Changes in Body composition and dietary patterns among HIV positive adults on first line Antiretroviral Treatment at The AIDS Support Organization (TASO) Mulago, Kampala

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DECLARATION

This dissertation is my own original work and has never been submitted wholly or in part for any prior academic award or qualification other than that for which it is now submitted.

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DEDICATION

This dissertation is dedicated with love, gratitude and respect to my father Mr. Tsehaye Haile and my mother Mrs. Zufan Mekonnen.

ACRONYMS AND ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
ARV	Antiretroviral
ATZ	Zidovudine
BCM	Body Cell Mass
BF	Body Fat
CD4	Cluster Designation four
CDC	Centre for Disease Control and Prevention
DEXA	Dual energy x-ray absorbometry
D4T	Stavudine
EFV	Efaviranz
FANTA	Food and Nutrition Technical Assistance
FAO	Food and Agricultural Organization
FM	Fat Mass
HAART	Highly Active Antiretroviral Therapy
HIV	Human Immunodeficiency Virus
LBM	Lean Body Mass
MOH	Ministry of Health
MUAC	Mid-upper Arm Circumference
NGO	Non-governmental organization
NNRTIs	Non Nucleolus Reverse Transcriptase Inhibitors
NRTIs	Nucleolus Reverse Transcriptase Inhibitors
NVP	Nevarapine
PEPFAR	President's Emergency Plan For AIDS Relief
PLHIV	People living with HIV
PI	Protease Inhibitors
SPSS	Statistical Package for Social Sciences
TASO	The AIDS Support Organization
UBOS	Uganda Bureau of Statistics
UDHS	Uganda Demographic and Health Survey
UHSBS	Uganda HIV/AIDS Sero-Behavioural Survey

UNAIDS	The Joint United Nations Programme on HIV/AIDS
UNWFP	United Nations World Food Program
USAID	United States Agency for International Development
UNSSCN	United Nations system standing committee on Nutrition
WHO	World Health Organization
3TC	Lamivudine

DEFINITION OF TERMS

AIDS: The last and most severe stage of the clinical spectrum of HIV-related diseases.

Anorexia: loss of appetite for food.

Anthropometrics: measure of the human body. That is height, weight, mid-upper arm circumference and triceps skin fold.

Antiretroviral: A drug that suppresses the activity or replication of retroviruses such as HIV by interfering with the various stage of viral lifecycle.

Asymptomatic: not feeling symptoms or showing signs of disease or condition.

Body Cell Mass: The total mass of all the cellular elements in the body which constitute all the metabolically active tissue of the body.

Body mass index: a measure of body mass that is calculated as weight in kilogram divided by height in meter squared.

Cluster Designation 4: a protein marker on the surface of certain types of T lymphocytes and other cells; HIV binds to CD4 receptors to enter host cells.

HAART: (Highly Active Antiretroviral Therapy) a term for potent combination anti-HIV treatment, usually with three or more drugs from different classes.

Lean body mass: The mass of the body minus the fat (storage lipid).

Nutrition: Process by which living things acquire and utilize food for growth and maintenance.

Nutritional assessments: measurements of body size, body composition, or body function, intended to diagnose single or multiple nutrient deficiencies.

Nutritional status: The nutritional health of a person as determined by anthropometric measures, biochemical, clinical measures or dietary analysis.

Side effects: Secondary effect of a drug other than the reason it is prescribed. Side effects are usually related to negative effects. They are also called adverse events or drug toxicity.

Viral load: amount of viral genetic material (ribonucleic acid or deoxyribonucleic) acid in the blood or other tissues, often expressed as number of copies per millilitre.

OPERATIONAL DEFINITIONS

In this study:

Body Composition: Refers to lean body mass, body fat, body cell mass, measurements of skin fold thickness, Body Mass Index, and Mid-Upper Arm Circumference.

Nutrition Related Life Styles: Refers to physical exercise, dieting, alcohol intake and smoking.

ABSTRACT

Background: There is lack of documented information on changes in body composition along with dietary patterns among PLHIV on first line ART in Uganda. In most HIV clinics in Kampala, patients are weighed almost at every visit; however this practice alone does not give adequate information on nutritional status or effectiveness of the treatment and other interventions.

Objective: The study aimed at documenting changes in body composition and dietary pattern of HIV positive adults on first line antiretroviral treatment in the first six weeks and ten weeks of treatment.

Design and Methods: A longitudinal study was conducted on 102 HIV positive adults commencing ART at TASO Mulago. Body Mass Index (BMI), Bioelectric Impedance Analysis (BIA) and dietary assessments were performed/used to assess changes in body composition and dietary patterns of the study subjects.

Results: The participants were aged 18-59 years old of whom 73.5% were women. Significant changes were observed in mean body weight gain (1.6kg± 4.41, p =0.001), fat mass (0.7kg±2.58, p=0.010), lean mass (0.9kg±3.5, p=0.012), body cell mass (0.6kg±1.7, p=0.002) and BMI (0.4±1.2kg/m^2, p=0.003) after 10 weeks of commencement on ART. Underweight reduced by 1.9% and overweight and obesity increased by 1.9% and 1% respectively. However there was no significant change in mean (triceps, biceps and subscapular) skinfold measurement. Both male and female subjects did not meet their daily energy requirements. Females had low intake of iron (<20mg) while the male subjects had low intake of vitamin B1 (<1.2mg) at all contacts. The dietary diversity of the subjects was low (less than six food groups) throughout the study period.

Conclusion: Individuals on first line antiretroviral treatment showed an increase in body weight, body fat, lean body mass and body cell mass. Although they met their protein requirement, the energy intake was not adequate.

Key Recommendation: Antiretroviral treatment among eligible HIV positive individuals should be scaled up as it improves body weight in terms of lean, fat and body cell mass. Also more emphasis should be given to ways of improving macro and micronutrient intake.

CHAPTER ONE

INTRODUCTION

1.1 Background

The AIDS epidemic is one of the most destructive health crises of modern times ravaging families and communities around the world. By the end of 2008, UNAIDS/WHO estimated that globally, a total of 33.4 million people were living with HIV, where by 31.3 million were adults. In sub-Saharan Africa, 22.4 million people were living with HIV in 2008 (UNAIDS, 2009). Although efforts have been put in place to fight HIV/AIDS in Uganda, about 1million people are leaving with HIV/AIDS (MOH and ORC Macro, 2006). According to Uganda HIV/AIDS sero-behavioural survey (2004-2005), the prevalence of HIV among adults (18-59 years of age) was 6.7 % and the prevalence is higher in Kampala district about 8.5 % than other districts. The high prevalence of HIV/AIDS in this most productive age has great impact on health, economic and social aspects.

HIV infection exacerbates malnutrition through its attack on the immune system and its impact on food intake, nutrient absorption and utilization. Malnutrition also increases fatigue, reduces physical activity and work productivity of people living with HIV and AIDS (Piwoz and Preble, 2000). Ott *et al.* (1993) noted that decrease in body weight and lean body mass (LBM) are common problems in HIV-positive persons and depletion of body cell mass may occur early in asymptomatic HIV positive individuals before progression to AIDS. Wasting in HIV/AIDS is usually preceded by losses in appetite, repeated infections, weight fluctuations, and subtler changes in body composition (Babammento and Kotler, 1997).

To understand the relationship between nutrition and HIV/AIDS, one must consider the effect of the disease on body size and composition. Body size is most commonly expressed in terms of body weight and height while body composition is expressed as body cell mass (the metabolically active, energy-exchanging tissue of the body), lean body (an estimate of protein and mineral reserves, mainly stored in muscle) and fat mass of the body (Piwoz and Preble, 2000). In a study by Reiter (1996) it was

reported that measurements of lean body mass can predict survival independent of CD4 count. The study also showed some similarity between weight loss in HIV and starvation. Further more, starvation caused death when people with AIDS reached 66% of ideal body weight or 54% of ideal body cell mass.

Studies conducted before the widespread use of ART showed that wasting was associated with diminished survival rate (Kotler *et al.,* 1989). Analysis of a more contemporary cohort of patients, many of whom were taking highly active antiretroviral therapy (HAART) showed that wasting still occurs and remains an important predictor of death (Wanke *et al.,* 2002). She suggested that effective screening tools are necessary for early diagnosis and treatment in case of negative changes of body composition. Body composition analysis is a proven way for identifying serial changes in BCM in HIV patients on HAART (Wanke *et al.,* 2002). Most of body composition studies have been done in developed countries and it was found out there were changes in body composition among HIV positive individuals on HAART or and those not on HAART (Ott *et al.,* 1993; Yelmokas *et al.,* 2001; Shikuma *et al.,* 2004). Although there are data available from developed countries indicating that HAART may result in changes in body composition, these changes along with dietary pattern of HIV positive individuals initiating HAART are lacking in resource limited settings (Schwenk, 1999; Wanke, 2002).

Good nutrition along with continued monitoring of body composition changes and antiretroviral treatment are therefore vital for the well being of PLHIV. The purpose of this study was therefore to assess changes in body composition and dietary patterns among HIV positive adults aged 18-59 years old initiating ARV treatment.

1.2 Problem Statement

The high prevalence of HIV/AIDS (6.7 %) among adults aged 18-59years in Uganda has great implications on nutritional status of PLHIV (MOH and ORC Macro, 2006). HIV infection increases energy requirements and affects nutrition through increasing energy expenditure, reductions in food intake, nutrient malabsorption and loss and complex metabolic alterations (Macallan, 1995; Babamento and Kotler, 1997). The inadequate dietary intake among PLHIV to meet the increased demand for both

energy and protein associated with HIV infection result in weight loss (Piwoz and Preble, 2000). Wasting in AIDS is characterized by catabolism, there is preferential loss of lean body mass over fat and conversely or preferential gain of fat over lean mass. This continuous loss of cell mass also promotes progression of AIDS and can hasten death (Reiter, 1996; Wanke *et al*., 2002). In most HIV clinics in Kampala and Uganda at large, patients are weighed almost at every visit however measuring weight alone can be a misleading indicator of nutritional status because lean body mass among PLHIV is lost in preference to fat. There is no way to distinguish between body fat (BF), lean body mass (LBM), and water when weight measurements are used alone (Wanke *et al*., 2002).

Hogg *et al*. (1998) and Castleman *et al.* (2004) noted the role of antiretroviral therapy in the management of HIV and contribution to improved nutritional status; however, they mentioned that ART could create additional needs and dietary constraints which can contribute to weight change. In addition, Wanke *et al.* (2002) noted that the improved nutritional status or the body weight gain that is from antiretroviral treatment does not necessarily mean gaining in lean body mass. Wanke *et al*. (2002) added complications of HAART such as fat maldistribution may mask the subtle change of lean body mass (LBM). Therefore this indicates that, even though HAART has dramatically altered the course of HIV/AIDS but questions related to the management of patients on HAART remain unanswered.

Most studies on body composition change have been done in non-resource limited settings (Ott *et al.,* 1993; Shikuma *et al*, 2004; Esposito *et al*, 2008; Yelmokas *et al*, 2001); however the trends of body composition changes could be different in resource limited settings and in population with different dietary patterns. Documented information on changes in body composition and dietary pattern among PLHIV after initiation of ART is lacking in Uganda. According to the TASO Uganda records for example, there were more than 20,000 clients on antiretroviral treatment in 2008 but no studies have been carried out to assess the changes in the body composition and dietary pattern among PLHIV at the start and after initiation of HAART. This study

thus aims to make this assessment in order to understand the changes which will help in making early intervention in case of any negative effect.

1.3 Objective of the Study

1.3.1 General objective

To assess the changes in body composition and dietary patterns among HIV positive adults aged 18-59 years on first line antiretroviral treatment at 6 and 10 weeks of treatment.

1.3.2 Specific Objectives

To:

1. Determine body composition of HIV positive adults aged 18-59 years on ARV during the first 6 and 10 weeks of antiretroviral treatment.
2. Establish dietary patterns and nutrition related life styles of HIV positive adults aged 18-59 years during the first 6 and 10 weeks of ARV treatment.
3. Describe the nutrition related side effects arising from taking of antiretroviral drugs.
4. Compare changes in body composition and changes in dietary patterns of HIV positive adults 18-59years old in the first 6 and 10 weeks of antiretroviral treatment.

1.4 Research Questions

1. Which changes occur in body composition of HIV positive adults initiating antiretroviral treatment after 6 and 10 weeks of treatment?
2. Which changes occur in dietary patterns of HIV positive adults initiating antiretroviral treatment after 6 and 10 weeks of treatment?

1.5 Hypothesis

- There is a significant difference in mean body composition of HIV positive adults (18-59 years old) on first line antiretroviral treatment in the first 6 and 10 weeks of treatment.

- There is a significant change in dietary patterns of HIV positive adults (18-59 years old) who are on first line antiretroviral treatment during the first 6 and 10 weeks of treatment.

1.6 Significance of the Study

The data on short term body composition changes after initiation of ART could help health care providers to understand the effect of the treatment on body composition in the first few months and make early intervention in case of any negative effects.

The findings on changes in dietary patterns of patients will help in planning short term nutrition intervention programs at the centre. This information will also help nutrition counsellors to identify appropriate and possible nutrition actions at the centre, in the implementation of best nutrition actions. Hence advice on necessary adjustments in dietary practices of clients at an early stage.

The findings on nutrition related side effects will help care providers to identify the side effects common to the first few months of treatment and manage them at early stage.

The findings will also serve as baseline data for further studies on long term body composition and dietary pattern changes among HIV patients initiating HAART in the centre.

CHAPTER TWO

LITERATURE REVIEW

2.1 Effect of HIV/AIDS on Nutrition

Individuals living with HIV/AIDS have special nutritional needs irrespective of whether they are on ART or not. Proper nutrition helps to strengthen the immune system, manage opportunistic infections, optimize response to medical treatment, and may contribute to the slow the progression of the disease (Castleman *et al*, 2004). Therefore ensuring a diet with sufficient quantities of nutrient dense foods is critical for all people living with HIV/AIDS. HIV affects nutrition by decreasing food consumption, impairing nutrient absorption, and causing changes in metabolism (Beisel, 1996).

2.1.1 Decreased Food Intake

Reduced food intake among PLHIV is due to painful soars in the mouth, pharynx and oesophagus; fatigue, depression, changes in metal state, and other physiological factors. Powanda *et al.* (2003) noted that poor dietary intake is due to the metabolic processes which reduce appetite in many infections. Powanda added that poor appetite is a result of several pro-inflammatory cytokines that are produced during infection. Wilson *et al.* (1979) noticed that both systemic infections such as TB and intestinal infections including *cryptosporidium* and *oesophageal* candidiasis contribute more to reduced food intake.

In a study by Amadi *et al.* (2002) it was found that encouraging food intake among people living with HIV was associated diarrhoea was the major challenge. Anorexia may also be caused by certain anti-retroviral drugs and this may interfere with dietary intake of the patients until they get established on the treatment.

Poor dietary intake also occurs in the background of poverty and household food security. The conditions may get worse as PLHIV may not be feeling well enough to work; either to grow or to earn enough to buy food (Buksuba *et al.,* 2007). Therefore the inability to eat or swallow because of painful sores in the mouth and throat, the

loss of appetite as a result of fatigue and depression, headache, diarrhoea, vomiting lead to considerably to the reduction of food intake (Piwoz and Preble, 2000). Macallan (1995) stated that poor dietary intake among HIV patients contributes to loss of lean mass or poor recovery among people with severe malnutrition.

2.1.2 Reduced Nutrient absorption

HIV will interfere with the body's ability to absorb nutrients (Beisel, 1996) if intestinal cells are affected leading to gastro intestinal damage. Furthermore the increased incidence of opportunistic infections such as diarrhoea cause poor absorption and use of fat-soluble vitamins A and E. This can further compromise nutrition and immune status (Piwoz and Preble, 2000). Malabsorption of iron also occurs under the same conditions (Castaldo, 1996).

Study by Griffin (1990) showed that intestinal malabsorption leading to nutrient energy loss was common in patient with HIV/AIDS. Damage caused by HIV to the intestinal villi usually leads to malabsorption and weight loss (Macallan *et al*, 1993). In addition to the damage to the intestinal villi caused by HIV, *Cryptosporidium*, one of the most common and more serious opportunistic gut infections, for example, causes malabsorption and the degree of intestinal injury is related to the number of the organism infecting the intestine (Sharpstone *et al*, 1999). Arpadi (2000) found that PLHIV with severe malabsorption have lower body mass index. The study by Sharpstone *et al.* (1999) showed that carbohydrate malabsorption occurs in HIV positive people, even those without bacterial or protozoal pathogens. In addition, Murphy *et al.* (1999) reported that carbohydrate malabsorption was severe especially among people immune depression.

2.1.3 Altered Metabolism

Changes in metabolism in PLHIV occur as a result of the immune system's response to HIV infection. When the body mounts its acute phase response to infection, it releases pro-oxidant cytokines and other oxygen-reactive species. These cytokines produce several results, for example fever (increasing energy requirements) (Piwoz and Preble, 2000). Muscle tissue is broke down to provide amino acids for the synthesis of immune protein and essential enzymes. WHO (2003) also noted that

asymptomatic people living with HIV/AIDS increase energy intake by 10% while the symptomatic increase energy intake by 20-30% over the requirement for healthy, HIV negative people of the same age, sex, and physical activity level.

2.2 HIV/AIDS, Nutritional Status and Immune System

Timely improvement in nutritional status can help strengthen immune system, thereby reducing the incidence of infections, preventing loss of weight and lean body mass, and delaying disease progression. Therefore HIV has less chance to develop in to AIDS in a person who is well nourished. Nutritional care and support helps people living with HIV to manage HIV-related complications, promotes good responses to medical treatment, and improves the person's quality of life by maintaining strength, comfort, level of functioning, and human dignity (FANTA, 2004). A well-nourished person has a stronger immune system for coping with HIV and fighting illness. Figure 2.1 illustrates good nutritional status in the context of HIV/AIDS.

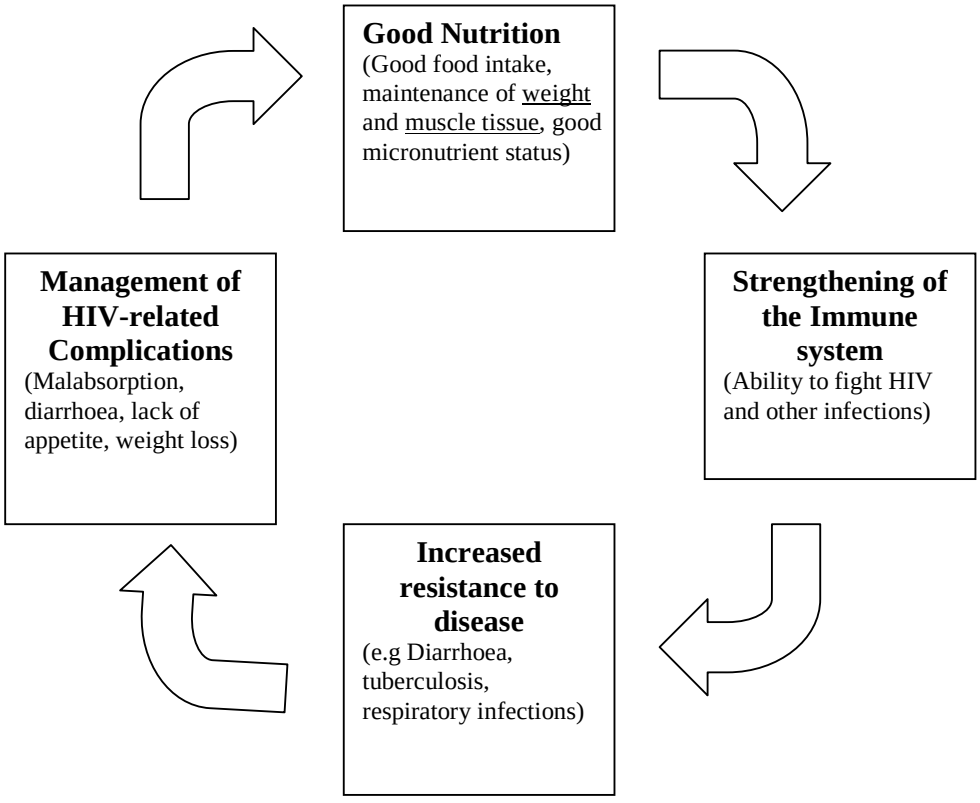


Figure 2.1 Good nutrition and care and resistance to infection. Source: FANTA (2004).

2.3 Human Body Composition

2.3.1 Compartments of Human body

It is important to understand what body compartments are in order to understand the changes in body composition. According to the fact sheet published by ROWETT Research Institute (2002), it was stated that; a healthy normal weight person has major component of water. Compared to water, the protein and fat components are small. The remaining body compartments are the bones and minerals. The non-fat compartment of body composition is termed as fat free Mass (FFM) and exists primarily as the chief structural and functional component of the human body. The FFM compartment consists (in proportions) of water (72%), protein (21%) and bone minerals (7%). Furthermore, FFM can be broken down to body cell mass (BCM) and extracellular tissue (ECT). Body cell mass is associated with survival and is primarily made up of muscles and organs, which process nutrients and medications. While the ECT compartment is comprised of structure and transport (such as bone, collagen and fluids outside of the body cell mass). Phase angle is calculated and appears to reflect the ratio of body compartments (Zaneta *et al.,* 2003). Components like proteins, body water and fat can be measured by a portable and user friendly machine called Bioelectric Impedance Analysis (BIA) machine while bone minerals can be measured by dual-energy x-ray absorpiometry (DEXA) (Wanke, 2002). Typically, an adult has around 2-4 kg of body weight only from bone.

The fat compartment of the body is termed fat mass (FM) and will vary considerably between individuals in terms of absolute amount. Fat mass consists of 20% water and 80% adipose tissue however in obese persons; it could be the largest component of the body. Table 2.1 shows an obese man has almost twice the amount of adipose tissue on his body, compared to the lean man.

Table 2.1 Comparison of body composition between obese and lean person

	Lean man (70 kg)	Obese man (100 kg)
Water	60%	47%
Protein	17%	13%
Fat	17%	35%
Remainder	6%	5%

2.3.2 Need for Assessment of body composition

In most HIV clinics in Kampala and Uganda at large, patients are weighed almost at every visit however measuring weight alone can be a misleading indicator of nutritional status because lean body mass is lost in preference to fat and in addition to it, there is no way to distinguish between body fat (BF), and lean body mass (LBM) when weight measurements alone are used (Wanke *et al*., 2002).

Serial weight measurements have been used by the Centers for Disease Control and Prevention (CDC) as a way to identify the wasting syndrome and predict the development of AIDS (Tamsin and *et al., 2003*). However, Kotler *et al.* (1989) showed that measurement of body weight alone failed to identify dramatic losses in body cell mass and other body composition parts. Thus, further measures of body composition are also needed, to identify losses or gains of lean body mass, body fat or body cell mass associated with increased mortality or/and nutrition intervention in patients with HIV (Tamsin, 2003).

Optimally, clinicians should try to prevent weight loss as well as treat it. Weight loss is often the first sign of a new AIDS-defining illness (Reiter, 1996). Patients should be weighed at every visit and their weight trends recorded on a graph. Because lean body mass is lost in preference to fat, weight alone can be a misleading indicator of nutritional status and clinical course (Reiter, 1996).

2.3.3 Methods of assessing of body composition in HIV/AIDS

Anthropometric measurements like skinfold thickness is the most widely used technique for estimating body fat and regional muscle mass. Using in-expensive calibrated-controlled tension callipers and semi flexible tape measures, the technique is inexpensive and particularly handy for use in many field environments (Wanke *et al.,* 2002). The validity of skinfold measurements is dependent on two assumptions. First, subcutaneous adipose tissue thickness represents a constant proportion of total body fat. Second, skinfold sites selected for measurements reflect average subcutaneous adipose thickness (Ludy *et al.,* 2005). Use of BMI in body composition is also important because it measures person's fat content, BMI is widely used to screen for obesity. However, BMI can not differentiate, between lean and fat. As

such, it is not able to distinguish between a body builder and an obese individual (Wanke *et al.,* 2002). Wanke *et al* also reported on the importance of MUAC in estimating of muscle mass that the measures of mid-upper arm circumference are correlated to measures of muscle mass. In general anthropometry is based on a two-component model of body composition, and provides estimates of fat and fat-free mass only.

Bioelectric Impedance Analysis (BIA) has great potential for the use in estimating body composition. BIA measures the opposition of body tissues to the flow of a small alternating current (Kotler, 1996). BIA is recommended in measurement of body composition (ultimately lean body mass) in individuals and those with chronic conditions such as HIV infection (NIH, 1994). It is preferred because its rapid and easy to perform. Portability of BIA machine also allows it to be used in a variety of settings including medical offices and hospitals (Wanke *et al.,* 2002). Other body composition assessment methods like Dual energy x-ray absorpiometry (DEXA), Isotope dilution methods, imaging techniques (CT and MRI) and total body potassium counting (TBK) in assessment of body composition.

2.4 Dietary Patterns and Nutrition Related Life Styles in HIV/AIDS

Having proper nutrition in HIV/AIDS includes; consuming diversified or variety of foods that will provide the body with the necessary energy, protein, fats, vitamins and minerals (MOH, 2006). According to the Kenyan national guidelines on nutrition and HIV/AIDS (2006), dietary intake along with regular exercise, controlling weight, avoiding alcohol intake, smoking and other narcotic drugs are make up nutrition related healthy life styles.

2.4.1 Food Diversity in Management of HIV/AIDS

Dietary diversity, the consumption of an adequate variety of food groups, is an aspect of dietary quality and can be considered an indicator of general nutritional adequacy (Nontobeko *et al.,* 2008). Low dietary diversity is associated with specific nutrient deficiencies. The main reason for promoting food diversification is that, no single

food except breast milk contains all the nutrients the body needs in the right quantities and combinations (MOH, 2006). Another study by Bukusuba *et al.* (2007) noted that there is very low dietary diversity in developing countries, the majority of studied households reported consuming fewer than six food groups (low quality diet) moreover their daily diet was dominated by one main staple food group mainly cereals. According to FANTA (2004), maintaining adequate nutritional status means consuming a variety and adequate quantity of foods to meet energy, protein, and micronutrients needs. PLHIV should eat balanced and diverse diets consisting of starchy staples with cooked legumes, nuts and animal foods, fat and oil, fruits, and vegetables.

A study by Nontobeko *et al* (2008) showed that in South Africa, diets for PLHIV were significantly less diverse than those of HIV negative individuals. However a balanced diet will ensure that the individual consumes sufficient nutrients to maintain energy, normalize weight, and ensure the body's proper functioning. The main types of food people need to live a healthy life include energy-providing foods (i.e. carbohydrates, fats), body-building foods (i.e., proteins, minerals), and protective foods (i.e., vitamins, minerals) (FANTA, 2004).

2.4.1.1 Energy Giving Foods

This includes the carbohydrates, fats and oils that are in food groups like cereals, tubers, and plantain. Staples are good sources of energy. Staple foods should be the part of every meal and form the base and largest part of daily meals.

Cereals

Cereals are one of the staple foods in Africa and other parts of the world. Examples of cereals are maize, sorghum, millet, rice etc. Some cereals such as millet and sorghum contain some proteins and iron. However, they don't contain adequate nutrients on their own. Nutrients from staple foods may not be available to the body unless eaten in combination with other foods (MOH, 2006b).

Tubers & Plantain

Tubers are known as good sources of energy. The most common tubers and roots that are consumed in Uganda are mattoke (plantain,) sweet potatoes, cassava, yams, are among others (MOH, 2006b).

Fats/Oils and Dairy products

Fats and oils are the richest sources of energy. One gram of fat provides twice the energy of one gram of carbohydrate. Therefore people only need small amount of fats because excessive consumption of fats may predispose individuals to obesity and heart disease. Vegetable oils are obtained from corn, simsim, sunflower, cotton seed, shear butter, palm oil and margarine. Animal source fats include butter, cheese, whole milk, fatty meat and fish (including fish oil) (MOH, 2006a). Fat also facilitate absorption and utilization of some essential vitamins such as A, E, D and K.

2.4.1.2 Body-Building Foods

Proteins are referred to as body-building foods. They are essential for cell growth, support the function and formation of the general structure of all tissues, including muscles, bones, teeth, skin and nails. The two main types of proteins are: plant source proteins and animal source proteins. Plant source proteins include beans and peas of different varieties, greengrams, groundnuts, soybeans and simsim. Where as animal source proteins include meat, milk (including products like cheese, yoghurt and fermented milk), fish and eggs. Other sources of protein include *nsenene* (grasshoppers) and white ants. Williams *et al.* (2003) found that high protein diets are associated with increased gain of Body cell mass among HIV positive persons.

Legumes

MOH (2006) recommends to include legumes in everyday diet as frequently as possible. Legumes include beans, peas, lentils, groundnuts, and soybeans. Legumes provide nutrients that are needed to develop and repair the body as well as building strong muscles. As compared to animal products, legumes provide cheaper source of protein and energy. Legumes when eaten with staple foods such as maize, millet, sorghum and rice, improve quality the diet. Legumes are also rich in other essential nutrients including: the B vitamins, vitamin E, iron, and calcium.

Animal Products

Animal products supply good quality proteins, vitamins, minerals and extra energy. Micronutrients in animal products include iron, vitamin A, selenium and zinc that strengthen muscles and immune system. Animal products include beef, chicken, fish, eggs, offal and milk (MOH, 2006b).

2.4.1.3 Protective Foods

Fruits and vegetables are known as protective foods because they provide vitamins and minerals that are important in strengthening the immune system. Vegetables and fruits are also major sources of fibre and roughage required for bowel movement and prevention of constipation (MOH, 2006a).

Vegetables

Vegetables add taste, flavour and colour to our meals. Common vegetables include: *doodo, nnakati, malakwang, eboo,* spinach, *kale (sukumawiki),* pumpkin leaves, cowpea leaves, carrots, cassava leaves, and green peppers. Cabbage is a vegetable that is important mainly as roughage. Vegetables contain useful immune substances called beta-carotenes. In many cases, vegetables are seasonal in availability, quality and prices (MOH, 2006a). Kristy (2003) noted that HIV patients who consume of high fibre foods have shown lower fat deposition in their bodies.

Fruits

A variety of fruits grow in Uganda. The deep yellow or orange coloured fruits are richer in vitamins, particularly beta-carotenes and vitamin A. Such fruits include avocadoes, mangoes, pawpaw, pumpkin, passion fruit, pineapple and jackfruit. Oranges, lemons and other citrus fruits are rich sources of vitamin C. Like vegetables, most fruits in Uganda are seasonal (MOH, 2006a). Fruits are known as good sources of antioxidant substances (FANTA, 2004).

2.4.2 Meal Frequency

The guideline by ministry of health (2006a) on nutrition for PLHIV encourages people living with HIV to increase the amount and frequency of eating meals that are

rich in energy, protein and plenty of fruits and vegetables. It also encourages eating of two to three snacks in addition to the main daily meals (Breakfast, lunch and Supper). By increasing meal frequency, PLHIV can meet the higher energy requirement of the body which is due to infection.

2.4.3 Nutrient Requirements of PLHIV

In general PLHIV have different nutritional requirements than HIV negative person. Further more the nutrient requirements with in PLHIV can also be different depending on the progress of the infection. Macallan (1995) stated that poor dietary intake among HIV patients contributes to loss of lean mass or poor recovery among people with severe malnutrition.

2.4.3.1 Macronutrient Requirements

Energy Requirement

Energy requirements are elevated with high viral load, fever, opportunistic infection, the need for weight gain and the increased energy cost of breathing in respiratory infections (Xuereb, 2004). According to WHO (2003), recommendation, for symptomatic HIV positive adults should increase energy intake by 10% and 20-30% during the symptomatic phase over the requirement for healthy HIV positive people of the same age, sex, and physical activity level. These recommendations are also for PLHIV persons, including those taking HIV-related medications such as ARVs (FANTA, 2004).

Researchers in United States found that weight gain and /or weight maintenance could be achieved among asymptomatic HIV positive individuals and among HIV positive people in the early stages of AIDS with no secondary infections, who received at least one day, high-energy, high protein, and liquid food supplementation along with nutritional counselling (Stack *et al.,* 1996).

Protein Requirement

According to WHO (2003), data are insufficient to support an increase in protein requirements due to HIV infection. HIV-positive persons do not require more protein than the level recommended for healthy HIV negative persons of the same age, sex, and physical activity level, that is, 12% to 15% of total energy intake. However,

Xuereb (2004) noted that, since energy requirements are higher, protein intake should increase proportionately with efforts to increase energy intake. On the other hand, there is the view that requirements are consistently elevated to provide substrate for immune cell replication (the acute phase response) lean body mass maintenance as well as during periods of septicemia when protein needs are dramatically elevated to attenuate hyper catabolism of somatic protein stores. Protein deficiency is closely associated with energy deficiency: both are often deficient in HIV/AIDS. Waterlow *et al.* (1992) stated that establishing the amount of protein which an individual needs to maintain body composition and body function is difficult.

Current evidence on macronutrient and HIV infection by WHO (2005) suggested that HIV positive individuals in a state of dietary protein depletion need greater amounts of protein. However more evident from animal and human studies models on septic or catabolic states similar to HIV/AIDS show inadequately utilised amino acid from increased intake (Garlick *et al.,* 1980, Tomkins *et al.,* 1983 and Powell, 1984).

In a study by Shabret *et al.* (1999) it was found, intake of protein supplements containing amino-acid glutamine along with anti oxidants, showed a significant gain in body weight and body cell mass in HIV patients who had lost weight. Another cross-sectional study in PLHIV found that, protein intake was highly correlated with lean body mass (Difranco *et al.,* 1996). Selberg *et al.* (1995) in his study of whole-body protein turnover in HIV patients found that it is correlated to BCM and protein intake.

Fat Requirement

According to the WHO (2003) guidelines, there is no evidence that fat requirements are different during HIV infection. However, certain ARVs or certain infection symptoms such as diarrhoea may require changes in the timing or quantity of fat intake (FANTA, 2004). Despite the well documented evidence on fat malabsorption in HIV/AIDS, Castaldo *et al.* (1996) suggested that it was possible to achieve nutritional rehabilitation using diets rich in fat.

2.4.3.2 Micronutrient Requirements of PLHIV

Micronutrients (Vitamins and minerals) are important in the HIV-nutrition relationship due to their critical roles in cellular differentiation, enzymatic processes, immune system reactions, and other body functions (Piwoz and Preble, 2000). Several micronutrients are required by the immune system and major organs to fight infectious pathogens. Persons with inadequate intake of micronutrients have difficulty in resisting infection. As a result, the role of micronutrients in HIV/AIDS takes on special importance in individuals and populations with marginal or low micronutrient intakes (Friis and Michaelson, 1998). Although micronutrients requirements are likely to be reduced when the HIV patient is put on ARV, micronutrient deficiencies may persist and affect absorption and efficacy of drugs. The following are some of the important micronutrients in management of HIV (Raten, 2005).

Vitamin A

Vitamin A is one of the most important nutrients in management of HIV. Vitamin A has a greater role in maintenance of epithelial cells, mucous membranes and the skin. It is also important in immune system function and resistance to infections and many others (Piwoz and Preble, 2000; Stephenson, 2001). The role of vitamin A was also seen in a study by Coutsoudis (1995) where vitamin A supplementation reduced morbidity due to diarrhoea by 50%. Main dietary sources of vitamin A are liver, dairy products, kidney, egg, some fishes, yellow fleshed sweet potato, pumpkin, palm oil, carrot, dark green leafy vegetables, fruits, such as papaya and mango (FANTA, 2004).

Vitamin B12

Vitamin B12 is important for new cell development and maintenance of the nerve cells. Low serum B12 intake that arise from either poor intake or other problems are associated with neurological abnormalities, reduced CD4 T-cell counts; increased bone marrow toxicity that is associated with the use of Ziduvodine (Tang and Smit,1998). Baum *et al.* (1998) also found that improvements in B12 levels were associated with increase in CD4 count. The main sources of B12 are Red meat, fish, chicken, shellfish, cheese, eggs, and milk (FANTA, 2004). Since the sources are vitamin B12 animal source, HIV positive person who are vegetarian should consider

getting the vitamin from other sources like nutrient supplements (Piwoz and Preble, 2000).

Vitamin E

Vitamin E is known for its protection of cell structures (as antioxidant) and facilitates resistance against diseases (FANTA, 2004). Supplementation of vitamin E, even more than the recommended levels has been shown to increase immune response and resistance to disease (Meydani and Hayek, 1992). HIV patients are therefore encouraged to take more vitamin E source foods in order to reduce the oxidative stress created by HIV and related opportunistic infections that may increase utilization of Vitamin E. Sources of vitamin E are leafy vegetables, vegetable oils, peanut, egg yolk, vegetables, nuts, and liver (FANTA, 2004).

Zinc

Zinc is known for its role in functioning of many enzymes, immune reactions, transport of vitamin A and also it acts as an antioxidant (FANTA, 2004). Meat, fish, poultry, shell fish, whole grain cereals, legumes, vegetables and pumpkin seeds are the main sources of zinc (FANTA, 2004). In populations where there is a mild and marginal zinc deficiency, problems like depressed immunity, damage to epithelial lining of the intestine and respiratory tract are common (Shankar and Prasad, 1998). Zinc may have indirect effect on controlling of weight loss and wasting where as zinc inhibits tumour necrosis factor (TNF), a cytokine that is important in triggering the process of wasting in HIV infection (Baum, 2000). Another study by Mocchegiani (1995) showed that zinc supplementation reduced the incidence of opportunistic infections, stabilised weight and CD4 count among adults with AIDS who are receiving ARV therapy.

Selenium

Selenium is believed to play an important role in metabolising reactive oxygen species or free radicals and reducing oxidative stress. This is because selenium is an essential cofactor for some antioxidant enzymes (Piwoz and Preble, 2000). Baum and Shor (1998) noted that selenium deficiency impairs the immune system and has been associated with faster HIV disease progression and reduced survival in adults. Main

sources of selenium are meat, eggs, whole grain, plants grown in selenium rich soils and sea foods.

Iron

Iron has a vital role for all cells in generating of energy. Iron is required by the body to produce new cells, amino acids, and hormones, as antioxidant and it is transported throughout the body to be used as needed. Iron is found in muscle, in blood, and in many enzymes required for metabolism (Piwoz and Preble, 2000). Dietary sources of iron include red meat, poultry, shellfish, egg, peanut, groundnuts, deep green leafy vegetables, lentils, beans, cereals (FANTA, 2004). Iron deficiency occurs mainly when the iron stores are depleted and the dietary intake of the patient can not compensate for these requirements. Anaemia can also be caused by Zidovudine an antiretroviral drug, which suppresses bone marrow function and synthesis of red blood cells (Piwoz and Preble, 2000).

2.4.4 Nutrition Related Healthy Life Styles

Physical activity is a fundamental way to improve physical and mental health. It improves physical fitness, lessens depression, improves appetite, relieves constipation, improves intestinal absorption, improves muscle tone and eliminates excess fat. Progressively resistant exercises reduce fat levels in blood, hence decreasing the risk of heart disease and diabetes, and improving lean body mass (LBM). Therefore the impact of physical activity leads to a better quality of life (MOH Kenya, 2006).

More activity may be required for weight reduction among the overweight. However, physical activity should always be within sufficient energy intake, otherwise it may cause unwanted weight loss. Service providers should assess a client's strength, and recommend suitable and various physical activities. For example, a hand grip will assess muscle strength and this measure correlates well with muscle endurance (glycogen levels) and hydration (Schlenzig *et al*, 1993).

Exercise coupled with healthy eating is needed to balance food intake with physical activity to maintain a healthy weight. The importance of exercise is often overlooked

among PLHIV. However, regular exercise, especially resistance training, has been found to assist with building lean body mass. Patients who exercise are stronger and better able to manage the activities of daily living independently (Florindo, 2004).

Moderation in the consumption of tea, coffee, sodas or other related drinks that may interfere with food intake, absorption and utilization medicine is important. Poor habits such as smoking, alcohol consumption and drug abuse that may affect food and nutrient intake; increase oxidative stress; and decrease the efficacy of some medications and immunity. Geetanjali *et al.* (2007) in his urban HIV patients cohort, found that hazardous alcohol use and active drug use were each independently associated with decreased antiretroviral uptake, adherence, and viral suppression. Therefore PLHIV are advised to stop consuming of alcohol, smoking or chewing tobacco and using illicit drugs while on ART.

2.5 Antiretroviral Drugs and Nutrition

2.5.1 Nutrition related effects of ARVs

ARVs interact with food and nutrition and result in positive and negative outcomes (Castleman *et al*, 2004). Some positive effects of ARVs on dietary intake are intense hunger and craving for certain foods. This is because the body is starting to rebuild itself and needs the energy that comes from food (Alliance, 2007). On the other hand, the side the negative effects that arise from taking of ARVs include nausea, taste changes, mouth ulceration, loss of appetite, abdominal pain, constipation, flatulence, headache, diarrhoea and vomiting which are common especially in the early stage of treatment (FANTA, 2004; Hoffmann *et al.*, 2006). These problems lead to reduced food intake or reduced nutrient absorption that exacerbates weight loss and nutritional problems experienced by PLHIV (Table 2.2). Moreover a study in the USA showed that 30% of drug interruption in the first 90 days is attributed to nausea, vomiting, and other gastrointestinal effects of ARVs (Chen *et al.*, 2003). This drug interruption can lead to health deterioration and risks of malnutrition in patients.

Table 2.2 Recommended first line antiretroviral treatment drugs in Uganda

ARV drug	Brand available	Nutrition related side effects(Adapted from FANTA, 2004)
Zidovudine	Retrovir ®	Anorexia, anaemia, nausea, vomiting, constipation, fever dizziness, headache, fatigue.
Lamivudine	Epivir ®	Nausea, vomiting, headache, dizziness, diarrhoea, abdominal pain, fatigue.
Stavudine	Zerit®	Nausea, vomiting, diarrhoea, chills and fever, anorexia, stomatitis, anaemia, headaches.
Efavirenz	Stocrin ®	Dizziness, anorexia, nausea, vomiting, diarrhoea, abdominal pain flatulence
Nevirapine	Viramune ®	Nausea, vomiting, fever, headache, fatigue, stomatitis, abdominal pain, drowsiness

Source: National Antiretroviral Treatment and Care Guidelines for Adults and Children (MOH, 2003)

2.5.2 First Line Antiretroviral Regimens

Antiretrovirals (ARVs) are medicines used to treat HIV infection. They reduce the amount of HIV (the viral load) in the body, which protects the immune system and allows it to recover. ARV treatment is a life long treatment (Alliance, 2007). According to a report by United States president's emergency plan for AIDS relief, about 145,000 individuals were receiving ARVs by September 2008 (PEPFAR, 2009). HIV positive patients, who are eligible to start ART, start with the first line regimens. A first line ART is an antiretroviral drug regimen that is recommended for patients who have never been exposed to ARVs or those who were on treatment but stopped all drugs at once for more than three months (MOH, 2003). In initiating of ART a three drug combination should be used. This combination may contain two Nucleo Reverse Transcriptase Inhibitors (NRTIs) plus one Non Nucleo Reverse Transcriptase Inhibitors (NNRTI) or a Protease Inhibitors (PI) (MOH, 2003). The starting (first line) regimens in adults that are used in TASO are listed in Table 2.3.

Table 2.3 Recommended First Line Antiretroviral Regimens for Adults at TASO

Regimen	Generics name
Zidovudine+ Lamivudine + Nevirapine (ZDV+3TC + NVP)	(Duovir-N)
Stavudine + Lamuvidine + Nevirapine (d4T+3TC + NVP)	(Triomune)
Stavidine +Lamivudine + Evafrenz (d4T+3TC + EFZ)	-
Tenofovir+Lamivudine+Efavirenz (TDF+3TC+EFV)	-
Tenofovir+Lamivudine+Nevrapine (TDF+3TC+NVP)	-
Zidovudine+ Lamivudine + Efavirenz (ZDV+3TC + EFZ)	-

Where; 3TC is Lamivudine, d4T is Stavudine, EFZ is Efavirenz, NVP is Nevirapine, ZDV is Zidovudine, Tenofovir is TDF

2.6 Body Composition Changes among HIV/AIDS Patients

2.6.1 Changes in Body Weight in HIV Patients

Decrease in body weight is a common problem in PLHIV and the decrease or loss in body weight is mainly associated with depletion of body composition components like lean body mass, body fat, and body cell mass (Ott *et al.*, 1993). On the other hand patients who have been on HAART regimens for some time may face morphologic complications such as abnormal fat distribution. The fat maldistribution may mask the underlying loss of important body composition parts such as the lean body mass and body cell mass. For this reason, early identification and treatment of weight loss is critical to ensure long-term survival and quality of life in patients with HIV infection (Wanke *et al,* 2002). Shikuma (2004) found that PLHIV normally gain weight after they are put on HAART. He also noted that HIV positive adults especially those with low CD4 lymphocyte count or severe immunosuppression at baseline experienced greater increases in body weight while on HAART. In addition, most PLHIV have big appetites after starting antiretroviral treatment because the body is starting to build itself and the effect the medicine on the virus (Alliance, 2007). The increase in food consumption may have a positive impact on the weight gain for people who are starting antiretroviral treatment.

2.6.2 Changes in Body Fat

Body fat oxidation increases in HIV-positive patients (Hsu *et al.,* 2005). Piwoz and Preble (2000) also noted that HIV infection affects the production of some hormones that are involved in metabolism of macronutrients including fat. Body fat loss is due to poor dietary intake, in conditions where there is inadequate energy intake; body fat is used as fuel source (Hsu *et al.,* 2005). Weight loss in HIV infection results from the depletion of both adipose and lean tissue, and may in part be detected by the severity of illness and initial body composition before weight loss (Xuereb, 2004). In addition fat loss could be more prominent among persons with a greater percentage of fat at baseline.

Fat maldistribution and Lipodystropy is another body fat change which is not common in patients starting HAART but a problem among patients who have been on HAART for years. Dermott *et al.* (2002) noted that the duration of HAART was associated with fat alterations in men, including decreased total fat mass, increased trunk fat mass, and decreased appendicular fat mass. He also noted that, women receiving HAART tend to have more trunk fat than women not receiving HAART.

2.6.3 Changes in Lean Body Mass

Losses in lean body mass (LBM) and body cell mass are common problems in HIV positive persons. Depletion of body cell mass may occur early in asymptomatic HIV positive people before progression to AIDS (Shikuma *et al.,* 2004*).* Moreover, the loss of such tissue can be progressive and may be reflected in weight changes even with asymptomatic HIV infection (Xuereb, 2004). Ott *et al*. (1993) also suggested that such depletion may be related, at least in part, to underlying HIV infection rather than the opportunistic infections associated with AIDS. Hsu *et al*, 2005 noted that protein depletion becomes more striking once fat reserves are lost. But a study by Reiter (1996) reported that HIV seems to induce a special metabolic effect in the host involving a preferential loss of body protein over fat. However in a longitudinal study of weight and body composition in HIV patients by Paton *et al.* (1997) showed that the ratio of change in lean body mass to total body weight was similar to that found in

dietary deprivation alone. Macallan (1995) added that poor dietary intake among HIV patients contributes to loss of lean mass or poor recovery among people with severe malnutrition. Another cross-sectional study in PLHIV found a strong correlation between gain of lean body mass and protein intake (Difranco, 1996).

2.6.4 Changes in Body cell mass

Total mass of all the cellular elements in the body constitute metabolically active tissue. BCM is one of the most important parameters in assessing of body composition since it is mostly associated with survival and is primarily made up of muscles and organs which process nutrients and medications (Zaneta *et al.,* 2003). Measure of BCM is found to be predictor of survival among HIV positive people. Other studies showed that there was an increase in body cell mass among PLHIV after they are treated with HAART. More over the gaining of body cell mass increases with increase effectiveness of the antiretroviral treatment. Ferrnado (2005) in his two years follow up study found, potent combination ART use increased from 6% to 79% and concurrently a significant increase in body cell mass and a reduction in prevalence of wasting were seen. Shabert *et al.* (1999) also found out HIV positive people tend to increase body cell mass when they feed on high protein foods.

CHAPTER THREE

METHODOLOGY

3.1 Study Area and Duration

The study was conducted at The AIDS Support Organisation (TASO) Mulago, Kampala. TASO is the largest indigenous non-governmental organization (NGO) providing HIV/AIDS treatment and management services in Uganda. TASO Mulago is the largest HIV care and treatment centre among other TASO branches countrywide. TASO-Mulago provides medical, counseling and social support services to PLHIV both at the centre and at community outreaches within Kampala and the neighboring districts. TASO Mulago has more than 7,000 active HIV positive clients and gives HIV counselling and treatment services to between 150 and to 200 clients daily. It also gives antiretroviral treatment service to about 2,300 to 2,500 active clients. The study was done from the middle of January, 2008 to end of August 2008. The data collection days coincided with weekly ART clinic days of TASO Mulago (Tuesday, Wednesday and Thursday).

3.2 Study Design

A longitudinal study with an observation component was conducted. This study design was used because it enabled the researcher to follow up individual subject and observe changes both in body composition and dietary pattern. It also enabled the nutrition related side effects of anti-retroviral treatment to be described.

3.3 Study Subjects

Inclusion criteria

- All HIV positive adults aged between 18-59 years who were eligible to start HAART according to the TASO protocol that follows WHO guidelines.

Exclusion Criteria

- HIV positive people who were under 18 years old or more than 59 years old.
- All individuals on second line antiretroviral treatment and those who are already on the treatment,
- All pregnant and lactating women

- Individuals who were on TB treatment, with any malignancy regardless of their age were also excluded from the study.
- Individuals who were planning to relocate or transfer to another treatment centre with in 10 weeks.

3.4 Sample Size Determination

According to the information obtained from the Data and Records office of TASO Mulago, the average number of clients who start antiretroviral treatment in a period of three months was 166. The statistical equation by Bryan (1992) was used to calculate the number of subjects were recruited in to the study. The calculation was done with tolerable sampling error of 5% (0.05) with a 95% confidence limit.

$$\mathbf{n = \frac{Z^2pq}{d^2}}$$

Hence, according to the expression:

$$n = \frac{Z^2pq}{d^2} ; \frac{(1.962\times0.071\times0.929)}{(0.05)^2}=101.6$$

n=102 subjects

Where:

n= Total number of participants

p= Proportion of HIV/AIDS positive adults who start ART in about 3 months

q= (1-p) proportion of HIV/AIDS positive adults who are already ART.

d= Acceptable degree of error (5%).

z= Normal deviation (confidence limit) taken as 1.96 at 95% CI.

3.5 Sampling Procedure

In this study, purposive sampling was used. Clients were assessed by TASO clinicians and found to be eligible to start ART were given appointment. The clients who were eligible for HAART and were ready to start the treatment were assessed by the research assistant from *triage desk* to establish whether they can meet the inclusion

criteria. Those who fulfilled the inclusion criteria and consented to participate in the study were recruited. This procedure continued until the required total number of subjects was obtained.

3.6 Data Collection Variables, Procedures and Tools

3.6.1 Socio Demographic Factors

Sociodemographic characteristics of the subjects were assessed using a questionnaire. The questionnaire was designed to capture on age, sex, educational level, marital status, occupation, and other relevant information (Appendix: A) on the study subjects.

3.6.2 Height

Height was measured using a stadeometer (Seca 225, column scale). The subjects were asked to remove their footwear (shoes, slippers, sandals etc) and head gear (hair bows, comb, ribbons, hat, cap etc) and then stand up straight on the stadiometer. It was ensured that the head, scapular and buttocks touched the measuring board. The rod was kept straight throughout the procedure. The subjects were then asked to keep their head up with their eyes focused straight ahead. The headpiece of the stadiometer was lowered gently until it was firm on top of the head of the participant. The headpiece was pressed gently on to the head to ensure that it was in contact with the head. Readings were taken thrice for each for each subject, and then an average was calculated. Height measured to the nearest ±1cm.

3.6.3 Weight

Weight was taken using a digital electronic scale (Seca 884, wrestler) the subjects were asked to remove their footwear (sandals, slippers, shoes and other heavy clothings) and stand on the centre of platform with the weight evenly distributed between the feet. The subjects waited until the reading on the scale was stable. Then the weight was measured to the nearest ± 0.1 kg. The same procedure was done in duplicate, and the average readings were recorded.

From the measurements of weight and height, body mass index (BMI) was calculated As ratio of subjects weight in kilograms and squared height in meters. The measurements obtained as well as the indices, were then used to classify the

individuals according to the WHO (2002) BMI cut-off values. The subjects were classified into to the following BMI categories: Underweight (<18.5 kg/m^2); normal weight (18.5-24.9 kg/m^2); overweight (25.0-29.9 kg/m^2) and obese (≥30 kg/m^2).

3.6.4 Mid-Upper Arm Circumference (MUAC)

The Mid-upper arm circumference (MUAC) was measured at the midpoint of upper arm, i.e between the shoulder bone and the tip of the elbow. The midpoint was located after bending the arm to a 90- degree angle at the elbow. During measurement it was ensured that, the upper arm was hanging down the side of the body and was relaxed. The MUAC was measured thrice to the nearest ± 0.1cm, and average taken as the MUAC reading.

3.6.5 Skin fold thickness

Skin fold thickness was measured using a calibrated skin fold Harpenden calliper (John Bull, British indicators Ltd, UK) with a precision of ± 2mm. During the measurements, the subjects were told to stand up strait with arms and shoulders relaxed. The sites were carefully identified and marked with a pen, and the skin folds were firmly grasped between the thumb and the index finger of the left hand at a distance of about 1cm above the marked site. The skin fold was lifted by raising the double fold of the skin and subcutaneous adipose tissue and leaving the underlying muscle undisturbed. The jaws of the calliper were then placed perpendicular to the fold 1cm below the thumb and index finger. The jaw pressure was then released gradually and the measurement was taken a few seconds after releasing the pressure. The skinfold measurements were taken three times at interval of about 10 seconds to allow the tissue to restore its uncompressed form. The measurement was taken from the four standard sites (triceps, biceps, Subscapular and supra-iliac) areas of the body and averages were calculated. All the skinfold measurements and procedures were performed according to (Gibson, 2005 and WHO, 1995). The skin fold was measured in the following positions:

i) Triceps skinfold

The triceps skinfold thickness was measured by vertically raising the skinfold on the posterior aspect of mid triceps exactly halfway between the olecranon process of the ulna and acromion process of the scapula. The measurement was taken at the back of the left arm over the triceps muscle at the level marked for the circumference measurement.

ii) Biceps skinfold

The biceps skinfold measurements were taken by vertically raising the skinfold on the front of the left arm directly above the centre of the arm mid point. The calliper was applied at the same marked level as for the triceps but on the ventral side of the left arm. During measurement, it was made sure that the left arm was extended along the side of the body.

iii) Subscapular Skinfold

The subscapular skinfold thickness was measured by obliquely raising the thickness of subcutaneous fat below the inferior angle of the scapular at approximately 45% to the horizontal plane following the natural cleavage line of the skin. The jaws of the calliper were applied lateral to the fingers, at a point lateral to and just inferior to the inferior angle of the scapula.

iv) Suprailiac skinfold

The Suprailiac skin fold thickness was measured on the midaxillary line immediately superior to the iliac crest. The midway fold then marked. During measurement, the skin fold was picked up obliquely just posterior to the midaxillary line and parallel to the cleavage lines of the skin about 1cm from the mark.

3.6.6 Lean body mass, Body fat and Body cell mass

Bioelectrical impedance analysis (BIA) was performed to measure lean body mass, body fat and body cell mass of the study subjects. This was done using (Bodystat® Quanscan 4000 Hydration/Body composition Monitoring Unit, Isle of man, UK) which is a battery-operated unit that is connected to the body through electrodes, to allow a small electric current to pass through the body. BIA is recommended in measurement of body composition (ultimately lean body mass) in individuals and

those with chronic conditions such as HIV infection (NIH, 1994). BIA is preferred for its rapid and easy to perform. Portability of BIA machine also allows it to be used in a variety of settings including medical offices and hospitals (Wanke *et al.*, 2002).

The principal research with the research assistant were trained on how to use the BIA by a senior nurse who had been trained to use the machine and had operated it for an earlier study on body composition for clients receiving UNWFP food supplementation at TASO Mulago. However to enhance reliability the assessments were done by the principal researcher. The BIA machine was calibrated before each analysis using the calliper supplied by the manufacturer. Measurements were performed according to the manufacture's instructions (Bodystat® Quadscan 4000 users Guide) and also following standard procedures (BODYSTAT, 2000 and Wanke *et al.* (2002).

The BIA measurement was taken on the right hand side of the body of the subjects while they were lying in a spine position with legs slightly apart and thighs not touching each other. During measurement, it was ensured that there was no contact between the thighs or the trunk as this would create a short circuit in the electrical path thereby dramatically affecting the impedance value.

Procedures used in measuring were as follows;

The skin was cleaned at the electrodes sites with alcohol swabs to ensure good adhesion. After the skin was cleaned with Lovis alcohol wipe (70%), four self adhesive electrodes with electro conducting gel and four leads (two black and two red leads) were attached at the following parts of the subjects;

a) One of the four self adhesive electrodes connected with red lead was attached to the right hand just behind the fingers.

b) The second self adhesive electrode connected to red lead was attached to the right foot just behind the toes.

c) The third self adhesive electrode connected with black lead was attached to the right wrist just behind the ulnar bone head.

d) The last self adhesive electrode which is connected to a black lead was attached to the right ankle between the medial and lateral malleoli (the large protruding bones on the sides of the ankle).

During measurement it was ensured that distance between the centre of two pair of the electrodes both on the hand and foot was at least 5cm. Prior to the procedure, the subjects were asked to remove any metallic materials near or in contact with their bodies like coins, phone and other conducting materials for they would interfere with the conductivity and leading to a wrong readings on the machine. The subjects were also told to lie quietly while measurements were being taken.

3.6.7 Dietary patterns of the subjects

Dietary data was collected using an interactive 24 hour dietary recall method to capture daily macronutrient and micronutrient intake of the subjects. To improve the food recall, the subjects were provided with bowls, plates and other common utensils to help them visualise the amount of food consumed. Along with the provision of the bowls and plates, weighing of the portion size of the salted replica of the actual food consumed by the respondent was done. Food frequency was also used to capture the frequency of different food groups consumed over a 7 days period. Along with assessment of dietary intake and food frequency, meal frequency and nutrition related lifestyles of the study participants were assessed using a questionnaire. Dietary diversity score of the subjects was calculated according to (Swindle and Bilinsky, 2006).

3.6.8 HAART regimens

All of the patients were prescribed the first-line HAART regimen which is based on a combination of one Non-nucleoside reverse transcriptase inhibitor (NNRTI) with two Nucleoside Analogue Reverse Transcriptase inhibitors (NRTI) and consisted of Nevirapine (NVP) with Zidovudine (ATZ) and Lamivudine (3TC), Efavirenz (EFV) with ATZ and 3TC or Stavudine (d4T), 3TC and NVP. The doses were as follows: ATZ, 300 mg every 12 hours; 3TC, 150 mg every 12 hours; d4T, 30 mg every12 hours; NVP, 200 mg once daily for 14 days, then 200 mg every 12 hours and EFV, 600 mg once daily. In some of the patients, ATZ and 3TC were prescribed as a single combination tablet, namely Combivir (CBV). The HAART regimens used at TASO are consistent with the WHO (2006) guidelines.

3.6.9 Side Effects Arising From Taking of ARVs

The subjects were also assessed for the presence of any nutrition related problems that arose after taking of ARVs using a separate questionnaire. The assessment was done after two weeks of commencing HAART. The nutrition related side effects like mouth sores, oral thrash, abdominal pain, diarrhoea, nausea/vomiting, dry mouth, loss of taste, constipation, anorexia, fatigue and dizziness were assessed in the study.

3.6.10 Follow up and contact points

Full contact addresses were obtained to assist with tracing of study subjects when ever possible and appointment slips (Appendix F) were given to the subjects after each contact in order to avoid absenteeism on the next appointment date. Each subject was contacted four times that is at the beginning of ART, after two weeks, six weeks and ten weeks after initiation antiretroviral treatment. No incentives were provided to the study participants. However in order to avoid any absenteeism of the clients, the contact days were made to coincide with those when the subjects came for their ARV refill and routine medical check up.

First contact: This was the first day of commencing of the antiretroviral treatment for the subjects. At this contact, socio-demographic characteristics, body composition of the subjects were measured. Lean body mass, body fat, anthropometric measurements were taken. Data on dietary pattern of the study subjects was also collected using the 24 hour dietary recall, meal frequency and food frequency questionnaires (Appendix A). All the data from the first time contact were used as baseline for the study.

Second contact: This was at two weeks after the first contact. This is because the clients were supposed to return to the centre for another drug refill and to report any drug related side effects. Therefore at the second contact point, the subject was asked for the presence of drug related side effects therefore at this contact point. All reported nutrition related side effects were recorded in separate questionnaire (Appendix B).

Third contact: This was at six weeks from the first contact. Body composition was measured using Bioelectrical Impedance Analysis (BIA) machine to compare with the previous body composition measurement. Along the body composition, dietary patterns were assessed following the procedure used at the first contact (Appendix C).

Fourth contact: This was at 10 weeks from the first contact. At this time body composition was measured following the procedures used in the previous contacts. Dietary patterns was also assessed using 24 hour dietary recall, meal frequency and food frequency questionnaires (Appendix D) for the last time and compared with the previous findings for any changes.

3.7 Data Analysis

After the data was collected, it was cross checked for completeness, consistency and stored safely. The Data was analysed using SPSS version 12.0 to generate descriptive statistics (frequencies and percentages) and to summarise continuous variables as means and standard deviations. Frequencies were used to assess scoio-demographic characteristics of the subjects. Frequencies were also used to assess nutrition related life styles and consumption of different food groups by the subjects. A combination of cross-tabulations and frequencies was used in order to establish the number and percentage of subjects who are in different drug regimens. Along the frequencies of drug regimens, all the nutrition related effects of the treatment were established using cross tabulation. Microsoft office excel 2003 was used to generate bar charts and line charts of BMI, meal frequency and food frequency of the subjects.

Independent samples T-test was used to compare means for statistically significant differences between males and females in the mean measurements of body composition and dietary intake. A paired sample T-test was conducted to compare the statistical significant differences in mean body composition and dietary intake between baseline and 6 weeks of treatment and/ or baseline and after 10 weeks of treatment. The mean change in variables between baseline and the six week and ten week visit was calculated by subtracting the mean value at baseline from the mean value at six and ten week visit.

Nutrisurvey for windows (Erhardt, 2003) was also being used to generate the daily dietary intake of the subjects. East African Food Composition Table (Kikafunda, *et al*, 2007) was used to modify the food data base of *Nutrisurvey for windows* (Erhardt,

2003) with some of the local foods that are not in the food database but consumed in Eastern part of Africa. All statistical tests were done at 95% CI or $\alpha = 0.05$, values less or equal to 0.05, were considered to be statistical significant.

3.8 Ethical Considerations

The study was approved by Makerere University Department of Food Science and Technology. Prior to the study, permission to conduct the research was got from TASO headquarters after revising and approving the research protocol (Appendix G). An informed consent (appendix F) was obtained for all participants before testing and commencing the study. In the consent form benefits of the study were explained and risks involved in participation in the study were also explained. Confidentially of the information collected from the subjects was assured. It was also explained that participation in the study is voluntary one had the right to withdraw at any stage of the study without losing the benefits from the treatment centre (TASO). No control group was used in the study as it is unethical to withhold HAART from eligible patients. A number was allocated to each subject and at no time were names of the subjects disclosed to anyone other than the researcher and his assistants. Subject confidentiality and privacy were protected by ensuring that no names appeared on any part of the report. Measurements and assessments were done in a private consultation room.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-demographic, background and household information

4.1.1 Socio-demographic characteristics

In this study, a total of 113 subjects were recruited. Out of the 113 subjects, one was known to be deceased, two were relocated to another treatment centre and the rest eight could not be traced after being recruited. However, 102 study subjects were able to complete the study.

The results in Table 4.1 show, that most of the study subjects were females (73.5%). A majority (38.2%) of the study population were aged between 36-45 years old. Of the 102 study Subjects 41.2% were married while 31.4% were single. Results further show that more than half (56%) of the study Subjects attended primary-level education. Thirty seven (37%) of the study Subjects were engaged in informal business while about one quarter (23.5%) were unemployed. Most of the study subjects were Catholics (41.2%) while Seventh Day Adventist and other religions were the fewest among all constituting only 5.9% of the total number of study subjects.

This result is in accordance with the report by MOH and ORC Marco (2006) which indicate the prevalence of HIV being higher among females than males. Similarly, Bukusuba *et al. (*2007) reported a majority of TASO Jinja beneficiaries were females. The high number of females in the study population could be because most females test for HIV during Antenatal Care (ANC) while men are reluctant to go to a Voluntary HIV Counselling and Testing (VCT) centres to know their status. Hence females account for the higher number of people on ART as compared to the males. The high proportion of study subjects in the age group 36-45 years old in agreement with MOH and ORC Macro (2006) findings which reported a high HIV prevalence (9%) among age group of 25-45 years in the general population. This could be due to the fact that most people in this age bracket are sexually active and are likely to have multiple sex partners hence putting them at a higher risk for HIV-infection.

Table 4.1 Socio-demographic data of HIV positive individuals starting ART at TASO Mulago

Gender	Frequency	Percent
Females	75	73.5
Males	27	26.5
Age Category		
<25	8	7.8
26-35	37	36.3
36-45	39	38.2
46-59	18	17.6
Marital Status		
Married	42	41.2
Single	32	31.4
Widowed	19	18.6
Divorced	9	8.8
Educational level		
Primary school	58	56.9
Secondary School	33	32.4
No formal education	11	10.8
Occupation		
Informal business	38	37.3
Unemployed	24	23.5
Farmer	18	17.6
Salaried employed	12	11.8
Formal business	10	9.8
Religion		
Protestant	35	34.3
Catholic	42	41.2
Pentecostal	11	10.8
Muslim	8	7.8
SDA	5	4.9
Others	1	1.0

Majority of the Subjects were married however some of the respondents explained that they divorced their spouses on knowing their HIV status. The findings from MOH and ORC Macro (2006) agree with the above findings where HIV prevalence was higher (8.2%) among those who have only primary education. The high level of illiteracy showed among the respondents could be a barrier to access of knowledge on HIV prevention methods and awareness. In this study informal business was described as street vending, art, craft, market vending, food vending were among others while the unemployed ones did not have a stable income. This could possibly be due to the effect of HIV/AIDS on health of the patients and leading to absenteeism from job (Bukusuba *et al.* 2007).

4.1.2 Subjects' Background

Majority of the study Subjects (32.4%) knew about their HIV status within the last two years prior to the study (Table 4.2). Of the 102 study subjects, 86.3% had a CD4 count of less than 199. Most (29.4%) of the respondent came from a distance of 4-6kms from TSAO Mulago while 26.5% came from a distance of 6-8kms. The subjects were largely (82.4%) perceived services from the centre are adequate and only 5.9% responded that the services are in adequate.

Table 4.2 Health status of HIV positive individuals starting ART and perception of quality of health services at TASO Mulago

	Frequency	Percent
Knowing HIV Status		
Less than 2 years	33	32.4
2-3 years	26	25.5
4-5 years	22	21.6
More than 5 years	21	20.6
CD4 count		
<100	43	42.2
100-199	45	44.1
=>200	14	13.7
Distance from the centre (TASO, Mulago)		
Less than 2	7	6.9
2-4 Kms	16	15.7
4-6 Kms	30	29.4
6-8Kms	27	26.5
More than 8Kms	22	21.6
Perception of services at the centre		
Adequate	84	82.4
Inadequate	6	5.9
Some how adequate	12	11.8

The reason for large number of the respondents knew their status in the last two years prior to the study could be possibly be because people are reluctant to go for HIV testing. Piowz and Preble (2000) in their report said that most people in Africa know their HIV status at late stage of the infection. Hence they are recruited on antiretroviral treatment within short time of knowing their status. The higher percentage of subjects with low CD4 count was the main reason for them to start

antiretroviral treatment. Studies show that HIV positive people with low CD4 lymphocyte count or severe immunosuppression can experience greater increase in weight after commencement of treatment with antiretroviral drugs (Shikuma, 2004). Only small number of the subjects who responded that they came from 2km away from TASO however the rest preferred to go to centres that are far from their residential area because of fear of stigmatization for being HIV positive.

4.1.3 Household Information

As it is indicated in Table 4.3, most (29.4%) of them had a house hold size of 3 to 4 people and 78.4% of the subjects households buy their food for eating. Except 3.9% of the households all responded that household members share food that is available in the house.

Table 4.3 House hold information of HIV positive individuals who are starting antiretroviral treatment at TASO Mulago

	Frequency	Percent
House Hold size		
Less than 2	24	23.5
3-4 people	30	29.4
5-6 people	25	24.5
7-8 people	13	12.7
9-10 people	8	7.8
11-12 people	2	2.0
Food source of subject's house hold		
Buying	80	78.4
Own Farm	14	13.7
Own Farm and Buying	6	5.9
Others	2	2.0
Food sharing among house hold members		
Yes	98	96.1
No	4	3.9

The main reason for the Subjects for buying their food is the fact they live in urban setting and majority of the respondents were engaged in non-farming activities. However the HIV/AIDS pandemic has increases the inability of affected households to put enough food on the table (Bukusuba *et al.* 2007). The very few subjects who responded that they don't share food in the household could be due to the reduced productivity and increased medical costs for the PLHIV (Bukusuba *et al.* 2007).

4.2 Body Composition

4.2.1 Body mass index

Study Subjects' body mass index is presented in Figure 4.1. The prevalence of underweight at the baseline, 6weeks and 10 weeks of treatment was 12.4%, 12.4% and 10.7 % the total population of the study respectively. Arpadi (2000) noted that PLHIV including those with severe malabsorption had lower body mass index. The percentage of study subjects who had normal body weight (BMI; 18.5-24.9) was the same (69.6%) throughout the study period. When compared to the baseline and 6 weeks of treatment, the prevalence of overweight (BMI; 25-29.9) and obesity (BMI≥30) was also almost the same after ten weeks of treatment.

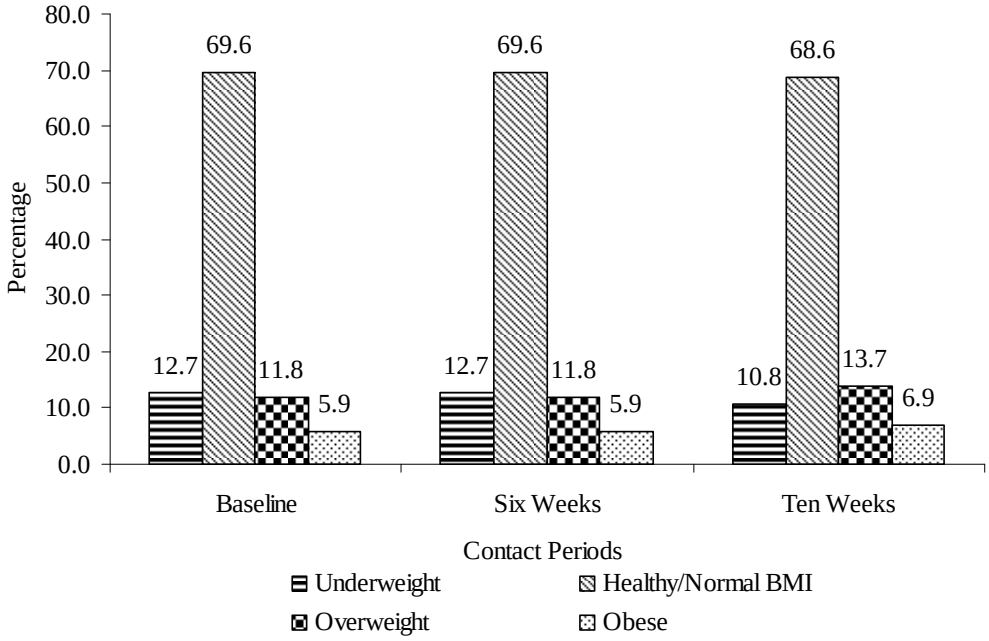


Figure 4.1 BMI of HIV positive individuals starting ART at TASO Mulago at baseline, 6 weeks and 10 weeks of ART

The above result is lower than the results by Nabiryo *et al.* (2004) carried out at TASO that showed the prevalence of underweight was 13.3%. The lower number of underweight subjects found in this study was possibly due to improved medical care in terms of treatment and prevention of opportunistic infections at the centre and decreased HIV and AIDS stigma among PLHIV. Those who were overweight and obese (20.6%) at 10 weeks of treatment are at health risks that associated with over

weight and obesity including type2 diabetes mellitus, hypertension, respiratory difficulties and dyslipdemia. On the other hand, above healthy/normal BMI may mean that a large proportion of HIV positive individuals may not seek care due to the common misconception that they are 'healthy' when in fact they may not only be HIV positive but already eligible to HAART (Puoane *et al.*, 2005). The stigma associated with HIV still exists and may increase the desire to gain weight to avoid being stigmatized for appearing thin and ill is still can be expressed by many patients, even those who have a normal or about normal BMI.

Table 4.4 shows that, the overall mean body mass index at baseline was 22.7±4 Kg/m^2, 22.8±4.0 Kg/m^2 and 23.0±4.0 Kg/m^2 at baseline, after six and 10 weeks of treatment respectively. Comparing the means between the male subjects and females, no significant ($p>0.05$) was seen at baseline and 6weeks of treatment. However the BMI for women subjects (23.5±4.0 Kg/m^2) was found to be significantly higher ($p=0.033$) than their males (21.7±3.4 $Kg/m^{2)}$ counterparts by the end of the study.

Table 4.4 Difference in mean BMI of the HIV positive individuals at baseline, after 6 and 10 weeks of ART by sex

Contacts	Females (n=75)	Males (n=27)	p Value	All (n=102)
Baseline	23.1±4.0	21.4±3.5	0.051	22.7±4.0
6 Weeks	23.2±4.1	21.5±3.4	0.060	22.8±4.0
10 Weeks	23.5±4.0	21.7±3.4	0.033*	23.0±4.0

Values are means and ± standard deviation
Values with * are statistically significant/different between males and females at $p<0.05$.

Esposito e*t al.* (2008) found out similar results where HIV patients tended to increase in body mass index after initiation of HAART. Use of BMI in body composition is important because it measures person's fat content, BMI is widely used to screen for obesity. However, BMI can not differentiate, between lean and either fat mass. As such, it is not able to distinguish between a body builder and an obese individual (Wanke *et al.*, 2002).

4.2.2 Mid-Upper Arm Circumference (MUAC)

The overall MUAC at baseline was 27.2±3.5 cm, 27.6±3.6cm and 27.6±3.3cm (Table 4.5). Comparing to the males, the female subjects had higher MUAC. However, no significant difference in MUAC was found between male and female subjects. A body composition assessment in Thailand reported higher MUAC for HIV positive females as compared to their male counter parts (Ludy *et al.*, 2005). Wanke *et al.* (2002) noted that the measures of mid-upper arm circumference are correlated with measures of total mass. Another study in South Africa showed that HIV positive individuals showed a significant increase in mean MUAC after being treated with HAART for 24 weeks (Esposito, 2008). The UNSSCN (2000), suggested MUAC cut-off points for moderate and severe acute adult under nutrition as <18.5cm and <16cm respectively, therefore according to the UNSSCN none of the study subjects were not malnourished.

Table 4.5 Difference in the mean Mid-upper Arm Circumference (cm) of HIV positive individuals at baseline, 6 and 10 weeks of ART by sex

Contacts	Females (n=75)	Males (n=27)	p Value	All (n=102)
Baseline	27.6±3.5	26.2±3.5	0.080	27.2±3.5
6 Weeks	27.9±3.6	26.6±3.5	0.104	27.6±3.6
10 Weeks	27.9±3.2	26.7±3.6	0.104	27.6±3.3

Values are means and ± standard deviation
Values with * are statistically significant/different between males and females at $p<0.05$.

4.2.3 Skin fold thickness

Table 4.6 shows that, the biceps measurement at baseline was 7.9±6.2cm and 14.1±7.2cm at 10 weeks of treatment. Like that of triceps skin fold measurement, females had significantly higher biceps skin fold measurements at baseline ($p=0.021$), six ($p<0.001$) and ten weeks ($p<0.001$) of ARV treatment. Except in Suprailiac measurement at 10 weeks, female subjects had significantly higher skinfold measurement than the males. This is due to the well established fact that women

possess more fat storing enzymes than men (Gibeny *et al*., 2002). The measure of skinfold thickness is important in estimating of body fat. The validity of skinfold measurement is dependent on two assumptions. First, subcutaneous adipose tissue thickness represents a constant proportion of total body fat. Second, skinfold sites selected for measurements reflect average subcutaneous adipose thickness (Ludy, 2005).

Table 4.6 Difference in mean Skin fold thickness (cm) of HIV positive individuals at baseline, 6weeks and 10 weeks of treatment by sex

Triceps	**Females (n=75)**	**Males (n=27)**	**p value**	**All (n=102)**
Baseline	16.1±7.9	6.9±3.3	<0.001*	13.7±8.1
6 Weeks	16.1±6.4	7.8±4.1	<0.001*	13.9±6.9
10 Weeks	16.3±6.8	8.2±4.2	<0.001*	14.1±7.2
Biceps				
Baseline	9.1±6.7	4.8±2.8	0.021*	7.9±6.2
6 Weeks	9.3±5.2	4.8±2.9	<0.001*	8.1±5.1
10 Weeks	9.6±6.0	4.9±3.4	<0.001*	8.3±5.8
Subscapular				
Baseline	13.4±5.9	10.0±5.5	0.010*	12.5±6.0
6 Weeks	13.6±5.6	10.1±5.3	0.006*	12.6±5.7
10 Weeks	13.7±6.6	10.3±5.5	0.021*	12.8±6.5
Suprailiac				
Baseline	10.6±6.5	6.7±4.0	0.004*	9.6±6.2
6 Weeks	10.9±8.2	6.9±4.4	0.018*	9.9±7.5
10 Weeks	10.9±10.2	7.6±4.5	0.107	10.1±9.2

Values are means and ± standard deviation
Values with * are statistically significant/different between males and females at $p<0.05$.

4.2.4 Body Weight, Fat, Lean Mass and Body Cell Mass

After receipt of HAART for 6 weeks and 10 weeks (Table 4.7), the overall body weight of the subjects was 58.9±10.7kg at the baseline then 59.3±10.5kg after six weeks and 60.5±10.6kg after ten weeks of treatment. Though not statistically significant, the males had relatively higher body weight at all contacts. The overall body fat was 16.7±6.9kg, 16.8±7.1kg, 17.4±7.3kg at baseline, six and ten weeks of treatment respectively. At all contacts, the females showed significantly higher body

fat than the male subjects at baseline (p= 0.01), at six (p<0.001) and (p<0.001) ten weeks of treatment. The overall lean body mass was 42.2±7.1kg and 43.1±7.7 at baseline and by the end of the study respectively. The overall body cell mass was 24.6±4.5kg, 25.0±4.8kg and 25.1±4.8kg at baseline, six weeks and ten weeks of treatment respectively. Unlike in body fat, the male subjects had significantly (p<0.001) higher lean body mass and body cell mass than the females at all contacts.

Table 4.7 Difference in mean Body weight, lean mass, fat mass, body cell mass of HIV positive individuals at baseline, 6 and 10 weeks of ART by sex

	Females (n=75)	Males (n=27)	p Values	All (n=102)
Body weight(kg)				
Baseline	57.8±10.2	62.0±11.7	0.081	58.9±10.7
6 Weeks	58.4±10.3	62.0±10.9	0.129	59.3±10.5
10 Weeks	60.0±10.2	61.9±11.7	0.421	60.5±10.6
Body fat(Kg)				
Baseline	18.1±6.9	13.0±5.7	0.001*	16.7±6.9
6 Weeks	18.6±7.0	11.9±4.9	<0.001*	16.8±7.1
10 Weeks	19.4±6.9	11.9±5.1	<0.001*	17.4±7.3
Lean body mass(Kg)				
Baseline	39.7±5.0	49.0±7.8	<0.001*	42.2±7.1
6 Weeks	39.8±5.2	50.1±8.1	<0.001*	42.5±7.6
10 Weeks	40.6±5.3	50.0±8.9	<0.001*	43.1±7.7
Body cell mass(Kg)				
Baseline	22.6±2.9	30.0±3.3	<0.001*	24.6±4.5
6 Weeks	22.9±3.1	30.8±3.8	<0.001*	25.0±4.8
10 Weeks	23.1±3.1	30.8±4.0	<0.001*	25.1±4.8

Values are means and ± standard deviation
Values with * are statistically significant/different between males and females at p<0.05.

The higher body fat observed in female subjects is because women have higher body fat than men even under normal circumstances (Robergs and Roberts, 1997; Chantal and Kravitz, 2003). Another study by Yelmokka (2001), had confirmed that the amount and distribution of body fat was higher among HIV positive women receiving HAART than HIV positive men. Women tend to have more body fat than men by about five to ten percent. By nature, a woman's body is developed to protect her and a potential fetus. The body fat of normal women ranges from 23-31 percent while the

optimal body fat percentage for normal men ranges from 13-21 percent of body weight (Whitney and Rolfes, 2005). From the above table, the percentage of body fat can easily be calculated by dividing the body fat by the body weight of the subjects and then multiplying the value by hundred. Therefore the body fat percentage of the female subjects was 31.3%, 31.9% and 32% at baseline, six and ten weeks of treatment respectively. This shows that the females have slightly higher body fat percentage than the optimum requirement. On the other hand having slightly above the normal body fat is, having almost the optimum lean body mass. Since lean body mass means the total non-fat part of the body. The males had fat percentage of 21%, 19.8% and 19.3% at baseline, six and ten weeks of treatment respectively. This shows the male participants had a body fat that is with in the normal range hence lean body mass. The difference in lean body mass was in accordance with the findings by Esposito *et al.* (2008) where he found the lean body mass in HIV positive women treated with HAART was different from the baseline.

4.3 Dietary Patterns and Nutrition Related life styles

4.3.1 Dietary patterns

4.3.1.1 Meal Frequency

The meal frequency of the subjects is presented in Table 4.8, At all contacts it was found that 36.3%, 34.3% and 34.3% of the subjects would eat four times per day at baseline, after 6 and 10 weeks of treatment respectively. While only 11.8%, 8.8% and 8.8% of the study subjects would eat less than two times in a day. MOH (2006) recommends that an HIV positive person should eat at least three meals and two to three snacks per day to meet their high energy and nutrient requirement of the body. Therefore those with lower meal frequency are at risk of getting malnourished and further deterioration of health. According to the findings in Table 4.8; 21.6%, 34.3 and 34.3% of the study subjects met the daily recommended number of meals by MOH at baseline after 6 and 10 weeks of treatment. The possible reason for this could be the effect of pre HAART counselling on the meal frequency and dietary intake of the subjects (Stack *et al.,* 1996).

Table 4.8 Meal frequency of HIV positive individuals on daily basis

	Baseline %	6 Weeks %	10 Weeks %
Two meals	11.8	8.8	8.8
Three meals	30.4	22.5	28.4
Four meals	36.3	34.3	34.3
Five meals	14.7	24.5	20.6
Six meals	6.9	9.8	7.8
Met MOH recommendation	21.6	34.3	28.4

4.3.1.2 Dietary intake

Energy

The female subjects consumed 2200.3±397.8 Kcal per day, 2191.7±320.4 Kcal per day and 2089.3±264.9 Kcal per day at baseline, 6weeks and 10 weeks of treatment respectively (Table 4.9). While the male subjects had daily caloric intake of 2317±538.2Kcal, 2249.5±311.0 Kcal and 2237.9±389.7 Kcal at baseline, 6weeks and 10 weeks of the study respectively. According to WHO (2003), the daily energy requirement for adults living with HIV/AIDS is 2400Kcal for females and 2670Kcal for males. When the energy intake of the subjects are compared with the recommendation by WHO (2003) both males and females did not meet the average daily energy requirements. The reason for not meeting the energy requirement by both sexes is most likely due to the effect of HIV/AIDS on food security which also affects food consumption by reducing of food portion size. In a study in the United States, it was reported that weight gain and /or weight maintenance could be achieved among HIV positive people in the early stages of AIDS with no secondary infections, who received at least once daily high-energy, high protein, and liquid food supplementation along with nutritional counselling (Stack *et al.,* 1996).

Table 4.9 Daily energy and macronutrient intake of the HIV positive individuals at baseline, six weeks and ten weeks of ART

	Females			Males		
Nutrient	**Amount Consumed**	**WHO (2003) Requirements** (Recommended)	**% fulfilled**	**Amount Consumed**	**WHO Requirements** (Recommended)	**%fulfilled**
Baseline						
Energy (Kcal)	2200.3±397.8	2400	91.7	2317±538.2	2670	86.8
Protein (g)	62.8±24.9	48	130.8	65.9±22.2	57	115.6
Protein %	11.6±3.8	10-15	100	11.73.6±	10-15	100
Fat (g)	57.9±21.2	53.3	108.6	54.2±18.8	44.5	121.8
Fat %	23.6±8.9	20-30	100	21.6±8.7	20-30	100
Carbohydrate (g)	355.8±101.3	330	107	386.6±132.1	367	105.3
Carbohydrate %	64.8±10.3	55-70	100	66.6±10.8	55-70	100
Six Weeks						
Energy (Kcal)	2191.7±320.4	2400	91.3	2249.5±311.0	2670	84.3
Protein (g)	66.4±22.1	48	138.3	74.4±31.1	57	130.5
Protein %	12.4±3.7	10-15	100	13.6±5.8	10-15	100
Fat (g)	48.1±18.4	53.3	90.2	44.3±14.7	44.5	99.6
Fat %	19.6±7.8	20-30	100	17.5±5.9	20-30	100
Carbohydrate (g)	370.8±89.9	330	112	384.3±90.9	367	104.7
Carbohydrate %	68.1±9.4	55-70	100	68.9±10.1	55-70	100
Ten Weeks						
Energy (Kcal)	2089.3±264.9	2400	87.1	2237.9±389.7	2670	83.8
Protein (g)	50.9±16.0	48	106	56.0±18.9	57	98.2
Protein %	10.0±3.1	10-15	100	10.4±3.4	10-15	100
Fat (g)	47.3±17.7	53.3	88.7	52.3±28.8	44.5	117.5
Fat %	20.3±8.1	20-30	100	20.7±9.5	20-30	100
Carbohydrate (g)	360.9±82.4	330	109.4	378.9±92.0	367	103.2
Carbohydrate %	68.7±9.1	55-70	100	68.5±10.4	55-70	100

Values are means and ± standard deviation
Values with * are statistically significant/different between males and females at $p<0.05$.

Protein

Like the energy intake, female subjects had lower protein intake than the male subjects at all contacts however, both sexes met the daily recommended amount of protein intake (Table 4.9). WHO and FAO (2003) suggest that proteins should contribute about 10-15% of the total caloric intake of individual. Adequate protein intake is important to maintain muscle mass and to regenerate liver cells in HIV positive people without cirrhosis. HIV positive people without cirrhosis may need up to two or three grams of protein per kilogram of body weight daily to regenerate liver cells (Fabris *et al.*, 1988). Further more, adequate protein intake is also equally important for the gain of body cell mass (Williams, 2003). Shabert *et al.* (1999)

observed HIV positive people tend to increase body cell mass when they fed on high protein foods. Studies of whole-body protein turnover in HIV patients suggest that it is correlated with BCM and protein intake (Selberg *et al.*, 1995). Another cross-sectional study in PLHIV found that, protein intake is highly correlated with lean body mass (Difranco, 1996).

Fat

As it is shown in Table 4.9, the baseline fat intake of the female subjects was 57.9±21.2gm and for the males 54.2±18.8gm. By the end of the study the fat intake of the subjects was 47.3±17.7gm for females and 52.3±28.8g for females. FAO (1994) recommends for most adults, that oils and fat should supply at least 15% of their energy intake. Women of reproductive age should consume at least 20% their energy from fat. Therefore, based on the above recommendation it was calculated that the males require about 44.5 grams while the females require 53.3 grams of fat. According to the WHO (2003) guidelines, there is no evidence that fat requirements are different during HIV infection. However, certain ARVs or certain infection symptoms such as diarrhoea may require changes in the timing or quantity of fat intake (FANTA, 2004). Although fats facilitate absorption and utilization of fat soluble vitamins such as A, E, K and D (MOH, 2006); their consumption should be limited due to the reason that excessive fat intake may predisposes individuals to obesity and obesity related complications.

Carbohydrate

Carbohydrate was the major energy source for the subjects throughout the study by contributing more than 55% of the total calorie that had been taken in (Table 4.9). It is suggested that carbohydrates should contribute about 55-70% to the total caloric intake of an individual (WHO and FAO, 2003). Based on the above recommendation, the carbohydrate requirements of the subjects were calculated as 330 grams for females and 367 grams for males per day. Therefore the carbohydrate intake of both males and females was adequate. This is most likely due to the low dietary diversity among the participants which makes them to feed on some energy rich staple foods like tubers, plantains and cereals. Williams (2002) noted that carbohydrate intake was negatively associated with body cell mass. The reason for this is unclear although it is

possible that patients whose diets include a greater proportion of carbohydrates consume a proportionally lower amount of protein (Bukusuba *et al.*, 2007). Similarly, Williams *et al.* (2002) noted that greater protein intake is positively associated with BCM. Macallan *et al.* (1995) reported that poor dietary intake among HIV patients contributed to loss of lean mass or poor recovery among people with severe malnutrition.

Micronutrients

Table 4.10 reveals that both females and males met the WHO requirements vitamin A intake in all contacts. The females had vitamin A intake of 2307.3±2812.1 µg, 1500.2±3193.3 µg and 1616.8±1820.7 µg at baseline, six weeks and ten weeks of treatment respectively. Meeting the requirements of Vitamin A is important for maintaining epithelial cells, mucous membranes and immune system function (Piwoz and Preble, 2000, Stepenson, 2001). On the other hand, long term consumption of vitamin A in excess of 10 times of RDA (25,000 IU/day) may cause side effects like nausea, headache, fatigue, loss of appetite, dizziness, dry skin, desquamation, cerebral edema and osteoporotic fracture (Penniston and Tanumihardjo, 2006). Although both males and females had almost the same intake of vitamin B1, the female subjects met their daily vitamin B1 requirements while the males only met 91.7%, 83.3% and 75.0% of the requirements at baseline, six weeks and ten weeks of treatment. The reason for not fulfilling the requirements is only that, males have higher vitamin B1 requirement than females (FAO/WHO, 1998). Both female and male subjects met their daily vitamin C requirements in all contacts. Meeting the requirements of Vitamin A especially in HIV patients helps the body to protect against opportunistic infections and also aids in recovery after infection (WHO and FAO, 2002).

Table 4.10 Daily Micronutrient intake of the HIV positive individuals at baseline, six and ten weeks of antiretroviral treatment

	Females			Males		
Nutrients	**amount consumed**	**FAO/WHO Requirements**	**%fulfilled**	**amount consumed**	**FAO/WHO Requirements**	**%fulfilled**
Baseline						
Vitamin A (µg)	2307.3±2812.1	500	461.5	2466.9±2663.5	600	411.2
Vitamin E (mg)	16.1±10.5	5	322.0	14.8±10.4	10	148.0
Vitamin B1(mg)	1.1±0.5	1.1	100.0	1.1±0.6	1.2	91.7
Vitamin B2(mg)	1.6±0.5	1.1	145.5	1.7±0.6	1.3	130.8
Vitamin B6(mg)	3.1±1	1.3	238.5	3.2±1.3	1.3	246.2
Vitamin C(mg)	212.5±108.2	45	472.2	175.2±85.5	45	389.3
Iron (mg)	11.4±6.4	20	57.0	12.6±9.2	9	140.0
Zinc (mg)	7.9±3.7	6.4	123.4	9.4±4.1	9.4	100.0
Six Weeks						
Vitamin A (µg)	1500.2±3193.3	500	300.0	1080.6±1027.3	600	180.1
Vitamin E (mg)	10.7±6.8	5	214.0	8.4±4.3	10	84.0
Vitamin B1(mg)	1.1±0.5	1.1	100.0	1.0±0.4	1.2	83.3
Vitamin B2(mg)	1.8±0.8	1.1	163.6	1.8±0.7	1.3	138.5
Vitamin B6(mg)	3.5±1.1	1.3	269.2	3.6±1.2	1.3	276.9
Vitamin C(mg)	181.7±83.3	45	403.8	154.2±61.1	45	342.7
Iron (mg)	14.0±7.8	20	70.0	13.5±9.9	9	150.0
Zinc (mg)	8.5±3.8	6.4	132.8	9.5±4.4	9.4	101.1
Ten Weeks						
Vitamin A (µg)	1616.8±1820.7	500	323.4	1653.5±1782.6	600	275.6
Vitamin E (mg)	12.6±7.9	5	252.0	11.8±6.4	10	118.0
Vitamin B1(mg)	0.9±0.3	1.1	81.8	0.9±0.3	1.2	75.0
Vitamin B2(mg)	1.4±0.4	1.1	127.3	1.5±0.5	1.3	115.4
Vitamin B6(mg)	3.3±1.2	1.3	253.8	3.2±1.2	1.3	246.2
Vitamin C(mg)	184.6±84.5	45	410.2	169.1±79.4	45	375.8
Iron (mg)	11.7±5.8	20	58.5	12.7±7.4	9	141.1
Zinc (mg)	8.0±3.0	6.4	125.0	9.0±3.1	9.4	95.7

Values are means and ± standard deviation
Values with * are statistically significant/different between males and females at $p<0.05$.

Male subjects met their daily iron requirement at all contacts but the female subjects met only 57%, 65.5% and 57% of their daily iron requirement at baseline, after six and ten weeks of treatment respectively. The possible explanation for females not meeting their iron requirement is, that females have more than twice higher iron requirement than males and meeting this requirement under resource limited settings makes it hard. In addition to that there is a food taboo and food habit in the study area

where women are not allowed to eat certain types of iron rich offal. Not meeting these daily iron requirements, may put the person at risk anaemia and other iron deficiency related problems. In addition to that, HIV positive individuals on HAART with Zidovudine in the combination are advised to take foods that are rich in iron since Zidovudine suppresses bone marrow function and synthesis of red blood cells (Piwoz and Preble, 2000). The zinc requirements were fulfilled by both sexes except by females at ten weeks of treatment. Ensuring adequate intake of zinc for HIV positive patients especially those who are on HAART helps to reduce the incidence of opportunistic infections as well as stabilize body weight (Mocchegiani, 1995).

4.3.1.3 Diet Diversity

The consumption of vegetables has been the highest throughout the study constituting 29%, 30% and 34% of the subjects at baseline, six weeks and ten weeks after the treatment respectively (Table 4.11). Vegetables contain useful immune substances and antioxidants like beta-carotenes, zinc, iron, and also dietary fibers. Kristy (2003) noted that HIV patients who consume vegetables and foods rich in fibre showed lower fat deposition in their bodies. Among the most common vegetables consumed by the subjects include: local vegetables *doodo, nnakati, malakwang, eboo, kale (sukumawiki)* and cabbage.

Table 4.11 Daily consumption of different food groups in percentage of HIV positive individuals at baseline, after 6 and 10 weeks of ART

Food groups	Baseline	Six weeks	Ten weeks
Cereals	16	16	12
Tubers and Plantain	16	15	16
Legumes	10	8	7
Dairy, Fats/oils	24	25	22
Animal Products	7	8	9
Vegetables	29	30	34
Fruits	10	10	8

Values are presented as percentages of the study subjects

Results in Table 4.11 show that, few number of subjects (7%) consumed animal products at baseline, 8% and 9% after six and ten weeks of treatment respectively. Animal source foods are good sources of Vitamin B complex especially Vitamin B12,

which is only found in animal source foods. Diets low in these vitamins expose persons to risks of deficiency of vitamin B12. Vitamin B12 is essential for its contribution to the synthesis of new cells. The fluctuation seen in the fruit and tuber consumption could be due to the fact that some foods are mostly seasonal and this affects their availability for consumption (MOH, 2006).

Table 4.12 shows the dietary diversity score of subjects was 4.9±3.2, 4.3±2.9 and 2.6±1.9 at baseline, six and ten weeks of treatment respectively. The subjects consumed less than six food groups out of the twelve food groups stated by Swindale and Bilinsky (2006). This shows that the subjects were having lower dietary diversity and the result is in agreement with the findings of Bukusuba *et al.* (2007) who noted that there is very low dietary diversity in developing countries, the majority of studied households that are affected by HIV/AIDS consumed less than six food groups. Another study by Nontobeko *et al.* (2008) showed that in South Africa, diets of PLHIV are significantly less diverse than those of HIV negative individuals. However a balanced diet will ensure that the individual consumes sufficient nutrients to maintain energy, normalize weight, and ensure the body's proper functioning.

Table 4.12 Dietary Diversity Score of HIV positive individuals on first line ART at baseline, 6 and 10 weeks

Sex of the Subjects	Baseline	Six weeks	Ten Weeks
Females	5.1±3.2	4.2±2.8	2.4±1.7
Males	4.4±3.1	4.6±3.0	3.0±2.4
All	4.9±3.2	4.3±2.9	2.6±1.9

Values are mean dietary diversity score ± standard deviation

4.3.2 Nutrition related life styles of the study subjects

Half (50%) of the subjects were physically active (figure 4.2). In the study, those who jog for 20 minutes a day, walk for more than an hour a day and those who do resistance exercise were considered as physically active (Schlenzig *et al.*, 1993). The Kenyan National Guidelines on Nutrition and HIV/AIDS, described that progressive resistant physical exercises reduced fat levels in blood, hence decreasing the risk of heart disease and diabetes and improving lean body mass (LBM) (MOH, 2006). Among the physically active subjects majority walked for more than an hour per day.

Only few men reported participation in resistance exercise therefore, physical activity level showed in figure 4.2 does not necessarily mean formal resistance physical exercise. Only 3 % of the subjects who were obese reported that they used dieting to control their total caloric intake. Fifteen percent of the subjects reported that they take alcohol and 3.9% of the subjects were all males were reported to smoke cigarettes.

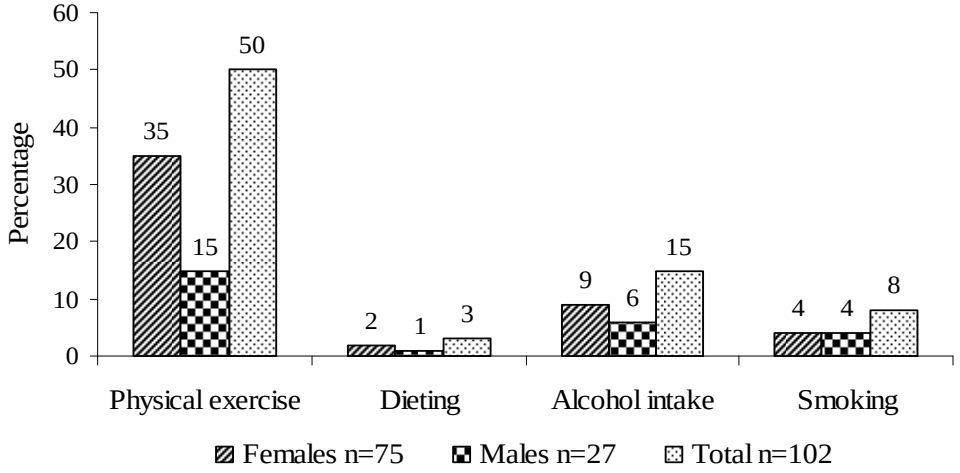


Figure 4.2 Nutrition related life styles of HIV positive individuals staring ART at TASO Mulago

Physical activity however should always be within sufficient energy intake, otherwise it may cause unwanted weight loss. Therefore it is advisable service providers should assess a client's strength, and recommend suitable and various physical activities. For example, a hand grip will assess muscle strength and this measure correlates well with muscle endurance (glycogen levels) and hydration (Schlenzig *et al.*, 1993). The importance of exercise is often overlooked among PLHIV. However, regular exercise, especially resistance training, has been found to assist in building lean body mass. Patients who exercise are stronger and better able to manage the activities of daily living independently (Florindo, 2004).

Poor habits such as smoking, alcohol consumption and drug abuse that may affect food and nutrient intake; increase oxidative stress; and decrease the efficacy of some medications and immunity. Geetanjali *et al.* (2007) in his urban HIV positive people cohort, hazardous alcohol use and active drug use were each independently associated

with decreased antiretroviral therapy uptake, adherence, and viral suppression. Therefore PLHIV are advised to stop consuming alcohol, smoking or chewing tobacco and using illicit drugs and substances. Moderate in the consumption of tea, coffee, sodas or other related drinks that may interfere with food intake, absorption and utilization of medicine is important.

4.4 Nutrition Related Side Effects of HAART

As indicated in Table 4.13 highest percentage (66.7%) of subjects experienced intense hunger. Among these, 46 subjects were on Combipack and 21 were on Triomune. International HIV/AIDS Alliance (2007) explained that most PLHIV do experience intense hunger in a few weeks after antiretroviral treatment. This is because the body is starting to build itself and it is demanding more energy and nutrients. Number of subjects who suffered headache as a side effects was high (45.1%); where among the subjects who suffered headache 30 were on Combipack while 15 on Triomune. Only 16.7% experienced diarrhoea. Side effects like fatigue, fever, sweating, dizziness and rash were presented in the table as 'Others' and experienced by 10.8% of the subjects.

Table 4.13 *Nutrition related side effects experienced by HIV positive individuals starting ART after two weeks of treatment

Side effects	**Drug regimens**			**Percentage of subjects**
	(Combipack) Combivar + Nevirapine n=71	**(Triomune)** Stavudine + Lamivudine + Nevirapine n=30	Zidovudine + Lamivudine + Efavirenz n=1	
Anorexia	34	10	0	43.1
Nausea/vomiting	32	12	1	44.1
Taste changes	24	9	1	33.3
Mouth ulceration, sores and thrush	22	10	0	31.4
Abdominal pain	22	10	1	32.4
Constipation	14	5	0	18.6
Flatulence or Bloating	24	13	0	36.3
Heart burn	15	5	0	19.6
Headache	30	15	1	45.1
Diarrhoea	13	4	0	16.7
Intense hunger	46	21	1	66.7
Other side effects	8	3	0	10.8

*Multiple response analysis

In the publication by International HIV/AIDS alliance (2007), ARVs like Zidovudine, Combivir, Didanosine, Indinavir, and Nelfinavir are responsible for causing Nausea and vomiting. An article review by Zaneta and Meyer (2003) stated that multiple regimens may have effects such as gastrointestinal upset, diarrhoea, nausea, vomiting, malabsorption and anorexia that negatively affect the patient's ability to eat adequate diet. In the study nausea and vomiting where found to be the third largest prevalent side effects of the treatment among the subjects accounting for 44.1%. HIV patients who experience anorexia are advised to eat small and frequent meals, also advised to eat foods that are their favourite and they must be energy and nutrient dense foods (FANTA, 2004). The 44.1 percent of the subjects who experienced nausea and vomiting are also advised to eat small quantities of food and frequently, limit intake of fluids with meals, avoid having an empty stomach, avoid laying down immediately after eating, rest between meals (Castleman, 2004) HAART induced side effects were established in another study in USA which showed that 30% of drug interruption in the first 90 days is attributed to nausea, vomiting, and other gastrointestinal effects of the drug (Chen *et al.*, CID, 2003). Therefore this drug interruption could lead to health deterioration and negative effect on body composition or risk of malnutrition among patients.

4.5 Changes in Body composition and dietary patterns

4.5.1 Changes in Body composition

4.5.1.1 Changes in Body mass index

There was a significant increase in body mass index all subjects from the baseline (22.7±4 kg/m^2) to ten weeks of treatment (23.0±4.0 kg/m^2; p=0.003) (Table 4.14). Unlike the males, female subjects showed significant increase in BMI (23.5±4.0 kg/m^2; p=0.003) at the end of the study. The increase in BMI is most likely due to the effect of ART against immune suppression which leads to body recovery and weight gain among HIV positive individuals. The results are in agreement with the findings of Wanke *et al.* (1998) where majority of the HIV positive individuals treated with HAART showed an increase in BMI. Esposito e*t al*. (2008) reported similar results in HIV patients, Body mass index tends to increase after initiation of HAART.

Table 4.14 Changes in BMI (Kg/m^2) of HIV positive individuals after 6 and 10 weeks of ART

Sex of the subjects	Baseline	6 weeks	Change	p Value	10 weeks	Change	p Value
Females (n=75)	23.1±4.0	23.2±4.1	0.1±0.9	0.445	23.5±4.0	0.4±1.2	0.003*
Males (n=27)	21.4±3.5	21.5±3.4	0.1±0.6	0.212	21.7±3.4	0.3±1.4	0.346
All (n=102)	22.7±4.0	22.8±4.0	0.1±0.8	0.242	23.0±4.0	0.4±1.2	0.003*

Values are means and ± standard deviation
Values with * are statistically significant/different from the baseline at $p<0.05$.

4.5.1.2 Changes in Mid-Upper Arm Circumference (MUAC)

The results in Table 4.15 show that there was a significant increase in overall Mid-Upper Arm Circumference after six weeks (27.6±3.6cm; p=0.003) and at ten weeks (27.6±3.3cm; p=0.017) of treatment. The female subjects also showed a significant increase (27.9±3.6cm; p=0.009) in MUAC after six weeks of treatment. While the males did not show any significant increase in MUAC after six and ten weeks of treatment. The significant change in MUAC shown in the female subjects could be showing females have good response towards HAART. A study in South Africa showed that HIV positive women showed a significant increase in mean MUAC after being treated with HAART for 24 weeks (Esposito, 2008). Therefore the increase in MUAC showed in the subjects was due to recovery and weight gain.

Table 4.15 Changes Mid-Upper Arm Circumference (cm) of HIV positive individuals after six and ten weeks of ART

Sex of the subjects	Baseline	6 weeks	Change	p Value	10 weeks	Change	p Value
Females (n=75)	27.6±3.5	27.9±3.6	0.3±1.0	0.009*	27.9±3.2	0.3±1.5	0.058
Males (n=27)	26.2±3.5	26.6±3.5	0.4±1.4	0.131	26.7±3.6	0.5±1.8	0.150
All (n=102)	27.2±3.5	27.6±3.6	0.3±1.1	0.003*	27.6±3.3	0.4±1.6	0.017*

Values are means and ± standard deviation
Values with * are statistically significant/different from the baseline at $p<0.05$.

4.5.1.3 Changes in Skin fold thickness

Table 4.16 shows the results on skinfold thickness, there was no statistically significant difference in overall skinfold thickness from the triceps, biceps, Subscapular and Suprailiac region of the body after 6 weeks and ten weeks of treatment. However male subjects showed significant gain (7.6±4.5cm; p= 0.014) in the Suprailiac skinfold measurement after ten weeks of treatment. The skin fold measurements were much lower than the general mean skin fold measurements of United States population. For example, the triceps measurement by the end of the study was 16.3±6.8cm for women and 8.2±4.2cm for men. While the United States population reference states 26.8mm for women and 13.3mm for men (Zhu *et al.*, 2003).

Table 4. 16 Changes in Skin fold thickness (cm) of HIV positive individuals after six and ten weeks of ART

	Baseline	6weeks	Change	p Value	10 weeks	Change	p Value
Triceps							
Females	16.1±7.9	16.1±6.4	0.0±5.6	0.958	16.3±6.8	0.2±6.2	0.790
Males	6.9±3.3	7.8±4.1	0.9±3.0	0.112	8.2±4.2	1.3±4.1	0.100
All	13.7±8.1	13.9±6.9	0.2±5.1	0.655	14.1±7.2	0.5±5.8	0.385
Biceps							
Females	9.1±6.7	9.3±5.2	0.2±5.0	0.717	9.6±6.0	0.5±5.8	0.454
Males	4.8±2.8	4.8±2.9	0.0±0.8	0.768	4.9±3.4	0.1±2.7	0.885
All	7.9±6.2	8.1±5.1	0.1±4.3	0.740	8.3±5.8	0.4±5.1	0.445
Subscapular							
Females	13.4±5.9	13.6±5.6	0.1±3.1	0.678	13.7±6.6	0.3±4.2	0.610
Males	10.0±5.5	10.1±5.3	0.1±1.6	0.824	10.3±5.5	0.3±2.8	0.580
All	12.5±6.0	12.6±5.7	0.1±2.8	0.642	12.8±6.5	0.3±3.9	0.495
Suprailiac							
Females	10.6±6.5	10.9±8.2	0.3±6.2	0.636	10.9±10.2	0.4±9.1	0.736
Males	6.7±4.0	6.9±4.4	0.2±1.7	0.476	7.6±4.5	0.9±1.8	0.014*
All	9.6±6.2	9.9±7.5	0.3±5.4	0.559	10.1±9.2	0.5±7.9	0.519

Values are means and ± standard deviation, Females were n=75, Males n=25, All n=102.
Values with * are statistically significant/different from the baseline at $p<0.05$.

4.5.1.4 Changes in Body Weight, Fat, Lean Mass and Body Cell Mass

Body Weight

After receipt of HAART for 6 weeks and 10 weeks, a significant increase in overall body weight was only observed after ten weeks of treatment with (60.5±10.6 kg,

p=0.001) (Table 4.17). Another significant gain in body weight was observed in female subjects after six (58.4±10.3kg; p=0.030) and ten (60.0±10.2kg; p<0.001) weeks of treatment respectively. Shikuma (2004) reported that PLHIV normally gain weight after receiving HAART. Shikuma (2004) in his study also noted that HIV positive adults especially those with low CD4 lymphocyte count or severe immunosuppression at baseline experienced great increase in body weight on while HAART. In addition to that most PLHIV do want to eat more food after starting antiretroviral treatment because the body is starting to build itself and the effect the medicine on the virus (Alliance, 2007). In this study (table 4.13; pg 53) more than 60 % of the subjects reported an increase in appetite on starting HAART. Therefore the increase in food consumption could have a contributed to the increased weight gain the study subjects.

Table 4.17 Changes Body weight, lean mass, fat mass, body cell mass of HIV positive individuals after six and ten weeks of ART in kilograms

	Baseline	6weeks	Change	p Value	10weeks	Change	P Value
Body weight							
Females	57.8±10.2	58.4±10.3	0.57±2.22	0.030*	60.0±10.2	2.16±3.42	<0.001*
Males	62.0±11.7	62.0±10.9	-0.02±2.38	0.966	61.9±11.7	-0.11±6.19	0.925
All	58.9±10.7	59.3±10.5	0.41±2.26	0.070	60.5±10.6	1.56±4.41	0.001*
Body fat							
Females	18.1±6.9	18.6±7.0	0.50±1.91	0.026*	19.4±6.9	1.33±2.25	<0.001*
Males	13.0±5.7	11.9±4.9	-1.14±2.56	0.029*	11.9±5.1	-1.16±2.60	0.029*
All	16.7±6.9	16.8±7.1	0.07±2.21	0.765	17.4±7.3	0.67±2.58	0.010*
Lean body mass							
Females	39.7±5.0	39.8±5.2	0.03±2.06	0.914	40.6±5.3	0.83±2.42	0.004*
Males	49.0±7.8	50.1±8.1	1.12±2.14	0.011*	50.0±8.9	1.04±5.58	0.341
All	42.2±7.1	42.5±7.6	0.32±2.13	0.137	43.1±7.7	0.89±3.51	0.012*
Body cell mass							
Females	22.6±2.9	22.9±3.1	0.36±1.27	0.016*	23.1±3.1	0.46±1.54	0.011*
Males	30.0±3.3	30.8±3.8	0.73±1.50	0.018*	30.8±4.0	0.80±2.19	0.069
All	24.6±4.5	25.0±4.8	0.46±1.34	0.001*	25.1±4.8	0.55±1.73	0.002*

Values are means and ± standard deviation
Values with * are statistically significant/different from the baseline at p<0.05.
Females were n=75, Males n=25, All n=102

Body fat

The results in Table 4.17 further show that there was a significant increase in overall body fat after 10 weeks of treatment (17.4±7.3; p=0.010). Body fat gain was also significant among female subjects (18.6±7.0kg; p=0.026, 19.4±6.9kg; p=0.029) after six and ten weeks respectively (Table 4.17). The most likely reason for females to gain body more body fat than the males is, the estrogen hormone in women which activates fat storing enzymes and causes them to multiply easily. As a result, women have more enzymes for storing fat and fewer enzymes for burning fat. The above finding is in agreement with (Yelmokas, 2001) findings, where female patients who were on HAART tend to gain more body fat when compared to their male counterparts. Furthermore he also added that the differences in body fat gain increased with duration of treatment.

Lean Body Mass

Like body fat, there was a significant increase (43.1±7.7kg; p=0.012) in overall lean body mass after ten weeks of treatment (Table 4.17). However the males showed significant increase in lean body mass after six weeks (50.1±8.1kg; p= 0.011) while females showed only after ten weeks of treatment (40.6±5.3kg; p= 0.004). Esposito *et al.* (2008) noted that subjects gained lean body mass after HAART treatment for six month. Other studies by Mallon (2003) and Shikuma *et al.* (2004) reported increase in lean body mass after the initiation of HAART, which they concluded was associated with improved functional performance. Therefore, this shows identifying ways of improving lean body mass is both effective and feasible may prove valuable. The possible explanations for the improvement in lean body mass observed could be due to increased physical activity level of the subjects (Figure 4.2; pg 52) that is associated with an overall improvement in health after starting HAART, and/or dietary changes. Continuous counselling at the centre (TASO, Mulago) prepares the patient for HAART, it can also have an effect on weight and lean body mass gain. Stack *et al.* (1996) noted that counselling along with proper dietary intake have an effect on weight gain and maintenance among HIV positive individuals.

Body cell mass

Significant increases were also seen in mean body cell mass after six weeks of treatment (25.0±4.8 kg; p=0.01) and ten weeks of treatment (25.1±4.8 kg; p=0.02) for all subjects (Table 4.17). The results are in accordance with the findings by Fernando *et al.* (2005) who noted a significant increase in body cell mass and decrease in wasting among HIV positive adults treated with five different antiretroviral drug regimens. Shabert *et al.* (1999) found that HIV positive people tend to increase body cell mass when they feed on high protein foods. As it was established in Table 4.9, the subjects met their protein requirement. Therefore the possible reason for the subjects to gain body cell mass could be as a result of adequate protein intake and the effect of the treatment that suppresses the virus.

However, a general increment in weight and lean body mass was seen among the subjects. Other studies in certain subpopulations of HIV positive subjects, reported that HAART to be associated with incomplete weight and LBM recovery (Schwenk *et al.* (1999). Some evidence suggests that a progressive decrease in lean body mass in the HAART era may be related to effect of catabolic cytokines (Roubenoff *et al.*, 2002).

4.5.2 Changes in Dietary patterns

4.5.2.1 Changes in Meal Frequency

Figure 4.3 shows that the percentage of subjects who eat four meals per day decreased from 36.3% at baseline to 34.3% after six weeks of treatment and also the same (34.4%) at ten week of treatment. On the other hand, the percentage of subjects who met the MOH recommendation that is having more than four meals increased from 21.6% at baseline to 34.3 % at 6 weeks of treatment and again reduced to 28.4% by the end of the study. The increase in percentage of those who had four and five meals at the sixth week of treatment was possibly due to the intense hunger caused by HAART (Table4.13, pg 53) which could possibly made them to eat more meals. However the number of meals went down after the patients stabilised from the HAART effect. On the other hand, the fluctuation in number of meals per day of the

subjects could possibly be due to the effect of HIV/AIDS on house hold food security which also affects food consumption of individual household members (Bukusuba *et al.*, 2007). Therefore one can imagine the effect of HIV/AIDS on reduced number of meals of the study subjects, as 23.5% of them were unemployed (Table 4.1) and 78.4% bought their own food (Table 4.3; pg 38). On the other hand Stack *et al.* (1996) reported that, counselling offered to HIV positive patients prior commencement of HAART had a role in increasing number of meals per day and their dietary intake.

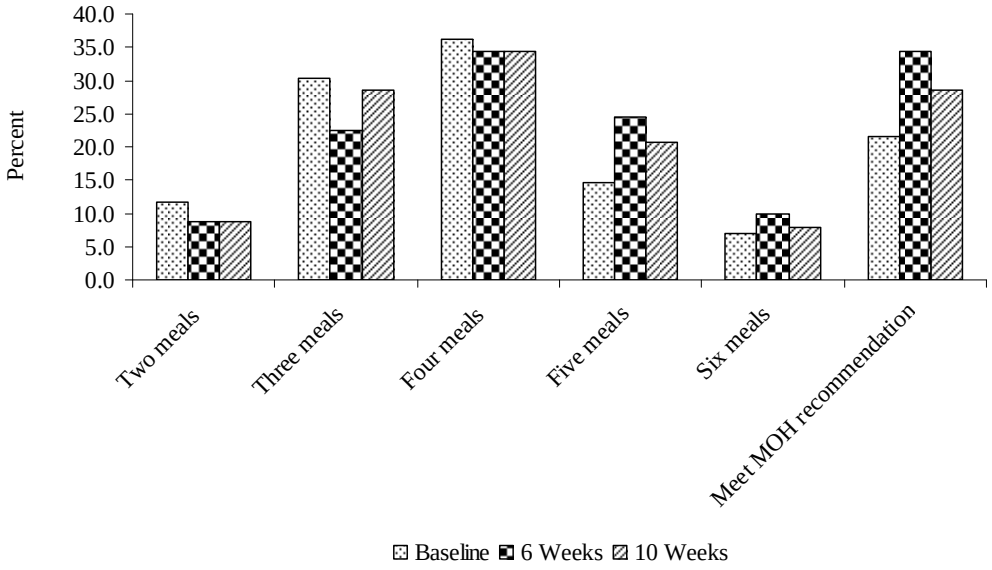


Figure 4.3 Numbers of meals consumed by percentage HIV positive individuals at baseline, six and ten weeks of ART treatment

4.5.2.2 Changes Dietary intake

Changes Macronutrient intake

As it is indicated in Table 4.18 the overall mean energy intake after 10 weeks of treatment (2128.6±308 Kcal; $p=0.023$) was significantly different from the baseline. However when protein intake was compared to the baseline (63.6±24.2g), there was a significant reduction ($p<0.001$) in overall intake of protein at the end of the study (52.3±16.8 g) and significant increase ($p=0.043$) in protein intake after six weeks of

treatment. Comparing the contribution of protein to the overall calorie intake of the subjects, a significant reduction ($p<0.001$) was seen at ten weeks (10.1±3.1 %) and increase 6 weeks ($p=0.005$) of treatment (12.7±4.4 %). The percentage contribution of carbohydrates to the total calorie in take of the subjects had increased significantly (68.3±9.5%; $p=0.007$) and (68.7±9.4%; $p=0.005$) after six and ten weeks of treatment. However looking at the overall carbohydrate intakes of the subjects, there was no significant difference in all contacts.

Table 4.18 Changes in daily energy and macronutrient intake of HIV positive individuals at TASO Mulago after six and ten weeks of ART

Nutrients	Baseline	six weeks	Changes	p Value	Ten weeks	Changes	p Value
Energy (Kcal)	2231.2±439.5	2207.0±317.4	-22.1±354.3	0.491	2128.6±308.0	-84.4±451.2	0.023*
Protein (g)	63.6±24.2	68.5±24.9	4.9±24.1	0.043*	52.3±16.8	-11.3±25.9	<0.001*
Protein %	11.6±3.7	12.7±4.4	1.1±3.9	0.005*	10.1±3.1	-1.5±4.0	<0.001*
Fat (g)	56.9±20.5	47.1±17.5	-9.8±23.1	<0.001*	48.6±21.2	-8.3±28.7	0.004*
Fat %	23±8.8	19.0±7.3	-4.0±9.7	<0.001*	20.4±8.5	-2.7±10.8	0.014*
Carbohydrate (g)	364.0±110.5	374.3±89.9	10.4±92.3	0.259	365.7±84.9	1.7±100.4	0.864
Carbohydrate %	65.3±10.4	68.3±9.5	3.0±10.8	0.007*	68.7±9.4	3.4±11.9	0.005*

Values are means and ± standard deviation
Values with * are statistically significant/different from the baseline at $p<0.05$.
The protein%, fat% and carbohydrate% indicate the contribution of the nutrients to the total energy in Kcal

Stack *et al.* (1996) reported that Weight gain and maintenance could be achieved in the early stages of AIDS if patients received at least one daily high energy food. Adequate intake of protein is also important to maintain muscle mass or body cell mass (Fabris *et al*., 1988; Willams, 2003) and it is highly correlated with lean body mass (Difranco, 1996). The increase in the percentage contribution of carbohydrates to the total calorie could be related to the reduced protein intake. The reason is unclear, although it is possible that patients whose diets include a greater proportion of carbohydrates consume a proportionally lower amount of protein (Bukusuba *et al.*, 2007). Similarly, Bruce *et al.* (2002) noted that greater protein intake is positively associated with BCM.

Changes in Micronutrient Intake

Even though both males and females met the required amount of vitamin A (Table 4.10; pg 48), the overall vitamin A intake was significantly lower (p=0.013) at 6 weeks and 10 weeks (p=0.003) of treatment than the baseline (Table 4.19). However there was a significant decrease in overall intake of Vitamin E, after six weeks (p<0.001) and at ten weeks of treatment with a (p= 0.002). Another significant reduction was seen in Vitamin B2 intake after ten weeks of treatment (p<0.001). However the consumption of Vitamin B6 increased at the end of the study (p<0.001). There was a significant (p=0.010) increase in iron intake after six weeks of treatment. No significant difference was seen in zinc intake of the subjects.

Table 4.19 Changes in daily micronutrient intake of HIV positive individuals at TASO Mulago after six and ten weeks of ART

Nutrients	Baseline	6 Weeks	Changes	p value	10 Weeks	Changes	p Value
Vitamin A (µg)	2349.5±2761.4	1389.2±2788.8	-960.4±3836.9	0.013*	1626.5±1802.0	-723.0±2427.4	0.003*
Vitamin E (mg)	15.7±10.4	10.1±6.3	-5.7±9.9	<0.001*	12.4±7.5	-3.3±10.4	0.002*
Vitamin B1(mg)	1.1±0.5	1.1±0.5	0.0±0.5	0.961	0.9±0.3	-0.2±0.6	0.006*
Vitamin B2(mg)	1.6±0.6	1.8±0.7	0.1±0.8	0.074	1.4±0.4	1.7±1.3	<0.001*
Vitamin B6(mg)	3.1±1.1	3.6±1.1	0.4±1.2	<0.001*	3.3±1.2	-1.7±1.1	<0.001*
Vitamin C(mg)	202.6±103.6	174.4±78.7	-28.2±113.4	0.014*	180.5±83.0	-22.1±104.5	0.035*
Iron (mg)	11.7±7.2	13.9±8.3	2.2±8.3	0.010*	11.9±6.3	0.2±8.2	0.761
Zinc (mg)	8.3±3.8	8.7±4.0	0.4±4.7	0.366	8.3±3.0	0.0±4.1	0.961

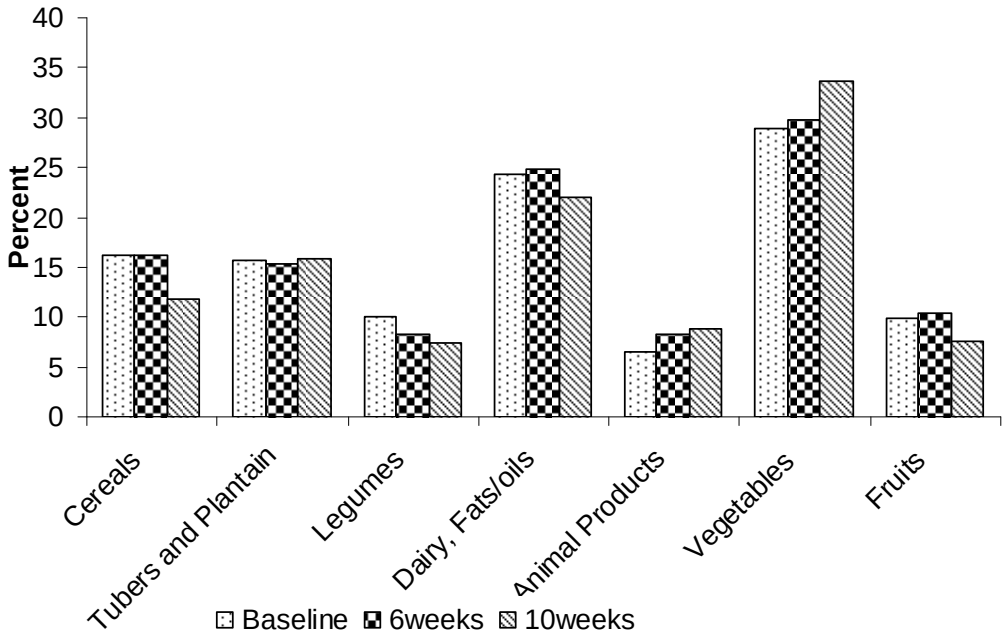
Values are means and ± standard deviation
Values with * are statistically significant/different from the baseline at p<0.05.

The changes in micronutrient intake are most likely due to the seasonal availability and price fluctuation of micronutrient rich vegetables and fruits. In this study (Table 4.3), 80% of the study participants responded that they buy their food. Therefore the price changes could have affected the purchasing power and consumption of the above food groups by the participants. Subjects with reduced Vitamin A intake are advised to consider consumption of Vitamin A rich foods, since there is significantly low concentration of plasma Vitamin A among HIV positive patients on HAART than those who were not receiving HAART (Toma *et al.*, 2001). In this study, zinc intake was not different from the baseline in all contacts. A study in Germany by Wellinghausen *et al.* (2000) also reported that plasma zinc concentrations were not

significantly different between those receiving and those not receiving HAART. Iron values were not significant. However, there was some reduction in iron intake at tenth week when compared to the intake of iron at the sixth week. This reduction can possibly increase with the duration of ART. Piwoz and Preble (2000) noted that HIV positive individuals on HAART that has Zidovudine, are advised to take foods that are rich in iron since Zidovudine suppresses bone marrow function and synthesis of red blood cells. As it was established from table 4.13; page 53, about 70% of the study subjects were on drug combinations that has Zidovudine. Therefore, such subjects need to eat foods that are rich in iron.

4.5.2.3 Changes in Diet Diversity

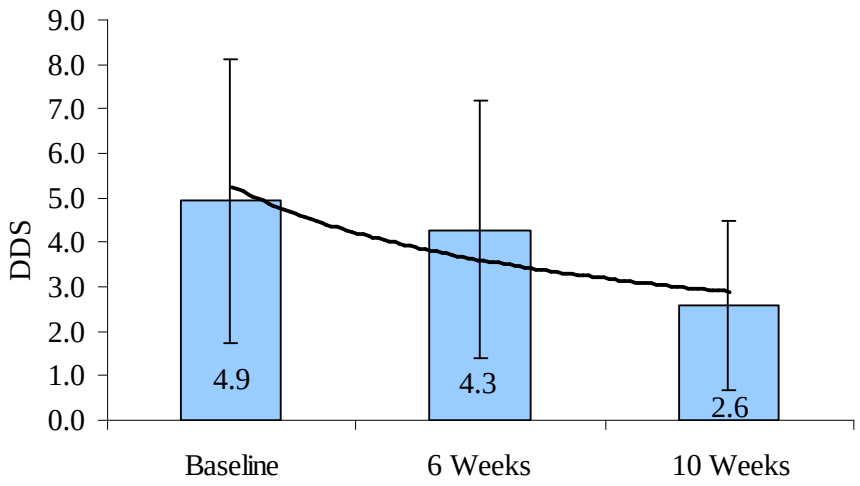
As shown in figure 4.4 the consumption of cereals didn't change after six weeks. The consumption of tubers and plantain was also the same (16% of the subjects) at baseline and ten weeks of treatment. Another note worthy finding was the increment in consumption of vegetables and animal products. Where vegetables were consumed by 29% of the study subjects at baseline then increased to 34% by the end of the study while animal products 7% at baseline and 9% after 10 weeks. The increment in vegetable consumption shown Figure 4.4 is very important for patients on ART as they benefit from the antioxidants and fibre in the vegetables. However, the fluctuations that were seen in the consumption of vegetables and fruits could be due to the fact fruits are seasonal and their price is relatively not constant (MOH, 2006).



Results are presented in percentages of the study participants

Figure 4.4 Changes in consumption of different food groups in percentage of HIV positive individuals at TASO Mulago

On the other hand, consumption of diets that are rich in vegetables could help in reducing deposition of body fat (Kristy, 2003). The increment in consumption of animal source foods at the tenth week may not seem in concurrence with the reduction of protein intake shown in (table 4.9; pg 46) but the consumption of food groups shown in the above figure does not indicate amount. On the other hand the increment of animal source foods with the duration of HAART could provide the subjects with vitamin B 12 which is obtained only from animal source foods. According to FANTA (2004), maintaining adequate nutritional status means consuming a variety and adequate quantity of foods to meet energy, protein, and micronutrients needs.



The Y-error bars indicate the standard deviation

Figure 4.5 Changes in dietary Diversity Score of HIV positive individuals at TASO Mulago after 6 and 10 weeks of ART

There was a reduction in dietary diversity score of subjects from the baseline 4.9±3.2 to 4.3±2.9 after six weeks and to 2.6±1.9 by the end of the study (Figure 4.5). The reduction in dietary diversity score could be one due to drug side effect on food selection which means the patients who are experiencing difficulties in food intake chose only a few types of foods that are convenient to eat and swallow. Second well established fact that the effect of the HIV/AIDS on dietary diversity (Bukusuba *et al.*, 2007; Nontobeko *et al.,* 2008). However a balanced diet will ensure that the individual consumes sufficient nutrients to maintain energy, normalize weight, and ensure the body's proper functioning. Another reason for promotion of food diversification is that, no single food except breast milk contains all the nutrients the body needs in the right quantities and combinations (MOH, 2006).

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Initiation of HAART, especially during the first ten weeks of treatment leads to reduction in prevalence of low BMI but no change occurs in MUAC, skinfold thickness and subjects with healthy/normal BMI.

Antiretroviral treatment leads to an increase in overall weight, lean body mass, body fat and body cell mass in the first ten weeks of treatment. However the gain in the above body compartments could be in different proportions.

Nutrition related lifestyles like alcohol intake and smoking are practiced by some of patients starting antiretroviral treatment at TASO, Mulago. However half of the participants were physically active.

Nutrition related side effects like headache, nausea/ vomiting and intense hunger are the most common among HIV patients starting ART.

Although patients starting antiretroviral treatment at TASO meet their daily protein requirements, they had low energy intake and their dietary pattern was not constant during the first months of treatment.

5.2 Recommendations

There is a need to introduce programs like physical exercise, nutrition education and counselling aiming at improving lean body mass and reduction of unnecessary body fat gain as well as abdominal obesity for the subjects who gain more body fat but less or not lean body mass.

TASO, Ministry of Health and other HIV care and treatment organizations, should introduce programs aiming at food security, sustainable agriculture and should

provide supplementary food parcels for people starting HAART in order to meet the energy requirements of patients and also to increase the effectiveness of the medication.

All HIV patients who are starting HAART at TASO, Mulago should be advised on dietary management of nutrition related side effects in order to reduce problems that are common in the first few weeks of ARV treatment.

5.3 Areas for Further Research

The findings in the study are only the body composition changes and dietary patterns that occur in the first few months after initiation of HAART. Therefore it is important to carryout larger and long duration studies to examine the long term body composition changes and anthropometric measurements as well as their relation to dietary patterns of the patients.

Further studies should examine the long term health implications of gain in fat mass in subjects on HAART. Further studies should also be carried out on the relationship or association of body composition changes and viral load, CD4 count or immune status of the patients in general.

Studies of large enough sample size to assess body composition and dietary pattern changes according to HAART regimen, clinical staging of HIV infection and other morbidity factors should be conducted that may help the development of widely applicable guidelines.

Further studies focusing on food security and socioeconomic status of the PLHIV on first line antiretroviral should examine the determinants of the fluctuations in micronutrient intake, and dietary patterns in general.

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APPENDICIES

APPENDEX A: QUESTIONNAIRE FOR THE FIRST CONTACT

Changes in Body composition and dietary patterns among HIV positive adults (18-59years old) who are on first line Antiretroviral Treatment at The AIDS Support Organization (TASO) Mulago, Kampala

QUESTIONNAIRE AT FIRST CONTACT

Name of interviewer _____ Date of interview _____

1. Name _____ 2. Sex _____ Age _____

Section A

Demographic data and House hold (Tick appropriately)

I. Respondent information

Age	Marital status	Education	Occupation	Religion
1 25-29	1 Married	1 No formal schooling	1 Unemployed	1) Catholic
2 30-34	2 Widowed	2 Primary school	2 Farmer	2) Protestant
3 35-39	3 Divorced	3 Secondary school	3 Salaried employed	3) Muslim
4 40-44	4 Single	4 Tertiary education	4 formal business	4) Pentecostal
5 45-49	5 Other(specify)	5 Vocational training	5 informal business	5 Other specify
		6 Other (specify)	6 Other(specify)	

II. Household information

1. How many people, including you, live in your household?

A) 2 B) 3-4 C) 5-6 D) 7-8 E) 9-10 F) 11-12 G)>12

2. Sources of income for the house hold **(circle that applies)**

A) Farming B) Salaried employee C) Formal business owner D) Unemployed E) Informal Business F) Other

3. What is the source of food consumed in your household? **(Circle that applies)**

A) Buying. B) Own farm C) Own farm and Buying D) Food aid C) 0thers (specify)

4. Does every household member share food available in the house? A. Yes B. No

Section B

General HIV status Drug administration, health services and Life style.

1. How long ago you knew you are HIV positive? A) <2yr B) 2yr to 3 yrs C) 4yrs to 5yrs D) more than 5 yrs E) Don't know

2. CD4 count at starting of the treatment? _____

3. What other services do you receive from the centre?

A) Medical treatment B) ARV supply C) Supplementary foods D) Nutrition counselling E) General counselling F) Other (specify) _____

4. How far is the centre from your residence? A) 0-2km (0-15 minutes) B) 2-4 km(16-30 minutes)

C) 4-6 km(31-60 minutes) D) 6-8 km(61-120 minutes) E) More than 8 km(More than 2 hours)

5. How do you rank the services at this centre?

A) Inadequate B) Some how adequate C) Adequate D) Don't know

2. Life style

Attribute	**Yes**	**No**
Physical Activity/ exercise		
Dieting to lose weight		
Alcohol Intake		
Smoking		
Use of Narcotic Drugs		

Section C

Dietary Pattern

1. Meal frequency

A. Did you consume the following yesterday?

Eating Occasion	Yes	No	Eating occasion	Yes	No
Morning meal(breakfast)			Supper		
Snack b/n morning and lunch			Bed time snack		
Lunch			Any meal at night		
Any food between lunch and supper					
Total number of meals					

3. Food frequency: What is the frequency of consumption and sources of the following foodstuff?

Food	Daily	4 -6Days/wk	1-3Days/wk	Rarely (Once a month)	Never	Food source
Cereals						
Millet(Kalo / porridge)						
Maize/Posho						
Rice						
Wheat& wheat prods						
Tubers & plantain						
Cassava						
Sweet potato (white)						
Sweet potato (yellow)						
Irish potato						
Yams						
Matooke						

Food	Daily	4 -6Days/wk	1-3Days/wk	Rarely (Once a month)	Never	Food source
Legumes						
Beans						
Peas						
Ground nuts						
Soybeans						
Dairy, Fats/Oils						
Milk						
Blue band						
Ghee						
Cooking oil						
Animal Products						
Meat						
Pork						
Poultry						
Eggs						
Fish /*mukene*						
Vegetables						
Green Leafy Vegetables						
Tomatoes						
Pumpkins						
Carrots						
Fruits						
Citrus e.g. Oranges						
Papaya						
Water melon						
Pineapples						
Mangoes						
Passion fruits						
Jack fruit						
Avocado						

*Cods for food source 1.Own farm 2.Bought 3.Own and bought 4. Donation

4. A 24-Hour Dietary Recall

A. Please name all foods and drinks that were consumed by the respondent starting from morning to evening yesterday including at night?

B. What amount of foods and drinks did the respondent consume and were they prepared including the method of preparation?

TIME/MEAL	NAME OF DISH/FOOD	NAME OF INGREDIENTS	*INGREDIENT DESCRIPTION (state)	**METHOD OF PREPARATION	***INDICATIVE LOCAL MEASURE	AMOUNT CONSUMED(g)
B/FAST						
SNACK						
LUNCH						
SNACK						
SUPPER						
SNACK						

***Description of ingredients:** 01=Fresh; 02=Dried; 03=Tinned; 04=Frozen; 05=Bottled; 06=Others (specify).

****Method of preparation:** 01=Eaten raw; 02=Boiled; 03=Steamed; 04=Roasted; 05=Deep fried; 06=Shallow fried; 07=Baked; 08=Mingled; 09=Others (specify).

*****Description of indicative local measure:** 01=Handful; 02=Cupful; 03=Spoonful; 04=Plateful; 05=Counts (eggs, slices); 06=1/2Cup; 07=1/2Plate; 08=Others (specify).

SECTION D

Anthropometric Data Body Composition Measurement

Sex	Male	female	Measurements in Duplicates			
Age						
Height(cm)						AV
Weight(Kg)						AV
MUAC						AV
Triceps						AV
Biceps						AV
Sub scapular						AV
supra-iliac						AV

Body composition

Test no	Gender	Age	Height	Weight	%Fat	Fat(kg)	Lean(kg)	TBW(lit)
ECW(lit)	ICW(lit)	BCM(kg)	BMR(kcal)	BMR/BW	Impedance			
					5 ZH	50ZH	100 ZH	200 ZH

Thank you!

APPENDIX B: QUESTIONNAIRE FOR THE SECOND CONTACT

Subjects Name _____TASO no_____

Subjects ID number_____ Date _____ Name of Interviewer _____

Nutrition related effects of antiretroviral treatment, and health services

1. What type of ARV combination do you receive?

A) Zidovudine+ Lamivudine + Nevirapine (ZDV+3TC + NVP) (Duovir-N)

B) Stavudine + Lamuvidine + Nevirapine (d4T+3TC + NVP) (Triomune)

C) Stavidine +Lamivudine + Evafrenz (d4T+3TC + EFZ)

D) Tenofovir+Lamivudine+Efavirenz (TDF+3TC+EFV)

E) Tenofovir+Lamivudine+Nevrapine (TDF+3TC+NVP)

F) Zidovudine+ Lamivudine + Efavirenz (ZDV+3TC + EFZ)

G) Other combination _____

2. Do you take the drugs exactly as you expected to take them? A) Yes B) No

3. How many do you take in reality? A) Exact number B) Part of them C) Over dose D) Other (specify)

4. How often are you expected to take them? A) Daily B) Every other day C) Every week D) Other specify

5. What strange feeling do you experience after taking the drugs or other medications? **(Tick all that applies and don't indicate the problems that were there before you start the medication)**

Side effects		yes	no	Side effects		Yes	no
1	Anorexia (Loss of appetite)			8	Heartburn		
2	Nausea and Vomiting			9	Headache		
3	Taste changes			10	Diarrhoea		
4	Mouth ulceration (Mouth sores) or Thrush			11	Intense Hunger		
5	Abdominal pain			12	Other specify		
6	Constipation			13			
7	Flatulence or bloating			14			

6. Haemoglobin level at the start of the treatment _____

APPENDIX C: QUESTIONNAIRE FOR THIRD CONTACT

(Dietary Pattern and Body composition)

TASO No _____

Name of the subject _____

Subjects ID number_____ Date _____ Name of Interviewer _____

1. Meal frequency

A. Did you consume the following yesterday?

Eating Occasion	Yes	No	Eating occasion	Yes	No
Morning meal(breakfast)			Supper		
Snack b/n morning and lunch			Bed time snack		
Lunch			Any meal at night		
Any food between lunch and supper					
Total number of meals					

2. Food frequency

What is the frequency of consumption and sources of the following foodstuff?

Food	Daily	4 -6Days/wk	1-3Days/wk	Rarely (Once a month)	Never	Food source
Cereals						
Millet(Kalo / porridge)						
Maize/Posho						
Rice						
Wheat& wheat prods						
Tubers & plantain						
Cassava						
Sweet potato (white)						
Sweet potato (yellow)						
Irish potato						
Yams						
Matooke						
Legumes						
Beans						
Peas						
Ground nuts						
Soybeans						
Dairy, Fats/Oils						
Milk						
Blue band						

Ghee						
Cooking oil						
Animal Product						
Meat						
Pork						
Poultry						
Eggs						
Fish /*mukene*						
Vegetables						
Green Leafy Vegetables						
Tomatoes						
Pumpkins						
Carrots						
Fruits						
Citrus e.g. Oranges						
Papaya						
Food	Daily	4 -6Days/wk	1-3Days/wk	Rarely	Never	Food source
Water melon						
Pineapples						
Mangoes						
Passion fruits						
Jack fruit						
Avocado						

*Cods for food source 1.Own farm 2.Bought 3.Own and bought 4. Donation

3. A 24-Hour Dietary Recall

A. Please name all foods and drinks that were consumed by the respondent starting from morning to evening yesterday including at night?

B. What amount of foods and drinks did the respondent consume and were they prepared including the method of preparation?

TIME/MEAL	NAME OF DISH/FOOD	NAME OF INGREDIENTS	*INGREDIENT DESCRIPTION	**METHOD OF PREPARATION	***INDICATIVE LOCAL MEASURE	AMOUNT CONSUMED(g)
B/FAST						

SNACK						
LUNCH						
SNACK						
SUPPER						
SNACK						

***Description of ingredients:** 01=Fresh; 02=Dried; 03=Tinned; 04=Frozen; 05=Bottled; 06=Others (specify).
****Method of preparation:** 01=Eaten raw; 02=Boiled; 03=Steamed; 04=Roasted; 05=Deep fried; 06=Shallow fried; 07=Baked; 08=Mingled; 09=Others (specify).
*****Description of indicative local measure:** 01=Handful; 02=Cupful; 03=Spoonful; 04=Plateful; 05=Counts (eggs, slices); 06=1/2Cup; 07=1/2Plate; 08=Others (specify).

Anthropometric Data Body Composition Measurement

Sex	Male	female	Measurements in Duplicates			
Age						
Height(cm)						AV
Weight(Kg)						AV
MUAC						AV
Triceps						AV
Biceps						AV
Sub scapular						AV
supra-iliac						AV

Body composition

Test no	Gender	Age	Height	Weight	%Fat	Fat(kg)	Lean(kg)	TBW(lit)

ECW(lit)	ICW(lit)	BCM(kg)	BMR(kcal)	BMR/BW	Impedance			
					5 ZH	50ZH	100 ZH	200 ZH

Thank you!

APPENDIX D: QUESTIONNAIRE FOR FOURTH CONTACT

(Dietary Pattern and Body composition)

Name of the subject _____

Subjects ID number_____ Date _____ Name of Interviewer _____

1. Meal frequency

A. Did you consume the following yesterday?

Eating Occasion	Yes	No	Eating occasion	Yes	No
Morning meal(breakfast)			Supper		
Snack b/n morning and lunch			Bed time snack		
Lunch			Any meal at night		
Any food between lunch and supper					
Total number of meals					

2. Food frequency

What is the frequency of consumption and sources of the following foodstuff?

Food	Daily	4 -6Days/wk	1-3Days/wk	Rarely (Once a month)	Never	Food source
Cereals						
Millet(Kalo / porridge)						
Maize/Posho						
Rice						
Wheat& wheat prods						
Tubers & plantain						
Cassava						
Sweet potato (white)						
Sweet potato (yellow)						
Irish potato						
Yams						
Matooke						
Legumes						
Beans						
Peas						
Ground nuts						
Soybeans						
Dairy, Fats/Oils						
Milk						
Blue band						

Ghee						
Cooking oil						
Animal Product						
Meat						
Pork						
Poultry						
Eggs						
Fish /mukene						
Vegetables						
Green Leafy Vegetables						
Tomatoes						
Pumpkins						
Carrots						
Fruits						
Citrus e.g. Oranges						
Papaya						
Water melon						
Pineapples						
Mangoes						
Passion fruits						
Jack fruit						
Avocado						

*Cods for food source 1.Own farm 2.Bought 3.Own and bought 4. Donation

3. A 24-Hour Dietary Recall

A. Please name all foods and drinks that were consumed by the respondent starting from morning to evening yesterday including at night?

B. What amount of foods and drinks did the respondent consume and were they prepared including the method of preparation?

TIME/MEAL	NAME OF DISH/FOOD	NAME OF INGREDIENTS	*INGREDIENT DESCRIPTION	**METHOD OF PREPARATION	***INDICATIVE LOCAL MEASURE	AMOUNT CONSUMED(g)
B/FAST						

SNACK						
LUNCH						
SNACK						
SUPPER						
SNACK						

***Description of ingredients:** 01=Fresh; 02=Dried; 03=Tinned; 04=Frozen; 05=Bottled; 06=Others (specify).
****Method of preparation:** 01=Eaten raw; 02=Boiled; 03=Steamed; 04=Roasted; 05=Deep fried; 06=Shallow fried; 07=Baked; 08=Mingled; 09=Others (specify).
*****Description of indicative local measure:** 01=Handful; 02=Cupful; 03=Spoonful; 04=Plateful; 05=Counts (eggs, slices); 06=1/2Cup; 07=1/2Plate; 08=Others (specify).

Anthropometric Data Body Composition Measurement

Sex	Male	female	Measurements in Duplicates			
Age						
Height(cm)						AV
Weight(Kg)						AV
MUAC						AV
Triceps						AV
Biceps						AV
Sub scapular						AV
supra-iliac						AV

Body composition

Test no	Gender	Age	Height	Weight	%Fat	Fat(kg)	Lean(kg)	TBW(lit)
ECW(lit)	ICW(lit)	BCM(kg)	BMR(kcal)	BMR/BW	Impedance			
					5 ZH	50ZH	100 ZH	200 ZH

Thank you!

APPENDIX E: APPOINTMENT SLIP FOR THE FOLLOW UPS

NUTRITION APPOINTMENT SLIP

NAME:_________________________________

DATE: ____________________

TO NUTRITION SECTION

TASO MULAGO, WHITE HOUSE

ROOM__________

NUTRITION APPOINTMENT SLIP

NAME:_________________________________

DATE: ____________________

TO NUTRITION SECTION

TASO MULAGO, WHITE HOUSE

ROOM__________

NUTRITION APPOINTMENT SLIP

NAME:_________________________________

DATE: ____________________

TO NUTRITION SECTION

TASO MULAGO, WHITE HOUSE

ROOM__________

NUTRITION APPOINTMENT SLIP

NAME:_________________________________

DATE: ____________________

TO NUTRITION SECTION

TASO MULAGO, WHITE HOUSE

ROOM__________

NUTRITION APPOINTMENT SLIP

NAME:_________________________________

DATE: ____________________

TO NUTRITION SECTION

TASO MULAGO, WHITE HOUSE

ROOM__________

NUTRITION APPOINTMENT SLIP

NAME:_________________________________

DATE: ____________________

TO NUTRITION SECTION

TASO MULAGO, WHITE HOUSE

ROOM__________

NUTRITION APPOINTMENT SLIP

NAME:_________________________________

DATE: ____________________

TO NUTRITION SECTION

TASO MULAGO, WHITE HOUSE

ROOM__________

NUTRITION APPOINTMENT SLIP

NAME:_________________________________

DATE: ____________________

TO NUTRITION SECTION

TASO MULAGO, WHITE HOUSE

ROOM__________

APPENDIX F: CONSENT FORM

Dear Participant my Name is Biniam Tsehaye pursuing MSc. Applied Human Nutrition at Makerere University, Faculty of Agriculture, and Department of food science and Technology. I am conducting a research in the under mentioned topic.

Changes in Body composition and dietary patterns among HIV positive adults on first line Antiretroviral Treatment at The AIDS Support Organization (TASO) Mulago, Kampala

Objective of the study

1. Determine body composition of HIV positive adults aged 18-59 years on ARV during the first 6 and 10 weeks of antiretroviral treatment.
2. Establish dietary patterns and nutrition related life styles of HIV positive adults aged 18-59 years during the first 6 and 10 weeks of ARV treatment.
3. Assess the nutrition related side effects arising from taking of ART.
4. Compare changes in body composition and changes in dietary patterns, among HIV positive adults occurring after 6 and 10 weeks of antiretroviral treatment.

Benefits

You may or may not personally benefit from the study. However by being a subject in this study you will help in getting a necessary data for the study. The results of the study will help counsellors and other stakeholders to improve the existing nutrition actions that promote effective treatment. It will also help to make some necessary adjustments to dietary practices.

Risks

The study may cause you anxiety or fatigue. The interview may take a maximum of forty minutes and may require having an appointment.

Non participation

Your non participation in this study will not anyway affect in any aspect of the treatments, care and support you are receiving from the TASO or from the centre. You also have the right to ask questions and obtain further information.

Confidentiality

Any information collected from you will be kept confidential and no personal name will appear on research documents, instead identification numbers will be used.

Do you consent to participate in this study? i. Yes ii. No

If yes, sign below and if no it is ok. Thank you!

Subject's signature _____ Date _____ Contact _____

Thank you for taking time and effort to participate in this study.

Yours sincerely- Biniam Tsehaye +256782759050

APPENDIX G: ETHICAL CLEARANCE

The AIDS Support Organisation
TASO (U) Ltd.

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January, 09th 2008

Manager
TASO Mulago

Dear Madam,

Ref: Permission to do Research in TASO Mulago

This is to kindly request your office to allow Biniam Tsehaye Haile a student at Makerere University doing a Masters in MSc Applied Human Nutrition 2nd Year to do his research at your centre.

The research topic is entitled: ***"Changes in Body Composition and dietary patterns among HIV positive adults (25- 49 years old) who are on the first line antiretroviral treatment at the AIDS Support Organization (TASO) Mulago, Kampala".***

Your kind consideration for this request will be highly appreciated

Thanks and Yours in the struggle against HIV/AIDS

Dr. Christine Nabiryo
Deputy Executive Director in charge of Programs

CC: Head of Department, Makerere University Food & Science Technology

CC: Director PSI

The AIDS Support Organisation
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Tel: 077 749 998
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TASO MBALE
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TASO MBARARA
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TASO MULAGO
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Tel: 041 530 034
Mob: 077 359 942

TASO RUKUNGIRI
Rukungiri Health Centre
P. O. Box 350, Rukungiri
Tel: 077 617 375

TASO SOROTI
Soroti Hospital
P. O. Box 422, Soroti
Tel: 077 428 640

TASO TORORO
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REGIONAL OFFICES

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SOUTHWESTERN
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TRAINING CENTRE

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28th January 2010

Dear Biniam,

RE: **PERMISSION TO CONDUCT RESEARCH IN TASOUGANDA**

Following review of your research proposal entitled "**Changes in body composition and dietary patterns among HIV positive adults (25 -49 years old) who are on the first line antiretroviral treatment at The AIDS Support Organisation, Mulago, Kampala**"

The committee has granted you permission to go ahead and collect data at TASO Mulago.

While at the TASO center, please ensure you observe the TASO values and not to interrupt the smooth flow of the service delivery.

Wishing you good luck.

Sincerely

Mr. Mwesigwa Robert
Chairman, TASO Internal Research Board (IRB)