30% 2= 50 % or less 3= Between 50 and 70%
4= 70-100% 5=More than 100% (all is spent yet it is not sufficient to meet the family basic food requirement)

SECTION C DIETARY INTAKE

31. FOOD FREQUENCY QUESTIONNAIRE

Please tell me in how many days **[Index child]** consumed [**Name specific food**]? How was the food acquired? [**Probe for items in the list below if not mentioned**].

Item	**Frequency** 0= not consumed 1=Not more than 4times per week. 3=4or more times per week	**Source** 1=Home garden 2=bought 3=both 4=Other (specify)	**Proportion for those bought** 1=all 2=50%/50% (HG/B) 3=25%/75% " 4=75%/25% " 5= None
Maize (Ugali/Uji)			
Pepper			
Amaranth	☐		
Avocado			
Banana			
Beans			
Blue band	○		
Carrots	☐		
Cowpeas	☐		
Eggs	○		
Groundnuts			
Kales			
Liver any type	○		
Mango	☐		
Maize			
Meat			
Milk			
Onion			
Papaya	☐		
Pumpkin	☐		
Spinach	☐		
Orange fleshed sweet potato	☐		
Tomato	☐		
Others (specify)			

Adapted from Rosen et al 1993

32. TWENTY FOUR-HOURS RECALL

Starting with what so and so (index child) ate first after waking up yesterday, please tell me all other food, drinks and snacks he took including those eaten out of the household up to the time he/she woke up this morning in household measures

Food/Drink/snack Name of dish	Time	Type of dish (how prepared boiled, Fried, Stewed etc	Name and amounts of ingredients in family/child meal		Name of household measure	Total volume of dish ml/g	Amount of food served to child (a) Total	Amount of food left over by child (b)	Amount consumed by child (a - b)
			Name	Amt g/ml					
B/Fast									
Snack									
Lunch									
Snack									
Supper									
Snack									

[Estimate volumes and weights of item indicate for each Code (household measure)] 1= Sufuria 2=gorogoro 3=Kasuku(2kg) 4=Kasuku(1kg) 5=Pint(------s) 6=Cup(-------mls/g) 7=Others(specify)

TABLE FOR OFFICIAL USE ONLY DURING ANALYSIS

Time	Prop. of dish taken (amount eaten/cooked (a-b)	Name of ingredients	Amount of ingredient eaten by the child
B/Fast			
Snack			
Lunch			
Snack			
Supper			
Snack			

33.What would you consider an ideal meal for **[index child]**?

34. Do you know of any foods that enhance eyesight? **[Circle]** 1=Yes 2=No **[If Yes List them below]**

____

____

____

MORBIDITY

35. Has ---------------------------- so and so (index child) had any illnesses in the last 2 weeks from today? **[Circle]** 1= Yes 2=No

37. [If yes], Tell me the types of illnesses and the number of times each has occurred? **[If no go to question 38]**

Illness	**Number of times**
Cough	
Diarrhea	
Night blindness	
Measles	
Worms	
Fever	

Night blindness

38. Does (index child) see well in the day? **[Circle]** 1=yes 2=No

39. Does (index child) see well at dusk/dim light? **[Circle]** 1=yes 2=No

40. Does (index child) see well at night? **[Circle]** 1=yes 2=No

[If the answer is No for one or more of three questions above, ask questions Nos. 41, 42 & 43 if not go to question No.44]

41. What indicators or reasons make you feel that this child do not see well?

____

____

____

42. What is the possible cause of this failure to see well?
____
____
____

43. Have you done anything to assist the child as far as this problem/issue is concerned?
____
____
____

44. Has index child received Vitamin A capsules supplementation? **[Show the capsule and confirm with the clinic card]** [Circle] 1=Yes 2=No

[If yes, ask question fill the table below from the clinic card, if no move to question no.45].

Name	No. of times supplementation .received	Date of first supplementation	No. Of months since last supplementation

45. Anthropometric measurements

Date-______________location______________sub-location______________
Village________________Questionnaire no.______Household No.______________

Name of child ____________________________Sex 1=M 2=F
Date of birth __________Age in months ________(use clinic card)
dd/mm/yy

MUAC1 --------mm (nearest 0.5mm)	MUAC1 --------mm (nearest 0.5mm)	Average MUAC --------mm (nearest 0.5mm)
Height 1 ---------cm (nearest 0.5cm)	Height 2 ---------cm (nearest 0.5cm)	Average Height ---------cm (nearest 0.5cm)
Weight 1 ---------kg (nearest 0.1kg)	Weight 2 ---------kg (nearest 0.1kg)	Average Height --------kg (nearest 0.1 kg)

46. STOOL COLLECTION FORM

Date-________________ location_____________________

sub-location_________________

Village________________ Questionnaire no.______

Household No._______________

Name of child ____________________________ sex_________

Age ________

Is the child sick 1=Yes 2=No

If Yes Explain

Date of specimen collection___________________________

Date of test___________________

Results 1=positive 2= Negative

If Yes parasite type:

1= Ascaris 2= hookworm 3= Trichuris 4=Enterobius

5=Strongiloides 6=E. Histolytic a 7=S. Mansoni

8=Others (specify)

Comment

Signed/rubberstump____

47. BLOOD SAMPLE ANALYSIS FOR SERUM RETINOL

Date-________________location_______________sub-location____________________________

Village______________ Questionnaire No.___________Household No.____

Name of child _______________________ sex 1=M 2=F Age ____

Is the child sick 1=Yes 2=No

If Yes Explain

Date of specimen collection ______________________________________

Date/time of centrifuge____

Date of test ____

Results ________________µMol/L.

Comment

Signed/rubberstump____

48. CLINICAL EXAMINATION
[To be filled by clinician]

Codes 1=yes 2=no

1 Oral Mucosa: lesions present __________ Bleeding gums____
1. Abscess________
2. Physical abnormality _____________
3. Pallor
4. Jaundice
5. Skin abnormalities__________________[If yes specify] ___________
6. Bitot spot ____________________
7. Conjunctiva xerosis____________________
8. Corneal xerosis________________________
9. Others (specify) _____________________
10. Comments

Appendix 4: INFORMED CONSENT INFORMATION

Client information to be read to participants

We are from the University of Nairobi and have been sent here to carry out research on Vitamin A and vegetable gardening. Vitamin A Deficiency is public health problem in the whole world. Kenya has a VAD prevalence of 85.9% among preschool of children (GOK/UNICEF .1999). Vitamin A mostly affects women and children and has severe consequences even at sub-clinical or mild deficiencies states. Vitamin A deficiency may lead to:

1. Irreversible blindness,
2. Increased risk to infections (morbidity),
3. Poor growth and development
4. Reduced immunity.
5. Measles becomes more complicated and may become fatal when there is VAD.
6. It generally increases child and maternal mortality.

VAD is preventable by sufficient intake of Vit A rich foods. The study will be seeking to establish whether Vitamin a is public health problem in Ngong Division and whether households with home gardens and those without are affected in the same way. We shall be using varies method, which include structured questionnaires and group discussions. For all children who participate in the study we shall take anthropometric measurements of height and weight. For some of these children we will do further clinical examination, and collect their blood and stool samples for biochemical retinol levels and gastrointestinal worms tests respectively. The results of the study will be used to recommend household vegetables production and consumption to improve Vitamin A and Nutrition status of the people in this area and other areas with similar climatic conditions.

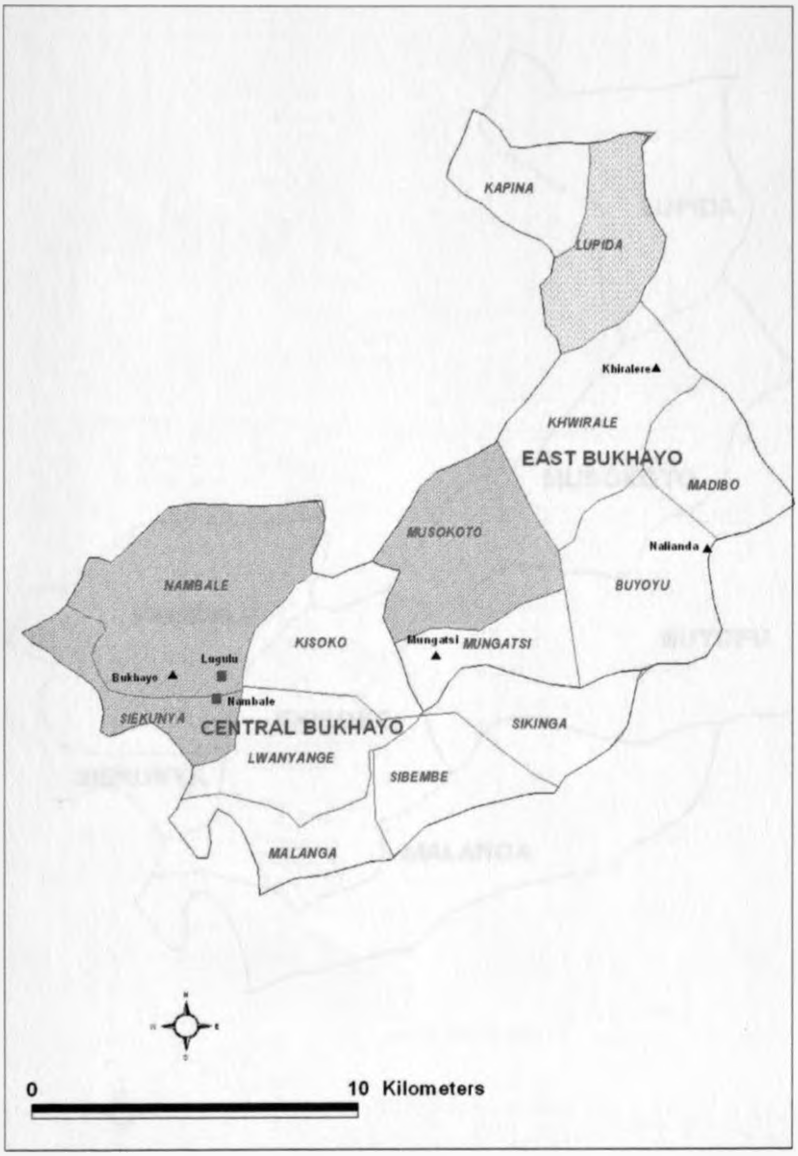
METHODOLOGY

1. We shall visit your households and questions on general food intake, vegetable growing and consumption, other crops production, livestock keeping and Vitamin A supplementation.
2. We shall carry out anthropometric measurements of height and weight.
3. Children participating in the study will be examined for clinical signs of Xeropththalmia.
4. We shall collect stool samples from some children to check on gastrointestinal parasites.
5. We shall collect blood sample for biochemical analysis of Serum retinol levels

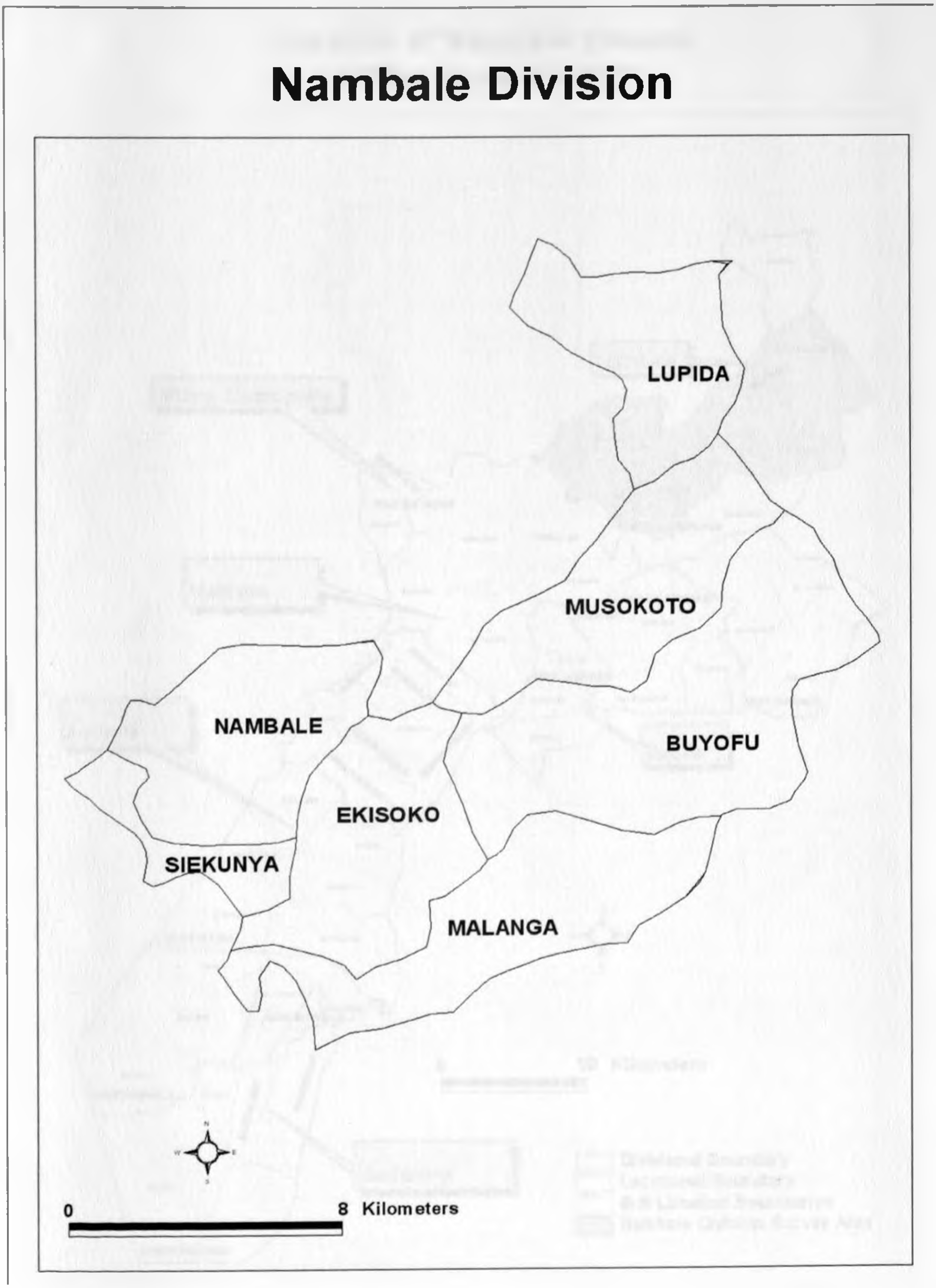
Benefits of the study

1. Level of VAD problem in the area will be known and will form a basis for future planning and also for campaigns in prevention of blindness.

Appendix 5. Map showing Nambale Division.

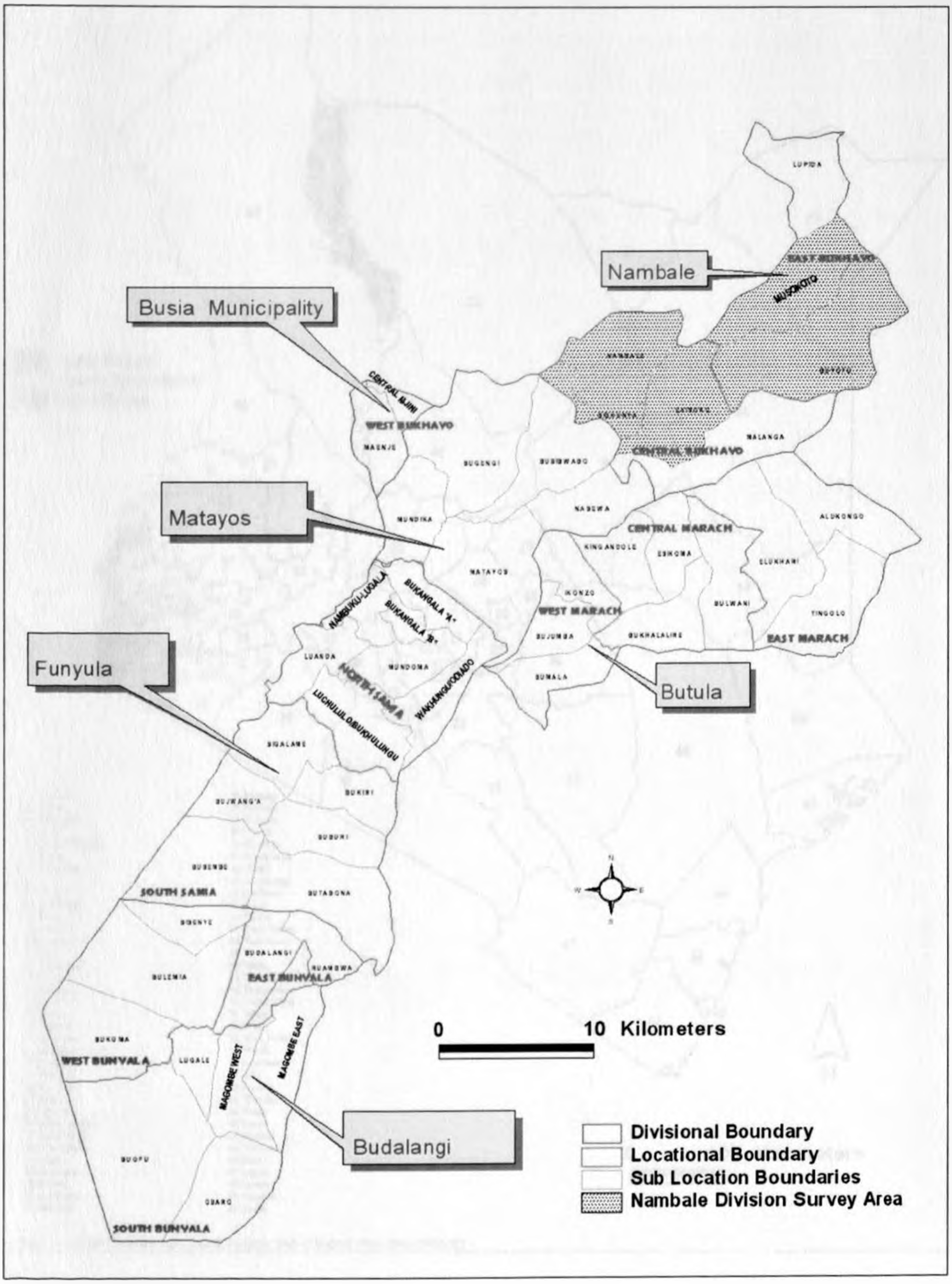


Appendix 5. Map showing Nambale Division.



Appendix 6. Map showing location of Nambale Division in Busia District

Location of Nambale Division Within Busia District



Appendix 7. Map showing the location of Busia District in Kenya

LOCATION OF BUSIA DISTRICT IN KENYA