DIET AND NUTRITIONAL STATUS OF WOMEN LIVING WITH HIV/AIDS IN NAIROBI, KENYA:
THE PLACE OF FERMENTATION AND GERMINATION TECHNOLOGIES

By

GLORIA MBERA

A DISSERTATION SUBMITTED TO THE DEPARTMENT OF FOOD SCIENCE, NUTRITION AND TECHNOLOGY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FORT HE DEGREE OF MASTER OF SCIENCE IN APPLIED HUMAN NUTRITION IN THE UNIVERSITY OF NAIROBI

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2009

DECLARATION

I **Gloria Mbera** 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

To all my family

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ABBREVIATIONS

ACC/SCN	-	Administrative Committee on Co-ordination (of United Nations) / Sub-Committee of Nutrition
AIDS	-	Acquired Immune Deficiency Syndrome
ARF	-	Amylase Rich Flour
ARV	-	Antiretroviral
CBS	-	Central Bureau of Statistics
CD	-	Cluster of Differentiation
DDI	-	Daily Dietary Intake
FANTA	-	Food and Nutrition Technical Assistance
GOK	-	Government of Kenya
HBC	-	Home-Based Care
HIV	-	Human Immunodeficiency Virus
IFT	-	Indigenous Food Technology
KDHS	-	Kenya Demographic Health Survey
KENWA	-	Kenya Network of Women with Aids
KNS	-	Kenya National Survey
LAB	-	Lactic Acid Bacteria
MOH	-	Ministry of Health
PLWHA	-	People Living With HIV/AIDS
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
WLWHA	-	Women Living With HIV/AIDS

OPERATING DEFINITIONS

- Amylase rich flour (ARF) – a sun dried or artificially dried and ground germinated cereal grain flour that is rich in amylase enzymes. The temperatures used for drying do not exceed 50°c.
- Asymptomatic patient – HIV infected individual who has not yet developed clinical signs or symptoms. For the purpose of this study, this is one who does not meet the clinical criteria for the diagnosis of AIDS (Appendix IV)
- Bulky foods – foods having low concentration of nutrients such that the volume needed to meet the energy requirements exceeds ingestive capacity.
- Diarrhoea – disease characterized by passing of three or more abnormally loose or watery stools per 24 hours.
- Dietary bulk – concept referring to factors in the food that make it difficult for an individual to consume that food in sufficient amount to cover the energy and nutrient requirements. The energy content / nutrient density and the consistency of the diet are the two characteristics identified as dietary bulk factors.
- Dietary diversification – the art of including a variety of foods in a meal, with the aim of getting adequate nutrients through complementation
- Dietary modification – the art of changing the routine diet by introducing other foods in addition to the traditional ones, increasing the amounts consumed per person per meal, or serving the usual diet/meal with foods that will enhance absorption.
- Energy density – the energy value per unit weight / volume of food. It is usually expressed as Kcal/gram or Kcal/ml.
- Fermentation – spontaneous, non-aseptic operation resulting from the competitive activities of a variety of microorganisms.
- Germination – 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.
- *Githeri* – a kikuyu word for a meal composed of a mixture of maize and beans cooked together; can sometimes be fried with fat, onions and seasonings or mixed with vegetable such as potatoes, carrots or cabbages

- Household – one or a group of persons with or without family relationship, who live together under the same roof, share a common food pot, earnings and expenditures.
- Indigenous food technologies (IFT) – technologies based upon indigenous knowledge and experience that can, but don't necessarily have to use indigenous produce.
- *Kienyeji* – a Kikuyu dish composed of mashed potatoes, maize, beans or peas and/or vegetables
- *Kimea* – Swahili word for amylase rich flour made from germinated sorghum or millet.
- *Mandazi* – Swahili word for sweetened leavened dough (with Bicarbonate) that is deep fried
- Nutrient bioavailability – the status in which nutrients derived from food are readily available for absorption in the body.
- Nutrient density – A measure of the nutrient content of a food in relation to the calories it supplies and determined in terms of specific nutrients. The more nutrients and the fewer calories, the higher the nutrient density.
- *Omena* – Luo word for stew made from silver fish, tomatoes and onions
- Probiotics – microbial food ingredients that have beneficial effect on human health.
- Snack – a quantity of food that is readily available and can be eaten without much preparation and is usually taken between main meals
- *Uji* – Kiswahili word for porridge made out of maize, millet, sorghum or cassava flour and sometimes fortified with legumes, groundnuts, fat, milk, and /or fruit juice
- Unmodified porridge – 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.

ABSTRACT

In Kenya, porridge typically made from cereal flours is a common meal for children and invalids (those living with HIV/AIDS included). Cereal porridges suffer from high dietary bulk as a consequence of their high starch content. The cereals also contain antinutritive substances which bind important micronutrients (zinc and iron) rendering them unavailable. Traditional food processing techniques, such as germination and fermentation have potential to modify starch content of cereals so that they do not thicken and therefore don't require dilution. Also, among many other benefits, the techniques have ability to increase bioavailability of zinc and iron. In light of the particular amenability of porridge to both fermentation and germination food technologies; this cross-sectional, descriptive and analytical study was carried out to provide a picture of the state of affairs regarding use of the two technologies in its preparation. A sample of 150 was drawn from a population of 2,895 HIV/AIDS positive persons, registered members of Kenya Network of Women Living with HIV/AIDS (KENWA). Anthropometric equipments, guided questionnaires and focus group guides were the main tools for data collection. Data were analyzed using SPSS computer software program. Majority (80%) of the respondents were from female-headed households with Many (63%) of the respondents having attained only primary level of education. The study established that porridge was the most widely consumed food within the study population, but the use of both germination and fermentation technology in porridge preparation was extremely low (3%). Dietary intake for all nutrients analyzed including total calorie, protein, iron and vitamin A was found to be inadequate, standing at 1674Kcal/day, 56.7g/day, 15.4mg/day and 284µg/day respectively. Average total calorie

intake indicated a shortfall of about 30% from the recommended daily intake level with a large proportion (83%) of the population recording inadequate intake. For protein, iron and vitamin A; 70%, 53.3% and 100% respondents were respectively found to be taking inadequate amounts from their diets. In the case of iron, the proportion of those with inadequate intake could be much higher when bioavailability of the mineral from cereal diets is taken into account. However, despite inadequate total energy intake levels recorded among the study respondents, the average BMI for the population was within normal range, being 22.4±0.37. In addition, 25% of the respondents were found to be overweight (none obese). From the study it was concluded that majority of the population prepared porridge simply by mixing fresh flour with water, then bringing it to boil. The use of germination and fermentation technologies in the making of porridge was very low (3%). Awareness campaigns to promote uptake of the two technologies in the preparation of porridge is recommended.

CHAPTER 1: INTRODUCTION

1.1 Global HIV/AIDS Situation

AIDS is a problem affecting all countries worldwide albeit with varying intensity. By the end of the year 2007, there were about 33.2 million people living with HIV/AIDS globally down from 37.8 million in 2003 according to a UNAIDS/WHO report (2007). In the same year (2007), it's estimated that there were approximately 2.5 million newly infected with HIV and approximately 2.1 million died from AIDS despite improvements in access to antiretroviral treatment. Although the prevalence rates show a downward trend, the absolute numbers of those affected is still high demanding sustained attention.

Sub-Sahara Africa is home to about 69% (about 22.5 million) of the world's people living with HIV. It remains the most affected region in the global AIDS epidemic. Although just over 10% of the world's population live in this region, more than two out of three (69%) adults and nearly 90% of children infected with HIV live here. More than three in four (76%) of global deaths due to an AIDS-related illnesses in 2007, occurred in sub-Sahara Africa (UNAIDS/WHO, 2007). Unlike other regions, the majority of people living with HIV in sub-Sahara Africa are women (61%).

1.2 HIV/AIDS in Kenya

Epidemic level and trend and gender data

In Kenya AIDS is a tragedy of devastating proportions adversely affecting vital sectors of the economy (health, education and agriculture) and destroying the social fabric of the country. In 1999, Kenya declared HIV/AIDS a national disaster and public health emergency. An

estimated 1.5 million people have died from AIDS since 1984. The national HIV prevalence among adults is estimated at 7.8 percent (NASCOP, 2008), translating into 1.54-1.87 million persons who are over age 15 and approximately 140,000 – 170,000 children aged 15 and under living with HIV/AIDS (UNAIDS, 2008). Prevalence is highest in Nyanza Province at 15.3 percent. The next highest prevalence is Nairobi at 9%, Coast at 7.9 % and Rift Valley at 7%, all markedly contrasting with the North Eastern Province at 1%. Gender disparities are also observed with women having higher prevalence (8.7 percent) than men (5.6 percent). Approximately 11 percent of Kenyan children below 15 years of age (2.4 million) are orphans. Out of these, 1.1-1.3 million children are orphaned by HIV/AIDS.

1.3 Nutrition and HIV/AIDS

Proper nutrition is an integral component in the management of HIV/AIDS. Available evidence shows that, malnutrition contributes to a weakening of immune status thus worsening clinical conditions amongst HIV infected persons (Piwoz & Preble, 2000; Fawzi, 2004). Also, due to manifestation of opportunistic infections, HIV/AIDS leads to nutritional deficiencies through decreased food intake, malabsorption and inefficient utilization, a situation that hastens the onset of AIDS (Semba & Tang, 1999).

A healthy diet is regarded as an integral defense against rapid degeneration of the immune system. In Africa, cereals such as maize, sorghum, millet are widely utilized as food. In fact, cereals account for as much as 77% of total caloric consumption in African countries (Mitchell and Ingro, 1993), and contribute substantially to dietary protein intake in a number of these countries.

1.4 Consumption of Cereal Gruels in Africa and Kenya

The mode of utilization of cereals is fairly similar in most African countries, either in the form of thin porridges, pastes or dumplings, after variable preparatory processing steps. Starchy porridges are by far the most common mode of utilization of starchy food in Africa. According to the Agriculture and Consumer Protection Division of the Food and Agriculture organization (1999), some of these porridges include: *Kenkey* from Ghana made from cereals or cassava; *Ogi* from Nigeria made from maize, sorghum or millet; and *Mahewu* from South Africa made from maize or millet.

The major cereals cultivated in Kenya are sorghum, millet, rice and maize. Maize is Kenya's staple food and is commonly prepared as *ugali* (a thick paste eaten with a stew) or in many other occasions as porridge, locally referred to as *uji*. For the preparation of porridge *(uji)*, other cereal flours such as millet and sorghum may be used singly or a blend of two or more of these flours.

1.5 Problem Statement

In Kenya, porridge is particularly a common meal prepared for infants and invalids (including people living with HIV/AIDS). Cereals used in porridge preparation suffer from a number of nutritional deficiencies: first, the protein levels they contain are inadequate if they were to be the sole source of protein, and especially so when presented in the form of porridge. Also, cereal proteins are known to be deficient in lysine and tryptophan, leading to less efficiency in their utilization. Starchy porridges also present a dietary bulk problem due to starch gelatinization and imbibition of water thus reducing the overall energy intake in a given

served porridge volume (Lorri, 1993). Further, cereals such as sorghum and millets contain variable amounts of polyphenols depending on the variety, which interfere with protein digestibility and availability of minerals such as zinc and iron.

People living with HIV/AIDS (PLWHA) have increased energy demands and compromised immunity. For the many PLWHA in Kenya taking cereal–based porridge, the highlighted nutritional limitations of cereals raise serious concerns.

1.6 Justification

Indigenous food technologies (IFTs) like fermentation and germination provide some solutions in addressing problems presented in cereal-based porridges. Using these technologies, both cereal staples and household diets can be manipulated to improve nutrition value. Traditional fermentation of porridge for example can be used to alter the levels of absorption modifiers to improve micronutrient bioavailability. For people with HIV/AIDS who experience increased energy requirements, germination can be used in porridge preparation to concentrate food nutrients and caloric density, permitting people to ingest better nutrition while eating less volume (Tomkins *et al.*, 1990). Fermentation also has an extra property of protecting against or relieving from diarrhoeal diseases (Lorri, 1993), a common problem for PLWHA.

According to Appleton *et al.*, (2005), local knowledge and skills held by women often differ from those held by men. Traditionally, domestic duties such as cooking were mainly a woman's domain. Traditional knowledge and skill in food preparation and processing are thus

best obtained from the women themselves and this informed their focus in the study. Indigenous food technologies are attractive since they are traditional in many countries and so would be expected to be not only feasible but perhaps more culturally acceptable and more effectively promoted than a totally new behaviour pattern.

1.7 Aim of study

Contribute to improved nutrition status of people living with HIV/AIDS through adoption of appropriate food preparation practices for good nutrition and healthy life

1.8 Purpose of Study

To provide information on the state of affairs regarding use of fermentation and germination technologies and their effect on the nutrition status of people living with HIV/AIDS in Nairobi.

1.9 General Objective

To determine the use of fermentation and germination technologies and implication of such use to the health and nutrition status of women living with HIV/AIDS in Nairobi

1.9.1 Specific Objectives

- To determine the socio-demographic characteristics (religion, family size, sex education level, marital status and occupation of household head) of the study population
- To determine the diet composition of WLWHA

- To establish the adequacy of vitamin A, iron, protein and energy intake from the diet of WLWHA
- To determine ways in which porridge is utilized among WLWHA (i.e. proportion of women taking porridge, frequency, ingredients and methods of preparation with reasons)
- To determine body mass index (BMI) of WLWHA
- To determine the incidence of diarrhoea among WLWHA
- Determine the relationship between utilization of fermented and germinated porridge with body mass index (BMI) and incidence of diarrhoea

1.10 Hypotheses

The following hypotheses were advanced:

- Nutrition status of WLWHA using fermentation and germination technologies (for porridge preparation) is significantly different from that of those not using the technologies.
- Incidence of diarrhoea among WLWHA using fermentation technology (in porridge preparation) is significantly different from that of those not using the technology

1.11 Study Questions

- What is the diet for WLWHA composed of?
- Does the diet meet their nutritional requirements for energy, proteins, vitamin A and iron?
- What percentage of Women living with HIV/AIDS takes porridge?
- How frequently is porridge taken and what ingredients are used in its preparation?
- How is porridge prepared? What is the reason for the method of preparation?

1.12 Study Limitations

The study was limited in its ability to give precise nutrient intake levels. This was mainly because of resource constraints that could only allow for nutrient assessment using dietary intake assessment methods (24-hour recall and food frequency questionnaire checklist). Although dietary assessments give a relatively good estimate of nutrient intake levels, they are less accurate because they don't take into account bioavailability. In addition, there were very few people found to be practicing either fermentation or germination in porridge preparation making it impossible to statistically test the hypotheses advanced regarding the technologies.

CHAPTER 2: LITERATURE REVIEW

2.1 HIV/AIDS – The Disease

Acquired Immune Deficiency Syndrome (AIDS) is a disease caused by retrovirus known as the Human Immunodeficiency Virus (HIV), which attacks and impairs the body's natural defense system against disease and infection. Upon entry into the body, HIV moves into the lymphatic system and migrates to the lymph nodes which act as reservoirs for the virus; from here it moves to other parts of the body where it infects and destroys white blood cells known as T-lymphocytes or CD4 cells (IAVI, 2008). The virus may take years to make the infected person ill. This is called the asymptomatic stage. During this stage, the immune system of a person infected with HIV would be getting weaker and other viruses and bacteria could take "opportunity" of the weakened immune system leading to illnesses (NFNC, 2004). When the HIV infected person starts getting opportunistic infections such as Pneumonia and/or Tuberculosis, it shows that the immune system has been weakened, and the person is said to have AIDS, the last stage of the HIV infection.

The amount of time taken from HIV infection to full-blown AIDS depends on: (a) mode of transmission - individuals who get infected following transfusion with HIV infected blood progress more rapidly to full blown AIDS than those who get infected through other means such as sexual contact; (b) age- younger infected persons progress slower to AIDS due to stronger immune system; (c) health and nutritional status (Babameto, 1997) - those already with ill health or malnourished progress faster to AIDS and (d) other infections- those exposed to other infections such as malaria, intestinal worms, typhoid and other tropical diseases are more likely to succumb faster to AIDS.

2.2 HIV/AIDS and Nutrition

HIV infection may result in insufficient dietary intake, malabsorption and altered metabolism resulting in: weight loss, loss of tissue and muscle fat, vitamin and mineral deficiencies, decreased immune function and competence, increased susceptibility to secondary infections, increased nutritional needs due to decreased food intake and increased loss of nutrients leading to rapid HIV progression (FANTA, 2001).

HIV infection is more complicated than other infections because the virus attacks and destroys the cells of the immune system, which later affects other body organs, as they are easily attacked by other various infections. These infections affect the nutritional status by reducing dietary intake and nutrient absorption. At the same time they increase the utilization and excretion of other nutrients. This leads to malnutrition, including certain micronutrient deficiencies as the body tries to fight the HIV attack on its immune system (Minnie, 2008). This usually contributes to the weight loss and the wasting syndrome, mostly noted in adult AIDS patients. Decreased food intake is the most prominent factor leading to the development of malnutrition and subsequent wasting. Other major causes include malabsorption and alterations in metabolism (Minnie, 2008). Malnutrition can exacerbate the effects of HIV and hasten AIDS-related illnesses in people living with HIV and good nutrition is thus essential to keep healthy for longer. According to Friis, (2006) a stronger, healthier body can better resist the opportunistic infections that affect people living with HIV, especially in resource-poor settings where preventive health care is not often available.

2.2.1 Interaction between Nutrition and Antiretroviral Therapy

Food security and nutrition are fundamental to HIV treatment. There is emerging evidence that patients who begin antiretroviral therapy without adequate nutrition have lower survival rates. A study carried out in Singapore by Paton, (2006) to determine the impact of malnutrition on CD4 count response and survival in HIV-infected patients starting antiretroviral therapy concluded that patients starting antiretroviral therapy without adequate nutrition are six times more likely to die. Adequate dietary intake and absorption are therefore essential for achieving the full benefits of the treatment.

Antiretroviral therapy itself may cause certain side-effects such as loss of appetite. It is possible to reduce some side-effects and promote adherence to the therapy if some of the medicines are taken with food. Given the importance of adherence in delaying viral resistance to first-line drugs, nutritional support becomes even more important in the longer run for sustaining antiretroviral treatment (Seumo-Fosso and Castleman, 2004).

2.2.2 Nutrition Requirements for People Living With HIV /AIDS

Food and feeding in PLWHA take on new connotations; one no longer eats for the sake of reducing hunger but to fight the disease and marshal up energy to maximize the effects of medication. A healthy diet is regarded as the primary defense against rapid degeneration of the immune system. According to NASCOP (2007) healthy HIV-uninfected adults require between 1,990 and 2,580 kilocalories per day depending on sex, age, level of physical activity and physiological state. Adult HIV-infected not showing AIDS symptoms (WHO Stage I) need 10% more energy or about 200-250 additional kilocalories compared to uninfected

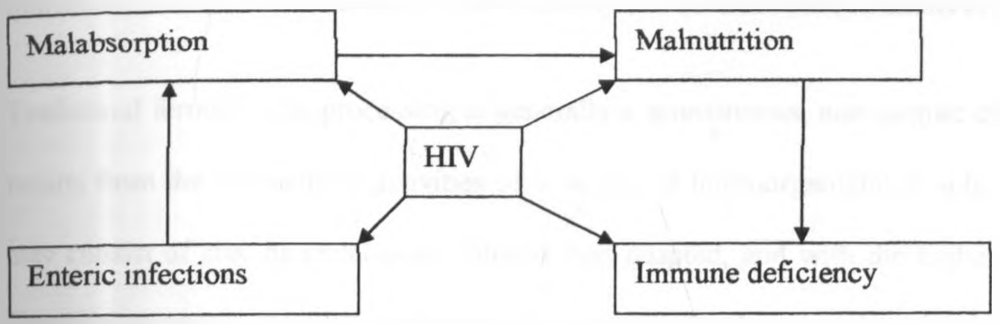
person; of the same age, sex, physical activity and physiological state. This translates into a food equivalent of about one additional snack (e.g. one mug of porridge) taken during the course of the day. Adults HIV-infected showing AIDS related symptoms (WHO Stage II and above) need 20% to 30% additional energy depending on the severity of symptoms, which is about 400 to 750 additional kilocalories depending on severity of symptoms. This translates into a food equivalent of between two to three snacks taken during the course of the day. Protein requirement for PLWHA are the same as that of non-infected persons i.e. 12 to 15% of the total energy needs. Also, the recommended fat intake for an HIV-infected person is the same as for a non-HIV- infected person, i.e. not more than 30-35 % of total energy needs. However, PLWHA on certain ARVs or with certain infection symptoms, such as diarrhoea, may require changes in the timing or quantity of fat intake.

Good nutrition for PLWHA also requires adequate consumption of all micronutrients but especially vitamins A, B6 (niacin) and B12, iron and zinc to build a strong immune system to fight infections (FAO, 2002). Vitamin A deficiency is associated with higher maternal–child transmission rates (Fawzi, 2002), faster progression from HIV to AIDS (Fawzi, 2003), higher infant mortality and child growth failure. The B group vitamins play an important role in immune regulations, and deficiencies play a role in disease progression.

2.3 Diarrhoea in HIV/AIDS

Weight loss and diarrhoea are the two major concerns with HIV/AIDS. Diarrhoea is mainly a health condition associated with low levels of friendly bacteria. It is a problem for many people with HIV/AIDS; it leads to loss of water and minerals from the body. The loss is even

greater when one is vomiting. In severe cases diarrhoea causes dehydration, poor absorption of food (due to flattening of the villous brush border of the gastric mucosa), significant weight loss and malnutrition resulting in weakness or further illness, see Figure 2.1 (Babgaleh et al., 1994). Diarrhoea may be a symptom of a disease or a side effect of medicines and is caused by contamination of food because of hygiene problems. It can be made worse by eating certain foods.



SOURCE: Babgaleh et al., (1994).

Figure 2. 1: The Relationship Between Malabsorption, Malnutrition, Immune Deficiency and Enteric infections.

Campylobacter sp., *Shigella* sp., *Salmonella* sp., *Vibrio cholerae*, enterotoxigenic *E. coli* (EPEC), enteroinvasive *E. coli* (EIEC), *Aeromonas* sp, are the most common bacteria causing diarrhoea while *Girdia lablia*, *Cryptosporidium*, *Capillaria* and *Trichuris* are the most common parasites causing diarrhoea (NASCOP, 2006). Rotavirus and Norwalk agent are the commonest viruses causing diarrhoea. The range of clinical symptoms from mild watery diarrhoea to dehydrating diarrhoea or dysentery depends on the type and infective dose of the organism. The parasite is easily spread by contaminated food or water or by direct contact with an infected person or animal.

2.4 Fermentation Process

The diet for persons with HIV-related infections should increase their appetite, and they should ingest enough nutrients to help the gastrointestinal tract manage and recover from diarrhoea and to regain weight and strength lost during illness (NFNC, 2004). All HIV-infected persons should eat as much as possible, particularly easy-to-eat and easily absorbed foods. Fermenting and/or germinating porridge makes it thinner, easier to swallow, and more nutritious; it also allows increased bioavailability of iron and zinc (Tomkins *et al.*, 1990).

Traditional fermentation processing is generally a spontaneous, non-aseptic operation, which results from the competitive activities of a variety of microorganisms in a bioreactor, which may consist of clay or metal pots. Strains best adapted, and with the highest growth rates, dominate under uncontrolled conditions. Fermentation has been used worldwide as a means of preserving food and increasing its nutritional value (Mbugua, 1995). A wide variety of foods may be fermented including milk, cereals, vegetables and root crops. Although detailed microbiology hasn't been done on many of these products, it's evident that a large number of different microorganisms are utilized. A closer examination shows that lactic acid bacteria (LAB) are often used in food fermentation processes (Lorri, 1993). Many LAB are considered probiotics, therefore, good for health.

2.5 Preparation of Fermented Porridge

Starchy porridges are by far the most common mode of utilization of starchy food in Africa. In Kenya porridge is known as *uji*. There are variations to the *uji* preparation in different parts of Kenya. *Uji* may be prepared by: (a) fresh flour plus water, boil and consume ("sweet

porridge"); (b) fresh flour plus water, ferment overnight, boil and consume (sour porridge); or (c) fresh flour plus water, boil, ferment and finally consume (sour porridge).

In the traditional way of making fermented *uji*, the cereal is first ground to a flour and mixed with water to form slurry at a concentration of about 30% w/v. The slurry (without inoculation) is then left at 25°C i.e. room temperature or near the fire place and is fermented for 1 to 3 days until the acidity reaches approximately 0.3% as lactic acid in order to increase nutrient intake (Mbugua and Njenga 1991). It is then diluted to about 10% solids, boiled, further diluted to 4 or 5% solids, sweetened with sucrose and consumed while still warm. The P^H of the final product is about 3.8 to 4.4; total acidity of the finished product is from 0.55 to 0.62% (Mbugua and Njenga, 1991).

2.6 Microbiology of Porridge

Microbial studies of the various flours used to make uji have revealed that the major constituents in the cereal flours are coliforms and yeasts and molds. Lactobacilli is a minor constituent (< 10 organisms/g flour), regardless of the cereal studied (Mbugua, 1995). During the first 24 hours of spontaneous fermentation coliforms predominate. Then the lactobacilli begin to dominate, and sufficient acid is produced to cause reduction in the number of total coliforms ensuring consumption safety of the final product. In typical uji fermentation *L. plantarum* is the predominant species of lactobacilli present (Mbugua, 1995).

2.7 Germination

The relatively high concentration of starch-containing staple foods that are often needed to achieve adequate energy density of porridges may result in final preparations that are too thick, or viscous. To reduce the viscosity of these porridges, the amylase and amylopectin fractions of starch must be partially hydrolyzed by the process of germination so that they swell less during cooking thereby reducing the bulk density by retaining less water (Tomkins *et al.*, 1990). Soaking seeds in water induces germination; it allows grains or seeds to sprout and produce small shoots resulting in production of amylase enzymes which breakdown starch, releasing sugars needed for the development of the now growing shoots. The process usually takes about 2 – 4 days (Tomkins *et al.*, 1990). Flour made from germinated grains contains amylase enzymes, which can make the food more liquid without reducing its food value. Germination can also be achieved by adding flours prepared from germinated grains (i.e. amylase-rich flours) to ungerminated flours.

2.8 Changes in Mineral Bioavailability Due to Germination and Fermentation

Studies in human beings and animals have confirmed that abnormalities of the immune system can be favourably affected by adjusting specific types of micro and macronutrients in the patient's diet. The deficiencies of micronutrients, especially iron and zinc, have been shown to influence susceptibility to infectious agents, including some opportunistic infections seen in patients with AIDS. Iron and zinc deficiencies provide conducive environment for *Candida* and *Salmonella* infections, which are both important conditions in HIV-infected individuals (Mosenon *et al.*, 1989).

Germination and/or fermentation of various food grains and legumes have been effective methods of improving nutritive value of foods. The low bioavailability of iron from cereal diets is explained by the presence of different inhibitors, occurring primarily in bran fraction; of these, phytates and tannins (polyphenols) are of major importance. Phytates are known to bind zinc and iron making them unavailable (Lorri, 1993).

Germination and more importantly perhaps, fermentation reduce levels of phytic acid and polyphenols (Kataria *et al.*, 1998). Germination increases the activity of endogenous phytases in cereals and legumes as a result of *de novo* synthesis or activation of the enzyme, although the extent to which this increase occurs depends on the species and variety.

Increases in, *in vitro* levels of soluble iron have been reported after fermenting porridges prepared from white sorghum and maize with a starter culture, with and without the addition of commercially prepared wheat phytase enzyme (Svanberg *et al.*, 1993). Investigation on the effect of natural fermentation on bioavailability of iron from high and low tannin sorghum varieties by Lorri, (1993) showed that lactic fermentation of non tannin cereals with added flour of germinated sorghum seeds or wheat phytase increased iron solubility form about 4% up to 9% and 50% respectively. The increase in soluble Iron was related to enzymatic degradation of phytate ($P<0.001$). Mahajan and Chauhan (1987) found out that the hydrochloric acid (HCL) extractability of calcium, iron, zinc and copper of pearl millet flour, an indication of their bioavailability, nearly doubled or more than doubled following natural fermentation. The levels of phytate reduction reportedly achieved by fermenting cereal-based flour slurries or porridges are variable, but reductions of about 50% appear achievable.

2.9 Changes in Digestibility Due to Germination and Fermentation

Tannins are known to bind proteins making them unavailable for digestion. Germination and fermentation offer unique nutritional approaches for making starch and protein (in pearl millet) more digestible. Studies by Lorri, (1993) and Mbugua, (1994) have shown that fermentation enhances nutritional quality of cereal porridges by improving protein and possibly starch digestibility, particularly in high tannin cereals such as sorghum. These studies have shown dramatic increase in protein efficiency ratio (PER) as well as in vitro protein digestibility in porridges made from brown or red sorghums through lactic fermentation. It is supposed that microbial enzymes produced during fermentation destroy tannins availing proteins for digestion. Mbugua *et al.*, (1992) observed a decrease in extractable tannins in fermented *uji* (a product prepared by boiling sorghum flour and fermented with 3-9% *Lactobacillus plantarum*.)

Germination of pearl millet for 24 hours was shown by Khetarpaul and Chauhan, (1990) to significantly improve its *in vitro* starch and protein digestibility. *In vitro* starch digestibility increased form 17% to 55% due to endogenous amylases while in vitro protein digestibility increased from 51% for raw to 77% due to endogenous proteases present.

2.10 Food Safety Accrued from Fermentation

Contamination of porridges occurs at the initial preparation when contaminated water is added. The situation is made worse by transfer of microbes from the hands of the food handlers at subsequent stages of food preparation. In addition to high temperatures in many

tropical communities, the long periods of storage between the time that the food is prepared and eaten may also contribute to high level of microbial contamination.

Cultures involved in *uji* fermentation have been shown to impart antimicrobial properties against diarrhoeal causing pathogens (Lorri, 1993). Fermented maize flour from Kenya has been demonstrated to have antimicrobial action against coliforms (Mbugua, 1988). Fermentation process also enhances food safety by reducing toxic compounds such as aflatoxins and cyanogens and produces antimicrobial factors such as lactic acid, bacteriocins, carbon dioxide, hydrogen peroxide and ethanol, which facilitate inhibition or elimination of food-borne pathogens.

Therapeutic properties of fermented foods have been reported. A study carried out by Kingamkono *et al.*, (1999) in Tanzania to evaluate the ability of a widely consumed fermented gruel to prevent enteropathogenic colonization and therapeutic influence against diarrhoea in children concluded that higher frequency and regular consumption resulted in significant reduction of faecal enteropathogenic bacteria in healthy children thus reducing the risk of diarrhoea. The result could be attributed to a synergistic effect due to a combination of lower transmission of enteropathogenic bacteria to consumers, inhibition of establishment of enteropathogenic bacteria in the intestines exerted lactic-acid bacteria activities and competition for nutrients and space. A significant faster recovery of the intestinal mucosa (damaged by diarrhoea) in pediatric in-patient children who were consuming the fermented cereal gruel compared to those fed on unfermented gruel was also demonstrated. This indicated presence of some useful factors in the fermented gruel that may be useful in

hastening the recovery hence improving nutrient absorption. These observations may have positive implications for HIV/AIDS patients who are at high risk of getting diarrhoea.

Despite the numerous benefits of fermentation, it must be recognized that not all pathogens are susceptible to its effects and other methods of control are necessary. For example some enteropathogens, such as *E. coli* 0157:H7 and some enteric viruses are acid resistant. There is little information on the impact of fermentation on enteric parasites such as *Cryptosporidium*, *Girdia* and trematodes, which often show resistance to adverse environmental conditions. Likewise, preformed toxins of *Staphylococcus aureus* and *Bacillus cereus* and toxins produced by certain molds are probably not affected by fermentation (WHO, 1998).

2.11 Other Benefits of Fermentation

Virtually all vitamins and minerals affect the immune system or are affected by infection. High or increased intake of the vitamins: thiamine (B1), riboflavin (B2), niacin (B3), pyridoxine (B6) and ascorbic acid (C) were, for the most part, associated with slower progression to AIDS in black South African AIDS patients (Kanter et al., 1999). Mbugua, (1986) analyzed the amino acid content of fermented porridge and noted significant increases in tryptophan and riboflavin. Fermentation has also been shown to reduce the cooking cycle for complete gelatinization of starch (Mbugua, 1994). This is important considering the scarcity in fuel plus the cost involved in cooking of food.

2.12 Gaps in Knowledge

People living with HIV/AIDS (PLWHA) require low cost, practical ways of ensuring they meet their increased nutritional demands. In general, there seems to be a big gap in the identification of locally appropriate, sustainable ways of increasing dietary intake to meet the additional energy needs of HIV infected adults (as well as children) in Kenya. Of particular interest to this study is the use of indigenous food technologies; germination and fermentation. Despite numerous documented evidence of the ability of the two technologies to improve nutritional quality of food, little research has been done to explore their potential in the context of HIV/AIDS.

CHAPTER 3: METHODOLOGY

3.1 Study Setting and Population

Nairobi is the capital city of Kenya, situated in the southern side of the agricultural heartland of Kenya with an estimated population of over 2.5million inhabitants (Central Bureau of Statistics, 2004). It is 1.19° south of the equator and 36.59° east of the prime meridian covering an area of 690km^2. It consists of eight divisions: Makadara, Starehe, Dagoretti, Kasarani, Embakasi, Westlands, Langata and Kamukunji. This study was carried out in the slums of Kasarani, Starehe and Embakasi divisions namely; Korogocho, Mathare and Soweto respectively.

There are no specific statistics on HIV/AIDS prevalence in these divisions but rates are considered to be generally high in the slums of Nairobi. There are various programmes targeting people with HIV/AIDS in the selected divisions but the Kenya Network of Women With AIDS (KENWA), programme under whose umbrella the study was carried out, is the only one specifically targeting women. As at the year 2006, the organization had 2,895 HIV positive members.

KENWA is a grassroots community based organization formed and run by women living with HIV/AIDS. It has five program sites in Pangani, Korogocho, Soweto, Mathare and Kiambiu. The organization has two main programme areas: (1) Advocacy and lobbying for the rights and needs of women living with HIV/AIDS and those of their children (2) Prevention, care and support of women with HIV/AIDS and their children. KENWA serves as a forum with objectives to empower women to: (i) Challenge the stigma, discrimination and isolation (ii)

Advocate for their rights and that of their children (iii) Support one another psychologically and materially (iv) share experiences and encourage one another (v) Develop coping strategies.

3.2 Study Design

A cross-sectional, descriptive & analytic study was carried out to determine the use of fermentation and germination technologies and implication of such use to the health and nutrition status of women living with HIV/AIDS in Nairobi.

3.3. Sample Size Determination

The sample size was determined by the following formula (Fischer, 1991)

$$N = (Z^2pq/ d^2)$$

Where N = sample size

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

p = proportion of WLWHA assumed to be preparing and consuming porridge

q = 1 – p

d = the precision estimate, in this case was 10%

Using d=0.1; z=1.96 and estimating the proportion of WLWHA preparing and consuming porridge to be 50%, p=0.5; q=0.5. The required sample size is calculated as:

$$N = \frac{1.96^2(0.5)(0.5)}{0.1^2} = 96$$

Add 20% attrition ≅19

Total sample size required is thus approximately 115.

Due to a large turnout of would-be respondents, a sample of 150 was taken to avoid shunning a large number away. In addition to these another 11 respondents were interviewed in the focus group discussion for cross checking purposes.

3.3.1 Determination of Sub-sample Size for 24 hour recall

A sample size of 30 was taken for the 24-hour recall. This sample size was chosen to reduce workload to a manageable level; the method being tedious and considering the relatively short time available for research. A sample size of 30 would provide enough data to allow for statistical manipulation and analysis.

3.4 Admission Criteria into the Study

Female of reproductive age and at the asymptomatic phase of HIV infection (NASCOP, 2006) were selected (see appendix V). Women were specifically chosen due to the high HIV/AIDS prevalence rates recorded for this particular group. For every infected male there are two infected females according to 2003 Kenya Demographic Health Survey (KDHS) (CBS, 2004). Further, those in the asymptomatic stage of HIV infection were chosen because at this stage the nutritional requirements have not increased too much and modest interventions to improve the nutritional value of food may have significant impact.

3.5 Sampling Procedures

The sampling methods used were random and purposive as shown Figure 3.1. The required sample was picked from the members of KENWA, a grassroots community based NGO formed and run by women living with HIV/AIDS with its activities mainly in the slums of Nairobi. Of the five programme sites that the organization runs, 3 were purposively selected i.e. Korogocho, Soweto and Mathare due to the relative ease in commuting between the three. First, a list of registered members was obtained at each site. Consent forms (Appendix V) to take part in the study were administered to all registered members of KENWA in asymptomatic phase of HIV infection in the 3 sites selected for study. All eligible participants who consented to taking part in the study were registered to make a sampling frame for each study site. Simple random sampling was applied to each sampling frame to allow for only 50 respondents at each of the respective sites. In each of the three study sites selected, only 10 respondents were randomly selected for administration of the 24-hour recall. In total 120 respondents were interviewed excluding the 24-hour recall while 30 were interviewed including the 24-hour recall (Figure 3.1).

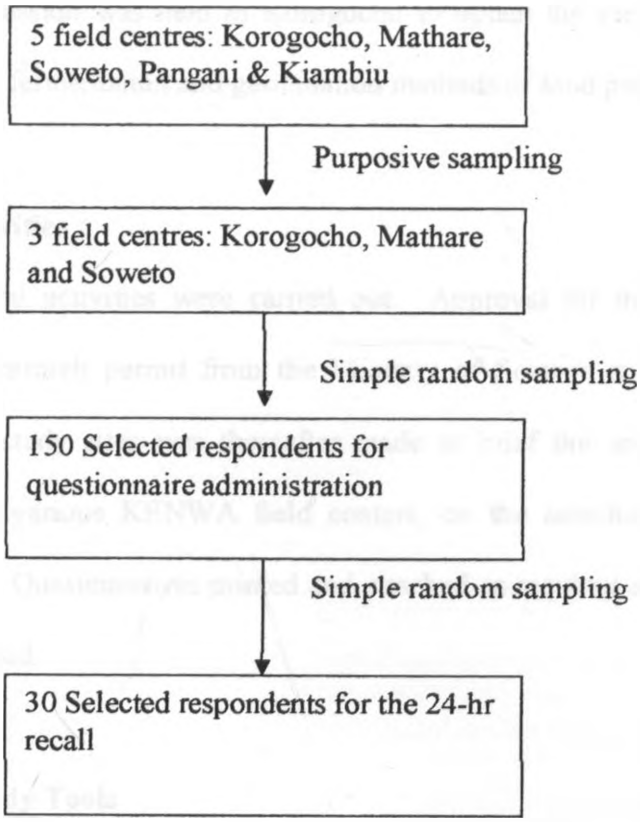


Figure 3. 1: Schematic presentation of sampling procedure

3.6 Survey Tools

The tools used in this survey included a pre-tested structured questionnaire, food frequency checklist, 24-hour recall and focus group discussion guides (Appendices I and II).

3.7 Data Collection Procedures

Data collection included: a pre-market survey, administration of structured questionnaires and focus group discussions. The structured questionnaire was administered to the respondents (once) at respective field centers on separate dates agreed upon. Visits were made to the selected households on dates agreed upon with the respondents to collect data for the 24-hour

recall. On completion of the data collection exercise for the questionnaires at all the selected sites, a focus group discussion was held in Korogocho to obtain the views of the women living with HIV/AIDS on fermentation and germination methods of food preparation.

3.8 Preliminary Activities

Before the survey, several activities were carried out. Approval for the study was first sought by obtaining a research permit from the Ministry of Science and Technology. A preliminary visit to the study sites was thereafter made to brief the area chiefs and the officers-in-charge at the various KENWA field centers, on the intention to carry out a research and its purpose. Questionnaires printed and attached as required and equipment for the 24-hour recall purchased.

3.8.1 Pre-testing of Study Tools

Pre-testing was carried out at on 14 respondents (approximately 10% sample size) at Pangani, one of the field centers run by KENWA. Results of the pretest were not included in the study results. The study tools were revised and modified after pre-testing.

3.8.2 Recruitment and Training of Research Assistants

Two research assistants were recruited and trained on administration of the research tools. The assistants were high school leavers (O-level), fluent in both Kiswahili and English. The training was conducted for three days at the Pangani drop in center. The first day covered a briefing on the study objectives, questionnaire administration; interviewing techniques (how to introduce oneself before starting an interview, how to probe for answers etc) and translation

of the questionnaire into Kiswahili. The second day involved a demonstration followed by role plays amongst the trainees on how to administer the questionnaire (Appendix I), mock interviews for the assistants using the pre-tested and corrected questionnaires to individuals visiting the center. The third day involved a review of the progress made and a discussion on the anticipated problems based on the pre-test to identify errors and make necessary corrections. The day ended with a visit to the study areas for familiarization. Actual data collection was conducted three days following the training. The mock interviews were not included in the study.

3.8.3 Pre-market Survey

Market surveys were conducted at the respective local markets of the selected study areas (Korogocho, Soweto and Mathare), prior to commencement of the actual data collection to establish the common types of food purchased by residents and the corresponding weights and units in which the foods were sold. This was used to develop conversion factors for the foods consumed by the study women, to be used in nutrient intake analysis from the 24-hour recall data.

3.9 Questionnaire Data Collection

Interviews were conducted on the selected respondents using the pre-tested structured questionnaire. Data were collected on the following aspects:

(a) Household Socio-demographic Characteristics

Data collected included relationships in the household, sex, age, marital status, religion, level of education and occupation of household members.

(b) Source of Food

This included data on the main source of food for the household. Also covered is information on whether supplements were being taken.

(c) Food Consumption Patterns

This covered information on frequency of consumption of certain types of foods; the food frequency checklist was used for this purpose. Views of the respondents on use of fermented and/or germinated porridge flour were also obtained in this section.

(d) Porridge Preparation Methods and Ingredients

The data on consumption of porridge flours were collected to establish the number and types of cereals used in formulating porridge flours and treatments applied to component flours during preparation. Proportions of flour ingredients and methods of porridge preparation were also established.

(e) Morbidity, Hygiene and Sanitation

This section provided data on the general personal hygiene of the respondents. It also provided information on the morbidity experience of the study respondents.

(f) Anthropometry

For each selected respondent weight and height measurements were taken using a bathroom scale and tape measure respectively. To obtain the height, respondents were asked to remove their shoes, stand perpendicular to flat, straight wall and to look up straight to allow for accurate measurement.

(g) 24-hour Recall

Data to facilitate determination of dietary adequacy was obtained using the 24-hour recall (Hartog et al., 1995) (Appendix I), on a sub-sample of 30 respondents. Data obtained helped establish the types of dish (food or drink) consumed, type and amounts of ingredients used during preparation and as such the amount of selected nutrients (iron and vitamin A) consumed per person per day.

The quantities of foods prepared and consumed were estimated using a kitchen weighing scale, volumetric cups, jars or spoons as appropriate; quantities used were recorded in grams (weight) or millilitres (volume). Where the actual foods were not available, food models were shown to the respondents to enable them recall the size and number of units of food used in the food preparation. Only the edible food portions were taken into account in cases where a food had parts that were trimmed off in its preparation.

3.10 Focus Group Discussions (FGD)

One FGD was held, the purpose of which was to crosscheck results obtained from the questionnaire interviews carried out. Views from WLWHA (who had not been included in the questionnaire interviews) were sort on various issues including: the use of fermentation and germination technologies in the preparation of porridge. FGD guidelines developed prior to the study were used to guide discussions (Appendix II). The FGD lasted 45minutes and consisted of 13 people; 11 women living with HIV/AIDS randomly selected (3 from Soweto, 4 from Mathare and 4 from Korogocho), an observer (who doubled as the recorder) and a leader of the discussions. Discussions were held at the KENWA Korogocho field center.

3.11 Data Quality Control

To ensure high quality of data, assistants were thoroughly trained on data collection procedures. Debriefs of each day's activities with the research assistants were held to identify problems and develop solutions. Research assistants were closely supervised. Only a maximum number of 5 questionnaires per assistant per day were allowed to prevent exhaustion that would otherwise lead to erroneous data entry.

3.12 Data Management and Analysis

All open-ended responses were manually coded. The instructions for coding were prepared after data collection, to capture all the views presented. Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 12. Proportions, frequencies, means, standard deviations, percentages and measures of relationship were computed using SPSS. Descriptive statistics were used to describe demography, nutritional status and porridge consumption levels and preparation methods and graphical presentations made using tables and figures such as bar charts and pie charts. Relationships between various variables including: Body mass index (BMI) versus household size and BMI versus caloric dietary intake was assessed using chi –square tests and pearson's correlation tests.

Hygiene Standards

Three health workers working with KENWA were used as key informants in the development of a hygiene index. The key informants helped to develop an index by first identifying good hygiene practices and then assigning weights to the identified practices (Appendix VI). The

sum of the weights allocated to the various hygiene practices identified represented the hygiene level of the respondent. Based on the index, respondents were classified into three levels of hygiene standards: Poor (0- 3), fair (4 – 6) and good (7– 10).

Energy and Nutrient Intake Assessment

Individual respondent nutrient intake levels were calculated using information obtained from the 24-hour recall conducted. The estimate amounts of food consumed were converted from household measures to grams (gms). Conversion was done using graduated measuring cylinders to estimate food volumes and/ or kitchen scales to estimate food weights. Food models were also used in cases where there were no left over ingredients to enable measurement. In cases where the respondents gave the ingredients in terms of their money worth in the market, samples of such foods were bought and weighed.

The proximate energy, protein and micronutrient (vitamin A and iron) intake of each food ingredient consumed were calculated using food composition tables (Sehmi, 1993). Based on the amount of a particular food consumed by an index respondent 24 hours prior to the study, syntax was generated to calculate the actual amounts of selected nutrients consumed in that particular food (Appendix VII). For vitamin A, the value obtained from the food compositional tables as IU retinol was converted to μg equivalent using the conversion factor: 1IU retinol = 0.300 – 0.344μg (Zapsalis and Beck, 1985).

When infected with the HIV virus the body's immune system works harder to fight infection. This increases energy and nutrient requirements. Further infection and fever also increase the

body's demand for food. Once people are infected with HIV they have to eat more to meet these extra energy and nutrient needs. Such needs will increase even further as the HIV/AIDS symptoms develop (FAO, 2002). A healthy non-HIV infected non-pregnant woman aged 18 - 50 and with moderate activity level needs about 2200 Kcal/day of energy in order to maintain the required body weight (National Research Council, 1989). A HIV infected adult woman in the asymptomatic phase of HIV/AIDS infection with the same description requires 10% more energy according to (NASCOP, 2007) amounting to 2440Kcal/day. For the asymptomatic patient, proteins should constitute 12%– 15% and fat 30%-35% of the total energy requirement (NASCOP, 2007). Thus, based on 2440Kcal/day energy intake requirement for the asymptomatic HIV-infected female, the specific nutrient intake levels were calculated as follows (Table 3.1)

Table 3.1: Recommended daily intake of energy and selected nutrients for asymptomatic HIV-infected, non-pregnant females of reproductive age

Nutrient	Recommended Daily Intake
Energy	2440Kcal/day
Protein	73g/day – 92g/day
Fat	81g/day – 95g/day
Vitamin A	500µg/day
Iron	20 – 30mg/day

Nutritional status

The nutritional status of the respondents was measured by calculating the body mass index (BMI) as: weight of index person in kg/ (height in metres^2) of index person. The BMI values so obtained were then classified into 4 groups based on (NASCOP, 2007) i.e. <18.5 – underweight, 18.5 to 25 – normal, >25 to 30 – overweight and 30+ - grossly obese.

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CHAPTER 4: RESULTS

4.1 Socio-Demographic Characteristics of Study Population

To better understand the study sample, it was important to provide a picture of the wider population from which the sample was drawn. A description of the population from which the sample was drawn enabled context specific analysis. Some important characteristics of the population were investigated including average household size and religion were assessed as well as specific characteristics of the respondents including education level.

Table 4. 1: Selected demographic characteristics of the study population

Household characteristic	Proportion (N=150)
Gender of household head	
Male	20
Female	80
Household religion	
Christian	98
Muslim	2
Level of education of respondents	
None	15
Primary	63
Secondary	21

As shown in Table 4.1, the vast majority of households, were Christian and female-headed About one third (36.7%) of the households had less than 3 members, 44.7% had 4 to 6 members while 18.7% had more than 6 members. The average household size was 4.49±0.17 (at the 95% level of confidence).

4.1.1 Occupation of Household Head

Different job categories attract different range of income. Generally, technical jobs, professional jobs and business enterprises with large capital bases attract higher incomes compared to job categories that require little or no specialized skill or businesses that have very small capital bases. This study revealed that casual labour (e.g. washing clothes) was the main source of income for majority of the households, followed closely by small business enterprise (see Table 4.2).

Table 4. 2: Occupation of study respondents

Occupation	Percent (%) (N=150)
Casual labour	40
Small business owners	37
Unemployed / housewife	9
Employed (salaried)	7
Commercial sex worker	7

4.1.2 Marital Status of Respondents

Table 4.3 shows the distribution of the respondents by their marital status. A quarter of the women interviewed were single, another quarter widowed and just slightly above a quarter were married (mostly in monogamous relationships). Those separated/ divorced made up for 22% of those sampled.

Table 4. 3: Marital Status of Respondents

Marital status	Percent (N=150)
Single	25.3
Married Monogamous	24.7
Widowed	24.7
Separated / Divorced	22.0
Married polygamous	3.3

4.2 Morbidity Experience of the Respondents

Disease is one of the immediate causes of malnutrition. In determining the incidence of disease in the population, the study sought to establish the vulnerability of the subject population to malnutrition. From the study respiratory diseases (pneumonia, dry cough and flu) accounted for a majority of the illnesses reported for the two week period prior to the study. Other illnesses included malaria, diarrhoea and associated symptoms of appetite loss (1.1%) and vomiting (see Figure 4.1).

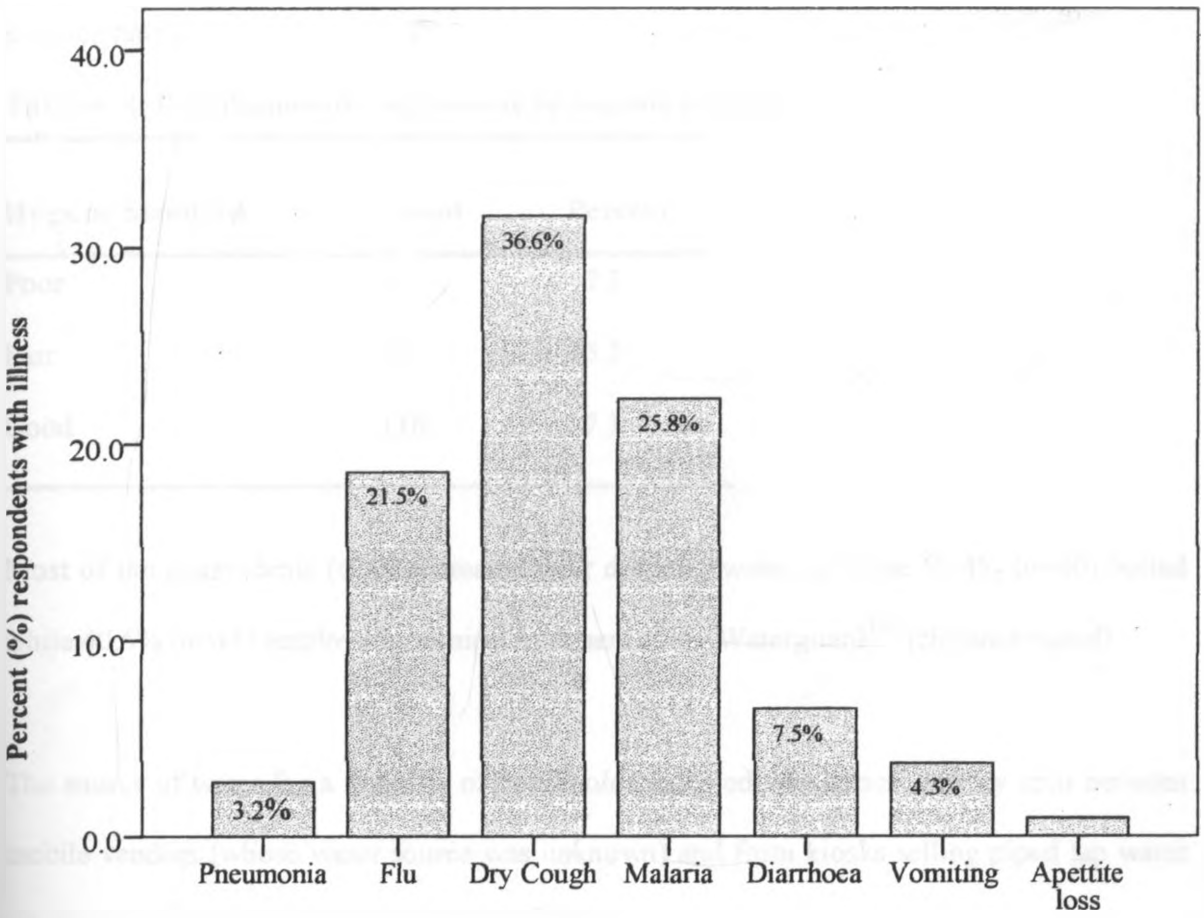

Figure 4. 1: Distribution of disease experience among study group

Of the individuals sampled 47.3% (n=71), were under septrin prophylaxis, 52.7% (n=76) were not. Also, majority of those sampled (64%, n=96) were taking antiretroviral drugs (ARVs).

4.3 Sanitation, Hygiene Practices and Prevalence of Diarrhoea

Poor personal and environmental sanitation are underlying factors causing malnutrition. Results from the study showed that more than three quarters of the respondents (77.3%) had

good levels of hygiene practice. Table 4.4 shows the distribution of respondents by hygiene practice rating.

Table 4. 4: Distribution of respondents by hygiene practice

Hygiene Standard	Count	Percent
Poor	11	7.3
Fair	23	15.3
Good	116	77.3

Most of the respondents (67.3%) treated their drinking water, of these 59.4% (n=60) boiled while 40.6% (n=41) employed chemical treatment using Waterguard™ (chlorine-based).

The source of water for a majority of households sampled was almost equally split between mobile vendors (whose water source was unknown) and from kiosks selling piped tap water i.e. 50.3% (n=76) and 49.3% (n=74) respectively.

Poor hygiene practice increases vulnerability to food borne and water borne diseases including diarrhoea. An analysis to establish the relationship between diarrhoea incidence and application of water treatment was carried out for this study. Due to the low numbers of respondents reporting diarrhoea, however, it was impossible to statistically establish a relationship (if any). Table 4.5 shows the distribution of diarrhoea incidence in relation to water treatment.

Table 4. 5: Relationship between water treatment method, source of water and incidence of diarrhea for the respondents

Water Treatment method	Source of water		Diarrhoea incidence
	Tap water kiosks (Percent)	Mobile vendors (Percent)	
None	40.8	59.2	4
Chemical	56.1	43.9	1
Boiling	51.7	48.3	2

4.4 Frequency of Food Consumption

For proper nutrition, it is imperative to not only eat adequate amounts of food but a variety as well. Different types of foods provide different types of nutrients and in varying amounts. Based on information obtained from the food frequency questionnaire, cereal-based porridge was the most consumed energy giving food on a daily basis followed by *ugali* as shown in Table 4.6. Detailed daily consumption patterns of food in the study population are shown in Appendix III.

Table 4. 6: Daily consumption of selected cereal products, roots and tubers

Cereals product, Roots and Tubers	Count (n)	% Responses
Porridge	109	72.7
Ugali	89	59.3
Bread	29	19.4
Irish potato	20	13.3
Sweet potato	14	9.3

As shown in Table 4.7, fresh milk was the most commonly consumed among body building foods on a daily basis followed by beans and greengrams.

Table 4.7: Daily consumption of selected legumes and milk

Legumes and milk	Count (n)	%Response
Fresh milk	21	14.0
Beans	11	7.3
Greengrams	10	6.7

The general consumption of fruits and vegetables was low (Table 4.8). Among the vegetables, kales (*sukuma wiki*) were the most commonly consumed and both oranges and ripe bananas among fruits.

Table 4.8: Daily consumption of selected fruits and vegetables

Fruits and Vegetables	Count (n)	%Response
Ripebanana	46	30.7
Oranges	46	30.7
Kale	28	18.7
Cabbage	16	10.7
Pawpaw	12	8.0

Tea among the breakfast beverages was the most consumed on a daily basis (Table 4.9).

Table 4. 9: Daily consumption of breakfast beverages

Beverage	Count (n)	% Response
Tea	101	67.3
Soya	4	2.7

Overall, daily food consumption indicated that porridge was the most commonly consumed (72.7%), followed by tea (67.3%) and *ugali* (59.3%). The FGD, confirmed this finding in that participants mentioned *ugali* (with kales), tea and porridge as foods they ate on an almost daily basis. They also mentioned that although they would have liked to make the regular inclusion of other foods in their diet, they could not afford them. Particularly, participants mentioned that they would have liked to have more fruits in their diet but they were beyond their reach in terms of cost.

4.4.1 Utilization of Porridge

General information on porridge consumption indicate that it is a popular meal within the study population (96% indicating consumption). Further interrogation of frequency of porridge consumption reveals daily intake levels of 72.7% (Table 4.6). Popularity of porridge consumption is validated by results of a focus group discussion (FGD) in which all the participants (n=11) agreed that they took porridge on an almost daily basis. The reasons given for consumption of porridge during the household interviews were varied (Figure 4.3). Reasons such as it being nutritious or affordable were however the most common. Participants in the FGD mentioned taking porridge for the reasons that it was nutritious and increased appetite. In the FGD, participants said they felt energized/ strong after taking porridge. Giving her experience during the discussion, one respondent said she'd normally feel physically drained and drowsy after taking her medication (ARVs) but that she felt rejuvenated and strong almost immediately after taking porridge. Participants felt that porridge, and in particular the one they received at the feeding centre was nutritious because it had a mix of high quality ingredients.

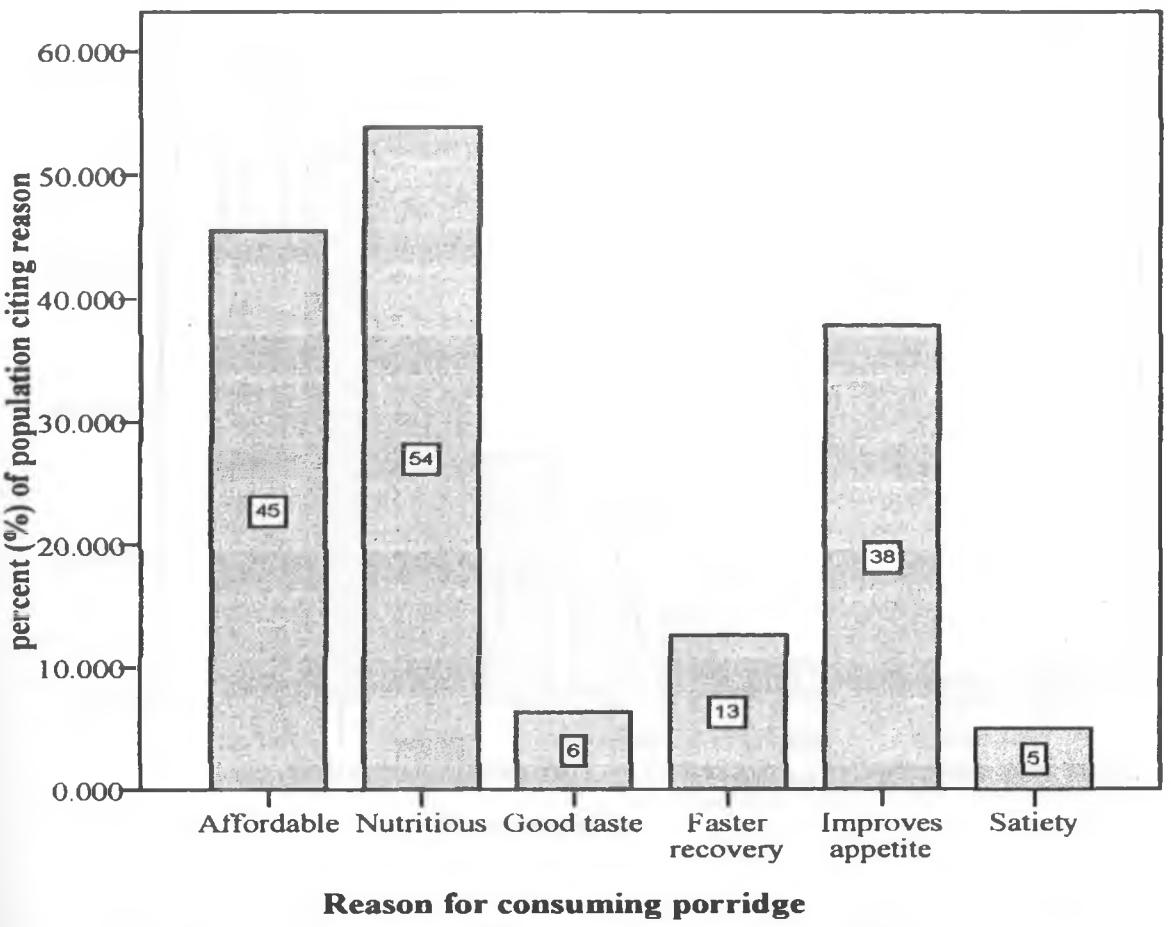

Figure 4. 2: Distribution of study sample by reason for porridge consumption

Although staple cereals are conventionally used in the making of local Kenyan porridge (*uji),* other ingredient flours may be incorporated. From the study, millet was the most commonly used ingredient in the making of porridge (88%). The use/incorporation of other flour ingredients was as shown in Figure 4.3.

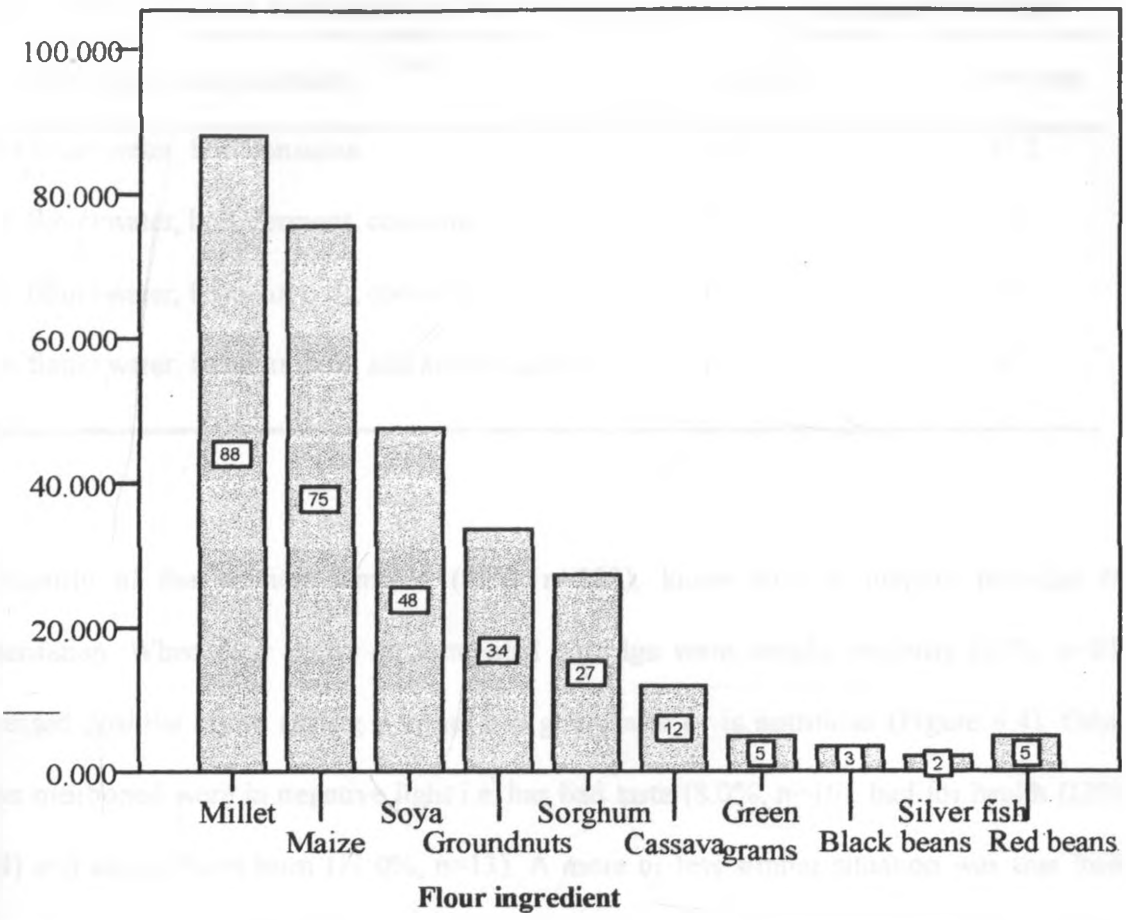

Figure 4. 3: Distribution of respondents by ingredients used in porridge preparation

Porridge may be prepared in a number of different ways including the application of traditional food technologies like germination (using germinated cereal) and fermentation. Results from this study indicated that out of the respondents who took porridge (96%, n=144), the majority prepared porridge simply by adding flour to water and then bringing it to boil (Table 4.10). Only 2.1% mentioned fermenting porridge and only 0.7% added *kimea* (germinated cereal).

Table 4. 10: Frequency distribution of respondents by porridge preparation method

Porridge preparation method	Count (n)	Percent
Fresh flour+water, boil consume	140	97.2
Fresh flour+water, boil, ferment, consume	2	1.4
Fresh flour+water, ferment, boil, consume	1	0.7
Fresh flour+water, ferment, boil, add *kimea*, consume	1	0.7

A majority of the women sampled (82%, n=123), knew how to prepare porridge by fermentation. When their views on fermented porridge were sought, majority (65%, n=81) expressed positive views saying it either has good taste or is nutritious (Figure 4.4). Other views mentioned were in negative light i.e. has bad taste (8.0%, n=10), bad for health (12%, n=14) and causes heart burn (11.0%, n=13). A more or less similar situation was true from discussions in the FGD. Majority of those included in the FGD, (63%, n=7) knew about fermented porridge even including its preparation process. However, none of the participants in the FGD employed porridge fermentation. The main reasons given were a lack of time and the fact that it caused them heartburn.

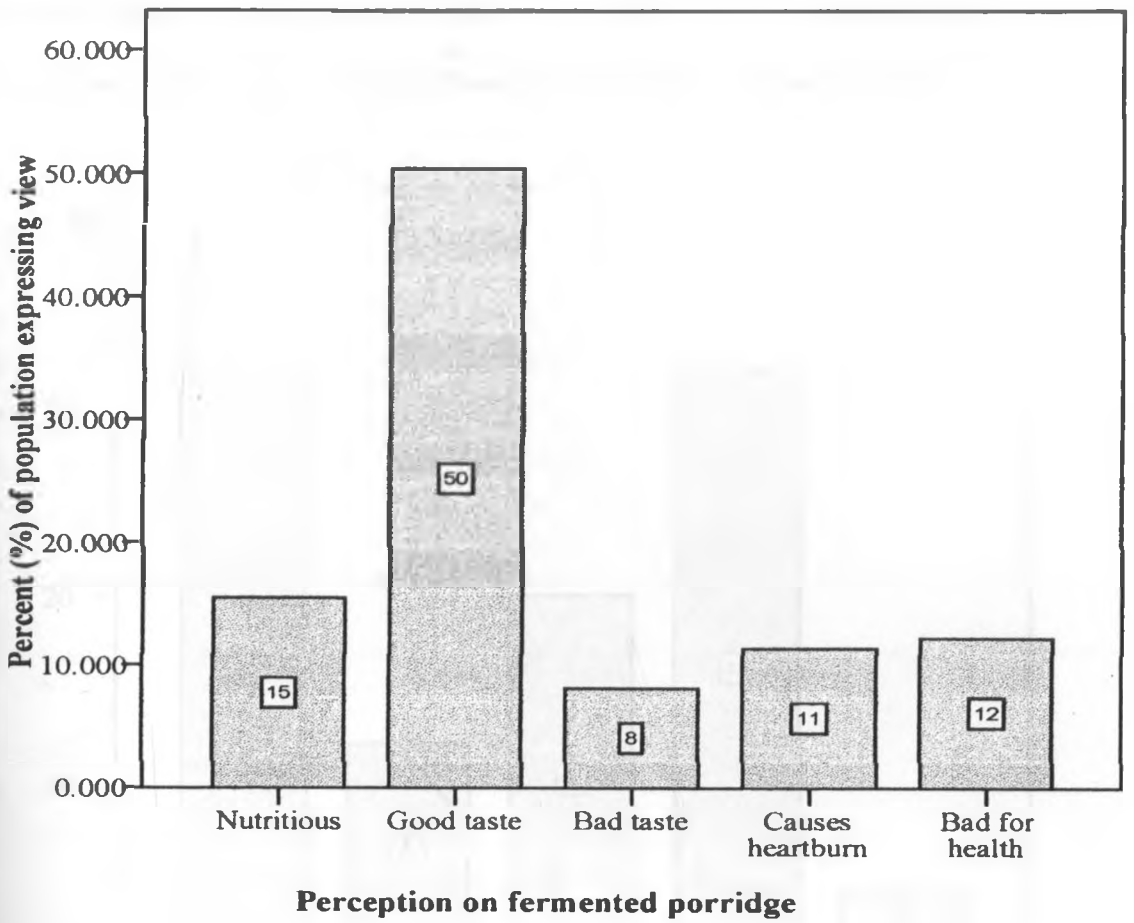

Figure 4. 4: Distribution of respondents by their views on fermented porridge

Very few respondents (16.7%, n=25) knew about the use or effects of addition of *kimea*[1] to porridge. The following views were expressed in relation to the use of *kimea* in the making of porridge (Figure 4.5): results in improved taste, makes porridge nutritious, bad for health, causes heart burn, and results in thinning of porridge. In the FGD, except one, all did not know of porridge preparation using *kimea*. The one lady, who knew about *kimea* mentioned

[1] Amylase rich flour (ARF) made from germinated sorghum or millet

that *kimea* made porridge light and improved its taste. Many of the participants in the FGD knew *kimea* but only in the making of local alcoholic brews and not porridge.

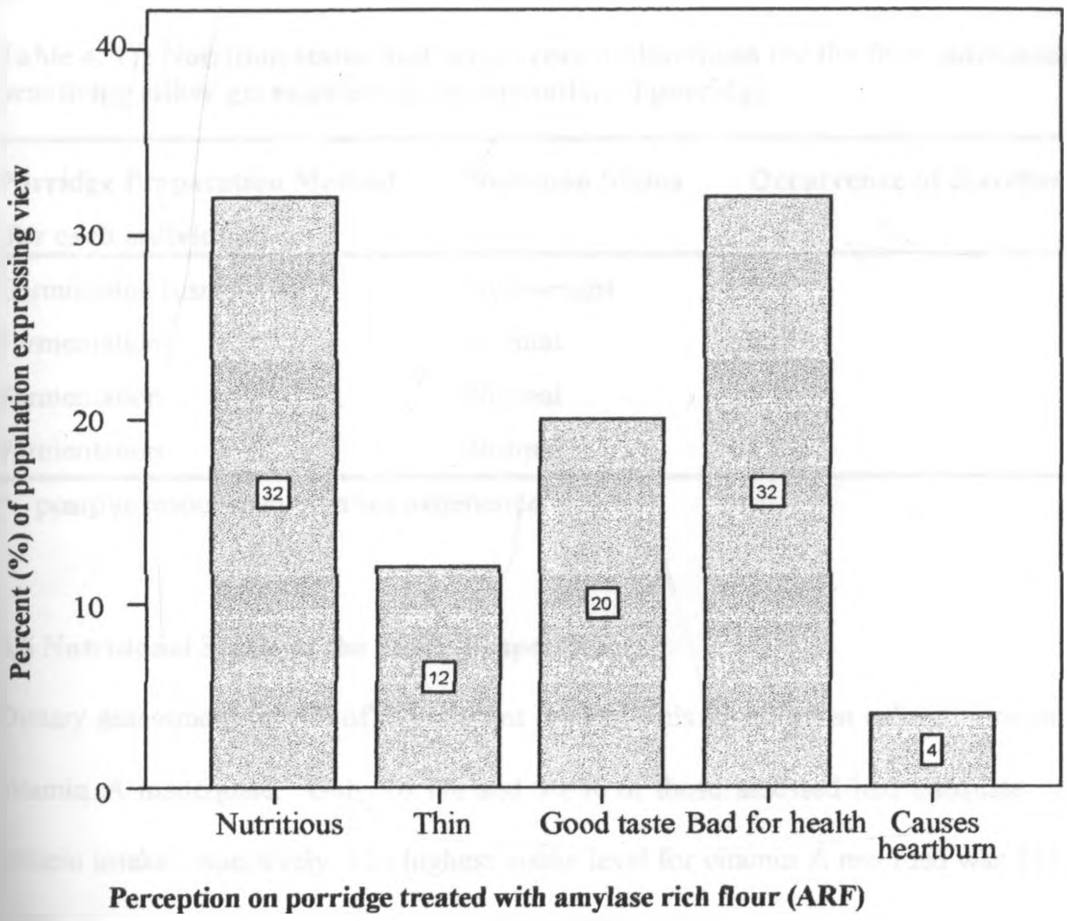

Figure 4. 5: Distribution of respondents by views on porridge prepared by adding ARF

The proportion of the study population that employed either fermentation or germination (through addition of *kimea*) technologies was too small to allow for statistical manipulation in relation to nutritional status or incidence of diarrhoea among the study respondents. Out of the 96% (n=144) who prepared porridge, only 3% (n=4) employed the technologies. Table 4.11

however gives a summary of the incidence of diarrhoea and nutrition status of the respondents in relation to porridge preparation method for the few who employed either germination or fermentation.

Table 4. 11: Nutrition status and occurrence of diarrhoea for the four individuals found practicing either germination or fermentation of porridge

Porridge Preparation Method (for each individual)	Nutrition Status	Occurrence of diarrhea
Germination (using ARF)	Overweight	0
Fermentation	Normal	0
Fermentation	Normal	0
Fermentation	Normal	1*

* - positive response to diarrhea experience

4.5 Nutritional Status of the Study Respondents

Dietary assessment (n=30) of the nutrient intake levels found mean caloric, protein, iron and vitamin A inadequate. Only 16.7% and 30 % of those assessed had adequate caloric and protein intake respectively. The highest intake level for vitamin A recorded was 311.2µg/day, still far below the recommended intake level (Table 4.12).

Table 4. 12: Nutrient adequacy of the diet taken by the study individuals

Nutrient	RDA*	Mean intake**	% Below RDA	% with inadequate intake
Calorie	2440Kcal/day	1674 ± 171.5Kcal/day	31.4%	83.3%
Protein	73 – 92g/day	56.7 ± 6.3g/day	22.3%	70.0%
Iron	20-30mg/day	15.37 ± 1.2mg/day	23.2%	53.3%
Vitamin A	500µg/day	284.9± 4.3µg/day	43.2%	100.0%

RDA* - Recommended Daily Allowance; Mean intake ** - at 95% level of confidence

Anthropometric measurements were also taken to further examine the nutritional status of the study respondents. Body mass index (BMI) results showed that a majority (56.7%) of those interviewed to be of good nutrition status (Table 4.13).

Table 4. 13: Nutritional Status of the Respondents based on BMI

BMI* Category	Frequency (n)	Percent	Nutritional status
<18.5	27	18.0	Underweight
18.5 - 24.9	85	56.7	Normal
25 – 29.9	38	25.3	Overweight

BMI* - Body Mass Index

There was no significant association established between BMI and household size (p=0.781). (See table 4.14). Further, correlation tests (pearson's correlation) for the two variables revealed no significant relationship ($r = -0.01$).

Table 4. 14: Association between household size and body mass index (BMI)

HOUSEHOLD SIZE	BMI			P – value
	<18.5	18.5 – 24.9	25 - 30	X^2 test
≤ 3 members	12	30	13	0.781
Between and Including 4 and 6	12	37	18	
≥ 6 members	3	18	7	

Significant at p<0.05

Based on data from individuals (n=30) included in the dietary assessment of nutrient intake (using the 24 hour recall method), a chi-square test to establish association between BMI and total energy intake was carried out. Results showed no significant relationship i.e. $p>0.05$, (see table 4.14).

Table 4. 15: Association between Total Energy intake and Body Mass Index

BMI	**Energy intake level**		**P – value**
	%Inadequate	**%Adequate**	**X^2 test**
Below 18.5	23.3	0	0.339
18.5 – 24.9	43.3	10	
25 - 30	16.7	6.7	

Significant at $p<0.05$

CHAPTER 5: DISCUSSION

5.1 Socio-Demographic Characteristics of the Study Population

Nutrition deficiency diseases in developing countries are primarily due to inadequate diets. They are also closely related to poor socio-economic and environmental conditions prevailing in these areas. The populations are usually of low socio-economic status, which is determined by socio-demographic characteristics such as large family sizes, high birth rates, low formal education levels, lack of health and nutrition education and poor environmental sanitation (Mitullah, 2003).

5.1.1 Household Type

From a number of studies done in informal settlements in Nairobi, a majority of households are struggling male-headed households, while a significant but lesser percentage are female-headed households who in many cases take care of their children, grandchildren and other relatives (Mitullah, 2003). In this study, however, majority of the households are female-headed. The fact that the study population focused on women living with HIV/AIDS could have contributed to the special results observed. HIV/AIDS is a fatal disease. If infected, chances that one if not both couples succumb to the disease are high. It is no wonder that a quarter of the respondents interviewed are widowed. In addition, there is a lot of stigma attached to HIV/AIDS. Stigma associated with the disease could be a contributing factor to a number of respondents (22%) being either divorced or separated.

5.1.2 Occupation of the Household Head

Slums are homes to urban residents who earn comparatively low incomes and have limited assets. Livelihoods are earned through different forms of economic activities, which include employment as house-helps, waiters, bar men and maids, drivers, watchmen, shop assistants, casual labourers in factories and construction sites, artisans, small business owners, and other income generating activities such as herbalists, entertainers, carriers of goods and any other assignment with money attached (Mitullah, 2003). An enumeration in Huruma by the Pamoja Trust shows that the largest single occupation group is small scale enterprise, followed by casual labourers, artisans, and formal employment as watch- men, domestic workers, clerks, and waiters (Mitullah, 2003). The findings of the current study, in which casual labour and small business enterprises are the main source of income, are in line with what is documented in literature. The low education standards or a lack of it for a majority of the population could be contributing to the situation observed.

5.2 Morbidity, Water, Sanitation and Hygiene

Poor environmental conditions including crowding and lack of clean water contribute to most of the ailments within slums (Mitullah, 2003). Common ailments in slum areas include malaria and waterborne diseases such as typhoid and cholera. Other common ailments include measles, flue, HIV/AIDS, and TB. This is in line with the findings of this study where malaria accounts for one quarter of illnesses reported and respiratory diseases (pneumonia, dry cough and flue) two thirds. The crowded living conditions found in the slums which encourage faster spread of communicable diseases combined with the cold weather season during which the study was carried out could have been factors that contributed to the high incidence of

respiratory diseases observed. Additionally opportunistic respiratory diseases associated with HIV/AIDS such as pneumonia could be contributing to the morbidity situation observed.

PLWHA are easily attacked by many illnesses that can affect their food intake and their nutritional status. The common HIV symptoms that affect food intake include: thrush, mouth and throat sores, fever, fatigue/lethargy, diarrhoea, nausea/vomiting, taste alterations, loss of appetite (anorexia), and fat malabsorption (NFNC, 2004). In the two weeks just preceding the study, there were only 7 reported cases of diarrhoea amounting to an incidence rate of 1/300women/day.

The relatively low incidence of diarrhoea cases may be attributed to intake of septrin®/ cotrimoxazole prophylaxis among the study subjects. A study of adult HIV-infected adults in Uganda showed that correct and consistent use of cotrimoxazole prophylaxis reduced diarrhoea by 35%, malaria by 72% and hospitalizations by 31% and mortality by 46% (PEPFAR, 2006). In addition to septrin® prophylaxis, about 43% of the respondents treat their drinking water with waterguard™, a chlorine-based water treatment product. When waterguard™ is correctly added to water, it purifies it from bacteria that cause cholera, diarrhoea and other fatal diseases rampant in slum areas where sanitation is poor.

In a study on Population and Health Dynamics in Nairobi's informal settlements, it was noted that lack of toilets was the most commonly cited health-related problem, followed by poor drainage and water supplies and lack of health services (APHRC, 2002). Slum residents are worse off when compared to residents of other urban areas in terms of their access to services and amenities. It has been documented that about 24 per cent of slum households in Nairobi

have access to piped water as compared to 92 per cent for the whole of Nairobi (Wasao, 2002). From the current study, none of the respondents interviewed have piped water pumped directly to their homes. The source of water for those included in the study is purchase either from mobile water vendors (whose water source is commonly not known) or private tap water kiosks. Although almost half the respondents use piped water (from kiosks), it's safety cannot be guaranteed due to high chances of contamination from sewage flowing from poorly constructed systems in the slums. Also although the piped water bought from the kiosks might be suitable for drinking, its safety becomes questionable depending on how it is stored. Treatment of water is thus important.

5.3 Porridge *(uji)*; Consumption and Preparation

Porridge consumption is highly prevalent in the study population (96%). The application of indigenous food technologies namely fermentation and germination, standing at less than 3%. Knowledge levels regarding how the technologies are applied in porridge preparation are high in the case of fermentation but low for germination (using amylase-rich flour).

In Kenya, germination is mainly known and applied in the making of local alcoholic brews. Home beer-brewing is illegal in Kenya and this could be the reason for low adoption and knowledge levels reported with regard to the use of germination in the making of porridge. In the case of fermentation, low adoption levels could be linked to an erosion of cultural practice attributed to missionaries who discouraged the preparation of sour porridge in the belief that it contained alcohol (Oniang'o and Alnwick, 1988). Also, low adoption levels for both technologies could be as a result of negative attitudes held by urban women. For urban

women traditional technologies have negative image and are not associated with modernity or sophistication (Ashworth and Alizon, 2000). The lack of knowledge on the nutritional benefits of both germination and fermentation could also be a significant factor contributing to the low adoption of the technologies in the making of porridge. A very small proportion of those who are aware of the use of fermentation in the making of porridge know its resultant product to be nutritious (15%) and in the case of germination even less.

In Kenya, porridge is typically prepared from cereal based flours (sometimes with added cassava). In urban areas however, the incorporation of other flour ingredients like legumes has become popular. In this, study about one-third incorporate milled legumes (soya, black beans, green grams and a variety of other beans in general) in porridge flour. Resultant unfamiliar and possibly undesirable changes when traditional technologies are applied on these flour mixes, could also be contributing to the low adoption levels of the two technologies noted. In addition, it could be that the incorporation of a variety of flour ingredients could be perceived as adding adequate nutritional value, hence, negating the need for further processing techniques like germination or fermentation. For example, from the FGD held, participants felt that porridge prepared at the feeding centre was particularly nutritious because it had in it a mix of high quality ingredients.

5.4 Nutrient Adequacy of the Diet and Nutrition Status of Respondents

People living with HIV/AIDS require more nutrients to compensate for poor absorption, adverse drug effects, frequent diarrhea, nausea and recurrent infections. The diet for people living with HIV/AIDS should consist of vegetables, fruits, nuts, lean meat, apart from staple foods (FAO, 2002).

5.4.1 Nutrient Adequacy of the Diet

Micronutrients (vitamins and minerals):

Vitamins and minerals protect against opportunistic infection by ensuring that the lining of skin, lungs and gut remain healthy and that the immune system functions properly. Of special importance are vitamin A, vitamin C, vitamin E, certain B-group vitamins and minerals such as selenium, zinc and iron (FAO, 2002). The manual for nutritional care and support by FAO (2002) recommends that PLWHA should eat vegetables and fruit everyday as they supply the vitamins and minerals that keep the body functioning and the immune system strong. Fruits and vegetables are especially important for people living with HIV/AIDS to fight infection. A wide variety of fruits and vegetables should be eaten as each one provides different vitamins and minerals.

Intake of Vitamin A is particularly low among the study respondents (284.9± 4.3μg/day) compared to the recommended daily intake of 500μg/day (NASCOP, 2007). This could be due to the limited variety vitamin A rich foods that the study sample consumed. Only pawpaw and pumpkin are particularly rich vitamin A foods mentioned by the respondents and of these two, only 8% and 1.2% of the respondents indicate daily consumption of pawpaw and pumpkin respectively.

Vitamin A is important to keep the lining of skin, lungs and gut healthy. Vitamin A deficiency increases the severity of diseases such as diarrhoea while infection will increase the loss of vitamin A from the body. However, the low incidence of diarrhoea established in the study population is attributed to the intake of cotrimoxazole prophylaxis. Good vitamin A sources

are dark green, yellow, orange and red vegetables and fruit. These include spinach, pumpkin, cassava leaves, green peppers, squash, carrots, amaranth, yellow peaches, apricots, papaya and mangoes. Vitamin A is also contained in red palm oil, yellow maize, orange and yellow sweet potatoes, egg yolks and liver (FAO, 2002). Vitamin A is more readily absorbed from animal products because of the form (retinol) in which it is stored.

Good iron sources are green leafy vegetables, seeds, whole-grain products, dried fruit, sorghum, millet, beans, alfalfa, red meat, chicken, liver, fish, seafood and eggs (FAO, 2002). The average daily iron intake level for the study population is less than the recommended minimum intake level (20mg/day). Further it is important to note that the main source of this mineral is cereal products, mainly maize. Cereals contain anti-nutritive substances that bind the iron making it biologically unavailable. Also, from this study tea is found to be the second most consumed food. Tea in itself contains tannins and phenols that could bind iron and if taken together with a meal could render any available iron unavailable to the body. Taking bioavailability into account thus, the actual iron adequacy for the study population is probably be much less.

Macronutrients:

Staple foods should make up the largest part of a meal FAO (2002). These foods are relatively cheap and supply a good amount of energy and some protein. Staples include cereals (such as rice, maize, millet, sorghum, wheat and barley), starchy roots (such as potatoes, sweet potatoes, cassava and yams) and starchy fruit (such as plantains). *Ugali* made from maize-meal is a particularly common Kenyan staple. Daily consumption of *ugali* in the study sample is quite high (60%). Porridge made from maize flour incorporated with other cereal flours in

varying proportions is markedly high too (73%). Even with this, the total calorie intake of the study group is inadequate, 30% short of the minimum recommended intake level.

Average protein intake among the study respondents is inadequate being 22% below the minimum recommended intake level of between 73 - 92g/day. This is especially worrying because proteins are important in building muscle and immune system. Milk is the most common protein source in the study population but its daily consumption level just stands at 14%. Although relatively expensive, milk is a rich source of good-quality proteins, vitamins and minerals and can supply extra energy.

Daily consumption levels of legumes are generally low. According to FAO (2002), legumes should be eaten everyday if possible, however, in this study daily intake levels of legumes is low. Apart from being cheap and good sources of protein legumes are also good sources of vitamins, minerals and fibre. When eaten with staple foods the quality of protein is increased. General consumption of foods from animal sources for this study sample is low; this is most likely due to the cost of such foods. The situation is indicative of poor quality of protein intake for the study population, with a reliance on cereals which are known to be poor protein sources especially in the form in which they are consumed.

5.4.2 Nutrition Status of the Study Population

Among the study respondents, 18% are underweight. A common problem among HIV-infected people is the wasting syndrome, accompanied by weakness, fever, nutritional deficiencies and diarrhea. According to Minnie (2008), the syndrome can diminish the quality of life, exacerbate illness and increase the risk of death for people with HIV. Wasting can occur as a result of HIV infection itself but also is commonly associated with HIV related

opportunistic infections. HIV-related symptoms & medicines lead to reduced food intake, by decreasing appetite. HIV causes diarrhea and intestinal cell damage, which leads to poor absorption of nutrients, including high-energy substances such as fats.

Despite HIV/AIDS being associated mainly with wasting, a quarter of the study respondents are overweight. Also, more than half of the respondents have normal BMI. However, closer scrutiny of macro and micronutrient adequacy reveals that the study sample is actually at risk of malnutrition. There are two possible explanations to the observed situation:-

- In the first case, it is possible that the respondents had in fact BMI beyond normal range before being infected with HIV and although their nutritional situation could be deteriorating (as evidenced by poor caloric and protein intake levels for a majority of the respondents) this could not be captured at the particular point of the study because they have not dropped to undesirable levels yet. In this regard, Maeyer (2001) recommends the use of Usual Body Weight (UBW), in order to capture the weight loss by PLWHA who had a BMI above the normal range before becoming infected with HIV. Jiamton *et al.* (2003) made similar findings of normal BMI in PLWHA.

- In the second case, there were those found to have adequate caloric intake, with either normal or overweight nutritional status (see table 4.15). For these, it could be that they actually be experiencing weight increase due to positive application of information from counseling sessions. Daniel (1998) and Malomo and Fakande (1998), achieved a gain in Weight by PLWHA, using nutritional counseling, food demonstration and soya

bean milk. Additionally, there could be a weight increase due to metabolic changes fully or partly associated with HIV/AIDS. According to FANTA (2004), if weight has increased rapidly despite little change in dietary intake, medical assessment and treatment is advised. A possible lack of physical exercise could be contributing to the overweight cases observed. These patients should be encouraged to continue with physical activity such as house work or other work (FANTA, 2004).

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Based on the objectives of this study, the following is concluded:

- Majority of the population prepares porridge simply by bringing a slurry of fresh/untreated cereal flour to boil. In the preparation of porridge, many do not take advantage of the benefits that can be accrued from application of germination or fermentation technologies; only 0.7% and 2.1% respectively apply the technologies.
- Dietary intake of energy, protein, iron and vitamin A is inadequate. Even so, majority of the population has good nutritional status (56.7%), with a significant number overweight (25%). The low incidence of diarrhoea (1/300women/day) recorded could probably be contributing to good nutritional status of the respondents observed.
- Majority (80%) of the households are female-headed, with a greater portion (63%) of the household heads having attained only primary level of education

6.2 Recommendations from the Study

- To meet the deficit in energy intake by the study population, food preparation methods that add nutritional value should be considered such as germination of cereal foods. Germination is able to increase the energy density of cereals allowing consumption of more energy per given volume. Additionally, application of fermentation technology will increase dietary intake levels of iron by improving bioavailability.
- Porridge being cereal based and having been identified as the single most commonly consumed food on a daily basis should be used as a channel by which to increase nutritional intake. Fermentation and germination are simple technologies that can be introduced at the household level in porridge preparation to increase its nutritional value. There is need to organize food fairs to bring together operators of indigenous food technologies and consumers to increase local awareness of the food technologies.

6.3 Recommendations for Further Research

- To ensure successful adoption of fermentation and germination technologies, consideration to the views of the target population is important; for example, further work should be done by food technologists to find ways of reducing the acid content of fermented porridge that may cause heart burns, one of the many reasons why the study population did not practice porridge fermentation.
- Addition of milled food products like peanuts, soya beans and green grams to the basic cereal gruel used to make porridge was relatively common in the study population. The effects of such supplementation on the cooking times, palatability and antimicrobial activities after fermentation should be investigated.

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APPENDIX I

Questionnaire no.....

DIET AND NUTRTIONAL STATUS OF WOMEN LIVING WITH HIV/AIDS IN NAIROBI, KENYA: *The Place of Fermentation and Germination Technologies*

Drop in center ..... Date of interview.....
Name of interviewer..... Name of index respondent... .....
Division..... Respondent's village. .....

A. SOCIO-DEMOGRAPHIC DATA

[Use the codes provided at the bottom of the page to fill in the table. For age, record to the nearest one year. For 'others' specify in the space below the codes]

Name	Relation to HHH head	Age (yrs)	Marital status	Religion	Educ. Level	HH size	Occupation

Relationship to HHH
1=Household head
2=Spouse
3= Son
4=Daughter
5=Brother / sister
6=Nephew / niece
7 =Other (specify).....

Occupation
1=Unemployed
2=salaried employed
3=Housewife
4=Small business
5=Student
6=Farmer
7=Not applicable (children<18yrs)
8= other (specify).....

Sex
1=Male
2=Female

Education
1=primary
2=secondary
3=post secondary
4=Nursery
5=None
Others (specify).....

Marital status
1=Single
2=Married monogamous
3=Married polygamous
4=Seperated divorced
5=Widowed
6=Not applicable

Religion
1=Christian
2=Muslim
3=None
4=other (specify)

Questionnaire no……

B. SOURCE OF FOOD

(Circle appropriate code for each of the following)

1. What is the main source of food your household?
   1=Purchase 3=Gifts from friends 5=own production
   2=Gifts from relatives 4=Food program 6=Other (specify)……..

2. **[If food program]** what is the name of the program / organization? ……

3. What types of food do you receive?
   1=Maize 2=Beans 3=cooking oil 4=other (specify)……

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

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

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

7. Do you receive any of the following?
   1=Zinc supplement 3=Iron Supplement 5=None of the above
   2=Vitamin A 4=Multivitamins 6=Other (specify)……

   [If none of the above, go to 8]

Questionnaire no……

C. FOOD CONSUMPTION PATTERNS

8. **[Tick the appropriate reponse]** How often have you consumed the following foods in the last sev days? **[If no consumption in past 7 days, probe to find out if there was any consumption at all in previous month]**

Type of food	Number of times in a week							Rarely (less than 4 times a month)	Nev
	1	2	3	4	5	6	7		
Cereal products, roots and tubers									
Ugali									
Maize/products									
Rice									
Porridge									
Irish potatoes									
Sweet potato									
Arrow roots									
Cooked bananas									
Chapati									
Legumes									
Ndengu									
Beans									
Njahi (pegion Peas)									
Animal products									
Fresh milk									
Mala (fermented milk)									
Meat									
Fish									
Eggs									
Fruits and vegetables									
Sukuma wiki									
Traditional vegetables									
Cabbage									
Pumpkin									
Banana									
Orange									
Pawpaw									
Mangoes									
Snacks									
Tea									
Bread									
Mandazi									

Questionnaire no……

D. PORRIDGE PREPARATION METHODS AND INGREDIENTS

9. **(If respondent mentioned never for porridge)** why don't you take porridge?
   1=don't like taste 2=cannot afford 3=not used to it **[go to 15]**

10. **(If respondent mentioned taking porridge)** what are your reasons for taking porridge?
……

11. How do you prepare porridge? **(Note down the steps)**
……
……
……

12. **[Fill in the required details in the table below. Where the respondent does not know the composition of the porridge flour, ask for the flour's brand name]**

Porridge flour ingredient(s) or flour brand name	Porridge additions

Code

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

Additions

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

Questionnaire no.....

[If uji is neither fermented nor germinated go to 15]

13. **(If porridge is fermented)** why do you ferment porridge?.....

14. **(If kimea is added to porridge)** what reasons do you have for adding kimea to porridge? .....

15. Have you heard of fermented uji? 1=Yes 2=No **[If No go to 17]**

16. What do you know about it?.....

17. Have you heard of germination of uji or addition of Kimea? 1=Yes 2=No **[If No go to 19]**

18. What do you know about it?.....

E. MORBIDITY, HYGIENE AND SANITATION

19. List any hygienic practices you employ in your daily activities? **(Circle appropriate response and probe for response on how hands are washed and how food is handled)**

1=Wash hands before and after eating
2=Wash hands after visiting toilet
3=Wash hands before and after preparing meals
4=Wash hands with clean water and soap
5=Use running water from tap or water poured from a clean container when washing hands
6=Wash fruits and vegetables with clean water
7=Cover food to prevent flies and dust
8=Wash container that stores drinking water at least once a week
9=Other(specify).....

20. Where do you get your water?
1=Tap in house 3=Private tap out of compound
2=Tap in compound 4= Buy from vendors 5=Other (specify).....

21. Do you boil water before drinking? 1=Yes 2=No

22. Do you add any chemical to water before drinking? 1=Yes 2=No

23. **(If Yes)** which one? .....

24. Have you suffered any illness in the last two weeks? 1=Yes 2=No

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

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

F. ANTHROPOMETRY

27. **(Using the tape measure and bathroom scale, take height and weight measurements of respondent)**

Height (m)	Weight (kg)	BMI (weight/ height^2)

Time	Dish	1	2	3	4	5	6	7	8	9
		Dish Preparation 1= for affected alone 2=family dish	Name of Ingredient used in Preparation	Amount in hh measure	Amount of Complete dish prepared (ml)	Amount of food served for the respondent (ml)	Name of extra ingredient added upon serving	Amount of extra ingredients added meal served (ml)	Amount consumed by the affected (ml)	Amount Left over by respondent (ml)

Questionnaire No……..

APPENDIX II

FOCUS GROUP DISCCUSSION GUIDELINES

1. Most commonly consumed foods and reasons for their consumption
2. Frequency of Porridge consumption
3. Reasons for porridge intake
4. Types of flours used for porridge preparation
5. Porridge flour pretreatments practiced by the affected
6. Thoughts on germination of flour for uji preparation
7. Thoughts on fermented porridge for PLWHA

APPENDIX III: DAILY CONSUMPTION LEVELS OF VARIOUS FOODS

Energy giving foods
(Consumption on a daily basis)

Name	Count	%Responses
UGALI	89	28.9
RICE	15	4.9
UJI	109	35.4
MUKIMO	2	.6
IRISH POTATO	20	6.5
CHIPS	12	3.9
SWEET POTATO	14	4.5
MATOKE	4	1.3
BREAD	29	9.4
MANDAZI	14	4.5
Total	308	100.0

Table 3: Daily consumption of specific Energy Giving foods

Body building foods
(Consumption on a daily basis)

Name	Count	%Responses
BEANS	11	21.6
NDENGU	10	19.6
FRESHMILK	21	41.2
FER.MILK	1	2.0
MALA	1	2.0
REDMEAT	2	4.0
FISH	2	4.0
CHICKEN	2	4.0
EGGS	1	2.0
Total responses	69	100.0

Table 4: Daily consumption count of specific Body Building foods

Protective foods
(Consumption on daily basis)

Name	Count	Pct of Responses
CABBAGE	16	9.6
S.WIKI	28	16.8
TRAD.VEG	13	7.8
PUMPKIN	2	1.2
RIPEBANA	46	27.5
ORANGES	46	27.5
PAWPAW	12	7.2
PASSION	1	.6
MANGOES	3	1.8
Total responses	167	100.0

Table 5: Daily consumption count of specific Protective foods

Beakfast beaverage
(Consumption on a daily basis)

Name	Count	Pct of Responses
TEA	101	96.2
SOYA	4	3.8
Total responses	105	100.0

Table 6: Daily consumption count of specific breakfast beaverages

APPENDIX IV

STAGE OF HIV INFECTION (NASCOP, 2006)

Diagnosis for asymptomatic stage of HIV infection:

- Weight loss of less than 5%
- Increased energy requirement (10%more)
- Largely no related symptoms (except the first few weeks)
- Generalized lymph glands enlarged
- Immune system weakening and upper respiratory tract infection
- Normal activity

APPENDIX V

CONSENT FORM

Proposed is a study to determine the composition of the diet for PLWHA and its nutritional adequacy. Results from the study will be used for academic purposes ONLY. Participants will be required to either visit the respective drop in centers for an interview or in some cases permission will be sort to allow interviews to be held at respective homes. Your consent to participate in this study will be highly appreciated.

Please append your name and signature below if you would like to take part in this research as a respondent.

I (name) ..... accept to take part in the study mentioned above as a respondent.

(signature).....

APPENDIX VI: WEIGHTS ASSIGNED TO HYGIENE PRACTICE

Practice	Weight
Wash hands before and after eating	1
Wash hands after visiting the toilet	1
Wash hands before and after preparing meals	1
Wash fruits and vegetables with clean water	1
Wash container that stores drinking water at least once a week	1
Cover food to prevent flies and dust	1
Wash hands with clean water and soap	2
Wash hands using running water or water poured from a clean container	2

APPENDIX VII: QUANTITATIVE ANALYSIS OF FOOD INTAKE (24-HOUR RECALL)

The amount of food consumed by the respondent from the total amount of food prepared for the family was established and disaggregated into its particular ingredients. For example; if 30grams of sugar was used to make 300grams of tea, of which the respondent took 150g, then the actual intake of sugar would be 15g. Using East African conversion figures, the kilocalories and protein content was calculated as follows:

100g sugar = 375 kilocalories

15g sugar=?

$\frac{15g \times 375Kcal}{100g} = 56.25Kcal$

For a composite food like *Githeri* (mixture of maize and beans, total nutrient intake are calculated by computing each ingredient separately and adding them together. For example *Githeri* made from 1000g maize, 500g beans, 200g potatoes, 20g cooking fat and 120g onion constitutes a mix in the proportion of 0.54: 0.27: 0.11: 0.011 and 0.06. From this food, kilocalories and protein were calculated as follows:

Kilocalories

100g maize = 335Kcal; 1g maize = 3.35Kcal

100g beans = 320 Kcal; 1g beans = 3.2Kcal

100g irish potatoes = 81Kcal; 1g irish potato = 0.81Kcal

100g onion = 38Kcal; 1g onion = 0.38Kcal

100g cooking fat = 900Kcal; 1g = 9Kcal

Protein

100g maize = 8g; 1g maize = 0.08Kcal

100g beans = 22g ; 1g beans = 0.22g

100g irish potatoes = 2.01g; 1g irish potato = 0.0201g

100g onion = 1.2g; 1g onion = 0.012g

Cooking fat does not contain protein. Similar procedures were followed for vitamin A and iron. Since *githeri* is prepared in the ration of 0.54: 0.27: 0.11: 0.011 and 0.06 of maize, beans, potatoes, cooking fat and onion respectively:

Maize – 0.54x105g *githeri* = 56.7g maize

56.7g of maize x 3.35 Kcal = 185.945 Kcal

56.7g of maize x 0.08g protein = 4.536g protein

Beans – 0.27x105g *githeri* = 28.35g beans

28.35g of beans x 3.2 Kcal = 90.72Kcal

28.35g of beans x 0.22g protein = 6.237g protein

Irish potatoes – 0.11x105g *githeri* = 11.55g irish potatoes

11.55g of irish potatoes x 0.81Kcal = 9.356Kcal

11.55g of irish potatoes x 0.0201g protein = 0.2322protein

Cooking fat = 0.0011 x 105g *githeri* = 0.1155g fat

0.1155g cooking fat x 9 = 1.04 Kcal

Onion – 0.06 x105g *githeri* = 6.3g onion

6.3g onion x 0.38 Kcal = 2.394 Kcal

6.3g onions x 0.012 = 0.0756g protein

105g *githeri* therefore provides 289.455Kcal and 11.08g protein. Similar calculations were carried out for vitamin A and iron using food composition tables.

(adapted from Kiige, 2004)