DETERMINANT FACTORS OF ANAEMIA AMONG THE PRESCHOOL CHILDREN AND WOMEN OF CHILD BEARING AGE IN GARRISSA DISTRICT, KENYA

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DECLARATION

I, Mohamud Hassan Hersi Hereby declare that this thesis is my original work and has not been presented for a degree in any other university.

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This thesis has been submitted with our approval as university supervisors.

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Dedication

To my father, Hassan Hersi Ismail (ARAH) without him I would have never managed my career this far.

Mohamud Hassan Hersi

December, 2004

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Abstract

A cross sectional study with an analytical component was conducted at Garrissa district to identify the effect of some important determinant factors of anaemia on Garrissa population. A sample of 384 households was used in three randomly selected villages in Garrissa town. A questionnaire was administered to gather information on demographic characteristics, socio economic status, physiological status (pregnancy, breastfeeding), water sanitation and hygiene, morbidity, and. food consumption patterns. Blood samples for haemoglobin concentration analyses and for malaria parasite and stool sample for Helminth and other intestinal parasites were also taken to determine the effect of parasitic infestation on the anaemia status. A majority of the people in Garrissa (89.1%) live in abject poverty and live below poverty line i.e. they earn < 1 dollar per household per day. The prevalence of anaemia in Garrissa district (63 to 86% from moderate to severe) proved to be the highest in the whole country. The households live below poverty had higher prevalence of anaemia. The stated hypothesis that socio-economic status has no effect on anaemia status has been rejected.

Literacy level of the mothers, defined as those who can read and write showed no effect on the anaemia status of the studied population. In fact the study showed that literate women had higher prevalence of anaemia compared to the illiterates.

Higher consumption of fruits and vegetables did not significantly increase Hb level and subsequently anaemia status. In fact only vitamin A had significantly correlated with Haemoglobin (Hb) level.

Vitamin A, Fibre, and zinc from the daily micronutrient intake showed to correlate with Hb level. Pregnant and breastfeeding women showed no difference in Hb level and anaemia status and therefore physiological status has no immediate effect on the anaemia situation of this community. Malaria had significant effect on the anaemia status of the population. Stool parasite infestation of the women of childbearing age showed to be significantly correlated with Hb levels. Unlike women, children morbidity two weeks prior to the study showed to be significantly correlated with Hb level and hence anaemia status.

The pregnant mothers who had the habit of practicing pica manifested higher anaemic prevalence than those who did not practice and as such the hypothesis that there is no significant difference in haemoglobin level between those who do practice pica and those who do not is rejected. Zinc is an important micronutrient and correlation was found between Zinc and Hb level among the studied population.

Though the iron consumption was adequate among the study population this has not helped in reducing the anaemia status. The consumed iron nutrient was mainly non heam iron from cereal characterised low bioavailability.

For effective primary prevention, there is need to increase bioavailability of micronutrients particularly vitamin A, and pro-vitamin A. Also mineral-releasing processes such as fermentation should be re-examined and promoted appropriately.

Health and nutrition education should be given in Barazas (chief's) and should rigorously discourage pica practice. In addition, sanitation should be encouraged within these forums. To prevent malaria and parasitic infestation, improving community awareness should also be emphasized within the existing health facility programs (MCHs) in the district. De-worming programs should also be emphasized in order to reduce parasitic loading.

NGOs and Ministry of Health (MOH) should implement a mosquito (malaria) control programs along the bank of Tana River with community participation. Distribution of treated bed nets should be widened in the area other than provisions only to those attend MCH (who are given as an incentive to visit MCH clinic).

Given the high level of poverty and its effect on the wellbeing of the community income generation program aiming at empowering women to improve their economic status should be introduced to improve the overall nutritional status including the anaemia situation considering the strong Somali social network. This is because Somali women are less likely to divert household resources to other non essential expenditure like Miraa and related expenses at the expense of household welfare.

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1.0. INTODUCTION.

1.1 Background of the Research Problem

The four most common forms of malnutrition in the developing world today are protein-energy malnutrition (PEM), iron deficiency anaemia (IDA), vitamin A deficiency (VAD), and iodine deficiency disorders (IDD) (Crompton et al., 1984; Stephenson et al., 1987).

In the past emphases was mainly on general nutrient deficiency particularly the protein energy malnutrition. Adequate attention has not been given towards micronutrient deficiencies before the last two decades. Anaemia is particularly of concern as it is widespread all over the world.

Anaemia, the subject of the present study is a manifestation of nutritional deficiencies and/or other diseases that accelerate haemolysis of red blood cells and/or interfere with haemoglobin (Hb) production or frank blood loss. Virtually all countries are afflicted with the problem with highest incidence occurring in developing countries. It affects over two fifth of the global population (YIP and Dallman, 1996).

Anaemia is defined as a state in which there is low oxygen carrying capacity of the blood. In measurable quantities there is low haemoglobin and /or reduced number of red cells, as well as reduced packed cell volume ((Ebrahim, 1984). According to the report on preventing micronutrients deficiencies of the 1992 International Conference on Nutrition (ICN) sponsored by WHO/FAO in Rome, approximately 2,000 million people worldwide suffer from anaemia, mostly due to iron deficiency.

Iron deficiency anaemia is the form, which dominates in regions where there is severe anaemia. The most afflicted groups in descending order are pregnant women, pre-school children, infants, other women, the elderly, school age children, and adult men (Young, 1998).

The contributory factors of iron deficiency anaemia (IDA) are multiple and frequently interactive, especially nutrient deficiency, and infectious diseases.

Inevitably, the burden of IDA is in sub-Saharan Africa and southern Asian countries, where the prevalence of anaemia in the population ranges between 40% and 52%. A fine illustration can be drawn from recent observations in Bagamoyo District in Tanzania where 93% and 77% of under 5 year old children and pregnant mothers, respectively, were anaemic (Ndossi et al. 1998)

1.2 Problem statement

A Survey conducted by Levy in Kenya in 1964 found that prevalence of anaemia was > 80% in Coast and 44% in the lake basin respectively. It also estimated prevalence of anaemia among under 5 year olds to be 85% in the coast, 13.4% to 38.4% in the midlands, 2.1% and 11.5% in the highlands and 44% in the lake basin and adjacent highlands. Iron deficiency anaemia (hypo chromic and microcytic anaemia) in the coast and lake basin populations was associated with hookworm and malaria (Levy, 1969).

Garissa district of North-eastern Province, Kenya, where the present study conducted, is an arid characterized the typical tropical arid climate. Like in the other arid regions in the tropics unreliable rainfall with poor distribution along the seasons, sparse vegetation, shortage of food production and food insecurity are common features characterizing the region. During the 1990-1993-prolonged drought, malnutrition levels reached unprecedented levels especially amongst displaced persons from interior.

High levels of malnutrition in the district are attributed to lack of balanced diet and insufficient food intake. Population continued to receive relief food from the government and cannot actively participate in the development activities.

Anaemia, a manifestation of nutritional deficiency and/or blood loss is a global problem. Anaemia is a public health problem sufficient to retard both immediate and future socio-economic development of the country. The 1999 National Survey Report on anaemia and status of Iron, Vitamin A, and Zinc in Kenya indicated the largest burden of anaemia among the population of the country was borne by the semi arid clusters of Garissa district. The prevalence of moderate and severe grades of anaemia observed in Garissa were 63% and 86% respectively (Mwaniki et al, 2000). However, the causes were not adequately addressed in the report. This study is an attempt to generate some of this information.

1.3 Research Objectives

1.3.1. Main Objective

To determine the effects of some selected factors on the anaemia situation of the population in Garissa district.

1.3.2. Specific objectives

1. To determine the prevalence of anaemia in Garissa district.
2. To determine the causes of anaemia in Garissa district.

1.4 Null Hypothesis

1. There is no difference in haemoglobin level between in low and high socio-economic status households in the study population.
2. There is no association between literacy level of the mothers and haemoglobin level/anaemia status.
3. The total macronutrient intake (Fat, Protein, and Carbohydrate) does not correlate with Hb level.
4. The total micronutrient intake (Vitamin A, Vitamin C, Iron, and zinc) does not correlate with Hb level/anaemia status
5. Increased micronutrient intake from fruits and vegetables can not increase the haemoglobin level of the studied population
6. There is no difference in haemoglobin level between pregnant and breastfeeding women (physiological status) of the study subjects.
7. There is no difference in haemoglobin level between pregnant women who do practice pica and those who do not.

1.5 Gap of Knowledge

The 1999 National survey on anaemia and status of iron, vitamina A, and Zinc (Mwaniki et al, 1999) showed that the prevalence of anaemia among the mothers of the district was the highest compared to the other clusters drawn from other districts. However, the determinant factors of this problem were not much emphasized in the report.

1.6. Expected Benefits

This study will be useful to health personnel, nutritionists, the community and non-governmental organizations, which are dealing with relief and development issues of North Eastern Province and especially Garissa District. This information will form the baseline data for further studies of anaemia in the area.

2.0 LITERATURE REVIEW

2.1 Essential Elements and Constituents of Blood Formation

Protein is needed both for framework of the red blood cells and for manufacture of the haemoglobin to go with it. Iron is essential for the manufacture of haemoglobin and if sufficient amount is not available the cells produced will be smaller and each cell will contain less haemoglobin than the normal. Copper and cobalt are minerals necessary for body requirement in small amount. Folates and vitamin B_{12} are essential for normal DNA replication, a prerequisite for haematopoiesis. Specifically, methylenetetrahydrofolateis required for the conversion of deoxyuridine to thymidine. Formation of this form of folate requires an adequate vitamin B_{12} status (Wickramasinghe, 1995). Consequently, either in folate or vitamin B_{12} deficiency, thymidine is in short supply and deoxyuridine is misincorporated into DNA in place of thymidine (Blount et al, 1997). This causes defective DNA synthesis, secondary brand breaks, and deranged growth and maturation of haematopoietic and other rapidly dividing cells. The net result is dyssynchrony between abnormal nuclear and apparently normal cytoplasmic development.

The role of ascorbic acid (vitamin c) in improving body iron stores has been tested in a few prospective studies summarized by Svanberg (Svanberg, 1995). These experiments all used vitamin C supplements as opposed to food source of vitamin C. A recent community trial carried out in rural Mexico tested the efficacy of adding lime juice (as a source of ascorbic acid) to a maize, beans, and salsa meal to improve iron bio availability from the diet of non-anaemic iron deficient women

It is now recognized that vitamin A deficiency may be a common cause of impaired Hb synthesis and contributor to anaemia. While the exact mechanism remains to be determined, they include impaired mobilization of iron stores, possibly due to an effect of vitamin A deficiency on transferin receptors (Sommer and West, 1996). Providing vitamin A during pregnancy has been shown to improve haemoglobin levels (Latham, 1997)

2.1.1 Physiological role of Iron

Iron is one of the nutrients needed for the synthesis of haemoglobin, the oxygen-transporting molecule in the blood. Haemoglobin is the pigment in the erythrocyte that carries oxygen from the lungs to the tissue. Myoglobin is an iron-containing molecule within each cell. It transports the newly arrived oxygen within the cell to be used to convert substances to energy and for all normal cell activities.

Atoms of iron are bound to each haemoglobin molecule in each blood cell. When the blood passes through blood vessels in the lungs, oxygen binds to iron and is carried to all tissues of the body. After releasing oxygen to the tissues, iron binds to the cellular waste product, carbon dioxide and carries it to the lungs for exhalation. (Sommer, 1992). Other iron functions include synthesis of carnitene and collagen, the latter is the main protein within tendons, ligaments and the intercellular material that binds cells together, catalysing the conversion of beta-carotene to vitamin A; detoxification of drugs in the liver a required production of antibodies (Guthrie, 1989; Yip and Dalman, 1996).

2.1.2 Dietary requirement and intake of iron

A dietary intake of iron is needed to replace iron lost in the stools and urine or through the skin. This basal looses represent approximately 14mg/kg of body weight per day or approximately 0.9mg of iron for an adult male and 0.8mg for an adult female. In addition, the iron lost in the menstrual blood must be taken into consideration for women of reproductive age (Demeayer, et al, 1989). Menstrual loss of iron has been estimated to average a little less than 1 mg per day during an entire year. The dietary requirement of iron is normally ten times the body's physiological requirements. If a normally healthy post menopausal women requires 1 mg of iron daily because of iron losses, then the dietary requirement are about 10 mg per day (Latham, 1997).

It is recommended that women of childbearing age have dietary intake of 18 mg per day. During pregnancy, the body requires on average about 1.5 mg of iron daily to develop foetus and supportive tissue and to expand the maternal blood supply. Most of this additional iron is required in the second and third trimesters of pregnancy. Breast-feeding women use iron daily to provide approximate 2 mg of iron per litre of breast milk (Latham, 1997).

Infants, children and adolescents require iron for their expanding red cell mass and growing body tissue. Iron requirements per kg of body weight are substantially higher in infants and children than in adults since they have lower total energy requirements than adults, They are thus at greater risk of developing iron deficiency, especially if the iron of their diets is of low bio availability.

Iron requirements increase in cases of chronic bleeding caused by parasites such as hookworm (*Ancylostoma* and *Nector*), *schistsoma* and possibly *Trichuras trichura*. These cause frequent infections in countries with hot, humid climate and poor sanitation (Demeayor, 1989).

2.1.3 Absorption and Utilization of Dietary Iron

Absorption of iron takes place mainly in the upper portion of the small intestine. Most of the iron enters the blood stream directly and not through the lymphatic system. Here comes the concept of bioavailability of the element. Bioavailability is the proportion of the nutrient capable of being absorbed and available for use and storage in the body. Iron bioavailability has been addressed by research workers (Hallberg and Rossader-hulten, 1993) but has not yet received the attention it deserves by those responsible for programmes controlling iron deficiency. The absorption of haem iron is assumed to be 15% in men and 23% to 35% in women, depending on iron stores. For non-haem iron, absorption depends on bioavailability (low, medium, high) (Monsen *et al*, 1978)
Evidence indicates that absorption is regulated to some extent by physiological demand. Persons who are iron deficient tend to absorb iron more efficiently and in greater quantities than do normal subjects (Latham, 1997). The absorption of dietary iron is influenced by the amount and chemical form of the iron, the consumption during the same meal of factors enhancing and/or inhibiting iron absorption and the health and the iron status of the individual (UNICEF/UNU/MI, 1998).

A major determinant of iron absorption includes both dietary factors and host factors. Dietary factors that enhance non-haem iron absorption are ascorbic acid (vitamin c), meat, poultry, fish and low PH (e.g. Lactic acid). Factors that inhibit non-haem iron absorption include phytates, polyphenols including tannins and dietary fibre. Tea and eggs are notable inhibitors of non-haem iron (FAO, 1988; Fair-weather- Tait, 1991). Host factors that influences iron absorption are iron status and health infections (Demeayer, 1989).

Geophagia depresses iron absorption and may be a more common cause of Iron deficiency in some countries than has been previously been realised (WHO, 1972; Bothwell et al, 1964). Iron is consumed in the ferric state must be converted to the ferrous state prior to intestinal absorption. Co-administration of ascorbic acid facilitates this conversion and consequently facilitates binding of iron to ferritin and transferrin by a change of the valence in iron (WHO, 1972).

2.1.4 Types of Dietary Iron

There are two distinct types of dietary iron, heam-iron and non-heam iron. Haem iron is a constituent of haemoglobin and myoglobin and therefore is present in meat, fish and poultry, as well as in blood products. Haem iron accounts for a relatively small fraction of total iron intake usually less than 1-2 mg of iron per day. In many developing countries, heam iron intake is lower or even negligible. The second type of dietary iron is a more important source. It is found to varying degrees in all foods of plant origins. Besides the iron derived from food, the diet may also contain exogenous iron originating from the soil, dust, water or cooking vessels. This is more frequently the case in developing countries, where the amount of such contaminated iron in meals may be several times greater than the amount of food iron (Demeayer, 1989).

2.1.5 Consequences of Iron Deficiency

The consequences of iron deficiency for various population categories are discussed below.

All Persons

- Iron deficiency can impair cognitive performance at all stages of life.
- Morbidity from infectious diseases is increased in iron deficient population and correcting iron deficiency can result in decreased morbidity.
- With severe anaemia, the ability to monitor and regulate body temperature when exposed to cold is reduced.
- Physical work capacity is significantly reduced in persons with iron deficiency (UNICEF/UNU/WHO/MI, 1998).

Infant and Young Children

- Infants born of mothers with iron deficiency anaemia are more likely to have low iron stores and require more iron than can be supplied by breast milk at younger age (UNICEF/UNU/WHO/MI, 1998).
- There is convincing evidence linking iron deficiency and anaemia to lower cognitive test scores and that these effects can be long lasting (UNICEF/UNU/WHO/MI).

Children, Adolescents and Adults

- There is increased susceptibility to heavy metal (including lead) poisoning in iron deficient children (UNICEF/UNU/WHO/MI 1998)

Pregnant Women

- Iron status at the beginning of pregnancy is a strong determinant of a haemoglobin concentration and iron status at the end of that pregnancy.
- Severely anaemic pregnant women are at greater risk of death during the prenatal period (UNICEF/UNU/WHO/MI).
- Iron deficiency during pregnancy is extremely common even among other well-nourished populations.

2.2 Classes of Anaemia

There are three classes of anaemia:

1 Nutritional anaemia is caused by lack of any dietary essential that is involved in the formation of haemoglobin or by poor absorption of vitamins B_6, C and E, protein, copper and iron (Guthrie, 1989). It is also caused by deficiencies of folic acid and vitamin A and B_{12} (UNICEF/GOK, 1994).

2 PERNICIOUS ANAEMIA is a condition where the number of red blood cells is low, caused by failure in the absorption of vitamin B_{12} (Passmore, et al, 1986).

3 Hemorrhagic anaemia is caused by excessive loss of blood due to blood donations, surgery and due to intestinal parasites, which destroy red blood cells (Mosses, 1998).

2.3 Causes of Anaemia

Many causes of Iron deficiency have been identified, among which nutritional deficiencies, infectious diseases, physiological conditions, environmental and socio-economic factors are the most important ones. These will be discussed in the succeeding sections. The commonest cause of anaemia is iron deficiency or the lack of the nutrient in the diets. Folate deficiency is the second common cause of nutritional anaemia. Women of childbearing age are most at risk but occur at all ages (University of Nairobi, 1994). Other causes of anaemia includes: anaemia due to malaria and parasitic infestations e.g. hookworm infestations. Less common causes of anaemia include anaemia due to genetic predisposition e.g. sickle cell anaemia, thalessammia etc. (Ebrahim, 1984).

2.2.3 Iron Deficiency Anaemia

Iron deficiency anaemia is a widespread and important nutritional problem worldwide. It is estimated that 30% of the developing world's populations suffer from anaemia (FAO, 1988). Pre-school children in Africa have some of the highest rates of nutritional anaemia, nearly 56%, in the world, (FAO, 1988). Iron deficiency when sufficiently severe, causes anaemia. Although some functional consequences may be observed in individuals who have iron deficiencies without anaemia, cognitive impairment, decreased physical capacity, and reduced immunity are commonly associated with iron deficiency anaemia. In addition capacity to maintain body temperature may also be reduced. Severe anaemia is also life threatening (UNICEF/UNU/WHO/MI `1998).

2.2.4 Folic Deficiency Anaemia

Folic acid deficiencies are caused by low consumption of animal products and fresh vegetables. Requirements are increased in women during pregnancy and lactation. Prolonged cooking destroys folic acid in foods and also contributes to deficiency of this nutrient, as do malabsorption syndromes (Berry-Koch A *et al.*, 1990). Folate deficiency occurs when:

1. There is not enough folate in foods
2. The need for folate increases, e.g., during growth but particularly during pregnancy

3. Red blood cells are destroyed inside the body faster than usual, so more folate is required.

Unlike iron, folate cannot be re used. The body stores have very little folate so people should eat enough nearly everyday. When red cells are destroyed inside the body as in malaria, sickle and thalasemmia Sp, iron deficiency is not problem but folate deficiency anaemia would be the problem (King and Burgess, 1992).

2.2.5 Anaemia Due To Parasitic Infections (Parasitic Anaemic)

Anaemia is widespread under unsanitary conditions in the tropics and subtropics. The adult worm lives in the small intestine hooked into the mucous membrane by its hooks, but wanders from one site to another leaving the bruised mucous bleeding. It is estimated that *Ancylostoma Daudanale* suck 0.15ml of blood per worm per day. The amount of blood lost from the gut determines the development of anaemia. The severity of anaemia depends upon worm load, the type of worm, the age of the child, the nutritional status of the child including the dietary iron intake etc. (Ebrahim, 1984). Hookworm anaemia is the commonest form of parasitic induced anaemia in the tropics. Other parasitic disease such as schistosomiasis also leads to blood loss and thus cause iron deficiency anaemia. Red cells, which are parasitized by the malaria parasite haemolyse easily when the parasite burst out at maturity. *Trichuris trichura* partially burrows in the wall of the large intestine and feeds on intestinal tissues causing irritation and chronic blood loss, which can lead to diarrhoea, iron deficiency anaemia, hypoalbuminaemia and rectal prolapse in extreme cases (WHO, 1981). Parasitized cells are also trapped and destroyed in the reticulo-endothelial tissue, mainly in the spleen bone marrow and the liver. *Plasmodium falciparum* attacks both young and old red cells while other species of malaria tend to parasite the older cells only. The resulting anaemia is therefore more severe in *falciprum* infection than in others. Clinically the patient has anaemia and the features of malaria such as fever diarrhoea and vomiting, weakness, enlarged spleen, anorexia and failure to thrive. The anorexia leads to dietary deficiency. Haemolysis may also depress the bone marrow thus complicating anaemia (Ebrahim, 1984).

2.2.6 OTHER FACTORS THAT RELATE TO ANAEMIA

2.2.6.1 Physiological Factors

The requirement for iron increases with growth. Iron deficiency is most common during infancy and puberty when velocity of growth is rapid (Marray, 1975; Herberg and Galons, 1989). Iron deficiency reduces appetite and affects intestinal nutrient absorption (Judisch, 1966), thereby impairing growth. Preventing and correcting Iron deficiency anaemia are urgent among the vulnerable group because of their negative consequences, some of which may be long lasting if not permanent (Mohamed *et al*, 1988; Joyson *et al*, 1972). For this reason, treating of anaemia in the vulnerable group through supplementation and fortification has been proposed (Dallman *et al*, 1989; Mohamed *et al*, 1988) and is carried out in many countries especially for pregnant women

2.2.6.2 Socio-economic and Cultural Factors

High poverty levels, inequitable availability, accessibility, and low coverage of health services, and inadequate knowledge and skill to reduce risk of developing anaemia in the general population are fundamental issues in the anaemia dialogue (Damaeyer, 1989). The majority of the developing countries' income distribution is skewed with a large proportion of the population having no reliable incomes. In many cases the income is concentrated among few individuals. In this regard, the policy of including Iron supplementation for the vulnerable group mainly for the pregnant women, which live the poor countries, has been going as an MCH package for many years albeit with controversial results in order to reach a high number of these mothers in the low socio-economic status (Demaeyer, 1989).

3.0. STUDY SETTING AND METHODOLOGY

3.1. Description of the Study Area.

Garissa district is one of the three districts forming Northeastern province. The district borders Wajir district to the north, Lamu district to the south, Tana River and Isiolo district to the west and the republic of Somalia to the east. The district covers an area of 43931 square kilometres, which is about 7.45% of the total area of the country (Republic of Kenya, 1997).

3.1.1 Population Size and Structure.

The district-projected population for 2001 is approximately at 251,025. This must be deducted the population of Ijara, 19,277. Ijara used to be a division under Garrissa but now it is an independent district. The district is generally youthful. The age group 0-19 represents 58.8% of the districts total population, which demands for more investment in food production and infrastructure development of socio-economic to cater for this group most of them are dependents. Except the age group 70-74 and 80^+ where females outnumber males it is evident from the figures that numerically males exceed females. The exception might be due to the general demographic factor where females' life expectancy is generally higher than for males. The age group 0-9 constitutes 32% of the district population whereas the age group 10-19 constitutes 27%, an indication that the population is very young (Republic of Kenya, 1997).

3.1.2. Socio Economic Situation of the Population in the District

The income distribution is skewed with a large proportion of the population having no reliable incomes. The district's income is thus concentrated among few individuals operating businesses mainly within Garrissa town and livestock dealers. The situation is worsened further by the fact that much of the livestock sold through Garrissa town might have originated from the neighbouring districts though figures are hard to get. To earn a meaningful living from livestock at least a minimum number of about eighty animals have to be kept for income generation (Republic of Kenya, 1997). As a result of the 1990-1993 drought most of the households lost nearly all their livestock hence reducing their source of income. These disadvantaged groups moved to Garrissa town and divisional centres where they have continued to rely on relief food. Most of the district's female-headed households have reliable sources of income and have continued to depend on relief food (Republic of Kenya, 1997). There are a total 1651 of classified road network in the district. Out of the total road network 3 Km are tarmac, less than 150 km are gravel whereas the rest are all earth roads. The sections of the roads gravelled are 50 km along Garrissa –Dadaab road, 40 Km along Garrissa-Madogashe road and 60 Km along Garrissa-Sankuri road. The single reliable surface source of water is the river Tana though not confined within district. There are 11 operational water supplies whose source is Tana River. These water supplies serve the settlements along the river. Thirty one operational boreholes mostly in the northern division of Shanta-Abaq, Liboi, and Dadaab serve the rest of the district. However, the water in the district is not adequate, as the volume of water in boreholes reduces during the dry season. Apart from the town water supply, all other water sources have no treatment works hence supplying raw water to the consumers (Republic of Kenya, 1997).

Education

There are 54 primary schools, 9 secondary schools and two youth polytechnic schools in the district. The district has also a farmers training centre and teacher training college. Most of educational facilities are found within Garrissa municipality within central division, where most of the district population lives. Educational facilities in other divisions face under enrolment. Lack of boarding facilities has also led to under-utilization across the divisions (Republic of Kenya 1997)

Health Context

Health services in the district are provided through 28 institutions comprising of one hospital, 4 health centres, and 17 dispensaries, 5 private clinics and 1 mobile clinic. Inadequate equipment, drugs and personnel have led to under utilization of all facilities except the Provincial General Hospital, which is over utilized. The major causes of morbidity within Garrissa district are diarrhoeal diseases, malaria, upper respiratory tract infection, anaemia and pneumonia (Republic of kenya, 1997).

3.2. Methodology

3.2.1 Study Design

The design of the study is a cross sectional with descriptive and analytical components.

3.2.2 Sampling Frame

All the households in the three target villages with at least a child of under five years of age and/or a woman of child bearing age (pregnant or breast feeding).

3.2.3. Sample Size Determination

Following is the formula used to determine the sample size in this study. Formula frequently used in the social science research (Maguenda O and Maguenda A, 1999)

$$n = \frac{2 Z^2 PQ}{d^2}$$

Whereby:

n = desired sample size

Z^2 = standard normal deviate

P = proportion of the population who are anaemic. (50%=0.5)

q = proportion of the population who are not anaemic. (50% = 0.5)

d = the desired degree of precision.(0.075).

Putting figures to the formula:

n = 341

13% Allowance for attrition was made therefore, n=384.

3.2.4 Sampling Procedures

This study was carried out in three randomly selected villages in Garissa town. A preliminary survey for identification and registration of all households with an under five child, breastfeeding and/or a pregnant mother was carried out. The mothers of 384 households with 128 comes from each of the three target villages (the three target villages have got roughly the same size) were interviewed to gather information on demographic characteristics, socio economic status, water sanitation and hygiene, morbidity, food consumption pattern, and a sub sample of 192 households 64 from each were asked the list recall for fruit and vegetable consumption. A sub sample of 60 households, which is more than the minimum sample size as recommended by fisher et al, 20 from each target village were interviewed the overall dietary intake using 24-hour recall method.

Three hundred and eighty four participants were drawn blood for haemoglobin concentration analysis. A sub sample of 135 participants, 67 under five children and 68 of women of child bearing age, (in this case pregnant and lactating mothers) had blood slide taken for malaria parasite and parasite counting. A sub sample of 120 participants, 84 women and 36 children of under had stool samples taken for analysis of Helminthes and other intestinal parasitic infestation.

3.2.4. Research Assistants

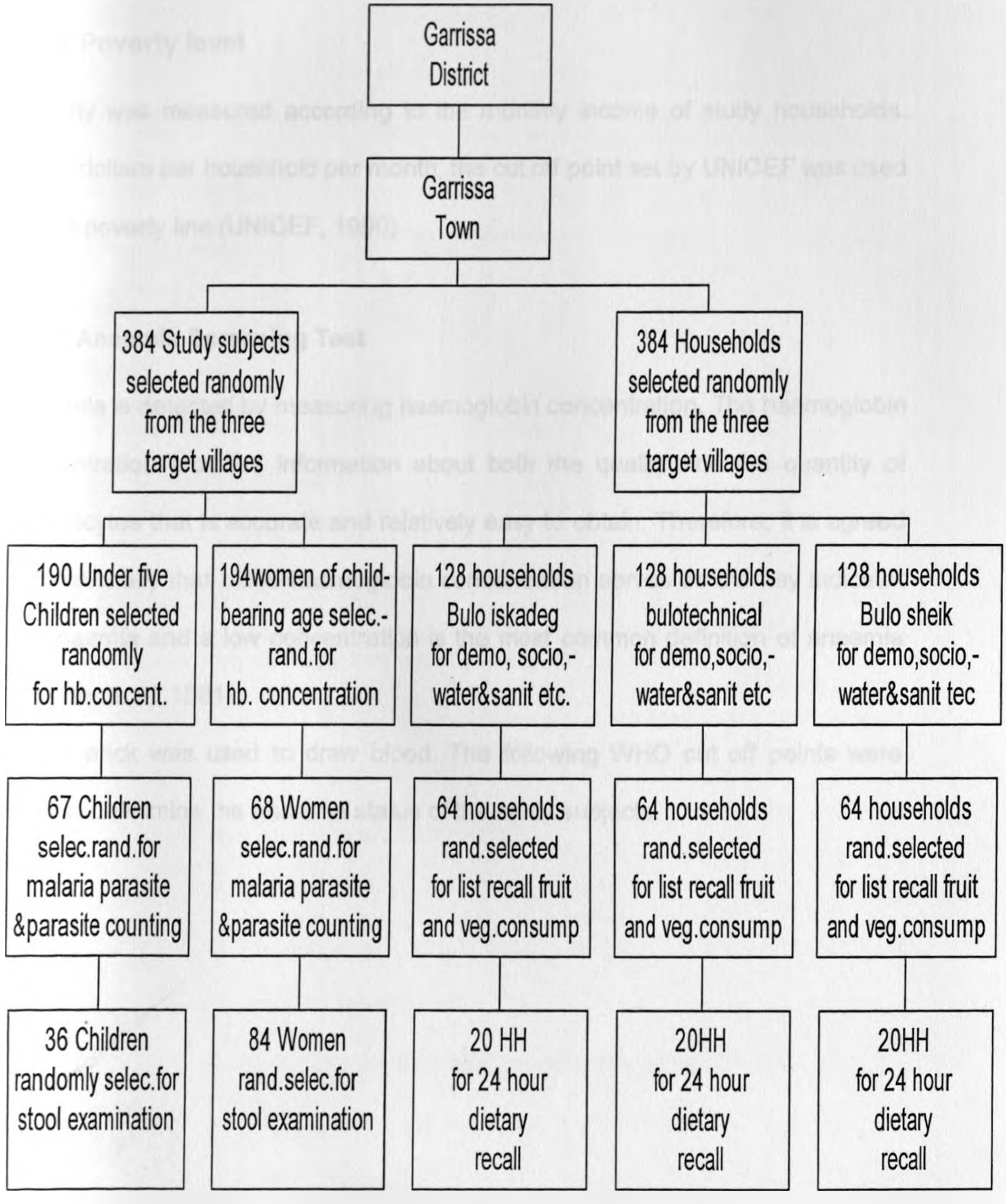
To ensure quick data collection, three research assistants, one nutritionist and two secondary school leaving certificate holders were recruited. The latter were trained thoroughly on the measurement of dietary intake and interviewing techniques among other things. The nutritionist's role was to assist and provide necessary counselling and guidance.

3.2.6. Pre-testing of Research Instruments

Bulo Iftin one of the not selected villages in Garrissa town was randomly selected .20 households are purposively selected visited and the questionnaire administered to pre-test the appropriateness of the study instruments. The exercise was also aimed at evaluating the skills, efficiency, and the performance of the research assistants. After pre-testing necessary guidance and counselling were given as necessary.

Based of the pre-test results appropriate changes and corrections were made on the study instruments For example, demographic and socio-economic part a column of average monthly income was included and the occupation column was also properly coded.

Fig 1: Flow Chart of the Sampling Procedure Of the research



3.3 Methods of Data Collection

3.3.1 Poverty level

Poverty was measured according to the monthly income of study households. Thirty dollars per household per month, the cut off point set by UNICEF was used as the poverty line (UNICEF, 1990)

3.3.2 Anaemia Screening Test

Anaemia is detected by measuring haemoglobin concentration. The haemoglobin concentration provides information about both the quality and the quantity of erythrocytes that is accurate and relatively easy to obtain. Therefore, it is agreed internationally that blood haemoglobin concentration serves as the key indicator for anaemia and a low concentration is the most common definition of anaemia (Graitcer *et al*, 1981).

Finger prick was used to draw blood. The following WHO cut off points were used to determine the anaemia status of the study subjects.

Table1: Suggested criteria for diagnosis of anaemia using haemoglobin (hb) and haematocrit (PCV) determinations.

Subject	Hb below (g/dl)	PCV below
1. Adult male	13	42
2. Adult female (Non-pregnant).	12	36
Pregnant female	11	30
Child 6 months to 6years	11	32
Child 6 to 14 years	12	32

Source WHO, 1975a

3.3.2.1 Haemoglobin Concentration

The procedures of haemoglobin concentration:

Sahli pipette was used for taking the whole blood specimen and the following steps were taken:

a. Draw mixed blood in pipette
b. Wipe off the tip
c. Dispense the blood specimen into the tube with 5ml of drabkin solution.
d. Wash out the inside of the pipette repeatedly, mix.
e. Wait for five minutes before the solution is taken for absorbance.

f. Set the 0% transmittance (without cuvette) with the help of the left control knob.

g. Insert the cuvette with the blank solution and set the 100% transmittance with the control knob on the right.

h. Finally insert the standard solution (S) and test solution (T1, T2, ----T_n) and read their respective absorbance on the scale.

3.3.1 Blood Slide for Malaria Parasite

The principle of the method

Detecting and identifying it microscopically in the blood films diagnosed malaria parasite. Malaria blood films were prepared directly from capillary blood; this is best preparation (Cheesbrough, 1998). Capillary blood method (thin and thick films on the same slide), which is more convenient method, was used.

Procedures of collecting blood were as follows:

1. Cleanse the lobe of the finger (or heel if an infant) using moistened with 70% v/w alcohol. Allow the area to dry.
2. Using sterile lancet, prick the finger or heel. Squeeze gently to obtain large drop of blood.
3. Add small drop of blood to the centre of the slide and larger drop about 15 mm to the right.
4. Immediately spread the thin film using a smooth edged slide spreader.

5. Without delay the large drop of blood to make the thick smear. Cover evenly in area about 15x15 mm.
6. Using a black lead pencil, label the slide with date and the participant's name and number.
7. Allow the blood films to air dry with the slide in the horizontal position and placed in a safe place.

3.3.2.1 Thin Film Field's Staining Technique

The method followed in this technique was as follows:

1. Place the slide on staining rack and cover the methanol fixed thin film with approximately 0.5 ml of diluted field stain B.
2. Add immediately an equal volume of field's stain B. leave to stain for one minute.
3. Wash off the stain with clean water. Wipe the back of the slide, clean and place it in a draining rack for the film to air dry.

3.3.2.2 Thick Film Field 'S Staining Technique

The method followed in this technique was as follows:

1. Holding the slide with dried films facing downwards, dip the slide into the field's

   Stain A for five seconds. Drain off the excess stain by touching a corner of the slide against the side of the container
2. Wash gently for about 5 seconds in clean water. Drain the excess water.

3. Dip the slide into the field's stain B for three seconds. Drain off the excess stain.
4. Wash gently in clean water. Wipe the back of the slide clean and place it upright in drain rack for the film to air dry.

3.3.2.4 Counting Parasite Numbers (Parasite Density)

Parasite numbers were counted on the blood slides of the participants that tested positive. Estimating parasite numbers/µl of blood by counting parasites against white blood cells did this.

The procedures were as follows:

1. Select part of the thick film where the white blood cells are evenly distributed and the parasites are well stained.
2. Using the oil immersion objective systematically count 100 white blood cells (WBC) estimating at the same time the numbers of parasites (asexual) in each field covered. Counting was done by using two hand tally counters. Repeat this into two other areas of the film and take an average of the three counts.
3. Calculate the number of parasite per µl of blood as follows:

$$\frac{\text{WBC count x parasite counted against 100WBC}}{100}$$

3.3.2. Stool Examination

The principle of stool examination

Stool examination was performed using the concentration method. The formol-ether technique (Fleck and Moody, 1993) was used.

3.3.3.1 Concentration Method

For this method following were the procedures followed:

1. Measure about 10 ml of 10% formal saline in the graduated glass centrifuge tube. Pour into the clean mortar.
2. Place 1-2 g of stool (approximately tea spoonful) in the mortar, using wooden applicator stick. Emulsify the stool with pestle.
3. Sieve the suspension through the strainer into the universal bottle. Label the bottle with the participant's laboratory number using a grease pencil.
4. Measure about 3 ml of ether in the graduated glass centrifuge tube. Pour into the universal bottle. Screw the cap tightly and shake vigorously.
5. Transfer the mixture into blain glass centrifuge tube; label the tube with the participant's laboratory number. Centrifuge at medium speed of 2 minutes using an electric centrifuge.
6. The mixture separated into 4 layers:
   - An upper layer of ether
   - A plug of debris and fatty materials
   - A layer of formal saline
   - Sediment.
7. Loosen the plug of debris with an applicator stick. Pour the supernatant (ether, formal saline, plug of debris, and fatty material) into a sink with running water.

8. Tap the bottom of the tube with finger to re-suspend the sediment. Transfer a drop of sediment on to clean slide using a Pasteur pipette with rubber teat.
9. Put on a cover slip. Label the slide with the participant's laboratory number. Place the slide on the microscope stage.
10. Swing the x10 objective into position and focus; examine the preparation systematically for cysts larvae and ova. Examine structures in more detail using the x40 objective.
11. If the cysts are seen, add few drops of lugol's iodine to the remaining sediment in the centrifuge tube and mix well. Place drop of sediment onto a clean slide a put a cover slip.
12. Examine systematically for cysts using x10 objective. Examine cysts in more detail using the x40 objective. Record findings.

3.3.4 24 Hour Dietary Recall

The purpose of 24-hour dietary intake was to determine the mean per capita calorie, protein and iron intake (both haem and non haem). This can help finding out the level of household food availability and consumption as this has direct linkage with the anaemia situation of the target groups.

Food intake data were collected from randomly selected 60 sub sample households. The method was appropriate for assessing the average usual intake of nutrients for a population provided that the sample is representative of the population under study and if all days of the week are proportionally included in the survey (Gibson, 1990).

Procedures mentioned in (Gibson, 1994) were followed during the time of data collection on food intake. Respondents were asked to recall and tell all meals consumed by the household during the preceding 24 hours. They were asked to show the amount of each ingredient used to prepare the meal, using household measures and food models. Detailed description of all meals and ingredients were recorded using a form designed for this purpose (appendix1). Values of household measures of each ingredient were converted into grams and/or millimetres. The amount of calorie, protein, fat, carbohydrates, fibre, vitamin A, vitamin C, zinc and iron content of each meal was calculated using Kenyan food composition table.

3.3.5 Fruit and Vegetable Consumption

List recall of fruits and vegetable consumption (see appendix1) was used to obtain information on frequency of consumption of fruits and vegetables commonly consumed by the households in the community of the study area. Respondents were the mothers of the selected households in the target villages. The mothers were asked to reveal the quantity of the fruit and/or vegetable consumed and to indicate how often each fruit and/or vegetable was consumed in the household.

To get nutrient content of iron and vitamin C of the consumed fruit and/or vegetable the Kenyan food composition table was utilized. This would enable us to come to know the contribution of fruits and vegetables to iron and vitamin C dietary intake to the target group. After pre-testing only those fruits and vegetables frequently consumed was included to the definitive study. Those that are not common in the area and/or were not available in the market by the time of the recall were excluded from this study. All fruits consumed both as piecemeal and/or snacks were recorded.

3.4 Data Collection Instruments

3.4.1 Questionnaire

A questionnaire comprising five sections was applied in this study. The first section sought information on demographic and socio-economic characteristics. These include sex, age, marital status, education, average monthly income, occupation, etc. The second section consists of a list recall of fruit and vegetable consumption of commonly and frequently eaten ones. The third section dealt with water sanitation and hygiene, seeking information on source of water, water treatment, as well as possession of latrines, and how to handle the refuse disposal among other things.

The fourth part regards the food consumption i.e. 24 hour dietary recall. A form which clearly indicated the dish consumed, ingredients, amount of ingredients, amount eaten etc, was utilized in this part. The fifth section constitutes accessibility and availability of health facilities, common disease of study areas, and information on immunization under fives, eating non-food items particularly pregnant mothers and much more. Three forms were used to record the results of different laboratory analysis.

The first form was used to record haemoglobin concentration results of the participants. The second was for the results of blood slide for malaria parasite and parasitic counting (counting the number of parasite per μl of blood). The last one was used in recording stool examination results.

3.4.2 Data entry, cleaning and analyses:

Data were entered, cleaned and analysed using SPSS (Statistical package for social science) version 9 at ANP (Applied Nutrition Program). Means and proportions were calculated for quantitative and qualitative data respectively. Chi square tests and t-tests were used to compare different amounts in proportion and means with reference to haemoglobin status (anaemic and normal). To control the determining factors for anaemia, ANCOVA (analyses of covariance) was used. A p-value less than 5% was considered statistically significant. Correlation coefficient to relate haemoglobin level with social, demographic, and economic factors was also applied in this study. Graphs were plotted using Microsoft excel version 10 and SPSS.

For the dietary intake assessment the Kenyan food composition was utilized for the calculation of the mean nutrient intake in terms of calorie, protein, dietary fibre, carbohydrate, vitamin A, vitamin C, Zinc and Iron.

3.4.3 Data Validity and Reliability

The questionnaire was validated through pre-testing. The assistants were closely supervised during pre-testing and early stages of actual survey by the researcher. Probing questions were asked to reduce errors arising from respondent memory lapses. Each completed questionnaire was checked immediately after return from interview to ascertain that all questions had been answered correctly and consistently.

4.0 RESULTS

4.1 Socio-demographic Profile of Study Population

The data analysed was obtained from 194 women of child bearing age (mothers) and 190 children aged 6-59 months. For the household level data was obtained from 384 households.

4.1.1 Socio-demographic characteristics of the study population

Table 2 shows socio-demographic and socio-economic characteristics of the study population. Overall the mean age of the mothers was 29.45 years. Over three quarter 87 % (169) of the mothers of the study population were in the age group (21-40 years), the overall mean age of the children was 41.05 months. Close to a half (47.9%) of the children in the study area were aged between 36-47 months, close to a third (32.1%) were in age bracket of 24-35 months.

Literacy, occupation of the mothers and income level

Close to two-thirds 66 % (128) of the study women of childbearing age were illiterate while the rest were literate. Most of the mothers in the study households 87.1 % (169) were housewives who did not earn any form of income. These mothers were mainly child caretakers. Majority of the studied mothers (184) around 95% were married and remaining few unmarried.

Table 2: Socio-demographic characteristics of the study population

Characteristics (N)	(n)	%
Mother age group (N=194)		
15-20 years	(15)	7.7
21-25 years	(53)	27.3
26-30 years	(62)	32
31-35 years	(26)	13.4
36-40 years	(28)	14.4
41-45 years	(3)	1.5
46-50 years	(5)	2.6
Above 50 years	(2)	1.0
Ethnicity (N=384)		
Somali	(368)	95.8
Other ethnic communities	(16)	4.2
Mother education level (N=194)		
Illiterate	(128)	66
Primary	(49)	25.3
Secondary school	(14)	7.2
Adult education	(3)	1.5
Occupation of the mothers (N=194)		
Business self employed	(12)	6.2
House wife	(169)	87.1
Small business (hawkers etc)	(6)	3.0
Salaried employed	(7)	3.5
Marital status (N=194)		
Not married	(10)	5.2
Married	(184)	94.8
Head of the households (n=384)		
Women (wives)	(82)	21.4
Men (husband)	(18)	47.11
Others (Sons & Daughters)	(12)	31.51

4.2 Socio-Economic Characteristics of the Study Population

4.2.1 Economic status

Table 3 shows the socio-economic characteristics of the studied population. Poverty status was determined using the collected average monthly income data. Majority of the study population 89.3% (343)-using the UNICEF definition of poverty line-were living below poverty line (earning less than 30$ per month) (UNICEF, 1990). . The overall source of income was mainly divided into almost an equal proportion by salaried employed 31.3% (150), casual work 39.1%, and small trade (Hawking) 29.7% (114).

4.2.2 Water and Sanitation

Close to third of the population 78.6% (302) had river as their source of drinking water. An overwhelming majority of them did not treat drinking water in one way or another. For storing drinking water most of the study population around 78% (299) keep drinking water in plastic containers.

Three quarters of the study population had a toilet facility. Almost equal proportions of them use enclosure 44.5% (130) and pit latrine 51.4% (150). Almost equal proportions of the population were handling their refuse disposal by burning 45.3% (174) and in putting pit composite. Small proportions of them were either buried 3.4% and or threw out 9.4% (36). Around two thirds of the population wash hands when handling food while one quarter of them wash hands sometimes.

Table 3: Household Socio-economic characteristics

Characteristics	(N)	%
Monthly income (N=384)		
Below poverty line	(343)	89.3
Above poverty line	(41)	10.7
Source of income (N=384)		
Employed	(150)	31.3
Casual work	(120)	39.1
Small trade (Hawkers, tea shops)	(114)	29.7
Water source (N=384)		
River	(302)	78.8
Tap	(57)	14.8
Well	(25)	6.5
Water treatment (N=384)		
Yes	(114)	29.7
No	(270)	70.3
Container for storage (N=384)		
Plastic	(299)	77.9
Clay pot	(73)	19.0
Metallic and fridge	(12)	3.1
Latrine possession (N=384)		
Yes	(292)	76.0
No	(92)	24.0
Type of latrine (N=192)		
Enclosure	(130)	44.5
Pit	(150)	51.4
VIP	(12)	3.1
Refuse disposal (N=384)		
Burning	((174)	45.3
Burying	(13)	3.4
Pit composite	(16)	41.9
Throwing out	(36)	9.4
Washing hands (N=384)		
Yes	(26)	68.0
No	(22)	5.7
Sometimes	(10)	26.3

4.3 Prevalence of anaemia

Table 4 well over three quarters of both mothers 82.6% (157) and children 79,9% (155) were anaemic (Hb < 11.0 g/dl for pregnant mothers and under fives and < 12.0 g/dl for breastfeeding).

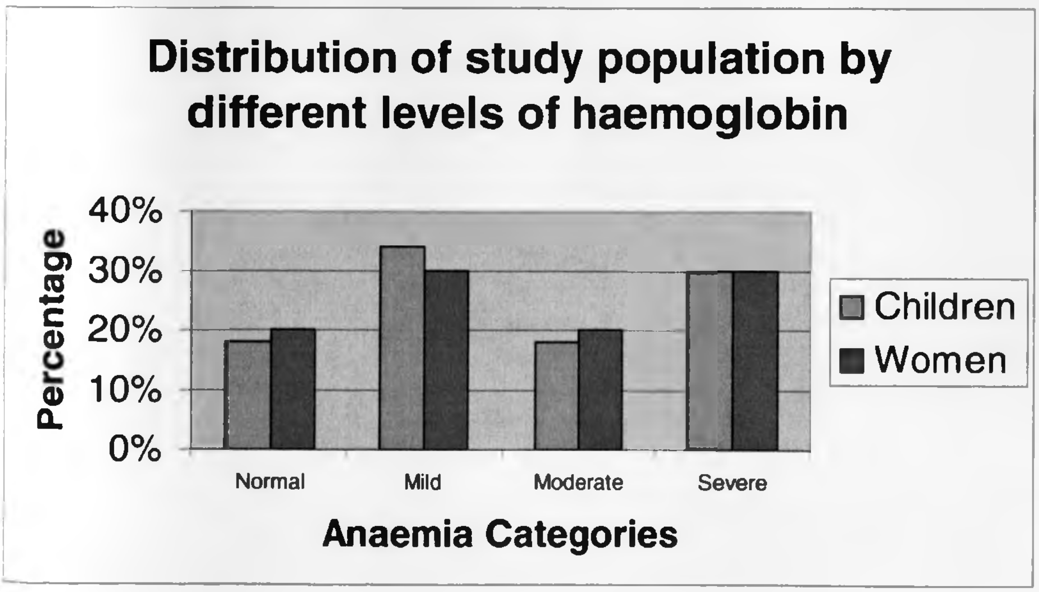
Table 4: Prevalence of anaemia among the study population in Garissa

Group	Hemoglobin status					
	Normal		Anaemic		Total	
	n	%	n	%	n	% of population
Children	33	17.4	157	82.6	190	49.5
Adults	39	20.1	155	79.9	194	50.5
Total	72	18.8	312	81.3	384	100

$\chi^2 = 0.471$ df = 1 p-value: 0.492.
No significant difference of anaemia between children and mothers (adults) among the studied population.

Figure 2 below shows haemoglobin level of the study subjects categorised into severe, moderate, mild and normal for women of childbearing age and children. More than three quarters (80%) of the studied women had anaemia. About a 30% of these had severe anaemic while about 20% and 30% were moderately and mildly anaemic respectively. Among the children also about a third (30%) was severely anaemic. Almost an equal number as was the case for women (18% and 34%) were moderately and mildly anaemic respectively.

Fig.2: Distribution of study population by different levels of haemoglobin



4.4 Socio-demographic characteristics and Anaemia

Table 5 present the proportion of anaemia by socio-demographic characteristics. The data showed that married mothers were slightly less anaemic than the unmarried though this difference was not significant ($p > 0.05$). No significant difference was observed in anaemia prevalence among ethnic groups. Surprisingly the anaemia prevalence was significantly higher among literate mothers (89.4%) compared to the illiterate (75%) though the illiterates were higher in number ($P < 0.05$).

Households headed by other relatives (Sons, Daughters, etc) had significantly higher prevalence of anaemia (95%) than those headed by husbands (79.6%) and by wives (64.6%) ($P < 0.05$).

Table 5: Distribution of socio-demographic characteristics by anaemia level

Characteristics	% Anaemic	p-Value
Marital Status		
Single	90.0	
Married	79.3	0.69
Literacy Level		
Illiterate		
Literate	89.4	0.018
Ethnicity		
Somali	81.5	
Other	75.0	0.531
Household Head		
Wife	64.6	
Husband	79.6	
Other	95.0	0.000

Table 6: Shows children sex, age distribution by anaemia status. There is no difference in the haemoglobin level and hence anaemia status between different age groups of the studied children. Meanwhile, the prevalence of anaemia was significantly higher among boys (94.1%) than girls (63.9%) (P <0.01).

Table 6: children sex and agegroup distribution by anaemia status

Characteristics (n=190)	% Anaemic	P value
Male	94.1	
Female	63.9	0.000
6-23 Months	87.5	0.707
24-59 Months	82.2	

4.5 Socio-economic characteristics and the anaemia status

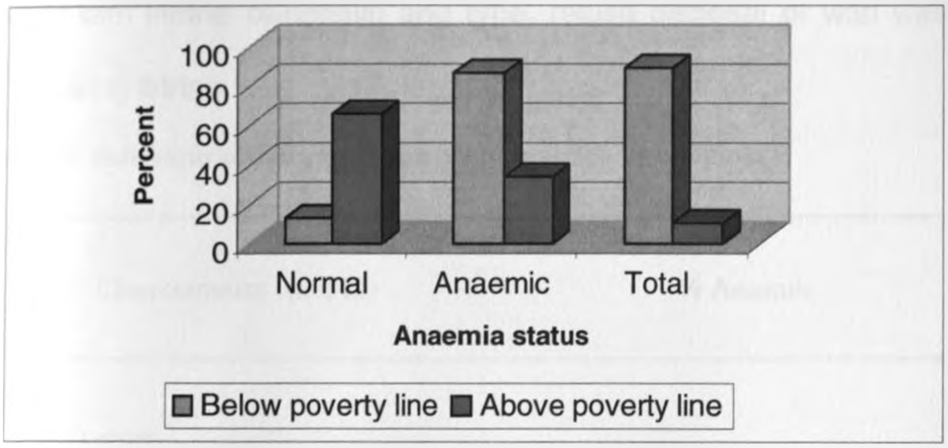
The table 7 below shows the socio-economic characteristics and anaemia of both children and women of childbearing age.

The overall mean income of the households was 1178.8. The mean amount of income for the households of the normal subjects (1672.8 Ksh) was significantly higher (P <0.01) than the mean income for the households with anaemic subjects (Appendix 6). As table 6 shows the prevalence of anaemia was significantly higher (P<0.01) in households living below the poverty line (86.9%) than in households living above the poverty line. However, Anaemia prevalence in this population was not associated with a particular source of income (p >0.05).

Table 7: Anaemia prevalence by monthly and source of income

Characteristics (n=312)	% Anaemic	p-Value
Monthly Income		
Below Poverty	86.9	
Above Poverty	34.1	0.000
Income Source		
Employed	79.3	
Business	80.0	
Others	85.0	0.452

Figure 3: Distribution of households by different income levels and by prevalence of anaemia



4.5.1 Water sanitation, hygiene and anaemia status of the community

As shown table 8 there was no significant difference in prevalence of anaemia associated either with water source, method of water treatment or with type of container for storing water.

Table 8: Anaemia prevalence by water source, treatment and storage container

Characteristics (n=312)	% Anaemic	p-Value
Water Source		
River	79.8	
Tap	84.2	
Well	92.0	0.267
Water Treatment		
Yes	79.8	
No	81.9	0.642
Container For Water Storage		
Plastic	79.9	
Clay Pot	86.3	
Metalic & Fridge	83.3	0.442

Table 9 shows toilet possessions, types of toilets, refuse disposal method, washing hands attitude when handling food and anaemia status of the study population. In all cases, the prevalence of anaemia was not associated ($p > 0.05$) either with latrine ownership and type, refuse disposal or with washing hands after using latrine.

Table 9: Behaviour toward, waste disposal practice Vs anaemia

Characteristics (n=312)	% Anaemic	p-Value
Latrine		
Yes	82.9	
No	76.1	0.146
Type of Latrine		
Enclosure	81.5	
Pit	84.0	
VIP	83.0	0.494
Refuse Disposal Method		
Burning	82.2	
Burying	84.6	
Pit Composite	81.4	
Throwing out	75.0	0.772
Washing Hands		
Yes	80.1	
No	90.9	
Sometimes	82.2	0.440

4.6 Morbidity incidence, parasitic infection and anaemia

Table 10 shows sickness incidence, malaria parasite examination, stool parasite examinations, and the anaemia status of the study population. There were significantly ($P < 0.05$) many more sick children who were anaemic compared to the health children. However, no significant difference in anaemia was found among sick women and healthy ones.

Immunization coverage of the children was very low 29.5%. Interestingly enough those who were immunized had high prevalence of anaemia (98.2%) than those who were not immunized (78.5%). However, there was higher number of not immunized than immunized. The data on seeking health services behaviour suggests that there is no association between this and anaemia prevalence.

There was significantly ($P < 0.01$) higher prevalence of anaemia of those who were malaria parasites positive than those who were malaria parasite negative. On the other hand, there were significantly many more anaemic women who had stool parasite positive than stool parasite negative. However, there was no significance difference between the children who were stool parasite positive and negative.

Figure 6 shows the types of different illness Vs anaemia. In all cases there were more cases of anaemia than normal. Examples were taken as diarrhoea, malaria, and pneumonia. For instance 88% of diarrhoea cases were anaemic and the remaining was normal. For malaria 86% of the cases were anaemic while only 14% were normal.

Malaria parasite density (count of malaria parasite number) was higher among the anaemic subjects as compared to the normal. However, this difference was not significant (P >0.05) (Appendix 6)

Table 10: Association of anaemia with morbidity incidence (two weeks prior of data collection)

Characteristics	% Anaemic	p-Value
Sickness Prevalence		
Children (n=190)	94.7	0.030
Women (n=194)	83.3	0.209
Immunization status of children (n=194)		
Immunized	81.5	
Not immunized	78.4	0.016
Seeking Health Services when ill		
Yes	80.9	
No	82.0	0.782
Malaria Parasite Examination (n=89)		
Positive	41.6	
Negative	93.7	0.010
Stool parasite positive		
Children (N=36)	33.3	0.507
Women (n=84)	91.7	0.024

Figure 4. Distribution of the study population by anaemia status and by sickness types.

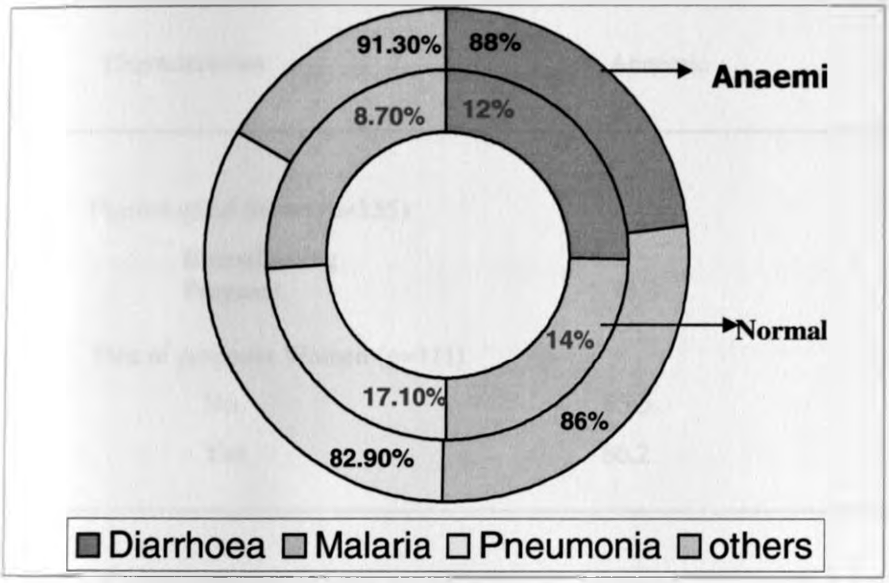
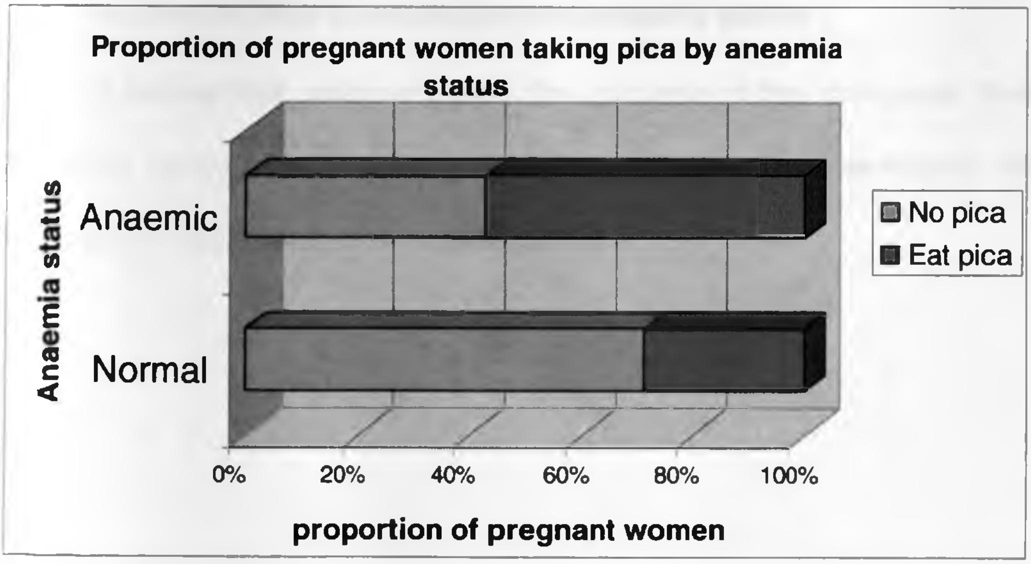


Table 11 shows that among lactating women had a prevalence of anaemia of 84.6% while it was 78.2% among pregnant women. However, there was no significant difference between pregnant and breastfeeding women. There was significantly higher prevalence of anaemia among women who had the habit of practicing pica (Pica=eating substance with little or no nutritional value like clay) (86.2%) than among those who were not (65.5%) as shown in table 9 and illustrated figure 6.

Table 11: Physiological status, pica habit, children immunization status by anaemia status.

Characteristics	% Anaemic	p-Value
Physiological Status (n=155)		
Breastfeeding	84.6	
Pregnant	78.3	0.321
Pica of pregnant Women (n=111)		
No	65.5	
Yes	86.2	0.004

Figure 5: Proportion of pregnant women with pica habit by anaemia status.



As shown in Table 12 the monthly amount of income earned per household was positively correlated (using Pearson correlation) with haemoglobin level ($r = 0.304$, $p = 0.000$). Other factors only market distance proved to have significant relationship with haemoglobin level and hence the anaemia status of the studied population.

Table 12: **Effect of social demographic and economic factors on haemoglobin level.**

	Haemoglobin	
Factor	**R**	**P value**
Market distance	0.222**	0.000
Distance to clinic	0.011	0.829
Water distance	0.019	0.707
Amount of income (monthly)	0.304**	0.000

**** Significant at 0.01** **R:** Pearson Correlation

4.7 Dietary intake and anaemia status

4.7.1 The effect of fruit consumption on anaemia status

Table 13 shows that when analysed the nutrients of the consumed fruits and vegetables among the studied population all were not associated with the haemoglobin level of subjects except vitamin A.

Table 13: Nutrient contents of fruits/vegetables consumed and anaemia

Nutrients	Haemoglobin level		
	N	r	p
% Fiber	192	0.021	0.389
% Vitamin A	192	0.156*	0.016
% Vitamin C	192	0.085	0.121
% Iron	192	0.096	0.093
% Zinc	192	0.015	0.416

4.7.2 The effect of overall dietary intake on anaemia

The dietary intake was measured by means of 24-hour dietary recall of the examined households. Table 14 shows that vitamin A, Fibre and zinc intakes were negatively correlated ($p<0.05$) with haemoglobin level. A weak (not significant) relationship was found between other nutrient intakes and haemoglobin level. In any case fruit consumption look at separately and the overall dietary intake for vitamin A nutrient was inadequate for the community. The overall intake of both zinc and fibre nutrient intake also proved to be insufficient.

Table 14: Nutrient content from overall dietary intakes (24-hour recall) and haemoglobin level

	Haemoglobin level		
Nutrients	N	r	p
Energy	60	-0.133	0.156
Protein	60	-0.199	0.063
Fat	60	0.028	0.416
Carbohydrate	60	-0.13	0.160
Fiber	60	-0.220*	0.046
Vitamin A	60	-0.212*	0.026
Vitamin C	60	-0.051	0.350
Iron	60	-0.179	0.086
Zinc	60	-0.232*	0.037

5.0 DISCUSSION

5.1 Anaemia prevalence

The study shows high prevalence of anaemia both women of childbearing age and under five children living in Garissa district. About 81% of the total population of the studied community was anaemic. This is in agreement to the results of National Survey Report on anaemia and status of Iron, Vitamin A, and Zinc in Kenya where the prevalence of moderate and severe anaemia was estimated between sixty-three and eighty-six percents respectively (Mwaniki et al, 1999). This is due to the fact that pregnant, lactating mothers and children under five years old are vulnerable to iron deficiency anaemia (Brooker et al., 1999, Yip and Dalman, 1995).

5.2 Demographic and socio-economic factors and anaemia incidence

5.2.1 Sex and physiological status

Yip and Dalman (1996) reported that Infant and preschool age children are at increased risk of iron deficiency due to high physiological demands combined with low iron stores and due to inadequate dietary intake of bio available iron and losses due to infection. However, in this study no difference was observed based on different physiological status of the population. Pregnant, lactating mothers and children had the same risk of suffering from anaemia. Research by the Washington Institute of medicine (1990) reported that Iron requirements during lactation are not increased as they are during pregnancy. This is due to the low iron content of the breast milk, the compensation by the absence of menstrual losses during lactation (at least part of it) and recuperation of iron reserves following delivery. This study showed that the prevalence of anaemia was slightly higher amongst lactating compared to the pregnant women. Among the lactating mothers the prevalence was 84.6%, while for pregnant women was 78.2%. However, this difference was not significant. Meanwhile boys were significantly more anaemic in anaemia than girls. This partially confirms other study in Cote d'Ivoire (Staubli et al., 2001) where the proportion of anaemia was found to vary with age and sex of the individual.

5.2.2 Mother marital status and ethnic group

Those who are married showed slightly less anaemic compared to unmarried women. However, marital status and ethnic group belonging did not show any association ($P > 0.05$) with the prevalence of anaemia. The reason that can explain may be married women are in better position to get some livelihood as there are partners who supports them and their children.

5.2.3 Mother education level.

Chaudury (1986) reported that higher education is positively associated with more awareness of the importance of nutrition, the nutrient content of food and nutrition options offered by market purchase or home production. Better-educated parents should be able to provide more nutritious diets due to their ability to identify the nutrition of the food. On the other hand, education is also a measure of taste. However, higher education increases the desire to consume status food and food items to the detriment level of nutrition. If education represents taste, the elasticity of nutrition with respect to education may be positive or negative. However, the anaemia prevalence was significantly higher (p-value < 0.05) among literate mothers (89.4%) than the illiterate (75%). This reflects either the fact that there are more factors affecting/influencing than the education level of the mothers toward the anaemia situation of the community in the studied population or in agreement with Chaudury (1986) that it is elasticity of nutrition caused by change of the taste with respect to education might be having negative effect to the anaemia situation of the study population.

5.2 Household income

Education and increased income controlled by mothers have been reported to improve nutrition security of the households (Chaudhury, 1986). However, this study did not relate any particular source of income with the prevalence of anaemia, as this association was not significant. The majority of the households in the studied population (89.3%) were living below poverty line as per the cut off point set by UNICEF which is 30$ per household per month (UNICEF, 1990). The present study showed that the household income is a major predictor of haemoglobin status of both mothers and the children. The prevalence of anaemia was significantly higher in households living below the poverty line (86.9%) than in those living above the poverty line (10.7%). This is in agreement with other study by Chaudury (1986) who observed that low household income affects directly the food intake, frequency, and childcare and health service of the poor. This means that poverty should be one of the prime considerations in this community when planning nutritional security strategies in general and nutritional anaemia prevention strategies in particular.

5.3 Water, sanitation and hygiene

It is an established fact that poor hygienic and unsanitary environmental conditions are usually associated with high prevalence of infection and hence the association with nutritional anaemia (INAGG, 1982). However, no significant association was found between variables of household water supply, kind of water treatment, type of container for storing water, sanitation, and hygiene with anaemia incidence. The prevalence of anaemia was not also associated (p-value >0.05) either with latrine ownership and type, refuse disposal or with washing hands after using latrine and/or after handling food.

5.4 Morbidity incidence, parasitic infestation and anaemia prevalence

WHO (1990) confirmed that Intestinal parasites exacerbated iron deficiency by increasing the loss of blood from the intestine. This loss in addition to a low intake of iron and/or its poor absorption can lead to profound anaemia which impairs the intellectual development of children and limits both children's and adults' capacity for physical activity. Eric (2001) found that the most significant risk of hookworm infection is anaemia secondary to loss of iron (and protein) into the gut. Children are infected more commonly and more heavily than adults. This is because children are more likely than adults to come in direct contact with fecally contaminated soil containing infective larva.

The present study showed that the prevalence of anaemia is higher among people who were sick two weeks prior to the study than healthy people. This confirmed that malaria parasite and stool infections are associated with high prevalence of anaemia. Different parasites namely hookworm (Brooker et al, 1999), *Ascaris lumbricoides* (Stoltzfus et al., 1997), *plasmodium falciparum* (Steketee et al., 2001) are the most involved in this causation. The high prevalence of those parasites in the sample of the current study showed significant difference ($P < 0.05$) than low prevalence of the parasites.

Studies conducted in Tanzania have indicated that malaria in pregnancy is often associated with increased risk of severe anaemia, abortion, intrauterine foetal death and low birth weight (Mwaniki et al, 2000). Malaria causes haemolyses, which in turn induces anaemia (UN-ACC/SCN, 1990). Malaria mostly affects children under 5 and pregnant mothers, whose immunity drops when they become pregnant. Malaria in pregnant women has two main results. First, death during childbirth, which occurs at the rate of about 1500/day in Africa, in part because of anaemia due to malaria. Second, incidence of low birth weight babies is 20-40% of all babies born in areas where malaria is prevalent.

Elizabeth (2001) affirmed that anaemia is the commonest complication of malaria in children. The rate of development and degree of anaemia depend on the severity and duration of parassitemia. In some children, repeated untreated episodes of malaria can result in normocytic anaemia. In these cases, bone marrow shows changes of dyserythropoeisis and peripheral blood shows low-grade parassitemia, sometimes with pigmented monocytes. In patients with high parassitemia, anaemia may develop rapidly due to haemolysis of the parasitised red cells and this may worsen even after completion of anti malarial therapy. It can present with serious problems in children with pre-existing anaemia (Elizabeth, 2001). In contrast to this, the present study found no association between parasitic loading (parassitemia) and haemoglobin level. This is because other factors seem to play bigger role than the parasitic loading.

In areas with no malaria, the mean haemoglobin levels were markedly higher than those found in areas with stable malaria transmission, though changes with increasing intensity of transmission were unclear. Eighteen studies from areas with stable malaria transmission in sub-Saharan Africa suggested that the median prevalence of severe anaemia in all-parity pregnant women is approximately 8.2%. Assuming that 26% of these cases are due to malaria, it is suggested that as many as 400,000 pregnant women may have developed severe anaemia as a result of infection with malaria in sub-Saharan Africa in 1995. Severe malarial anaemia occurs 1.42–5.66 million times annually and kills 190,000–974,000 (> 13% CFR) children < 5 years of age annually (Murphy and Bremen, 2001).

Findings by Monsen et al (1978) indicated that the prevalence of anaemia (haemoglobin < 110 g/l) was high (54%) among schoolchildren, particularly those with high intensities of hookworm and schistosomiasis. The same author suggested that hookworm and schistosomiasis were responsible for 6% and 15%

of anaemia cases, respectively. Fifteen months after de-worming with albendazole and praziquantel the prevalence of anaemia was reduced by a quarter and that of moderate-to-severe anaemia (haemoglobin < 90 g/l) was reduced by nearly a half.

5.5 Food intake and anaemia

As assessed by the 24-hour recall, food intake did not show much association with anaemia. This study proved that only vitamin A, zinc, and fibre showed to be significantly correlated with the haemoglobin level of study subjects. This is consistent with what Sommer and West (1996) found. They have concluded that vitamin A deficiency may be a common cause of impaired Hb synthesis and contributor to anaemia. While the exact mechanism remains to be determined, they include impaired mobilization of iron stores, possibly due to an effect of vitamin A deficiency on transferin receptors. Suharno and Muhilal (1996) found that large body of evidence indicates that vitamin A deficiency is an important factor in the aetiology of nutritional anaemia. In their findings they suggested that measures to combat anaemia in pregnant women at the population level should involve improving nutrition status with respect not only to iron but also to vitamin A. Their study showed also that Vitamin A and iron supplementation significantly increased haemoglobin by 12.78 g/L compared with the double-placebo group. One-third (3.68 g/L) of the increase could be attributed to vitamin A supplementation and two-thirds (7.71 g/L) to supplementation with iron. The pattern of changes in packed cell volume was similar to that in haemoglobin.

A combined iron and vitamin A supplement has been found to be 40% more effective in reducing anaemia than iron supplement alone (Suharno and Muhilal, 1996). Such findings are not specific to supplementation. Vitamin A sugar fortification program in Guatemala resulted in improved iron status of the population (Mejia and Arroyave, 1982). A trial with vitamin-A fortified Mono-Sodium Glutamate (MSG) in Indonesia increased haemoglobin levels among children (Muhilal et al, 1988).

Zinc is another important micronutrient and its deficiency is going to be the next priority micronutrient after iodine, iron, and vitamin A to receive global effort toward its elimination (Mwaniki et al, 1999). Zinc deficiency is now known to be fairly widespread throughout the world. From FAO national food balance data it is estimated that 48% of the global population is at risk of Zinc deficiency. The base of dietary pattern among the studied population was cereals which are high in phytic acid, a potent inhibitor of zinc absorption a fact which explains that the association between zinc dietary intake and anaemia among the subjects.

In agreement with present study, another one conducted in Kwazulu Natal, South Africa concluded that marginal zinc deficiency mainly coexists with marginal deficiency in vitamin A and iron (Spinnler et al, 2000).

5.6 Pica and anaemia

According to Worthington and Williams (1985), craving, a strong desire to specific food item, is widespread phenomenon. They observed that almost all women interviewed craved at least one food. Craving Unsatiable substance having little or no nutritional value is common phenomenon during pregnancy. The cause of pica is not well understood. However there is widely held hypothesis, which states that Pica is induced as a response to deficit in one of the essential nutrients (Worthington-Roperts and Williams, 1985).

The impact of practising Pica on maternal health is not well understood. However, there is speculative assertion that Pica can cause anaemia and that it may associate with maternal and perinatal mortalities (Horner, 1991). Some speculate that Pica substances can contain toxic or infectious substances and cause ill effects. They also speculate that Pica substance like clay can bind mineras and make them unavailable (Worthington-Roperts and Williams, 1985). In agreement with Horner (1991) this study has confirmed the speculation that pica can cause anaemia. In fact it was found higher prevalence of anaemia among those who have the habit of practicing pica (86.2%) than among the ones who were not (65.5%). This might also support another speculation previously quoted by Worthington and Williams (1985) that pica substance like clay can bind minerals such as iron and make them unavailable.

6.0 Summary and Conclusion

6.1 Conclusion

1. A majority of the people in Garrissa (89.1%) live in abject poverty and are below poverty line.
2. The prevalence of anaemia in Garrissa is among the highest in the whole country. The households live below poverty (earn less than one dollar per day) had higher prevalence of anaemia. The hypothesis that socio-economic status has no effect on the anaemia status is therefore rejected.
3. Literacy level of the mothers (defined as those who can read and write) has no effect on the level anaemia in Garrissa district. The hypothesis, that literacy has no clear effect in increasing the Hb level is accepted.
4. Higher consumption of fruits and vegetables in Garrissa does not significantly increase Hb level and subsequently does not improve anaemia status. The hypotheses,that micronutrients consumption from fruits/vegetable sources has no effect on increasing the Hb level is accepted.
5. Total daily macronutrient intake (protein, fat, and carbohydrate) does not show any significant correlation with Hb level and the hypothesis that the Total macronutrient intake does not correlate with Hb level is therefore accepted

6. The micronutrient intake specifically Vitamin A, and zinc show significant correlation with Hb status. The hypothesis that the total micronutrient intake does not correlate with Hb level is partly rejected.
7. The physiological status of women (pregnant and lactating) in Garrissa has no effect on Hb level/anaemia status thus, the hypothesis that there is no difference in haemoglobin level, between pregnant and a breastfeeding woman in the study subjects is accepted.
8. For children there is no significant difference in the prevalence of anaemia between those who have parasitic infestation and those without. While for women is vice versa.
9. For morbidity status there is significant difference in the prevalence of anaemia between women who have sickness two weeks prior the survey and those without. As for the children cases is vice versa.
10. The pregnant mothers who had the habit of practicing pica manifested higher anaemic prevalence than those who did not practice. The hypotheses, that there is no difference in haemoglobin, between pregnant women who do practice pica and those who do not is therefore rejected.

6.2 Recommendations

1. For effective primary prevention, there is need to increase the intake and bioavailability of micronutrients particularly Vitamin C, vitamin A, and zinc is required. Bioavailability could be increased by fermentation particularly in the case of minerals iron and zinc and probably vitamin A. a process of breaking down the matrix in which nutrients in particular vitamin A and probably zinc is required. This process which involves size reduction and probably in combination with sieving will also reduce fibre contents thereby increasing mineral intake.
2. Health and nutrition education should be given in Barazas (chief's) and should rigorously discourage pica practice. In addition sanitation should be encouraged within this forum. To prevent malaria and parasitic infestation improving community awareness should also be emphasized also within existing MCH programs in the district.
3. A deworming program should be emphasized as the effect of parasitic infestation on anaemia was clear.
4. NGOs and MOH (Ministry of Health) should implement a mosquito (malaria) control program along the bank of the Tana river with community participation. Distribution of mosquito treated nets should be widened in the area other than provisions only to those attend MCH (who are given as an incentive to visit MCH clinic).
5. Given the high level of poverty and its effect on the wellbeing of the community, an income generation program aiming at empowering women

to improve their economic status should be introduced to improve the overall nutritional status including the anaemia situation considering strong Somali social network. This is because Somali women are unlikely to divert household resources to other non essential expenditure like chewing Miraa and related expenses at the expense of the household welfare.

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APPENDEX

APPENDIX...1 Demographic And Socio-economic Characteristics

VILLAGE--------------------V.CODE--------HH.NO------------------------

Date of Interview ---------------- Name of the interviewer--------------------------------

Name of the head of the HH------------------------ Name of the respondent-----------------

Sex---------- relationship with the head of the HH --------------------------------
Please if the members outnumber this page use next page.

Form .1

S.No	Name	Sex	Age	RHHH	Ethnic	Marital	Education	Occupation	Average incoı month

Sex
Male = 1
Female =2

RHHH
Head Of The HH =HHH
Daughter =D
Son = S
Wife =W

Ethnic
Somali =1
Others =2

Marital Status
Single =1
Married =2
Divorced =3
Widowed =4
Separated =5

Education
Illiterate =1
preschooler =2
Primary =3
Secondary =4
Adult Education =6
University =6

Occupation
Small business = 20
Casual labourer = 22
Salaried Employed = 18
Farmer = 16
School Age = 14
Preschooler = 12
Housewife = 10
Jua Kali = 24
None = 8

Source of income

1 =employed, 2 =livestock, 3 =business, 4 =casual labour, 5 =remittance 6 =mix (bus and empl)

How far is the nearest market?

Distance --------------------------- time -------------------------

Which of these fruits and vegetables do your family consume?

Form .2

Fruit and vegetable	Yes =1 no =2	Amount in g	Source	Usual frequency	Price per unit	Micronutrients
Avocado						
Banana						
Lemon						
Onion						
Papaya						
Passion fruit						
Pineapple						
Tomato						
Cabbage						
Kales						

Frequency of consumption
Once daily =1/d
Once per week =1/w
Twice per week = 2/w
Once per month = 1/m

Source
purchased =1
home grown =2
gift =3
field gathering =4

Never =N
Rarely =R
Twice Daily =2/D

Water Sanitation And Hygiene

What is the main source of water for the house hold

1 = river, 2 = well, 3 = tap, 4 = others, specify-----------------

What is the distance and /or the time to the water source

Time (min) ---------------- distance (km)--------------

How Do You Purify Your Water Before Drinking

1 = boiling, 2 = filtering, 3 = sedimentation, 4 = chlorination

5 = not treated

Where do you store your drinking water

1 = plastic 2 = clay pot, 3 = metallic, 4 = others, specify--------------------------------

Do you latrine in your homestead? 1 = yes 2 = no

if yes indicate the type of latrine

1 = enclosure 2 = pit 3 = VIP 4 = others, specify ---------------------------------

Where do you dispose your refuse 1 = composite pit 2 = bury, 3 = burn, 4 = others,

Specify----------------------------

Do your wash hands before handling food 1 = yes 2 = no 3 = sometimes

HOUSEHOLD FOOD INTAKE: 24 HOUR RECALL

1. Name Of The Head Of The Household ------------------------------- Household
2. Number---------------- 3.Date--------------_____________
4. Name of The Interviewer --
   ____
5. What Did Your Family Eat The Whole Of Yesterday?

Form .3

Meal time	Dish	Ingredients	Amount of ingredient	Volume of cooked dish	Amount eaten	Leftovers
Breakfast						
Snacks						
Lunch						
Supper						

Morbidity Data

1. When you or other members of the family get sick, where do they go for treatment?

(a) At home (explain) --

(b) Hospital

(c) Health centre

(d) Dispensary

(e) Traditional medicine practitioner (specify)

1. (a) which of the above is the nearest medical facility to your household

(e.g.) hospital, dispensary ? --

(b) How far is it from the household (in Kms) ---------------------------------

2. Are the available medical facility adequate?

(1= not at all)

(2= not adequate)

(3= fairly adequate)

(4= quite adequate)

3. Do you medical assistance when sick (modern medicine) ? Yes = 1
No= 2

4.Which are the five commonest diseases in this area? (List in order of priority).

1.		
2.		
3.		
4.		
5.		

4. Is there a child or children of under five years of age in this household?
1 = yes
2 = No

(a) If yes, is she immunized or not?
1. = Yes
2= no

(b) If yes ask the mother to show up immunization card.

If the child has not been immunized, why?

(1= the clinic is far)
(2= I do not think is important)
(3= my child is big)
(4= my child gets sick when immunized)
(5= others, specify________________________________)

5. Is there any pregnant woman in this household? 1= yes
   2= no

6. If yes, ask that particular mother whether she likes to eat

   (a) Clay
   (b) Charcoal
   (c) Other non food items, specify ______________________

7. Is there any person who got sick the last 48 hours in this household?

   1= yes
   2= no
8. If yes, what was the disease

   a. Malaria
   b. Diarrhoea
   c. Pneumonia
   d. Upper respiratory tract infection
   e. Typhoid
   f. Worms
   g. Others, specify ---

APPENDIX...2 Haemoglobin Result Forms

Form.4

Name	Age	Sex	Physiological Status	Hb Level

CODE FOR PHYSIOLOGICAL STATUS.
U = Under Five (6-___ 59)
P = Pregnant
Bf = Breast Feeding

APPENDIX...3 Malaria Parasite Result Forms

Form.5

Name	Age	Physiological Status	Parasitic Infection		Parasite Density
			Positive	Negative	

<u>Physiological status</u>
U= under fives
P= pregnant mothers
Bf=breast feeding

<u>parasitic infection</u>
positive = ps
negative = n

APPENDIX...4 Stool Examination Result Form

Form.6

Name	Age	Sex	Parasitic Infection		If Positive Type Of Infection

APPENDIX... 5. List of Activities During the Data Collection.

Activity	Time Line
Meeting with Garissa D.C.	23rd of April 2001
Meeting with Garrissa D.E.O.	24 of April 2001
Meeting with district M.O.H.	24th of April 2001
Meeting with medical superintendent G.HOSP.	25th of April 2001
Recruiting field assistants and briefing them.	26-28 April 2001
Pre-testing of study instruments.	29-5th may 2001
Corrections, revising and printing questionnaire	6-9th May 2001
Definitive data collection	10th may-10th june2001
Laboratory analysis.	11th june-20th June 2001

Fig. 1 Example of the consent form, which the participants have signed before the study, is commenced.

Consent form

I, the undersigned Mr/Mrs-----------------------------------, agreed to participate in the study entitled: analysis of determinant factors of anaemia among the population of Garrissa district after I was briefed about the project.

Signed---

APPENDIX…6. The effect of income, market distance, water source, clinic distance and malaria parasite density

		Anaemia status				t-test	p-value
		Anaemic		Normal			
	N	Mean	SD	Mean	SD		
Age of mother	194	28.76	7.09	30.15	6.23	-1.121	0.264
Age of child	190	41.04	11.25	40.97	10.93	0.032	0.975
Income (Ksh)	384	684.85	659.37	1672.8	1201.1	-6.749	0.000
Market distance	384	3129.58	2573.11	1809.86	2088.1	4.054	0.000
Water source distance	384	1940.67	2046.1	1678.56	1705.3	1.009	0.314
Distance to the clinic	384	3578.21	2434.8	3663.9	2328.2	-0.271	0.786
Malaria parasite	135	5152.22	12486.2	3891.5	11919.7	0.591	0.556