ASSESSMENT OF DIETARY INTAKE AND NUTRITIONAL STATUS OF CHILDREN (UNDER FIVE YEARS) WHO ARE HIV POSITIVE ATTENDING THE AIDS SUPPORT ORGANIZATION (TASO) ENTEBBE

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CONSENT FOR SUBMISSION

I have satisfactorily read through the Dissertation and consent to its submission to the School of Graduate Studies for award of Master of Science in Applied Human Nutrition of Makerere University.

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DECLARATION

I, Ali Duale Jama, declare to the best of my knowledge that the study here forth is my original work, and has not been submitted to Makerere University or any other University/Institution before for the award of a degree.

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DEDICATIONS

To my relatives who stood for their self support and beloved friends whose love and support has pushed me through.

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ACRONYMS

AIDS :	Acquired Immuno Deficiency Syndrome
ARI :	Acute Respiratory Infections
ART :	Antiretroviral Treatment
ARV :	Antiretroviral drugs
BMI :	Body Mass Index
CD4 :	Cluster of differentiation 4
CD8 :	Cluster of differentiation 8
CDC :	Center for Diseases Control
DNA :	Deoxyribonucleic acid
FANTA:	Food and Nutrition Technical Assistance
FAO :	Food and Agricultural Organisation
HAAR:	Highly Active Antiretroviral Therapy
HIV :	Human Immunodeficiency Virus
IDO :	Indoleamine 2, 3 Di oxygenase
IF-g :	Interferon-gamma
LBM :	Lean Body Mass
LIP :	Lymphoid Interitial Pneumonitis
MACS:	Multicenter AIDS Cohort Study
MCHN:	Maternal and Child health and Nutrition
MOH :	Ministry of Health
MTCT :	Mother –To Child- Transmission
MUAC :	Mid-Upper Arm Circumference
NAC :	N- acetyl-Cysteine
NAIDS :	Nutritionally Acquire Immuno Deficiency Syndrome
NARTIs:	Nucleoside Analogue Reverse Transcriptase inhibitors
NNRTI:	Non-Nucleoside Reverse Transcriptase inhibitor
NVP :	Nevirapin
PCP :	Pneumocystis jiroveci Pneumoia

PCP : Pneumocystis Carinii Pneumonia

PCR : Polymerase Chain Reaction

PEM : Protein Energy Malnutrition

PEP : Post- Exposure Prophylaxis

PLWHA: People living with human immuno deficiency virus and AIDS

RDA : Required Daily Allowance

RNA : Ribonucleic acid

ROS : Reactive Oxygen Species

STDs Sexually Transmitted Diseases

TASO : The AIDS Support Organisation

TB : Tuberculosis

UDHS: Uganda Demographic and Health Survey

UN : United Nations

UNAIDS: United Nations AIDS Programme

UNICEF: United Nations Children's Fund

VCT: Voluntary Counseling and Testing

WHO : World Health Organisation

ZDV : Zidovudin

ABSTRACT

BACKGROUND: HIV/AIDS still remains a challenging pandemic worldwide, with Sub-Saharan African being the most affected region. In Uganda, the impact of the disease at household, community and national level has been enormous. A large proportion of HIV positive children less than five years of age are malnourished. HIV infection in children less than five years of age increases energy requirements and affects nutritional status through increase in resting energy expenditure, reduction in food intake, nutrient malabsorption and loss, and complex metabolic alterations that culminate in weight loss and wasting which is common in AIDS.

Exclusive breastfeeding during the first 6 months of life has been recommended. Exclusive breastfeeding is more protective than mixed feeding for infant's survival and development followed by complementary foods in addition to breastfeeding for 24 months.

OBJECTIVES: The aim of this study was to assess the dietary intake and nutritional status of children under five years who were HIV positive. Specifically the study sought to determine factors affecting children's nutritional status, the effect of the caretakers' knowledge attitudes and practices on dietary patterns and establish the health related problems associated with HIV/AIDS that may hinder food intake.

METHODS: The total number of children under study was 245. 50.2% were males while 49.8% were females. The methodology undertaken was a cross-sectional study employing both qualitative and quantitative methods. Data was collected using a questionnaire covering background information of the caretakers and children, social economic status, and food consumption patterns/ habits of the children, 24-hr dietary intake, and nutrition knowledge, access to health, and nutrition information.

Nutritional status of the children was determined using anthropometric measurements. Epi-Info 2003 statistical package was used to compute Weight-for- age (WAZ), Height-for-age (HAZ), and Weight-for-height (WHZ) z-scores. SPSS version 12.0 was used to present descriptive statistics (Mean, Std. Deviation, and Frequencies). Statistical significance was set at 95% Confidence Interval.

RESULTS: The results revealed that exclusive breastfeeding was positively correlated with nutritional status (r^2 = 0.624, P= 0.004). In the study, immunization had a positive impact on HIV/AIDS positive children, where 60.4% completed their immunization. The most frequent illness the children got within the past 30 days prior to the research was nausea (14.4%) and the least was difficult in swallowing/Candida esophagus (6.3%). Majority of the children (72.7%) got side effects from the use of ARV drugs including reduced appetite (27.3%), headaches (18.4%), abdominal pain (15.1%), and heartburn (12.7%). The result also revealed that the total number of children who consumed 3 to 4 meals per day was 77.9% while only 12.7% could afford more than 4 meals per day as recommended by MOH (2003). From the results on nutritional information, 63.3% of the caretakers received information on nutrition and care on HIV positive children from health workers in TASO Entebbe Centre. The information included foods good for the patients, foods that should not be given the patients e.g. alcohol, and consequences of poor or/ and bad feeding, improving children's nutritional status at household level, hygiene and proper sanitation. The survey also revealed that 13.5% of the children were underweight, 11.3% were stunted and 12.1% were wasted while 63.1% were normal.

CONCLUSION: From the study it was observed that the children did not meet their requirements for zinc, iron and vitamin A and therefore were at high risk of becoming deficient in these micronutrients

CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND

Nutritional status of HIV positive children should be assessed at regular intervals as part of management of human immunodeficiency virus (HIV) infection. The simplest approach to assessment is serial weight measurement. A comprehensive nutritional assessment includes anthropometric measurements, biochemical measurements of serum protein, micronutrients, and metabolic parameters; clinical assessment of altered nutritional requirements and social or psychological issues that may preclude adequate intake; and measurement of dietary intake. Nutritional assessment and intervention in children with HIV can help to prevent stunted growth and development. Many nutritional, health and psycho-social challenges threaten HIV/AIDS-affected children under age 5, the majority of whom live in Africa. It has been discovered that no tools were designed for assessing the dietary intake of HIV/AIDS-affected children under five and very few studies and programs directed to this age group in Sub-Saharan African Countries (WHO/UNAIDS/UNICEF, 2003).

Breastfeeding provides optimum energy, protein and micronutrients for young infants and toddlers who are HIV positive. Because of its anti-infective properties, breastfeeding helps prevent or reduce the severity of common illnesses, especially the diarrhea and pneumonia that are major causes of death in HIV positive children under five years. In some communities there is inadequate understanding that HIV/AIDS-affected children under five years of age who are not breastfed need special and additional foods beyond milk substitutes.

Malnutrition affects children under five years who are HIV positive because of their high demand for nutrients to meet rapid growth rates. Low quantity and quality of complementary foods, poor child-feeding practices, and high rates of infections, contribute to poor health and growth in this vulnerable group.

The human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) pandemic is a crisis with devastating impacts. It is currently one of the greatest threats to global development and stability. Since the emergence of the epidemic in the early 1980s, about 95% of the people living with HIV/AIDS (PLWHA) are in the developing world. At the end of 2003, approximately 38 million people worldwide were infected with HIV, many of whom had AIDS (WHO/UNAIDS/UNICEF, 2003). In 2004, HIV/AIDS killed more than 3 million people, and nearly 5 million became infected, bringing to 39 million the number of people living with the virus worldwide. More than 25 million (64.1%) of these people live in Sub-Saharan Africa, where in some countries one in 3 adults was infected (UNAIDS/WHO, 2004). Most, if not all, of the 25 million people will have died by the year 2020 (UNAIDS/WHO, 2004).

In 2003, over 90% newly born infected children were babies born to HIV–positive mothers who acquired the virus at birth or through their mother's breast milk worldwide. Of these nine out of ten were from Sub-Saharan Africa. Around 2 million children under 15 are living with HIV and more than twelve million children have been orphaned by AIDS (UNAIDS/WHO, 2004). More than 50% of children's deaths are just due to communicable diseases such as pneumonia, tuberculosis, diarrhea and measles in addition to HIV/AIDS (WHO, 2004).

In Uganda, about 530,000 women, 400,000 men and 100,000 children under 15 years were living with HIV/AIDS at the end of December 2001 (STD/ACP/MOH, 2002). However, about two million Ugandans had been infected with HIV by the year 2002, and more than 900,000 had died of HIV-related illnesses.

The majority of people living with HIV/AIDS including children suffer from gastrointestinal disorders. The common clinical features include diarrhea, malabsorption of nutrients and weight loss which are important predictor of death (Marston *et al.,* 2004). These people, including children below five years, have significant variability in nutrient intake mainly due to diarrhea, nausea, thrush and mouth sores. Unfortunately, appropriate nutritional evaluation of such patients is often not done, and it is assumed that treatment with potent antiretroviral (ARV) therapy will ameliorate nutritional deficiencies; however, this has been reported not to be consistently the case (Silva *et al.*, 1998). Hence nutritional management during the transition to improve immune function is critical.

Given the high prevalence of malnutrition in many countries where the HIV epidemic is an important contributor to morbidity and mortality among children under five years, the interaction between HIV/AIDS and nutrition make this an important area of study. However, while a number of HIV-related nutrition interventions have been piloted and implemented, the benefits of such interventions have not been rigorously investigated. For example, Although ARVs can contribute to the maintenance of health and avoidance of weight loss in children below five years (Silva *et al.*, 1998), malnutrition and wasting are still common, among HIV-infected children on ARV treatment and this has been observed in both developing and developed countries (Walker *et al.*,

2000). Weight loss among HIV infected children below five years is a very strong predictor of mortality and in turn viral load is a strong predictor of weight loss.

Deficiencies of vitamins and minerals, which are needed by the immune system to fight infection, are common in children below five years living with HIV (Semba *et al.*, 1999; Kim *et al.*, 2002). Nutritional and micronutrient deficiencies play an important additive role in immune degradation and impaired development in children. Careful implementation of antiretroviral drugs, complemented by simultaneous efforts to ensure proper nutrition among HIV-infected children below five years are essential components of an effective response to the HIV/AIDS pandemic in Africa and else where (Anabwani *et al.*, 2005).

This study therefore sought to evaluate the nutritional status of children under five years living with HIV/AIDS and establish the effectiveness of diet for predicting nutritional status and hence providing a basis for better nutritional interventions.

Feeding and food intervention has not been focused on HIV/AIDS positive children below five to assess the effectiveness of diet and their nutritional status. Therefore a study to evaluate the effectiveness of diet on the nutritional status of children living with HIV/AIDS was carried out at The AIDS Support Organization (TASO) Entebbe Centre from 15th May to July 2006.

1.1 PROBLEM STATEMENT AND JUSTIFICATION

HIV infection in children below five years increases energy requirements and affects nutritional status through increase in resting energy expenditure, reduction in food intake, nutrient malabsorption and loss,

and complex metabolic alterations that culminate in weight loss and wasting common in AIDS (Babamento *et al.*, 1997; Mahan *et al.*, 2000). The effect of HIV on nutrition in children below five years begins early in the course of the disease; even before it is evident that the child is infected with the virus (Beach *et al.*, 1992; Semba *et al.*, 1999; Bogden *et al.* 2000). In addition, when dietary intake is inadequate to meet the increased energy and protein needs associated with HIV infection, children below five years experience weight loss (Piwoz *et al.*, 2000). Early studies demonstrated that weight loss and wasting were associated with increased risk of opportunistic infections (Wallace *et al*, 1990) and shorter survival time in HIV-positive children below five years, independent of their immune status (Kotler *et al*, 1989; Suttmann *et al.,* 1995).

Poor dietary intake is recognized as major causes of poor health in HIV positive children less than five years. It is aggravated by insufficient food intake during replacement in particular. Replacement feeding should be with appropriately prepared family foods which are further enriched with protein, energy and micronutrients. Many factors contribute to poor nutritional status of HIV positive children under five years including: low levels of food intake; high rates of morbidity; inadequate child care, poor water, sanitation, and health services.

Children's nutritional status directly impact the children's nutrition and health status, and the elevated needs for mineral and vitamin by children means that any intervention directed at promoting the use of micronutrient-dense foods should ideally focus on this vulnerable group.

In Uganda, the assessment of dietary intake in relation to health status in HIV/AIDS children below five years of age and HIV/AIDS has not been

sufficiently studied, and knowledge in this area is still limited. Therefore, this study will help to provide information to nutritionists, health workers, and policy makers on the assessment of dietary intake and nutritional status of children under five years who are HIV positive.

1.2 OBJECTIVES OF THE STUDY

1.2.1 General Objectives:

To evaluate dietary intake and nutritional status of children below five years of age who are HIV/AIDS positive.

1.2.2 Specific Objectives:

The specific objectives of the study are to**:**

1) Evaluate the nutritional status of children below five years of age living with HIV/AIDS.
2) Assess dietary patterns of the children below five years of age who are HIV/AIDS positive.
3) Establish the health related problems associated with HIV/AIDS that may hinder food intake.

1.3 SIGNIFICANCE OF THE STUDY

The study will be of importance to health care providers and policy makers in the promotion of nutritional status among children below five years infected with HIV. It is hoped that the findings will help improve feeding and food intervention programs in the promotion of health of HIV/AIDS infected children that are also malnourished because of the disease. The generated knowledge on proper nutrition is expected to benefit not only the children in the study area but all children in Uganda.

The results of this study will provide a basis for recommendation on dietary intake for children with HIV/AIDS in Uganda. The findings will also provide useful data on the response of HIV/AIDS malnourished children which will help to health workers in TASO and other organizations working in the same area and could also be referred to teachers and other professionals working in the area of nutrition and HIV/AIDS.

1.4 HYPOTHESES

1) Nutritional status of HIV/AIDS infected children is influenced by dietary practices to various degrees. Pattern.
2) There is a multifaceted relationship between the health problem of HIV infected children below five years and poor dietary intake.

CHAPTER TWO

LITERATURE REVIEW

2.0 EPIDEMIOLOGY OF HIV/AIDS

Sub-Saharan Africa remains by far the worst affected region, with an estimated 1.5 to 3.0 million children below five years of age currently living with HIV. AIDS accounts for the deaths of 500,000 children in this region in 2005 (Gorbach *et al.,* 2005). The development of highly active antiretroviral therapy (HAART) as effective therapy for HIV infection and AIDS has substantially reduced the death rate from this disease in those areas where it was widely available (Hommes *et al.,* 1991). Other studies showed that clinical outcome was poor and risk of death was higher in these HIV-positive children with compromised nutrient intake which contribute to disease progression (Baum, 1998). However, studies have shown that, a higher level of nutrition knowledge is positively and significantly associated with better dietary quality (Moore *et al.,* 1999).

Every minute of every day, a child under five years dies of AIDS-related causes and another child becomes infected with HIV. In 2002, 380,000 children under five years died of AIDS-related causes and about 540,000 children were infected with HIV (FAO and WHO, 2002). Yet children are the missing face of HIV/AIDS. The children of Sub-Saharan Africa have been hardest hit by HIV/AIDS. About 2 million children under five are living with HIV in the region, representing 90% of all those children living with the infection worldwide. In 2005, about 500,000 children died of AIDS-related causes and 640,000 children became infected with HIV (Grinspoon *et al.*, 2005).

In Asia and the Pacific, 180,000 children under five were living with HIV. In South and Southeast Asia alone, 37,000 children under five died from

AIDS-related illnesses and 51,000 children were infected with HIV in 2002 (Verweel *et al.*, 2002).

UNAIDS and the WHO (2005) estimated AIDS has killed more than 25 million people since it was first recognized in 1981. Despite recent, improved access to antiretroviral treatment and care in many regions of the world, the AIDD epidemic claimed 570,000 lives of children in 2005 (UNAIDS and WHO, 2006).

2.1 PATHOPHYSIOLOGY OF HIV/AIDS

HIV attaches to and penetrates host T cells via $CD4^+$ molecules and chemokine receptors. After attachment, HIV RNA and enzymes are released into the host cell. Viral replication requires that reverse transcriptase (an RNA-dependent DNA polymerase) copy HIV RNA, producing proviral DNA; this copying mechanism is prone to errors, resulting in frequent mutations (Semba *et al.,* 1999). These mutations facilitate the generation of HIV that can resist control by the host's immune system and by antiretroviral drugs. Proviral DNA enters the host cell's nucleus and is integrated into the host DNA in a process that involves HIV integrase. With each cell division, the integrated proviral DNA is duplicated along with the host DNA. Proviral HIV DNA is transcribed to viral RNA and translated to HIV proteins, including the envelope glycoproteins 40 and 120. The HIV proteins are assembled into HIV virions at the inner cell membrane and budded from the cell surface; each host cell may produce thousands of virions. After budding, protease, another HIV enzyme, cleaves viral proteins, converting the immature virion into a mature, infectious form.

Infected CD4+ lymphocytes produce more than 98% of plasma HIV virions. A subset of infected CD4+ lymphocytes constitutes a reservoir of HIV that can reactivate.

The high volume of HIV replication and high frequency of transcription errors by HIV reverse transcriptase result in many mutations, increasing the chance of producing strains resistant to host immunity and drugs.

The main consequence of HIV infection is damage to the immune system, specifically loss of CD4+ lymphocytes, which are involved in cell-mediated and, to a lesser extent, humoral immunity. CD4+ lymphocyte depletion may result from: Direct cytotoxic effects of HIV replication, Cell-mediated immune cytotoxicity, and/or Thymic damage that impairs lymphocyte production.

Infected CD4+ lymphocytes have a half-life of about 2 days, which is much shorter than that of uninfected CD4+ cells. Rates of CD4+ lymphocyte destruction correlate with plasma HIV level. Typically, during the initial or primary infection, HIV levels are highest, and the CD4 count drops rapidly. The normal CD4 count is about 750/μL, and immunity is minimally affected if the count is more than 350/μL. If the count drops below about 200/μL, a variety of opportunistic pathogens may produce clinical disease, often by reactivating from latent states.

The humoral immune system is also affected. Hyperplasia of B cells in lymph nodes occurs, causing lymphadenopathy, and secretion of antibodies to previously encountered antigens increases, often leading to hyperglobulinemia. Total antibody levels and titers against previous antigens may be unusually high. However, response to new antigens (vaccines) decreases as the CD4 count decreases (Semba, 1999).

2.2 MOTHER TO CHILD TRANSMISSION OF HIV (MTCT)

HIV can be passed from a mother to her infant during pregnancy, during labor and delivery, and through breastfeeding. Transmission through breast milk is particularly important because breastfeeding is the basis of most infant nutrition in Sub- Saharan Africa, regardless of the mothers' HIV status (ACC/SCN**,** 1997).

To mitigate the high rate of infection in infant feeding and prevention of MTCT, replacement feeding and complementary feeding are recommended for children over 6 months (Anabwani *et al.*, 2005). A study by Nduati and colleagues in Nairobi, Kenya, compared the rates of HIV transmission and mortality between breastfed and formula-fed infants. The study showed that the frequency of breastmilk transmission of HIV-1 was 16.2%, and that the majority of the infections (75%) occurred by 6 months. The use of formula prevented 44% of infant infections and was associated with significantly improved HIV-1 free survival. In Uganda, studies in Mulago Hospital have shown a transmission rate of 27.5% in a cohort of 800 HIV positive and negative women who were breast-feeding (Guay, 1996). This level is comparable to a rate of 25% seen in developed countries without breast feeding and if the antiretroviral zidovudine (AZT) is not used.

These findings suggest that exclusive breastfeeding followed by early and abrupt weaning to replacement feeding may be one option for reducing MTCT through breastfeeding while minimizing the adverse consequences of replacement feeding (MOH, 2001).

2.2.1 HIV Transmission during pregnancy and breastfeeding

Malnutrition during pregnancy may increase the risk of MTCT (Semba *et al.*, 1995). For example Vitamin A deficiency may impair T and B cell function, resulting in an increased maternal viral load, reduced antibody concentrations, and therefore contributes to mother-to- child-transmission (WHO, 2001). Transmission during pregnancy occurs when the placental protection of the fetus is compromised, allowing for viral transmission. Immune deficiencies in the mother, including a low CD4 or high CD8 cell count, increase the risk of transmission of HIV. A study in Uganda (Nadal *et al.,* 1998) found a strong correlation between low CD4 counts and detection of HIV-DNA in breast milk.

Deficiencies in the antioxidants vitamin E and selenium also may increase the risk of mastitis (Ellen *et al.*, 2000). Mastitis causes junctions in the mammary epithelium to become leaky, and thus allowing blood plasma constituents including HIV to enter breast milk. Cytokines and other immune reactions resulting from cracked and bloody nipples can damage the intestines of children. Breast health related to mastitis, cracked and bloody nipples and other indications of breast inflammation may affect transmission of HIV. The risk is also higher in an infant with oral lesions such as thrush (Ellen *et al.*, 2000). And Mastitis is caused by infectious agents, poor positioning and attachment, or weak suckling.

The time that HIV transmission occurs following birth is difficult to determine precisely. The presence of maternal antibodies, combined with a period of time during which the infection is undetectable, makes it difficult to determine whether infection occurred during delivery or through breastfeeding (UNAIDS, 2004). Late post-natal transmission (after 3-6 months) can be estimated with the polymerase chain reaction (PCR) test. A meta-analysis of five studies concluded that the best

available estimate of the risk of breast milk transmission is 14% (Dunn *et al.,* 1992). Hence the risk of HIV transmission through breastfeeding for a particular population can be calculated by multiplying percentage of HIV-infected mothers at time of delivery by 14% (WHO, 2003).

Up to 70% of breast milk samples from HIV-infected mothers have been shown to contain cell-associated and cell-free HIV. Transmission is not necessarily a result of the presence of HIV in breast milk, however, but of a complex interaction between the anti-infective agents macrophages, lymphocytes, and immunoglobulin in breast milk and HIV (Serwadda *et al.*, 1985). Maternal viral load is higher in mothers with recent HIV infection or advanced disease. The risk of mother-to- child transmission during breastfeeding nearly doubles if the mother becomes infected while breastfeeding.

One theory to explain the transmission of HIV through breastmilk is that M-cells—specialized epithelial cells that comprise only one percent (1%) of all epithelial mucosal cells found in the Peyer's patches of intestinal mucosa—engulf the virus and allow it to pass through to the macrophages on the other side. The M-cells could facilitate passage through the single layer of cells in the gut that are connected with mostly impermeable junctions (Dudek, 1993). Another study showed the HIV-infected cells in the intestinal lumen stimulated enterocytes to engulf HIV particles (Blank *et al.*, 1994).

Research conducted in Uganda with 215 HIV-1-infected women examined show three factors namely HIV-1-infected cells, deficiencies in anti-infective substances in breastmilk, or both influenced transmission at 15 days, 6 months, and 18 months post-partum (WHO, 2005). Immunoglobulin (Ig) G was the most frequently identified HIV-specific antibody in breast milk, followed by immunoglobulin (Ig) M. The

strongest predictor of transmission was HIV-1 infected cells in breast milk and combined with a defective IgM response (Gorbach *et al.*, 2005).
A study in Kenya and Uganda showed that HIV-infected mothers who breastfed lost more weight and were more likely to die in the 2 years following delivery than HIV-infected mothers who did not breastfeed (Hartman *et al.,* 2006). Another study in Uganda, however, showed no increase in morbidity or mortality among breastfeeding women (Coutsoudis *et al.,* 2001). Due to these conflicting results, it is believed that there is insufficient evidence therefore additional research is needed.

2.3 PREVENTION OF MOTHER- TO- CHILD TRANSMISSION OF HIV

In 1994, a clinical trial demonstrated that a regimen of Zidovudine (ZDV, AZT) known as ACTG 076 regimen, administered to non-breast feeding HIV- positive pregnant women reduced the risk of HIV vertical transmission by almost 70% (from 25% with out AZT to 8% with AZT). This became standard care in developed countries resulting in significant declines in prenatal HIV infection (Newell *et al.*, 1998). The cost of the antiretroviral drugs (ARV) alone was close to 1,000 US dollars. Since the children were not breast-fed, the cost of substitute formula feeds for one year was an additional 600-1,000 US dollars. In spite of the well- known benefits of this regimen, it was not implemented in the developing countries including Uganda. This was mainly due to prohibitive costs of ARVs and substitute feeding, late presentation of mothers for the first prenatal visit, especially in rural areas; and difficult in intravenous drug administration during labour.
Research efforts to find alternative therapeutic regimens for low-income countries were intensified in the late 1990s. Studies done in USA, France, Thailand, South Africa, Tanzania and Uganda, showed that administration of short course antiretroviral drugs during pregnancy, labor and post partum period resulted in tremendous reduction of MTCM

of HIV by 50% or more. There was a different in reduction depending on whether mothers enrolled in these studies breast fed their infants or not. Further studies were conducted to especially address the issues of cost-effectiveness and timing of dosing for nevirapine (Marseille, 1999).

2.3.1 Early Cessation of Breast Feeding

Early cessation of breastfeeding reduces the risk of HIV transmission by reducing the length of time during which an infant is exposed to HIV through breast milk. The optimum time for early cessation of breastfeeding is not known. However, it is advisable for an HIV-positive woman to stop breastfeeding as soon as she is able to prepare and give her infant adequate and hygienic replacement feeding. The most risky time for artificial feeding in environments with poor hygienic conditions is the first two months of life, and family circumstances will therefore determine when the mother is able to stop breastfeeding and start replacement feeding (MOH/RSA, 2001).

Early cessation of breastfeeding is also advisable if an HIV-positive mother develops symptoms of AIDS. Early cessation of breastfeeding could be considered as an option by HIV-positive women who: find it difficult for social or cultural reasons to avoid breastfeeding completely, develop symptoms of AIDS during the breastfeeding period, or can provide adequate replacement feeds, and can prepare and give these hygienically, only after their infants are a few months old (MOH, 2001). UNAIDS/WHO (2000) recommended that HIV infected mothers who breast feed should be provided with specific guidance and support when they cease breast feeding to avoid harmful nutritional and psychological consequences and to maintain breast health.

2.4 HIV AND CHILD FEEDING

2.4.1 Breast Feeding

Exclusive breastfeeding for six months followed by continued breastfeeding with complementary foods and fluids for up to age two years and beyond is the normal, optimal way of feeding children and the foundation of health and development, except in rare circumstances (Bahl, 2005). Artificial feeding increases infants' risks of acute illness, chronic disease, and slower cognitive development, and increases mothers' risks of cancer (De Cock, 2000). Globally, over 90% of deaths among children one month to five years are due to other causes other than HIV/AIDS. Malnutrition is an underlying cause of about 60% of these deaths. Lack of exclusive breastfeeding, complementary feeding that begins too early or too late, inadequate quality or quantity of complementary foods, and challenges in safely preparing, serving and storing such foods all contribute to malnutrition (Ziegler, 1985).

The benefits of breast feeding are not in dispute and it offers the greatest protection against infant morbidity and mortality during the first six months of life. However, breast feeding by a mother who is living with HIV is associated with transmission of the virus to the baby. It is estimated that up to 20% of infants born to women living with HIV may acquire the virus through breast feeding (De Cock, 2000).

Among newborn infants testing HIV-positive within 48 hours after birth, approximately 50% die within six months, primarily due to infectious diseases such as pneumonia (75%) and diarrhea (40%), diseases which are known to occur more frequently and with more severe consequences when infants are not exclusively breastfed (Coutsoudis, 2001). Therefore, breastfeeding is a significant preventable mode of HIV transmission to infants.

Any replacement of breastfeeding must be acceptable, feasible, affordable, sustainable, and safe, or it will increase risks to infant survival, regardless of exposure to HIV. Child feeding counseling must comprehensively address changing circumstances surrounding replacement feeding, acknowledging the difficulties of re-establishing a mother's breastmilk supply (Iliff *et al.*, 2005).

2.4.2 Replacement feeding

Breastfeeding is normally the best way to feed an infant. However, when the mother is infected with HIV, it may be preferable to replace breast milk to reduce the risk of transmission to her infant (Hartmann *et al.*, 2006). The risk of illness and death from replacement feeding should be less than the risk of HIV transmission through breastfeeding. Otherwise there is no advantage to replacement feeding (Hartmann *et al.*, 2006).

Exclusive breastfeeding is less associated with HIV transmission than mixed breastfeeding. WHO and UNICEF recommend that HIV-infected mothers should avoid breastfeeding when replacement feeding is acceptable, feasible, affordable, sustainable and safe. These conditions, however, are not easily met for most mothers in the Sub Saharan African region (RCQHC/USAID, 2003).

Infants born to HIV-positive mothers are at a substantially higher risk of low birth weight, early malnutrition, and mortality in the first two years of life, than children born to mothers without HIV, and the risks are greatest for infants of mothers with more advanced disease (Hartmann *et al.*, 2006). Providing nutritional care is essential to minimize HIV transmission in the postnatal period, while at the same time maximizing overall child survival. Critical interventions for HIV-exposed infants include nutritional assessment, infant feeding, counseling and support,

periodic vitamin A supplementation, provision of suitable replacement foods as appropriate and regular growth monitoring (Raiten *et al.*, 2005).

HIV-positive infants are at increased risk of low birth weight and early growth faltering. Frequent untreated infections, nutrient malabsorption, and other metabolic complications of HIV place these children at extremely high risk of severe malnutrition. Early detection and initiation of therapeutic feeding increases the likelihood that HIV-infected children will recover from severe acute malnutrition. However, failure to respond to nutritional therapy is an indication that anti-retroviral therapy (ART) should be initiated.

2.4.3 Complementary feeding

After six months of age, replacement feeding should preferably continue to include a suitable breast-milk substitute. In addition, complementary foods made from appropriately prepared and nutrient-enriched family foods should be given three times a day (RCQHC and FANTA, 2003). If suitable breast-milk substitutes are no longer available, replacement feeding should be with appropriately prepared family foods which are further enriched with protein, energy and micronutrients and given five times a day (Wilson *et al.*, 1997). If possible other milk products, such as unmodified animal, dried skimmed milk, or yoghurt should be included as a source of protein and calcium; other animal products such as meat, liver and fish should be given as a source of iron and zinc; and fruit and vegetables should be given to provide vitamins, especially vitamin A and C. Micronutrient supplements should be given if available (UNICEF, UNAIDS and WHO, 2004).

2.5 HIV TRANSMISSION AND COMPLEMENTARY FOODS

The pattern or mode of breastfeeding also affects transmission of HIV to the baby. Babies who are exclusively breastfed may have a lower risk of becoming infected than those who consume other liquids, milks, or solid foods in addition to breast milk during the first months of life (Coutsoudis., 1999, 2001; Sue, 1999). The research conducted in Uganda (Coutsoudis *et al.,* 2001) showed that mothers who exclusively breastfed their infants for 3 months were less likely to transmit the virus than mothers who introduced other foods or fluids before 3 months. At 3 months, infants who were exclusively breastfed had significantly lower transmission rates (19.4%) than mixed-fed infants (26.1%) and the same transmission rate as formula-fed infants (19.4%).

However, recent studies (Magoni *et al.,* 2005) showed that HIV transmission rates were significantly lower in formula fed infants in comparison with both exclusively breast feed and mixed feed in Uganda.

Studies show that the disruption of the epithelial integrity of the mucous membranes of the intestine or mouth of the infant increases the risk of transmission (Magoni, 2005). Mixed feeding, allergic reactions to complementary foods and infectious illness can damage the intestine and increase risk of transmission (Creek, 2006; Rabeneck *et al.,* 1998; Tomkins *et al.* 2002). Oral thrush in an infant may also be associated with mother-to-child-transmission.

Other studies suggest that the risk of transmission declines with the age of the infant. It is difficult, however, to ascribe increased risk only to breast feeding duration and the age factor, as feeding patterns change over time. Breast milk intake is gradually decreased, which reduces exposure to the virus but also causes the infant to become increasingly vulnerable to the other infections (Swindale, 2004).

2.6 NUTRITIONAL STATUS OF CHILDREN<5YRS AND HIV/AIDS

There are multiple relations between HIV/AIDS and nutritional status of children below five years of age. Research has shown that the chance of infection with HIV virus might be reduced in children who have good nutritional status, and at the same time, the onset of the disease and even death may delay in well-nourished HIV-positive children below five years of age (ACC/SCN, 1997). HIV/AIDS children are vulnerable to multiple infections because the virus damages the immune system. In the early stages of infection, a child shows no visible signs of illness but later many of the signs of HIV/AIDS will become apparent, including weight loss, fever, diarrhea and opportunistic infections such as sore throat and tuberculosis (Scrimshaw *et al.*, 1997). Good nutritional status is very important from the time a child is infected with HIV.

Good nutritional habit is also vital to help maintain the health and quality of life of the children suffering from HIV/AIDS. These infections can lower food intake or dietary practices because they both reduce appetite and interfere with the body's ability to absorb food. As a result, the infected children become malnourished, loose weight and are weakened (Schwenk et *al.,* 1993).

2.6.1 Good Nutritional Status

Good nutrition is key to a healthy lifestyle in children living with HIV/AIDS. Optimal nutrition can help boost immune function, maximize the effectiveness of antiretroviral therapy, reduce the risk of chronic illnesses such as diabetes and cardiovascular disease, and contribute to a better overall quality of life (Arpadi *et al.*, 2001).

In the early years of the AIDS epidemic, many children less than five years with HIV were dealing with wasting and opportunistic infections linked to unsafe food or water. While these problems are less common

today in developed countries with widespread access to highly active antiretroviral therapy (HAART), many HIV positive children have traded these concerns for worries about body weight loss, elevated blood lipids, and other metabolic complications associated with antiretroviral therapy (Chintu *et al.*, 2004).

Fortunately, maintaining a healthy diet can help address these problems. As HIV positive children live longer thanks to effective treatment, good nutrition can also help prevent problems such as bone loss associated with normal age growing (Hunter, 1990). But there is no single, optimal eating regimen appropriate for every child living with HIV/AIDS. Instead, HIV positive children should eat a balanced diet which meets their requirement (Green, 1995).

2.6.1.1 Energy and Protein intake

Loss of appetite leading to reduced energy intake is the main reason why children lose weight in HIV/AIDS (Schwenk *et al.*, 1999). Chronic weight loss in HIV/AIDS positive children often related to gastrointestinal disease and malabsorption (Macallan *et al.*, 1993).In addition to the damage to the intestinal villi caused by HIV, Cryptosporidium, one of the commoner and more serious opportunistic gut infections, for example, causes malabsorption and the degree of intestinal injury is related to the number of organisms infecting the intestine (STD/ACP/MOH, 1999). Children with HIV can have devastating severity of diarrhea, making it almost impossible to keep pace with dehydration therapy (Arpadi *et al.*, 2000). Food is essential for good nutrition, providing the fuel the child's body needs to function and the building blocks that make up cells, tissues, and organs (Jaimton, 2003). The energy provided by food is expressed in terms of calories. The body requires a certain number of calories simply to carry out its basic metabolic functions such as

respiration and maintenance of body temperature. Additional calories are needed to support physical activity, fight infection, and rebuild damaged tissues. If an HIV positive child does not take in enough calories, fat is broken down to provide fuel. Once the fat is consumed or if child's metabolism is disrupted due to illness lean body mass is then used for fuel and raw materials. If the children takes in more calories than needed, the extra energy will be stored as fat (Baum *et al.*, 1997).

Protein deficiency is closely associated with energy deficiency; both are often deficient in HIV/AIDS and there is so much evidence of severe protein deficiency in HIV/AIDS that it is has been proposed that children with HIV need much protein than in their uninfected peers (WHO, 2002). Most studies have examined the metabolism of individual child labeled amino acids as they become incorporated into pools of body protein or excreted as metabolic products.

Several pro-inflammatory cytokines are produced during infection, which results in poor appetite and failure to grow or regain lost weight even when abundant nutrient supplies are provided (Beverly *et al.*, 1990).

Protein provides the building blocks of lean body mass. When a protein-rich food is consumed, it is broken down into amino acids, which are reassembled to create enzymes, hormones, and bodily tissues. Good sources include meat, poultry, fish, eggs, dairy products, tofu, nuts, and legumes (Beaugerie *et al.*, 1998). Carbohydrates, which are converted to glucose in the body, are a primary source of energy. Carbohydrates are classified as simple or complex. Simple carbohydrates are found in processed sugar, honey, fruit and juice, and lactose. Complex carbohydrates are found in grain products such as bread, pasta, and rice; legumes; and starchy foods such as corn, potatoes, and root

vegetables (Beaugerie *et al.*, 1998). Fat in food is a source of energy and has a high concentration of calories. Excess energy from any source not just fatty food is converted to fat in the body and stored for later use (McComsey *et al.*, 2004). Cholesterol and triglycerides are present in food, but are also produced when the body metabolizes sugar and saturated fat. Every HIV positive child below five years needs some dietary fat, but getting too little is rarely a problem. More important is the type of fat. Saturated fats promote elevated blood levels of low-density lipoprotein (LDL) bad cholesterol, which can clog arteries and increase the risk of cardiovascular disease (Miller *et al.*, 2001). Saturated fat is found in meat, butter, tropical oils, and trans- fats or hydrogenated oils. Polyunsaturated fats are generally considered more healthful, and monounsaturated fats can help raise levels of high-density lipoprotein (HDL) which protects against heart disease. A balanced diet also contains essentially fatty acids, including omega-3 (Shevitz *et al.*, 1999).

Along with the macronutrients described above, a balanced diet also contains many micronutrients, organic and inorganic substances necessary for proper biological functioning. Water-soluble vitamins are excreted in the urine and children with HIV should consume more often; fat-soluble vitamins are stored in the liver and can reach toxic levels if taken in large doses (Tang *et al.*, 1998). Most vitamins must be obtained from food, although the body manufactures vitamin D when the skin is exposed to sunlight and others are produced by bacteria in the gut. Minerals are inorganic substances found in the environment. The child's body with HIV needs several trace elements in tiny amounts, including boron, chromium, cobalt, copper, iodine, manganese, molybdenum, selenium, and zinc (Marston *et al.*, 2004).

2.6.1.1.1 Loss of body protein

Body protein loss is due to poor dietary intake, malabsorption and metabolic change. In the absence of adequate energy intake, body fat and protein are used as fuel sources, thus energy and protein metabolism can not be separated within the context of HIV/AIDS. During weight loss in HIV/AIDS the proportion of body stores that are lost, be they protein, fat or carbohydrate depends on the underlying nutritional state and the dietary intake. Thus the initial level of body protein and fat, together with the dietary intake and the severity of the inflammatory response will affect the rate of weight loss (Piwoz *et al.*, 2000).

Children with HIV/AIDS experience frequent experience episodes of clinical infection from repeated opportunistic pathogens infection, in between which they can rebuild nutrient stores. Repeated episodes of weight loss due to loss of fat and lean tissue followed by recovery appear to allow fat to be preferentially depleted and thus measurement of weight gain without assessment of body composition may lull clinician into a safe sense of security (Castleman *et al.*, 2003).

2.6.2 Malnutrition of Children <5 years infected with HIV/AIDS

Malnutrition is a problem not only for children infected with HIV but also for HIV-negative children born to infected mothers. Although numerous factors known to clinically indicate HIV infection in children have been used to define the essential actions for care of HIV-affected children less than five years but many other factors are still unknown. The Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO) recognize malnutrition or growth faltering as an important sign of AIDS infection in children below five years (CDC, 1987).

Malnutrition in HIV positive children below five years is not to be equated simply with lack of food, or regarded as a medical problem; it is the

outcome of complex inter-related social, economic, political and other processes. Where malnutrition does not cause death, it impacts on the quality of life and opportunities of those affected children, and on their ability to earn adequate income. While the risk of death increases with severity of malnutrition, the largest number of deaths occurs among those affected children by mild to moderate malnutrition (Mahan *et al.*, 2000).

Opportunistic infections (Melchior *et al.,* 1993) are associated with increased resting energy expenditure, and highly active antiretroviral therapy may be associated with increased (Shevitz, 1999) or decreased resting energy expenditure. Clinically, these symptoms may prevent adequate nutritional intake or dietary intake (Thuret *et al.,* 1999) resulting in continued weight and lean tissue loss, vitamin or mineral deficiencies, (Baum *et al.*, 1995) and poor nutritional status (Gorbach *et al.*, 2005). Chemical dependency and socio-economic factors can limit access to proper food and nutrition [(Blank *et al.,* 1994). The malnutrition that results can it self contribute to an increased immunocompromised state (MOH, 1999).

Immediate causes of malnutrition in HIV infected children include inadequate dietary intake and opportunistic diseases. The underlying causes are related to household food security, adequate maternal and childcare, and adequate access to basic health services and a healthy environment. On the other hand, the basic causes relate to the availability and control of human and economic resources (Wilson *et al.,* 1997).

To combat malnutrition in HIV infected children, the immediate, underlying and basic causes of the problem need to be addressed, and there must be short-, medium- and long-term actions at various levels

and by a range of actors. In addition, relatively low-cost direct nutrition programmes such as behaviour change strategies and micro-nutrient fortification, can have considerable impact (RCQHC/FANTA, 2003).

Protein-energy malnutrition (PEM) is associated with adverse clinical outcomes in children below five years of age living with HIV in both the developed and the developing world. The relation between depletion of body cell mass and survival in children with HIV/AIDS was first observed by Kotler *et al.* (1990), who hypothesized that the degree of malnutrition affected the clinical course and survival of these children. Suttmann *et al.* (1995) showed that loss of body cell mass independently predicted death. In a U.S. study, Dreimane *et al.* (2001) found weight loss of 5% over a period of four months to be associated with an increased risk of death and opportunistic infections. Loss in weight, fat-free mass, body cell mass, and fat mass were all significant predictors of mortality among HIV-positive children below five years with wasting syndrome in the Tufts Nutrition for Healthy Living Study in Boston (Tang, 1996).

In children with HIV infection, wasting, particularly loss of metabolically active lean tissue has been associated with increased mortality (Kotler, 1989) accelerated disease progression (Dreimane *et al.,* 2001) loss of muscle protein mass, and impairment of strength and functional status (Grinspoon *et al.,* 2003). Although the Centers for Disease Control (1987),case definition of wasting as an AIDS-defining event requires a net weight loss of at least 10%, a weight loss of as little as 5% has been associated with increased morbidity and mortality (Dreimane *et al.,* 2001). These observations make it critically important to identify and characterize early risk factors for wasting in HIV-infected children below five years and to monitor wasting with a standardized set of strategies for diagnosis, surveillance, and appropriate treatment. Unfortunately, the appropriate nutritional evaluation of such children is often not

performed, and it is assumed that treatment with potent antiretroviral therapy will ameliorate nutritional deficiencies. This is not consistently the case (Silva, 1998), and nutritional management during the transition to improved immune function is critical.

Among the factors that have been demonstrated or hypothesized to contribute to wasting are inadequate food intake, malabsorptive disorders, metabolic alterations, and excessive cytokine production. Wasting is a multifactor phenomenon; therefore strategies for its prevention, interruption, or reversal are complex. Despite a growing body of evidence on the importance of nutritional intervention to prevent wasting in children, maintain growth velocity in them, and promote restoration of weight and lean body mass (LBM) in stable, low-weight children, no therapeutic guidelines exist for the management of weight loss and wasting in HIV-infected children (Gillespie *et al*, 2005).
In contrast to the treatment of other HIV-related complications, a standardized approach to the management of active weight loss in children has not been established. A comprehensive assessment of co-morbidities, including evaluation for gastrointestinal disease, opportunistic infections, malignancy, adrenal insufficiency, or medication-related side effects, is critical in HIV infected children with active weight loss. A significant mismatch between energy intake, which is often reduced, and energy expenditure during opportunistic infection has been shown (Grunfeld *et al.*, 1992 and Macallan, 1993). These findings underscore the need to assess the adequacy of energy and nutrient intake requirements and exacerbate acute weight loss.

Micronutrient malnutrition, prevalent in many developing countries, may also contribute to a weakening of immune status and thus worsening of clinical condition among HIV- infected children (Piwoz *et al.*, 2000; Fawzi, 2005). There is substantial evidence that specific nutritional deficiencies

may accelerate HIV disease progression and hasten the onset of HIV/AIDS and death.

2.6.2.1 Immune impairment and malnutrition

Nutrition and immunity in HIV- positive children who are under five years of age can interact in two ways. First, HIV- induced immune impairment and the heightened risk of subsequent infection can worsen nutritional and dietary status. Secondly, HIV infection can also lead to nutritional deficiencies through decreased food intake and malabsorption and increased utilization and excretion of nutrients, which in turn hasten the onset of AIDS (Semba *et al.*, 1999). Nutritional status modulates the immunological response to HIV infection, affecting the overall clinical outcome. Immune suppression caused by PEM is similar in many ways to the effects of HIV infection (Shevitz *etal.,* 1989).

Among vulnerable children who are HIV/AIDS positive, the prevention of food-borne illnesses is extremely important as these would further increase the children's needs and, at the same time, reduce their absorption of nutrients. Hygienic food handling and access to safe foods are, therefore, imperative. The effects of malnutrition on the immune system are well known and include decreases in CD4 T-cells, suppression of delayed hypersensitivity, and abnormal B-cell responses (Gorbach *et al.*, 2005).

For children below five years of age living with HIV/AIDS, nutritional counseling, care, and support are necessary. Nutritional or dietary support or dietary intake can prolong the asymptomatic period of relative health, forestall the onset of debilitating and life-threatening opportunistic diseases such as diarrhea, pneumonia, malaria and tuberculosis, and ultimately prolong the lives of the young children who depend on them (Pernertorfer *et al.*, 1999).

2.7 HIV/AIDS AND DIETARY INTERVENTIONS

Daily micronutrient supplementation improve body weight and body cell mass (Shabert *et al.*, 1999); reduce HIV RNA levels (Miller, 2003); improve CD4 cell counts (Miller, 2003, Jaimton, 2003); and reduce the incidence of opportunistic infections (MAAIF, 1997) in children with HIV/AIDS, including those on antiretroviral therapy. Larger clinical trials demonstrated that daily micronutrient supplementation increase survival in children with low CD4 cell counts (Jaimton *et al.*, 2003); prevent adverse birth outcomes when given during pregnancy (Fawzi *et al.*, 2002); and reduce mother-to-child HIV transmission in nutritionally vulnerable women with more advanced HIV disease (Fawzi *et al.*, 2002).
Since micronutrient deficiencies are frequently present in HIV-infected children below five. Micronutrient intakes at daily recommended levels need to be assured in HIV-infected children through consumption of diversified diets, fortified foods, and micronutrient supplementation as needed. WHO/UNICEF (1999) recommendations on vitamin A, zinc, iron, folate and multiple micronutrient supplements remain the same. Micronutrient supplements are not an alternative to comprehensive HIV treatment including ARV therapy. Studies have shown that some micronutrient supplements may prevent HIV disease progression.

Other types of dietary supplements may also benefit HIV/AIDS children who have experienced weight loss. Some fatty acids, such as omega-3-fatty acids common in fish oils and some seeds, are required for the children's body to respond to inflammation and to reduce the impact of cytokines that promote wasting e.g. interleukin-1 and tumor necrosis factor (Vorster *et al.*, 2004).

In addition to food, children living with HIV may need additional micronutrients due to decreased intake. The same cycle of malnutrition

and infection that occurs with macronutrients is seen with micronutrients as well. Children with serious infections or diseases may have altered intake, absorption and metabolism of various micronutrients. These deficiencies in turn can weaken the immune system and increase the risk of infection and HIV/AIDS disease progression (Baum *et al.,* 2000). In fact HIV infection increases a child's requirements for a number of micronutrients, but, the magnitude of the effect of HIV on micronutrient status or requirements depends on: the micronutrient in question, the stage of HIV infection - it is clear that the effect increases as the child becomes more symptomatic - and the child's access to care and treatment of the common opportunistic infections and HIV (UNAIDS/WHO, 2006).

In severe cases, micronutrient deficiency leads to a complex known as nutritionally acquired immunodeficiency syndrome (NAIDS) - which, like AIDS, increases susceptibility to secondary infections. In children with HIV, NAIDS may contribute to CD4 cell decline and increase the risk of progression to AIDS and death. In addition, poor micronutrient status also leads to oxidative stress, which has been directly shown to increase HIV replication thus potentially speeding disease progression (Baum *et al.*, 1995).

2.7.1 The Role of Food Rations

Food rations to counter mild weight loss and the nutrition-related side effects of antiretroviral drug (ARV) therapy and to address nutritional needs in food-insecure areas. Children less than five years old infected with HIV/AIDS or tuberculosis need food as well as medication. Food should be provided these patients to reduce the stigma associated with the HIV disease (WHO, 2006).

Illnesses causing pain, nauseas, or loss of appetite, depression and isolation and difficulties to absorb food associated with diarrhoea and vomiting, put children infected with HIV/AIDS at high risk of malnutrition (WHO, 2003). This can be caused by chronic changes to the gut infected with HIV or side effects of medicines (Lawrence, 1997). Food accessibility is also frequently affected due to the reduction of household income. Children affected by HIV/AIDS also are at a high risk of malnutrition as household providers and caretakers often become unable to work or to maintain home agricultural activities. In turn this leads to less income available for food purchase exacerbated by scarce resources being spent on expensive healthcare.

2.7.2 Protein and Energy Requirement

HIV infected children have higher nutritional requirements than normal, particularly with regard to protein (up to 50% increase). They are also more likely to suffer a loss of appetite, even anorexia, thus reducing dietary intake at the very time when requirements are higher (Marston *et al.*, 2004). It has been shown that the possibility of infection with HIV virus might be reduced in children below five who have good nutritional status, while the onset of the disease and even death may delay in well-nourished HIV-positive children (ACC/SCN, 1997).

Adequate protein intake is important to maintain muscle mass and to regenerate liver cells in HIV positive children without cirrhosis. Some HIV positive children 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).

With respect to energy requirement, asymptomatic HIV-positive children require 10% more energy, while symptomatic HIV-positive children

require 20%-30% more energy than HIV-negative children of the same age, sex, and physical activity level (WHO, 2003). During the symptomatic phase with weight loss**,** energy requirements increase by 50 to 100%. From a practical viewpoint, it is often difficult for children experiencing opportunistic infections and weight loss to consume 50% to 100% more energy than normal levels. Therefore, it is important to encourage children to consume additional food following bouts of illness and weight loss as well (WHO, 2005).

Protein requirements vary with children's age and medical condition. The bottom line is that protein intakes should not be increased beyond the Required Daily Allowance (RDA) goals unless advised by a professional (Jimenez *et al.*, 1998). Glutamine (GLN) is produced in skeletal muscle and used by the immune system, the gastrointestinal tract, and other organs. Muscle wasting occurs, in part, to satisfy the child body's need for GLN during infection. This was one of the first studies to show that nutritional/dietary supplementation, including the amino acid glutamine (GLN), can restore body cell mass in HIV-infected children already experiencing weight loss and muscle-wasting (Shabert *et al.,* 1999).

2.7.3 Multimicronutrient Supplementation and HIV Infection

In addition to food, children with HIV may need additional micronutrients. Children with serious infections or diseases may have altered intake, absorption and metabolism of various micronutrients. These deficiencies in turn can weaken the immune system and increase the risk of infection (Fawzi et *al.*, 2002).

Micronutrient supplementation can improve health - for example, vitamin A supplementation reduces mortality from a variety of causes in children under five. Moreover, vitamins and minerals can be relatively

easy and inexpensive to administer. However, they should not be seen as a magic bullet (WHO, 2006). HIV infection increases a person's requirements for a number of micronutrients, but, it is clear that the effect increases as the children become more symptomatic - and the children's access to care and treatment of the common opportunistic infections and HIV (Gillespie *et al.*, 2005). There is clear evidence that micronutrient status affects both susceptibility to and progression of HIV infection as well as general health, pregnancy including growth in children, etc (WHO/UNAIDS/UNICEF, 2003). Micronutrients also interact with drug therapy, affecting the bioavailability, effectiveness, and/or safety or medicines.

2.7.4 Vitamins and Mineral supplementation

Micronutrient malnutrition, prevalent in many developing countries, may also contribute to a weakening of immune status and thus worsening of clinical condition among HIV- infected children below five years (Piwoz *et al.*, 2000; Fawzi, 2005).

In one study, vitamin A was an independent predictor of mortality among HIV –positive intravenous drug users in children below five years (Semba *et al.,* 1995). In a study among HIV –negative Kenyan children below five years, lower plasma vitamin A levels were associated with a decreased risk of HIV seroconversion (Romeyn *et al.,* 1999). In another retrospectives study among HIV – infected children in the United States, a U-shaped relationship was observed between dietary vitamin A and the risk of progression to AIDS and mortality (Tang *et al.*, 1998). These investigators also reported dietary zinc intake to increase the rate of the disease progression and mortality. In contrast, those who progressed to AIDS in the study had significantly lower serum zinc levels than non-progressors and HIV- negative subjects.

Several studies have documented marginal-to-deficient vitamin and mineral status associated with adverse outcomes (Oster *et al.*, 1994). However, there is little documentation in the literature that supplementation beyond what is recommended has had any impact on clinical outcome. If the children's vitamin or mineral status is deficient, supplementation is clearly necessary. Few studies have looked at enteral and parenteral feedings in HIV-infected children. In general, HIV positive children who have gastrointestinal disease, including malabsorption, benefit from enteral or parenteral feedings (Gaare *et a.l.,* 1991). Despite the small number of studies, the benefit of enteral and parenteral feedings was demonstrated for children less than five years who were not receiving active antiretroviral therapy. This benefit was also demonstrated to extend life expectancy (Fawzi *et al.*, 2002).

Deficiencies in vitamins and minerals, such as vitamins A, B-complex, C, and E and selenium and zinc, which are needed by the immune system to fight infection, are common in children living with HIV (Semba *et al.*, 1999).

Vitamin C, vitamin E, selenium, and zinc act as antioxidants, helping prevent cell damage caused by highly reactive free radicals. While free radicals play a role in immune defense against invading pathogens, they can also harm surrounding cells. Research has shown that children less than five years with HIV and other chronic infections have higher levels of free radicals, which promote viral replication. Conversely, antioxidants appear to reduce oxidative stress, inhibit HIV activity, and possibly slow HIV disease progression (Baum *et al.*, 1998).

The body manufactures certain antioxidants as needed, but this process requires adequate amounts of several nutrients. Studies suggest that a major intracellular antioxidant, glutathione, may help reduce the rate of HIV disease progression. Nutrients that help raise glutathione levels

include selenium, alpha-lipoic acid, N-acetyl-cysteine (NAC), acetyl-L-carnitine, L-glutamine, and coenzyme Q10. High-dose N-acetyl-cysteine (NAC) supplementation leads to decrease HIV viral load. There have been several case reports and small studies in which supplementation with antioxidants or precursors including NAC, acetyl-L-carnitine, and coenzyme Q10 seemed to counter lactic acidosis (a sign of mitochondrial toxicity) related to antiretroviral therapy (Baum *et al.*, 1995).

2.7.4.1 Vitamin A supplementations

Vitamin A is very important to immune function, particularly in HIV positive children in preventing infection and mortality. However, in vitro data suggests that vitamin A has a complex interaction with HIV. According to this data, the effect of vitamin A during HIV infection varies dichotomously depending on timing of infection and exposure to the vitamin (Semba *et al.*, 1995).

In a randomized, placebo-controlled trial in Durban, South Africa, vitamin A was given in single age-adjusted doses to children of HIV-positive mothers at one and three months (50,000 IU), six and nine months (100,000 IU), and at 12 and 15 months (200,000 IU). There was a reduction in diarrhea by 28%, 40% shorter bouts of diarrhea, and reduction in hospitalization for diarrhea by 77%. In a randomized, placebo controlled study from Tanzania, 600 children between 6 and 59 months old were admitted for pneumonia, and supplemented with 200,000 IU vitamin A. The dose was repeated the next day, and at four and eight months. This resulted in a significant increase in linear growth in children with HIV infection, ponderal growth in children with malaria, and reduced stunting in children with persistent diarrhea (Baum *et al.*, 1998). It is believed that benefit of supplementation with vitamin A may only occur when there is pre-existing deficiency. No benefit was observed

with vitamin A supplements in largely replete children of HIV-positive. Further investigation of treatment with vitamin A is needed into the differential treatment effect of vitamin A with or without deficiency (Gillespie *et al.*, 2005). Some studies have shown that low vitamin A levels were an independent predictor of death from AIDS-related causes. In another study, serum retinol (vitamin A) levels were shown to be inversely associated with the risk of mortality in HIV-infected intravenous drug users (Semba *et al.* 2004).

2.7.4.2 Vitamins B- Complex Supplementation

A number of observational studies suggest that vitamins B and C, all potent antioxidants, are associated with a reduced risk of HIV disease progression among children below five years. One small study reported that vitamin C had an effect on viral load, though the study was too small to show statistical significance (Tang *et al.*, 1997). Higher intakes of vitamin B-complex (niacin, B1, B2, and B6) and vitamin C were associated with slower progression to AIDS in children (Tang *et al.*, 1996). Good sources of niacin include yeast, meat, poultry, fish (e.g., tuna, salmon), cereals (fortified cereals), legumes, and seeds, all these are make strong the immune system of HIV positive children. Milk, green leafy vegetables, coffee and tea also provide some niacin. In plants, especially mature cereal grains like corn and wheat, niacin may be bound to sugar molecules in the form of glycosides, which significantly decrease niacin bioavailability (MOH, 1999).

2.7.4.3 Vitamin E supplementation

An increase in serum levels of vitamin E has been seen with vitamin E or multivitamin supplements. Low levels of serum vitamin E and B12

were shown to prospectively increase disease progression (Baum *et al.*, 2000). Vitamin E plays a role in metabolism and proper immune function, and laboratory studies suggest it has an antiviral effect. It has been suggested that supplementation might slow HIV replication enough to inhibit the emergence of drug-resistant virus in resting cells and to delay viral rebound after treatment interruption. But while low levels of vitamin E have been linked to CD4 cell declines and HIV disease progression, this does not imply causality (Schwenk *et al.,* 1999). Low levels of serum vitamin E and B12 were shown to prospectively increase disease progression (Baum *et al.*, 2000).

2.7.4.4 Zinc supplementation

Zinc supplements could be a simple and safe way to reduce illnesses such as diarrhea in children infected with HIV. Zinc is an essential mineral for development and a healthy immune system but there has been concern about the safety of supplements for HIV positive children because the virus that causes AIDS also needs it to function and replicate (Isa *et al.*, 1992). In their study, they further said that supplements did not produce any adverse effects in the children under five who are HIV positive. Children infected with HIV who took the zinc supplements for 6 months had fewer diarrheas than children who had been given a placebo, or dummy pill.

Zinc is essential for growth and synthesis of lean body mass and for a healthy immune system. However, if the given dose of zinc is too high, it can be immunosuppressive (Newell, 2004). Zinc supplementation reduces complications from diarrhoea, pneumonia and malaria among others, and theoretically beneficial. More recently, a few South African studies have reported that zinc supplementation is safe in HIV-infected children and does not increase HIV viral load or reduce CD4 cell count

(Wilson *et at.*, 1997). Zinc supplementation has been suggested as a treatment for children living with HIV/AIDS, but studies to date have produced conflicting results. While some suggest that zinc enhances the body's ability to fight HIV and improves disease symptoms, others have found it has a detrimental effect (Ellen *et al.*, 2000). Some researchers have hypothesized that this may be related to the fact that HIV requires zinc-containing structures called "zinc fingers" to produce functional viral progeny (Fawzi, 2005).

In one placebo controlled study at Greys Hospital zinc supplementation as zinc sulphate 10 mg/d significantly reduced frequency of watery diarrhea, and there was a trend toward reduced frequency of pneumonia (FAO/WHO, 2002). Also, Zinc could be a safe, simple and cost-effective intervention to reduce illnesses such as diarrhea and pneumonia in HIV-positive children. Scientists have been concerned that zinc supplements for HIV-positive children might not be safe because the virus uses the mineral - which is important for the development and maintenance of a healthy immune system to replicate and infect new cells (UNICEF, 1998). Consequently MOH/RSA (2001) administered zinc supplements for six months to half of a group of 96 HIV-positive South African children between the ages of six months and fifty nine months. The children who received the zinc supplements had fewer occurrences of diarrhea and did not experience an increase in HIV levels in their bloodstreams. Zinc intake in deficient children below five with a high prevalence of HIV-1 infection can be implemented without concern for adverse effects on HIV-1 replication. In view of the reductions in diarrhea and pneumonia, zinc supplementation should be used as adjunct therapy for children with HIV-1 infection.

More recently, (Bogden *et al.,* 2000) reported that in a randomized, placebo-controlled trial of some HIV positive South African children aged

between six months to five years, zinc supplementation for six months reduced the incidence of diarrhea and pneumonia, and did not appear to promote viral replication. Given the degree of uncertainty, most experts do not recommend zinc supplementation beyond the amount contained in a multivitamin and mineral pill.

2.7.4.5 Iron supplementation

Iron like zinc, is important to the host but it can also be important to the pathogen. The children's body has no very potent iron withholding mechanisms to keep from stimulating the growth of the invasive organisms. Thus, iron supplementation can actually increase infectious disease risk - which has been observed in some malaria, diarrhoea and TB studies (Marston *et al.*, 2004).

In the case of HIV, studies suggest that iron supplementation increases viral replication. HIV may initially reduce iron status, but later lead to iron accumulation. Observational data suggests that iron can increase HIV disease progression (Marston *et al.***,** 2004). However, a randomized control trial of iron supplementation in Kenya found that low dose iron given to HIV positive children had no effect on viral load. There is hence an urgent need to establish the effect and safety of iron supplementation in the doses that are commonly given to prevent and treat anemia (Tang *et al.*, 1996). Iron Supplementation to prevent or treat anemia is widespread in children where HIV prevalence is high. But some times iron supplementation can be harmful (Wilson *et al.*, 1997).

2.7.4.6 Selenium supplementation

Selenium is important for the immune system. In vitro studies suggest that selenium deficiency increases HIV replication. Observational studies

suggest that low serum selenium is a predictor of mortality in children with HIV (Allard *et al.*, 1997). But there is little clinical data to show that supplementation reduces the risk of transmission ((Allard *et al.*, 1997).

Anecdotal evidence has been documented that selenium supplementation leads to clearance of thrush on children (Guenter *et al.*, 1993). Selenium deficiency has been demonstrated to be a significant predictor of HIV-related mortality independent of CD4 cell count over time, CD4 cell count of less than 200cells/μL at baseline, and antiretroviral treatment (Heller *et al.*, 1998). The trace element selenium is also known to play a role in proper immune function has received considerable attention as a treatment for HIV/AIDS and a variety of other diseases. Some in *vitro* research indicates that HIV requires selenium in order to replicate (Heller *et al.*, 1998).

2.7.5 Vitamins and Minerals Deficiencies

In HIV positive children less than five years of age, deficiencies of vitamins and minerals, such as vitamin C, E, B-Complex, and vitamin A and selenium, zinc and iron which are needed by the immune system to fight infections, are common (Marston *et al.*, 2004). In addition, deficiencies of vitamins and minerals in HIV positive children under five years of age contribute to oxidative stress and accelerate immune cell death and increase the rate of HIV replication (Prisca, 2004). Micronutrient supplementation improves body weight and body cell mass and reduces HIV RNA levels, and also improves CD4 cell counts (Marston et *al.*, 2004), and at the same time reduces the incidence of opportunistic infections. Daily micronutrient supplementation increase survival in children with low CD4 counts, hence prevent adverse birth outcome when given pregnancy, and reduce MTCT in nutritionally vulnerable women with more advanced HIV/AIDS disease (FAO/WHO, 2002). Iron is

the biggest micronutrient problem which may affect the children infected the HIV pandemic globally and account for anemia among them (WHO, 2003). Young infected children are most commonly and severally affected because of the spike in iron demand with infancy. HIV positive children who are deficient in vitamin A, the B vitamins, E, and the mineral selenium have been observed to get ill more quickly than those without deficiencies (Dohert, 2006).

Some researchers and dieticians believe that it is necessary for children living with HIV/AIDS to take in amounts of vitamins and minerals that are many times higher than the RDAs. In Sub-Saharan African countries, where the prevalence of HIV/AIDS is higher, mortality and morbidity of children is an important public problem with diarrheal and respiratory diseases being important causes. Oxidative stress in HIV infection and opportunistic infections in children resulted in high level of free radicals and depletion of vitamin E. Resulting deficiency of vitamin E may then increase susceptibility to further infection, and HIV disease progression (FANTA, 2001).

2.7.5.1Vitamin A Deficiency

In general, deficiencies of fat soluble micronutrients occur in HIV infection due to fat malabsorption, general malabsorption, diarrhea, gut infection, altered gut barrier function, and altered metabolism (Semba *et al.,* 1995). WHO reported in 1994 that 1.1 million children less than five years who are HIV positive had eye damage due to Vitamin A deficiency (WHO, 1994). Vitamin A mitigates the adverse effects of HIV infection and malaria. Vitamin A is available in dark orange fleshy fruits and vegetables (e.g., papaya, or sweet potato) and dark leafy greens, although the vitamin appears to be less available for human consumption in the latter source (Marston *et al.*, 2004).

2.7.5.2 Vitamins B-complex Deficiency

Deficient serum levels of vitamins of the B-complex occur in HIV positive children between 6-59 months, in the absence of symptoms. Some researchers assessed micronutrient concentrations in children below five years with HIV, and found low riboflavin levels, low B6 levels, and low B12 (NAP, 2002*).* Higher intakes of vitamin B complex (niacin, B1, B2, and B6) and vitamin C were associated with slower progression to AIDS in children (Prisca, 2004).

2.7.5.3 Vitamin E Deficiency

Low serum concentration of vitamin E has been seen in children under five who are HIV positive in different observational studies. In a study of 100 asymptomatic HIV positive children between 6-12 months in Durban, South Africa, had overt or marginal deficient levels. In another study, 50% of HIV-positive children had intake of vitamin E less than 50% of required daily amount (MOH/RSA, 2001). Low serum concentration of vitamin E was seen in observational studies. In a study of 100 asymptomatic HIV-positive children, 26% had intake of vitamin E that was 50% less than RDA, and 27% had overt or marginal deficient levels (Wang *et al.*, 1994). Oxidative stress in HIV infection and opportunistic infections results in high level of free radicals and depletion of vitamin E. Resulting deficiency of vitamin E may then increase susceptibility to further infections (Allard *et al.*, 1997).

2.7.5.4 Zinc Deficiency

Zinc deficiency is common in the HIV-infected children. Zinc levels are known to be depressed during acute phase reaction to infections, reflecting increased uptake by the liver. A higher incidence of bacterial

infections was reported in HIV positive children below five years with low zinc levels (Fabris *et al.*, 1988).

Malabsorption, altered metabolism, anorexia, and diarrhea may produce low levels of micronutrients and trace elements. Low zinc levels were also seen in early disease, and in the absence of symptoms. Some studies reported no effect on serum zinc levels in HIV infection, and others reported lower levels with more advanced stages of the disease (Isa *et al.*, 1992). Since zinc deficiency and zinc-dependent immunity are responsive to acute and subsequent chronic phase reaction, levels of thymulin (a thymic hormone activated only by binding with zinc ions) may be a more sensitive marker of deficiency than serum zinc levels (Fabris *et al.*, 1988).

2.7.5.5 Iron Deficiency Anemia (IDA)

Iron is the biggest micronutrient problem which may affect the HIV positive children globally and account for anemia among these children infected by the pandemic [WHO, 2002]. Young children infected with HIV are most commonly and severely affected because of the spike in iron demands with infancy. About 90% of HIV positive children under five affected by iron deficiency anemia live in the developing world. Evidence show that the prevalence of iron deficiency in HIV infected children has increased in South Asia and Sub-Saharan African countries (WHO, 2006).

2.7.5.6 Selenium Deficiency

In different studies in HIV positive children below five, both plasma and red blood cells were found to be deficient in selenium. This was reported in HIV-positive children and occurred even in early disease when malabsorption and malnutrition were unlikely contributors (Fawzi,

2005*)*. Selenium deficiency levels correlates with weight, serum albumin, and CD4 cell counts (Cirelli *et al.*, 1991).

Association of lower selenium levels with progression of HIV disease was found in several studies (Cirelli *et al.*, 1991). It was independent of malabsorption and correlated with CD4 cell counts. Mantero-Alienzo *et al* (1991) also demonstrated correlation between both CD4 cells and serum selenium with mortality and opportunistic infections in 95 HIV-positive children. In a study of HIV-infected children, showed that HIV-positive children with low levels of selenium had a significant 20-fold risk of death from HIV related causes than those with adequate serum levels. The risk was 16 times greater than of low CD4 cell count, and greater than with any other micronutrient. In another study of HIV-infected children, investigators showed that low plasma selenium concentration and CD4 cell count below 200/µl were independent predictors of child mortality and faster HIV disease progression (Sue, 1999). Selenium deficiency has been demonstrated to be a significant predictor of HIV-related mortality independent of CD4 cell count over time, CD4 cell count of less than 200 cells/ uL at baseline, and antiretroviral treatment.

2.8 PREVENTION AND TREATMENT OF HIV/AIDS AMONG CHILDREN LESS THAN FIVE YEARS.

2.8.1 ANTIRETROVIRAL (ARV) Treatment

More than 20 years since HIV was first diagnosed, help is reaching less than 10% of children below five years affected. HIV can be treated effectively with anti-retroviral drugs (ARVs). Anti-retroviral drugs (ARVs) and medicines to treat other life-threatening infections like tuberculosis, pneumonia and malaria can help keep HIV- positive children alive for many years (Moore *et al.*, 1999). While regimens such as those based on

the anti- retroviral drugs Zidovudine (ZDV, AZT) or Nevirapine (NVP) have achieved reductions in mother-to- child transmission of up to 50% in developing countries, there is limited availability of these drugs (Dreimane *et al.*, 2001).

Once a child is HIV positive, there is no cure. The disease course is very aggressive in children. HIV targets the immune system and thus a child living with HIV becomes less able to resist potentially deadly opportunistic infections such as tuberculosis (TB), malaria and pneumonia, among others. Up to half of all deaths of children under the age of five in the hardest-hit countries are due to AIDS- related causes. AIDS is rapidly catching up with measles as the second greatest cause of death among children. Anti-retroviral drugs (ARVs) and other medicines to treat opportunistic infections can help keep HIV-positive children to live for many years (Wintergerst *et al.*, 1998).

The possibility of obtaining treatment for HIV-related disease – and with it the reality that HIV is not an immediate death sentence – brings hope and draws children under the age of five to health care services. In mid-2005, an estimated 660,000 children needed anti-retroviral treatment (ART) worldwide (Scrimshaw *et al.*, 1997). In well-resourced settings, viral load tests and CD4 cell counts may be used to assess the progression of HIV and to determine the right time to start antiretroviral treatment. Because children under the age of five years don't have fully-developed immune systems, the results of these tests must be interpreted very carefully, which calls for specially-trained medical staff.

Children with HIV are vulnerable to opportunistic infections such as pneumonia, tuberculosis and others. The antibiotic co-trimoxazole is effective at preventing various opportunistic infections, and can delay the need for antiretroviral treatment. Co-trimoxazole is recommended for the infants and children in resource-poor countries when: HIV-exposed

infants and children, starting at 4-6 weeks after birth and continued until HIV infection is excluded, HIV-positive children less than 1 year old, HIV-positive children aged 1-4 years who have mild, advanced or severe symptoms of HIV disease, or a CD4 count below 25%,or HIV-positive children aged 4-5 years who have mild, advanced or severe symptoms of HIV disease, or a CD4 count below 350 cells/ml, or have a history of treated pneumonia (Mahan *et al.*, 2000).

Treatment with co-trimoxazole should continue until at least age 5, and in general should continue indefinitely, though it may sometimes be stopped following successful antiretroviral treatment. Some of the worst affected countries may choose to treat all infants and children born to mothers confirmed or suspected of living with HIV, until HIV infection is excluded (Thuret *et al.*, 1999). There is currently no vaccine or cure for HIV or AIDS. The only known methods of prevention are based on avoiding exposure to the virus or, failing that, an antiretroviral treatment directly after a highly significant exposure, called post-exposure prophylaxis (PEP). Post-exposure prophylaxis has a very demanding four week schedule of dosage. It also has very unpleasant side effects including diarrhea, malaise, nausea and fatigue (Buchacz *et al.*, 2001).

Current treatment for HIV infection consists of highly active antiretroviral therapy, or HAART. This has been highly beneficial to many HIV-infected children since its introduction in 1996 when the protease inhibitor-based highly active antiretroviral therapy initially became available (Chantry *et al.*, 2003). Current optimal highly active antiretroviral therapy options consist of combinations or consisting of at least three drugs belonging to at least two types, or classes, of anti-retroviral agents. Typical regimens consist of two nucleoside analogue reverse transcriptase inhibitors (NARTIs or NRTIs) plus either a protease inhibitor or a non-nucleoside reverse transcriptase inhibitor (NNRTI). Because HIV disease progression

in children under five is more rapid than in adults, and laboratory parameters are less predictive of risk for disease progression, particularly for young infants, treatment recommendations are more aggressive for children than for adults. In developed countries where highly active antiretroviral therapy is available, doctors assess the viral load, rapidity in CD4 decline, and children readiness while deciding when to recommend initiating treatment (Brambilla *et al.*, 2001).

Highly active antiretroviral therapy (HAART) allows the stabilisation of the child's symptoms, but it neither cures the child of HIV, nor alleviates the symptoms, and high levels of HIV-1, often highly active antiretroviral therapy resistant, return once treatment is stopped. Moreover, it would take more than the lifetime of children to be cleared of HIV infection using highly active antiretroviral therapy (Heller *et al.,* 1998). Despite this, many HIV-infected children have experienced remarkable improvements in their general health and quality of life, which has led to the plummeting of HIV-associated morbidity and mortality. In the absence of HAART, progression from HIV infection to AIDS occurs at a median survival time after developing AIDS is only 9.2 months. Still, for some children- and in many clinical cohorts this may be more than 50% of children- HAART achieves far less than optimal results (Clarick *et al.*, 1997). This is due to a variety of reasons such as medication intolerance/side effects, prior ineffective antiretroviral therapy and infection with a drug-resistant strain of HIV. The complexity of these highly active antiretroviral therapy regimens, whether due to pill number, dosing frequency, meal restrictions or other issues along with side effects that create intentional non-adherence also has a weighty impact. The side effects include lipodystrophy, dyslipidaemia, and insulin resistance.

Anti-retroviral drugs are expensive, and the majority of the world's infected children do not have access to medications and treatments for HIV and AIDS. Research to improve current treatments includes decreasing side effects of current drugs, further simplifying drug regimens to improve adherence, and determining the best sequence of regimens to manage drug resistance. Only a vaccine is postulated to be able to halt the pandemic. This is because a vaccine would possibly cost less, thus being affordable for developing countries, and would not require daily treatments. However, after over 20 years of research, HIV-1 remains a difficult target for a vaccine (Uganda AIDS Commission, 2003).

A number of studies have shown that measures to prevent opportunistic infections can be beneficial when treating children with HIV infection or AIDS. Vaccination against hepatitis A and B is advised for children who are not infected with these viruses and are at risk of becoming infected (Uganda AIDS Commission, 2003). In addition, HIV/AIDS children should receive vaccination against Streptococcus pneumoniae and should receive yearly vaccination against influenza virus. Children with substantial immunosuppression are also advised to receive prophylactic therapy for Pneumocystis jiroveci pneumonia (PCP), and many children may benefit from prophylactic therapy for toxoplasmosis and Cryptococcus meningitis. Examples of alternative medicine that children hoped would improve their symptoms or their quality of life include massage, herbal and flower remedies and acupuncture when used with conventional treatment. None of these treatments has been proven in controlled trials to have any effect in treating HIV directly (Van Dyke *et al.*, 2002).

Antiretroviral (ARV) treatment can extend the healthy life of children living with HIV. If other factors remain the same and antiretroviral (ARV) medication helps HIV positive children to survive for longer, then HIV

prevalence will increase. The introduction of ARV medication can however contribute to reducing prevalence by presenting children with an incentive to be tested, because those who know their HIV status are less likely to engage in risky behaviour (Verweel *et al.*, 2002). Without antiretroviral treatment, 60-75% of children infected with HIV die before the age of five years but with effective antiretroviral treatment, this figure can be reduced below 20% (Mwanburi, 2005).

2.8.2 Nutrition/Dietary and ARV Interventions

The main nutrition/dietary interventions are counseling on specific behaviors prescribed and targeted nutrition supplements, and linkages with food-based interventions and programs (Piwoz, 2000). Nutritional dietary intake has been shown to be effective; it has also been shown to influence health outcomes in HIV infection (Rabeneck *et al.*, 1998). When dietary intake is combined with oral nutritional supplements, there is additional evidence for its value (Burger *et al.*, 1994).

Food and drug interactions are an important issue for effectiveness and tolerability of highly active antiretroviral therapy regimens. The presence of food in the gastrointestinal tract can influence the absorption of several HIV medications such as didanosine, indinavir, saquinavir, and nelfinavir (Heller *et al.*, 1998). Drug-food interactions can influence serum drug concentrations, thus increasing the likelihood of side effects when serum concentrations are too high and increasing the risk for viral resistance and loss of durable viral suppression when serum concentrations are too low (Castleman *et al.*, 2003). In addition, complicated medical and food schedules as well as side effects of the medications can compromise adherence to and tolerability of the regimen. It is important for health care professionals to be knowledgeable about these interactions so they can help infected children with timing of

their antiretroviral regimens with regard to food. Anorexia and oral/gastrointestinal symptoms such as abdominal pain, nausea, vomiting, malabsorption, and diarrhea may arise from HIV infection in the children, secondary infections, encephalopathy, or drug therapies (Mintz, 1996). Inability to eat food secondary to complicated medical regimens or fatigue adds to the nutritional risk.

The life-saving benefits of ARVs are clearly recognized. To achieve the full benefits of ARVs, adequate dietary intake is essential. Dietary and nutritional assessment is an essential part of comprehensive HIV care both before and during ARV treatment (Domek, 2006). However, long term use of ARVs can be associated with metabolic complications in the children. The value of ARV therapy far outweighs the risks and the metabolic complications need to be adequately managed. The challenge is how best to apply that extensive clinical experience in managing these types of metabolic disorders (McComsey *et al.*, 2004).

2.8.3 Drug therapy

Weight loss and muscle wasting have been unique identifying characteristics of HIV infection early in the epidemic (Serwadda *et al.,* 1985) and remain significant clinical problems for children, even in the modern era of potent antiretroviral therapy. Surveillance data by the Centers for Disease Control and Prevention (CDC, 1997) suggest that the incidence of new wasting has declined in proportion to opportunistic infections, but data from other studies indicate that wasting remains a significant complication, even in populations with widespread access to highly active antiretroviral therapy. Antiretroviral (ARV) drugs have been developed to combat HIV/AIDS. In children, the use of these medications has transformed HIV/AIDS from a lethal condition into a potentially manageable chronic illness. Research has shown that the best results

are achieved by combining three or more drugs from at least two classes of ARV drugs. This is because each of drug attacks the virus at a different stage of the virus's life cycle. Use of this three-drug cocktail strategy is often referred to as Highly Active Antiretroviral Therapy.

ARV therapy is not a cure and there are many complex issues that need to be addressed when using them. ARV therapy is required for life and strict adherence to therapy is important (UNAIDS, 2006). Expertise and patience are required to determine the particular ARV drug, or combination of drugs, and dosages that will be most effective in each case, and to regularly monitor the child's response to the drugs, making adjustments to the therapy as necessary. Adjunctive management, such as provision of immunizations and nutritional support is very important. HIV can become resistant to ARV drugs over time. ARV drugs can also interact with many other medications, including some of those used to prevent or treat opportunistic infections, such as tuberculosis (Reddignton *et al.*, 2000). Research has found that ARV therapy, when administered properly, is effective in controlling HIV in children. Independent studies on HAART done in the United States, the Ivory Coast, the Netherlands, Italy, and Spain have shown clinical, virological, and immunological improvements in children below five, similar to those observed in adults (Chintu *et al.*, 2005).

HIV DNA polymerase chain reaction (PCR) is the most widely used method for the diagnosis of HIV infections in children less than 18 months of age in developed countries. The test can detect HIV infection acquired during pregnancy, or around the time of birth, within 2 months of birth in almost 100% of cases. In most developed countries this in done with a simple blood test. The advantages of this method are that not much blood is required and the specimen can be easily transported without refrigeration. In developing countries, early and accurate infant testing and diagnosis is a priority because 50% or more of untreated HIV

infected children die before two years of age. Early diagnosis must be coupled to the provision of HIV-specific care including ARV therapy in order to be of benefit for children with HIV infection.

Restoration of a healthy weight in stable subjects with a history of weight loss, and catch-up growth are important goals for a large number of HIV-infected children. Significant loss of lean body mass (LBM) and muscle mass is seen in the children, emphasizing the need to consider intervention with nutrition, exercise, and/or pharmacologic therapies. An important consideration for such children is identification of a reasonable target weight. Fat redistribution, dyslipidemia, and hyperinsulinemia can occur among children with weight loss (Grinspoon *et al.*, 2003), suggesting the importance of counseling on appropriate carbohydrate, lipid, protein, and cholesterol intake. Early nutritional intervention is important in such HIV positive children to maximize gain of lean body mass (LBM) and minimize gain of visceral fat.
A regular resistance exercise program has been shown to improve lean body mass and strength in HIV-infected children (Roubenoff *et al*, 1999); such exercise reduces serum triglycide levels with and without anabolic therapies. Promoting regular fitness may minimize muscle wasting, and normalize blood lipids without requiring the addition of pharmacologic therapies to the children already receiving complicated medical regimens (Reddington *et al.,* 2000).

The World Health Organisation recommends that if the children has reached a stage of severe or advanced HIV infection, then they need to start treatment. The children may be assumed to have reached these stages if they are suffering from any condition that is strongly associated with AIDS, or if symptoms of oral thrush, severe pneumonia or severe sepsis are present (WHO, 2006). To judge whether an HIV-positive child

needs to start receiving treatment, a CD4 test is usually carried out. This test measures the number of T-helper cells – white blood cells that are attacked by HIV – in a child's blood. It can either measure the absolute number of CD4 cells, or the percentage of white blood cells that are CD4 cells, in a sample of blood. A falling CD4 count is a sign that HIV is progressing, and that the immune system is becoming weaker (Fassinou, 2004).

Children have a much higher CD4 level than in adults, unless their immune system has been damaged by AIDS. The CD4 levels found in children therefore need to be judged in context of their age, which can make it difficult to know exactly when treatment should be started (Faye, 2003). Since percentage CD4 count generally varies less with age, this type of test is generally recommended in children under the age of five. It is generally agreed across guidelines that a child aged less than one year with a percentage CD4 count below 25% should be started on treatment, whether symptomatic or not (Gortmaker *et al.*, 2001)

CHAPTER THREE

SUBJECTS AND METHODS

3.0 Study Design

This study was carried out at The AIDS Support Organisation (TASO) in Entebbe Centre, Kampala district. The study design was cross-sectional. Data was collected from HIV/AIDS infected children (under 5years of age) in the months of May to August, 2006.

3.1 Inclusion criteria

HIV positive children under five years were eligible for the study if they were residents of Entebbe town. In each household, all HIV positive children under five were selected. A household was defined as a group of people who lived under the same roof in the same house and ate together. All children 0-59 months attending TASO (May-August 2006) were included in this study.

3.2 Ethical Considerations

Permission to carry out the research was obtained from The AIDS Support Organization (TASO). The protocol was approved by TASO Review Committee and written, informed consent form was obtained for all participants, before testing, in accordance with the TASO Research and Ethics Committee. Consent was also obtained from all respondents after having been explained before they could participate in the research.

3.3 Sample size

The sample size required for this study was determined according to Bryan (1992) using the equation below.

$$n = Z^2pq/d^{2.}$$

Where;

n= population sample size.

p= proportion of HIV/AIDS infected children receiving ARV-80%.

q= (1-p) proportion of HIV/AIDS infected children not receiving ARV-20%.

d= acceptable degree accuracy of error (5%).

z= normal deviation (confidence limit) taken as 1.96 at 95% Confidence Level (CI).

Thus expression gives;

$$n = \frac{1.96^2 \text{ X}0.8 \text{ X}0.2}{0.05} = 245 \text{ Subjects}$$

3.4 Sampling procedure

Systematic sampling method was used to select HIV/AIDS positive children under five years old from TASO. Child's HIV status was established from previous results testing for HIV from which a systematic sample of the children was drawn. This was equal-probability method, in which every HIV positive child under five years was selected to include in the study.

3.5 Data Collection

3.5.1 Questionnaire

A detailed questionnaire was used. This type of questionnaire is a restricted form that calls for a 'yes' or 'no' answers or short responses. The questionnaire also included a consent form that was signed by the caretakers or guardians (Appendix A).

3.5.2 Dietary Assessment

Dietary assessment data was collected using a 24-hour dietary intake recall method following the method of Uganda Demographic and Health Survey (UDHS 2000/01), to capture frequency consumption of foods containing the nutrients of interest to this study (Appendix B). The key nutrients of interest to this study were water, carbohydrates, protein, (or amino acids), lipids, vitamins and minerals. Also dietary diversity was collected based on the FAO (2003) food groupings. In 24-hour dietary intake recall data processing, the caretakers of the children were asked to recall every thing consumed for the 24-hour period of interest. This ensures the collection of complete food description and food preparation methods.

3.5.3 Clinical Features

Diet related HIV/AIDS symptoms were examined. These included mouth sores, oral thrush, anemia, diarrhea, nausea, and vomiting. The health of the HIV/AIDS positive children was assessed by clinical examination with assistance of doctors, and registered health care professionals which included a pediatrician and a nurse. The assessment of clinical examination took place during the fieldwork. Careful clinical history, including contact history and suggestive symptoms has been done.

3.5.4 Morbidity

All children under five years who were HIV positive were assessed for previous sicknesses for example diarrhea, acute respiratory infections (ARI), and TB, influenza, measles, pneumonia, among others in the last 30 days prior to the interview. The presence of the diarrhea, measles, or cough/influence was assessed according to the symptoms of the children in the month before the interview as described by the caretakers/mothers.

3.5.5 Anthropometry Measurements

Physical growth indices, height-for-age, weight-for-age and weight-for-height, are calculated to describe children's nutritional status in comparison to a standard schedule developed by the U.S. National Centre for Health Statistics (NCHS). Children whose height-for age is more than two standard deviations below (-2SD) the median of the NCHS reference population are considered short for age, or "stunted". Children whose weight-for-age is below (-2SD) the median of the reference population are classified as "underweight". Children whose weight-for-height is below (-2SD) the median of the reference population are considered "wasted" or too thin for their height.

3.5.5.1 Height

Body height was measured using a stadiometer height measuring board with a precision of 0.1cm. Height was measured with the patient standing up straight against a skirting-board- free- wall and on a flat, hard surface. No shoes were worn and the patient stood up right with the head positioned in the horizontal plane. The head board was lowered to

the head and measurement was read. The height of the children younger than 2 years was measured while they were lying on a flat surface. This measurement is called the child's length

3.5.5.2 Weight

The weight of the patients was taken using a weighing scale, Seca model 770 weighing scale. Heavy dresses and ornaments if worn were removed. The child was hanged on a spring balance and the weight read and recorded in kg.

3.5.5.3 Mid-upper Arm Circumference (MUAC)

Skeletal muscle mass and muscle wasting were measured using an insertion or MUAC measuring tape. After determining the mid point of the patients left arm, it was placed in dependent position (folded across the chest) and the tape was gently and firmly drawn around the arm without compressing the soft tissue. The reading was taken to the nearest cm.

3.6 Data Analysis

Statistical programs EPI INFO 2003, version 3.2 (US Centres for Disease Control) statistical package was used to analyze anthropometric (z-score for Weight-for age (WAZ); Height-for age (HAZ); Weight-for height (WHZ). SPSS version 12 was used to present descriptive statistics (Mean, std. Deviation, and Frequencies). Chi-square tests were carried out to establish assessments with statistical significance set at a p value of less than 0.05. Linear regressions were done to control for confounders. Correlation analysis was done using Pearson correlation coefficients.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 SOCIAL DEMOGRAPHIC FACTORS

4.1 Gender of the children

Figure 1 shows the gender/sex of the HIV/AIDS positive children at The AIDS Support Organization (TASO) Entebbe Centre.

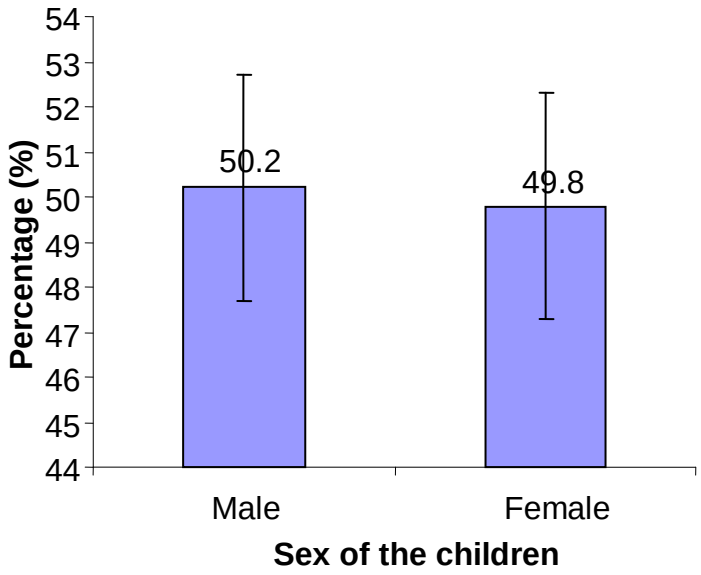

Figure 1: Gender status of the children.

The results from the survey show that over half of the children (50.2%) were males while 49.8% were females. This is contrary to the findings of Jitta *et al.* (1992) who stated that, gender was significantly related to the children's nutritional status with female children being more susceptible to HIV infection. It was observed from the survey of the study that there was no significant association between sex of HIV positive children and their nutritional status (P=0.087) at 95% confidence interval. This means that the male and female children had more or less the same nutritional status.

4.1.1 Age and Gender of the caretakers

The caretakers for the HIV positive children less than five years old at The Aids Support Organization (TASO) Entebbe Center were between the ages of 18-65 years. The highest percentage of the caretakers were between 26-49 years of age (69.8%), followed by those between 18-25 years (24.5%). The least number of caretakers (5.7%) were those above 50 years. Majority (87.8%) of caretakers were females while 12.2% were males as shown in Figure2.

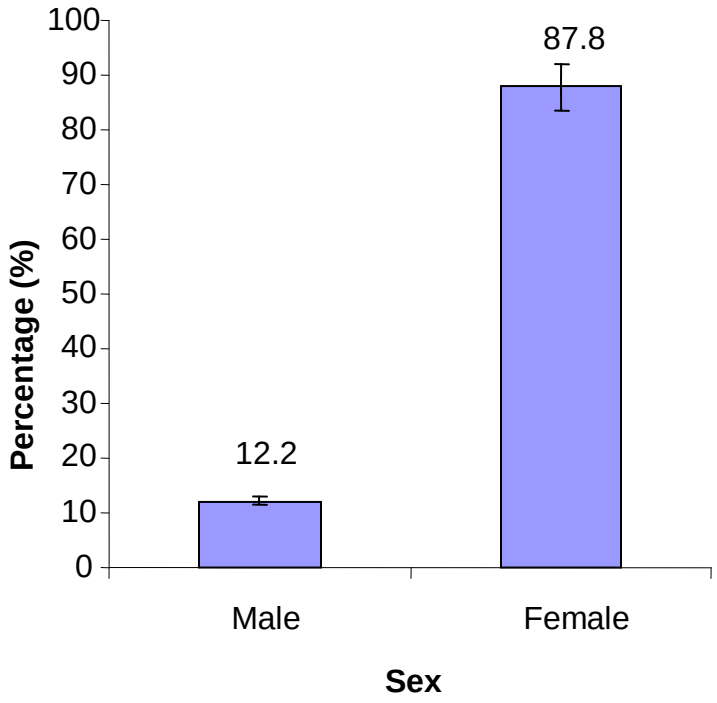

Figure 2: Gender of the caretakers.

Of the caretakers that fell within 26-49 years 66.9% were mothers and were the majority. These results correspond with earlier findings of UNAIDS and WHO (2006) that the over-25 year age group was found to have the highest HIV/AIDS prevalence, since it is likely to be the most sexually active group. This fact puts the younger adults at risk for HIV/AIDS since they are in the period of developing sexual

characteristics e.g. attraction to opposite sex, hence, their children are more likely to be infected with the HIV disease. The results also confirm the report of Uganda AIDS Commission which states that the vast majority of people living with HIV/AIDS in Africa (2003) are between the reproductive age group of 15 and 49 years. HIV/AIDS disproportionately affects women and especially young women. Data suggests that about 55% of all new infections occur among women.

Although 87.8% of the caretakers were females, but findings from the results of the survey show that the gender of the caretakers was not significantly related to the nutritional status of the children (P=0.068) at 95% confidence interval.

4.1.2 Religion of the Caretakers

The caretakers were found to be mainly Catholics, followed by Protestants and Muslims as shown in figure 3. However, some of the caretakers were Pentecostal and Seventh day Adventists (2.4% and 5.7% respectively).

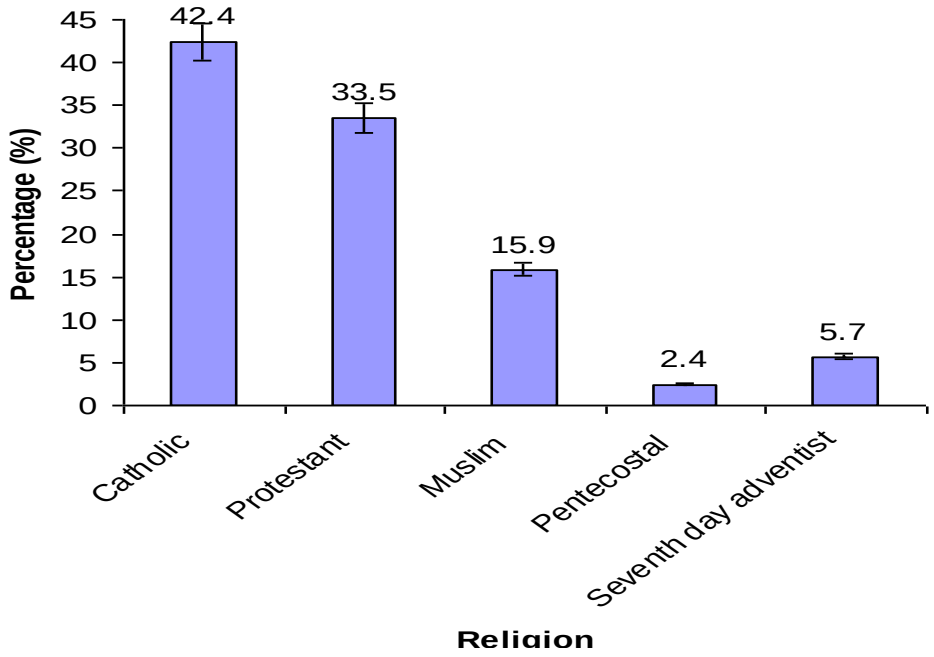

Figure 3: The religion of the caretakers

The majority of the caretakers were Catholics because the organization has Catholic foundation and attracts the Catholics who are living in the area. However, other reports have stated that in Uganda, Muslims have the lowest HIV/AIDS prevalence rate and Protestants/Anglican have the highest prevalence rate (UNAIDS and WHO, 2006). Despite fact that Protestants are the biggest majority religious denomination in Uganda, studies have shown that alcohol consumption could lead to the highest rates HIV infection among Catholics and Protestants as compared to Muslims who do not consume alcohol (Gillespie *et al.*, 2005). Hence, most of the children infected by the HIV disease were from Catholic and Protestant families. Findings from results of the survey show that the religion of the caretakers was not significantly associated with the nutritional status of the children (P=0.065) at 95% confidence interval.

4.1.3 Marital status of the caretakers

The highest proportion of caretakers was married followed by single parents. Few caretakers were widowed or divorced (Figure 4).

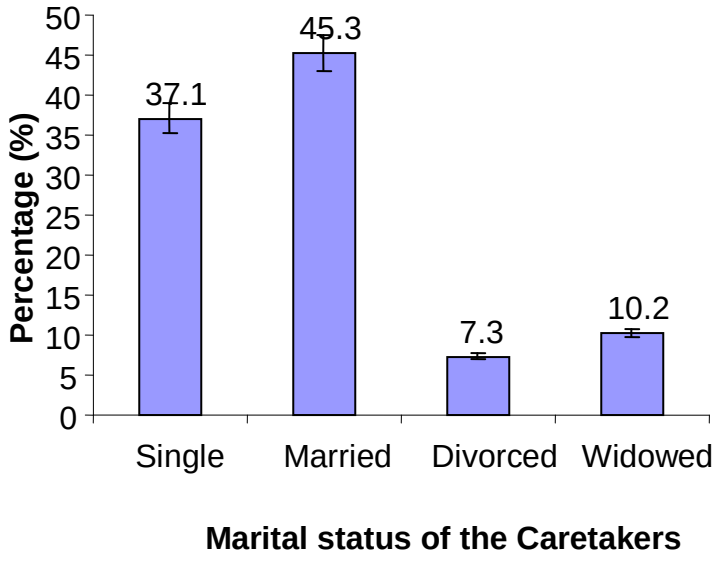

Figure 4: Marital status of the Caretakers

The results show that most of the caretakers were married (45.3%), followed by single (37.1%), followed by widowed (10.2%) and the divorced/separated (7.3%) were the least. Some of married couples end up divorced on finding out their HIV status (Hunter, 1990). In a study conducted in Uganda, by Zaramba (1998), it was reported that 37% of widows and 17% of widowers were due to spousal death from HIV/AIDS. From the results of the survey it was observed that there was no significant relationship between the marital status of the caretakers and nutritional status of the children (P= 0.321) at 95% confidence interval.

4.1.4 Educational level of the caretakers

Figure 5 shows the educational level of the caretakers of the HIV/AIDS positive children at TASO Entebbe Centre.

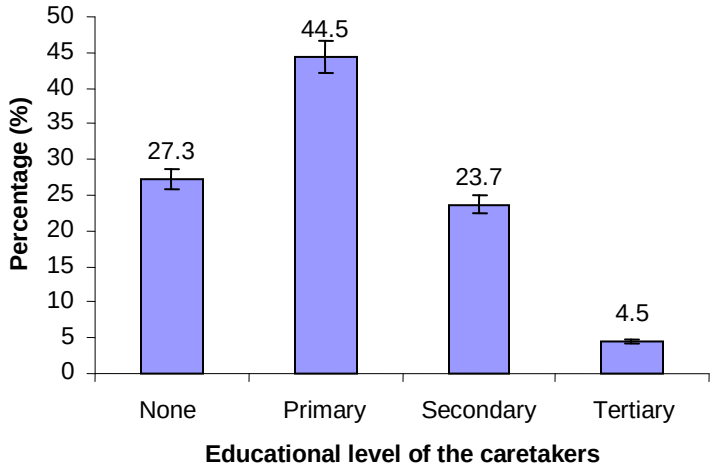

Figure 5: Educational level of the caretakers.

The results in Figure 5 show that there was a high level of illiteracy among the caretakers of HIV positive children at the TASO Entebbe Center. About 27.3% of the caretakers had not attended any level of

education at all and 44.5% had stopped at primary level. The result also showed that 23.7% attended secondary school and very few (4.5%) had gone beyond Advanced level of education. This corresponds with findings by UNAIDS/WHO (2006) that high illiteracy level can lead to increased incidence of HIV infection in the infants during pregnancy, labor and delivery and/or during breast feeding. The levels of illiteracy lead to increased HIV infection in mothers due to lack of knowledge on the use of condoms or protective methods used to safeguard from acquiring HIV/AIDS. Hence, infants are at high risk of acquiring the infection during pregnancy, delivery and/or breast feeding. Girls and young women are highly vulnerable to HIV/AIDS, and a lack of education makes them more so. Girls are at greater risk than boys because of gender inequalities in status, power, and access to resources. Girls are particularly vulnerable to contracting HIV/AIDS for social, cultural, economic, and even physiological reasons (Caldwell *et al.*, 1999). Findings from the result show that the educational level of the caretakers of HIV positive children at TASO Entebbe Center were significantly related to the nutritional status of the children (P=0.036) at 95% confidence interval. The lower the educational level, the lower the nutritional status. These findings support Zaramba's report that, high education especially secondary and tertiary education is associated with high social economic status, good quality environment in which the children thrives and good quality care (Zaramba, 1998).

4.1.5 Occupation of the caretakers

Most of the caretakers of the children were peasant farmers and formal business owners while others were salaried, unemployed and others who were fed by TASO and other charitable organizations (Figure 6).

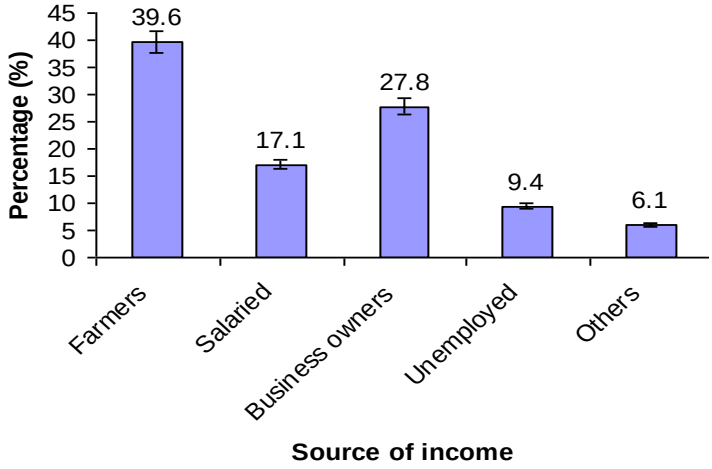

Figure 6: The sources of income for the caretakers

Results in Figure 6 show that, 39.6% of the caretakers were peasant farmers while those who were formal business owners were 27.8%. Only 17.1% were sure of salaries at the end of the month, while 9.4% of the caretakers were unemployed therefore did not have a stable source of income. Those that fell into the category of others (6.1%) were those whose income depended on donors like TASO among other charitable organizations. Food accessibility is frequently affected due to the reduction of household income level. Children affected by HIV/AIDS are at high risk of malnutrition as household providers often become unable to work or to maintain home agricultural activities. This leads to less income available for food purchase exacerbated by scarce resources being spent on expensive healthcare.

HIV/AIDS dramatically affects labour, setting back economic activity and social progress. The loss of young adults in their most productive years will affect overall economic output and if AIDS is more prevalent among the economic elite, then the impact may be much larger than the absolute number AIDS deaths indicates. The direct costs of AIDS include expenditures for medical care, drugs, and funeral expenses while indirect

costs include lost time due to illness, recruitment and training costs to replace workers, and care of orphans. So, if costs are financed out of savings, then the reduction in investment could lead to a significant reduction in economic growth. Due to the increased illiteracy levels, this forces the mothers to get low-income jobs or increased poverty. This means that lack of employment means increased food insecurity and poor life styles, etc. This agrees with data presented by Uganda AIDS Commission (2003) in Uganda that the level of unemployment for HIV caretakers of the children increases the poverty level hence reducing the nutritional status of the children.

In Guatemala, the level of income was highly correlated to nutritional status of HIV positive children among poor families, while among richer families with children affected by the epidemic; the effect of additional income on nutritional status was reduced (Doherty, 1996).
However, from results of the survey it was observed that there was a significant association between those with stable jobs of the household/caretakers and nutritional status of children (P=0.042) at 95% confidence interval. Those with stable incomes had children with higher nutritional status. This is because diverse income sources results into increased access to food intake, health facilities and better environment.

4.1.6 Relationship of the caretakers to the children

The caretakers were found to be mostly parents of the children as shown in Figure.7. However, some children lost both of their parents and were taken care of by their grand parents, brothers and sisters (18.0%).

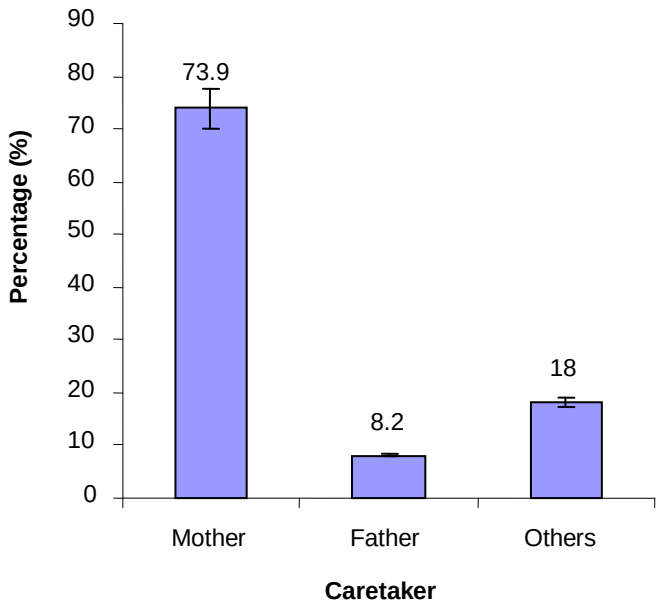

Figure 7: Relationship of the caretakers to the children.

The results in Figure 7 show that majority of the caretakers were mothers (73.9%). This is due to the fact that women are more at risk of HIV and AIDS than men and that the reason why more females were the caregivers of the children; therefore the chances of infecting the women are high compared to men. According to Uganda AIDS Commission (2003) in Uganda infection rate is consistently higher for women than men, with the national average prevalence among women at 8.1% and at 5.8% for men.

In Uganda, studies in Mulago Hospital have shown a transmission rate of 27.5% in a cohort of 800 HIV positive and negative women who were breast feeding (Guay *et al.*, 1996). HIV can be passed from mother to her infant during pregnancy, during labour and delivery, and through breast feeding (ACC/SCN, 1997).

From results of the survey, it was observed that there was no significant association between relationship of the caretaker and nutritional status of the children (P=0.164) at 95% confidence interval.

4.2 CHILD FEEDING HABITS

4.2.1 Exclusive Breastfeeding

Table 1 shows the exclusive breastfeeding status of the HIV positive children at The AIDS Support Organization (TASO) Entebbe Center.

Table 1: Duration of exclusive breastfeeding

Duration: Months	Frequency	Percentage (%)
0-6	190	77.6
7-8	50	20.4
9-12	5	2.0
Total	**245**	**100.0**

The results in table 1 shows that 77.6% of the children had been exclusively breastfed in the first six months of the age while 20.4% were exclusively breastfed up to 7 to 8 months, however 2.0% were exclusively breastfed 9 to 12 months. These results are different from those of MOH (1993) who revealed that in Uganda, between 0-4 months of age, 66% of rural mothers practice exclusive breastfeeding, and is also differs from the study of UDHS (2000/01), that exclusive breastfeeding at 0-3 months of age was 73.7% while at 0-4 months it reduced to 43.1%. The higher number of mothers breastfeeding exclusively for a longer time compared to earlier studies could be due to more awareness by the mothers of the advantages of exclusive breastfeeding and good nutritional status.

In developing countries like Uganda, infants who are not breastfed have higher rates of illness, malnutrition and mortality than breastfed infants. Without breastfeeding the mortality rate in Uganda is estimated to increase from 88-132 per live births due to replacement feeding, lack of safe water and limited supply of fuel for boiling water (WHO, 2003).

The result from the survey show that there was a significant association

between exclusive breastfeeding and nutritional status of the children (P=0.004, r=0.0188) at 95% confidence interval. Those that exclusively breastfed for 6 months had better nutritional status than those who were breastfed for a longer time.

4.3 NUTRITIONAL **KNOWLEDGE, ATTITUDES AND PRACTICES**

The nutritional information/knowledge and practices of the caretakers of the HIV positive children at TASO Entebbe Center is shown in figure 8.

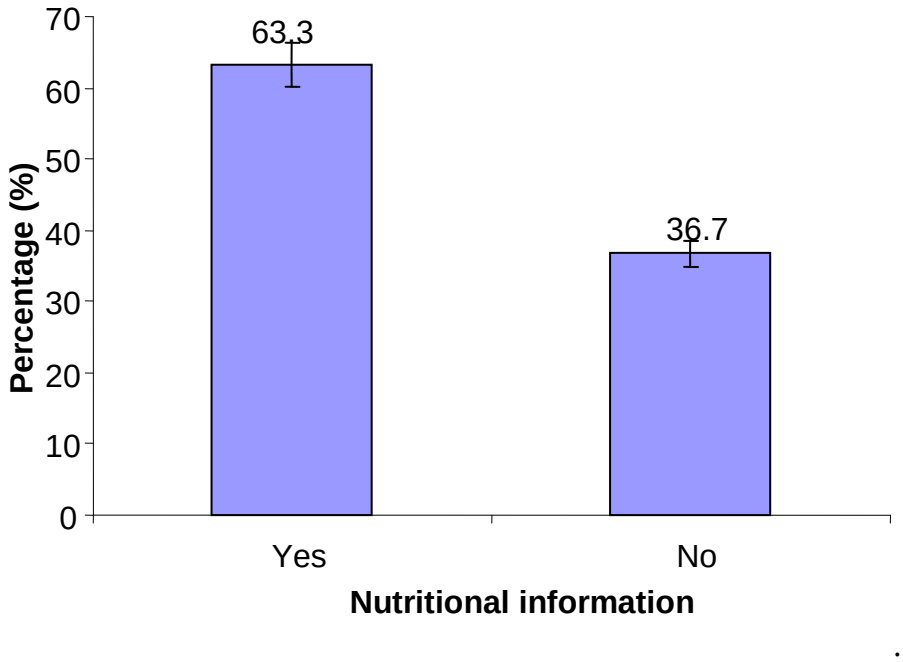

Figure 8: Nutritional information/knowledge

From the results on nutritional information, 63.3% of the caretakers received information on nutrition and care on HIV positive children from health workers in TASO Entebbe Centre while 36.7% did not receive any information at all. The information included: foods good for the children, foods that should not be given the children e.g. alcohol, and consequences of poor nutrition and bad feeding of the children, improving the children's nutritional status in HIV at household level like sanitation, and importance of exercise to patients. In order to improve

the HIV children's nutritional status at household level, 16.3% of the caretakers said it could be improved through reduced poverty, while 50.2% said it could be improved through feeding children well; however 15.9% said it could be improved through educating caretakers while 2.4% said through improving sanitation, however, 5.3% of the caretakers said it could be improved through improving health of the child, and 4.9% said they do not have any idea, while 4.9% gave other reasons (figure 9).

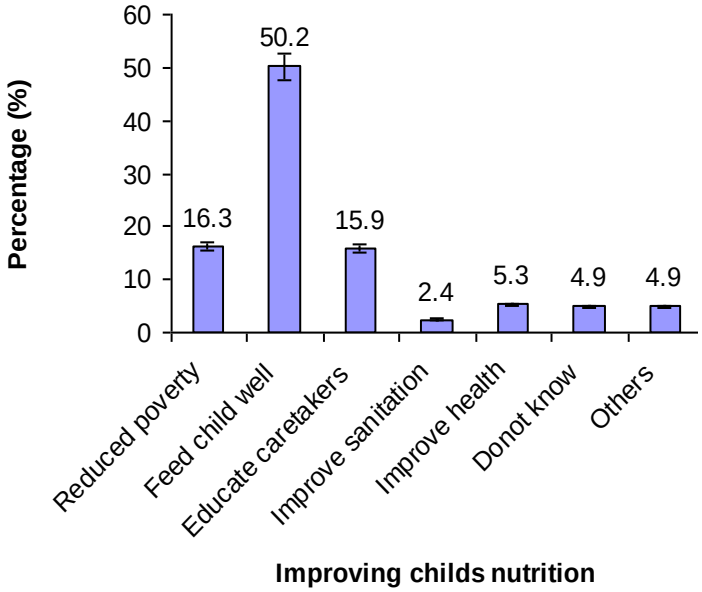

Figure 9: Improving nutritional status of HIV children.

Studies have shown that, a higher level of nutritional knowledge is positively and significantly associated with better dietary quality (Miller, 2003).

Although the caretakers had adequate nutritional information, majority could not implement the knowledge taught. This was due to reasons like unemployment, low income level, educational level among others. This is the reason why the majority could not afford buying the different foods required to meet the nutritional requirements for their children. Furthermore, poor nutrition or/and bad feeding always bring negative

consequences on the nutritional status of the HIV positive children. In this study, 55.9% of the caretakers indicated that consequences of poor feeding could result in poor health, while 20.4% said it could be death while 10.2% had no idea; however 13.5% gave other reasons different from those given in figure 10.

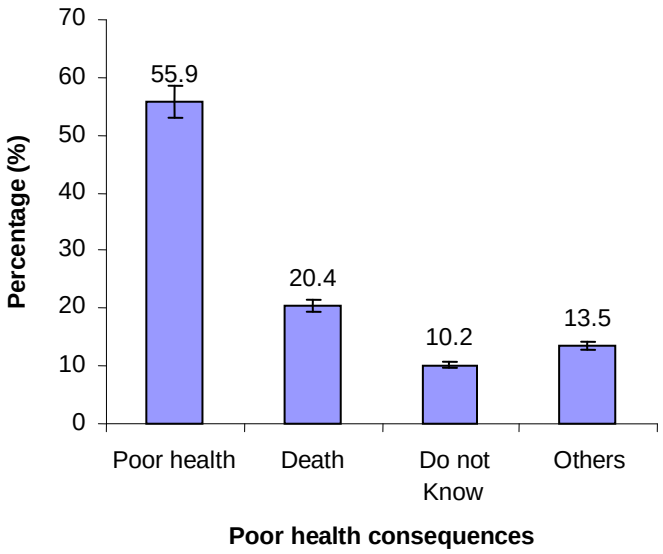

Figure 10: Consequences of poor nutrition.

These results show that the majority of the caretakers (55.9%) had knowledge that children living with HIV and AIDS needed proper nutrition to help ward off disease and keep immune systems stronger. This was also suggested by Vorster *et al* (2004) that food insecurity and inadequate feeding practices increase disease susceptibility and prevalence therefore aggravates immediate causes of malnutrition. 20.4% of the caretakers said that HIV threatens the life of the children and their survival, and development by impacting on immediate causes of malnutrition. Therefore, the children were at high risk of malnutrition. They had higher energy requirements due to the nature of the virus and repeated infections and yet at the same times, often suffer from reduced nutritional intake. This can be due to illness causing pain, nausea or

loss of appetite, and difficulties to absorb food associated with diarhoea and vomiting. This can be caused by changes to the gut infected with HIV or side effects of medications (Varille *et al.*, 1997).

4.4 EVALUATION OF THE CHILDREN'S DIETS

4.4.1 Dietary Diversity

Table 2 shows the different types of foods consumed by the HIV positive children at The AIDS Support Organization (TASO) at Entebbe Center

Table 2: Foods consumed by children in the day or night preceding the interview

Food category	Percentage (%)*	Food category	Percentage (%)
Cereals	67.2	Oils and fats	46.3
Roots and Tubers	30.2	Sugar/honey	50.2
Legumes	66.1	Poultry	1.2
Milk and products	11.6	Fruits	20.0
Eggs	7.3	Vegetables	20.3
Meat	10.2		
Fish	25.4		

* Multiple response analysis

Legumes were consumed by 66.1% of children, with beans and groundnuts being the main sauces eaten at home. Poultry, milk and milk products, vegetables and fruits were the least consumed foods as shown in Table 2.

Legumes being the most consumed sources of protein by the children

indicate that their major source of protein was plant proteins compared to the low intake from animal proteins. Animal sources tend to be richer sources of micronutrients and the nutrients are high in absorbable or bioavailability of nutrients; for example iron, zinc, and vitamin A (Piwoz *et al.,* 2002). Small amount of animal source foods added to a diet can compensate for many of the vitamin and micronutrient inadequacies or fill gaps at a lower volume of intake than can plant source foods.

Legumes provide a child infected with HIV/AIDS with the proteins needed to develop and repair the body and also to build muscles. They are good sources of vitamins, minerals and fibre and help to keep the immune system active (WHO, 2003). Legumes include beans, peas, lentils, groundnuts and soybeans. When eaten with staple foods the quality of protein is increased. Legumes are a cheaper protein source than animal foods, such as beef and chicken, and should be given to the children with HIV/AIDS every day, if possible. Legumes have high protein which provides the building blocks of lean body mass. When a protein-rich food is consumed, it is broken down into amino acids, which are reassembled to create enzymes, hormones, and bodily tissues. Other good sources of protein include meat, poultry, fish, eggs, dairy products, tofu, and nuts (Semba *et al.*, 1999).

If energy intake is insufficient, protein will be used to provide the body with energy (Shevitz *et al.*, 2001). This means that there will be less protein available for maintaining muscle tissue and strengthening the immune system and in HIV positive children less protein for growth and development. It is, therefore, important to have adequate energy intake at all times, especially during infections. In this way, protein may be used for building or maintaining lean muscle and strengthening the immune system.

The most eaten carbohydrates were cereals (67.2%), sugar and honey (50.2%), followed by roots and tubers (30.2%). These are good energy

foods that are needed to meet the high caloric requirement for HIV/AIDS children. Carbohydrates, which are converted to glucose in the body, are a primary source of energy. Carbohydrates include foods such as rice, maize, millet, sorghum, orange fleshed potatoes, sweet potatoes, bread, pasta, cassava and green bananas. Carbohydrates are classified as simple or complex; complex carbohydrates take more time to break down, and thus provide fuel over a longer period of time (WHO, 2005). Carbohydrates make up at least 50% of daily calorie intake. Simple carbohydrates are found in processed sugar, honey, fruit and juice, and lactose (Marston *et al.*, 2004). Complex carbohydrates are found in grain products such as bread, pasta, and rice; legumes; and starchy foods such as corn, potatoes, and root vegetables (Nambuya *et al.*, 2004). It is better to diversify the carbohydrate foods that the HIV/AIDS positive children are fed on as the children gets older.

While 46.3% of the children consumed oils and fats, the majority (53.7%) had no access to oils and fats. Fats and oils group contributes to the energy intake of the children and also helps to convert beta-carotene to retinol (vitamin A) in the body (Shevitz *et al.*, 1999).

The consumption of vegetables (20.3%) and fruits (20.0%) was very low in children's diet yet these are the major sources of zinc, iron and vitamin A, the essential micronutrients in the diet of children below five years living with HIV/AIDS. Zinc and vitamin A rich sources such as liver, dark green vegetables and yellow fruits were rare in the diet of the children. Negative health out comes are known to occur if intake of these nutrients is below requirements. Deficiencies of vitamin A deficiency and iron contribute to oxidative stress, a condition that may accelerate immune cell death and increase the rate of HIV replication (WHO, 2005).

A low intake of fruits and vegetables also implies inadequate intake of antioxidants and minerals. Micronutrients protect the integrity of oral

and gastro intestinal epithelia and enhance local and systemic immunity (Piwoz *et al.*, 2000). Vitamin B complex, E and C and antioxidants delay the progression of the HIV/AIDS disease, incidence of complications such as oral thrush, oral ulcers and difficulty in swallowing, which are potential indicators of esophageal candidiasis (WHO, 2003). They also reduce the prevalence of side effects of the ARV drugs, for example nausea, vomiting and diarrhea (Kim *et al.,* 2001). Therefore, the findings from this study suggest that the children may not be able to maintain their antioxidant levels, restore protein lost during secondary infection and face the high risk of wasting, malnutrition and progression of disease. The antioxidants scavenge and neutralize free radicals. By disrupting the oxidation process, antioxidants help protect cells from damage. Antioxidants include vitamins C and E, beta-carotene, the minerals selenium and zinc, and glutathione (Jaimton, 2003).

4.4.2 Meal Pattern

Meal frequency of the patients is shown in figure 11. Most children could afford 3 and 4 meals per day while only 7.8% were able to afford at least 2 meals per day and 1.6% could only afford one meal per day.

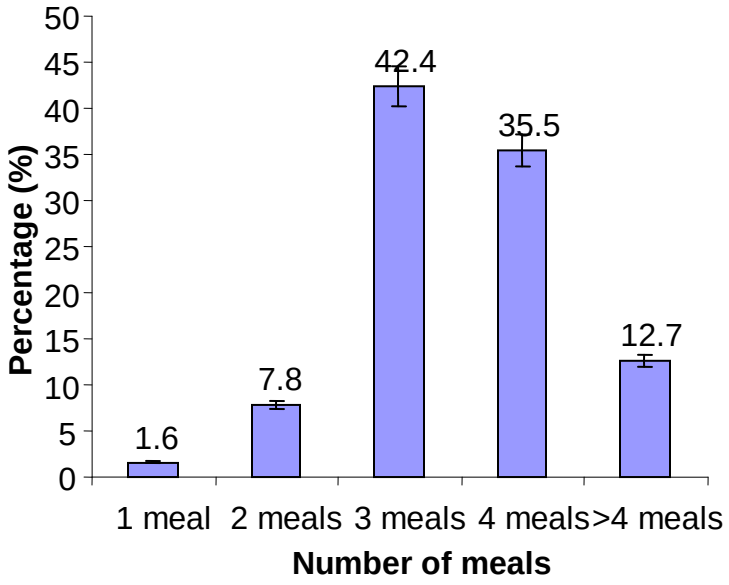

Figure 11: Number of meals eaten by the children

The results from survey indicates that the total number of children who consumed 3 meals and 4 meals (77.9%) were more than those that could afford more than 4 meals per day (12.7%). Therefore, only a few of these children who were fed more than 4 meals met the MOH (2003) recommendations that children under five years who are HIV/AIDS positive should be given diversified diets with small frequent meals to improve their health status and micronutrients intake. For those children that are breastfeeding, complementary foods with an energy density of 0.8 kcal should be fed. However, since the majority of the children in this study were not breastfeeding 201 (82.0%) the food frequency in the study is not likely to meet the energy and nutrient needs of most children. This is possibly because of the low level of income of the caretakers, or the fact that mothers have many chores that prevent them from feeding their children or due to their level of illiteracy.

HIV infected children have an increased frequency of common childhood infections such as diarrhoea, ear infections, pneumonia, chronic gastroenteritis and TB, all of which can affect nutrient intake

leading to malnutrition and which puts them at greater risk for mortality (WHO/UNICEF, 1999). Poor appetite, swallowing difficulties, nausea, frequent infections with fever all increase the risk of malnutrition in the HIV infected child. It is important to ensure that the child consumes adequate amounts of macro and micronutrients to meet the increased metabolic demands and the demands for growth and development. With appropriate management, HIV positive children can improve their nutritional status. Energy needs in children vary depending on the type and duration of the HIV related infections such as weight loss with acute infection.

The appropriate number of feedings depends on the energy density of the local foods and the usual amounts consumed at each feeding. For the average HIV positive breast fed infant, complementary foods should be provided 2-3 times per day at 6-8 months of age and 3-4 times per day at 9-11 and 12-24 months of age, with additional nutritious snacks offered 1-2 times per day, as desired (Creek, 2006). If energy density or amount of food per meal is low, or the HIV positive child is no longer breast fed, more frequent meals may be required. When energy density of the usual complementary foods is less than 0.8kcal/g, or infants typically consume amounts that are less than the assumed gastric capacity at each meal, then meal frequency would need to be higher than the values mentioned. The results from the survey show that the number of times that children were fed was significant and positively correlated with nutritional status of the children (P=0.001, r=0.032) at 95% confidence interval. The children with higher meal frequency had better nutritional status.

4.4.3 24-hr Dietary intake

4.4.3.1 Daily energy intake requirements

The average of energy intake that was consumed by HIV positive children in a 24-hr dietary intake is shown in Table 3.

Table 3: Energy intake requirements.

Age group	Energy Consumed (Kcal)	Energy Requirement* (Asymptomatic) (Kcal)	%age Energy requirement	Energy Requirement (Symptomatic) (Kcal)	%age Energy requirement
6-11 Months	650	800	81.3	880-950	71.0
1-2 Yrs	900	1,380	65.2	1,500-1,630	57.6
3-5 Yrs	1,590	1,650	96.4	1,800-1,950	84.8

*MOH (2004) energy recommendation.

From the results of the 24-hr dietary intake, the average intake of energy per day of the children aged between 6-11 months was 650 kcal, those 1-2 years was 900 kcal, while the 3-5 year old children consumed only 1,590 kcal. This indicates that all the children in the various age groups did not meet their energy requirements at all when compared to the MOH (2004) energy recommendations. The increased energy needs depends on whether the HIV positive children do or not have symptoms of HIV/AIDS. The HIV infected child who has no symptoms requires 10% more energy above the level recommended for a healthy non-infected child of the same age, sex and physiological activity level. If the infected child has symptoms the child requires 20%-30% more energy above the level recommended for a healthy non-HIV infected child of the same age, sex and physiological activity level (Raiten *et al.*, 2005). The reason why the energy requirement is not met particularly during the transition period is

that children are weaned on thin porridges introduced to supplement breastmilk.

Low energy density in weaning foods has been pointed out as major cause of poor growth and under-nutrition among children in developing countries. These gruels have low energy densities and are a major cause of malnutrition among 6-24 months old children in Sub-Saharan Africa (Piwoz *et al.*, 2000; RCQHC/FANTA/LINKAGES, 2004).

From the result of the survey, show that the daily energy intake of the children was significant and positively correlated with nutritional status of the children (P= 0.007, r=0.028) at 95% confidence interval. .

4.4.3.2 Daily protein intake requirements

The average amount of protein intake that was consumed by HIV positive children in 24-hour dietary intake is shown in Table 4.

Table 4: Protein intake requirements.

Age group	Protein consumed (g)	Protein requirement (Asymptomatic) (g)*	%age protein requirement	Protein requirement (symptomatic) (g)*	%age protein requirement
6-11 months	12.5	15.0	83.3	25.0	50.0
1-2 yrs	18.3	20.0	91.5	26.0	70.4
3-5 yrs	23.7	30.0	79.0	36.0	65.8

Sources*: Hommes *et al*. (1991).

The results of the 24hr recall for dietary intake showed an average daily protein consumption of 12.5g for HIV positive children aged between 6-12 months, 18.3g for children aged 12-24 months, and 23.7g for children aged 24-60 months. However, when these protein intakes for the various age groups were compared with Hommes *et at.* (1991) it was observed

that the protein consumption was below the standard requirements in all HIV and AIDS children. The children under five years infected with HIV, the protein intake increment is 30-50% (Grinspoon *et al.*, 2003). Therefore, this shows that the children did not meet their daily protein intake requirements. Although it has been documented that protein intake is adequate in non- HIV/AIDS, particularly with regard to protein intake, HIV positive children need much more protein (up to 50% increase) than the uninfected peers. They are more likely to suffer a loss of appetite, even anorexia, thus reducing dietary intake at the very time when requirements are higher (Marston *et al.*, 2004). Adequate protein intake is important to maintain muscle mass and to regenerate liver cells in HIV positive children without cirrhosis.

Loss in weight, fat free mass, body cell mass, and fat mass have been found to be significant predictors of mortality among HIV- positive children with wasting syndrome in the Tufts Nutrition for Healthy Living study in Boston (Arpadi *et al.*, 2000). In children below five years with HIV infection, wasting, particularly loss of metabolically active lean tissue has been associated with increased mortality, accelerated disease progression, and loss of muscle protein mass (Kotler *et al.*, 1989).

The main nutrition interventions are counseling on specific behavior prescribed and targeted nutrition supplements and programs (Piwoz, 2002). Adequate protein intake is important to maintain muscle mass and body composition in HIV/AIDS children below five years old. Protein also provides the building blocks of lean body mass (Fabris *et al.*, 1988). When a protein rich food is consumed, it is broken down into amino acids, which are reassembled to create enzymes, hormones and bodily tissues. A balanced diet contains many micronutrients, organic and inorganic substances necessary for proper biological functioning. The child's body with HIV needs several trace elements in tiny amounts,

including boron, chromium, cobalt, iodine, manganese, molybdenum, selenium, and zinc (WHO, 2005).

From the result of the survey, show that the daily protein intake of the children was significant and positively correlated with nutritional status of the children (P= 0.004, r=0.031) at 95% confidence interval.

4.5 NUTRITIONAL STATUS OF THE CHILDREN

4.5.1 Nutritional status of children by Mid-Upper Arm Circumference

According to Table 5, the nutritional status of the children by Mid-Upper Arm Circumference (MUAC) which is an indicator of chronic malnutrition is shown in table 5.

Table 5: Mid-Upper Arm Circumference (MUAC) of HIV children.

Age (m)	Sex	Mean±SD	Severe		Moderate		Normal		Total
			n	%	n	%	n	%	n
<6	Female	12.4±0.9	1	11.1	3	33.3	5	55.6	9
	Male	11.9±0.3	2	14.3	5	35.7	7	50.0	14
6-8	Female	10.2±0.8	3	12.5	8	33.3	13	54.2	24
	Male	11.3±0.5	3	20.0	3	20.0	9	60.0	15
9-11	Female	12.9±2.4	6	20.0	7	33.3	14	46.7	27
	Male	12.2±0.2	1	5.6	5	27.6	12	66.7	18
12-17	Female	11.0±1.2	2	20.0	5	50.0	3	30.0	10
	Male	12.2±0.2	5	20.0	8	32.0	12	48.0	25
18-23	Female	12.5±0.2	3	11.1	7	33.3	11	52.4	21
	Male	12.4±1.0	4	17.4	9	39.1	10	43.5	23
24-35	Female	11.8±0.4	2	20.0	1	10.0	7	70.0	10
	Male	13.3±1.1	2	28.6	1	14.3	4	57.1	7
36-47	Female	13.4±1.4	1	25.0	1	25.0	2	50.0	4
	Male	11.9±0.3	3	30.0	2	20.0	5	50.0	10
48-59	Female	12.2±0.3	2	11.8	3	17.8	12	70.6	17
	Male	12.2±1.1	3	27.3	4	36.4	4	36.4	11
Total	Female	12.2±1.3	20	16.4	35	28.7	67	54.5	122
	Male	12.2±0.5	23	18.7	37	30.1	63	51.2	123

The results of Mid-Upper Arm Circumference (MUAC) shows that 43 children (17.6%) were severely malnourished, 72 children (29.4%) were moderately malnourished and 130 children (53.1%) were normal. One can distinguish between moderate acute malnutrition and severe acute malnutrition when children's weight-for- height ratio drops to less than 70% of the standard weight-for height and the MUAC is less than 11.0 cm. This is the most severe form of acute malnutrition requiring specialized medical treatment (WHO/UNICEF, 2001).
Growth monitoring and promotion is a critical child-survival strategy in resource-poor settings, especially in areas with high rates of both childhood malnutrition and HIV/AIDS, and particularly for children in directly affected households. Poor growth is a sensitive indicator of HIV disease progression in HIV-infected children.

The proportion of children who were chronically malnourished (severe, moderate) was higher in boys 60 (48.8%) than girls 55 (45.1%). Chronic malnutrition can cause anaemia and lethargy, blindness, or mental problems. Signs of acute malnutrition are bilateral oedema, middle upper arm circumference (MUAC) of less than 12.0 cm for the HIV children under five years old and a weight to height ratio of less than 80% of the standard weight to height ratio of the children.

Prevalence of chronic malnutrition started at the age of 0 to 5 months. The reason why chronic malnutrition started at the age of 0 to 6 months is that the majority of the children 201 (82.0%) were not breastfeeding and the weaning foods were mostly thin porridges prepared from maize, sorghum, millet, or cassava among others which had low density energy and protein intake. In addition, infants who are not breastfed have higher rates of illnesses, mortality and malnutrition compared to breastfed infants. The chronic malnutrition increased and peaked at 9 to 11 months in female 6 (4.9%) while in males it peaked at 12to 17 months

5 (4.1%), and again declined at 48 to 59 months. However, in this survey study, 115 out of the HIV positive children studied (46.9%) were chronically malnourished. This figure was above to the national figure (Uganda), which is 39% (UNICEF, 2003). This is because the nutritional intake requirement for HIV positive children is always higher than the normal children and at the same time this sample survey is very few according to the nationwide. From the results of the survey it was observed that there was a significant association between the MUAC of the HIV children and their nutritional status (P= 0.032, r=0.0283) at 95% CI. This was due to the fact that majority of the patients were normal.

4.5.2 Nutritional Status of the Children according to age and Sex

4.5.2.1 Weight-for-age (WAZ)

The nutritional status of children with HIV and AIDS according to Weight-for-age is shown in Table 6.

Table 6: Nutritional status of children according to weight-for-age

Age (M)	Sex	Mean±SD	Severe		Moderate		Mild		Normal		Total
			n	%	n	%	n	%	n	%	n
<6	Female	8.7±2.9	0	0	0	0	3	27.3	8	72.7	11
	Male	7.2±2.1	0	0	1	6.3	4	25.0	11	68.8	16
6-8	Female	14.7±2.6	1	5.9	2	11.8	5	29.4	9	52.9	17
	Male	12.8±1.3	3	12.0	4	16.0	6	24.0	12	48.0	25
9-11	Female	13.5±2.9	0	0	4	12.5	2	6.25	26	81.3	32
	Male	13.4±3.6	2	9.5	2	9.5	1	4.8	16	76.2	21
12-17	Female	9.7±2.9	2	18.2	1	9.1	4	36.4	4	36.4	11
	Male	8.8±3.1	5	22.3	7	31.8	2	9.1	8	36.4	22
18-23	Female	15.7±2.6	0	0	2	20.0	3	30.0	5	50.0	10
	Male	16.8±1.3	2	16.7	0	0	4	33.3	6	50.0	12
24-35	Female	12.7±4.0	1	6.7	3	20.0	1	6. 7	10	66.7	15
	Male	12.1±3.9	2	13.3	0	0	6	40.0	7	46.7	15
36-47	Female	13.4±3.6	2	11.1	1	5.6	3	16.7	12	66.7	18
	Male	9.8±2.1	1	16.7	0	0	2	33.3	4	66.7	6
48-59	Female	13.5±2.9	0	0	1	12.5	2	25.0	5	62.5	8
	Male	9.7±2.9	0	0	0	0	1	20.0	4	80.0	5
Total	Female	16.8±1.4	6	4.9	14	11.5	23	18.9	79	64.8	122
	Male	12.1±3.7	15	12.2	14	11.4	27	21.9	67	54.5	123

The results of weight-for-age shows that 21 children (8.6%) were severely underweight, 28 children (11.4%) were moderately underweight, 50 children (20.4%) were mildly underweight and 146 children (59.6%) were normal. Weight loss and malnutrition are common among patients with HIV infection and are likely to accelerate disease progression, increase morbidity and mortality.

The proportion of children who were underweight (severe, moderate, mild) was higher in boys 56 (45.5%) than in girls 43(35.2%). Prevalence of underweight started at the age of 0 to 5 months for both boys and girls. It increased and peaked at 12 to 17 months 2 (1.6%) in girls and 12 to 17 months 5(4.1%) in boys, and again declined at 48 to 59 months. Furthermore, in this study, 99 out of the HIV positive children studied (40.4%) were underweight. This figure was approximately above to the national figure (Uganda), which is 23% (UDHS 2000/01). This is because these children were infected with HIV/AIDS; therefore their food intake requirement is higher than the normal children. However, the reason for loss of weight found among HIV/AIDS children was due to the poor diversified foods that were both low in energy, protein and other nutrients as observed from the children's dietary intake. There was no significant association between the age of the children and their nutritional status (P=0.212) at 95% confidence interval.

4.5.2.2 Height-for-age (HAZ)

The nutritional status of HIV positive children at TASO Entebbe Centre according to Height-for-age is shown in Table 7.

The results of height-for-age-Z scores according to age and sex show that 40 children (16.3%) were severely stunted, 16 children (6.5%) were moderately stunted, 27 children (11%) were mildly stunted and 162 children (66.1%) were normal. The number of girl who were severely

stunted was higher 22 (17.8%) than boys 18 (14.6%) (18). However, more boys were found to be moderately stunted 11 (4.5%) than girls 5 (4.1%). Furthermore, more girls were found to be mildly stunted 14 (11.5%) compared to the boys 13 (10.6%).

Table 7: Nutritional status of children according to height-for-age

Age (M)	Sex	Mean±SD	Severe		Moderate		Mild		Normal		Total
			n	%	n	%	n	%	n	%	n
<6	Female	64.2±3.7	0	0	0	0	0	0	10	100	10
	Male	67.2±4.2	0	0	0	0	1	7.7	12	92.3	13
6-8	Female	71.1±5.7	2	12.5	1	6.3	1	6.3	12	75.0	16
	Male	70.2±6.7	1	6.5	0	0.0	1	6.5	14	87.5	16
9-11	Female	86.2±8.7	7	18.4	4	10.5	3	7.9	24	63.2	38
	Male	84.9±9.4	5	25.0	2	10.0	1	5.0	12	60.0	20
12-17	Female	95.4±10.7	3	33.3	0	0	1	11.1	5	55.6	9
	Male	90.3±10.5	7	23.3	5	16.7	2	6.7	16	53.3	30
18-23	Female	93.5±11	7	30.4	0	0	3	13.0	13	56.5	23
	Male	95.7±8.7	5	16.1	3	9.7	3	9.7	20	64.5	31
24-35	Female	95.4±8.9	1	10.0	0	0	2	20.0	7	70.0	10
	Male	90.3±10.6	0	0	1	16.7	2	33.3	3	50.0	6
36-47	Female	92.3±10.7	2	22.2	0	0	3	33.3	4	44.4	9
	Male	99.5±11.2	0	0	0	0	1	33.3	2	66.7	3
48-59	Female	102.8±2.8	0	0	0	0	1	16.7	5	83.3	6
	Male	103.6±2.3	0	0	0	0	2	50.5	2	50.0	4
Total	Female	86.4±14.3	22	18.0	5	4.1	14	11.5	81	66.4	122
	Male	88.0±13.5	18	14.6	11	8.9	13	10.6	81	65.9	123

The proportion of children stunted (severe, moderate, and mild) was higher among boys 42 (34.1%) than in girls 41 (33.6%). The low height-for-age observed in this study reflects chronic inadequate intake of food (energy, protein and other nutrients) among the children. The present study has shown that 100% of the children do not meet their energy and protein requirements. In addition, most can not buy the foods and may not have diversified foods, while others do not eat animal protein which

are known to be richer sources of micronutrients and nutrients (which) are high in absorbable or good availability of nutrients available, for example zinc and vitamin A. Therefore, the low height-for-age reflects a prolonged inadequate intake of food which is experienced by children from the time of weaning- when they cease breast milk. For the children of age 0-6 months, this is a critical period of rapid growth and any failure to supply the body with inadequate nutrients results into undergrowth and stunting.

Prevalence of stunting started at the age of 0-5 months for boys while for girls it started at the age of 6 to 8 months. The highest number of stunting among boys was found at the age of 12-17 months and it was found to reduce when it was lowest 48-59 months. In addition, the highest of stunting among girls was found at the age of 9-11 months and it was found to reduce when it was lowest 48-59 months. In addition, in this study, 83 out of 245 children studied (33.8%) were stunted. This figure was approximately lower to the national figure (Uganda), which is 38% (UDHS 2000/01). This is because these children in this survey study were few compared to the whole nation and they were particular group who were sick and infected with HIV/AIDS, therefore their food intake requirement is higher than the normal children.

Low height-for-age (HAZ) indicates shortness or stunting of the children and it is frequently associated with poor overall economic conditions, which result in long-term, inadequate calorie intake and/or repeated exposure to illness, and other adverse conditions (Paton *et al.*, 2003).

HAZ is a measure of a children's linear growth and is an indicator of inadequate nutrition over time as such, shows the nutritional history of the children. A low height-for-age (stunting) reflects inadequate intake of food relative to the children's need over time. One possible explanation for the strong association between dietary diversity and HAZ is that dietary diversity may act as a proxy for household economic status

(Guenter *et al.*, 1993). In other words, it may be that children with more diverse diets were from wealthier homes and had better nutritional status for reasons other than dietary diversity.

It was observed from the results of the study there was significant association between the height-for- age and nutritional status of the children (P= 0.019) at 95% confidence interval.

4.5.2.3 Weight-for-height (WHZ)

The nutritional status of HIV children according to weight-for-height is shown in Table 8. The results from the survey for weight-for-height –Z scores according to age and sex of the children show that 30 children (12.2%) were severely wasted, 24 children (9.8%) were moderately wasted, 35 children (14.3%) were mildly wasted and 156 children (63.4%) were normal

Table 8: Nutritional status of children according to weight-for-height

Age (M)	Sex	Mean±SD	Severe		Moderate		Mild		Normal		Total
			n	%	n	%	n	%	n	%	n
<6	Female	64.2±3.7	0	0	0	0	2	18.2	9	81.2	11
	Male	67.2±4.2	0	0	0	0	2	16.7	10	83.3	12
6-8	Female	71.1±5.7	3	16.7	2	11.1	2	11.1	11	61.1	18
	Male	70.2±6.7	1	5.0	0	0.0	5	20.0	14	75.0	20
9-11	Female	87.2±8.6	4	15.4	4	15.4	3	11.4	15	57.7	26
	Male	84.9±9.4	6	30.0	2	10.0	4	20.0	8	40.0	20
12-17	Female	95.4±10.7	1	7.7	2	16.7	2	16.7	7	35.0	12
	Male	89.3±10.5	5	17.9	5	17.9	1	3.6	17	60.7	28
18-23	Female	94.5±11	4	17.4	3	13.0	2	8.7	14	60.9	23
	Male	97.7±8.7	3	10.0	3	10.0	3	10.0	21	70.0	30
24-35	Female	95.4±8.9	1	5.9	0	0.0	2	11.8	14	82.4	17
	Male	90.3±10.6	0	0	1	16.7	1	16.7	4	66.7	6
36-47	Female	92.3±10.7	2	22.2	1	11.1	2	22.2	4	44.4	9
	Male	98.5±11.2	0	0	0	0	1	33.3	2	66.7	3
48-59	Female	106.8±2.8	0	0	0	0	2	33.3	4	66.7	6
	Male	102.6±2.3	0	0	1	25.0	1	25.0	2	50.0	4
Total	Female	86.4±14.3	15	12.3	12	9.8	17	13.9	78	63.9	122
	Male	88.0±13.5	15	12.2	12	9.8	18	14.6	78	63.4	123

The same boys and girls (15) were severely wasted. In addition, same boys and girls (12) were found moderately wasted. However, more boys were found to be mildly wasted 18 (14.6%) compared to the girls 17 (13.9%). The proportion of children who were wasted (severe, moderate, mild) was higher among boys (36.6%) than in girls (36.1%). The prevalence of wasting started at the age of 0-5 months for both boys and girls, and it was found to reduce when it was lowest at 48-59 months.
Generally, 89 out of 245 children studied (36.3%) were wasted. This figure was approximately higher to the national figure (Uganda), which is 4% (UDHS 2000/01). This is because these children surveyed were few compared to whole children and they were sick and infected with HIV/AIDS; however their food intake requirement was higher than the normal children's food intake requirements.

Weight for Height (WHZ) is a measure of body mass in relation to body length. It converts weight into a percentage of the standard weight expected for the height of the reference population. This indicator measures the current nutritional status of the patients. According to WHO (2003), children who are below -2 SD from the reference median for WHZ should be considered to be too thin for their height or are wasted.

In HIV infected children under five years it is difficult to link poor growth and specific nutrient deficiencies in epidemiological studies because multiple nutrients are required for growth and deficiencies usually involve several nutrients. Moreover, accurate measurement of nutrient intakes is no small challenge. In this regard, qualitative and easier-to-measure characteristics of diet which are associated with nutrient adequacy could serve as alternative determinant factors in studies looking at causes of malnutrition. Dietary diversity is proposed as a candidate indicator of food security and predictor of HIV infected children's nutritional status (Rabeneck *et al.*, 1998).

On the other hand, from the results of the study it was observed that there was a highly significant association between the weight-for- height of the children and their nutritional status (P= 0.000) at 95% confidence interval.

4.5.3 Summary of Nutritional Status (WAZ, HAZ, WHZ)

The nutritional status of the children with HIV/AIDS at TASO Entebbe Center is summarized as shown in figure 12.

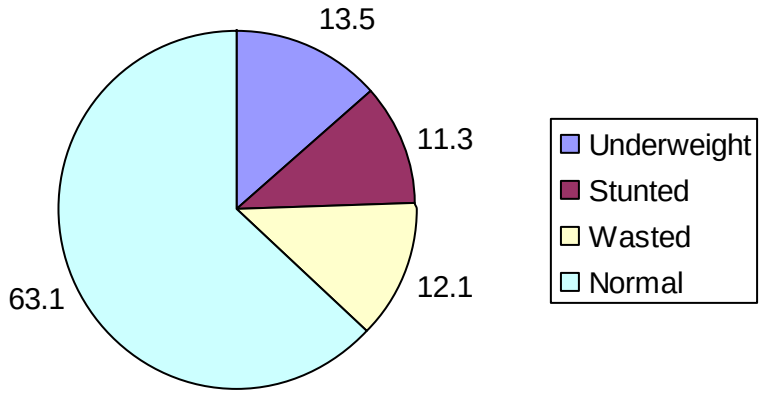

Figure 12: Summary of Nutritional Status

The results from the survey shows that 13.5% of the children were underweight, 11.3% stunting and 12.1% were wasted while 63.1% were normal. Further categorization of the type of nutritional status assessment of the children underweight was most common among the children.

4.6 PREVALENCE OF NUTRITIONAL RELATED DISEASES AMONG THE HIV INFECTED CHILDREN UNDER FIVE YEARS.

4.6.1 Diseases and Symptoms Occurrences

The following figure 13 shows the prevalence of diseases and symptoms occurrence among HIV infected children below five years of age at TASO Entebbe Center. The most prevalent diseases occurrences included: nausea (14.7%), anemia (13.9%), cough (13.9%), fever (10.2%), mouth sores (9.8%), vomiting (9.8%), mouth thrush (9.4%), diarrhea (8.6%), TB (5.7%) and esophagus Candida (4.5%).

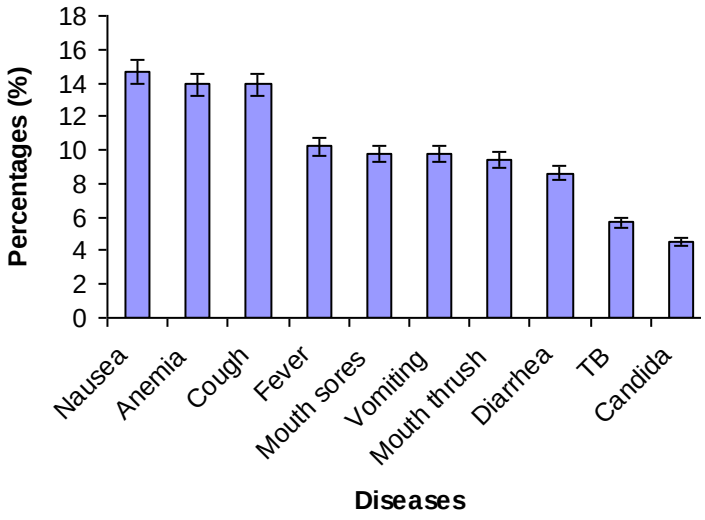

Figure 13: Frequency of diseases and symptoms.

Nausea, anemia and cough were the most prevalent diseases symptoms among HIV/AIDS children (Figure 13). Nausea causes taste change in food intake and loss of appetite which reduces food consumption, and diarrhea and vomiting increases nutrient losses. In addition, nausea and vomiting affects food intake and nutrient utilization. However, children with HIV/AIDS often consume less food due to loss of appetite, mouth or throat sores, pain and nausea, side effects of medication, or as a result of worsening household poverty and livelihood security. Furthermore,

HIV/AIDS impair the absorption of nutrients consumed on account of diarrhea and vomiting, damaged intestinal cells and other effects of other opportunistic infections. These can rapidly accelerate weight loss, malnutrition, and wasting (Piwoz *et al.*, 2002).

Multiple factors, both disease and treatment-related, are known to cause anemia during HIV infection and less common mechanisms for HIV associated anemia include vitamin B12 deficiency and the auto immune, destruction of red blood cells (Henry, 1992*).* However, low intakes of iron foods is consistent with a high prevalence of anemia as was seen among HIV/AIDS infected children below five in this study. The result in the study also agree with those of Daley *et al.* (1992) who reported TB among HIV infected children are at markedly increased risk for primary or reactivation tuberculosis. This can be seen with the children each of whom had at least suffered from disease.

Diarrhea is one of the leading causes of morbidity and mortality among HIV-infected children less than five of age. Diarrhea incidence, duration, severity and mortality are all higher in HIV-infected children than uninfected children and acute and persistent diarrhea is four times more common in HIV-infected children than in uninfected children (Horton *et al.*, 2003). In a study in Uganda, use of safe water decreased diarrheal illness by 36% (Bakaki *et al.*, 2001). It is believed that careful hand washing and food preparation by caregivers could reduce the incidence of children in HIV-infected children.

HIV-infected children are at increased risk of malnutrition from oral disease, anorexia associated with illness, malabsorption of nutrients, increased metabolism from HIV infection, and frequently compromised household food security and inadequate childcare because of parental death or illness. Poor nutrition in HIV-infected children weakens the

immune system and predisposes children to more severe common and opportunistic infections (Bakaki *et al.*, 2001).

4.6.2 Immunization Status of the children

Figure 14 shows the immunization status of the HIV positive children less than five years of age attending The AIDS Support Organization.

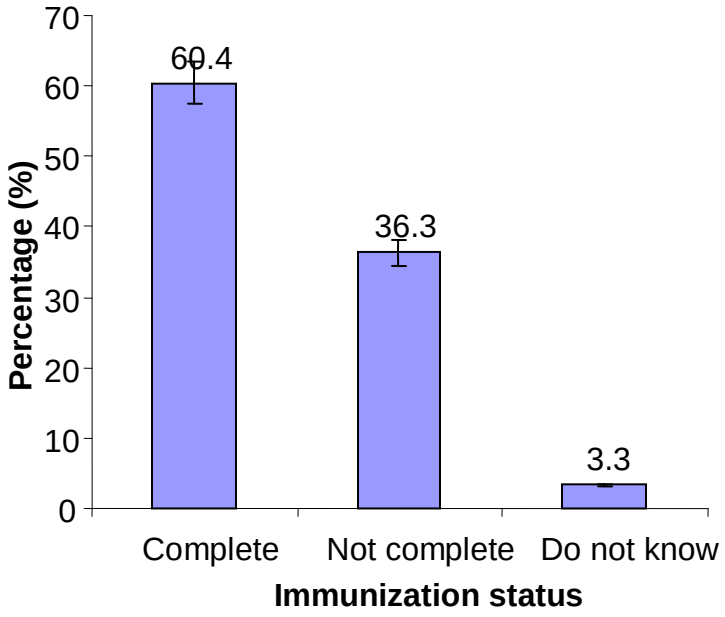

Figure 14: The immunization status of the children

From the results of the survey, 60.4% of the children finished their immunization while 36.3% were not yet completed and 3.3% of the children's caretakers did not know the immunization status of the children. Immunization cards were used as proof of immunization status of the children in this study. Most of the children received the last doze of immunization on routine visits to the TASO Entebbe Center.

In HIV, the immunization status of the children is a vital asset to good health with lessened diseases. According to American Academy of

Pediatrics (1999), immunization fights the progression of HIV disease among children below five years and strengths the immune system and make the child to resist the opportunistic diseases like TB, pneumonia, fever and cough among others. Children under five years of age with HIV have a range of health needs in addition to access to antiretroviral treatment. These include immunization and prevention and early treatment of all infections. Immunization helps a child with HIV stay healthy even where there is no access to antiretroviral drugs (Brambilla *et al.*, 2001). However, the clinical course of HIV is rapid in children, early diagnosis is critical to initiating interventions that can prolong life.

Like other children, HIV –exposed children should receive all routine childhood immunization, including live viral vaccines, even if a parent or other household contact is HIV- infected (Walker *et al.*, 2002). HIV infected children should receive all routine no-live viral immunizations especially for measles, Bacille Calmette Guerin, and yellow- fever vaccination. According to American Academy of pediatrics (1999) Streptococcus pneumoniae and Hemophilus influenza type b are responsible for the majority of bacteria meningitis and pneumonia in HIV-infected children. Both the conjugate Haemophilus influenza type b and pneumococcoal vaccines are effective in HIV positive children.

Furthermore, from the results of the survey it was observed that there was significant associations between the immunization and nutritional status of the children ($p=0.042$, $r=0.0367$) at 95% confidence interval. This was due to the fact that immunization lessens the HIV disease and fights the progression of HIV disease and strengthens the immune system, and also makes the children to resist the opportunistic diseases like fever, TB, malaria and pneumonia.

4.7 ANTIRETROVIRAL (ARV) DRUGS GIVEN TO CHILDREN AND THEIR SIDE EFFECTS.

4.7.1 Antiretroviral (ARV) Drugs Given to the Children

All the children in this study got free ARVs treatment and treatments for other infections. This was made possible because most of the caretakers (76.4%) were within 4km to 10km range from the Center and hence took less than one hour to reach the health center. Few of them come from the Ssese islands in the Lake Victoria.

The ARVs, given to these children were in the form of one or combination of two or more than two drugs and these include: Stocrin and Combivir, aspenlamzid and nevirapin, triommune 30, stavudine and epivir. Majority of the children (63.6%) were also given other treatments along with the ARVs which include: vitamin B6 supplements to prevent inhibition of vitamin B6 absorption by the tuberculosis drugs such as isoniazed, septrin, and panadol, TB drugs for those with tuberculosis, fluconazole and cotrin as shown in Table 9.

Table 9: Different types of ARV drugs given to the HIV children

Types	Frequency	Percentage (%)
Stocrin	46	18.8
Combivir	42	17.1
Aspelamzid	39	15.9
Nevirapin	34	13.9
Triommune 30	31	12.7
Stavudine	25	10.2
Epivir	28	11.4
Total	**245**	**100.0**

Majority of the children (72.2%) got side effects from the use of the ARVs drugs. The most prevalent side effects included: reduced appetite (27.3%), headaches (18.4%), abdominal pain (15.1%), nausea (14.7%), and heart burn (12.7%), numbness (11.8%) as shown in Figure 15.

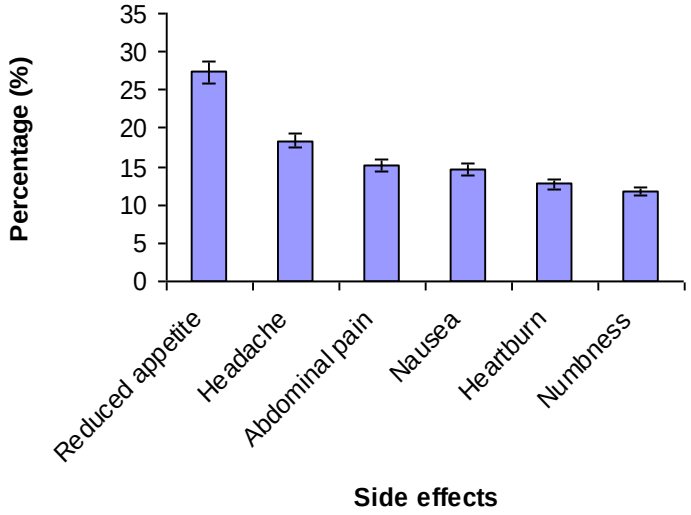

Figure 15: Side effects of taking ARVs.

Several ARVs drugs like stavudine, stocrin may cause anorexia (reduced appetite) and lead to reduced food intake, or cause changes in taste which cause food to taste metallic, sweeter, sourer or too salty, which in turn may cause an individual to consume less food (WHO, 2003).

Children receiving ARVs can suffer from the same side effects that adult experience. Because children's bodies are still developing, and they are likely to be exposed to HAART for prolonged periods of time, they were particularly vulnerable to the above mentioned complications. Side effects can occur at various stages of a child's course of treatment, and may be acute, sub-acute, or late (Gortmaker *et al.*, 2001). It can be difficult to distinguish between adverse events caused by ARVs given to a child and complications caused by HIV itself, so care should be taken to exclude other possible causes of illnesses before it is concluded that they

are a result of ARVs. The impact of side effects may vary from mild to severe and life-threatening. Some moderate or severe side effects may require drug substitution, or even the discontinuation of HAART (Faye, 2003). In general, mild side effects do not require such changes, and symptomatic treatment for the side effects may be given. If side effects are regarded as life threatening, all ARVs should be stopped until the child has stabilized.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.0 CONCLUSION

From the evaluation of dietary intake of the children in the study it was observed that legumes were the most consumed plant protein sources by 66.1% of the children. This shows that the major sources of protein for the children were plant proteins compared to animal proteins. There was little diversification of the foods given to HIV positive children. Therefore, the children were not receiving high quality proteins and micronutrients from animal source foods in their diet. Small amounts of animal source foods added to diet can compensate for many of vitamins and micronutrients inadequacies or animal source foods.

The majority of the children (67.2%) were fed on cereals. Cereals are important sources of energy containing a range of micronutrients such as Vitamin E, B-Complex, zinc and iron. These play an important role in the synthesis of hormones of proteins and other materials that promote optical physical and mental growth.

The consumption of fruits and vegetables was very low in children's diets yet these are the major sources of zinc, iron and vitamin A, which are the essential micronutrients in the diet of HIV infected children. Iron and vitamin A sources such as dark green vegetables and yellow fruits were rare in the diet of the children.

ARV side effects included; nausea, numbness, headaches, reduced appetite and vomiting were found to affect the food intake of the children,

hence predisposing them to malnutrition. Therefore, failure to address drug -food interactions can reduce efficacy, lead to poor adherence to drug regiments, aggravate side effects, or undermine the nutritional status of children living with HIV/AIDS.

The results from the survey showed that 60.4% of the children finished their immunization while 36.3% were not yet completed and 3.3% the children's caretakers did not know the immunization status of the children. Immunization strengths immune system and make child to resist the opportunistic diseases like TB, diarrhea, fever, and cough among others.

5.1 RECOMMENDATIONS

In view of the results and findings concerning the dietary intake of HIV/AIDS children in relation to nutritional status at TASO Entebbe Center, the following recommendations have been made**:**

1. Adjusting household food expenditure patterns and intra-household food allocation can help improved management of HIV/AIDS children. For example, caretakers may have to reallocate their food expenditures to increase purchase of foods rich in the nutrients that are required in specific drugs intake.

2. Children in the study did not meet their energy and protein intake. Inadequate energy intake will lead to malnutrition and lowered immune system functions. The reason why the energy requirement was not met the children were weaned on thin porridges introduced to supplement breast milk. Lowered density foods caused poor growth and under-nutrition in this study population. HIV positive children

need much more protein (up to 50% increase) than the uninfected children.

3. Mothers can be educated about the MTCT; they should be encouraged to go for voluntary counseling and testing (VCT) during pregnancy to avoid transmitting the HIV infection to their babies.

4. The nutrition educationists at rehabilitation centers like TASO Entebbe Center should try to break through the culture barriers and introduce and encourage fermented foods such as porridges to the children infected by the HIV virus since they are low in bulk and higher in energy and nutrient density.

CHAPTER SIX

REFERENCES

ACC/SCN. 1997. Third Report on the World Nutrition situation. Vol. II UN, WHO headquarters, Geneva. Switzerland.

Allard JP, Eighties E, Nadine N. 1997. Effects of antioxidant vitamin supplementation in patients with HIV infection. *Nutrition*; 13:272.

American Academy of Pediatrics. **1999**. Measles Immunization in HIV-infectedChildren, Pediatrics; 10(5).

Anabwani G, Navario P. (2005); Nutrition and HIV/AIDS in Sub-Sahara Africa:
Anoverview.http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=pubmed&dopt=abstr act&list_uids=15661483&query_hl=l

Arpadi SM, Cuff PA, Horlick M. 2001. Lipodystrophy in HIV-infected children is associated with high viral load and low CD4+ -lymphocyte count and CD4+ -lymphocyte percentage at baseline and use of protease inhibitors and stavudine. *J Acquir Immune Defic Syndr*, 27(1):30-4.

Arpadi SM, Cuff PA, Kotler DP. **2000**. Growth velocity, fat-free mass and energy intake are inversely related to viral load in HIV-infected children. *J Nutr*, 130(10):2498-502.

Bahl R. **2005**. "Infant feeding patterns and risks of death and hospitalization in the first half of infancy: multicentre cohort study", Bulletin of the World Health Organisation 83(6).

Bakaki P, Kayita J, Moura Machado JE, Coulter J, Brian S, Tindyebwa, D, Ndugwa CM, Hart CA. **2001.** Epidemiologic and Clinical Features of HIV-Infected and HIV-Uninfected Ugandan Children Younger Than 18 Months. J AIDS; 28(1):35-42.

Babamento G and Kotler DP.1997. Malnutrition in HIV infection. *Gastroenterolgy Clinics of North America* 26: 393-415.

Baum MK, Shor-Posner G, Campa A. **2000**. Zinc status in children with immunodeficiency virus infection. J Nutr; 130(Suppl): 1421S–3S.

Baum MK and Shor-Posner G.1998. Micronutrient status in relationship to mortality in HIV-1 Disease. *Nutr Reviews.* 51: S135-S139.

Baum MK, Shor Posner G, Zhang G. **1997.** HIV-1 infection in children less than 5years is associated with severe nutritional deficiencies. J Acquir Immune Defic Syndr Hum Retrovirol; 16:272–8.

Baum MK, Shor-Posner G, Lee Y. **1995**. Micronutrients and HIV-1 disease progression. AIDS; 9:1051–6.

Baum M, Cassetti L, Bonhevi P. 1994. Inadequate dietary intake and altered nutrition status in early HIV infection. Nutrition; 10:16–20.

Beach RS, Mantino-Atienza E, Shor-Posner G. **1992**. Specific nutrient abnormalities in asymptomatic HIV infection. AIDS; 6:701.

Beaugerie L, Carbonnel F, Carrat F. **1998**. Factors of weight loss in patients with HIV and chronic diarrhea. J Acquir Immune Defic Syndr Hum Retrovirol ; 19:34–9.

Beverly AC and MW Tessa. 1990. A global, region & country assessment of child malnutrition. A publication of the UNICEF, Kampala, Uganda.

Blank A, Mofenson LM, Willoughby A. **1994**. Maternal and pediatrics AIDS in the United States: the current situation and future research directions. Health Serv Res; 29:549–68.

Bogden JD, Kemp FW, Han S. **2000.** Status of selected nutrients and progression of human immunodeficiency virus type 1 infection. *Am J Clin Nutr*. 72(3):809-15.

Brambilla P, Bricalli D, Sala N. 2001 Highly active antiretroviral-treated HIV-infected children show fat distribution changes even in absence of lipodystrophy. *AIDS*, 15(18):2415-22.

Buchacz K, Cervia JS, Lindsey JC. **2001**. Impact of protease inhibitor-containing combination antiretroviral therapies on height and weight growth in HIV-infected children. *Pediatrics*, 108(4):72. *Guidelines for the Use of Antiretroviral Agents in Pediatric HIV Infection November 3, 2005.*Supplement II: Pediatric: Managing Complications of HIV Infection.

Burger B. Schwenk A, Junger H. 1994. Oral supplements in HIVinfected patients with chronic wasting: a prospective trial. Med Klin; 89:579–81, 633.

Caldwell, B., I. Pieris, B. Khuda, J. Caldwell, and P. Caldwell. 1999. "Sexual Regimes and Sexual Networking: The Risk of an HIV/AIDS Epidemic in Bangladesh." *Social Science & Medicine* 48: 1103–16.

Castleman T, Seumo-Fosso E, Cogill B. **2003**. Food and nutrition implications of antiretroviral therapy in resource limited settings. Washington, DC, FANTA Project.

Chantry CJ, Byrd RS, Englund JA. 2003. Growth, survival and viral load In symptomatic childhood human immunodeficiency virus infection. *PediatrInfect Dis J*, 22(12):1033-9.

Chintu C., Mwaba P.2005. 'Tuberculosis in children with human immunodeficiency virus infection', The International Journal of Tuberculosis and Lung Disease, 9:5(477).

Chintu C., Bhat G.J., Walker A.S. 2004, 'Co-trimoxazole as prophylaxis against opportunistic infections in HIV-infected Zambian children (CHAP): a double-blind randomised placebo-controlled trial', The Lancet, 364(1865).

Cirelli A, Ciardi M, de Simone C. **1991**; Serum selenium concentration and disease progress in patients with HIV infection. *Clin Biochem*; 24:211-214.

Clarick RH, Hanekom WA, Yogev R, Chadwick EG. **1997**. Megestrol acetate treatment of growth failure in children infected with human immunodeficiency virus. *Pediatrics*, 99(3):354-7.

Creek, **2006.** " Early infant diagnosis of HIV and the diarrhea outbreak - Updates from BOTUSA ".

Coutsoudis. 2001."Method of feeding and transmission of HIV-1 from mothers to children by 15 months of age: prospective cohort study from Durban, South Africa", AIDS 15(3).

Coutsoudis A, Pillay K, Kuhn L. **2001**.Method of feeding and transmission of HIV-1 from mothers to children by 15 months of age: prospective cohort study from Durban, South Africa. *AIDS* 15:379-387.

Coutsoudis. 1999."Influence of infant-feeding patterns on early mother-to-child transmission of HIV-1 in Durban, South Africa: a prospective cohort study" Lancet 354(9177).

Daley,CL. Small,PM.Selecter,GF .1992. An odberb of tuberculosis with accelerated progression among children infected with HIV, analysis using restriction-fragment length polymorphisms. N. Engl. J. Med.326:231-235

De Cock, **2000**."Prevention of Mother-to-Child HIV Transmission in Resource-PoorCountries", JAMA 283(9).

Doherty. 2006. "Effect of the HIV epidemic on infant feeding in Guatamala", Bulletin of the World Health Organization 84(2).

Domek G. J.2006, 'Social consequences of antiretroviral therapy: preparing for the unexpected futures of HIV-positive children', The Lancet, 367(1367).

Dreimane D, Nielsen K, Deveikis A. **2001**. Effect of protease inhibitors combined with standard antiretroviral therapy on linear growth and weight gain in human immunodeficiency virus type 1- infected children. *Pediatr Infect Dis J*, 20(3):315-6.

Dudek SG. 1993. Nutrition Handbook FOR Nursing Practice 2nd Edition published by J.B Lippincott Co., Philadelphia. Pp 215-14,227,228.

Dunn, **1992**. "Risk of human immunodeficiency virus type 1 transmission through breastfeeding", Lancet 340(8819).

Ellen GP and AP Elizabeth. 2000. **HIV/AIDS** and Nutrition, A review of the list & recommendations for Nutritional Care & Support in Sub-Saharan Africa. Support for Analysis & Research in Africa (SARA) Project. Academy for educational Development, Washington DC 20009. III: 8-21.

Fabris N, Mocchegiani E, Galli M. **1988**. AIDS, zinc deficiency, and thymic harmone failure. JAMA 259(6):839-40.

Food and Nutrition Technical Assistance (FANTA) project.**2003**. Anthropometric Indicators Measurement Guide. Bruce Cogill. Academy for Educational Development 1825 Connecticut Ave. NW, Washington DC.

FANTA, 2001. HIV/AIDS: A Guide for Nutrition, Care and Support. Food and Nutrition Technical Assistance Project, Academy for Educational Development, Washington DC. www.fantaproject.org

FAO/WHO, 2002. Living Well with HIV/AIDS: Nutritional Care and Support for People Living with HIV/AIDS. Food and Agriculture Organization and World Health Organization, Rome/Geneva. www.fao.org

FAO/WHO. 1994. Codex Standard for Infant Formula, Codex STAN 1987, Codex Alimentarius, Volume 4: Foods for Special Dietary Uses, Second Edition, Rome.

Fawzi W. 2005.Studies of Vitamins and Minerals and HIV Transmission and Disease Progression. Journal of Nutrition 35:938- 944.

Fassinou P. 2004, 'Highly active antiretroviral therapies among HIV-1-infected children in Abidjan, Cote d'Ivoire', AIDS.

Fawzi WW, Msamanga GI, Hunter D. 2002. Randomized trial of vitamin supplements in relation to transmission of HIV-1 through breastfeeding and early child mortality. *AIDS*; 16(14): 1935-1944.

Faye. E. 2003. 'Mortality and morbidity in HIV-infected infants treated before 6 months of age', Second International AIDS Society Conference on HIV Pathogenesis and Treatment, Paris, abstract 33

Gillespie S and Kadiyala S. **2005**. HIV/AIDS and Food and Nutrition Security. From Evidence to Action. International Food Policy Research Institute.

Gaare J, Singer P, Katz D. **1991**. Enteral supplementation in AIDS: an open trial. FASEB J; 5:A1688.

Gaillard P, Fowler M-G, Dabis F. **2004**.Use of antiretroviral drugs to prevent HIV-1 transmission through breast-feeding: From animal studies to randomized clinical trials. *J Acquir Immune Defic Syndr* 35:178-187.

Gortmaker S.L., Hughes M., Cervia J. 2001. 'Effect of combination therapy including protease inhibitors on mortality among children and adolescents infected with HIV-1', The New England Journal of Medicine, 345(1522).

Gorbach SL, Knox TA, Roubenoff R.2005. Interaction between nutrition and infection with human immunodeficiency virus. Nutr Rev; 51:226–34.

Green, C. 1995 .Nutritional Support in HIV infection and AIDS. Clinical Nutrition 14, 197- 212. Ref Type: Generic.

Grinspoon S, Mulligan K. **2003**. Weight loss and wasting in patients infected with human immunodeficiency virus. Clin.Infect.Dis. 36(Suppl 2):S69-S78

Grunfeld C, Pang M, Shimizu L, **Shigenaga JK, Jensen P, Feingold KR.1992**. Resting energy expenditure, caloric intake and short-term weight change in human immunodeficiency virus infection and the acquired immunodeficiency syndrome. Am J Clin Nutr; 55(2):455–60.

Guay,L.A. 1996. Detection of Human Immunodeficiency Virus type1 (HIV-1) DNA P24antigen in breast milk of HIV-1 infected Ugandan women and vertical transmission. Pediatrics,98 (3 pt1): 438-44.

Guenter P, **Muurahainen N, Kosok A, Cohan GR, Rudenstein R, Turner J**. **1993**. Relationships among nutritional status, disease progression, and survival in HIV infection. J Acquir Immune Defic Syndr; 6:1130–8.

Hartmann SU, Berlin CM, Howett MK. **2006**. Alternative Modified Infant-Feeding Practices to prevent postnatal transmission of Human Immunodeficiency Virus Type 1 through breast milk: Past, present and future. *J Hum Lact*, 22(1):75-88.

Heller, Papathakis, Rothpletz-Puglia, **1998**.HIV/AIDS Medical Nutrition Therapy Protocol for The Pediatric Population. Medical Nutrition Therapy Across the Continuum of Care. *The American Dietetic Association*.

Henry. 1992. Recombinant human erythropoitiens in the treatment of anemia associated with HIV infection and zidovudine therapy: overview of four clinical trials. Ann Inter Med.117: 739-748.

Holtzclaw, B. J. 1998. Managing fever in HIV disease journal of the Association of Nurses in AIDS Care (07/98-08/98) vol.9, No.4, p.97.

Hommes MJ, Romijn JA, Endert E, Sauerwein HP. **1991**. Resting energy expenditure and substrate oxidation in human immunodeficiency virus (HIV)-infected asymptomatic children: HIV affects host metabolism in the early asymptomatic stage. Am.J.Clin.Nutr. 54(2):311-5.

Horton C, Liebeschuetz S, Blaaw D, Cassol S, Qazi S. 2003. Diagnosis of pediatric HIV infection in a primary health care setting with a clinical algorithm. Bulletin of the WHO.; 81(12): 858-865.

Hunter SS. 1990. Orphans as a window on the AIDS epidemic in sub-Saharan Africa: initial results and implications of a study in Uganda. *Soc. Sc. & Med.*; 31 (6):681-690.

Jaimton. 2003. A randomised trial of the impact of multiple micronutrient supplementations on mortality among HIV infected individuals living in Bagkok. AIDS; 17:2446-2469.

Jitta J. Migadde M. AND Mudusu J. **1992**. Determinants of malnutrition of the under fives in Uganda. An in-depth secondary analysis of the UDHS (1988/98). Child health and development center, Makerere University.

Kim JH, Spiegelman D, Rimm E & Gorbach SL.2001. The correlates of dietary intake among HIV positive children. American Journal of Clinical Nutrition; 74(6):852-861.

Kotler D, Tierney AR, **Culpepper-Morgan JA**. **1990**. Effect of home total parenteral nutrition on body composition in patients with acquired immunodeficiency syndrome. J Parenter Enteral Nutr; 14:454.

Kotler D, Tierney A, Wang J, Pierson R, Jr. **1989**. Magnitude of body-cellmass depletion and the timing of death DS. Am J Gastroenterol; 84:1288–93.

Kotler D, Tierney AR, Wang J, Pierson RN. **1989**. Magnitude of body cell mass depletion and the timing of death from wasting in AIDS. *Am J Clin Nutr*; 50: 444-447.

I Liff RJ, Piwoz EG, Tavenawa NV, Zunguza CD, Marinda ET, Nathoo KJ, Moulton LH, Ward BJ, Humphery JH, ZVITAMBO 2005 Study group. Early exclusive breast feeding reduces the risk of postnatal HIV-1-transmission and increase HIV free survival, AIDS 19 (7).

Isa L, Lucchini A, Lodi S, Giachetti M. **1992.** Blood zinc status and zinc treatment in human immunodeficiency virus-infected patients. *Int J Clin Lab Res*; 22:45-47.

Latham and Preble, **200**0. "Appropriate feeding methods for infants of HIV infected mothers in sub-Saharan Africa", BMJ 320(7250).

Macallan D, Noble C, Baldwin C. **1995**. Energy expenditure and wasting in human immunodeficiency virus infection. N Engl J Med; 333:83–8.

Mahan LK, Escott-Stump S. 2000. Medical nutritional therapy for human immunodefiency virus (HIV) infection and acquired immunodefiency syndrome (AIDS). In: Food, nutrition, and diet therapy. Philadelphia: W.B Saunders Company; 889-911.

Magoni M. Bassani L Okong P. Khuka P. Germinario EP. Guiliano M.Vella S.2005. Mode of infant feeding and HIV infection in children in a program for prevention of MTCT in Uganda, AIDS 19 (4), 433-7.

Magoni. 2005. "Mode of infant feeding and HIV infection in children in a program for prevention of mother-to-child transmission in Uganda", AIDS 19(4).

Mantero-Atienza E, Beach RS, Gavancho MC. 1991. Selenium status of HIV-1 infected individuals. *JPEN J Parenter Enteral Nutr* **1991**; 15:693-694.

Marseile, E. 1999. Cost-effectiveness of single-dose nevirapine regimen for mothers and babies to decrease vertical HIV-1 transmission in Sub-Saharan Africa. Lancet, 354 (9181): p.803-9.

Marston B, De Cock KM. 2004. Multivitamins, nutrition, and antiretroviral therapy for HIV disease in Africa. New England Journal of Medicine, 351:78-80.

McComsey GA, Leonard E. 2004. Metabolic complications of HIV therapy in children. AIDS, 18(13): 1753–1768.

Melchior JC, Raguin G, Boulier A, Bouvet E, Rigaud D, Matheron S. **1993**. Resting energy expenditure in human immunodeficiency virus-infected patients: comparison between patients with and without secondary infections. Am.J.Clin.Nutr. 57(5):614-9.

Melvin AJ, Mohan KM, Arcuino LA. 1997. Clinical, virologic and immunologic responses of children with advanced human immunodeficiency virus type 1 disease treated with protease inhibitors. *Pediatr Infect Dis J*, 16(10):968-74.

Mhiri C, **Belec L, DiCostanza B, Georges A, Gherardi R**. **1992**. The slim disease in African patients with AIDS.Trans R Soc Trop Med Hyg; 86:303–6

Mwanburi MD. **2005**. Understanding the role of HIV load in determining weight change in the era of highly active antiretroviral therapy (HAART). Clinical Infectious Diseases, 40:167-173.

Miller TL. , **2003**. Nutritional aspects of HIV-infected children receiving highly active antiretroviral therapy. AIDS, 17(S1):130-140.

Miller TL, Mawn BE, Orav EJ. **2001**. The effect of protease inhibitor therapy on growth and body composition in human immunodeficiency virus type 1–infected children. Pediatrics; 107 E77.

Mintz M. **1996**. Neurological and development problems in pediatric HIV infection. J Nutr; 126:2663S–73S.

Ministry of Health, 2005. MEASURE HDS, CDC**.** Uganda HIV/AIDS Sero-Behavioral Survey 2004-05. Preliminary Report.

MOH.2004. Nutritional Care and Support for People Living with HIV/AIDS in Uganda.

MOH.2003: Antiretroviral Treatment Policy for Uganda. Draft.

MOH/RSA, 2001. *South African National Guidelines on Nutrition for People Living with TB, HIV/AIDS and Other Chronic Debilitating Conditions*. Ministry of Health, South Africa.

MOH, 2001. *Policy Guidelines on Feeding of Infants and Young Children in the Context of HIV/AIDS*, Ministry of Health, Kampala, Uganda.

MOH, 2001. *Policy for the Reduction of the Mother-to-Child HIV Transmission in Uganda*, Ministry of Health, Kampala, Uganda.

MOH, 1999. The Management of Severe Malnutrition in Uganda: A Guide for Health Workers. Ministry of Health, Kampala, Uganda.

Moore RD, Chaisson RE. **1999**. Natural history of HIV infection in the era of combination antiretroviral therapy. AIDS; 13:1933–42.

Mosha T. and Vicent M. 2004. Nutritional Value and acceptabilityof home made maize/sorghum based weaning mixtures supplemented with posho bean flour, and pea nut paste. Inter. J. of Food Sciences and Nut. 55(2+): 301-315.

Nadal D, Steiner F, Cheseaux JJ, Rudin C. **1998**. Ritonavir promotes increased growth in HIV- infected children. Paediatric AIDS Group of Switzerland. *AIDS*, 12(17):2356-7.

Nambuya. A, Sewankambo. N, Mugerwa. 2004. Handbook for people living with HIV/AIDS and their career.

NAP. 2002. *Food for People Living with HIV /AIDS*. Network for African People Living with HIV /AIDS. Nairobi, Kenya.

Newell, **2004**. "Mortality of infected and uninfected infants born to HIV-infected mothers in Africa: a pooled analysis", Lancet 364(9441).

Newell, M, L. 1998. Mechanisms and timing of mother-to- child transmission of HIV-1. AIDS,12(8): P.831-7.

Oster M, Enders S, Samuels S. **1994.** Megestrol acetate in patients with AIDS and cachexia. Ann Intern Med; 121:400–8.

Paton NI, Ng YM, Chee CB, Persaud C, Jackson AA. 2003. Effects of tuberculosis and HIV infection on whole-body protein metabolism during feeding, measured by the [15N]glycine method. Am.J.Clin.Nutr. 78(2):319-25.

Pillay T, Adhikari M, Mokili J, Moodley D, Connolly C, Doorasamy T, Coovadia HM. **2001**.Severe, rapidly progressive human immunodeficiency virus type 1 disease in newborns with co-infections. Pediatr Infect Dis J. 20(4):404-10.

Preble EA, Piwoz EG. **2002**. Prevention of Mother-to-Child Transmission of HIV in Asia: Practical Guidance for Programs. A joint publication of the LINKAGES and Support for Analysis and Research in Africa (SARA) Projects. Academy for Educational Development: Washington, DC.

Piwoz EG & Preble EA.**2002**. HIV/AIDS and Nutrition. A review of the literature and recommendations for nutritional care and support in Sub-Saharan Africa. Academy for Educational Development. Pp 1, 2, 3,8,12.

Piwoz, Ellen G. and Elizabeth A. Preble, 2000. HIV/*AIDS and*

Pernerstorfer-Schoen H, Schindler K, Parschalk B. **1999**. Beneficial effects of protease inhibitors on body composition and energy expenditure: a comparison between HIV-infected and AIDS patients. AIDS; 13:2389–96.

Prisca NN. 2004. Health and nutrition risk factors among orphans in a rural community of Zimbabwe. Ph.D., C.N.S. Institute for African child, OhioStatersity.ww.ohiou.edu/afrchild/HIV_CONF/abstracts/nemapare.htm.

Rabeneck L, Palmer A, Knowles JB. **1998.** A randomized controlled trial evaluating nutrition counseling with and without oral supplementations in malnourished HIV-infected patients. J Am Diet Assoc; 98:434–8.

Raiten DJ, Grinspoon S, Arpadi S. **2005**. Nutritional consideration in the use of ART in resource-limited settings. Consultation on Nutrition and HIV/AIDS in Africa: Evidence, lessons and recommendations for action. Durban, South Africa, Geneva, World Health Organization.

RCQHC/FANTA/LINKAGES projects/USAID. **2004**. Food and nutrition counseling for PLWHA on antiretroviral therapy: A job aid for counselors and antiretroviral therapy service providers. Kampala, Regional Centre for Quality of Health Care.

RCQHC/FANTA, 2003. *Handbook: Developing and Applying National Guidelines on Nutrition and HIV/AIDS*. Regional Centre for Quality of Health Care, Kampala, Uganda. www.fantaproject.org

RCQHC/FANTA/LINKAGES, 2003. *Nutrition and HIV/AIDS: A Training Manual*. Regional Centre for Quality of Health Care, Kampala, Uganda.

RCQHC/USAID, 2003: *Counseling Mothers on Infant Feeding for the Prevention of Mother-to-Child Transmission of HIV: A Job Aid for Primary Health Care Workers*. Regional Centre for Quality of Health Care, Kampala, Uganda.

Reddington C., Cohen J., Baldillo A. 2000, 'Adherence to medication regimens among children with human immunodeficiency virus infection', The Paediatric Infectious Disease Journal, 19:12(1148).

Romeyn MD and N Gunn 1999. Global Perspectives on Nutrition and HIV. Published in the Bulletin of Experimental Treatments for AIDS Summer issue, by the San Francisco AIDS Foundation.

Ross and Labbok, **2004.**"Modeling the Effects of Different Infant Feeding Strategies on Infant Survival and Mother-to-Child Transmission of HIV", American Journal of Public Health 94(7).

Roubenoff R, McDermott A, Weiss L, 1999. Short-term progressive resistance training increases trength and lean body mass in children infected with human immunodeficiency virus. AIDS; 13:231-9.

Schwenk A, Kremer G, Cornely O, **1999**. Body weight changes with protease inhibitor treatment in undernourished HIV-infected patients. Nutrition; 15:453–7.

Schwenk A, Burger B, Wessel D, **1993**. Clinical risk factors for malnutrition in HIV-1–infected patients. AIDS; 7:1213–9.**Ssekiwanuka J. 1989.**A report on people's alternatives for children orphaned as a result of AIDS and their experience of the problem in Social terms in Rakai

District**.** Research report, Rakai District Headquarters, Uganda**.**

Scrimshaw NS and SanGiovanni JP. **1997**. Synergism of nutrition, infection and immunity: an overview. *Am J Clin Nutr*; 66: 464S-477S.

Serwadda D, Mugerwa R, Sewankambo N. **1985**. Slim disease: a new disease in Uganda and its association with HTLV-III infection. Lancet; 2:

Semba RD and Tang AM. 1999. Micronutrients and the pathogenesis of human immunodeficiency virus infection. Br J Nutr; 81: 181-189.

Semba RD and Tang AM. **1999**. Micronutrients and the pathogenesis of human immunodeficiency virus infection. *Br J Nutr*; 81: 181-189.

Semba R, Caiaffa W, Graham N, Cohn S, Vlahov D. **1995**. Vitamin A deficiency and wasting as predictors of mortality in human immunodeficiency virus–infected injection drug users. J Infect Dis; 171:1196–202.

Shabert JK,Winslow C. Lacey JM. 1999. Glutamine-oxidant supplementation increases body cell mass in AIDS patients with weight loss: A randomized, double blind control trial. Nutrition; 15:860-864.

Shevitz AH, Knox TA. 2001. Nutrition in the era of highly active antiretroviral therapy. CID; 32: 1769-1775.

Shevitz AH, Knox T, Spiegelman D, **1999.** Elevated resting energy expenditure among HIV-seropositive persons receiving highly active antire troviral therapy. AIDS; 13:1351–7.

Silva M, Skolnik P, Gorbach S, **1998.** The effect of protease inhibitors on weight and body composition in HIV-infected patients. AIDS; 12:1645–51.

STD/ACP/MoH, 1999. HIV/*AIDS Surveillance Report*, Ministry of Health, Kampala, Uganda.

Sue RW. 1999. Essentials of Nutrition and Diet Therapy. Seventh Edition, Sally Schrefer, Mosby, Inc. 23: 488-504.

Suttmann U, Ockenga J, Selberg O, Hoogestraat L, Deicher H, Muller M.1995. Incidence and prognostic value of malnutrition and wasting in human immunodeficiency virus–infected outpatients. J Acquir Immune Defic Syndr; 8:239–46.

Swindale, A. (FANTA). 2004. Assessing the Potential for Food Aid Interventions in High HIV Prevalence Contexts. Presentation at Entebbe, Uganda.

Tang AM, Smit E. **1998**Selected vitamins in HIVinfection: a review. *AIDS Patient Care STDS*, 12(4):263-73.
Tang AM, Graham NM, Saah AJ. **1996**. Effects of micronutrient intake on survival in human immunodeficiency virus type 1 infection. Am JEpidemiol; 143:1244–56.

Thior. 2006."Breastfeeding plus infant zidovudine prophylaxis for 6 months vs formula feeding plus infant zidovudine for 1 month to reduce mother-to-child HIV transmission in Botswana: a randomized trial: the Mashi Study", JAMA 296(7).

Thuret I, Michel G, Chambost H. **1999**. Combination antiretroviral therapy including ritonavir in children infected with human immunodeficiency. *AIDS*, 13(1):81-7.

Tomkins, A. **2002.** Nutrition, Infection and Immunity: Public Health Implications. Calder, P.C., Field, C. J., and ill, H. S. Frontiers in Nutritional Science, No 1.Nutrition and Immune Function, 375-412. 2002. CABI Publishing, Wallingford, Oxon OX10 8DE, CABI Publishing. Frontiers in Nutritional Science, No 1. 1-1-0002. Ref Type: Generic.

Uganda AIDS Commission, 2003. *The Overarching HIV/AIDS Policy for Uganda*. Kampala, Uganda.

UNAIDS/WHO 2006. Report on the Global AIDS Epidemic.

UNAIDS/WHO, 2006 "National population based HIV prevalence surveys in sub-Saharan Africa: results and implications for HIV and AIDS estimates", Sexually Transmitted Infections, Volume 82 Supplement iii.

UNAIDS, 2004. AIDS epidemic update: December 2003. (Accessed June 4, 2006 at http://www.unaids.org.)

UNAIDS/WHO 2004. *AIDS Epidemic Update*. Geneva.

UNICEF/UNAIDS/WHO, **2004.** "HIV transmission through breastfeeding - A review of available evidence".

UDHS, 2001. *Uganda Demographic and Health Survey, 2000/2001*, Uganda Bureau of Statistics, Entebbe, Uganda.

UNAIDS/WHO. 2000. AIDS epidemic Update: December 2000.

UNICEF.**2003**. Nutrition and HIV/AIDS; Paper for the technical consultation on Vulnerability in light of the HIV/AIDS pandemic.

UNICEF. 1998. The state of World's children: Focus on Nutrition. UNICEF, New York. USA.

Van Dyke R.B., Lee S., Johnson G.M. 2002, 'Reported adherence as a determinant of response to highly active antiretroviral therapy in children who have immunodeficiency virus infection', Paediatrics 109:4(e61)

Varille V, Faye A, Levine M, **1997**. Resting energy expenditure (REE) and growth velocity (GV) in HIV-infected children [abstract 0-28]. In: Program and abstracts of the International Conference on Nutrition and HIV Infection, Cannes, France; 13:274.

Verweel G, van Rossum AM, Hartwig NG. 2002. Treatment with highly active antiretroviral therapy in human immunodeficiency virus type 1-infected children is associated with a sustained effect on growth. *Pediatrics*, 109(2):E25.

Vorster HH, Kruger A, Margetts BM, Venter CS, Kruger HS, Veldman FJ. **2004.** The nutritional status of asymptomatic HIV -infected Africans: directions for dietary intervention? Public Health Nutr. 7(8):1055-64.

Walker N, Schwartlander B, Bryce B. **2002.** Meeting International goals in child survival and HIV/AIDS. Published online April 30, 2002; http://image.thelancet.com/extras/01art 9188web.pdf-checked on January 2007.

Wallace M & kanti G. 1990. Health care of women and children in developing countries. (C) by third party publishing company. Pp 167,168172,296,297, 299.

Wang Y, Watson RR. **1994** Potential therapeutics of vitamin E (tocopherol) in AIDS and HIV. *Drugs.* 48:327-338.

Wilson, D and Pencharz, P. 1997. Nutritional Care of the chronically ill. In: *Nutrition during infancy: birth to 2 years*. 37-46. Cincinnati: Digital Educational Publishing Inc. Ref Type: Generic.

Wintergerst U, Hoffmann F, Solder B. 1998. Comparison of two antiretroviral triple combinations including the protease inhibitor indinavir in children infected with human immunodeficiency virus.*Pediatr Infect Dis J*, 17(6):495-9.

WHO. 2006, 'Antiretroviral Therapy of HIV Infection in Infants and Children in Resource Limited Settings: Towards Universal Access (Recommendations for a Public Health Approach)'

WHO. **2005**.Nutrition and HIV/AIDS.Geneva, World Health Organization.

WHO,2003. *Nutrient requirements for people living with HIV/AIDS.* Report of a technical consultation. World Health Organization, Geneva.

WHO. 2003. HIV and Infant Feeding: Framework for Priority Action. World Health Organization: Geneva.

WHO/UNAIDS/UNICEF. 2003. HIV and Infant Feeding: Guidelines for Decision-makers. World Health Organization: Geneva.

WHO/UNAIDS/UNICEF. **2003.** HIV and Infant Feeding: A Guide for Health Care Managers and Supervisors. World Health Organization: Geneva.

WHO. **2002**. Child Health Research: A Foundation for improving child health. The State of Child Health Today. EHO/FCH/CAH/02.

WHO, **2001**."New data on the prevention of Mother-to-Child Transmission of HIV and their policy implications".

WHO/UNICEF. 2001. Infant Feeding in Emergencies: Relief Staff (Revision 1).

WHO 2000a. New data on the prevention of MTCT of HIV and their policy implication, conclusion and recommendation. WHO Technical Consultation on behalf of the UNFPA/UNICEF/WHO/UNAIDS in to Agency Task Team on MTCT of HIV. Geneva 11-13 Oct.

WHO 2000b. Effect of breastfeeding on infant and child mortality due to infectious diseases in less developing countries. A Pooled Analysis Lancet355; 781-785.

WHO/UNICEF, 1999. *Nutrition Essentials: A Guide for Health Managers*. Washington DC.

Zaramba 1998. Nutritional Status and its determinants in children under five years of age in Mpigi district.

Ziegler, **1985**."Postnatal transmission of AIDS-associated retrovirus from mother to infant", Lancet 1(8434).

APPENDICES

APPENDIX A: INFORMED CONSENT FORM

Consent form to participate in the study of the: Assessment of Dietary Intake and Nutritional Status of Children Under Five Years Who are HIV/AIDS Positive

I am **Ali Duale Jama** a postgraduate student of Department of Food Science and Technology at Makerere University. I am conducting, as my research dissertation. A study to: Assessment of dietary intake and nutritional status of children under five years who are HIV positive in The AIDS Support Organisation (TASO).

I have selected the patients under five years in TASO Entebbe Center as part of study subjects. You have been randomly identified as the caretaker as a potential respondent and hereby reminded of your right to or not to participate in this study.

I ---------- (caretaker) after being explained to the above study and having been informed of my rights to or not to participate fully or partially, do hereby consent to participate in the study by authority of my signature.

Caretaker

Signature**.....date.....**

APPEDIX B: QUESTIONNAIRE

Assessment of Dietary Intake and Nutritional Status of Children Under Five Years Who are HIV Positive

SECTION A: <u>DEMOGRAPHIC AND HOUSE HOLD INFORMATION</u>

1) Demographic Characteristics of the Caretaker:

a. Age_____ (yrs) Sex: 1= Male 2= Female

b. Relationship to the patient:

1. Mother 2. Father 3. Other

c. Marital status of the caretaker:

Single Married Divorced/separated Widow

d. Is the mother alive? Yes No Do not know

e. If dead in d, what was the cause of death?

(i) AIDS (ii) TB (iii) Accident (iv) Other

f. Is the father alive? Yes No Do not know

g. If dead in f, what was the cause of death?

i) AIDS ii) TB iii) Accident iv) Other

2) **Childs Identification**:

a) Name_____

b) Sex: Male Female

c) Age_____ (months/years)

d) Date of birth _____

e) Birth order_____

f) Are the others living? Yes No

g) What was the birth weight of the child? 2.5kg above 2.5kg Below 2.5kg

3) **Religion**: 01) Catholic 02) Protestant 03) Muslim 04) Pentecostal
05) Seventh Day Adventist 06) Others (specify)

4) **House Hold Type**: **01**) Male headed 02) Female headed
03) Child headed

5) Total number of people in the house hold ----------

6) Education level of mother/main caretaker:
a) None b) Primary c) Secondary d) Tertiary

7) Education levels of house hold head (if head is different from above)
a) None b) Primary c) Secondary d) Tertiary

8) Sources of income for the house hold:
a) Farming b) Salaried employee c) Formal business owner
d)Unemployment e) Others (specify)

SECTION B: <u>FEEDING HABIT/PATTERNS (CHILD EATING HABITS AND</u> WELFARE)

I) Breast Feeding:

01) Is the child breast feeding? Yes No
02) If not, was the child ever breast fed? Yes No
03) If yes, what was duration of exclusive breast feeding?
_____ (months).
04) Age at which breast feeding stopped (months) _____
05) Diet that child was introduced _____
06) If breast feeding stopped, have you introduced other feedings to the child? _____
07) If yes, when were these foods introduced? _____ months

II) Other Feedings:

1) What is the source of food consumed in your household?

01) Buying. 02) Own farm 03) 0thers (specify).....

2) How many meals are eaten in a day in your household?

01) 1meal 02) 2meals 03) 3 meals 04) 4 meals

05) > 4meals

3) What meals are they? (Mark all applicable)

01) Breakfast 02) Break snack 03) Tea break 04) Lunch

05) Snacks 06) Supper 07) Other (specify) ----------

SECTION C: <u>DIETARY INTAKE/DIVERSITY (HOUSEHOLD NUTRITION)</u>

1. What is the **source** of food for your household? 01) Own farm 02) Bought 03) Both own farm and bought 04) Donation
2. What are the four **<u>most important</u> relishes (sauce)** foods in your household in order of importance?

   1----------

   2----------

   3----------

   4----------
3. How do you prepare food for your child (preparation method)?

   a. mashing b. puree c. cooling d. boiling e. frying f. steaming g. Others

4. How do you feed your child? Example:

   a. mouth feeding b. NG tube feeding c. Perit-----feeding

   d. Other (specify)

5. How many times does your child feed in a day?

Once Twice Three Times Four Times Five Times

>Five Times

6. Are there times when your child refuses food? Yes No

7. If yes, what do you do in such case? Example: Appetite loss;

(i) Leave him/her alone or stop feeding (ii) forced feeding

iii) give smoke feeds iv) change feeds v) sought medical help

8. Are there foods which your patient (child) like/tolerate Yes

No

9. If yes, what are they? _____

10. Are there foods which your patient (child) does not tolerate?

11. If yes in no.11, what are they? _____

FOOD FREQUENCY

13. What is the frequency of consumption and sources of the following foodstuff in the household?

Food	>1/day	1/Daily	>1/wk	1/wk	>1/mth	Rarely (Once a month)	Never
Cereals							
Millet							
Maize							
Rice							
Maize porridge							
Millet porridge							
Wheat products							
Tubers & plantain							
Cassava							

Sweet potato (white)							
Sweet potato (yellow)							
Irish potato							
Matooke							
Legumes							
Beans							
Peas							
Ground nuts							
Soybeans							
Dairy, Fats/Oils							
Milk							
Blue band							
Ghee							
Cooking oil							
Animal Products							
Meat							
Pork							
Poultry							
Eggs							
Fish /mukene							
Vegetables							
Dark green Leafy Vegetables							
Light green Leafy Vegetables							
Tomatoes							

Pumpkins							
Carrots							
Fruits							
Citrus e.g. Oranges							
Papaya							
Water melon							
Pineapples							
Mangoes							
Passion fruits							
Jack fruit							
Avocado							

24-HOUR DIETARY RECALL (HOUSE HOLD).

14) Starting from morning to evening yesterday, please name all foods and drinks that the child consumed amounts and preparation method.

Time/ Meal	Name of dish	Ingredients	Unit of Measure	Description*	Preparation method **	Local indicative Measure	Amount consumed (Average Unit)
B/FAST	1						
	2						
	3						
	4						
B/SNACK	1						
	2						
	3						

LUNCH	1						
	2						
	3						
	4						
	1						
SNACK	2						
	3						
	4						
SUPPER	1						
	2						
	3						
	4						
	1						
SNACK	2						
	3						

***Codes for description** 1=Fresh **2**=Dried **3**=Tinned **4**=Frozen **5**=Bottle **6**=Processed

****Codes for method of preparation:** **1**=Eaten raw **2**=Boiled **3**=Steamed **4**=Roasted **5**=Deep fried **6**= Shallow fried **7**=Baked **8**= mingle **9**= Processed

SECTION D: ANTHROPOMETRIC DATA/MEASUREMENT

Anthropometry

Sex Male___ Female___ **Measurements in duplicates**

Height (cm) _____

Weight (kg) _____

Mid-Upper Circumference (MUAC) _____

Waist (cm) _____

Hip (cm) _____

Waist Hip ratio (cm) _____

CD4 _____

SECTION E: NUTRITION KNOWLEGDE, ACCESS TO HEALTH AND NUTRITION INFORMATION

1. Have you ever recieved information (education/training) on nutrition and care in HIV?
   1) Yes 2) No

2. What do you understand by the term good nutrition (**Circle only one**)
   a) Feeding Infant/Child a lot of food b) Feeding Infant/Child a variety of foods c) Feeding Infant/Child a balanced diet
   d) Feeding infant/child a lot of meat e) Other (Specify)_____.

3. What do you think are the consequences of poor nutrition/bad feeding of child in HIV infection (**Circle all that apply**)
   a) Poor health/sickness b) Death c) Do not know d) Others (Specify) _____.

4. Which foods should not be given the child while taking drugs?.

5. What do you think can be done to improve childs nutrition in HIV at house hold level?(**Circle all that apply**)
   a) reduce poverty b) feed child well (balanced/varied diet)
   b) educate caretaker c) improve sanitation d) improve health
   e) do not know f) other (specify) _____

SECTION F: <u>HEALTH CONDITION, AWARENESS AND ACCESS TO HEALTH SERVICES</u>

1. Immunization History:
   i) Is the immunization/health card available? Yes No
   ii) What is the immunization status of the child?
   Complete Not complete Do not know

2.a) How many times have your child been sick in the last 30 days (last month)?

b) Please tick one of the following on your child's health condition in the past month

i)	Diarrhoea	Yes	No
ii)	Nausea	Yes	N o
iii)	Vomiting	Yes	No
iv)	Sores in the mouth	Yes	No
v)	Thrush in the mouth	Yes	No
vi)	TB	Yes	No
vii)	Cough	Yes	No
viii)	Fever	Yes	No
x)	Reduced appetite	Yes	No
xi)	Numbness	Yes	No
xii)	Abdominal pain	Yes	No

xiii) Headache Yes No

ix) Heart burn Yes No

iix) Anemia Yes No

iiix) Esophagus Candida Yes No

c) What type(s) of ARVs have your child been using in the last month?.

3.a) Are your child accessing any different treatment apart from ARVs?
1) Yes 2) No
b) If yes, what is this treatment? _____
c) For how long have your child used this other treatment? _____

4. How do you acquire for your child this treatment?
1) Free at TASO 2) Buy 3) subsidized 4) Other (Specify) _____.

5. Why not?
1) Do not know about them 2) Can not afford
3) Other (Specify) _____

6. How far is the Entebbe Health Center (probe how long it takes you to reach the Center?. Please tick only one answer

Time	**Km estimate**
01) 0-15 minutes	01) 0-2km
02) 16-30 minutes	02) 2-4 km
03) 32-60 minutes	03) 4-6 km
04) 61-120 minutes	04) 6-8 km
05) More than 2 hours.	05) More than 8 km.

7. How can you rank the adequacy of services at the Center?

a) Inadequate b) Some how adequate c) adequate
d) Do not know.