NUTRIENT ADEQUACY OF PORRIDGES USED FOR COMPLEMENTARY FEEDING IN KANGEMI-NAIROBI

BY

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DECLARATION

I, Margaret P.W Aleke hereby declare that this dissertation is my original work, and has not been presented for a degree in any other university.

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DEDICATION

This dissertation is dedicated to people who have played a critical role in my life. My parents, Nathan Wanyanga and Harriet Omina provided my first foundation in life. My loving husband Aleke Dondo encouraged and supported my studies. My children Daline, Harriet and Baraka tolerated the reduced attention from a mother without full understanding.

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ABBREVIATIONS

ACC/SCN	Administrative Committee on Co-ordination (of United Nations)/Sub- committee on Nutrition
ACTS	African Centre of Technological Studies
AIDS	Acquired Immunodeficiency Syndrome
ARF	Amylase Rich Flour
CAC	Codex Alimentarius Commission
CBS	Central Bureau of Statistics
DDI	Daily Dietary Intake
GOK	Government of Kenya
HIV	Human Immunodeficiency Virus
ICFSN	International Course in Food Science and Nutrition
IFPRI	International Food Policy Research Institute
IVACG	International Vitamin A Consultative Group
KDHS	Kenya Demographic Health Survey
KNS	Kenya National Survey
MOH	Ministry of Health
NINI	Netherlands International Nutrition Institute
RDA	Recommended Daily Allowance
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

DEFINITION OF TERMS

Amylase Rich Flour: A sun dried or artificially dried and ground germinated cereal grain that is rich in amylase enzymes. The temperatures used for drying do not exceeding 50°C.

Anti-nutrients: Are substances in foods that impair the absorption and utilization of nutrients in the body. They interfere with the nutrients in foods such that they are not taken up and used by the cells in body functions.

Anti-nutrients: Are substances in foods that impair the absorption of nutrients and/or cause discomforts in the body. Their consumption may result in poisoning, stomach upsets, diarrhoea, nausea and/or loss of appetite

Breast-milk substitute: Any food being marketed or otherwise represented as a partial or total replacement for breast milk, whether or not suitable for that purpose.

Bulky Foods: Are foods, which contain low concentration of nutrients such that the volume needed to meet the energy requirements exceeds ingestive capacity.

Complementary Feeding: The gradual process by which breast milk is increasingly complemented or supplemented with other foods from the age of 4-6 months in order to supply the additional nutrients required by the growing infant or young child for which breast milk alone cannot satisfy.

Complementary Food: Any food, whether industrially processed or locally prepared and fed alongside breast milk or in place of infant formula.

Daily Dietary Intake: The amount of nutrients derived from food consumed within a day (24 hour period).

Fermentation: Fermentation is a microbiological process in which starch is modified into simple sugars and lactic acid at temperatures of 30°C for 24-48 hours. This reduces waterholding capacity of starch, and enhances taste, aroma, texture, nutritional value, safety and shelf life (preservation) of foods.

Fortification or Enrichment: The addition of one or more essential nutrients to a food whether or not it is normally contained in the food for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups. Foods rich in the missing nutrients can also be used.

Germination: Is a process of sprouting grains in which natural enzymes such as amylases are produced. The enzymes predigest the starchy portion reducing the bulk of the food when prepared for feeding and, ultimately, increasing the nutrient density.

Infant: A child from birth to 12 months of age.

Kimea: Amylase rich flour made from germinated sorghum or millet

Nutrient bioavailability: The status in which nutrients derived from food are readily available for absorption in the body. Energy and proteins must be broken down into smaller molecules and, minerals and their absorption sites must be freed in order for absorption to take place.

Nutrient Dense Foods: Foods containing high concentration of protein, vitamins and/or vitamins per unit of energy (kcal). A small amount of such food provides the needed nutrients.

Omena **(dagaa):** Small whole fish **(***Rastrienola argentea***).**

Recommended Daily Allowances: The average daily amounts of nutrients considered adequate to meet the known nutrient needs of practically all healthy people, a goal for dietary intake by individuals.

Replacement Feeding: The process of feeding a child, who is not receiving any breast milk, with a diet that provides all the nutrients the child needs. During the first six months, this should be with a suitable breast-milk substitute: commercial infant formula or home prepared formula high nutrient density. After six months this should preferably be with a suitable breast-milk substitute, and complementary foods made from appropriately prepared and nutrients-enriched family foods that are given three times a day. If breast-milk substitutes are not available, appropriately prepared family foods should be further enriched and given five times a day.

Soaking: The process of steeping grains or grain products in water to initiate the activity of inherent natural enzymes and to reduce anti-nutrients.

Supplementation: The addition of nutrients that are missing or are in insufficient quantities in the basic staple foods. This should coincide with complementary feeding.

Unmodified Porridge: A thin porridge, whose nutrient content is wholly derived from flour solids without exposing it to a preparation step that further changes its natural starch properties, increases its nutrient density and/or bioavailability.

Weaning: Ceasing to breastfeed and displacing breast milk or breast-milk substitutes with other foods. A child is weaned when all energy and nutrients are supplied with other foods.

Young child: A child from 13 to 24 months of age

ABSTRACT

The main objective of the study was to investigate the nutrient adequacy of porridges used for complementary feeding among children aged 6-24 months in Kangemi. To achieve the objective, the types of porridges consumed, levels and patterns of their consumption, preparation methods and nutrient (energy, protein, calcium, iron, zinc and vitamin A) content were determined. The extent of use of the porridges by mothers, the proportions of nutrients contributed by porridges to the daily dietary intake and storage practices were also examined.

Using a purposive and systematic sampling procedure, 144 children aged 6-24 months and their mothers were identified and interviewed. A cross-sectional descriptive and analytical study was carried out using structured and pre-tested questionnaires, and focus group discussions. Information was sought on feeding frequency, composition of porridge flours, types and amounts of ingredients used in preparation of complementary foods (including porridges), the amounts consumed by the child in 24 hours, hygienic practices and illnesses.

The main findings were that the porridges were only adequate in protein but not in energy, calcium, iron, zinc and vitamin A. They were made from raw-dry-whole milled grains (millet, sorghum and/or maize, beans and soybeans) with or without enrichment with sugar, milk and/or margarine. The enrichment of porridges with other foods improved nutrient concentration, but their bioavailability was uncertain.

It is recommended that, nutrition guidelines be reviewed to cover existing technologies, update nutrition knowledge of health workers and, sensitise mothers and millers on the nature of porridges. They should be sensitised and encouraged to use simple technologies such as soaking, roasting and fermentation and, addition of amylases, micronutrient rich foods to improve nutrient density and bioavailability, and on the need to sustain breastfeeding to supplement porridge. Further research is required to validate nutrient content of the porridges; determine optimum cooking times and; appropriate flour formulations that provide minimum composition of nutrients to meet the RDAs for energy, protein, calcium, iron, zinc and vitamin A. It was also recommended that the necessary national standards for monitoring the quality of the flour formulations be developed.

CHAPTER 1: INTRODUCTION

1.1 Background Information

Complementary feeding is a gradual process during which breast milk is increasingly complemented with other foods that fully meet a child's nutrient requirements. It ends when the child is completely weaned from breastfeeding and is fed with other foods. Complementary foods are given in addition to breast milk to make certain that the young child continues to have enough energy, protein, and other nutrients necessary in order to grow normally. By six months, most children cannot get enough energy and nutrients from breast milk alone. At this age, they have rapid physiological, immunological and mental growth development. Adequate growth development depends on food intake and the health of the child.

In Kenya, as in many parts of the world, the basic staple foods available in the area determine the type of complementary foods. Young children among the low-income groups are fed on a thin porridge made from millet, sorghum, maize or their mixtures. Some mothers add beans, soybeans, groundnuts, other legumes and *omena* (dagaa fish) flour to the cereals to improve the protein quality. Porridge is mainly used as an introductory food because of its thin consistency. The age of introduction depends on when the mother considers that the child is not getting satisfied on breast milk alone. Porridges are prepared with or without addition of other foods. Foods such as *ugali* (stiff porridge), potatoes and bananas are introduced later into the diet. Fortified infant cereals such as *cerelac* are rarely used because of their high price.

In developing countries such as Kenya, the complementary feeding period is often marked with malnutrition (deficiency diseases) due to low nutrient intake. The thin porridges used are known to be low in critical nutrients like energy, protein, iron, zinc, calcium and vitamin A. The proteins and minerals are bound by anti-nutrients such as tannins and phytates, found in millets, sorghums, and legumes (King and Burgess, 1993; Lorri, 1993; Mbithi-Mwikya *et al,* 2000).

In an effort to improve nutrient intake, the Ministry of Health in Kenya in collaboration with the support of development agencies has developed nutrition education approaches that include mixing of cereals and legumes, and /or addition of foods to (fortification or enrichment with) the flours or porridges to improve their nutrient content. They promote addition of milk, *omena*, margarine (fats), eggs and oilseed pastes, as well as use of other nutrient rich foods. From the literature available, traditional food preparation methods like fermentation of porridge, and addition of *kimea* have also been recommended for use to improve nutrient density of flour solids in the porridges (Karuna *et al*, 1991; King and Burgess, 1993; Lorri, 1993; Tontisirin and Yambosirit, 1995; Mbithi-Mwikya *et al*, 2000). However, there is little information on porridge preparation methods in use and no attempt has been made to estimate daily nutrient intake from porridges at the community level.

This study attempts to identify the current methods in use and estimate energy, protein, iron, zinc, calcium and vitamin A provided by the porridges in Kangemi, an urban area in Nairobi inhabited by low socio-economic groups.

1.2 Statement of Problem

Inadequate nutrient intake among infants and young children is a foundation for malnutrition. Malnutrition is one of the most important health and welfare problems among infants and young children in Kenya where they consume porridge daily. This porridge maybe enriched with other foods when available. Traditionally fermented porridges known to have a higher concentration of nutrients when unfermented ones are rarely used for feeding children.

Continued feeding of children on low nutrient porridge without fortification and/or modification, and other quality complementary foods is likely to result in nutrient deficiency diseases that retard growth, the immune system response and the integrity of epithelial tissues. Rise in rickets cases in Kenya has been attributed to use of more than two cereals in a complementary food.

Adoption of improved porridge preparation methods such as addition of legumes and other foods by the mothers has led entrepreneurs to market various grains, and flour mixes for use in making porridge for complementary feeding. A look at the shops and markets in Nairobi show that many types of grains and flours are available. Some of the ready-packaged-branded flours are labeled with claims such as high nutrient porridge, sour porridge, makes children strong, baby porridge, for children, for complementary feeding, and for invalids. Where the flours are not labeled, they are often claimed by the sellers to be nutritious. These claims have not been verified; no local standards are in place to govern formulation of these mixes; and hence these flours have a questionable quality in terms of nutrient composition, nutrient availability, and in meeting children's nutrient requirements.

1.3 Justification

Complementary feeding period has been termed as a dangerous time for infants and young children (Allen and Gillipsie 2001). The quality of feeding and care requires great attention to make it safe, increase the children's survival rates, reduce risks of abnormal development and increase the productivity potential of the nation at large (Smith, 2000). Appropriate and adequate complementary feeding of children is very important. It reduces the rates of infection, deficiency diseases and mortality associated with children aged 6-24 months. Management of nutritional status in children helps maintain competence of the immune system (Tomkins and Watson 1989). Therefore, there is need to find ways and means of improving the quality of the most commonly used foods such as porridges in complementary feeding.

As mothers try to improve the nutrient quality of porridges, there is no information on their nutrient adequacy, and the extent to which they are used for complementary and replacement feeding (in cases where mothers have stopped breastfeeding, including those who are HIV-infected). Information on the extent to which porridge is used and its nutrient adequacy is necessary. The study focuses on the types of porridge, preparation methods, the extent to which it is used, and its adequacy in meeting energy, protein, calcium, iron, zinc and vitamin A requirements of children. These nutrients are critical for the normal growth, development and immunity of children. Data from this study provides the basis for reviewing and designing appropriate programmes to improve the nutrient intake of children aged between 6-24 months who depend on porridges in Kangemi.

1.4 Objective

The main objective of the study was to investigate the nutrient adequacy of porridges used for complementary feeding among children aged 6-24 months in Kangemi.

1.4.1 Specific Objectives

To achieve the main objective, various activities were carried out with different specific objectives as follows:

i) To determine the proportion of mothers using porridge as complementary food.

ii) To determine the proportion of mothers using porridges as replacement food

iii) To determine the type of porridges consumed.

iv) To document the preparation methods of porridges

v) To determine consumption levels and patterns of porridges

vi) To determine the energy, protein, calcium, iron, zinc and vitamin A. content in the porridges

vii) To determine the contribution of porridges to the nutrient (energy, protein, calcium, iron, zinc and vitamin A.) dietary intake of children.

viii) To determine hygienic practices for the prepared porridge

ix) To determine prevalence of common illnesses

1.4.2 Research Questions

The underlying questions of the study were:

i) What types of porridges are used in Kangemi?

ii) Do the porridges used provide adequate energy, protein, calcium, iron, zinc and vitamin A to the 6-24 month old children?

iii) What factors determine the adequacy of the porridges?

1.4.3 Study Benefits

This study provides baseline information needed for strategic planning to improve energy, protein, calcium, iron, zinc and vitamin A intake among children who use porridges in complementary feeding. Institutions such as Ministry of Health, UNICEF, Kenya Bureau of Standards and others involved in child nutrition intervention programmes will find the information beneficial. Messages given to mothers on child feeding may require review;

advocacy for appropriate technology among health workers, mothers, millers and suppliers may be required to promote use of quality flours for porridge preparation; and standards may be required to monitor flours and improve energy, protein. calcium, iron, zinc and vitamin A density of porridges.

CHAPTER: 2 LITERATURE REVIEW

2.1 Nature of Porridge Flours

Porridges are made from single cereals such as maize, millets, sorghum or their mixtures. Legumes may be added to the flours in an effort to improve the nutrient quality. These flours have a tendency to absorb too much water on cooking leading to increased volume (dietary bulk), and high viscosity (King and Burgess, 1993).

2.1.1 Nutritional Value

Cereals and legumes have nutritional complementarities. Cereals contain high carbohydrates (70-80%) with a lower protein level (7-11%), while dry legumes have high protein (22-38%) with lower carbohydrates levels (29-58%). They all are good sources of iron but it is not easily absorbed because they contain antinutrients. They are not rich in vitamin A except for yellow maize, which is rarely used in Kenya. The food legumes are valuable in supplementing protein in cereals. The two complement each other well in provision of a more complete protein. Each is low in some essential amino acids. Legumes are rich in lysine that is limiting in cereals while; cereals are comparatively rich in methionine and cystein that are limiting in legumes. The combined protein is cheaper and more accessible to the low-income groups than the higher quality animal proteins that are more balanced in essential amino acids. It is recommended that in order to achieve optimum nutritional complementarities, cereals and legumes need to be eaten at an approximate ratio of 65-70% and 30-35% respectively. However, proteins and minerals such as zinc, iron and calcium from cereals and legumes are not well absorbed. They are complexed with substances inherent in the grains (Siegel and Fawcett, 1976; Bourne, 1989: King and Burgess, 1993; FAO/WHO, 1995).

2.1.2 Anti-nutritive Factors

Sorghums, millets and legumes used in the preparation of porridges contain substances such as trypsin inhibitors, lectins (hemagglutinins), tannins, and phytates (phytic acid salts) and oligosaccharides (alpha-galactosides), which interfere with animal physiology and proper utilization of nutrients particularly proteins and minerals. (Bourne, 1989; King and Burgess, 1993; Besancon, 1999).

Trypsin inhibitors, lectins (haemagglutinins) and alpha-galactosides are commonly found in legumes. Trypsin inhibitors bind trypsin and chymotrypsin enzymes making them unavailable for protein digestion. Lectins bind sugar reaction sites in the small intestines and disrupt the luminal surfaces causing decreased digestive capacity of glucose and proteins, and agglutinate red blood cells. They also cause damage to the intestinal epithelial cells and agglutinate erythrocytes. These result in gastro-intestinal disorders such as mal-absorption of nutrients, absorption of harmful substances (toxins), vomiting and diarrhea in children. The human digestive system does not have the enzymes to hydrolyze flatulence-causing alpha-galactosides (raffinose, starchyose and verbascose). They pass through the small intestines undigested. into the large intestines, where they undergo microbial fermentation with production of gases, causing discomfort. This may also result in diarrhea and vomiting consequently causing nutrient loss, mal-absorption and diet inadequacy. However, appropriate food preparation methods can inactivate or reduce the protease inhibitors, lectins and alpha-galactosides, thus reducing their effects (Bourne 1989, Pamplona-Roger 2001(1)).

Tannins and phytates are present in cereals and legumes, but brown sorghums and millets have high concentrations. Tannins (polyphenols) are astringent in taste making it difficult for children to take porridge, depress food intake, bind proteins, and may cause toxicity in the body if absorbed. They also inhibit lactic acid fermentation thereby slowing the process, the effect of phytase activity and absorption of minerals. The concentration of tannins is highest in the hulls, which can be removed during grain preparation. Phytates bind minerals making them unavailable for body utilization. A diet high in phytates leads to loss of bioavailability of minerals and may lead to aneamia. However, iron, zinc, and calcium can also be rendered bioavailable in these grains (Bourne, 1989; Lorri, 1993; FOA/WHO, 1995; Mbithi-Mwikya et al 2000; Besancon, 1999).

Elimination of antinutritive factors can improve nutrient adequacy of porridge. The bound nutrients can be released; protein made available for absorption; oligosaccharides hydrolysed; and gastrointestinal disorders reduced.

2.2 Preparation of Thin Porridges and Their Nutritional Implication

Complementary foods make up a large proportion of the child's diet and contribute a significant amount of nutrients necessary for growth, development and immunity. Infants must receive foods containing essential nutrients to complement breast milk. It is recommended that 100g of formulated supplementary foods for older infants and children provide at least 400kcal and 15g protein on dry matter basis (CAC, 1994). Preparation methods should be such that complementary foods given three times a day to infants consuming average amounts of breast milk have an energy density of 0.6kcal/g for 6-8 months old children, increasing to 1.0kcal/g at 12-23 months old. However, when the breast milk intake is low the energy density needs to be 0.8-1.2 kcal/g (Allen and Gillipsie, 2001).

2.2.1 Preparation Methods

Complementary foods made from staples such as maize, millets, sorghum, cassava, potato or their mixtures absorb large amounts of water on cooking, which lowers their energy and nutrient density. On cooking porridge, starch granules in flour swell as they take up water and solubilize in a process called gelitinization. This results in a viscous product (thick porridge) that is difficult for a child to swallow. Since children prefer thin porridge, it requires addition of water to make it thinner. However, addition of water increases the volume and reduces the energy and nutrient density thereby making it bulky. This nature of porridges has led to many efforts in improving the nutrient density (Yadav, 1997; Bourne, 1989; Karuna et al, 1991).

2.2.2 Nutritional Requirements

Infancy is a time of rapid physical growth as well as physiological, immunological, and mental development. During the first year of life, nutritional requirements are at the highest in the entire life cycle. Optimal utilization for a particular nutrient depends on others being available at the same time, if growth and development are to take place in the normal way. Deficiency in energy, protein, iron, zinc, vitamin A, calcium and other essential nutrients can have serious consequences, some of which are long lasting. These may include reduced adult size, low productivity in adults, mental retardation, bowed legs and birth of low weight babies (Allen and Gillipsie, 2001; Smith, 2000; Yadav, 1997). However, the initial manifestations of deficiencies may be protein energy malnutrition. This is manifested by failure to gain weight (low weight-for-height), stunting, frequent illnesses and eventually nutrient deficiency complications and death among children aged 6 to 24 months (King and Burgess, 1993; Sanghvi and Murray, 1997; USAID, 1999). The Recommended Daily

Table 1: Recommended Dietary Allowances for 6-24 Month Old Children for Developing Countries.

Nutrient	Nutrient Requirements by Age (Months)		
	6-8	9-11	12-24
Energy (Kcal)	680	830	1092
Protein (g)	9.1	9.6	10.9
Vitamin A (ug RE)	350	400	400
Calcium (mg)	525	525	525
Iron (mg)			
Low bioavailability	21	21	21
Medium availability	11	11	11
High availability	7	7	7
Zinc (mg)	2.8	2.8	3

Allowances (RDA) required for sustaining normal development and growth of a healthy child in developing countries is shown in table 1(Lutter and Dewey 2003, Brown 2000, Treche 1999).

(i) Energy

Energy is needed by the body to carry out essential functions namely breathing, rapid growth, physical activities, fight infections and catch-up growth after infections. Without it, protein and other nutrients cannot be used efficiently for growth, development and immunity (Cameron and Hofvander, 1983). The infant's energy and nutrient needs are relatively very high for their size. The energy and protein needs of an infant are at least three times greater than a woman's needs for each kilogram body weight (King and Burgess 1993). HIV-infected children may require 10-15% more energy than recommended requirements per day in table 1, considering the extra energy that an HIV-infected adult needs (USAID 2001).

Cereals are the major sources of starch and energy (King and Burgess 1993). Diets with less than 15% energy from fat and low in refined carbohydrates, as is the case of most porridge are not sufficiently concentrated for children to meet their needs (Collaway 1995). Energy content is often lower in thin porridges than in milk. They may contain 0.5kcal/ml, compared to breast milk density of 0.75kcal/ml that they are supposed to complement (King and Burges 1993).

When energy intake from foods is low, there is a high likelihood that the intake of many other nutrients will also be inadequate (Benbouzid and Benoist 1999). A diet of thin porridge leads to energy deficiency conditions such as wasting, stunting, reduced physical and physiological activity, frequent infections and even death (King and Burgess, 1993).

(ii) Protein

Protein with a balanced amino acid pattern is important for growth and replacement of body tissues and fluids. Protein is essential for the structure and function of all cells in the body. It is part of all tissues, and body fluids such as blood, enzymes and hormones; and antibodies. It is a source of energy when other energy sources like carbohydrates and fat are low (Cameron and Hovfander 1983).

An HIV-infected child may require 50-100% more protein per day than the requirements shown in table 1 above, considering the extra protein that an HIV-infected adult requires to meet increased protein needs (USAID 2001).

Quality of a diet depends largely on the amount of protein it contains because protein-rich foods are usually carriers of other important nutrients such as vitamins and minerals. If a child receives a varied diet, protein quantity and quality are seldom a problem (Sizer and Whitney 2000, Cameron and Hofvander 1983). However, most complementary diets are limited in variety, and protein quantity, quality and availability. Unmodified porridge flours with no added animal products are deficient in protein. Protein deficiency results in breakdown of body proteins in an effort of maintaining body functions. Protein deficiency manifestations are like for energy, but with added fluid retention (oedema) (Allen and Gillipsie 2001).

(iii) Micronutrients

Micronutrients especially vitamins A, B_6, B_{12}, iron and zinc are important in building a strong immune system and fighting infections (Allen and Gillipsie 2001). However, it is said that it is difficult to meet all the micronutrient needs of infants and young children through plant based foods, unless they are fortified. Animal products are high in most micronutrients, and many minerals and vitamins are absorbed from milk, meat, and eggs than they are from plant-derived foods. Unfortunately, children in low-income families receive only small amounts, if any, of animal food products. It is reported that, it is difficult to meet the zinc needs of a child at 6-12 months unless there is a high intake of liver (Benbouzid and Benoist 1999, Allen and Gillipsie 2001). This may not be true if the micronutrient in cereals and legume flours used for porridge making were made available.

a) Iron

A child of 6-24 months requires 21mg of iron per day to meet his daily requirements, if the diet is very low in animal protein (Allen and Gillipsie 2001). The body needs iron to make haemoglobin for the red blood cells, transport oxygen, acting as an antioxidant, and in the utilization of energy and metabolism by cells. It is essential for strengthening the immune system and increasing resistance to colds, infections and diseases, maintaining adequate mental skills and coordination, and for prevention of anaemia (Sizer and Whitney 2000, USAID 2001).

The iron content of cereals and legumes is generally high. However, they contain non-heme iron that is bound by phytates and tannins and is not easily absorbed (Besancon, 1999). Consumption of unmodified porridges is likely to result in iron deficiency.

Anaemia, an iron deficiency condition is a major public health problem in Kenya. Prevalence of iron deficiency is 40% and anaemia is at 76.5% in children aged 6-24 months (MOH, 1999). Iron deficiency can result in impairment of psychomotor function such as reduced activity, slow learning and development in children. The main causes of nutritional anaemia are low intake of absorbable iron from plant foods including porridges, malaria and hookworms (King and Burgess, 1993).

b) Zinc

Zinc is an essential component of the immune system, some proteins, hormones, and enzymes. It is needed for growth and development, mineralization of the bone, digestion of proteins and energy metabolism. It is also required for maintenance of the immune system and vitamin A blood levels (Somer and Health Media 1992, ACC/SCN 1997). The requirements of zinc for this age group are shown in table 1.

The zinc in cereals and legumes is of low bioavailability and is affected by the same factors affecting iron absorption. Therefore, reduction of tannins and phytates may be required to increase its absorption (ACC/SCN 1997). Zinc deficiency leads to anaemia, delayed maturation, poor wound healing, mental disorders and dermatitis (Somer and Health Media 1992). It also causes damage of epithelial lining of the intestines and respiratory tract, which are part of the immune barrier system, as well as delayed cognitive and motor development (Osendarp 2001, USAID 2001).

c) Calcium

It is needed to sustain steady growth that demands high calcium utilization. Calcium is required for the growth of a healthy skeleton in childhood. It is essential for the formation of bones, teeth and muscle contraction, transmission of nerves, blood clotting and facilitation of digestion absorption and transport of nutrients across membranes and connective tissue. (Whitney and Rolfes, 1999; Guthrie, 1989; Pamplona-Roger, 2001(2)). The amounts required for normal growth and developments are shown in table 1.

However, calcium utilization is dependent on other factors. Calcium phosphate ratio (1.3:1), presence of vitamin D, protein, lactose and ascorbic acid enhance absorption while oxalic acid, phytic acid and high phosphorus levels interfere with absorption (Guthrie, 1989;Whitney and Rolfes, 1999; Pamplona-Roger 2001 (2)). Therefore, deficiency of enhancers and presence of inhibitors as is the case in cereals and legume flours will lead to low calcium availability from unmodified porridges. In addition change in diet from absorbable calcium rich breast milk to low calcium staple foods at this age may lead to calcium deficiency. Calcium deficiency results in deformation of bones (rickets), impairment of nerve stimulation (tetany), rickets and stunted growth (Yadav, 1997). The formation of strong bones in children requires a combination of vitamin D, phosphorus, magnesium and fluorine in appropriate amounts (Pamplona-Roger, 2001(2)).

d) Vitamin A

The requirement of a child aged 6-24 months for vitamin A is shown in table 1. Vitamin A is necessary for the normal functioning of the visual system, growth and development, maintenance of epithelial cellular integrity and mucous membranes, immune system function and reproduction (Sizer and Whitney, 2000; Somer and Health Media, 1992).

Risk factors for early onset of vitamin A deficiency in infancy and childhood include early introduction of complementary foods, low intake of breast milk, and poor vitamin A status of the mother and subsequently low concentration of the vitamin in the breast milk (ACC/SCN, 2000). Vitamin A deficiency results in dry scaling skin (keratinosis), xerophthalmia, poor tooth formation, growth retardation and increased incidence of respiratory tract infections, increased severity and duration of measles and anaemia (Somer and Health Media, 1992; Tomkins and Watson, 1989). Between 33.3-50% of the children in Eastern and Southern Africa are vitamin A deficient (Wagt, 2001). It is also reported that in children born of HIV-infected mothers, vitamin A deficiency is associated with higher maternal-to-child transmission rates, faster progression of HIV to AIDS, higher infant mortality and growth failure (USAID, 2001).

2.3 Vulnerability to Malnutrition

Infants are vulnerable to deficiency diseases because their food choices are limited; the amount of food they can consume is relatively low, while the demand for nutrients is high. The cause of infant under-nutrition is lack of suitable dense complementary foods during complementary feeding period. The highest rates of malnutrition are reported among the 3-24 month old infants and children. The rates of stunting (low height-for-age), underweight (low weight-for-age) and wasting rise to a peak of 50%, 32% and 12% respectively. Malnourished (under-nourished) children are also reported to have a much higher death rate than the well-nourished children. In Kenya, malnutrition accounts for 38% of all deaths in children under fives years of age, of which 4% is a result of severe, and 34% a result of mild and moderate malnutrition (Sanghvi and Murray, 1997; Cameron and Hofvander, 1983; UNICEF, 1998). Malnutrition contributes to death by weakening the child's immune system. Infection and malnutrition are synergistic in nature. 'Acute malnutrition from recent failure to receive adequate food. maybe affected by acute illness especially diarrhoea leading to wasting. Chronic malnutrition results from inadequate food intake over a long time and is exacerbated by chronic illness leading to stunting. Chronic malnutrition and/or acute malnutrition may also cause a child to be underweight (USAID, 1999). In addition, it increases the likelihood that opportunistic diseases will be severe particularly in HIV infected children, because of their poor immune systems (USAID, 2001). A sick child needs adequate food so that he can fight infections without using up all nutrient reserves in the body and risking malnutrition (Sanghvi and Murray, 1997).

In view of the above, porridges used in complementary feeding should provide adequate nutrients to reduce malnutrition resulting from inadequate food intake to achieve maximum survival and healthy living. This requires constant nutrition education on risks of under nutrition, monitoring of porridges to establish their nutrient adequacy, and making necessary improvements to avoid the above consequences.

2.4 Feeding Practices

High prevalence of malnutrition in children below 24 months in Kenya is mainly due to poor feeding practices and short duration of breastfeeding (UNICEF, 1998). Feeding practices are directly related to economic and social-cultural factors. In peri-urban areas such as Kangemi, most foods and fuel are purchased (Mukasa-Mwathi, 1990). Their availability at household level depends entirely on cash income (Mitzner *et al,* 1984).

The cost of available food and fuel determine the frequency, amount and variety of food cooked. It also determines the feasibility of boiling water and sanitizing utensils. Consequently the quality, quantity and hygiene of the food used in complementary feeding are affected. Therefore, the cost of food and fuel has an overall effect on energy and nutrient intake, safety of the food and nutrient loss from the body (Mitzner *et al,* 1984).

Level of education and knowledge about nutrition and health, beliefs and attitudes of the caretaker determine usage of the foods. A mother's knowledge or beliefs about nutritional content of foods and causal factors of disease may have a powerful effect on the child's well being. A mother with a formal education is more likely to utilize the resources available to her to sustain good health of the child (Smith, 2000). In Kenya, for example, mothers who are knowledgeable mix cereals and legumes and/or other foods to improve the nutrient concentration and quality of porridges. Use of fermented porridges for infants is however not practiced because of the belief that they cause stomach problems.

2.4.1 Breast Feeding

Exclusive breastfeeding for about six months ensures that the young infant receives maximum health and nutritional benefits from breast milk. By 2, 4 and 6 months of age, 28, 17 and 1% of the children respectively are exclusively breastfed. Exclusively breastfed infants are at a much lower risk of infection from diarrhea and acute respiratory infections than non-breastfed infants. However, exclusive breast-feeding is not common in Kenya. Liquids and solid foods are introduced earlier than the recommended age. The liquids offered are inferior to breast milk. They include plain or sugared water, juice, infant formula, porridge, and other milks and semi solids. Consumption of liquids and solids decreases an infant's intake of breast milk, which in turn reduces the mother's breast milk output since the production and release are modulated by the frequency, and intensity of suckling. Introduction of other foods at this age increases the risk of exposing the young infant to pathogens that cause illnesses, leading to decreased nutrient intake and death (KDHS, 1998; UNICEF, 1998; USAID, 1999).

Breast-feeding is critical where complementary foods are made of local staple foods with low energy and protein density. Continued breastfeeding up to 24 months, can supply half of the requirements in the second six months of life and one third of requirements in the second year of life. It ensures that the mother, who is unable to give her child dairy or animal products everyday, provides the minimum intake of good quality protein. She also needs to continue providing calcium and micronutrients to meet the child's requirements. Such feeding practice provides immunity as well as other factors that protect the child from illness. During illness, breastfeeding provides an important source of nutrients because its intake is not reduced in contrast with the intake of complementary foods that decline considerably. Breast-feeding also provides emotional and psychological comfort and allows the child to gradually be independent from their mother while adapting to the environment (Benbouzid and Benoist, 1999; ACC/SCN, 2000).

2.4.2 Complementary Feeding

Introduction of complementary foods is important at six months. At this age, the energy and nutrient needs of the child are high. The tongue, gastro-intestinal tract and the immune system are developed. The child can swallow, digest food, and respond to environmental pathogens (Sanghvi and Murray, 1997; Benbouzid and Benoist, 1999; Cameron and Hofvander, 1983; King and Burgess, 1993). Accordingly, other foods are required, along with sustained breast-feeding to promote growth, prevent stunting, and healthy development to an adult (Linkages, 1999).

Recommended complementary feeding requires a combination of strategies. These are maintaining frequent breastfeeding; and increased quantity of food, feeding frequency and energy density. Also the diet should be diversified to include micronutrient rich foods and embrace practices such as feeding during illness and good hygiene (Linkages, 1999). However, these may be limited by inadequate income and education.

Breast-feeding should be done before feeding of complementary food and on demand. Increase in the quantity and frequency should be done to ensure nutrient adequacy of foods (ACC/SCN, 1997). If a child is maintaining frequent average breastfeeding, he requires fewer nutrients than the Recommended Daily Allowances (Treche 1999, Allen and Gillipsie 2001).

The recommended daily feeding frequency is 2-3 times for the 6-8 month old, 3-4 times for the 9-11 month old and 4-5 times for the 12-24 month old. In addition to staple foods, fruits and vegetables should be taken on a daily basis as well as animal products. Fortified foods or staples when available, plus vitamin-mineral supplements and/or fortified foods can be used when animal products are not available. Both the mother and child should consume these types of foods (Linkages, 1999; King and Burgess, 1993).

Industrialized countries have shown that the best way to ensure that infants consume all essential nutrients is to provide culturally acceptable foods that are affordable and fortified with nutrients that are commonly missing in traditional diets. In these countries nutrient fortified cereals, are the first complementary foods to be introduced to infants followed by vegetables, fruits (fruit juices) and meat products. The progression allows for a balanced diet containing all nutrients to be achieved by the time the child is 8-9 months (Yeung, 1998).

Children born of HIV-infected mothers may not enjoy the benefits of breast-feeding if the mothers choose not to breast-feed. In an effort to prevent mother-to-child transmission of the virus, such mothers have the option of not breast-feeding if they can afford appropriate breast milk substitutes. If a mother takes the option of breast-feeding, exclusive breast-feeding should be limited to a period of six months only (Piwoz and Preble, 2000; USAID, 2001)

2.4.3 Child Feeding Practices in Kenya

In Kenya, exclusive breastfeeding is poorly practiced and supplementation of breast milk starts too early. By 3 and 5 months, 82 and 94% respectively of the children have received some form of food or liquid supplementation. However, those receiving appropriate complementary feeding at 6 months are 89 %, while 4% are already weaned, and 5% are fed on breast milk and fluids. The breastfeeding process is continued between 12 and 24 months when 5% and 67% are weaned respectively. The median duration reported is 21 months (KDHS, 1998; UNICEF, 1998)

Porridges constitute the highest proportion of foods frequently used for supplementation (KDHS, 1998). By 3 and 12 months, 25% and 75% receive it daily. Other foods introduced slowly into the diet include potatoes, bananas, fruits, vegetables and animal products depending on their availability. They are introduced with increasing age. Fruit juices are introduced starting at 2 months; animal products at 2-3 months; and potatoes, bananas and vegetables at 4-5 months (KDHS, 1998).

In Kangemi, where households depend entirely on cash for food and fuel purchases, prices may limit the amounts of food cooked and the feeding frequency (Mitzner *et al* 1984). Addition of animal protein and/or fortified foods may not be a common practice because they are often more expensive than plant foods (Allen and Gillipsie, 2001). As breast-feeding offers the cheapest source of animal protein, it is highly likely that porridge remains the cheapest and most preferred complementary food within this group. The porridges are mostly prepared once a day and kept at ambient temperature or warm in a food flask. The amounts prepared are normally enough for the child to feed on whenever s/he is hungry and/or other foods are unavailable. Therefore, it is important that the porridge preparation and handling methods be investigated to determine the quality of porridges, and review the existing educational approaches to ensure that the child maintains adequate nutrient intake.

2.5 Improving Nutrient Intake

Governments, international development agencies and non-governmental groups support a wide range of interventions to improve nutrient intake. The interventions are frequently based on locally available foods whether prepared at home or through large-scale production and marketing schemes (Dop *et al*, 1999). Mothers should be educated about appropriate complementary foods, feeding practices and hygienic handling of children foods (UNESCO, 1984). In Kenya, nutrition education supported by Ministry of Health, UNICEF, WHO and other development agencies takes place in Maternal and Child-care Health Centres (Clinics). Guidelines are available for use by the health workers. Mothers are advised on what foods to use in improving nutrient intake and child growth, including children born of HIV positive mothers (MOH, 1986; GOK, 1999). The guidelines used in the 1980s put emphasis on the content aspects, without recognizing the importance of quality aspects such as digestibility, availability of micronutrients and nutrient density from cereals and legumes (Benbouzid and Benoist, 1999). However, it is now widely recognized and recommended that some traditional methods of food processing such as germination and fermentation can improve nutrient concentration, digestibility and availability in cereals and legumes based foods used in complementary feeding (Lorri, 1993; Makokha *et al*, 2003; Mwiwa, 1995; FOA/WHO, 1995; Mbithi-Mwikya *et al*, 2000; Mensah and Sefah-Dedeh, 1991; Collaway, 1995). In

Kenya, fermentation is mainly used in making porridge for older children and adults, while germination or malting is used in the brewing industry (own observation).

2.5.1 Improving Energy Concentration

Studies have shown that use of germinated, malted or amylase rich flours (ARF) and/or fermentation allow extra flour solids to be added to porridge thus increasing nutrient concentration in porridges. Fermentation and/or small amounts (2-5%) of malted flour is required to enable increase flour solids and energy concentration between 2-3 times. The most effective way of improving energy concentration is the addition of ARF after fermentation and cooking (Tontisirin and Yamborisit, 1995; Akpapunam and Sefah-Dedeh, 1995; Lorri 1993, Mbithi-Mwikya *et al,* 2000; Mensah and Sefah Dedeh, 1991; Mbugua and Keya, 1992).

2.5.2 Improving Nutrient Availability

Soaking, germination and fermentation are reported to improve absorption and bioavailability of nutrients in porridges (Treche, 1999; KIRDI, 1999; Pamplona-Roger, 2001(1); Mbithi-Mwikya *et al,* 2000; FOA/WHO, 1995). Carbohydrate digestibility is also improved, and abdominal discomforts and flatulence are reduced by the hydrolysis of oligosaccharides. The bioavailability of iron, zinc, and calcium and protein availability is improved by the phytase activity (Mwiwa *et al*, 1996; Besancon 1999; Mbithi-Mwikya *et al,* 2000; FOA/WHO, 1995; Lorri, 1993). The inhibitory effect of tannins on mineral absorption and protein digestibility can be effectively reduced by fermentation and germination (Mbithi-Mwikya *et al*, 2000; FOA/WHO, 1995). In addition, physical removal of hulls can reduce tannin concentration (Tontisirin and Yamborisit, 1995; Mwakolo and Smartt, 1996). However, high-tannin cereals (brown sorghum and millet) may require long fermentation periods of more than 48 hours and/or germination for 72-144 hours in order to achieve high iron, zinc and calcium bioavailability, and protein digestibility. Soaking for about 12-24 hours already yields good results without fermentation. Addition of organic acids, especially vitamin C (ascorbic acid) and mango puree also results in significant improvement of minerals bioavailability in plant-based foods (Makokha *et al*, 2002 and 2003; FOA/WHO, 1995; Mbithi-Mwikya *et al,* 2000; Pamplona-Roger, 2001(2)). Calcium content can also be increased by addition of sesame flour, milk or sustained breast-feeding to provide lactose, which improves the absorption of calcium and phosphorus (Karuna et *al*, 1991; Sajilata *et al*, 2002)

2.5.3 Improving Protein Digestibility

Improving protein digestibility in legumes using soaking, germination and fermentation is not enough without cooking. These processes have minimal effects in reducing anti-nutritional effects of trypsin inhibitors and the toxicity of lectins that are heat stable. They maybe appropriate as pre-processing procedures and improvement of other anti-nutrients (FOA/WHO, 1995; Pamplona-Roger, 2001(2); Mbithi-Mwikya *et al,* 2000). Under normal conditions, raw legumes require two hours of cooking to inactivate them. Fermentation may reduce cooking time of legumes (FAO/WHO, 1995; Siegel and Fawcett, 1976). Other studies have shown that roasting, extrusion cooking at 140°C followed by 15 minute cooking inactivates them, while extrusion cooking below 140°C and fine milling, drum drying followed by the same duration of cooking does not. In as much as lectins can be inactivated by the same heat treatment as protease inhibitors, they may require more severe heat treatment (Mbugua and Keya, 1992). They have been reported to cause gastrointestinal disorders after consumption of flaked beans cooked for 15 minutes (Bourne, 1989).

2.5.4 Improving vitamin A Intake

It has been shown that vitamin A requirements can be met by consumption of yellow fruits and green leafy vegetables (IVACG, 1993; Kipkurui, 1998). In the process of adding Vitamin A. vitamin C is also availed to promote availability of minerals in the porridges (Mbithi-Mwikya *et al*, 2000; Badifu *et al*, 2000). Studies being carried out by Hagenimana *et al* (2001) on utilization of the orange-fleshed-potato show that the potato flour has potential for improving Vitamin A content in porridges.

2.6 Improved Porridges

Intervention studies in normal and hospitalized children with severe protein energy malnutrition showed that fermented porridges are effective in the control of diarrhea; improvement of catch-up-growth and recovery rates (Haggerty and Tomkins, 1987; Lorri, 1993; Mwiwa, 1995; Mwiwa *et al,* 1996). Children fed on porridge with amylase rich flour also showed improved growth (Tontisirin and Yamborisit, 1991).

Fortification in developed countries has provided a convenient and cheap alternative in improved nutrient intake. It ensures a balanced and adequate nutrient intake (Allen and Gillipsie, 2001), and is the reason for low incidence of deficiency diseases in the developed countries. However, efforts are required to ensure that it is accessible to the low-income groups.

It would be appropriate to promote technologies such as fermentation of porridges at home, and use of amylases or amylase rich flours (ARF). Germination or malting processes are however often associated with mycotoxin contamination, which require control to ensure microbiologically safe porridges. ARF production may also be more expensive than fermentation (FAO/WHO, 1995; Tontisirin, 1991; Treche, 1999; CAC, 1994). However, Tara *et al* (1991) found that mothers preferred ARFs because they shortened the time used in porridge preparation.

CHAPTER 3: METHODOLOGY

3.1 Study Setting and Population

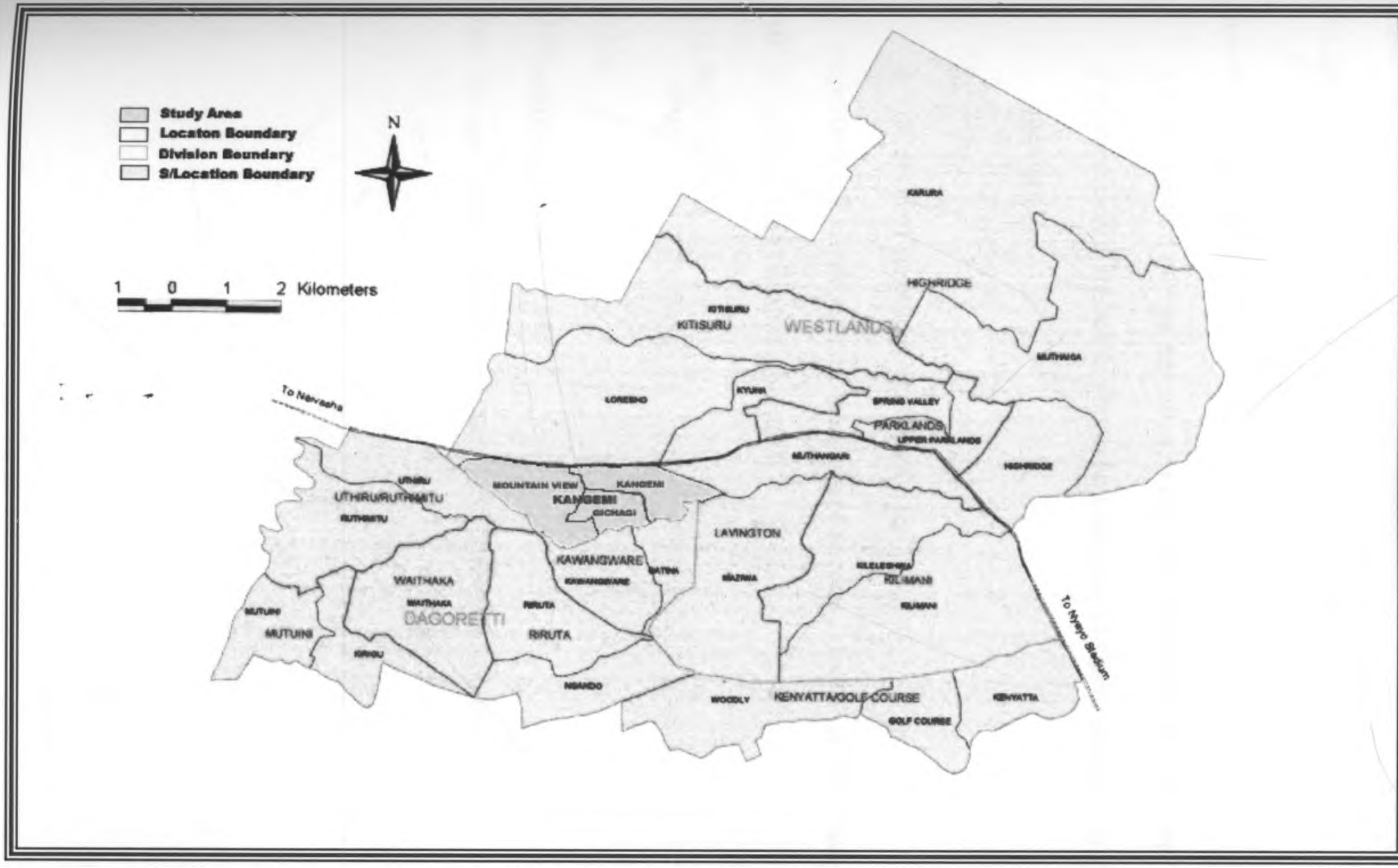
Kangemi is a location on the western outskirts of Nairobi in Westlands Division along the way to Naivaisha as seen in figure 1. It has a total population of 59,288 people concentrated within an area of 4.5 square km. It is divided into three sub-locations; Kangemi Central with a population of 32,396, Gichagi 14,942 and Mountain View 11,950 people (CBS 2001). It is divided into approximately 16 villages: ten in Kangemi Central, three in Gichagi, and three in Mountain View. Most villages are crowded, have poor infrastructure, environmental sanitation and water services. They are served with an open-air market, food-vending outlets (kiosks), shopping centres and, one public and several private mother and child health care centres (clinics).

The population in the 15 villages is characterized by low socio-economic status, while one village in Mountain View is of high socio-economic status. The people in the low-income area are mainly housed in wooden and iron sheet structures, with one family usually occupying one room. They are characterized by low level of education (the highest being secondary), low-level employment cadres, provision of unskilled labour, being engaged in informal activities and formal employment. Unlike the villages of the low socio-economic status, those of high socio-income status have big stone and tile-structured houses in clean, individual family secured compounds.

3.2 Study Design

A cross-sectional, descriptive and analytical study was conducted at the community level from 6th -28th March 2003 in Kangemi.

Figure 1: Map of Dagoretti and Westlands Divisions of Nairobi Province Showing the Study Area



3.3 Sample Size Determination

(i) Determination of Sample Size: N.

The sample was determined by the following formula (Fischer, 1999)

$$N = \frac{z^2pq}{d^2}$$

Where N = sample size

z = the standard normal deviation of the 95% confidence level = 1.96

p = proportion in the target population estimated to have characteristics being measured

q = 1-p

d = the level of statistical significance test

The proportion of children fed with complementary foods at six months is 90% (UNICEF 1998). Using the above formula:

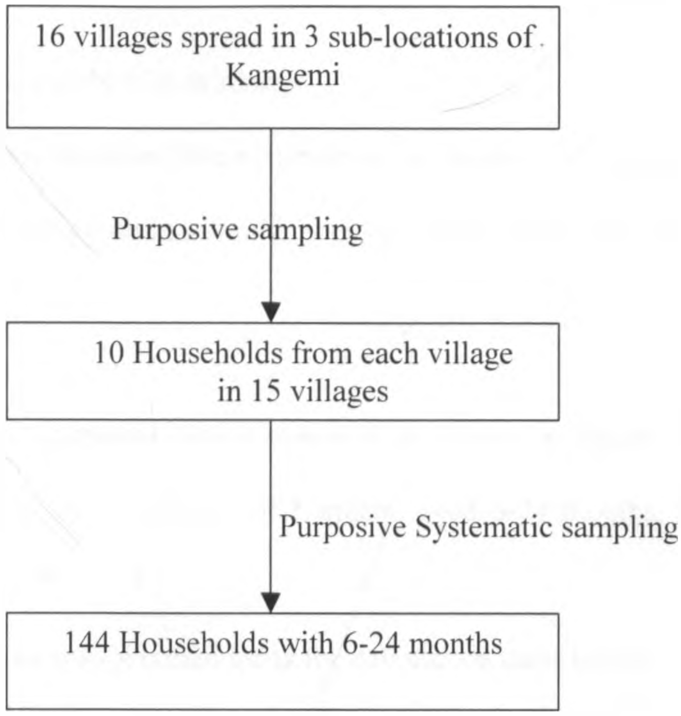
$$N = \frac{(1.96)^2(0.9)(0.1)}{(0.05)^2}$$

= 138

Add 5% attrition, = 138 +7=145

Therefore, the appropriate sample size N was 145 children and mothers.

Figure 2: Schematic Presentation of the Sampling Procedure



(ii) Determination of Sub-sample size: n for 24-hour recall.

n =20% of N=29 (Omwega 2002).

Therefore sub-sample size is approximately =30 children.

The sub-sample size was based on the fact that little variation occurs in diet and consumption patterns among children within this age group in a similar socio-economic group and setting.

3.4 Sampling Procedure

The sampling methods used were purposive and systematic as shown in figure 2. The sampling frame included all children in 15 villages of Kangemi aged 6-24 months, whose mothers consented to the interview.

The sample interval used for sampling was obtained using the calculation steps below:

(i) Estimated population size of 6-24 month olds

Proportion of children aged 6-24 months old in Nairobi is approximately 1.5% of total population (CBS, 2001). Therefore 1.5% of Kangemi population is 1.5(59288)/100=889 children.

(ii) Calculating sample interval

$$K = \frac{\text{Population size of 6-24 month old children}}{\text{Sample size}} = \frac{889}{145} = 6$$

The sampling methodology included 15 low socio-economic status villages from which 10 households each were visited for interview. The only high socio-economic status village was excluded from the study.

A centre was identified in each of the study villages. Using a spin of a pen, the direction followed for sampling was randomly determined from the centre. The first house was then determined by picking a random number from 1-6. Thereafter, every sixth house with a 6-24 month old child and the mother consenting to an interview was systematically visited. If no child aged 6-24 months old was found or consent was not given, the next immediate house with a child meeting the selection criteria was visited.

A sub-sample for the 24-hour recall was obtained by selecting every fifth and tenth qualifying house. A household qualified for a 24-hour recall interview if the child was fed on porridge within 24 hours to the time of the visit. If not, the next immediate house with a qualifying child was considered. The intervals and sequence for selecting qualifying houses were maintained until the required sample sizes were achieved in a village.

3.5 Survey Tools

The tools used in the survey included a pre-tested structured questionnaire and focus group discussion guidelines. The structured questionnaire was administered to the mothers during a single visit and two focus group discussions (appendix IV) were held to confirm the information obtained from the mothers.

3.6 Data Collection Procedures

3.6.1 Preliminary Activities

Before the survey, several activities were carried out. Approval of the study was sought by obtaining research permit. A preliminary visit to the study site was made to brief the area Chief. and the officer-in-charge of the Maternal and Child Care Clinics on the intention to carry out research and its purpose. The research area was mapped, questionnaires were prepared and equipment purchased.

3.6.2 Pilot study

A pilot study was carried out in Kawangware, a neighbouring area with a similar setting to Kangemi. It was used to pre-test the planned survey tools and methodology. It covered 15 mothers (10% sample size) and lasted for three days. It resulted in review and modification of the questionnaires and methodology. The sampling procedure was changed from purely purposive sampling to purposive and systematic, while the questionnaires were corrected to remove unnecessary questions.

3.6.3 Training of Research Assistants

Two research assistants were recruited and trained for three days in Kangemi. The first day covered briefing on the study objectives; familiarization with the study area, questionnaires and sampling procedures. The second day covered mock interviews using the pre-tested and corrected structured questionnaires in households as a group. The first two questionnaires provided a demonstration on carrying out an interview using structured questionnaires after which, each assistant interviewed two mothers in presence of others. On the third day, they interviewed three mothers each unaccompanied. Meetings were held on the second and third day to review the progress made and discuss problems experienced with the questionnaires.

Household data collection followed immediately after the training. The mothers interviewed during training were not included in the survey.

3.6.4 Household Data Collection

An interview was conducted at every sixth house using a structured questionnaire on socio-economic structures, complementary feeding practices, and hygiene and morbidity status (appendix I). However, an additional 24-hour recall structured questionnaire was administered on every fifth and tenth qualifying house.

a) Household Socio-economic Structure

Data collected included relationships in the household, sex, age, marital status, religion, tribe, level of education and occupation. It also covered source of income, fuel, water and food; material ownership within households; materials used for housing and rooms occupied by family.

b) Feeding Practices

Child feeding information included the knowledge and source of information on child feeding, breasting status, frequency and reasons for stopping breastfeeding. First foods to be introduced, reasons for introduction, age at introduction, methods of feeding and frequency of meal preparation in day for children were also sought. Food consumption patterns and frequency distribution of mothers and children using various foods were established. A three day-feeding frequency was also established and later used for validating information on food intake. The following additional data was collected on feeding practices in order to meet the study objectives.

Formulated Porridge Flours

The data on composition of porridge flours was collected to establish the number and types of cereals used in formulating porridge flours, treatments applied to component flours during preparation and who prepared them. Proportions of flour components and methods of porridge preparation were also established. Where the mother did not know the proportion of components in the mixture as required in question 40 (Appendix I), data was collected at the point of sale and/or from the miller (see section 3.6.5).

24-Hour Recall

The 24-hour recall data was collected on a sub-sample of 30 children to facilitate determination of the nutrient dietary intake from foods and the proportion contributed by the foods consumed. It was done using the 24-hour recall questionnaire (appendix II). It established the type of dish (foods or liquids) consumed, type and amounts of ingredients used in preparation and at consumption, and consumed by the child and frequency of feeding on the dishes within 24 hours to the interview.

The quantities of foods consumed or prepared were estimated using kitchen weighing scale, volumetric cups, jars and spoons (household measures). The quantities used were recorded in grams (weight) or millilitres (volume). Where the actual foods were not available, food models were shown to the mothers to enable them recall the size and number of units of food used in the food preparation. The food model size identified was thereafter weighed using household measures. Two readings were taken; each by a different person and an average of the two used in data analysis. Only the edible portion was taken into account incase a food had parts that were trimmed off in its preparation (Christakes 1984, King and Burgess 1993)

Focused Group Discussions

Two group discussions were carried out after the household data collection was complete. The purpose was to confirm the information obtained from the structured questionnaires. Focus Group Guidelines developed prior to the study were used to guide discussions (appendix IV). They lasted approximately one hour each. They focused on complementary feeding practices; porridges used in complementary feeding and their preparation methods. The groups composed of ten mothers each. The mothers were selected from those attending the child clinic at Maternal and Child-care Health Centre. The criteria used were that the mother should not have been visited or interviewed in the survey, had a child aged 6-24 months and was willing to participate in the focus group discussion after attending the clinic.

c) Hygiene Practices

The information sought on hygienic practices included handling practices of porridge and utensils, and the mothers' personal hygiene. Observations were made on the cleanliness of the child, utensils, house and the immediate environment. Information on illnesses was also sought.

d) Morbidity Status

Data obtained on the morbidity status of children included illnesses that occurred within two weeks to the day of the interview and their duration.

3.6.5 Data Collection at Point of Sale

Follow-up interviews were conducted at outlets selling branded porridge flours and millers whose ingredients and/or the mothers did not know proportions. This was done using the Mixed Flour Composition Questionnaire (appendix III). Incase of branded flours, labeling information was used to identify ingredients and pre-treatments done on the flours. Where ingredient labeling was not adequate, physical location and telephone contacts were used for further follow-up.

3.7 Data Analysis

The data collected at household level using the 24-hour recall in section 3.6.4 was analyzed for each type of food and ingredient used to give nutrient intake for each child in the sub-sample. Using food compositional tables West *et al* (1988) and Sehmi (1999), estimated daily calorific (energy), protein, iron, calcium and vitamin A intakes of children were calculated. Nutrient values for zinc were derived from Holland *et al* (1991) and Yomadji-outangar (1999). The nutrient values were expressed per 100g edible portions. Considering that a food with low moisture content has a higher concentration of nutrients than that with high moisture, a correction factor was used to reduce errors that would be introduced by using different compositional tables with varying moisture content for the same food. For example, the values for zinc from Holland *et al* (1991) compositional tables were corrected to correspond with moisture content of other nutrients derived from other compositional tables such as West *et al* (1988) for the same food (West *et al* 1988). Vitamin A units were changed from μg/100g β-carotene to μg/100g retinol equivalents (μg RE) by dividing the β-carotene values by 6 (μg/100g β-carotene/6=μg/100g retinol equivalents)

3.7.1 Calculating Nutrient Intake

$$X = a \times \frac{b}{100} \times c$$

Where X[1]=Amount of nutrient in a given weight of food consumed

a= Weight of nutrient in 100g of food ingredient used, derived from compositional tables based on specific moisture content. Correcting for moisture,

$a^2 = a + a\,(f)$

f = Correction factor= $\frac{(g-h)}{100}$

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[1] **X** denotes the total sum per nutrient derived from each food ingredient used in the food preparation.
[2] Nutrient content corrected for moisture content to correspond of West *et al* (1988) or Sehmi (1999).

g = Moisture of food at which zinc was derived in Holland et al (1991)

h = Moisture of same food at which other nutrient values were derived according to West *et al* (1988) or Sehmi (1999)

b= Weight of edible portion (EP) of food ingredient used. Where,

b^3=Weight of whole food ingredient x $\frac{\% EP}{100}$

c=Conversion factor = $\frac{\text{Weight of raw food}}{\text{Weight of cooked food}}$ or

Estimates for cooking conversion factors calculated using the same formula in King and Burgess (1993)

3.7.2 Calculating Nutrient Intake from Breast Milk

The volumes used were based on daily breast milk intake of 6-24 month old children. They were derived from frequency of breast-feeding and categorised as follows: 5-7, 8-11 and more than 11 times per day as low, average, and high breastfeeding levels respectively. According to Allen and Lindsay (2001) and Treche (1999), the volumes of intake (low, average, and high) vary with age in months as follows: 6-8; 350, 666 and 982 ml, 9-11; 253, 611and 696 ml, 12-24; 145, 558, and 971 ml respectively. The nutrient intake calculations were based on breast milk composition according to Pamplona-Roger (2001 (1)). Thus;

$X = a \times \frac{b}{100}$ where,

a= Weight of nutrient in 100mls of breast milk ,

b= Volume of breast milk intake by child.

Statistical Package for Social Scientists (SPSS) was used to process all data from the survey including nutrient intake. The data was analysed using descriptive statistics such as frequency

[3]Edible portion was calculated for foods that had an inedible portion. EP was obtained from the compositional tables

distributions, cross tabulations, means, standard deviations, correlations and significance tests. This covered distribution of households according to population characteristics, feeding practices, complementary foods and types of porridge used, consumption levels and patterns by age, mean nutrient intake and, its variation with age and socio-economic characteristics. The significant difference in adequacy of nutrients and recommended dietary allowances were also determined.

3.7.3 Calculating Proportion of Nutrient Adequacy of Porridges

The proportion of nutrients contributed by porridge and breast milk in 24 hours (per day) based on the amount of nutrient calculated above using the following formula;

$$\% \text{ RDA} = \frac{\text{Nutrient consumed in 24 hours}}{\text{RDA for nutrient}} \times 100.$$

Therefore,

Nutrient Adequacy of Porridge=%RDA from Porridge + %RDA from breast milk.

The WHO (1998) Recommended Dietary Allowance (RDA) values for developing countries were used (Lutter and Kathryn, 2003; Brown 2000) as basis for determining adequacy of nutrient intake from porridges.

CHAPTER 4: RESULTS

4.1 Population Characteristics

4.1.1 Demographic and Socio-economic

Households

Table 2 shows that most households studied in Kangemi were from the Luhya and Kikuyu ethnic groups. They (82%) lived in wooden and/or iron sheets housing structures. They had a mean household population density of 4±1 persons per room. Many (60%) had upper primary level of education. Further analysis showed that level of education had a significant effect on household population density ($p<0.05$).

Most households' source of income was salaried employment (62.9%) and micro (small) scale business (35.4%). Although, the household heads sought employment out of the home, they were mainly involved in informal (freelance) activities (60.5%). These included providing casual labour, trading, plumbing, welding, electrician, mechanics and masonry. Low cadre jobs (37%) included security guards, gardeners, waiters, cooks, clerks and drivers. Others were not involved in any income generating activity. Most food (96.6%) for the child was purchased. Kerosene was the main fuel used for cooking at 86.6% and lighting at 61.3%. Although, electricity was available, only 44.7% used it for lighting. The studied households also owned basic items such as radio and/or seats (68.6%), while the better-off families owned a television and/or telephone (31.4%).

Mothers

Table 2 shows that mothers were aged 17-39 years with a mean of 25.2 ±4.3 years. Most of them were housewives with upper primary level of education and were occupied at home. Other mothers carried out informal activities such as trading, hairdressing and tailoring.

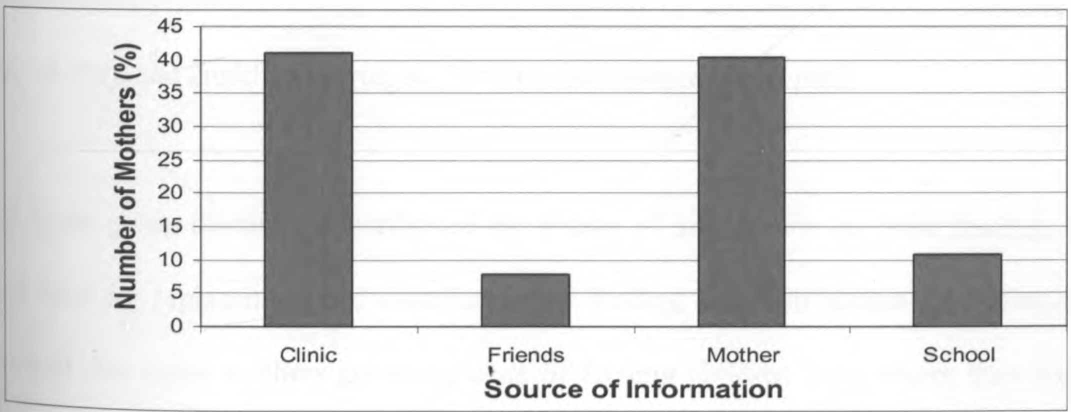
Table 2: Demographic Characteristic of the Mothers in Kangemi

Characteristic	Percent %
Age of mother (years): n=138	
<20	12.3
21-35	86.3
36-40	1.4
Tribe: n=142	
Luhya	44.3
Kikuyu	31
Others	24.7
Marital status: n=140	
single	11.4
Married	86.4
Separated	2.1

Table 3: Socio- economic Characteristic of the Mothers in Kangemi

Characteristic	Percent %
Level of Education: n=137	
Lower primary	0.7
Upper primary	51.8
Secondary incomplete	21.2
Secondary complete	23.4
Post secondary	2.9
Occupation : n=138	
Housewife	66.7
Informal activities	15.9
Low cadre jobs	9.0
Student	2.9
Unemployed	6.5

Figure 3: Distribution of Mothers by Source of Information on Child Feeding.



They were also employed in low cadre jobs as house helps, cleaners, messengers, typists. Further analysis showed that 57% mothers with secondary school education compared to 26% of those with upper primary education had an occupation out of the home.

Children

The mean age of 144 children studied was 13.9±5.6 months. Many of them were between 13-24 months old (55.6%), followed by the 6-12 month olds (44.4%).

4.1.2 Source of Nutrition Information

Most (98%) mothers interviewed took their children to various Maternal and Child Health Care Centres (clinics) within and outside Kangemi for health and nutrition services. Kangemi Health Centre had the highest attendance of 61%. Figure 3 shows that many young mothers relied more on clinics and their mothers for general information on child feeding than formal education. However, it was found that specific information on foods used to replace breast-milk by non-breastfeeding and/or HIV positive mothers was obtained from radio (75%) and was limited to 22.5% (n=41) of study population. They believed that cow's milk (75.5%), complementary foods (12.3%), foods recommended by the doctor (4.9%), expressed breast milk (4.9%), and enriched porridges (2.4%) could replace breast milk.

The focus group discussions confirmed the source of information on child feeding, types of food used for replacement and complementary feeding and their source. In addition, it was revealed that some mothers got experience of feeding children from where they worked as house-helps.

4.2 Complementary Foods

Among 144 mothers studied, 6.5% introduced complementary foods as early as two days after birth, while 0.7% introduced them as late as nine months old. There was a significant difference in age at which mothers with different levels of education and household sizes introduced first foods ($p<0.005$). The most common first food introduced was porridge (59.1%). Other preferred foods included fruit juices, cow's milk, and potato based food mixes respectively. By four months, 87.7% children were receiving complementary foods, while at six months only 2.8% were yet to be introduced. The peak period for introduction was at four months (36%). Most (82.5%) mothers introduced foods to children below 4 months old because they felt their children were not getting satisfied on breast milk alone. This was found to apply even at two weeks. The choice of foods used was determined by a mother's perception of nutritious, balanced, and high-energy foods that were light on the stomach (44.6%), its affordability (33.5%) and advice received from clinic and friends (18.6%).

Table 4 shows that the children in Kangemi were fed on a wide variety of foods. Most starchy foods, milk and fruits were introduced at a mean age of two months. Vegetables soups, commercial drinks and, plain legumes were introduced at three months old except for those who fed on porridges. Animal proteins, other than cow's milk were introduced late into the diet at six months.

Table 5 shows that porridges, *ugali*, potatoes and rice were the most preferred foods used for complementary feeding. Potatoes were used singly or in combination with milk, bananas, carrots, pumpkin and/ or spinach, while *ugali* and rice were accompanied with vegetables, legumes, meat, fish or their soups, and/or milk. In as much as a few mothers used animal proteins and vegetables, rarely were they minced or pureed. Many times, they used the soups

Table 4: Type of Complementary Foods used and Mean Age of Introduction

Food	Age in months	Food	Age in months
Starchy foods		**Vegetables**	
Porridge	2	Tomato	3
Ugali	3	Carrots	2
Potato	3	Kale soup (*Sukuma*)	3
Rice	2	Cabbage	3
Bananas	2	Spinach	3
Bread	3	Pumpkin	2
Mandazi	3	Night shade (*Managu*)	3
Chapatti	4	Cowpeas	2
Chips	4	Amaranth	3
Cerelac	2	Pumpkin leaves	3
Weetabix	2	**Fruits**	
Spaghetti	3	Pawpaw	2
Protein Foods		Ripe banana	2
Milk	2	Orange	2
Egg	6	Mango	2
Meat	6	Water melon	2
Meat soup	7	Passion fruit	2
Fish	9	Pineapple	2
Fish soup	7	Avocado	2
Liver	6	**Commercial drinks**	
Chicken	6	*Quencher*	2
Beans	3	*Lucozade*	3
Green grams (*Ndengu*)	3	*Ribena*	2

Common name in italics

Table 5: Distribution of Mothers by Type of Complementary Food on Day of Interview

Food	Proportion of Mothers (%)	Food	Proportion of Mothers (%)
Starchy foods		**Vegetables**	
Porridge	85.4	Tomato	77.8
Ugali	73.6	Kale (*Sukuma*)	25.0
Potato	61.0	Carrots	23.6
Rice	59.0	Cabbage	17.4
Bananas	29.0	Pumpkin (*Malenge*)	10.4
Bread	25.0	Spinach	11.8
Mandazi	18.1	Cowpeas (*Mkunde*)	2.8
Chapatti	4.9	Night shade (*Managu*)	1.4
Chips	4.2	Pumpkin leaves	1.4
Weetabix	4.2	Amaranth (*Terere*)	0.7
Spaghetti	2.1		
Sweet potato	1.4		
Protein Foods		**Fruits**	
Milk	60.4	Pawpaw	12.5
Beans	27.7	Ripe banana	16.7
Meat	18.1	Orange	14.6
Fish	15.3	Mango	9.0
Fish soup	14.6	Avocado	7.6
Green grams *(Ndengu)*	14.6	Passion fruit	4.9
Meat soup	13.2	Water melon	4.2
Egg	4.2	Pineapple	0.7
Peas	2.1	Pear	0.7
Liver	1.4		
Chicken	0.7		

Common names in italics

to accompany the rice, potatoes and *ugali*. The fruits were consumed as snacks singly or in combination.

Most (82.4%) children were fed on the above complementary foods at a mean frequency of 4±1 times a day. The consumption of vegetables, fruits and meat was low. A three-day recall revealed that children received vegetables twice, while meat and fruits were received once in three days. In addition, about 65.3% of the children breastfed more than 8 times a day, 13.8% 3-7 times a day and 20% did not breast feed. Approximately 43.3 % of the non-breastfed children (n=30) were given porridge in place of breast-milk.

The focus group discussions confirmed the type of foods commonly used for complementary feeding, why they were introduced and the total number of feeds (complementary and breast) given per day. They also confirmed the reasons for the choice of the foods and the age at which they were introduced.

4.3 Types of Flour Used in Porridges

Table 6 shows fifty varieties of porridge flours used for complementary feeding within the population. These varieties were categorized broadly into two; single and composite (mixed) flours. Millet and beans were the most commonly used cereal and legume. The number of flour ingredients (as number of cereals and legumes) ranged from 2-9 in a mixture as shown in Table 7. Amongst the commonly used composite flours, the cereal/legume mixture of porridge flours contained oil-seeds (groundnut and soybean). Composite flours were perceived to be nutritious, balanced and required no addition of milk. The focus group

Table 6: List of Porridge Flour Varieties According to their Type and Composition

Type of Flour	Type of flour continued....
Single cereal flour Maize Millet **Composite flours** **1. Cereal composites** Millet/sorghum Maize/millet Millet/bulrush Maize/ millet /sorghum Millet/sorghum/cassava Maize/millet/ cassava Millet/maize/sorghum/cassava Millet/sorghum/bulrush **2. Cereal/legume composites**: **a. Cereal/non-oil seed legume based** Maize/millet/sorghum/bean Millet/maize/sorghum/bulrush/bean Millet/sorghum/cassava/beans Maize/ millet /rice/green gram Maize/sorghum/*njahi*/bean Baby porridge **b. Cereal/oilseed legume based** Millet/beans/groundnuts Maize/millet/sorghum/groundnuts Maize/millet/sorghum/beans/groundnuts Maize/millet/sorghum /green grams/groundnuts Millet/sorghum /groundnuts Maize/millet/soy bean Maize/sorghum /soy bean Millet/green gram/beans/soybean Millet/sorghum/ green gram / soy bean Maize/millet/sorghum/bean/ soy bean Maize/millet/sorghum/wheat/ soy bean Millet/sorghum /groundnuts /soy bean	**c. Cereal/oilseed legume based** Maize/millet/sorghum/bean /groundnut/soy bean Maize/millet/sorghum/bean /groundnut /soy bean Maize/millet/sorghum/bean / groundnut/ soy bean Maize/millet/sorghum/green gram / groundnut /soy bean Maize/millet/sorghum/green gram/bean /groundnut/soy bean Maize/millet/sorghum/cassava/peas /*njahi*/green gram/bean/groundnut /soy bean Maize/millet/sorghum/bulrush /green gram/bean/groundnut/soy bean Maize/millet/sorghum/rice/groundnut /sesame seed Millet/sorghum/bean/ groundnut /sesame seed **d. Cereal / legume/or Dagaa based** Millet/groundnut/bean/*dagaa* Maize/millet/green gram/bean /groundnut/*dagaa* Millet/sorghum/soy bean/dagaa Millet/bean/soy bean/*dagaa* Maize/ Millet/sorghum / green gram/soy bean/*dagaa* Maize/millet/ bean/groundnut/*dagaa* Maize/sorghum/cassava/green gram / groundnut/*dagaa* Millet/rice/bulrush/ peas/ bean /groundnut/*dagaa* Maize/millet/sorghum/cassava/rice /green gram/bean/groundnut/*dagaa* Maize/millet/ bean/ *dagaa* Sorghum/ bean/ *dagaa* Maize/millet/rice/bulrush / green gram/bean /*dagaa* Maize/millet/sorghum/*dagaa*

Table 7: Distribution of Mothers by Type of Porridge Flours Used on Day of Interview

Type of Flour (n=123)	Proportion of Mothers (%)
Single cereal (n=35)	
Millet	22
Maize	6.5
Composites	
1. Cereal (n=37)	
Two-cereal	8.9
Three-cereal	13.8
Two-cereal/1 root	3.3
Three-cereal/1root	4.1
2. Cereal/legumes	
a. Cereal/legume non-oilseed (n=11)	
Two-cereal/two-legume	0.8
Three-cereal/1legume	3.3
Baby porridge (defatted)	5.7
b. Cereal/oilseed legume (n=24)	
One-cereal/two-legume (1oil)	0.8
One-cereal/three-legume (1oil)	0.8
Two-cereal/one-legume	1.6
Two-cereal/three-legume (2oil)	2.4
Three-cereal /two-legume (1oil)	3.3
Three-cereal/one-legume	0.8
Three-cereal/two-legume (1oil)	1.6
Three-cereal/three-legume (2oil)	0.8
Three-cereal/three-legume (1oil)	1.6
Four-cereal/one-legume	1.6
Four-cereal/two-legume	0.8
Four-cereal/three-legume (1oil)	0.8
Four-cereal/three-legume (2oil)	0.8
Four-cereal/five-legume (3oil)	1.6
c. Cereal/legume /dagaa (n=15)	
One-cereal/one legume/*dagaa*	0.8
One-cereal/ two-legume (1oil)/*dagaa*	1.6
Two-cereal/one-legume / *dagaa*	1.6
Two-cereal/two-legume/*dagaa*	1.6
Two-cereal/three-legume/*dagaa*	0.8
Three-cereal/two-legume (1oil)/*dagaa*	1.6
Three-cereal/three-legume/*dagaa*	0.8
Four-cereal/two-legume (1oil)/*dagaa*	0.8
Five-cereal/three legume (1oil)/*dagaa*	0.8
Three-cereal/*dagaa*	1.6

(oil) number of oilseed legumes in the cereal legume mix.

discussions confirmed the porridge flour ingredients used and reasons for preferring composite flours.

The flours were sourced from three categories of outlets. These were characterized by the mode of dispensing (vending) grains or flours. Most mothers preferred to select grains or flours at the outlet for subsequent milling and/or mixing as shown in Table 8. Although some mothers bought ready packaged and branded flours from supermarkets, about half were single cereal flours. Further analysis showed that there was a significant correlation between mother's levels of education and, household population density (household size) and source of income, and cultural backgrounds with preference and use of porridge flours among households ($p<0.05$).

It was revealed by 123 mothers that porridge flours were prepared from dry-milled-raw (unprocessed) grains. Only 6.5% of these mothers reported using pre-processed flours. These included flours from Proctor and Allan *Baby Porridge* (4.9%), Kirinyaga Flour Millers (0.8%) and a mother (0.8%), who roasted their legumes. A follow-up with the proprietor of Kirinyaga Millers showed that roasting of legumes started when they became aware that legumes could be toxic if not adequately cooked. It was also reported that they add orange-fleshed sweet potatoes to the porridge flours.

The focus group discussions confirmed the type of flours and methods used for porridge preparation. It was also confirmed that grain pre-treatments involved only cleaning and drying before milling, and mothers preferred self-selection outlets. However, "sour porridge" flour found in the shops and fermented porridge is not given to children. It is believed to cause heartburn. In addition, health workers did not recommend it for the same reason.

Table 8: Distribution of Mothers (%) By Source and Type of Porridge Flours

Type of Flour	Source of Flour		
	Open-air market (Dispensing of grains)	Supermarket (Branded-packaged flour)	Cereal shops (Dispensing of flour)
Single cereal	5.7	20.3	2.4
Cereal composite	11.4	5.7	13.0
Cereal/non-oil seed legume	2.4	0.8	2.4
Cereal/oil seed legume	1.6	1.6	0.8
Cereal/mixed legume	9.8	4.1	0.8
Cereal/oilseed/*dagaa*	2.4	_	2.4
Cereal/non-oil/*dagaa*	6.5	_	0.8
Baby porridge	_	4.9	_
Total	39.8	37.4	22.8

( ) Dispensing mode

Table 9: Range of Ingredient Proportions (%) in the Flour Mix

Type of Flour (n=43)	Total Cereal (%)	Total legume (%)	Small Fish (omena/dagaa) (%)	Cassava (%)
-4 IngredientS Composite				
One-cereal/two-legume	30-66.7	33.3-60	10	_
Two-cereal/one-legume	66.7-72	15-33.3	2.9-7.7	_
Three-cereal/one-legume	75-80	20-25	_	25.0
Three-cereal/*dagaa*	90.0		10.0	
5-6 Ingredient Composite				
Two cereal /three legume	50-71	23-50	8.3	_
Three-cereal/two-legume	50-60	33-50	_	_
Three-cereal/two-legume	56-80	16-40	4-6.3	18.8-24
Three-cereal/three-legume	48-60	40-50	3.2	_
Four-cereal/one-legume	80-87	12.5-20	_	_
Four-cereal/two-legume	49-68.7	31.8-46	4.6	15.3
Four-cereal/*dagaa*	92.3		7.7	23.1
-9 Ingredient Composite				
Four-cereal/three-legume	47-86	14.3-46	3-7.5	7.7-8.8
Four-cereal/five-legume	40-44	55.6-60		10.0
Mean	65.6±14.9	34.2±12.5	6.2±2.4	16.5±7.1

± Standard deviation

Table 10: The Calculated Energy and Protein Content in the Flour Formulations Used for Porridge

Type of Porridge Flour	Energy (kcal) per 100g flour	Protein (g) per 100g flour
Single cereal	321±4.7	5.8±0.8
Cereal composite	329±1.8	7±0.8
Cereal/oilseed legume composite	365±5	11±0.3
Cereal/non oilseed legume composite	329	9
Cereal/mixed legume composite	363	17
Cereal/oilseed legume *dagaa*	372±25	18±3
Cereal/non-oilseed legume /*dagaa*	342	18
Cereal/ *dagaa*	329	11
Baby porridge	400	14

± Standard Deviation

Table 11: Percentages of Children Fed on Porridges by Type of Flour and Fortification Ingredients

Type of Porridge Flour	Fortifying Ingredients								
	Nothing	Milk only	Sugar only	Milk and sugar	Milk, margarine and sugar	Margarine and sugar	Margarine and milk	Milk and egg	Sugar and fruit juice
Single cereal	4.1	0.8	4.9	9.8	4.9	4.1	_	_	_
Cereal composite	1.6	0.8	3.3	8.9	8.1	3.3	2.4	_	1.6
Cereal/non- oil legume	1.6	0.8	_	1.6	0.8	_	0.8	_	_
Cereal/oil seed legume	0.8	_	_	1.6	1.6	_	_	_	_
Cereal/mixed legume	1.6	_	1.6	4.9	3.3	0.8	1.6	0.8	_
Cereal/oilseed legume/*dagaa*	_	_	_	2.4	1.6	0.8	_	_	_
Cereal/non oil legume/*dagaa*	_	0.8	0.8	1.6	3.2	0.8	_	_	_
Baby porridge	_	_	1.6	1.6	1.6	_	_	_	_
Total %	9.8	3.2	12.2	32.6	25.2	9.8	4.8	0.8	1.6

Table 9 shows proportions in which grains and flours selected from dispensing outlets were mixed. The proportions of cereals, legumes, and *dagaa* in cereal-legume and cereal-*dagaa* composite flours varied widely among mothers (n=43). Cereal and cereal-legume composites, depending on the type, were mixed in equal proportions most of the time. Where this did not apply, millet (cereal) proportions were higher. Table 10 shows the implied energy and protein content that 100 grams of porridge flours in Table 9 could supply. High values were observed in the composites, which contained cereal-oilseed legume-*dagaa* ingredients. Education of mother, occupation of household head and household size also had a significant ($p<0.05$) correlation with legume proportions added in flour mixes

4.4 Preparation Methods

Porridge preparation by most mothers included addition of sugar (81%), milk (67%), and margarine (40%). Egg and fruit juice were rarely added. These ingredients were used in combination as shown in Table 11. Water in the porridge comprised 90% of the total volume, except where milk was added. The milk replaced water at a mean rate of 40±23%. The 24-hour recall responses revealed that milk, sugar and margarine were added at a mean rate of 40±23%, 2.5±1.6g and 3.5±2.4g per 100 ml respectively. The porridges were cooked for 5-60 minutes with a mean of 24.9±11.35 minutes. There was no indication of sieving the porridge flour or slurry to reduce fibre. Further analysis of data showed education was significantly correlated with the amount of milk, sugar and *omena* added to porridge ($p<0.05$). Different types of porridges used in porridge making had no significant relationship with cooking time ($p>0.005$).

Table 12: Distribution (%) of Children by Age and Frequency of Porridge Consumption

Age in Months of Index Child	Distribution of Children by Number of Times Porridge Taken per Day (n=123)			
	1	2	3	>4
6-12	4.1	17.1	13.0	11.4
13-24	7.3	17.9	13.8	15.4
Total (%)	11.4	35.0	26.8	26.8

Table 13: Flour Solids Intake in Form of Porridge in 24 hours

Age Group (Months)	Mean Number of Servings	Mean Volume (ml) Per Time of Serving	Mean Total Volume (ml) Per Day	Mean Flour Solids (g)
6-8 (n=7)	2	149±65	326±155	33±16
9-11(n=3)	2	107±40	387±130	43±21
12-24 (n=20)	2	270±58	544±194	55±20

± Standard Deviation

4.5 Consumption levels and Patterns

The total feeding frequency on non-breast milk complementary foods was 4±1times per day. Porridge was the most consumed complementary food at a mean frequency of 3 ±1 times per day. Focus group discussions confirmed that most mothers fed their children twice a day on porridge as shown in Table 12. Porridge was mainly taken as a snack two times a day. As a meal, it was usually served for breakfast and rarely for lunch or dinner. The consumption patterns varied with age, just like the mean consumed volumes and the flour solids shown in Table 13. More information revealed that more of the 6-12 month old children took porridge as a meal (74%) compared to the 13-24 month olds who took it as a snack (95%). In addition breast milk intake among them varied with age at a mean of 352, 492, and 613 ml per day among the 6-8, 9-11 and 12-24 month old children respectively. There was a significance difference in frequency of porridge intake among children of mothers with different education levels, household source of income, and breastfeeding status of children ($p<0.05$).

4.6 Dietary Nutrient Intake

4.6.1 Contribution to Daily Dietary Intake

All types of complementary feeds consumed in a day contributed to the daily dietary intake comprised of porridge, other foods and breast milk. Table 14 shows the contribution made by each complementary feed to the daily dietary intake (DDI). Further analysis showed that the DDI met the recommended daily allowances (RDA) of all children, except for iron among children aged 6-8 months old. Porridge provided a significant proportion ($P<0.05$) of protein, calcium, iron and zinc to the DDI among all children. Other foods provided all the requirements for vitamin A among all children, as well as breast milk to the 6-8 month old children. They also had major contribution to energy among the 9-24 month olds. Breast milk contributed the highest proportion of energy among the 6-8 month old children.

Table 14: Daily Nutrient Intake Derived from Complementary Feeding

Nutrient	**Nutrient Intake by Age**								
	6-8 Months			**9-11 Months**			**12-24 Months**		
	Porridge	Other Foods	From Breast Milk	Porridge	Other Foods	From Breast Milk	Porridge	Other Foods	From Breast Milk
Energy (kcal)	334	307	427	369	605	342	352	751	245
Protein (g)	8.3	5.9	6.3	9.6	17	5.1	9.4	20.6	3.6
Calcium (mg)	253	144	197	292	308	158	304	317	114
Iron (mg)	6.5	3.5	0.2	14.3	5.4	0.1	20.4	4.2	0.1
Zinc (mg)	1.2	1.1	1.0	3.4	2.7	0.8	2.1	3	0.6
Vitamin A (μ RE)	37	454	392	116	856	314	75	446	226

Table 15: **Nutrient Content Derived From Flour Solids and Porridges Consumed in 24 Hours by 6-8 Month Old Children**

Type of mixture	Nutrient Content Contributed by Flour Solids in porridges Consumed in 24 hours (per day)						Nutrient Content Contributed by Porridges Consumed in 24 hours (per day)					
	Energy (kcal)	Protein (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Vitamin A (µg RE)	Energy (kcal)	Protein (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Vitamin A (ug RE)
Single	12.8	0.2	12.6	2.2	0.1	0.1	60	2.5	99.6	2.2	0.4	34
Cereal composite	125	2.7	47	8.6	0.9	0.9	360	8.0	251	8.6	1.4	94
Cereal/non-oilseed legume	115	3.8.7	40	8.4	0.8	0.6	580	15.9	527	8.4	1.3	14
Cereal/oilseed/ legume/dagga	172	3.2	119	1.9	1.3	0.4	439	8.7	122	1.9	2.1	9
Cereal/dagga	99	3.4	122	9.5	0.5	0.6	215	7.0	268	9.5	0.9	13
Total mean	108	3.4	65	6.5	0.8	0.6	334	8.5	253	6.5	1.3	37

Table 16: Nutrient Content Derived From Flour Solids and Porridges Consumed in 24 Hours by 9-11 Month Old Children

Type of Mixture	Nutrient Content Contributed by Flour Solids in Porridges Consumed in 24 Hours (per day)						Nutrient Content Contributed by Porridges Consumed in 24 Hours (per day)					
	Energy (kcal)	Protein (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Vitamin A (μRE)	Energy (kcal)	Protein (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Vitamin A (μRE)
Single cereal	192	3.4	189	32.4	1.9	1.0	477	7.4	343	32.4	2.3	2.5
Cereal composite	65	1.3	32	5.5	0.5	0.0	226	6.9	242	5.5	1.1	0.4
Baby porridge	200	7.0	-	5.1	6.0	1.2	405	14.6	290	5.1	6.8	345
Total mean	152	3.9	74	14.3	2.8	0.8	369	9.6	291	14.3	3.4	116

Table 17: Nutrient Content derived from Flour solids and Porridges Consumed in 24 Hours by 12-24 Month Old Children

Type of Mixture	Nutrient Content Contributed by Flour Solids in Porridges Consumed in 24 Hours (per day)						Nutrient Content Contributed by Porridges Consumed in 24 Hours (per day)					
	Energy (kcal)	Protein (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Vitamin A (ug RE)	Energy (kcal)	Protein (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Vitamin A (ug RE)
Single cereal	203	3.6	184	32	2.0	2.4	412	8.5	370	32	2.5	110
Cereal composite	152	3.1	67	12.5	1.1	1.3	269	6.8	209	12.5	1.5	55
Cereal/non-oilseed legume	209	6.3	217	23	2.2	1.9	430	13.3	486	23	2.9	76
Cereal/mixed legume	163	7.8	47	6.9	1.2	1.6	268	11.4	185	6.9	1.6	40
Cereal/oilseed legume/dagga	368	21	203	4.3	2.9	1.6	462	21	203	4.3	2.9	1.6
cereal/non-oilseed legume/ dagga	164	8.7	148	7.3	1.3	2.8	268	12.5	293	7.3	1.7	42
Total mean	190	5.1	139	20	1.7	1.9	352	9.4	304	20.4	2.1	75

Tables 15, 16 and 17 show comparisons of daily nutrient intake derived from porridge flour solids only with porridges to which other foods were added. They reveal that addition of other foods during porridge preparation improves nutrient content of porridges. Thus, the enriched porridges provided a higher nutrient content per day in each age group than those to which nothing was added. All nutrients increased except for iron. There was significant ($p<0.05$) improvement in energy, protein, calcium, and zinc. However, there was no significant improvement in vitamin A intake ($p>0.05$), while iron had nil.

4.6.2 Contribution of Porridge to RDA

Figures 4, 5 and 6; show that porridge met 85-100% protein requirements all children, 50-60 % calcium, over 65% iron, and zinc requirements for 9-24 month old children. It provided less than 30% of vitamin A requirements among all children, 30-50% iron, zinc, and calcium requirements among 6-8, and energy requirements among 9-24 months old children. In addition, breast milk provided extra nutrients exceeding requirements for protein among all age groups, and energy and vitamin A among 6-11 month old children. It covered the deficiencies in porridge intake and met the requirements for calcium among 6-11, and energy among the 9-11, zinc among 12-24 month old children respectively. However, they provided 32 % iron, 80% zinc among the 6-8, 54-84% energy, vitamin A and calcium among the 12-24 month old children respectively. There was no significant difference ($p>0.05$) in the proportion of calcium intake among the 6-11, energy among 9-11 and zinc among the 12-24 month age groups compared to the RDA requirements. Level of education was significantly correlated ($p<0.05$) with energy, protein, calcium and vitamin A intake, while source of income and household size were correlated with energy and protein intake respectively.

Figure 4: Proportion of Nutrients Contributed by Porridge and Breast Milk to the Recommended Daily Allowances (RDA) for 6-8 Month Old Children

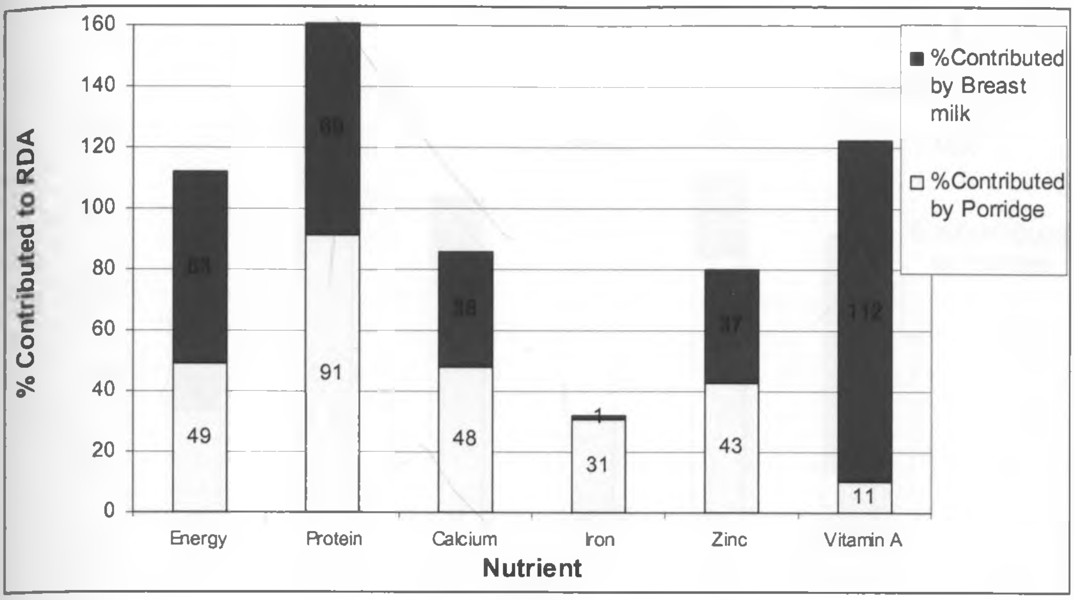


Figure 5: Proportion of Nutrients Contributed by Porridge and Breast Milk to the Recommended Daily Allowances (RDA) for 9-11Month Old Children

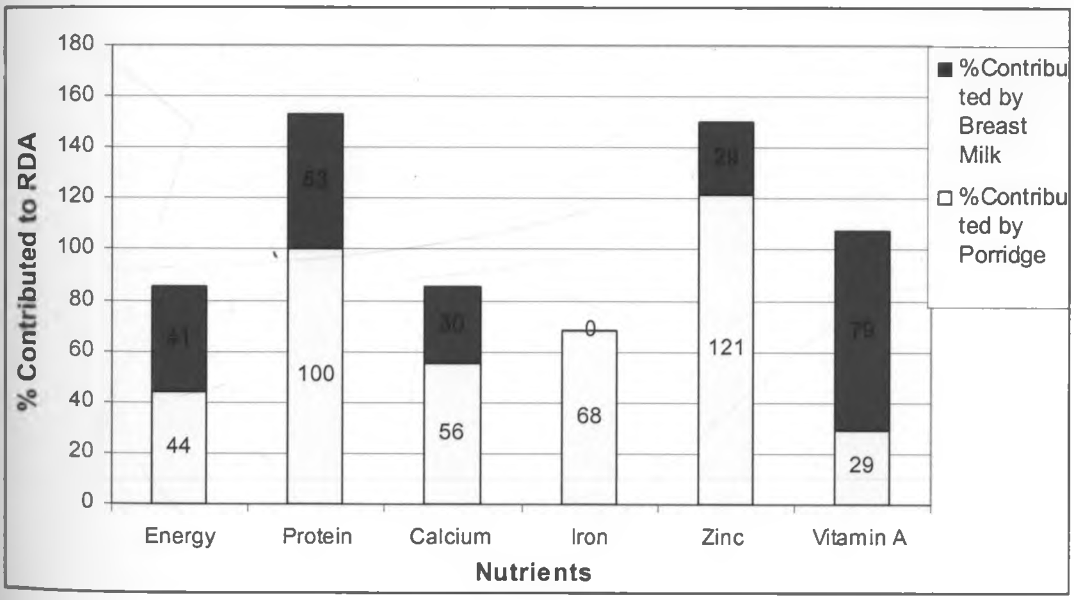
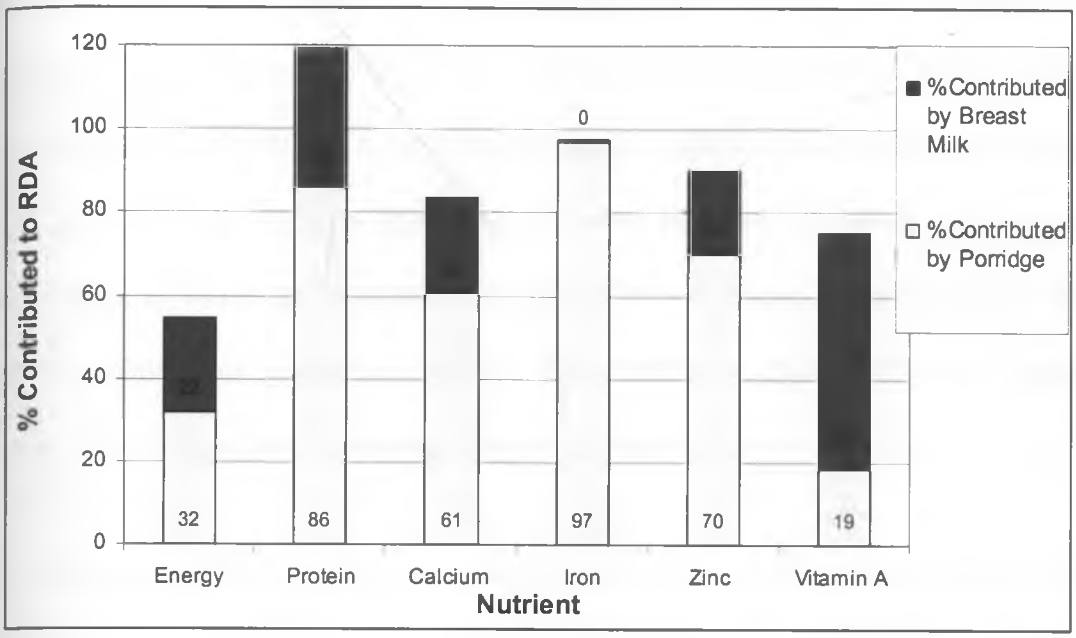


Figure 6: Proportion of Nutrients Contributed by Porridge and Breast Milk to the Recommended Daily Allowances (RDA) for 12-24 Month Old Children



4.7 Hygienic Practices

Most (91.6%) mothers cooked enough porridge to last the whole day. Methods of storing porridge included: keeping porridge warm in food flasks (62.9%) and in covered containers at room temperature (33.3%). Despite the fact that some porridge was kept at room temperature, rarely was it given to children when cold. However, there was no information regarding the temperatures to which the porridges were heated. It was also found that most of the water used for drinking or preparing of drinks for children was boiled (81.1%). Focus group discussions confirmed that enough porridge is cooked to last the whole day.

The children were fed using plate, cup and/or spoon. There was no bottle used for feeding of the children. All mothers reported washing utensils with soap, while 50% used warm water, and 17 % boiled utensils after washing.

On personal hygiene, figure 8 shows that most mothers reported washing hands after visiting the toilet and before feeding the child. However, fewer washed their hands after changing the baby, before cooking and whenever hands were dirty. There was no indication of use of soap. Observations made on sanitation revealed that 54-75% of the surroundings, house, children, and utensils were dirty, and foods were not covered during storage.

4.8 Illnesses

More than half (58.7%) of the children studied had been ill within the two weeks preceding the survey. The types of illnesses and prevalence are as shown in figure 9. Other illnesses included mouth sores, rashes, ear infection; tonsils, chest problems, chicken pox, and stomach upset. Some children had more than one illness. Most illnesses (78%) lasted three days. However, some cases such as diarrhea (36.8%) and colds (21.9%) lasted 1-2 weeks.

Figure 7: Distribution of Mothers by Washing of Hands

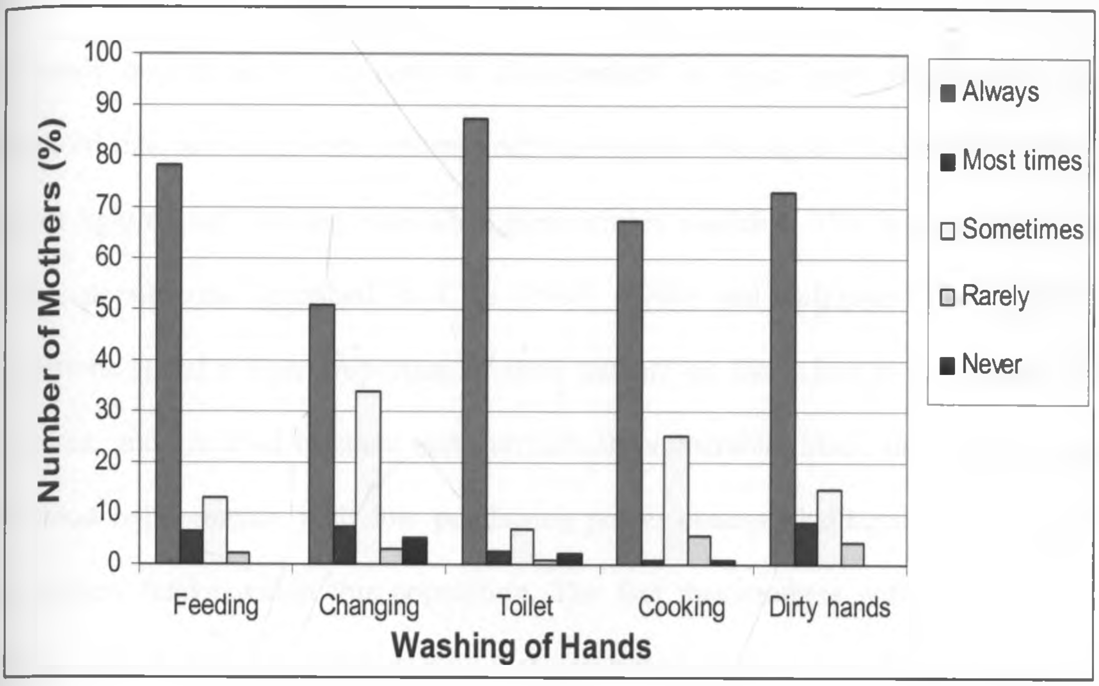
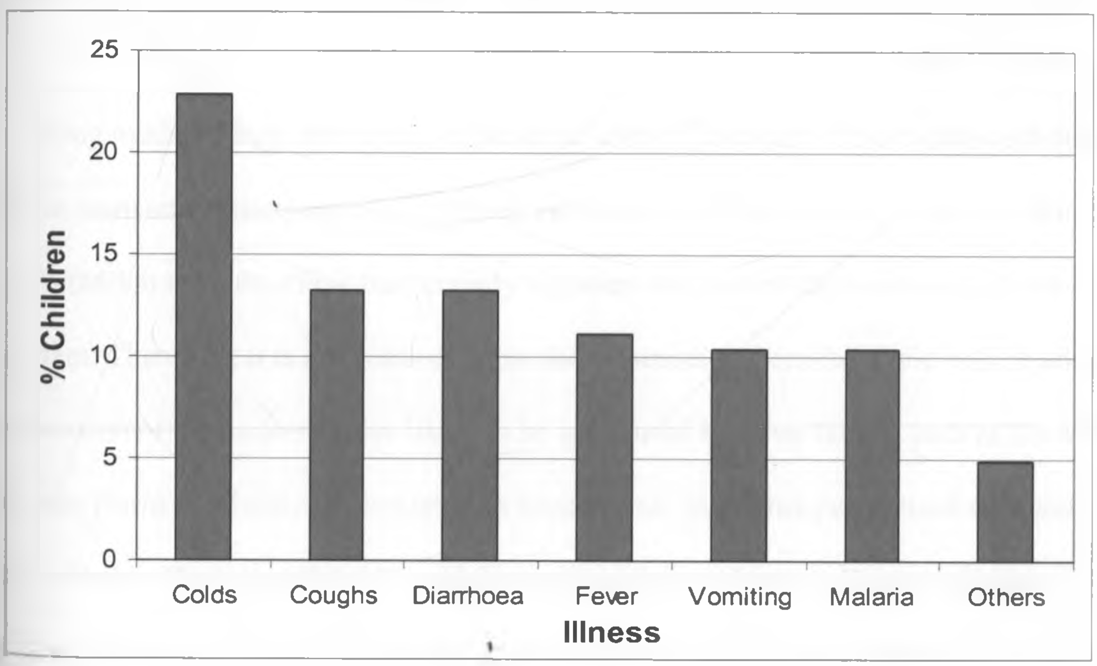


Figure 8: Distribution of Children with Illnesses



CHAPTER 5: DISCUSSIONS

5.1 Population Characteristics

The study population in Kangemi is characterized by high level of primary education, household size, low cadre jobs, informal activities, poor housing and; use of kerosene as main fuel for lighting and cooking even when electricity is available. This is consistent with low-income populations described in CBS (1998, 2000) and Gillipsie *et al* (1996). Such populations spend a high proportion of their income on food, live in low quality housing structures, and are food insecure and nutritionally vulnerable. Since they have to purchase their food requirements, their low purchasing power creates likelihood of inadequate food and nutrient intake within this population. The fact that mothers with secondary level of education had lower population density than those with primary school education could be a result of their husbands having at least similar level of education and earning more income from skilled labour. This enables them to have more rooms than the rest with low education.

The young mothers' high attendance of Maternal and Child Health Care Centres exhibit their quest to learn and participate in child health and nutrition. However, in as much as they relied on information from the clinic they equally regarded and trusted their mothers' advice as important. Therefore, it is not automatic that the information from the clinic will be adopted. The decision of the mother is also likely to be influenced by other factors such as the media, what was learnt in school, interaction with friends, and finally her perceptions or beliefs, and access to cash. The accessibility to cash by most mothers is limited. Given the nature of occupations, most mothers are likely to depend on household heads for cash.

This is consistent with the fact that a mother's knowledge and beliefs; access to cash and other family resources determine her capacity to give improved complementary foods. Her decisions and actions depend on family interactions, cultural attitudes, norms, and economic conditions. (ACC/SCN, 2000; Mitzner *et al*1984)

5.2 Complementary Foods

The early introduction of foods amongst mothers with a high rate of clinic attendance implies that the guidelines in MOH (1986) have not been very effective in changing child-feeding practices. This can be attributed to poor understanding of the detrimental effects of early introduction of foods and the benefits accrued from introducing complementary foods at 4-6 months by the mothers. Furthermore, the MOH (1986) guidelines do not cover current technologies that improve nutrient availability in the complementary foods. This can be attributed to delays in updating the guidelines with the existing knowledge on nutrient availability and disseminating the same to health workers. Also the low level of education; inadequate food intake by the mothers; cultural influence and lack of knowledge by the health workers can have a role in this. The effect of education and household size on the age at which first foods were introduced confirms that highly educated women have a better knowledge of complementary feeding requirements as documented by Mitzner *et al* (1984) and UNESCO (1984). The effect of high household size may be a result of low food distribution in the household due to low incomes, and the fact that an under-nourished or a starving mother produces less breast milk insufficient to satisfy the child at an early age (Cameron and Hofvander, 1983). This is supported by the fact that mothers introduced first foods when they felt that the child was not getting satisfied on breast milk alone. In addition, the effect of cultural influence can be explained by the fact that young mothers got advice for feeding of children from their mothers. The wrong information passed on to mothers could be attributed to wrong beliefs held by health workers (section 4.3) and the fact that some advise mothers to introduce semi-solids either too early or too late (BIG, 1982).

The complementary foods introduced, though early, were consistent with those recommended as suitable for the children in MOH (1986) and Sajilata *et al,* (2002). These included mashed fruit and vegetables, and gluten free cereals like porridge. The children consumed a wide variety of foods. According to Linkages (1999), such foods should provide a diversified diet necessary to sustain the nutrient requirements, if given alongside breast milk, and at the reported mean frequencies of feeding. However, there is low consumption of animal protein, vegetables and fruits. In addition, the form in which animal protein and vegetables are given may not provide concentrated nutrients. They are difficult to chew and their soups are likely to contain lower nutrients than the pureed meat or vegetables. This may not ensure adequate intake of energy, protein, calcium, iron, zinc, and vitamin A (Linkages, 1999; Sijilata *et al* 2002).

A pattern of low animal protein intake, low-density foods and high consumption of porridge is consistent with a population that is of low-income (Allen and Gillipsie, 2001; UNICEF, 1998). This is likely to increase the children's vulnerability to deficiency diseases. The non-breastfeeding children, though few are even at a much higher risk since the main source of protein, calcium and vitamin A are not provided. Porridges used were not concentrated enough to provide adequate energy.

5.3 Types of Porridge Flours Used

The wide variation of porridge flours used; the type of cereal flour and proportions preferred and; reasons given for components used; and the reasons given for preference, show that mothers were eager to provide their children with what they perceived as nutritious and balanced. They were cautious enough to select and formulate the flours themselves as seen in section 4.3. The effect of source of income. household size. education and cultural backgrounds on the types of porridge flours used is confirmed by the uncertainty of casual labourers of an income. The low use of cereal-legume composites by the unemployed and large sized households implies that the cereal composites are cheaper than the former. Timmer *et al* (1983) explains that average food quality measured by price increases with income, and the starchy ratio declines as the household income increase. The reasons given for using composite flours were consistent with the principle for improving energy, and protein intake, thus encouraging the use of cereal-legume composites (MOH, 1986).

According to FAO/WHO (1995), cereals and legumes should be mixed in proportions of 70:30. Mothers did not however comply with this recommendation when mixing (compositing) cereal-legume flours. This may imply that the mothers were not aware of it. Pamplona-Roger (2001(1)) explains that cereals and legumes are mixed to complement each other and provide a complete protein that would otherwise be limiting in essential amino acids. The resultant flours did not meet both requirements of 400kcal and 15g protein per 100g dry matter for supplementary feeding in young children (CAC, 1994). The flours that partly met the requirements were the extrusion-cooked cereal-legume composite flour from Proctor and Allan, which provided an adequate energy requirement. Those with less than 60% cereals and more than 35% legumes, and containing *dagaa* provided enough protein but not energy. This is due to the high protein in legumes and *dagaa* (Sehmi, 1999).

5.4 Preparation Methods

The observations made in section 4.4 reveal high usage of composite flours made of dry raw whole cereals and legumes, and fish (*dagaa*). The flours were further enriched with sugar, milk, and margarine. Such enriched porridges have improved nutrient content than the unfortified (unmodified) or the non-enriched porridges. The fact that the types of porridge did not determine cooking periods reveals that mothers were not aware of the nature of legumes. This is supported by the fact that Kirinyaga Millers and Proctor and Allan started pre-processing after learning that legumes can be toxic if they not adequately cooked, particularly using normal cooking times (my personal communication). The cooking times were insufficient to inactivate trypsin inhibitors and lectins except for the pre-treated flours from, Kirinyaga Flour Millers and one respondent. The methods known to reduce water absorption capacity and porridge viscosity, increase nutrient digestibility, concentration and bioavailability such as fermentation, germination or addition ARF were not used in porridges preparation. Therefore, the nutritional benefits derived from digestible, and bio-available nutrients in these porridges can be questioned (FAO/WHO, 1995; Besancon, 1999; Lorri, 1993; Mwiwa *et al* 1996, Mbithi-Mwikya *et al,* 2000; Mbugua and Keya, 1992). The roasted and extrusion-cooked flours used by a few mothers are likely to have low bioavailability and flatulence characteristics since the processing involved does not affect phytates, tannins, and oligosaccharides (Mbithi-Mwikya *et al* 2000; Bourne, 1989). In addition, the digestibility of proteins is questionable, if legumes were not soaked. Trypsin inhibitors are resistant to dry heat (Mwakolo and Smart, 1996).

The flour solids addition rates used in Kangemi are consistent with the fact that raw porridge flours absorb a lot of water, swell and limit usage of flour solids used in porridge preparation to a rate of 10%. However, the soaked, fermented, and germinated (pre-treated) flours can result in porridges with 20-30% flour solids. A combination of germination, fermentation and/or addition of ARF give the highest concentrations. ARF should be added after cooking the porridge to effectively reduce viscosity because cooking destroys the enzymes. Inclusion of amylase enzymes in starchy porridges destroys the water binding properties of starch, allowing addition of more flour solids without increasing porridge viscosity. Thus the porridge viscosity can be maintained at a level acceptable to children (FAO/WHO, 1995; Lorri 1993; Karuna *et al,* 1991; Akpapunam and Sefah-Dedeh, 1995; Treche, 1999; Mensah and Sefah-Dedeh, 1991; Tontisirin and Yamborisit, 1995). Soaking, fermentation and germination are also effective in reducing tannins, phytates and oligosacharrides. Tannins, phytates and oligosacharrides are heat resistant and cannot be destroyed by cooking or hydrolysed by digestive enzymes (Besancon, 1999). Dehulling can reduce Phytates and tannins because they are concentrated in the skin of millets, brown sorghums and beans. Soaking for four days and germination for 48 hr has been shown to destroy trypsin inhibitors and leach out oligosaccharides, tannins and other phenolic compounds. In addition, germination periods of 72-144 hours, lactic fermentation for 48 hours can significantly improve the sorghum protein digestibility and finger millet mineral bioavailability (Makokha *et al,* 2003; Mbithi-Mwikya et al, 2000). Organic acids, and in particular vitamin C have been found to solubilize the negative effects of phytic acid and, improve mineral absorption in a plant based meal. This would prevent rickets and other calcium deficiency diseases. The addition of vitamin C through fresh fruits and vegetables to the porridges also improve the vitamin A concentration and subsequently promote utilization of calcium (Kirshmann and Dunne, 1984; Pamplona-Roger, 2001(2); Towo *et al* 2003).

Heat stable trypsin inhibitors and lectins cannot be destroyed by the usual periods of cooking exposed to porridges. Under normal conditions, dry whole beans require a minimum of 2 hours to cook to inactivate trypsin inhibitors and lectins (Siegel and Fawcett, 1976). Even after such cooking, some other residual heat stable protease inhibitors that interfere with digestibility are found (Nwakolo and Smartt, 1996). Mbugua and Keya, (1992) showed that 60 minutes of cooking cereal-legumes porridge was insufficient to destroy them. Soaking, roasting, germination, or fermentation pretreats the grains or flours thus enabling the reduction of these anti-nutrients in the porridges

Soaking, fermentation, and addition of ARFs and fruit and vegetable juices (vitamin C) are not practiced in Kangemi. This is attributed to lack of knowledge of such methods in improving nutrient availability and; cultural beliefs that fermented porridges cause stomach upset in children. From my personal experience, germination of cereals is a preserve of the local brewing industry and may not be easily associated or automatically adopted in child feeding practices. The belief associated with use of fermented porridges denies children the benefit of low diarrhoeal incidences, high catch-up growth after an illness and nutrient bioavailability (Lorri, 1993; Mwiwa, 1995; Mwiwa *et al* 1996). However, the use of germinated grain has been associated with the risk of bacterial pathogen contamination, and is discouraged for use at household level. It requires strict quality control to eliminate growth of mycotoxins and other pathogenic bacteria (Allen and Gillipsie, 2001; FAO/WHO, 1995; CAC, 1994). The alternative would be to promote application of hygienically produced amylase rich flours.

The fact that Kirinyaga Flour Millers and Proctor Allan started roasting legumes on the knowledge that raw legumes are toxic confirms that millers of porridge flours also require knowledge about nutritional contents and causal factors of disease to improve the nutritional status and health of the child like the mothers (Mitzner *et al* 1984).

5.5 Consumption Levels and Patterns

Amongst all foods consumed in complementary feeding, porridge forms the highest proportion. This is consistent with KDHS (1998), and is explained by the socio-economic status of the population observed in the preceding sections. The porridge is easily available, affordable, easy to prepare, and convenient to use. Porridge once cooked is kept for use throughout the day. The fact that mothers with higher education and higher incomes (with bussinsses) used cereal-legume composites more confirm that such mothers had a better understanding of child nutrition (Mitzner *et al* 1984); are more in employment; their husbands earn higher pay from skilled labour and can afford other foods. Also some non-breastfeeding mothers used porridge as a replacement food (Section 4.1, 4.2).

The fact that porridge is used as a meal among the younger children and, a snack among the older children is explained by the perception that it is a light food, thus suited for younger children. In addition, it is consistent with the recommendations that nutrient density in complementary foods should be increased as the child becomes older, in order to adjust the nutrient adequacy (Linkages, 1999; King and Burgess, 1993; Sajilata *et al* 2002). The volumes consumed are normal and consistent with the small size of their stomachs as stated by Mitzner *et al* (1984) and MOH (1986). This also implies that it is difficult to increase the feeding frequency, hence the need to increase the density of the complementary foods (Sajilata *et al* 2002).

5.6 Dietary Nutrient Intake

The nutrient intake in this study is based on one 24-hour recall session, and a three-day food consumption frequency interview. The pattern revealed by the frequency interview was confirmed by the focus group discussions. It therefore provided a good estimate required to assess the nutrient adequacy of the diet on the day of the interview (Hartog *et al*, 1995; Grant and Dehoog, 1985). The three-day food frequency confirmed that porridge was a food consumed daily, and the frequency of consumption rarely varied from day to day. The types and amounts of foods consumed, their composition, preparation methods, and frequency of feeding on both foods and breast milk determined the daily nutrient intake. In addition, the education level of the mother, source of income of household head, and household size determined the type and amounts of food ingredients added and nutrient intake.

The consumption of both porridge and breast milk was adequate in protein among all age groups, energy, calcium, and vitamin A among the 6-11, zinc among the 9-24 and iron among the 12-24 month old children. They were deficient in iron among 6-11, zinc among the 6-8, and energy, calcium and vitamin A among the 12-24 month old children respectively.

The higher nutrient intake from porridges compared to the nutrients provided by flour solids was attributed to their enrichment with sugar, margarine and milk. This is due to the high contents of energy in sugar and margarine, protein and calcium in milk, as well as vitamin A in fortified margarine. Cereal-oilseed legumes-*dagaa* porridge flours and milk may have contributed to the improved values of calcium and zinc in porridge (Sehmi, 1999; West *et al,* 1988; Holland *et al,* 1991). However, lack of improvement in iron may be explained by its absence in the fortifying foods. Addition of margarine, however little, contributed to the high increase in vitamin A content in the porridges. The correlation between education, household size and source of income on energy, protein, calcium and vitamin A intake confirm the variation in quantities of sugar, milk, margarine and legumes added to the porridges. This is consistent with the fact that quality of food purchased is determined by income.

The low energy and vitamin A contributed by the porridges could be explained by relative increase in consumption of other foods that are denser in energy and vitamin A than porridge, and increased demand for energy and vitamin A without a corresponding increase in nutrient intake. In addition, as children grow older, they progressively become accustomed to family foods and, their dependency on porridge as a meal reduces to a snack. The family foods consumed include *ugali* (thick porridge), potatoes, rice, beans, carrots, spinach and pawpaw. The low iron and zinc proportions among the 6-11 month olds is explained by the fact that they consume low volumes of porridge compared to the 9-24 month old. This is consistent with the fact that iron and zinc requirements for the 6-11 month olds can only be met on consumption of highly concentrated foods. High concentrations of iron and zinc are reported to be available in liver or modified foods (Benbouzid and Benoist, 1999). However, the high intake among the 9-11 can be explained by the fact that they took "baby porridge" which had higher concentrations of zinc and was not taken in other age groups. In addition, the sample size was very small, thus introducing a deviation from what is known about zinc deficiency in this age group. The introduction of other foods that are more concentrated in nutrients, and continued breastfeeding within this period is consistent with the findings by UNICEF (1998), recommendations of MOH (1986), Linkages (1999) and King and Burgess, (1993). The study showed that porridge was major source of protein, calcium, iron and zinc, while other foods and breast milk provided vitamin A among all age groups. Fortified-margarine provided the vitamin A in porridges. Other foods were the major source of vitamin A among all age groups and energy among the 12-24, while breast milk was the major source of energy and vitamin A among the 6-8 month old children respectively.

The high proportions of protein, calcium, iron, and zinc contributed by the porridges to the RDA compared to breast milk confirm that porridges are the major source of proteins and, iron, calcium and zinc among the 12-24 month old children. This could be attributed to the use of legumes, *dagaa* and milk that are high in proteins and calcium, millets and legumes that are high in iron and zinc, and the higher volumes of porridge consumed in this age group.

(West *et al,* 1988, Holland *et al,* 1991). Energy and vitamin A proportions could be improved by addition of more sugar, and margarine, while the same energy, calcium, iron and zinc could be improved by further increasing the nutrient concentration through addition of extra flour solids as explained in the preceding sections. Increased amounts of milk in porridges could also contribute to increased intake of zinc. The main source of zinc is millet, sorghum, maize and legumes (Holland *et al,* 1993; Yomadji-Outangar, 1999; Holland *et al,* 1991). Vitamin A intake could be improved by addition of fruit and vegetable puree, orange-fleshed sweet potato or increasing the amount of margarine added. Vitamin C in the fresh fruits and vegetable puree is known to enhance the absorption of minerals even in the brown sorghum and finger millet that show resistance during short fermentation periods (FAO/WHO, 1995; Mbithi-Mwikya et al, 2000; Hagenimana *et al*, 2001).

Fermentation and addition of germinated foods (ARF) to cereal-legume porridges reduces porridge viscosity, thus allowing for addition of more flour solids and increasing the nutrient concentration in the same volume of porridge. This is likely to make porridges denser in energy without necessarily adding other foods like margarine and sugar. In such situations, they are likely to add excess calories. Taking advantage of such benefits is necessary. It could reduce the cost of porridge by not adding sugar and margarine, while achieving adequate nutrient density. Furthermore, such preparation methods improve energy and protein digestibility, mineral and protein bioavailability and, even reduce flatulence. (Lorri 1993, Mbugua and Keya 1992, Tontisirin and Yamborisit 1995, FAO/WHO 1995, Mbithi-Mwikya et al, 2000, Makokha et al 2002 and 2003). For these reasons, mothers need to be encouraged to adopt such preparation methods, particularly those who are not able to access other high quality nutrient foods. In addition, sustained breastfeeding should be promoted in order to benefit from its significant contribution to RDA for energy, protein, calcium and vitamin A. The porridges containing *dagaa* and legumes may also not require addition of milk. The protein, calcium and zinc they provide would be derived from their concentration in the additional flour solids after fermentation or germination. In addition, the porridges would be free from phytates and tannins. However, a moderate amount of fat is required to enhance vitamin A and calcium utilization (Kirschmann and Kirschmann, 1996). This could be provided if oil-seed flours are added to the porridges. Karuna *et al* (1991) confirms that sesame flour can be used for improving energy and calcium in porridges.

It is well known that fibre, anti-nutrients, low heme iron, and lack of vitamin C in the porridges or low fat (less than 15%) in diet, nutrient interactions and an individual nutrient status determine the bioavailability of calcium, zinc, iron and vitamin A (Whitney and Rolfes, 1999; Holland *et al;* 1993; Hurrel, 2003). The fact that the porridges were based on whole meal types of flour without sieving, have little or no margarine, *daggaa* and no fresh fruit or vegetable added and were insufficiently cooked makes the nutrient availability of these porridges highly questionable. In addition, different authors have given varying bioavailability values of 40, 60 and 75% calcium, and 35% zinc as that which is absorbed by rapidly growing children, and 15% zinc unqualified, 2-10% iron and 20-50% vitamin A from plant based foods with inhibitors. It has been shown that iron-deficient children can have iron absorption of 2-3% from porridges (Collaway, 1995; and Sizer and Whitney, 2000; Guthrie, 1989 and Pamplona-Roger, 2001 (1); Somer and Somer and Health Media, 1992, Hurrel, 2003). Therefore, the porridges are likely to be adequate in protein, but not in energy, calcium, iron, zinc and vitamin A among the children. However, those derived from breast milk are of high bioavailability (Allen and Gillipsie, 2001). Nutrient inadequacy could be worse among the children feeding on porridge and breast milk at lower frequencies than two and eight times a day respectively. Therefore, porridge used in complementary feeding is likely to be deficient in calcium, iron, and zinc among all age groups, and in energy and vitamin A among the 12-24 month old children respectively.

Therefore, using porridge in Kangemi is likely to expose children to protein energy malnutrition (PEM), anemia, vitamin A, low immunity, rickets, slow teeth development and mental impairment, even in the presence of adequate energy. These nutrients interact to alleviate deficiency diseases and conditions. Zinc is required in the conversion of calorie containing nutrients into energy, and in protein digestion to facilitate normal growth and development (Somer and Health Media, 1992; Osendarp, 2001: Umeta et al, 2000). Therefore, the high protein intake in the diet among the 12-24 month old children may not be adequate for use in both targeted functions and supplementing the deficient energy. Zinc mobilizes vitamin A out of its storage depots (liver) (Kirschmann and Kirschmann, 1996) for use by the tissues and together maintain normal blood levels and epithelial tissues integrity that provide barriers to infection. It also aids in bone mineralization in presence of moderate fat, vitamin A and C (Somer and Health Media, 1992).

In view of this, adequate intake of protein should be accompanied with adequate energy and bio-available, zinc, iron, calcium and vitamin A to alleviate the above deficiency conditions of public health concern and rickets among children aged 6-24 months in Kenya. Therefore, porridge preparation methods should involve treatments that eliminate or reduce anti-nutrient factors, increase nutrient concentration and/or amounts of enriching foods added.

5.7 Hygiene

King and Burgess (1993), FAO/WHO (1995) and MOH (1986) recommend good hygienic practices to ensure that food contamination and diarrhoea incidences are reduced during complementary feeding. However, insufficient hygienic practices and poor sanitation observed in this study indicate that children are exposed to infections and are at risk of contracting illnesses particularly diarrhea (Yohani, 1981; Mitzner *et al* 1984; USAID, 1999). It is also likely to worsen the situation of a child who is already sick because diarrhea causes loss of nutrients from the body. FAO/WHO (1995) and King and Burgess (1993) also recommend that food for children should be freshly prepared. Foods may be kept for 2-3 hours in a cool place (<10°C) or hot (>60°C). and should be reheated to at least 70°C. In contrast to this, most porridge was prepared once a day and kept warm. This provided an appropriate environment for bacteria to proliferate. There was no information on the temperatures to which porridges were kept or heated before consumption. The insufficient practices used in keeping or heating porridges, and use of undercooked porridges with lectins is likely to be the cause of diarrhoea and vomiting among the children. Diarrhoea results in loss of nutrients from the body (FAO/WHO, 1995; Bourne, 1989; MOH, 1986).

Studies show that fermented porridge lowers diarrhoea incidences in children, inhibits growth of pathogenic micro-organisms and improves its keeping quality (Lorri, 1993; Mwiwa *et al,* 1996).

5.8 Illnesses

The early introduction of other foods, low quality of food intake and poor sanitation puts children at risk of illnesses (USAID, 2000). This situation is likely to be a result of reduced immuno-competence in the children due to inadequate intake and low bioavailability of nutrients (Tomkins and Watson, 1989). The diet as described in this study has a high potential for triggering off deficiency diseases in children as explained in section 5.6. This diet, high in lectins, low in energy and bio-available calcium, iron, zinc, and vitamin A is likely to be a major contributing factor to reduced appetites, colds, coughs, diarrhoea, fever, vomiting, malaria and other diseases conditions reported in section 4.8 (Bourne, 1989; FAO/WHO, 1995; Somer and Health Media; 1992; Black, 2001; MOH, 1999). Adequate and bio-available zinc intake can reduce the likelihood of persistent, severe and long duration of diarrhoea, pneumonia, malaria and death (Black, 2001). Low nutrient bioavailability in complementary foods, unhygienic practices and illnesses among the 6-24 month olds in Kangemi can easily slide into malnutrition because of the higher demand of nutrients beyond the recommended dietary allowances. The high prevalence of illnesses is consistent with urban poor populations, which depend on the informal sector (Gillpsie *et al*, 1996).

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The porridges used for complementary feeding in Kangemi were inadequate for the 6-24 months old children using the current preparation methods, quantities of feeds and feeding frequencies. Despite the adequate complementary feeding frequencies, amounts of porridge and breast milk, and providing all requirements for protein to all and, energy, vitamin A and calcium to 6-11, zinc to 9-24, and iron to 12-24 month old children through enrichment, the bioavailability and adequacy of calcium, zinc, iron and vitamin A derived from flour solids were highly questionable. The porridges as used were likely to be deficient in calcium, iron, and zinc among all age groups and, vitamin A and energy among the 12-24 month old children respectively.

The types of porridges used were insufficiently cooked single cereal and composites (mixed cereal, cereal-legume and cereal-legume-*dagaa*). They were made from raw-dry-whole milled grains with or without fortification with sugar, milk and/or margarine.

The limiting factors for adequate intake of nutrients were the low incomes and inadequate education (formal and nutrition) within the community. The incomes were so low that some mothers were not able to afford adequate quantities of fortifying foods. Furthermore, there was limited knowledge of nutrient availability, appropriate technology to improve the porridge nutrient availability and quality, and causal factors. As a consequence, inadequate porridge preparation methods were practiced. The health workers delivered inadequate information on the quality of porridges; thus without addressing nutrient availability. In addition, they promoted the same cultural beliefs held by mothers, which are against the use of beneficial technologies such as fermentation. The mothers and millers added inadequate amounts of fortifying foods such as legumes, *dagaa*, milk and margarine. In addition, they did not use porridge preparation methods that enhance nutrient density and absorption, reduce tannins and phytates. The cooking periods were insufficient for inactivation of trypsin inhibitors and lectins. Therefore, the low intake of bio-available zinc, iron, vitamin A, and energy among the various age groups, and presence of lectins, poor sanitation, and hygiene are the likely causes of low appetites, reduced immunity to colds and coughs, vomiting, diarrhoea, and other illnesses reported in Kangemi.

6.2 Recommendations

To improve nutrient adequacy of porridges, it is critical that nutrition knowledge be updated; attitudes (beliefs) and practices of individuals be changed and; further research be done to validate the nutrient adequacy of porridges and related factors.

Nutrition education guidelines (MOH, 1986) should be reviewed to include the existing simple technologies that improve nutrient digestibility, concentration, availability and absorption. This will provide up-to-date reference information on appropriate preparation methods for porridges. Health workers need refresher courses to sensitise and update their nutrition knowledge on nutrient availability and the need and benefits of adopting appropriate technologies. This will also enhance the delivery of facts on child nutrition and reduce anti-nutrition cultural beliefs.

Mothers and millers should be sensitised on the nature of porridges, detrimental effects of anti-nutrients in cereal and legume flours, the need to use appropriate flour and porridge preparation methods to improve nutrient digestibility, concentration and bioavailability. This will promote production of safe germinated flours (amylase rich flours) and, the use of technologies such as roasting among the millers. The same will encourage and promote mothers to use simple methods for grain and/ or porridge preparation such as roasting, soaking, fermentation, and use of amylase rich flours. In addition, there should be emphasis on the need and benefits of a balanced diet, sufficient cooking of the porridges, use of fermented porridges in reduction of diarrhoea incidences, sustained breastfeeding for at least two years and, good sanitation and hygienic practices. This would promote mixing cereal-legume composites according to the recommended ratios, adequate fortification of porridge flours with foods rich in energy, protein, calcium, iron, zinc, addition of vitamins A and C (fruits and vegetables puree), pre-processing (roasting, extrusion cooking) of the legumes to inactivate trypsin inhibitors and lectins, and, also use of fermentation. It would also enhance compliance with the recommended nutrient quality for supplementary foods (flours) used for feeding infants and young children and, breastfeeding to provide extra and bio-available nutrients to supplement porridges.

It is necessary that further research be done to:

(i) Validate the nutrient (energy, protein, calcium, zinc and iron) content of porridges consumed in the community using laboratory analytical techniques;

(ii) Determine sufficiency of cooking times for porridges that render nutrients bioavailable;

(iii) Determine the bioavailability levels for calcium, zinc, iron and vitamin A in the porridges in the community.

(iv) Determine the formulations of porridge flours that provide minimum composition of nutrients to meet the RDAs for energy, protein, calcium, iron, zinc and vitamin A and;

(v) Develop national guidelines or standards to guide and monitor the millers in formulating porridge flours that are safe and free from anti-nutrients in order to promote supply of porridge flours with good quality protein and bio-available nutrients.

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APPENDIX 1

QUESTIONNAIRE FOR NUTRIENT ADEQUACY OF PORRIDGES USED FOR COMPLEMENTARY FEEDING IN KANGEMI NAIROBI

Date of interview............... Questionnaire no......... Household no.........
Name of interviewer.......................................
Name of index child.......................... Date of birth ....
Name of Mother .... Clinic Attended...............
Location.................. Sub-location.................... Area....................

A. GENERAL INFORMATION, DEMOGRAPHY AND SOCIO-ECONOMIC CHARACTERISTICS

1. Please tell me about permanent household members **[list them according to age starting with the oldest. Fill in appropriate codes]**

S.No	Name	Relation to hh head	Sex	Age (yrs)	Marital status	Religion	Tribe	Educ. Level	Occupation

Code:

Relation to hh
1. Household head
2. Spouse
3. Son
4. Daughter
5. Bother/ sister
6. Nephew/niece
7. Other(specify).........

Sex
1. Male
2. Female

Marital Status
1. Single
2. Married
3. Separated
4. Widowed

Religion
1. Christian
2. Muslim

Tribe
1. Luo
2. Kikuyu
3. Luhya
4. Kisii
5. Kamba
6. Kalenjin
7. Other (specify) ....

Highest Level of Education
1. Pre-school
2. Lower Primary 1-4
3. Upper Primary 5-8
4. Post primary training
5. Secondary
6. Post secondary training
7. University
8. Adult/informal education
9. Not attended school
10. Not applicable

Occupation
1. Unemployed
2. Casual laborer
3. Security guard
4. Teacher
5. Clerk
6. Cleaner
7. Tailor
8. Carpenter
9. Housewife
10. Business/ trader
11. Driver
12. Tout
13. House-help
14. Gardener
15. Messenger
16. Student
17. Not Applicable
18. Other (specify) ....

[Circle appropriate code for each of the following]

2. What is the main source of income in this house hold?
   1=Salary 2=Sale of labor 3=Business 4=Other (specify) ....

3. Which of the following items do you own?
   1=Radio 3=Telephone 5=Sofa set 7=None of the above
   2=Television 4=Mobile 6=Car

4. What is the main source of lighting in this house?
   1=Electricity 2=Gas lamp 3=Paraffin lantern 4=Paraffin tin lamp 5=Solar

5. What fuel do you mainly use for cooking?
   1=Charcoal 2=Charcoal brickets 3=Paraffin 4=Gas 5=Electricity
   6=Other (specify) ....

6. Where do you get your water from?
   1=Tap in house 3= Out of compound
   2=Tap in compound 4= Other (specify) ....

7. **[Interviewer observation of housing materials]**
   Roof: 1= Iron sheets 2=Tiles 3=Other (specify) ....

   Floor: 1=Mud 3=Stone 5=Cemented
   2=Wooden 4=Not observed 6=Other (specify) ....

   Walls: 1=Stone 3=Wood 5=Other (specify) ....
   2=Mud 4=Iron sheets

   Rooms: 1=1 room 3=3rooms
   2=2 rooms 4=>3 rooms

B. SOURCE OF FOOD

8. What is your main source of food for the child?
   1=Purchase 3=Gifts from friends 5=Own production
   2=Gifts from relatives 4=Food program 6=Other (specify) ....
   [If not food program go to 14]

9. **[If food program]** What is the name of the program/organization? ....

10. What types of food do you receive for the index child? ....

11. How often do you receive the food?
    1=Weekly 2=Every 2 weeks 3=Monthly 4=Other (specify) ....

12. Are these foods sufficient for the child from one collection to the other?
    1=Yes 2=No

13. How long do the foods last?
    1= <A week 3=2 weeks 5=A month
    2=One week 4=3 weeks 6=>A month

14. Let me know if the child receives any of the following?
    1=Cod liver oil 3=Iron supplement 5=None of the above
    2=Vitamin A 4=Multivitamins 6=Other (specify) ....

    [If none of the above, go to 16]

15. When was the last supplement received?
    1= < A week ago 3=3 weeks ago 5=>3months ago
    2=1-2 weeks ago 4=1-2 months ago 6=Other (Specify) ....

C. COMPLEMENTARY FEEDING PRACTICES

16. Are you breastfeeding your index child? 1=Yes 2=No **[If not, go to 21]**

17. How many times do you breastfeed your index child per day?
    1=On demand 2=>3times /day 3=1-2 times /day 4=Rarely

18. What was the first food/fluid given to the child?
    1=Cows milk 4=Fruit juice 7=Potato 9=Other (specify) ...
    2=Porridge 5=Sugar water 8= Potato/Banana mixture
    3=Plain water 6=Infant Milk formula (specify) ....

19. At what age **[in months]** did you introduce these food/fluids? ....

20. What was the reason for introducing the food/fluids at this time?
    1=Felt child was not getting satisfied on breast milk alone 3= Advised by friends
    2=Breast milk secretion had reduced 4=Other (specify) ....
    [Go to 25]

21. **[If not breastfeeding]** At what age **[in months]** did you stop breastfeeding? ....

22. What was your reason for stopping breastfeeding?
    1=Sickness 3=I did not want to 5=Child refused
    2=No breast milk secretion 4=Pregnancy 6=Other (specify)......

23. What food did you introduce in place of breast milk?
    1=Cows milk 2= Infant milk formula 3=Porridge 4=other (specify) ....

24. How many times is the mentioned food/fluid given per day?
    1=>5times 2=4 times 3=3 times 4=2 times 5= once

25. What was the reason for your choice?
    1=Provided by feeding program 3= Advised by friends 5=affordable
    2= Advised at clinic 4= Easily available 6=Other (specify) .....

26. How did you get the information about feeding of the child?
    1=Taught at clinic 3=Advised by mother
    2=Learnt from friends 4=Other (specify) ....

27. What do you know about feeding of children born to HIV positive mothers?
    1=Should not breast feed 3=No difference in feeding
    2=Breastfeed for only six months 4=Do not know 5=other (specify) ....
    [If not 1 or 2 go to 30]

28. **[If 1 or 2]** What should be given in place of breast milk?
    1=Any food 3=Cows milk 5=Other (specify) ....
    2=Infant milk formula 4=Porridge

29. Where did you get this information?
    1=Clinic 3=Friends 5=Other (Specify) ....
    2=Feeding program 4=VCT

D. MODE AND FREQUENCY OF COMPLEMENTARY FEEDING

30. Do you give the child water or drinks? 1=Yes 2=No

31. [If Yes] What type of water do you use for giving and preparing drinks for the child?
1=Boiled water 2=Non-boiled water 3=Other (specify) ………………..

32. Does the child consume all food cooked in a meal [e.g. Porridge]? 1=Yes 2=No
[If not go to 35]

33. [If Yes] How do you store the left-over food?
1=Covered at room temperature 3=Kept warm in a flask
2=Not covered at room temperature 4=Other (specify) …………………… …

34. At what temperature is the left-over porridge taken?
1=Cold 2=Warm 3=Other (specify) ………………………

35. Please tell me about the type of food and beverages (drinks) the child has been feeding on in the last three days from morning until bedtime. **[Using the record sheet below, fill in TIME meal was taken all types of food: STARCHES/PROTEINS/ VEGETABLES/ FRUITS/DRINKS taken by child during these three days]**

Mode and Frequency Record Sheet
(Meals taken by child from time of waking up in the morning till bedtime)

Day	Time meal or drink was taken	Food Item: **starch/protein/vegetable/fruit/drink**	Age at Introduction (months)	Method of Feeding	No of times food is prepared /day
1					
2					
3					

Code: **Method of feeding**
1=Cup and spoon 3=Hand 5=Plate and spoon
2=Cup 4=Bottle 6=Other (specify) ………………

36. Does the child feed at night? 1=Yes 2=No **[If not go to 38]**

37. **[If yes]**

Type of Food	Number of Times

E. COMPOSITION OF PORRIDGE FLOURS

38. Let me know the type of flour used for preparing child's porridge in this house hold. 1= one cereal 2=mixture of cereals

39. **[If mixture]** Who does the mixing of the cereals? 1=Self 2=Supplier 3=Other (specify) ………………….

40. **[Fill in the required details in the table below. Where the mother does not mix the flour, nor know proportions in the mixture, request for the name and location of the supplier (shop/ miller/ other), and brand name. In addition, request for the method used for preparing porridge and ingredients added during and after cooking]**

Flour component/s	Amount of flour component (Measure/weight)	Treatment of component	Method of porridge preparation and additions	Name supplier / other	Location of supplier	Brand Name

Code

[Example of Flour component]

1= Maize
2=Millet
3= Sorghum
4=Cassava
5=Rice
6=*Njahi*
7=Green gram (*Ndengu)*
8= Beans
9= Groundnuts
10=*Simsim*
11= Soya beans
12=Omena

Treatments

1= None
2=Roasted
3=Addition of Malt (*Kimea*)
4=Fermented
5=Clean and dry
6=Other (specify) …………

Additions

1=Milk
2=Margarine (Blue band/Prestige/Gold band)
3=Egg
4=Sugar
5=Orange
6=Lemon
7=Other (specify) ………………

41. How do you wash utensils for feeding the child?
1=Soap, rinse, boil separately
2=Soap, rinse, sterilize with chlorine
3=Soap, rinse, dry after feeding and hot rinse before feeding
4=Soap, rinse, dry together with other utensils
5=Other (specify) ………………

42. Please let me know when you usually wash your hands and how often? **[Insert appropriate response]**

When do you wash hands?	How Often?

Code: **When**
1=Before feeding child
2=After changing child
3=After visiting toilet
4=Before preparing food
5=After returning home
6=Other (specify) …….
……………………..

Frequency
1=Always
2=Most times
3=Sometimes
4=Rarely
5=Never
6=Other (specify)
………………..

43. Has your child suffered any illness in the last two weeks? 1=Yes 2=No

44. [If yes] which ones?
1=Diarrhoea 2=Vomiting 3=Cough 4=Cold 5=Fever 6=Malaria 7=Other (specify)……………..

45. How long did it last? 1=<2days 2=3-5days 3=A week 4=Other (specify)………………

F. OBSERVATION

46. [Observe the following during interview and fill table appropriately]

Cleanliness	**Remark: 1=Yes 2=No 3=Not Seen**
Surroundings	
House (inside)	
Children	
Utensils	
Food covered?	

47. [Ask for clinic card and record the following]:

Name of index child ……………………..
Date of birth …………………………..……
Clinic attended …………………………..

APPENDIX II

24=HOUR RECALL QUESTIONNAIRE

24- Hour Recall Food Intake Record Sheet

Time	Dish	1	2	3	4	5	6	7	8[4]	9	10[5]
		Dish Preparation 1=child alone 2=Family dish	Name of Ingredient used in Preparation	Household Measure used	Amount in hh measure **[ml or gm]**	Amount of Ingredient in dish **[ml or gm]**	Complete dish prepared **[ml or gm]**	Amount of food served to the child **[ml or gm]**	Extra amount of ingredients added to child portion **[ml or gm]**	Amount Left over By child **[ml or gm]**	Amount consumed by the child (=7-9) **[ml or gm]**

Questionnaire No .... Name of child .... Date of birth .... Clinic attended ....

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[4] Extra amount of ingredient consumed in child portion=$\frac{\text{amount in column (8)x amount in column(10)}}{\text{amount in column (7)}}$

[5] Amount of ingredient consumed by the child=$\frac{\text{amount in column (5)x amount in column (10)}}{\text{amount in column (6)}}$

APPENDIX III

MIXED FLOUR COMPOSITION QUESTIONNAIRE

1. Date of interview……………….Name of interviewer ……………………………
2. Name of shop/ market/ miller…………………….. Type of flour ……………..…
3. Brand name ……………………   Date of interview……………………..
4. Name of child using flour ……………… Age (Months)……..… Sex F/M……
5. Name of respondent at time of interview in household ………………...………
6. Household No. (Where flour was found)   ……….…………………..…………..
7. **[Using the columns in the table below fill in the required information from the miller]**

Flour component	**Amount in Batch milled (Kg)**	**Amount of flour type in mixture**	**Treatment of flour component before mixing or packing**
Maize			
Millet			
Sorghum			
Cassava			
Green gram			
Groundnuts			
Soya beans			
Beans			
Omena			
Others (Specify)			

Treatment:
1= None   2=Roasted   3=Other (specify)

APPPENDIX IV

FOCUS GROUP DISCUSSION GUIDELINES

1. Source of information on child feeding
2. Knowledge on HIV and child feeding
3. Length of breast-feeding
4. Reasons for stopping breast-feeding
5. Foods used in place of breast milk
6. Type of first foods introduced
7. Age of introducing other foods to children
8. Type of porridge flours used
9. Reasons for choosing flours
10. Source of flour
11. Porridge flour preparations and pretreatments
12. Porridge preparation methods
13. Food ingredients used for fortification (enrichment)
14. Total number of complementary feeds per day
15. Number of breastfeeds per day
16. Number of porridge feeds per day