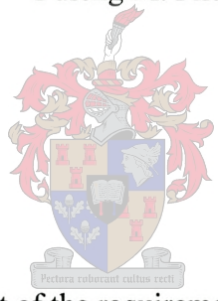
NUTRITIONAL FACTORS ASSOCIATED WITH ORAL LESIONS IN HIV DISEASE AND TB INFECTION

Puleng M. Phooko



Thesis presented in partial fulfilment of the requirements for the degree of Master of Nutrition at the University of Stellenbosch

Study Leader: Professor D. Labadarios

Study Co-Leader: Dr. R. Blaauw

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"Declaration

I, the undersigned, hereby declare, that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

ABSTRACT

Problem Definition: In the context of HIV/AIDS malnutrition is almost universal among children, and of the adverse effects of Protein Energy Malnutrition, the most frequent seems to be the occurrence of opportunistic infections with micro-organisms such as oral *Candida*.

Objective: The aim of this study was to determine the nutritional status of children with oral complications in relation to HIV/AIDS as well as the effects of the oral lesions on nutritional status.

Subjects/setting: The subjects of study were 24 children co-infected with TB and HIV who were admitted consecutively to the paediatric ward of Brooklyn Chest Hospital in Cape Town, South Africa. The nutritional status of the children was assessed over a maximum period of six months by nutrient intake, anthropometric status, and by biochemical parameters and clinical and oral examination on admission and at discharge from hospital.

Results: Children with HIV and TB infection presenting with or without oral lesions were similarly malnourished throughout the period of hospitalization. There was no improvement in the nutritional status as indicated by height and weight measurements. Throughout the time of hospitalization, 7% of the children had a combination of stunting, underweight and wasting.

Average nutrient intake was not found to be higher than the Recommended Dietary Allowance (RDA) in any of the children. At the time of admission to hospital and at discharge, carbohydrate intake provided most of the daily energy (36% and 42%, the difference not being statistically significant). There was a significant increase in the intake of energy ($p=0.04$) and a decrease in total fat intake ($p=0.03$) at discharge. Although not significant, mean protein intake at admission was higher than at time of discharge.

Selected sub-optimal biochemical values were prevalent among the children studied, with 45% and 41% showing low serum albumin values (<2.9g/dL) at the time of admission and at discharge respectively. Both on admission and at discharge, 38% of the children had Haemoglobin levels below normal values. Serum ferritin levels below normal values were present in almost all the children and the trend was similar for the prevalence of low zinc values. Sub-normal plasma retinol was present in 79% of the children at time of admission, while only 21% had deficient

values at time of discharge (p=0.03). On admission, 29% of the children had vitamin C values below the normal range whereas at time of discharge 17% of the children had values below normal (p=0.04).

A total of 29% children presented with oral complications on admission. These included oral herpes, oral thrush, reflux, bleeding gums and stomatitis/angular cheilosis. Two children were asymptomatically colonized with *Candida* of the oral cavity. Mean total protein intake was higher (p=0.057) among the children who were not diagnosed with oral complications.

Conclusions: This study confirmed that malnutrition is not only a common and serious problem associated with HIV and AIDS, but also that nutritional problems cannot be dealt with in isolation where Opportunistic Infections are present. The severity of malnutrition depends on various factors including oral complications. Additionally, appropriate management and treatment of tuberculosis did not appear to affect the nutritional status significantly.

Recommendations: On the basis of these findings, and because of the increased risk of growth failure and developmental delays, children should be referred for full nutritional evaluation as soon as possible after diagnosis of HIV-infection. In addition, there is a need for intervention programmes to identify the immediate underlying causes of malnutrition and the ways in which such causes interact, in order to ensure that such interventions increase the resistance of HIV infected infants and children to the disease.

ABSTRAK

Probleemdefiniëring: Binne die konteks van MIV/VIGS is wanvoeding bykans universeel onder kinders en van die nadelige effekte van proteïen energie wanvoeding is die voorkoms van opportunistiese infeksies (OI) met mikro-organismes soos orale candida die algemeenste.

Doelwit: Die doel van dié studie was om die voedingstatus van kinders met orale komplikasies in verhouding tot MIV/VIGS en die effek van orale letsels op voedingstatus, te bepaal.

Proefpersone/omgewing: 'n Groep van 24 kinders, met beide tuberkulose en MIV/VIGS-infeksie, wat agtereenvolgend in die kindersaal van Brooklyn Bors-Hospitaal in Kaapstad, Suid-Afrika opgeneem is, is bestudeer. Vir 'n periode van ses maande is die kinders se voedingstatus geassesseer deur middel van voedingstofinname, antropometriese status en biochemiese parameters met opname in en ontslag uit die hospitaal. Kliniese en orale ondersoeke was op elke kind uitgevoer met opname sowel as ontslag.

Resultate: Kindres met HIV en tuberkulose, met of sonder orale letsels, het soortgelyke wanvoeding tydens hospitalisering ervaar het. Volgens antropometriese metings was daar geen verbetering in die voedingstatus nie. 'n Kombinasie van belemmerde groei, ondergewig en uittering het in 7% van die kinders tydens hospitalisering voorgekom.

Nie een van die gemiddeldes van die voedingstowwe was hoër as die Aanbevole daaglikse toelatings (ADT) in enige van die kinders wat bestudeer is nie. Met opname sowel as ontslag, was koolhidraatinname die grootste energieverskaffer met onderskeidelik 36% en 42% (alhoewel die verskil nie statisties beduidend was nie). Daar was 'n beduidende toename in energie-inname ($p=0.04$) en 'n afname in totale vetinname ($p=0.03$) met ontslag. Alhoewel nie beduidend nie, was die gemiddelde proteïeninname hoër met ontslag.

Die voorkoms van geselekteerde sub-optimale biochemiese waardes met toelating en ontslag wys dat onderskeidelik 45% en 41% van die kinders lae serum albumienwaardes (<2.9g/dL) getoon het. Subnormale plasma retinol het in 79% van die kinders met toelating voorgekom, terwyl slegs

21% gebrekkige waardes (p=0.03) met ontslag getoon het. Tydens opname, sowel as met ontslag, was 38% van die kinders se hemoglobienvlakke laer as die normale. Serum ferritienvlakke was amper by al die kinders laer as die normale vlakke te bespeur, met sinkvlakke wat op soortgelyke lae vlakke voorkom. Met toelating was 29% van die kinders se Vitamien C-waardes laer as normaal en met ontslag was sowat 17% se waardes steeds laer as die normaal (p=0.04).

Met toelating het 29% van die kinders orale komplikasies getoon. Ingeslote hierby was orale herpes, orale sproei, refluks, bloeiende tandvleise en stomatis/ angulêre cheilose. Slegs twee kinders was asimptomaties met orale *Candida* van die mondholte gediagnoseer. Die gemiddelde proteïeninname was hoër (p=0.057) onder die kindres wat nie orale komplikasies getoon het nie.

Gevolgtrekking: Hierdie studie bevestig dat wanvoeding nie net 'n algemene en ernstige probleem is wat met MIV en VIGS geassosieer word nie, maar ook in die teenwoordigheid van opportunistiese infeksies, die voedingsprobleem nie in isolasie gehanteer kan word nie. Die graad van wanvoeding hang af van ander faktore, insluitende orale komplikasies. Voldoende behandeling van TB het ook nie 'n beduidende effek op voedingstatus gehad nie.

Aanbevelings: Op hierdie bevindings gebaseer, en as gevolg van die verhoogde risiko vir belemmerde groei en vertraagde ontwikkeling wat al die liggaamstelsels van MIV-positiewe kinders affekteer, moet kinders so gou as moontlik nadat die MIV-infeksie gediagnoseer is, vir volle voedingsevaluasies verwys word. Daarmee gepaardgaande is daar 'n behoefte aan programme wat die onmiddellike onderliggende oorsake van wanvoeding identifiseer, asook om interaksie van hierdie oorsake met HIV vas te stel, ten einde intervensies wat weerstand van HIV-kinders en-babas verbeter, positief toe te pas.

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ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
AZT	Azidothymidine
CDC	Centre for Disease Control
CMV	Cytomegalovirus
CHI	Creatinine Height Index
CDC	Centre for Disease Control
CMV	Cytomegalovirus
DNA	Deoxynucleic Acid
FFQ	Food Frequency Questionnaire
FTT	Failure to Thrive
GI	Gastrointestinal
H/A	Height for Age
Hb	Haemoglobin
HCT	Haematocrit
HPLC	High-Performance Liquid Chromatography
HIV	Human Immunodeficiency Virus
MAC	Mycobacterium avium complex
MAIDS	Murine Acquired Immuno Deficiency Syndrome
MCV	Mean Corpuscular Volume
MUAC	Mid-Upper Arm Circumference
MRC	Medical Research Council
MTCT	Mother-to-child HIV Transmission
NAIDS	Nutritionally Acquired AIDS
NCHS	National Centre for Health Statistics
OI	Opportunistic Infections
PEM	Protein Energy Malnutrition
PPN	Peripheral Parenteral Nutrition
RBP	Retinol Binding Protein
RDA	Required Dietary Allowance
RNA	Ribonucleic Acid
SD	Standard Deviation
SAIMR	South African Institute of Medical Research
TB	Tuberculosis
TF	Tube Feeding
TG	Triglycerides

TPN	Total Parenteral Nutrition
UNICEF	United Nation's Children's Fund
UNAIDS	Joint United Nations Programme on HIV/AIDS
VAD	Vitamin A Deficiency
W/A	Weight for Age
W/H	Weight for Height
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

1. INTRODUCTION

1.1 Background

Beyond an awareness of higher mortality, little is known about the impact of HIV-infection on the clinical features and the course of illness in malnourished children. In the absence of HIV infection, malnutrition in children manifests itself as failure to grow [1,2] in a manner consistent with local or international norms, but it has long been recognized that malnutrition is a complex clinical syndrome that impacts on every aspect of metabolism and function in all tissues of the body, and that HIV proliferates where malnutrition is prevalent [1,3,4]. Studies have indicated that 50% of child deaths may be attributed to potential effects of malnutrition where growth failure and malnutrition coexist with infection [2,5].

Far from being a simple deficiency of protein or energy, malnutrition is almost always accompanied by overt or occult infection, infection being one of the most frequent, and sometimes life threatening, complications of malnutrition [9,10,11]. In HIV-infection and AIDS, the effects are multiple and are attributed to an already compromised immune system [6,7,8]. Among HIV infected patients, malnutrition is mostly related to the development of opportunistic illnesses [8], of which TB is the most frequent in Africa. TB and AIDS interact especially powerfully and have been dubbed the "dual epidemic" [14].

A number of studies and clinical observations have shown that nutritional status is a significant co-factor in the progression of HIV-infection to AIDS, Guenter *et al.* (1993) concluded that malnutrition may impact on the length of survival of persons with HIV-infection by a number of different mechanisms, including compromising host immune function, causing organ damage, diminishing response to therapy and promoting debilitation[17].

It has long been recognized that malnutrition is an uncompromising co-morbidity of HIV infection[12], and that significant loss of lean body mass, which proceeds more rapidly than the clinical appearance of weight loss, will lead to a patient's death regardless of the co-existence of an AIDS defining illness [7,10,13]. It is also important to note that ultimately nutritional support serves as an effective administrator of nutrients to the body and repletion of body cell mass [14].

All this makes malnutrition an important factor in the prognosis of patients infected with HIV where the diminished host resistance due to malnutrition may contribute to the higher incidence and severity of infectious disease with HIV/AIDS [15,16]. Certain studies that have investigated the nutritional status of subjects co-infected with HIV and TB have shown that body weight and lean body mass measurements underestimate the nutritional deficit of these patients [13,14].

Understandably, nutrition intervention becomes particularly necessary at all stages of HIV/AIDS in patients with oral complications. Chlebowski *et al.* reported that during the asymptomatic period, the goal of nutrition counselling is to promote an adequate, balanced diet for weight maintenance and prevention of vitamin and mineral deficiencies. In the later stages of the disease, nutrition recommendations may involve enteral or parenteral nutrition support, the goal being administration of nutrients to the body and repletion of body cell mass for maintenance of a healthy immune system.

1.2 Role of Immunonutrition

Nutrition is the single most important component of preventative health care. The ability of the human to respond to stresses such as heat, trauma, surgery and infection can be influenced by nutritional status [6,7,16,17,18]. In simple terms, nutrition plays an important role in helping the immune system work optimally. When one is infected with HIV, one's immune system is impaired and becomes less effective. Good nutrition habits simply assist the body fight the virus to the best of its ability[19], and to remain resilient during medical treatment. In other words, many of the physical symptoms associated with HIV/AIDS can be made better or worse depending on the nutritional status [11,20,21].

Since host immunity is an important protective mechanism against micro organisms, immuno-competence has the advantage of being a sensitive functional index of nutrition [9,22]. Nutritional status, like genetics, is a major determinant of the host's resistance to infections [11], and is known to play an important underlying role in the full clinical expression of AIDS in HIV seropositive individuals [3,16]. Factors most likely to promote the rapid transition from asymptomatic HIV infection to AIDS, characteristic of many African communities, include malnutrition induced

antecedent impairment of the host's immune system, such as depleted levels of key antioxidants, nutrients and enzymes [8,16,23]. In effect, the clinical expression of HIV-infection is more severe when the infection co-exists with or is preceded by malnutrition [16,20].

Since HIV-infected persons are immuno-suppressed, they are highly susceptible to inflammatory responses induced by oxidative stress resulting from exposure to viral/opportunistic pathogens, drugs and other xenobiotics [2,8,9]. Inflammation is associated with the formation of reactive oxygen intermediates and cytokines such as interleukins (IL-1, IL-2, IL-6), granulocyte/macrophage colony stimulative factor and tumor necrosis factor alpha or beta (TNF) [16,24]. Periodic exposure to oxidative stress may create episodes of increased inflammatory response and HIV activation contributing to progressive CD4 + T-cell depletion [16].

Malnutrition leads to cell-mediated immunodeficiency related to thymolymphatic atrophy [25], which results in increased susceptibility to infection and higher mortality rates [7,8]. Moreover, recurrent infections, caused by declining immune function, compound growth failure and malnutrition. Watson (1994) indicates that experiments using the Murine Acquired Immuno Deficiency Syndrome (MAIDS), have been helpful in understanding HIV wasting syndrome, where changes induced by dietary omega-3 (n-3) lipids and/or moderate energy restriction on the composition of lymphoid cell membranes can modulate the production or response of lymphokines, including immunosuppressive PGE2, which appears to delay progression of the retroviral infection.

Both direct and indirect mechanisms are responsible for the impact of nutrition on HIV. Directly, nutritional factors are required for specific immune cell triggering interactions and expression. Indirectly, nutritional factors are essential for DNA and protein synthesis and the physiological integrity of cell tissues and organ systems including lymphoid tissues [8,16]. The T4 helper lymphocyte is a target for HIV-infection and decreased levels as a result of the infection, are a predictor of the development of serious diseases classified as Opportunistic Infections (OI) [8,16].

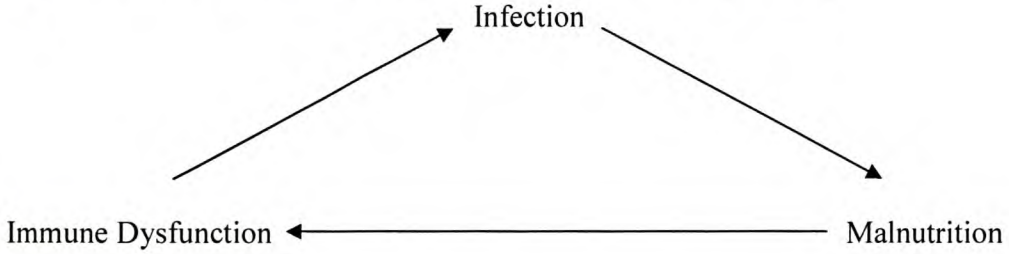
AIDS patients basically suffer from a single underlying deficit, which is the loss of CD4 positive T cells resulting in immunodeficiency [8,15,26]. The clinical presentation is quite diverse and

depends on the presence or absence of OI and, if present, the nature of infection. Many of the mucous membranes of the body are constantly exposed to microbes and the secreting epithelial surfaces play a role in the protection of mucous surfaces against micro-organisms which include various fungi such as *Candida* [27,28,29,30].

The epidemiology of malnutrition and of infectious disease is inextricably intermingled, particularly in impoverished communities in the Third World [1,16]. Nevertheless, the fact that nutrient deficiencies of various types are immunosuppressive, especially among children, is a global phenomenon[11]. Bloom *et al.* (2000) state that those with compromised immunity are weakened by poor nutrition and other contributing factors such as lack of safe water and poor hygiene. This means that the disease burden in developing countries is disproportionately high [8,16,23,31], thus heightening the dangers of a disease that attacks the immune system, where malnutrition may contribute to the frequency and severity of infection as seen in AIDS, by compromising immune function.

Normal immune function is critically dependent upon good nutritional status. If malnutrition accompanies stress factors, the immune system is forced to work without adequate nutrient support, thus further impairing its activity [8]. Impaired immunity raises the risk of disease, disease impairs nutrition and poor nutrition impairs immunity, thereby creating a synergistic cycle that must be broken to permit recovery from the disease [1,32]. Figure 1, termed NAIDS, illustrates a three-way relationship, between malnutrition, immunodeficiency and infection. The relationship delineates that Protein Energy Malnutrition (PEM) leads to immunodeficiency, which predisposes to infection, and further aggravates poor nutritional status [1,8,21].

Figure 1: Nutritionally Acquired Aids Syndrome (NAIDS)



Source: [1]

The interrelationship between infection, nutritional status and immune function are especially apparent in individuals with HIV, who exhibit impaired immune function and altered nutritional status [1, 2,8,31,33] . Immune changes in PEM are similar to those seen in AIDS [14,22]. Both conditions are marked by multiple opportunistic infections of viral, bacterial, parasitic, and fungal origin [9]. Abnormalities occur in all limbs of the immune response; decreased production of thymic hormones, decreased cell-mediated immunity with inverted T-helper suppressor cell ratios, diminished natural killer cell numbers, and diminished responses to T-cell dependent antigens [8,17].

1.3 HIV/AIDS Prevalence

The HIV epidemic not only continues to expand rapidly in many parts of the world but also continues to have a major impact on child health and survival worldwide. Seventy five percent of all infected children die before the age of 5 years, the majority because of OI or malnutrition [1,19].

At the end of 1999 UNAIDS and the WHO estimated that 34.3 million people in the world were living with HIV/AIDS, including 1.3 million children less than 15 years of age [19]. The overwhelming majority of these children were born to mothers with HIV, acquiring the virus in the womb, around the time of being born, or during breastfeeding [1, 34, 35]. Their right to survive, grow and develop is threatened from their very beginning, and most of these children will live shortened lives, dying before they are in their teens [1,19]. Successful public health measures have stabilized the epidemic in most developed countries, but this is true of only some developing countries[14]. As of end 2001, the vast majority of people living with HIV/AIDS are in developing countries – 28.5 million people in sub-Saharan Africa [19].

HIV/AIDS is the single greatest threat to Africa's efforts to achieve its full potential. The firestorm rages most prominently in sub-Saharan Africa [36,37] (Figure 2), the home of 10% of the world's population, 70% of the world's HIV-infected people, 80% of AIDS deaths and 90% of AIDS orphans [37]. Since the start of the pandemic to the end of 1999, some 14.8 million people in Sub-Saharan Africa have died. Just over 20% of these deaths were among children. In some African countries, more than 10% of children under 15 years old are now orphans. Earlier estimates that more than 13 million children worldwide would lose their mothers or both parents

to AIDS by the year 2001 were surpassed by the end of 1999. Ninety percent of these orphans live in sub-Saharan Africa [19].

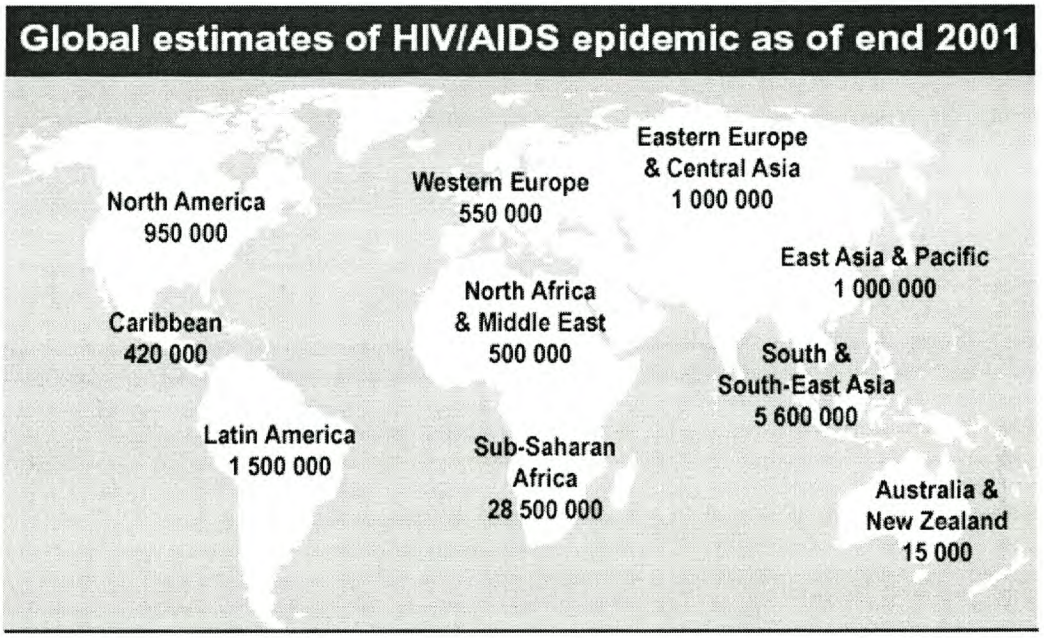
UNAIDS estimated that Southern Africa was experiencing the fastest growing epidemic in the world, with 24% of pregnant South African women HIV positive in 2000. At the time, South Africa, a country of over 43 million people, an estimated 3.6 million (7%) were infected with HIV as of year-end 2000 —of those, half were women aged 15-49. Among pregnant women, 16% were HIV-infected. There were 180,000 living children who had been orphaned by the disease and another 80,000 children infected with HIV, according to the 1999 South African Annual Department of Health Survey. High rates of teenage pregnancy and sexually transmitted diseases indicated the existing levels of unsafe sex. Vulnerability is much more complex than the obvious and tragic cases of street children and orphans, of whom UNAIDS estimated there were 40 million at end of 2001.

The continuing spread of HIV/AIDS increases pre-existing vulnerability levels of households and communities and, as women are becoming increasingly affected by HIV and AIDS, the household impact of the disease is increasingly overwhelming. Research indicates that food insecurity and malnutrition ranked foremost among the immediate problems faced by female-headed AIDS-affected households [36,37]. HIV/AIDS poses a potentially major threat to food security and nutrition, mainly by diminishing the availability of food (due to falling production and loss of family labour, land, livestock and other assets) and reducing access to food as households have less money. Due to the loss of family members, fewer people are available to work in the fields, households often farm smaller plots of land or switch to less labour-intensive subsistence crops, which often have lower nutritional and/or market value [2,32].

In Asia and sub-Saharan Africa women contribute to over 50% of food production, and typically carry out most labour-intensive farming activities [1]. In many regions, they are the core of subsistence farming, which tends to be most vulnerable to the effects of HIV/AIDS [1]. And they are usually responsible for preparing food. Illness and death among women thus contribute to reduced consumption and less nutritious diets.

Figure 2: Global estimates of HIV/AIDS epidemic

UNAIDS



Total number of adults and children living with HIV/AIDS: 40 million

People newly infected with HIV in 2001	**Total**	**5 million**
	Adults	4.2 million
	Women	*2 million*
	Children <15 years	800 000
Number of people living with HIV/AIDS	**Total**	**40 million**
	Adults	37.1 million
	Women	*18.5 million*
	Children <15 years	3 million
AIDS deaths in 2001	**Total**	**3 million**
	Adults	2.4 million
	Women	*1.1 million*
	Children <15 years	580 000
Total number of children orphaned by AIDS, and living, end 2001**		**14 million**

**Defined as children aged 0–14, as of end 2001, who have lost one or both parents to AIDS.

1.4 TB and HIV

Approximately one-third of people living with HIV worldwide are co-infected with TB[14]. TB kills more HIV-infected people in Africa than any other AIDS related disease, and in South Africa 50% of all HIV-infected patients have TB [37]. Many of the risk factors for TB are also risk factors for HIV-infection. The effects of HIV on T-cells make patients co-infected with HIV especially vulnerable to TB. The risk of progression to active TB disease after infection is greatly increased in-patients with HIV [39]. In a recent study, it was found that roughly 50% of 100 patients who stayed for 2 months of treatment in a TB sanatorium were also affected with HIV [8]. In contrast, a study followed through by the RETRO-CI researchers revealed that TB remains relatively rare in AIDS patients in Europe and the US.

1.5 Fighting Weight Loss

Weight loss is one of the most common and challenging health problems facing children with HIV-infection [41]. In Africa, chronic diarrhoea and wasting occurs in up to 50% of patients with AIDS [3, 16, 42]. Malnutrition is frequently encountered in the later stages of HIV-infection, and both patients with AIDS and individuals with PEM will experience multiple infection of viral, bacterial, parasitic and mycotic origin. However, medical researchers have made the distinction between wasting that accompanies HIV-infection and "AIDS wasting syndrome", which is more precisely defined as "Slim disease" [3,7,16]. This term denotes loss of subcutaneous fat deposits and muscle mass due to reduced energy intake, systemic infection, malabsorption and neoplasm [7,16].

Weight loss, body cell mass depletion, decreased skin-fold thickness and mid-arm circumference, decreased iron binding capacity and hypo-albunaemia are frequently reported in AIDS patients[7]. Due to illness, fatigue and lethargy that accompany malnutrition, disuse of muscle inevitably results in atrophy of the muscle and this may be a factor in muscle wasting found in AIDS patients. Severe weight loss may result in organ damage, which increases the risk of a fatal outcome from infections. In the absence of disease, starvation leads to death at 66% of ideal body weight [14,16]. Body cell mass, the amount of functional protoplasm in non-adipose tissue (muscle and visceral), may be the best predictor of death [38,43,44].

Metabolic abnormalities such as lipid metabolism occur in AIDS patients, ultimately affecting

the way in which wasting occurs and contributing to the total lean tissue depletion seen in patients with severe wasting. Persons with AIDS tend to lose body cell mass with little loss of fat [3,7,45] , in contrast with uncomplicated starvation, in which fat stores are depleted, which is the reason that body fat is not a predictable marker of wasting [16]. This complicates the task of detecting malnutrition. It is necessary that the initial scrutiny for malnutrition includes a thorough history and physical examination with special attention to alterations in body weight and body shape, changes in appetite, eating habits and functional status (including physical activity).

Paediatric HIV-infection causes early and progressive decrements in attained linear growth of mass, early and sustained decrements in head growth and marked increments in body mass index [17,46,47]. Postnatal growth differences between infected and un-infected children are maintained throughout childhood. However while an uninfected child born to a sero-positive mother can show catch-up growth, infected children fail to catch-up [35,48]. Growth failure often precedes the onset of OI [2], and some infections such as Cytomegalovirus (CMV) and Mycobacterium avium Complex (MAC) may have a slowly progressive clinical course, with up to two months of poor appetite and weight loss prior to the development of specific symptoms and clinical diagnosis. This is why it may be important to carefully monitor body weight and body composition as well as fever curves, which could provide the earliest evidence of OI [17,32].

Attrition of somatic and visceral proteins are features of HIV associated malnutrition [8,33]. The major site of protein loss is skeletal muscle because it is by far the largest single protein pool in the body. Changes in lean body mass primarily affect changes in muscle protein content. Other smaller systems are adversely impacted upon by protein deficiencies. Of particular importance to the AIDS patients are the immune, respiratory and gastrointestinal (GI) systems [11].

Factors responsible for protein wasting are: 1) activation of the immune system with increased cytokine production, including TNF that promotes catabolism, 2) disease associated fever, cough, anorexia, 3) medication induced anorexia, dyspepsia, dysgeugia, and 4) malabsorption of vital nutrients and medications [1,19,49].

Contributors to the net loss of muscle protein in AIDS patients include, most importantly, energy deficit, due to increased energy expenditure or reduced intake. Energy needs vary depending on the health status at the time of HIV-infection, the progression of the disease and the development of complications that will impair nutritional intake and utilization [16,18]. There had been limited data published on the energy needs of persons infected with HIV. It has been suggested in some of the few existing studies, that energy needs can be elevated as much as 50% above baseline, but other studies have shown no effect on energy expenditure. Macallan *et al.* declare that reduced energy intake rather than elevated energy expenditure may be the primary factor in HIV related weight loss[18].

Other mechanisms likely to be contributors to the net loss of muscle protein breakdown are hyper-metabolism, where muscle is a source of glutamine to support the immune system in stressed states, and atrophy secondary to disuse of non-metabolic origin, such as muscle loss secondary to the effects of the AIDS virus on the nervous system [3].

1.6 Malabsorption

Malabsorption is common with advanced AIDS [19,21,49]. As the disease progresses and signs and symptoms of HIV-infection and AIDS manifest, nutritional complications develop. Diarrhoea and malabsorption are the major nutritional problems seen [3,13, 25], this is due to a relatively high cell turnover rate encountered by the mucosal tissue of the gastrointestinal tract[19]. Thus, not only are intestinal infections and diarrhoea promoted, but absorption of several essential nutrients is impaired [12,25, 46, 49].

Protozoal microsporia is a common cause of wasting due to diarrhoea and malabsorption in patients with HIV and a CD4 count below 100/mm^3 [18]. This may mean that nutrients or drugs ingested by the individual with AIDS are not absorbed into the body. Due to HIV-infection the finger-like projections, villi, which extract nutrients and water from food as it passes through the gut, may begin to malfunction. The villi may no longer draw nutrients out of food with the same efficiency, and the body may be unable to produce the antibodies needed to combat microbes, as a result the gut may become inflated or perforated [8, 18, 32].

Malabsorption of fat, monosaccharides, disaccharides, nitrogen, vitamin B12, folate, minerals, and trace elements occur in patients [5] with intestinal infections of the small bowel. When the large intestine is infected, malabsorption of fluids and electrolytes is seen [8,32]. The clinical evaluation of malabsorption may be confounded by the presence of diarrhoeal illnesses that are not associated with malabsorption, including GI complications[12]. Additionally, fat malabsorption has been found to be very common in AIDS patients and appears to occur throughout the disease process, and not is always accompanied by diarrhoea or other typical symptoms.

1.7 Nutritional Support

The rationale for providing nutritional support for AIDS patients is based upon the assumption that nutritional status can be improved, and such progression may improve survival and quality of life. Nutritional recommendations for HIV-infected children are largely based on theoretical considerations where age-related macro- and micro- requirements have been optimised. Watson (1994) emphasises the five goals for nutritional support in HIV patients as being to:

1) minimize metabolism/control weight loss [6, 38, 49, 50],
2) minimize and/or replenish nutrient loss [6, 19, 38, 49,50],
3) replenish visceral and somatic protein mass [5, 6, 38, 49, 50],
4) maximize respiratory function/improve host resistance to opportunistic infections [4, 6, 38, 49,50],
5) enhance quality of life [4, 5, 6, 13, 40, 49,50]

Mahan and Escott-Stump (1996) mention that the use of specially designed formulae may slow down the progressive decline towards malnutrition in HIV/AIDS. There are three basic types of supplemental nutrition for AIDS patients. These are total parenteral nutrition (TPN), peripheral parenteral nutrition (PPN) and tube feeding (TF), also known as enteral nutrition. The more aggressive nutritional support (enteral and parenteral) is required for patients who are unable to gain weight through conventional means and is shown to be effective in maintaining body cell mass once the specific disease complication is controlled [2,8, 38].

Generally TPN is administered in acute settings to provide a temporary source of nutrients. Research done in this area has indicated that parenteral nutrition has led to an increase in body weight and fat, but provides no changes in body cell mass (particularly in wasting HIV patients)

(Kottler *et al,* 1989). However, the results distinguished between the effects of total parenteral nutrition in the presence of malabsorption and systemic infection. Patients with malabsorption syndromes or eating disorders responded well to TPN, with significant increases in body cell mass, while patients with systemic infections continued to lose body cell mass, and gained fat instead [20]. It may also be noted that, in most cases, HIV associated wasting is not corrected simply by feeding [32,38].

The composition of enteral feeding meant for HIV patients varies widely. The most commonly used and least expensive are polymeric in nature and not different from ordinary food, other than being liquid and that some have no residue [51]. Enteral feeding can be formulated to provide specific nutrients that are more easily tolerated in the event of small intestine injury. Some of these formulae contain protein hydrolysate rather than whole proteins. Others are lactose free supplements or supplements that contain medium chain triglycerides [18]. Substitution of medium-chain triglycerides lessens fat malabsorption, short peptides can be substituted for whole protein and lessen the effect of defective intraluminal digestion, as well as the hyperosmolarity associated with standard enteral formula and free amino acids. The use of protein supplements is common though there is little information about their use. The evaluation for malabsorption can be implemented by careful history, stool examinations, and non-invasive tests such as the D-xylose absorption test and/or the qualitative faecal fat analysis [20].

There are no data to support the standard use of enteral formula in normally nourished HIV-infected individuals. Supplements are most indicated in the presence of fatigue and debility since the formulae require little effort to prepare. Supplementation is also useful to ensure that no nutritional deficiencies occur [18,19,38].

1.8 Micronutrients

There is now a large body of evidence linking micronutrient deficiencies with accelerated progression of HIV-infection to AIDS, suggesting that such deficiencies are predictive of AIDS related mortality. Micronutrients play an important role in key cellular and metabolic processes [8,15]; micronutrient deficiencies can therefore be expected to alter the immune system as already indicated. In addition to generalized PEM, AIDS patients exhibit deficiencies in a variety of

nutrients [4,20], including low levels of plasma zinc, selenium, copper and folic acid despite what appears to be adequate dietary intake [14,16,18]. Impaired cellular antioxidant status is a consistent prominent feature of PEM and other forms of malnutrition [22,52], and may very well play a key role in the rapid replication of HIV in the malnourished [10,16]. Specific micronutrient deficiencies that have been frequently observed in children with HIV disease include deficiencies of iron and vitamins A, B complex and E, which are all needed by the immune system to fight infection.

As a result of malabsorption, the blood micronutrient levels of HIV-infected individuals are often lower than those of comparable individuals without the virus. Micronutrient deficiencies may be caused by poor food intake, by malabsorption, by increases in nutritional needs or by the disease itself [12,15,43,53]. The nutrients under investigation for their potential usefulness against AIDS include the trace elements selenium and zinc; the pro-vitamin beta-carotene; folate; and vitamins A, B_6, B_{12} and C [46].

The impact of HIV-infection on vitamin A status has been examined by a number of studies over the past years, with consistent results. HIV-positive individuals are at particular risk of vitamin A deficiency (VAD) [43] for several reasons: chronic and recurrent infections, inflammatory status, poor intake, and diarrhoea with or without malabsorption [9, 15, 24, 38]. In a 1994 study among HIV-infected women in Malawi, it was found that 32% of those who were vitamin A deficient during pregnancy had transmitted HIV on to their infants, while only 7% of HIV-infected women with sufficient levels of vitamin A did so. It was concluded that pregnant women that are HIV-infected are four and a half times more likely to infect their child if they are vitamin A deficient (Malawi College of Medicine, 1999).

Interestingly De Kock *et al.* (2000) indicated that, vitamin A supplementation trials, like other trials, have not shown reduced peri-natal HIV transmission. Meanwhile, the latest evidence indicates that VAD is associated with an increased risk of mother-to-child HIV transmission (MTCT), and vitamin A supplementation reduces pre-term births and improves the health of unborn children. VAD has also been associated with diminished CD4-counts and tripling of the risk of HIV related deaths, and is a good indicator of morbidity associated with diarrhoea in HIV infected children[52].

Incidentally, a study conducted in New York also indicated that severe VAD increases the risk of maternal-infant transmission among HIV-infected women. Further analysis of the data indicated that VAD is associated with low economic status women, inner city women, race, and pregnancy. However the same study did not identify whether vitamin A supplementation was able to reduce the vertical HIV transmission rate.

Researchers have provided human evidence that adequate vitamin A levels are important for modulating normal immune function through lymphopoiesis, cellular differentiation, growth, reproduction, vision and haematopoiesis. Evidence suggests that VAD is common among HIV-1 infected pregnant women and children. Although a cause-effect relationship is not established, evidence suggests that HIV-1 infection results in less vitamin A stores in the liver [43]. There is further, though not conclusive, evidence that VAD is associated with increased risk of development of diarrhoea, wasting syndrome, increased risk of progression of AIDS, reduced circulating CD4+ T-cells, increased HIV-1 viral load and increased risk of mortality [15, 23 43].

Vitamin A has remarkable pleotropic effects including established roles in haematopoiesis, the maintenance of epithelial integrity and optimal function of the immune system [9, 43, 52]. Loss of vitamin A on epithelial tissues, may therefore lead to a deterioration in non-specific immune surveillance, and adaptive immunity may therefore be inadequate HIV-infection, initiating a vicious spiral of infection/inflammation, further depletion of vitamin A stores and even greater susceptibility to infection/inflammation and malignancy [9,16, 32] (Figure 1).

Further VAD has been found to be associated with an increased risk of vaginal HIV-1 viral shedding after adjustment for CD4+cell count [43]. Given the adverse effect that VAD has on immune function and mucosal integrity and the evidence that deficiency among HIV-1 infected women is associated with increased vaginal viral shed, it may be concluded that, during delivery, women with VAD have more HIV-1 in the vaginal cavity. Among infants born to VAD women, an increase in viral load in the vaginal cavity may increase risk of transmission during vaginal delivery [43, 51].

While noting that most vitamin supplementation trials have failed to show a positive effect of vitamin A on growth of children, Rahman suggests that it is not a single nutrient that limits a child's growth potential but rather a combination of several micronutrients that act as limiting factors for growth in children. For example, iron plays an essential role in the optimum activity of enzymes which play a crucial role in the functioning of lymphocytes and neutrophils. Copper is needed for synthesis of a specific type of white blood cells by the immune system, which also needs adequate amounts of vitamin C, protein, vitamin B_6, folate and B_{12} for general cell synthesis, and later for cell activity [9,16,54]. Zinc and vitamin A are also needed for the overall growth and development of immune cells [16,18,43,51]. Ascorbic Acid and vitamin A are antioxidant micronutrients whose tissue levels are depleted in PEM and in HIV-infection [18,51,54,61].

Furthermore malnutrition on its own has been known to affect the oral cavity, with iron and other vitamin deficiencies being implicated as predisposing factors for *Candida* infection [29,55] . In addition to epithelial infection, iron deficiency could substantially decrease the cell-mediated immune response. Iron could influence the carriage of *Candida* by diverse mechanisms. Most importantly, however, iron deficiency may produce an impairment of iron-dependent enzyme systems, thereby affecting the metabolism and hence the kinetics of the rapidly dividing oral epithelial cells [15]. Such alterations may result in an epithelial surface more conducive to the invasion, adhesion and growth of *Candida*. Furthermore the increased thickness of keratin seen in iron deficient oral mucosa is more suitable for *Candida* growth [15, 29].

1.9 Nutrition and Drug Interactions

Treatment of children with symptomatic HIV-infection often involves the use of many drugs as in antibacterial and antifungal chemotherapy, in addition to specific antiretroviral therapy [8,32,38,55,56]. Drug interaction has been shown to lead to toxicities or antagonism that can diminish a drug's effect [8]. Additionally, drugs may interfere with absorption of nutrients, protein binding mechanisms, or excretion. Many of the drugs prescribed with HIV are associated with GI disturbances such as oral thrush, nausea, vomiting, and constipation, and thus ultimately interfere with an adequate dietary intake. Meanwhile, the stress malnutrition places on an already weakened system, appears to complicate treatment of the disease by affecting the intestinal tract's ability to absorb drugs [21].

Serious problems associated with long-term use of drugs, particularly Azidothymidine (AZT) may include severe and painful myopathy and bone marrow depression, often leading to symptomatic anaemia that requires transfusion [26,38]. From the nutritional point of view, AZT has been reported to be a potential mechanism of B_{12} deficiency. Other drugs which are used as immunomodulators may inhibit initial transcription of viral messenger RNA and protein synthesis [8,32].

On the other hand, drug therapy may be ineffective due to malabsorption [8]. In such cases hyper-alimentation and increased oral drug dosing or intravenous administration have been shown to be helpful when administering anti-mycobacterial drugs. Table 1 indicates the effect drugs have on the body and the nutritional means of counteracting the problems encountered in HIV-infection and AIDS patients.

Incidentally, there is limited information on how HIV-infected children with poor diets respond to medication when compared with those well nourished.

Table 1: Drug and Nutrient Interaction

Drug	Use	Effects	Ensure that (food interaction)
Bactrim (Clotrimoxazole)	drug resistant TB, toxoplasmosis	vomit and nausea	ensure adequate hydration/electrolytes
Acyclovir	prophylaxis	headache and nausea	ensure adequate hydration/electrolytes
Azidothymidine (AZT)	HIV infection with CD4 count <500cells	nausea, vomit, muscle damage, bone marrow suppression	monitor for anaemia, increase food intake
Ganidovir (Cytovene)	herpes simplex/zoster	diarrhoea, anorexia, vomit, low WBC count	monitor WBC (especially if taken with AZT), replace fluid/electrolytes, increase food intake, use medium chained triglyceride oils
Ddi (Videx)	inhibits HIV replication	diarrhoea, vomit, nausea, peripheral neuropathy	replace fluid/electrolyte, avoid magnesium or aluminium containing antacids, increase food intake
Megestrol	enhance appetite, treat anorexia	short breath, sexual dysfunction	---
Clarithromycin (Biaxin)	mycobacterium avium complex (MAC)	taste alteration, diarrhoea, nausea, vomit	
Isionazid (INH)	pulmonary TB	liver problems if alcohol consumed	food may reduce drug uptake
Rifampin	pulmonary TB	loss of appetite, nausea, diarrhoea	drug to be taken an hour before or two hours after meals as food may affect uptake
Ethambutol	TB and MAC	nausea, vomit, appetite changes, upset stomach	magnesium or aluminium containing antacids, may reduce uptake
Bismuth Salicyclate	anti-diarrhoeal	taste alteration	---
Ketoconazole (Nizonal)	Fungal infection including Candidiasis(oral thrush)	nausea, vomit, bowel change	absorbed more effectively when taken with food
Clotrimazole	fungal infection of mouth, skin and vagina	---	---
Fluconazole	Fungal infection, especially Candida infection of mouth and vagina	nausea, vomit, diarrhoea, abdominal pain	---
Nystatin	Fungal infection, especially Candida infection of mouth and vagina	diarrhoea, vomit, stomach upset	

1.10 Oral Manifestations in HIV-Infection

Oral infections tend to be recurrent, severe and sometimes resistant to treatment [27,28,29,30,57,58] and lead to food intake being directly inhibited. The most common patient complaint is odynophagia due to esophagitis caused by *Candida albicans*. Esophageal ulcers of viral, mycobacterial, and neoplastic varieties also affect food intake [16,27].

The oral cavity harbours an extremely varied and complex microbial flora with marked potential to probe the host defences and produce disease when those defences are in the least compromised [24, 27,57, 59]. In the oral cavity, malnutrition induced mucosal disruptions with poor oral hygiene is expressed in angular cheilosis, stomatitis, Candidiasis and severe periodontal lesions [55]. It is widely recognized that oral Candidiasis, in one or more of its many guises, is common among those with HIV-infection [27,28,29,55,57]. Wozniak (2002) indicates that oropharyngeal *Candida* is a common opportunistic infection among HIV-infected patients, with occurrence rates of 50% - 95%. These oral manifestations of HIV may cause considerable pain, discomfort, inability to swallow and difficulties in eating [27, 28, 60], and can occur at multiple sites in the gastrointestinal tract, which may lead to malnourishment and emaciation [4]. Pons *et al.* (1993) indicate that oral Candidiasis occurs in more that 90% of HIV-infected patients at some time during their illness.

HIV induces immunological effects that allow for the development of opportunistic infections and neoplasms, and because the oral cavity is particularly susceptible to HIV related infections, a great variety of oral lesions have been described in association with the epidemic (Table 2). Several case reports in the dental literature have demonstrated oral Candidiasis preceding the development of AIDS among risk groups [55]. Watson (1994) points out that oral lesions may also indicate a diagnosis of AIDS or may be the first clinical features of immuno-suppression [29,55], as the oral cavity is the prime site for soft tissue lesions associated with AIDS [55, 56, 57, 71].

Table 2: Classification of Common Oral Infections

Group 1 **Lesions strongly associated with HIV infection**	Candidiasis - Erythematous - Hyperplastic - Pseudomembranous - Angular cheilosis is often associated with *Candida albicans* Hairy Leukoplakia Kaposi's sarcoma Non-Hodgkin's lymphoma Periodontal disease Linear gingival erythema Necrotising (ulcerative) gingivitis Necrotising (ulcerative) periodontitis
Group 2 **Lesions less commonly associated with HIV infection**	Bacterial infections Mycobacterium avium inracellulare Mycobacterium tuberculosis Melanotic hyperpigmentation Necrotising (ulcerative) stomatitis Salivary gland disease Dry mouth due to increased salivary flow Unilateral or bilateral swelling of major salivary glands Thrombocytopaenic purpura Ulceration NOC (not otherwise specific) Viral infections Herpes simplex virus Human papillomavirus (wart-like lesions) Condyloma acumination Focal epithelial hyperplasia Verruca vulgaris Varicella-zoster virus Herpes zoster Varicella
Group 3 **Lesions seen in HIV infection**	Bacterial infections Actinomyces israeli Escherichia coli Klebsiella pneumoniae Cat-scratch disease (also) bacterial Epithelioid (bacillary) angiomatosis (also bacterial) Drug reactions (ulcerative, erythema multiforme, lichenoid, toxic epidermolysis) Fungal infection other than Candidiasis Cryptococcus neoformans Geotrichum candidum Histoplasma capsulatum Mucoraceae (mucormycosis/zygomycosis) Aspergillus flavus Neurologic disturbances Facial palsy Trigeminal neuralgia Recurrent apthous stomatitis Viral infections Cytomegalovirus Molluscum contagiosum

Adopted from source: [29]

The mucosal tissues of the oral cavity and the rest of the gastrointestinal tract have relatively high turnover rates [28,71]. In PEM, a fundamental problem is poor cell production resulting in intestinal mucosal atrophy, thus PEM not only promotes intestinal infections and diarrhoea, but also impairs absorption of several essential nutrients [8, 28, 49]. Mucosal disruptions may also be a consequence of PEM whereby hypofunction of the salivary glands results in xerostomia, and therefore, inadequate provision of salivary factors required to protect the oral tissues against the numerous potentially pathogenic oral microbial organisms [62]. As Greenspan (1991) indicates, it is not, therefore, surprising that oral lesions such as Candidiasis and periodontal diseases are generally more severe in HIV-infected individuals [57].

Although oral *Candida* is seen to be common in children with AIDS and can cause significant morbidity, the infections can be treated using fairly simple therapeutic approaches. Symptoms include soreness of the mouth and tongue, often described as a "burnt" sensation, and pain or difficulty with swallowing. Along with Candidiasis, oral complications may include apthous ulcers, gingivitis, leukoplakia, herpetic lesions, and oral Kaposi's sarcoma. Local symptoms such as dysphagia due to oesophageal Candidiasis will, obviously, directly influence food intake and accelerate wasting. Kaposi's Sarcoma or herpes in the oropharyngeal area can also inhibit normal chewing and/or swallowing and therefore limit nutrient intake [28,29].

While nutrition is clearly important for the maintenance of a healthy immune system and the development of malnutrition is likely to further contribute to the clinical dysfunction of the immune reaction and be an aggravating factor for the progression of HIV, the incidence and prevalence of oral lesions seen in association with the AIDS epidemic has drawn attention also to the importance of this group of diseases. Oral examination is an important part of any examination, and nowhere is this more important that in suspected HIV-infection [29,30,53]. The inter-relationship of oral lesions and nutritional status and the lack of data on the topic is a major part of the reason why this study was undertaken.

CHAPTER 2: METHODOLOGY

2.1 Motivation for the Study

This study was conducted at Brooklyn Chest Hospital, Cape Town, South Africa where in-patient records of the paediatric ward from July 2000 reveal that of the 60 infants (under 120 months of age) that were present in the ward being treated for TB in that month, approximately 50% were co-infected with HIV. Of these, some had full-blown AIDS; others had complications associated with malnutrition.

On average, Brooklyn Chest Hospital admits 3 children per week. Their ages vary from 6 months to 10 years and their length of stay at the hospital varies from 3–6 months (sometimes longer). A large number of these children present with oral *Candida*, which may have resulted in reduced dietary intake, further pre-disposing them to a multitude of infections. Most are not from affluent families and do not have ready access to medication/drugs.

This study was prompted by the apparent need for nutrition intervention among children such as those at Brooklyn Chest Hospital. This study took place from March 2001 to February 2002.

2.2 Objectives

The study aims to examine the nutritional status of children aged 9 months to 9 years that present with HIV and TB infections and with oral lesions. Its specific objectives are to:

1) determine the prevalence of malnutrition associated with oral complications in children infected with HIV and TB,
2) investigate the effects of oral lesions on nutritional status, and
3) determine whether the presence and severity of oral complications in HIV and TB-infections preclude adequate food intake, thereby leading to malnutrition.

2.3 Methodology

2.4 Study Design

The study uses a prospective cohort with a descriptive component. The convenience sampling method was employed for the consecutive selection of subjects on admission to hospital. The descriptive component allowed for quantitative data.

2.5 Study Population

The study population included only children under the age of 10 years (<120 months) and over 9 months who were infected with HIV and TB. A total of 24 children were monitored and followed up until their discharge from hospital or for a maximum period of 6 months (some children were still in hospital after 6 months).

2.6 Data Collection Tools

In the data collection phase, anthropometric measurements of the children were taken on their admission to Brooklyn Chest Hospital. Standard equipment that was used for data collection included a Recumbent Infant Length Board (model PE-R145-122, Perspective Enterprises, Michigan USA); a Portable Infant Weighing Scale (model MP25 CNS Weighing Equipment, UK); a non-stretchable measuring tape made of fiberglass; and a Lange Skinfold Caliper (Lange products, USA). Standing heights were obtained by means of a mounted standiometer (Holtain Limited, Crymych, Dyfed, UK). Other equipment included 5ml EDTA blood sample bottles.

Three questionnaires were employed: a structured questionnaire, a 24-hour recall questionnaire, and a food frequency questionnaire (Appendices 1, 2 & 3). Prior to commencement of the study, both the food frequency and the 24-hour recall questionnaires were tested and validated (Appendix 4) on a pilot population of children admitted to the hospital who met the inclusion criteria of the study. The purpose of the pilot study was to test the accuracy and precision of the measuring tools to be employed and to assess measurement bias such as the use of scales. The pilot study took place in November and December 2000. It also allowed the researcher to familiarise herself with all equipment to be used in the research.

2.7 Data Collection Procedures

When a child that met the criteria described in section 2.5 was admitted to the hospital and was confirmed HIV sero-positive and TB-infected, the researcher would be informed by a Registered Nurse at the hospital. Data collection began with the recording of personal details, including name, age, home address, from the patient's personal record/file. Additional information was obtained from the medical records, such as previous incidents of malnutrition, CD4+ cell count (Appendix 1), nutrition related illnesses and/or diseases that could have placed the child at risk for malnutrition, and/or oral complications. The purpose of extracting information from the medical records was to give the researcher a profile of the child's nutritional status. The following procedures were subsequently followed, as summarized in Table 3, which outlines tasks performed by the researcher from the time of admission up to discharge of the child from the hospital.

Table 3: Data collection procedures

Tasks Performed	Admission	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
Interview (parents/ guardians)	✔						
Anthropometric measurements	✔	✔	✔	✔	✔	✔	✔
7-day dietary record (recorded every 4th week till discharge)	✔	✔	✔	✔	✔	✔	✔
24-hour dietary recall (on children)	✔						
FFQ recall (on children)	✔						
Urine analysis (for creatinine)	✔						
Clinical evaluation	✔						
Oral examination	✔			✔			
Biochemical assessment	✔			✔			

2.7.1 Interview with Parents/guardian

A person-to-person interview was conducted by the researcher with parents/guardians of the child immediately upon admission of the child to hospital. If the parents/guardian of the child were unavailable at the hospital, an effort was made to locate and meet with them elsewhere. (If the researcher was unable to get hold of the parents/guardians within 24 hrs of admission of the child to hospital, the child was excluded from the study). Once contacted, the parents/guardians of the child were briefed on the details of the on-going research and their consent to the research was sought. If consent was obtained, they were asked to complete the standardized structured questionnaire (Appendix 1) which covered 1) socio-economic variables such as gender, age and employment, 2) details of the child's eating habits (dietary intake is described in section 2.7.4), and 3) disease/illness related variables.

2.7.2 Anthropometric Measurements

Standard NCHS/WHO procedures developed for various age groups were used to measure body weight, height and mid-upper arm circumference (MUAC) [76].

Weight

The scale was calibrated to zero before weighing and weight was then recorded to the nearest gram. Children who could not stand independently (generally those < 24 months) were carried by an adult whose weight without the child was subtracted from weight with the child in order to calculate the child's weight. Children were weighed with minimal clothing: either naked or with just a dry nappy. Care was taken to ensure the child remained as still as possible in order to take a reading [4,18,69,76].

Height

Children who could stand independently (those >24 months) were measured in standing position using a standiometer. They were positioned such that the Frankfurt plane was horizontal, their feet together, knees straight, arms loosely hanging at the sides, heels, buttocks and shoulder blades in contact with the vertical surface of the standiometer. The child's height was recorded three times and the average of the measurements was recorded to the nearest centimetre [18,69,76].

Crown-heel length

For infants and children under 24 months of age, recumbent length was measured on a wooden length board. The assistance of a Registered Nurse was required to correctly position the child and ensure accurate measurements and to keep the child's knees straight. The child was measured without shoes or socks, with the head facing upwards, the crown of the head placed against the headpiece of the board and the shoulder touching the base, the heels resting against the foot piece. The movable footboard was then placed firmly against the heels of the child and the measurement read to the nearest centimetre [18,70,76].

Mid-upper-arm circumference

The right arm of the child was measured along the horizontal line on the level of the mid-point of the upper arm. The mid-point was located by letting the arm hang relaxed at the side and marking the mid-point of the distance between the acromion process and the tip of the olecranon. Care was taken not to compress the soft tissue when placing the measuring tape around the marked mid-point of the arm. The measurement was read to the nearest 0.5 millimetre [18,70,76]. Children who could not stand were seated in an upright position, right arm bent at 90° angle, palm of hand facing upwards; the distance between

Tricep Skinfold

The mid-point between the angle of the acromion process and the point of the olecranon was obtained in the posterior of the upper arm, with the child seated in an upright position and the arm bent at the elbow at an angle of 90°, palm of hand facing upwards. Measurement was done using calipers. The skinfold was grasped with fingers vertically at the marked mid-point and calipers were used to measure the fatfold (skin plus underlying fat), the caliper jaws being applied at a right angle. The measurement was taken three times and the average of the three measurements was recorded to the nearest 0.5mm [4,18,70,76].

2.7.3 Clinical Examination

The researcher conducted a physical examination of the child to discover signs and symptoms associated with malnutrition. Areas examined closely for muscle wasting included the temporal muscles and the interosseous muscles on the hands [76]. The skeletal muscles of the extremities also served as indicators of malnutrition [26]. Subcutaneous fat stores were examined for losses

reflected by reduction in weight. Nutrition-oriented aspects of the examination focused on the skin, head, hair, eyes, mouth, teeth, gums, nails, extremities, abdomen, skeletal muscle and fat stores (Appendix 5).

2.7.4 Dietary Intake

24-hour recall

The researcher asked the parent/guardian to recall all foods, beverages and snacks consumed by the child in the previous 24 hours. Detailed descriptions of all food and beverages were recorded including amounts (weights) of each item, food portions and the cooking method. The size of the food portions was estimated by using standard household utensils. The respondents were also asked to recall vitamin and mineral supplements. Data obtained from the recall procedure was recorded by the researcher on the 24-hour recall sheet (Appendix 2).

Food Frequency questionnaire

In order to assess the association between dietary habits and disease, and also to assess food frequency in a period of a month (30 days) prior to admission to hospital, a food frequency recall questionnaire was used (Appendix 3). Parent/guardian was asked to recall all foods, beverages and snacks consumed by the child in the previous month. This food frequency questionnaire was filled out on the same day as the 24-hour recall or on the following day. Detailed descriptions of all foods and beverages were recorded along with the amounts (grams, ml) of each item, food portions and the cooking method. The size of the food portions was estimated by using standard household utensils. The respondents were again asked to recall vitamin and mineral supplements. The food frequency questionnaire consisted of a list of foods that focus on specific food groups.

Having completed the recalling session, (a similar procedure was conducted for the 24-hour data) the researcher later checked and recorded the coding of the food items in accordance with the South African Food Composition Table 2001 [79]. The researcher then noted and recorded the type and estimated quantity of food consumed by the child.

2.7.4.1 Dietary Record in Hospital

Actual food intake during hospitalization was monitored by the researcher with the assistance of

the Registered Nurses, using the standardized daily intake sheet (Appendix 6), which displayed the type and quantity of meals consumed by the child. All foods, beverages, and snacks consumed by the child were recorded for a period of one week (7 days) per month, beginning with the first week of admission to hospital (and every fourth week subsequently). To obtain an idea of how the meals were prepared, the researcher had to consult with the hospital kitchen staff. Food that was brought into hospital for the children by visitors, parents and relatives, was also recorded. A daily intake was calculated from the data. The data was transferred into the computer using the Foodfinder II software [79] . The daily nutrient intake was calculated for each child from a nutrient database stored on the software. The average of month 3, 4, 5, or 6 (depending on the length of stay of the child in the hospital) was recorded.

2.7.5 Oral Examination

An Oral Medical Specialist (or a Registrar or Paediatrician, who were debriefed and trained by the Oral Medical Specialist regarding the specifics and the research requirements) examined each child and classified any oral complications of observed HIV lesions according to the WHO criteria on Oral Manifestations of HIV in children [55]. Lesions were recorded (Appendix 7), the descriptions included appearance of oral thrush, oral lesions, pain and difficulty chewing and swallowing (the children were observed for signs of discomfort and/or refusal to chew and eat, and closely monitored by the researcher during meals), the duration and frequency of the oral complications and the recurring rate of the complications.

To compliment the nutritional assessment, information in this section was obtained from the dental Faculties of the Tygerberg Hospital and Brooklyn Chest Hospital, where a study to assess the change in the oral carriage of *Candida* species in patient's co-infected with HIV and TB was already in place and was supervised by the Head of Dentistry Department, University of Stellenbosch, who was supervising the above project.

2.7.5.1 Laboratory Diagnosis of Oral Candidiasis

Direct examination

The Oral Medical Specialist made a diagnosis of lesions (pseudomembranous or erythematous oropharyngeal) on the basis of a clinical appearance of removable white plaques or atrophic

erythematous areas of the oral mucosa [29].

Swabs

For infants too young to enable oral rinses, the Oral Medical Specialist had to obtain swab samples, which were obtained by rubbing a sterile cotton-tipped swab over the lessional tissues of the child. The swabs were then conveyed to the dental department of the Tygerberg Hospital within a 24-hour period to prevent desiccation – *Candida albicans* can survive at least 24 hours on a moist swab without gain or loss of viability.

For analysis, swabs from lesions were inoculated onto an agar jar and identified by perm tube production and sugar assimilation tests. The Oral Medical Specialist then stained the swabs with gram stain, which showed characteristic rounded or ova budding cells of yeast blastospores (yeast formation). These were readily distinguished from bacteria by their greater size (3-6°m), budding, oval shape and their tendency to produce elongated pseudophyphae (mycelial forms) [29].

Oral rinse technique

The older children, who were able to rinse their mouths, were asked to provide rinse samples by rinsing the mouth for 60 seconds with 10ml of phosphate buffered saline (PBS) supplied in universal containers. The sample was then sent to the laboratory for analysis [29], where it was concentrated by centrifuging at 1700xg for 10 minutes and re-suspending the deposit in 1ml of sterile phosphate buffered saline (PBS). The concentrate was inoculated on appropriate media to assess colony-forming units (CFU) of rinse sample using a spiral platter [26,29]. All the plates were then incubated for 48 hours at 37°C. Candidal density was determined by a Gallenkamp Colony counter and expressed as CFU/mm^2. CFU counts in excess of 30CFU^{-2} suggested candidal infection

2.7.6 Collection of Blood Specimen

A specimen from each child was drawn from the antecubital fossa into a syringe by a medical doctor experienced in taking blood from children or a qualified nurse. Blood was drawn into an EDTA tube for full blood count and aliquoted into a second EDTA tube for nutrient analysis. The tubes were then placed into a cooler box containing ice packs. The blood was then

transported to the laboratories in either the department of Human Nutrition or Haematology at Tygerberg Hospital by the end of the day. Haematological, nutrient and protein analysis included serum levels of albumin, haemoglobin, hematocrit, total lymphocyte count, creatinine, vitamins A, B_{12}, C, zinc and folic acid. Full blood count values were also derived from the patients' records (if available). In the third month of follow-up, a repeat of the above-mentioned analysis was performed (Table 3).

2.7.6.1 Biochemical Analysis

Vitamin C - The plasma and leucocytes were immediately separated. Using the Spectrophotometer method, ascorbic acid was oxidized to dehydroascorbic acid in the presence of iodine and the excess iodine destroyed [60,78] (normal values: >15µg/dl). The coefficient of variation for standards used for the normal values was 7.7%.

Vitamin B_{12} - Radioassays that measure serum folic acids were used to determine vitamin B_{12} levels [78] (normal values: 148 –682pmol/l). The coefficient of variation for the standard used for the normal value was 5.2%.

Retinol (Vitamin A) – The high performance liquid chromatography (HPLC) method was used to determine retinol levels[60] (normal levels >20mg/ml). This method involves de-proteinising plasma with ethanol (containing retinyl acetate) and extracting the lipid with hexane. After an aliquot of the solvent phase is evaporated, the residue is injected into a C_{18} reversed phase chromatographic column, and the absorbance of the vitamin and internal standard is measured [60]. The coefficient of variation for standards used for the normal values was 4.5%

Serum Ferritin - Serum Ferritin was determined using the Nephelometer method. The coefficient of variation for standards used in the analysis for normal values was 6.8%.

Hematocrit – This involved spinning a small volume of blood collected into a heparinized glass capillary tube, using a special microhematocit centrifuge. Haematocrit is calculated by comparing the height of the column of packed red cells with the height of the entire column of red cells and plasma [60] (normal values: in ages <2years, 2-5 and >6 the levels are respectively

>31%, >34% and >36%) The coefficient of variation for standards used for the normal values was 6.1%

Serum Transferrin - Serum Transferrin was measured by enzyme immunoassay (normal values: 0-5months; >2.5g/dL, 1-5 years; >3.0g/dL, 6-17years; .3.5g/dL). Serum transferrin concentration was estimated by quantitating transferring in plasma, utilizing antigen-antibody reactions in a gel matrix, in which a monospecific antiserum was incorporated in uniform concentrations. The antigen applied was quantitated by determining the diameter of the precipitin ring that forms when diffusion of the antigen has ceased. The diameter of the ring is directly proportional to the amount of antigen applied. The coefficient of variation for standards used for the normal values was 1.15%.

Serum Albumin - Plasma albumin and pre-albumin were measured by laser immunonephelometry [54]. Pre-albumin, Creactive protein (CRP was defined as the detection of light energy scattered toward a detector that is not in the direct path of the transmitted path) (normal albumin values: 0-1 years; 2.9-5.5g/dL, >1 years; 3.5-5.0g/dL, normal pre-albumin: 0.25-0.45g/L).

MCV - MCV was determined directly with an electronic impedence (ADVIA 120 system) via histogram analysis.

Plasma Retinol Binding protein (RBP) - Retinol was freed from RBP by adding ethanol to diluted plasma and extracting it with n-hexane. The extract was separated by straight phase HPLC on a silica gel column [60] (normal values: 0.3 –0.6g/L). The coefficient of variation for standards used for the normal values was 7.6%.

2.7.7 Collection of Urine Specimen

To determine urinary creatinine levels, 24-hour urine samples were collected from each child in individual patient polyethylene containers and kept in the cool box. The times of voiding for each child were noted. Children were instructed to void in clean, dry pans and the specimens were then transferred in to a 24-hour labelled container. Specimens for infants were collected

into disposable apparatus consisting of plastic bags with adhesive backing around the opening that could be fastened to the perineal area around the penis to permit voiding directly into the bag. In this case it was difficult to note the times the infant voided. After careful removal of the bag, the specimen was transferred to an individual urine containers, labelled and placed in the refrigerator until the end of the 24-hour period, when the entire specimen per child would be transferred (in a cool box) to the laboratory. The total volume was recorded in millimetres per 24-hour.

2.7.7.1 Analysis of Urine Specimen

To analyse the 24-hour individual specimens, each was placed in a bottle containing 2ml of hydrochloride acid. An aliquot of the sample was filtered through a Number 4 sintered glass funnel and distilled at –20°C. The urine was diluted 1/10 with bidistilled water. The data is expressed in mmols of creatinine in 24-hour urine, where one gram (8.84mmol) is equivalent to 20kg muscle tissue [77]. Urinary Creatinine excretion was expressed as a percentage of Creatinine Height Index (CHI%). This was done by referring to a standardized table of expected 24-hour creatinine excretion for "normal" children (Appendix 8), whereby a ratio consisting of the creatinine excretion of a child per unit of time (24 hours), over the "normal" for a child of the same height, regardless of age, reflected the relative mass of the child. Creatinine Height Index was calculated by using the following formula:

$$\text{CHI} = \frac{\text{24-hour urinary creatinine excretion of child}}{\text{24 hour creatinine excretion of normal child of same height}}$$

2.7.8 Assessment of HIV Status

Some of the children had already been diagnosed HIV positive before admission to hospital. For those children who were diagnosed HIV positive after being admitted to hospital, the standard test for HIV antibody at the Brooklyn Chest Hospital was the ELIZA enzyme-linked assay. If found positive, the results were confirmed by further assay, usually the Western blot, using the same serum sample.

Additional information was obtained from the hospital files of the children who had transferred

from other hospitals. It was not always known, thus, by what procedure the CD4 count recorded in the file had been measured. Not all children had records of their CD4 counts. Unfortunately the funds for this study did not allow for the counts to be done for such children (CD4 unknown).

2.8 Data Analysis

Data Entry

All laboratory analysis was done by the Metabolic Research Group of the Department of Human Nutrition, the Department of Haematology and the Chemical Pathology Department. These departments are all based at Tygerberg Hospital, University of Stellenbosch.

To analyse the quantitative data, Excel, Quattro Pro and Statistica software was used. A p-value was taken as statistically significant if <0.05. To assess distribution of observations, the mean and standard deviation were used. Both the non-parametric test (Wilcoxon Rank Sum) and paired t-test were used to determine the relation of oral complications and nutritional status. The students t-test was used to determine differences between the results on admission and at three months follow-up. The assessment of relative risk was used in contingency tables to assess the likelihood of a malnourished child acquiring oral lesions.

2.8.1 Analysis of Anthropometric Measurements

Each measurement was taken three times and the mean of the three measurements analyzed. Nutritional parameters were compared with international norms using z-scores derived from comparison with NCHS standards[76]. Malnutrition was defined as stunted, wasted, and/or underweight as defined by the NCHS classifications recommended by WHO [67,68]. Height for age, weight for age and height for weight indicators were expressed as standardized scores (z-scores) or standard units from the median for the international reference population recommended by WHO. Children who fell more than 2 standard deviations below the reference median were regarded as undernourished. Those who fell 3 standard deviations below the reference median were considered severely malnourished. **Stunting** (height-for-age < -2SD) was used to signify an overall slowing of skeletal growth that occurs over a long period of time [67,68]. **Wasting** (weight-for-height < -2SD) was used to signify a shortfall in tissue and fat mass compared with

the amount expected in a child of the same length or weight [67,68]. **Underweight** (weight-for-age < -2SD) was used as an indicator of poor weight gain within a particular age group [69].

Mid-upper arm circumference is a good nutritional indicator of muscle growth, and is almost stable from 6 to 59 months and does not need to be related to the age of the child. MUAC was used as a complementary tool to assess nutritional status in this study.

To analyse nutritional status, the Waterlow Classification[76] was used where:
Percentage weight for height was calculated as: weight of child/weight of normal child of same age X 100
Percent height for age was calculated as: height of child/height of normal child of same age X 100
MUAC was considered normal if >12.5cm, normal MUAC was 13.5cm.

2.8.2 Dietary Analysis

Once the researcher had ensured that all data were collected and questionnaires completed fully, and that, errors that could have occurred during data collection, coding, aggregation, and transcription were identified, data was entered into the computer using Foodfinder II software. With the assistance of a Statistician, data was entered by the researcher and crosschecked to ensure correct entry coding and correct quantities. Foodfinder II (2001), designed by MRC, was utilised to determine and analyze nutrient intake for each child [80].

Information recorded on the FFQ and 24-hour recall questionnaire was also coded and transferred into Foodfinder II for analysis [80], to determine the percentage distribution of energy derived from protein, fat and carbohydrate. All dietary data was quantified using the South African RNID food composition tables [80].

Energy was compared with the Recommended Daily Allowance (RDA) values, which are expressed as recommended daily intakes per age group with the energy value of the food given as (Kcal). Nutrient intake was compared using the RDA reference where cut-off points such as 67% of the standard intake was used to describe inadequacy of nutrient intake [76].

2.9 Ethical Considerations

The Research and Ethics Committee of the University of Stellenbosch approved the overall study. Parents/guardians gave informed consent to the recording of anthropometric measurements and clinical and biochemical assessment and agreed to provide the necessary information for completion of questionnaires and assessment of the dietary intake of patients. Written parental/guardian consent was obtained for drawing of blood and collection of urine samples prior to the child being included in the study. The consent forms were translated into Afrikaans for non-English-speaking participants (appendix 9).

All information pertaining to each child was kept confidential. Some of the children were referred as the need arose: for example a child requiring a gastrostomy would be referred to a multi-sectoral plenary team (see section 2.10) or, if a child's T-helper count was repeatedly less than $400mm^3$, it was concluded that there was a worsening immune deficiency, and where a count was less than $200mm^3$, the Department of Health was petitioned for anti-retrovirals. Through the plenary group, the necessary follow-up care was ensured.

2.10 Interventions

At the Brooklyn Chest Hospital, a multi-disciplinary team composed of doctors, nurses, a social worker, a medical specialist and medical students hold weekly meetings to discuss problems in the paediatric ward, the progress (or lack of) of patients and the way forward, as well as to share information on national or international research developments. Discussions allowed for technical and or expert advice and feedback. In the last week of the month, the progress of 10 selected patients from the paediatric ward is assessed and the necessary steps taken to improve current status.

All the children received drug treatment for TB, but no drug treatment was administered for HIV in the paediatric ward. However all children were given multivitamin supplementation upon admission to Brooklyn Chest Hospital. Ferrous sulphate was administered as follows: up to 3mg/kg/24hrs as single or divided doses for three months. Children found to have severe

Vitamin A deficiency were given vitamin A supplementation: 1st dose 200,000IU on day 1, 2nd dose 200,00IU 24 hours later and 3rd dose 200,000IU 4–6 weeks later. Children younger than 12 months of age received half the dose 100,00IU using the same administration routine.

CHAPTER 3: RESULTS

3 RESULTS

3.1 Socio-economic Status of the Parents/Guardians

Parents/guardians were interviewed not only to obtain information on the dietary intake of the children during the last month (30 days) prior to their admission to hospital, but also to define the socio-economic profile of the concerned families.

More than half (58%) of the respondents (Table 4) were the biological parents of the patients, 21% were grandmothers, and 21% were a step-parent, sibling or other relative. Of the respondents, 42% were working and the remaining 58% were unemployed. The average number of children in each household was 5. Additionally, 29% of the respondents had not completed matric, 54% had matriculated and 17% had received tertiary education.

3.2 Demographic Characteristics of Children

Of the children studied, 11 were male and 13 were female (Table 5). Of the 27 children enrolled, 3 were subsequently excluded from analysis because the final diagnosis was not tuberculosis (n=1), the patient was discharged from hospital to continue with TB medication at home (n=1), or the patient died (n=1). Results from the 24 remaining patients were therefore included in the final analysis.

Of the 24 children analyzed, 2 completed follow-up for three months, another 3 for four months, 11 for five months, and 8 for six months. The mean for duration of hospital stay was 5 months, (SD of 0.9) (Table 5).

The ages of the children studied ranged from 9 months to 9 years, with a mean age of 39 months and a Standard Deviation (SD) of 26 months. The age distribution of the children indicated that the largest number (33%) were in the 24– 48 month category, followed by those younger than 24 months of age (25%) (Figure 3).

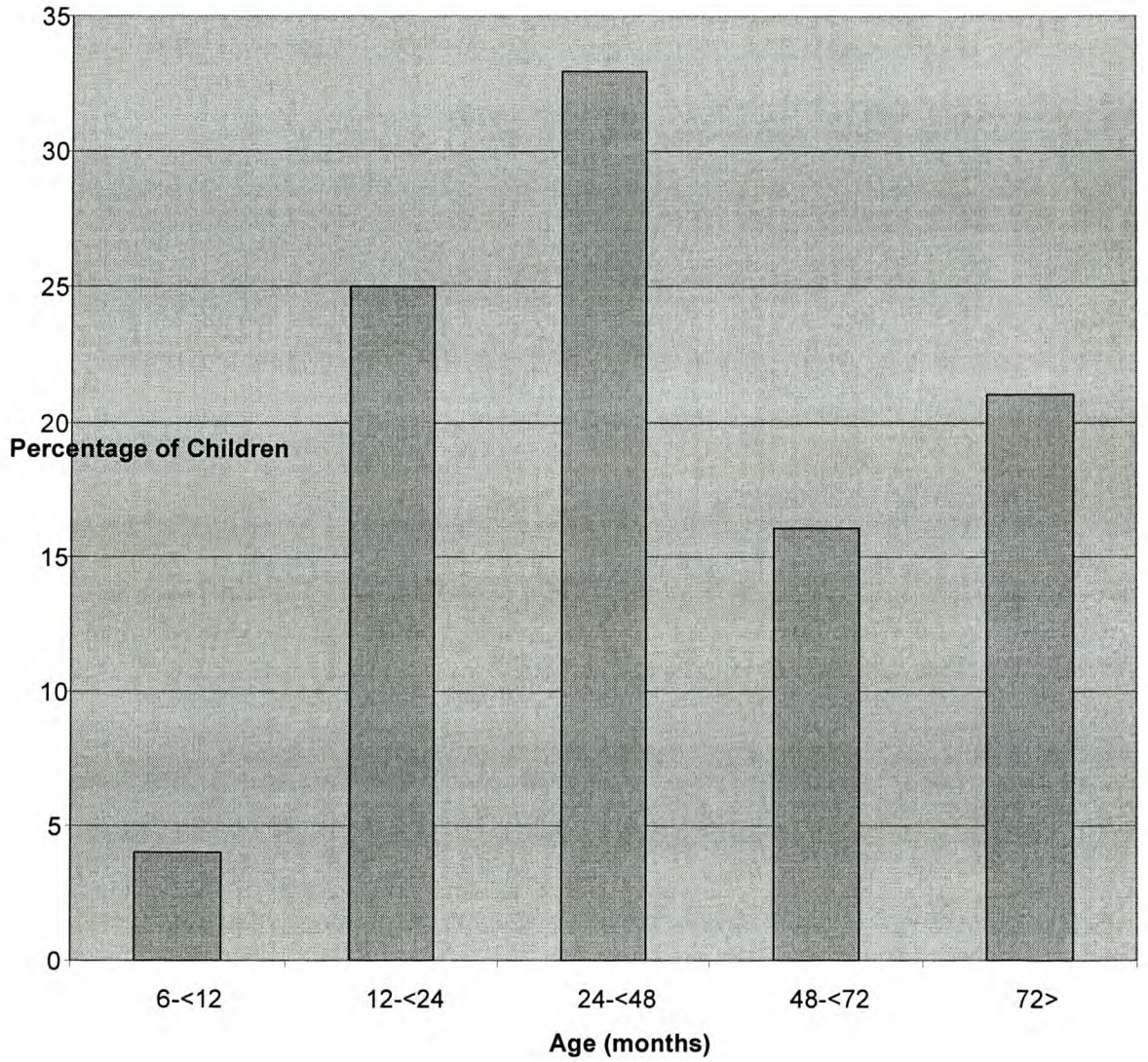
Table 4: Demographic characteristics of parents/guardians

Socio-economic Profile (Parent/guardian)			
		Number	**Percentage (%)**
Marital Status	Single	6	25
	Married	8	33
	Divorced	3	13
	Other	7	29
Relationship with patient	Mother	12	50
	Father	2	8
	Grandparent	5	21
	Other	5	21
Occupation	Employed	9	38
	Self-employed	1	4
	Unemployed	14	58
Education	<Matric	1	29
	Matriculated	13	54
	Tertiary	4	17
Average No. children per household	5		

Table 5: Demographic characteristics of children

Patient Characteristic			
		Number	**Percentage (%)**
Gender	Male	11	46
	Female	13	54
Age (in months)	6 - <12	1	4
	12 – <24	6	25
	24 – <48	8	33
	48 – <72	4	17
	>72	5	21
Length of stay in hospital	3 months	2	8
	4 months	3	13
	5 months	11	46
	6 months	8	33

Figure 3: **The age distribution (in months) of children studied (in the age range of 9 months to 9 years)**



3.3 HIV Status of Children

All the children studied were HIV sero-positive. The clinical presentations of HIV infection varied among the children during period of hospitalization. The mean CD4 count of 16 children was 514.5/µl (n=16). Table 7 indicates that, of the 16 children, half of them had moderately decreased counts (CD4 {<12 months} 750-1499, {1-5 years} 500-999, {6-12 years} 200-499) CD4 count, and the remainder had severely decreased counts ({<12months} <750, {1-5 years} 500, {6-12 years} <200). The CD4 count of 33% of the children was unknown (Appendix 10).

3.4 Clinical

Among the more common clinical findings on admission of the children to hospital were features such as failure to thrive (FTT) identified in 67% of the children, chronic fever (54%), recurrent infections (41%) and chronic dermatitis in (33%). All the children were suffering from respiratory infections. At three months hospitalization, a reduction (although not significant) of chronic fever was noted in 21% of the children. A 50% weight loss or FTT was elicited for the same period (Table 6).

Upon admission to hospital, clinical examination of nutritional deficiencies revealed signs of colour and texture changes on the skin in 38% of the children, dischromotrichia in 29%, oedema in 16 %, and lethargy and lack of interest in food in 25% of the children. Anaemia was noted in 13% of children and smooth tongues in 16%, while 21% had angular scars (angular cheilosis). Only one child had ridged nails. Half the children presented with dry skin and skin rashes and 8% seemed disoriented and confused.

Table 6: The CD4 count of children studied (percentage in brackets)

CD4 count (cells/μL) on admission to hospital	Number of Children (%)
> 500	5 (20.8)
301 – 500	3 (12.5)
201 – 300	3 (12.5)
101 – 200	5 (20.8)
50 – 100	---
0 – 49	---
CD4 count unknown	8 (33.3)

Table 7: Percentage of children presenting with clinical signs and symptoms associated with HIV-infection

Clinical Findings	% of Children with Signs or Symptoms on Admission	% of Children with Signs or Symptoms at Three Months Hospitalization
Recurrent infections	41	46
Chronic diarrhoea	25	16
Respiratory Infection	100	100
Chronic fever	54	21
Weight loss or FTT	67	50
Neurological complications	4	4
Chronic dermatitis	33	25
Persistent generalized lymphadenopathy	12	12

In relation to objective 1 of this study, the following findings are of relevance:

Diarrhoea was noted in 25% and 16% of the children on admission and at three months following hospitalization respectively, and could have been due to the HIV-infection causing changes in the gastrointestinal tract and therefore resulting in food intake not being absorbed adequately. Additionally the recurrent infections in 41% and 46% of the children on admission and at three months of hospitalization resulted in lethargic children that had no interest in food. As a result there was a notable FTT/weight loss, in 67% and 50% of the children on admission and at three months of hospitalization respectively.

In relation to objective 2 of this study the following findings are of relevance:

Upon admission to hospital, the smooth tongue noted in 16% and the angular cheilosis in 21% of the children were likely to be thought to have contributed to inadequate intake resulting in nutritional deficiencies and weight loss as well as the recurrent infection noted in 41% and 46% of the children on admission and at three months of hospitalization respectively.

In relation to objective 3 of this study the following findings are of relevance:

Sixty seven percent and 50% of the children on admission and at three months of hospitalization respectively showed signs of FTT/weight loss irrespective of the presence of oral symptoms.

3.5 Nutritional Status

3.5.1 Anthropometry

Although routine measurements were taken once a month during hospitalization, only results on admission and discharge are presented in the text of thesis as no significant changes in these parameters occurred during hospitalization.

Upper arm circumference measurements showed that on admission 37% of the children were either mildly malnourished or malnourished. At time of discharge 21% of the patients were mildly malnourished or malnourished, p= 0.03 (Table 8).

Anthropometric indices identified stunting, and underweight as the most common type of malnutrition. At time of admission, 7% of the children had a combination of stunting, wasting and underweight, and the same 7% continued to have a combination of were stunting, wasting and underweight at time of discharge (Table 9). In the underweight category, there was no statistically significant change. Underweight (W/A <-2 std) was observed in 17% of the children on admission to hospital, and in 21% at time of discharge (Table 10). There were no significant changes in the height for age category either. On admission to hospital, more than half (63%) of the children were short for their age. Of these, 58% remained short (H/A <-2std) at time of discharge, implying long term malnutrition and poor general health (Table 11).

Tables 10 and 11 show the percentages of children categorized for weight for age (W/A) and height for age (H/A) on admission to hospital and again at time of discharge. The classifications are based on the WHO international reference, using standard deviations (SD). The changes in z-score suggest there was very little catch-up growth in any of the indicators (H/A, W/A and H/W).

Table 8: **The mid-upper arm circumference on admission and at discharge (percentage in brackets)**

MUAC (cm)	Admission n (%)	At time of discharge n (%)
Normal - 13.5	15 (63)	19 (79)
Mildly malnourished – 12.5 – 13.5	7 (29)	3 (13)*
Malnourished - <12.5	2 (8)	2 (8)

*P=0.03

Table 9: **Percentage of malnourished children using the Waterlow Classification, on admission and at discharge (SD)**

Nutritional status	On Admission (%)	At discharge (%)
Stunted (H/A)	6 (40)	7 (50)
Underweight (W/A)	1 (7)	1 (7)
Stunted & Underweight	7 (47)	5 (36)
Stunted, Underweight & Wasted	1 (7)	1 (7)
Total	15 (100)	14 (100)

Waterlow classification

Table 10: Percentage Weight for Age (W/A) z-score distribution on admission and at discharge (SD)

	Weight for Age					
	On Admission			At Discharge		
Age group in months	Below –2 std	Below –1 std	Normal	Below –2 std	Below –1 std	Normal
6 - < 12		3			1	
12 - < 24	3	5	3	1	4	4
24 - < 48	1	3	2	2	3	2
48 - < 72		1	2	1	2	2
72 >		1		1	1	
All Ages combined	4 (17%)	13 (54%)	7 (29%)	5 (21%)	11(46%)	8 (33%)

None of the differences were statistically significant

Table 11: Percentage Height for Age (H/A) z-score distribution on admission and at discharge

	Height for Age					
	On Admission			At Discharge		
Age group in months	Below –2 std	Below –1 std	Normal	Below –2 std	Below –1 std	Normal
6 - < 12						
12 - < 24	2	4		2	4	
24 - < 48	7	1		8		
48 - < 72	3	2		3	2	1
2 >	3	2		1	2	1
All Ages combined	15 (63%)	9 (37%)		14 (58%)	8 (33%)	2 (8%)

None of the differences were statistically significant

In relation to objective 1 of this study the following finding are of relevance:

The changes in z-score suggested very little catch up growth in the weight for age in 17% and 21% of children, and height for age in 63% and 58% of children on admission and at discharge respectively. It would appear that malnutrition had been long-standing and hospitalization had no significant effect on these parameters.

In relation to objectives 2 and 3 of this study the following finding are of relevance:

Of the seven children found to have oral complications, five were stunted and underweight on admission and of these, three continued to be underweight and stunted at three months of hospitalization.

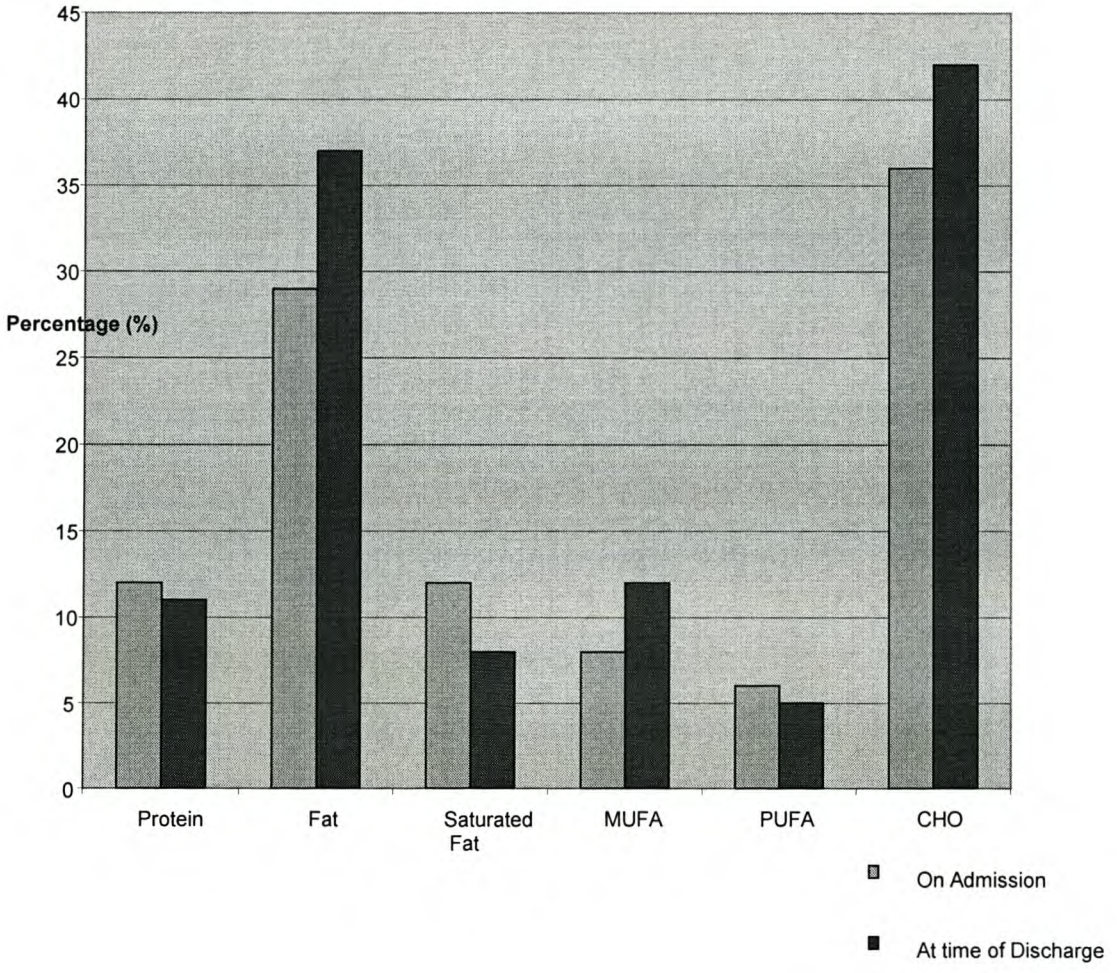
One of the children presenting with oral herpes had recurrent episodes of the infection throughout hospitalization.

3.5.2 Dietary

Of the mean intake at time of admission and at discharge respectively, the mean energy intake provided by protein was 12% and 11%, fat intake provided 29% and 37% of mean energy intake, saturated fats provided 12% and 8% of mean energy intake, mono-unsaturated fatty acids provided 8% and 12% of mean energy intake respectively, while polyunsaturated fatty acids provided 6% and 5% of mean energy intake. Carbohydrate intake provided the most energy with 36% and 42% of mean energy intake on admission and at discharge respectively (Figure 4). None of the differences were statistically significant.

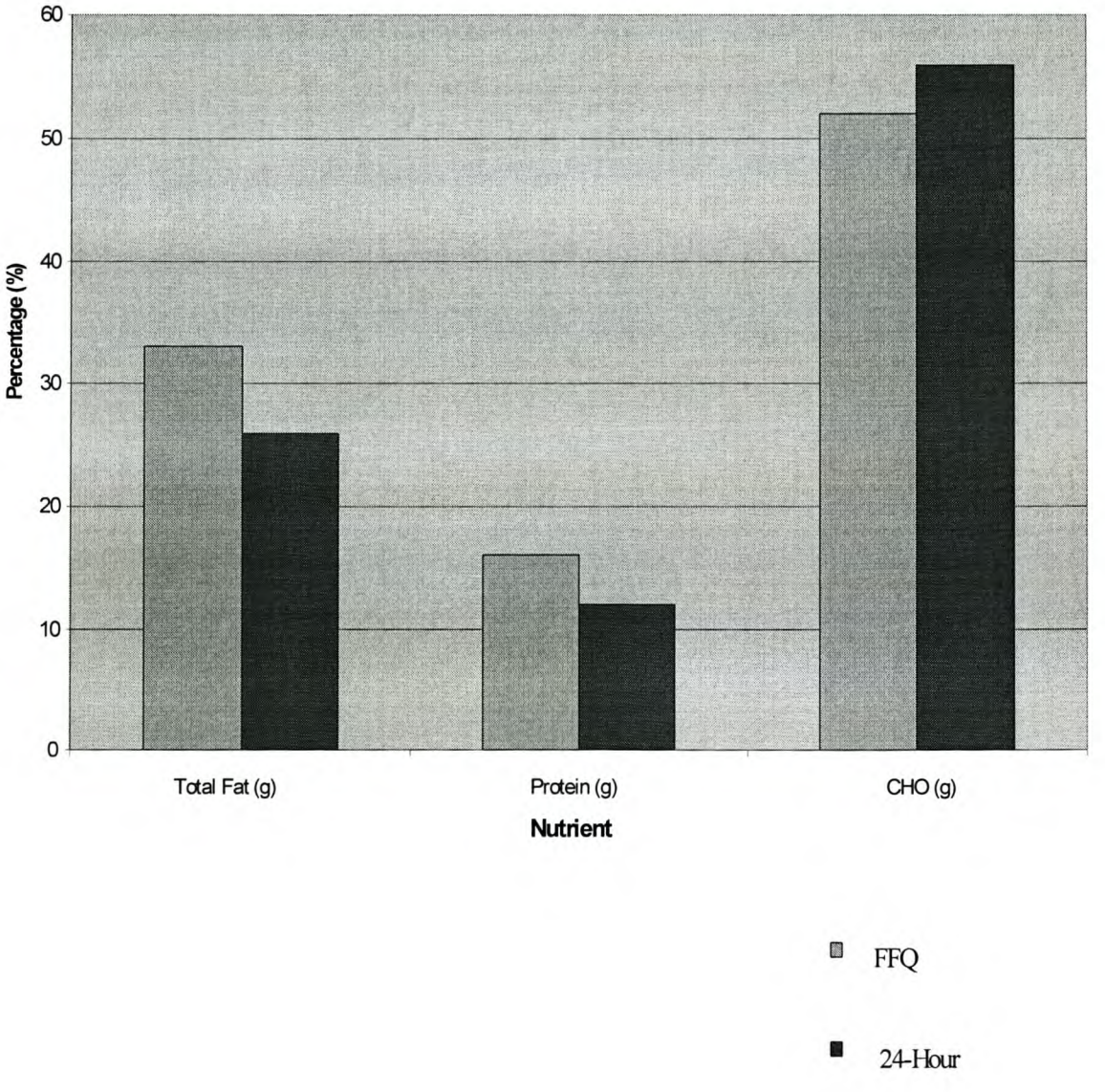
Dietary data obtained from the FFQ and 24-hour recall questionnaires showed that carbohydrate yielded more than 50% of the mean energy intake while protein yielded the least amount, namely 16% and 12%, FFQ and 24-hour recall respectively. Total fat contributed 33% and 26% of the energy, FFQ and 24- hour recall respectively (Figure 5).

Figure 4: Percentage of mean energy distribution of macronutrient intake (dietary intake during hospitalization)



*Admission in this case refers to dietary intake data recorded the first week of hospitalization

Figure 5: **Mean energy distribution (percentage) of the macronutrient intake derived from FFQ and 24-hour recall**



The mean dietary intake from time of admission of children to time of discharge is indicated in Table 12, and in reviewing the data as it stands, no significant differences were found between mean dietary intake of these nutrients at time of admission and at discharge other than in the higher intake of energy ($p=0.04$) and total fat was lower ($p=0.03$) at discharge respectively (Figures 6 and 7). Although not significant, mean protein intake at admission was higher than at time of discharge (Table 12).

At time of admission to hospital (i.e. dietary intake data recorded in the first week of hospitalization), 17% of the children had intakes of less than 67% of the RDA for energy, carbohydrates and iron (Figure 8). Protein intake for 8% was less than 67% of the RDA, and 13% of the children had sub-optimal levels for calcium, vitamin A and ascorbic acid. Sub-optimal intake for thiamin, vitamin B6, folic acid, vitamin B12, and vitamin E were recorded for 8% and 29% had sub-optimal intake of riboflavin. Only 4% of the children had sub-optimal intake of vitamin D.

During hospitalization (Figure 8), dietary intake indicated that 8% of the children had intakes less than 67% of the RDA for energy and calcium. An intake of less than 67% of the RDA for protein and sub-optimal levels of thiamin, vitamin B6, folic acid and ascorbic acid, vitamins D and E were recorded for 4% of the children. There were 8% with sub-optimal levels of vitamin A, and 21% presented with levels of riboflavin less than 67% of the RDA.

Table 12: Comparison of mean dietary intake derived from FFQ, 24-hour recall and dietary Intake during hospitalization

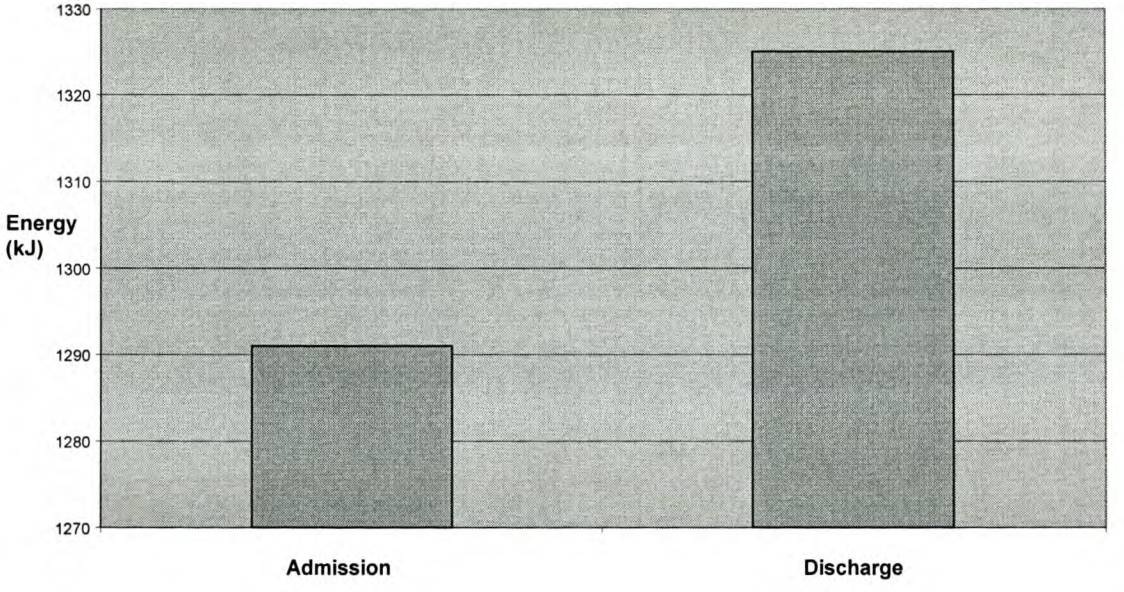
Nutrient	FFQ Mean (SD)	24-hour Mean (SD)	Dietary intake (◊admission) Mean (SD)	Dietary intake during hospitalization Mean (SD)
Energy (kJ)	1827 (19)	914 (23)	1291 (553)	1325 (473)*
Carbohydrate (g)	80 (21)	69 (8)	170 (12)	194 (9)
Total Protein (g)	58 (9)	49 (4)	50 (8)	44 (12)
Total fat (g)	22 (15)	29 (11)	56 (9)	52 (10) **
Calcium (mg)	334	212	541 (42)	553 (36)
Iron (mg)	5 (2)	1 (.3)	9 (5)	7 (4)
Zinc (mg)	1 (.2)	1 (.4)	3 (1)	5 (2)
Vitamin A (RE)	190 (7)	235 (8)	549 (36)	701 (40)
Thiamin (mg)	0.1	0.5	0.4 (.04)	.6 (.03)
Riboflavin (mg)	0.6	0.4	0.6 (.04)	0.6 (.05)
Vitamin B6 (mg)	0.5	0.3	0.3 (.04)	.4 (.04)
Folic Acid (µg)	14 (5)	10 (3)	30 (9)	46 (10)
Vitamin B12 (µg)	2	.9	1.6 (.9)	2.2 (.8)
Ascorbic Acid (mg)	185 (32)	96 (9)	43 (13)	43 (9)
Vitamin D (µg)	12 (5)	8 (2)	6.2 (.9)	6.9 (1)
Vitamin E (mg)	6	5	3 (.8)	4 (.7)

◊ Admission in this case refers to dietary intake data recorded the first week of hospitalization

*p=0.04

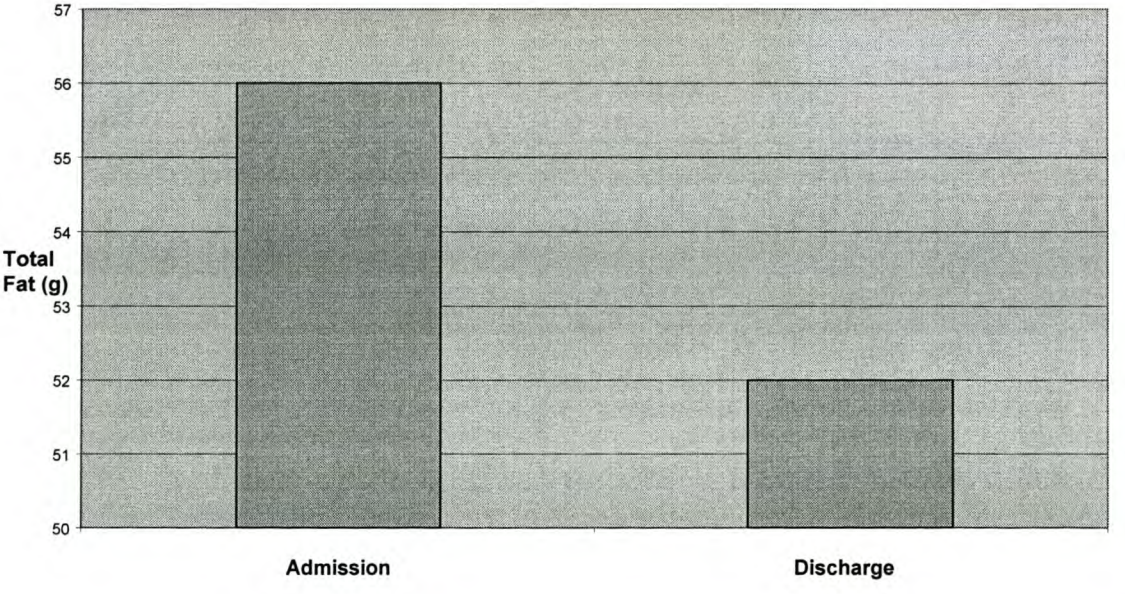
**p=0.03

Figure 6: **Mean energy intake (kJ) on admission and at discharge (dietary intake during hospitalization)**



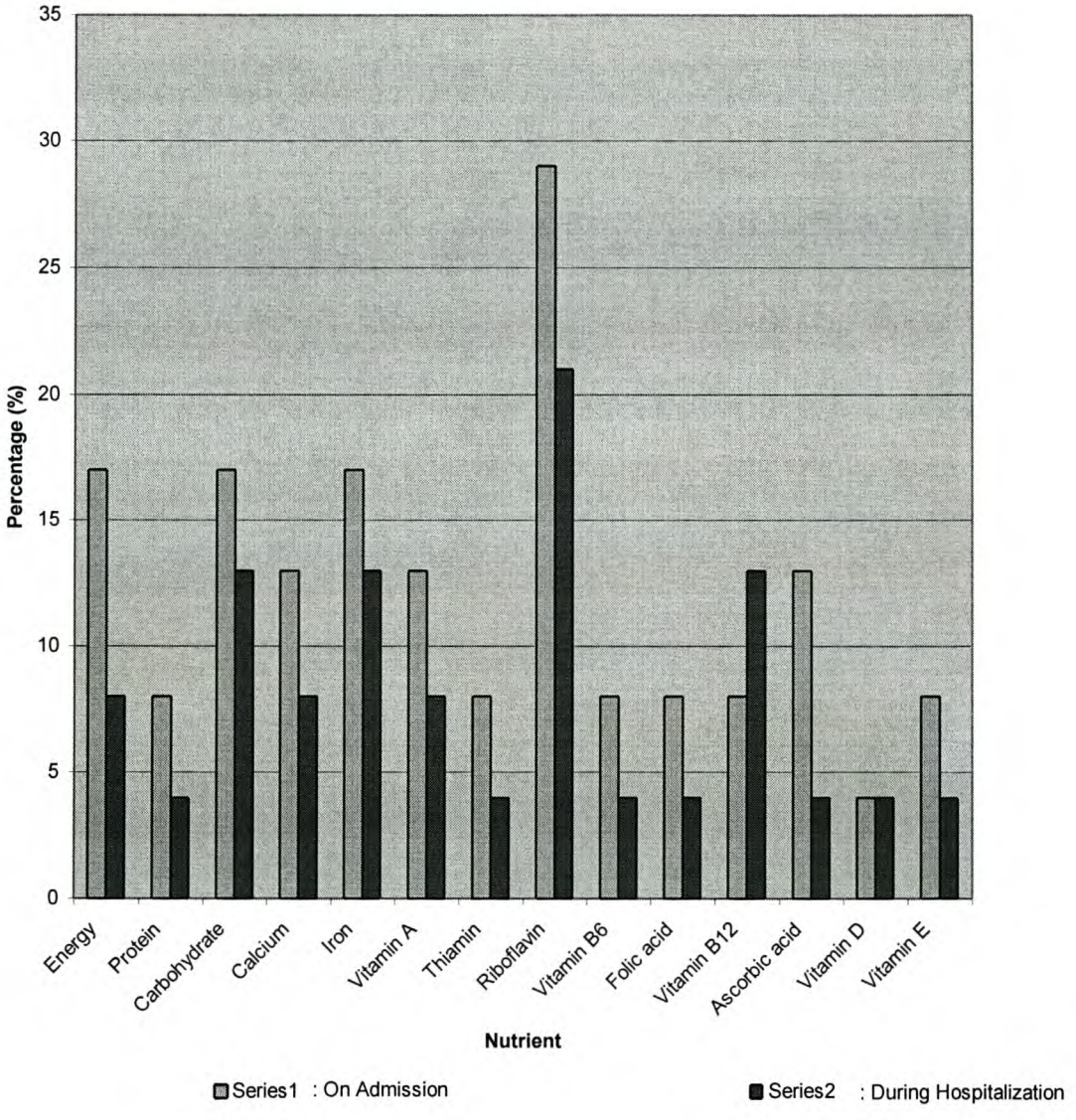
p=0.04

Figure 7: **Mean total fat intake (g) on admission and at discharge (dietary intake during hospitalization)**



p=0.03

Figure 8: **The percentage of children with dietary intake below 67% of the Recommended Daily Allowance on admission and during hospitalization**



In relation to objective 1 of this study the following findings were of relevance:
At three months of hospitalization, a marginally significant difference was noted in 71% of the children who did not present with oral complications where protein intake was higher (p=0.0576) than among the children presenting with oral complications.

In relation to objective 2 of this study the following findings were of relevance:
Whether the children had oral complications or not, the dietary intake was similar: i.e. there were no significant changes on admission or during the three months of hospitalization among all the children, and throughout hospitalization the children presented with similar dietary inadequacies.

In relation to objective 3 of this study the following findings were of relevance:
Among the children that had oral complications, there were no significant changes in nutrient intake at the time of admission and at three months following hospitalization. In further exploring these findings, of the children presenting with an intake of less than 67% of the RDA iron, half of them had oral complications on admission, and at three months of hospitalization 2 of the three had oral complications. Of those children who had an intake of less than 67% of the RDA for vitamin A, again 2 of three had oral complications both on admission and at the third month of hospitalization. Of the children with intake of less than 67% for vitamin B_6 only one of three had oral complications at the third month of hospitalization. When looking at ascorbic acid on admission as well as at three months following hospitalization, it was the same two children of the 3 children who had intake less than 67% of the RDA, and for intake less than 67% of vitamin D only one of the 3 had oral complications at admission and at three months following hospitalization all 3 children had oral complications. Lastly, of the children with intake less than 67% of RDA for vitamin E, only one child was noted to have oral complications on admission to hospital.

When looking at the macronutrients, there were no significant changes in the total protein intake, caloric intake and total fat intake from the time of admission and following three months of hospitalization among the children presenting with oral complications. However, when the

children with oral complications were combined with those without oral complications there was a significant increase in the mean energy intake and a significant decrease in the mean total fat intake at three months of hospitalization.

3.6 Biochemical

Biochemical values of the children were compared at admission and at three months of hospitalization. The prevalence of the sub-optimal values was also determined. Results indicate that there was no significant change in the mean values of all parameters measured from time of admission to time of discharge. However, there was a marginal significant increase in the mean MCV from time of admission to time of discharge, ($p=0.05$), and mean vitamin B_{12} levels had increased at time of discharge, ($p=0.02$) (Table 13).

The prevalence of selected sub-optimal biochemical values at time of admission and at discharge is indicated in Figure 9. Forty five percent and 41% of the children had low serum albumin values (<2.9g/dL), on admission and discharge respectively. Sub-normal plasma retinol was present in 79% of the children at time of admission, while only 21% had deficient values at time of discharge ($p=0.03$). Both on admission and at discharge, 38% of the children were presenting with haemoglobin levels below normal values. Serum ferritin levels below normal values were present in 96% of the children on admission and all the children (100%) remained at values below normal at time of discharge. The trend was similar for the prevalence of low zinc values. On admission 29% of the children had vitamin C values below the normal range, but there was a significant improvement ($p=0.04$) at time of discharge where 17% of the children presented with values below normal.

According to the Creatinine Height Index (Appendix 8), the prevalence of severe loss of muscle mass of the children was 71% at time of admission with a moderate loss being present in 29% of the children (Table 14).

Table 13: Mean of biochemical assessment on admission and at three months of hospitalization

	Mean (admission)	SD	Mean (discharge)	SD	Student t p-value
Haemoglobin (g/100ml)	9	1.19	8.9	1.18	0.65
MCV (fl)	74	3.42	76	2	0.05
Serum albumin (g/l)	2.8	0.6	2.8	0.57	0.86
Serum Ferritin (mg)	13	2.53	12	0.02	0.08
Plasma Retinol (µl)	0.4	0.08	0.3	0.09	0.72
Zinc (mg)	4	2.17	4	1.95	0.31
Vit C (mg)	11	3	10	2.23	0.58
Vit B_{12}	1.8	0.98	2	0.64	0.02

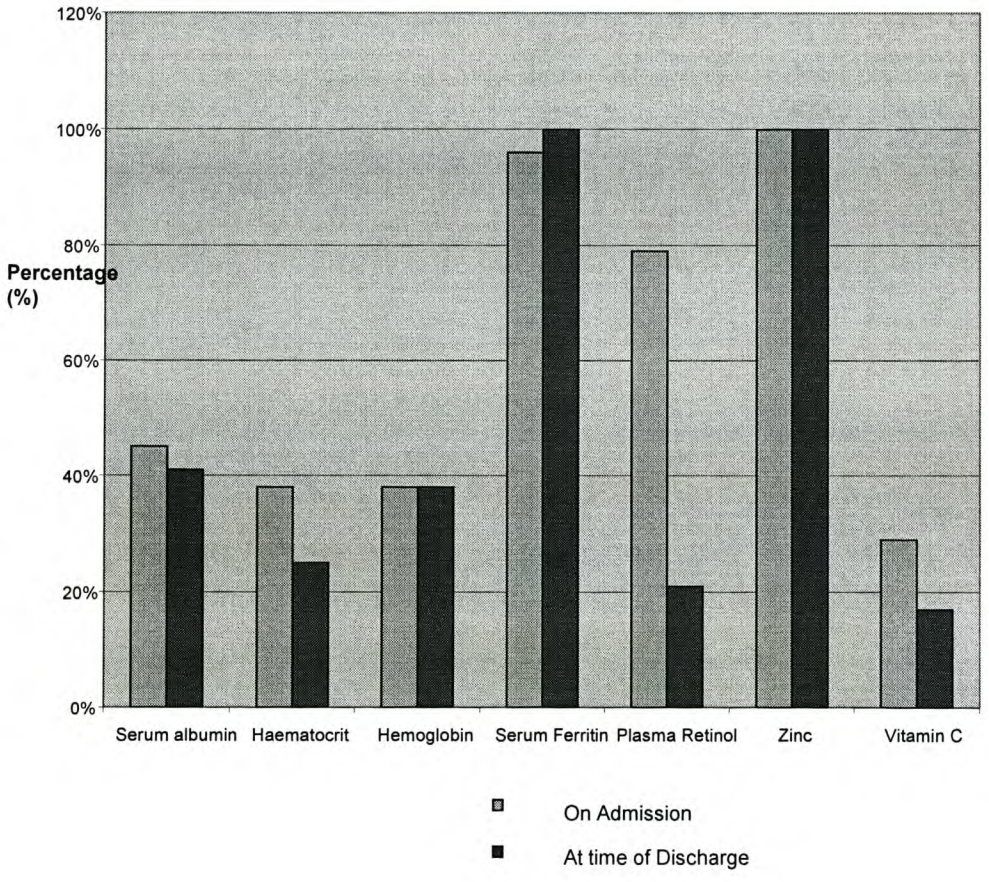
Table 14: Creatinine Height Index of children studied on admission to hospital (percentage in brackets)

Creatinine Height Index	**Number of Children (%)**	**Mean age in months (age range)**
<0.40 (s)	4 (17)	35 (13-55)
0.40-0.49 (s)	9 (38)	43 (17-96)
0.50-0.59 (s)	4 (17)	38 (15-72)
0.60-0.69 (m)	4 (17)	49 (9-108)
0.70-0.79 (m)	3 (12)	15 (16-29)

S – indicates severe loss of muscle mass

M – indicates moderate loss of muscle mass

Figure 9: Percentage of children presenting with haematological, serum proteins, and serum micronutrients concentrations below normal values



◊ Discharge in this case refers to biochemical assessment conducted at three months hospitalization

In relation to objective 1 of this study the following findings are of relevance:

Biochemical results indicated that serum ferritin, haemoglobin and zinc levels of all the children presenting with oral complications was below the normal range both on admission as well as at three months of hospitalization. Serum albumin levels were below the normal range in 3 of 7 and 4 of 6 children presenting with oral complications at admission and at three months of hospitalization respectively. Vitamin C levels below the normal range were identified in 3 of 7 and 2 of 6 of the children presenting with oral complications at admission and at three months of hospitalization. Of the children presenting with oral complications only one child did not have plasma retinol levels below the normal range on admission, and at three months of hospitalization, and 4 of 7 children who did not have oral complications had levels below the normal range on admission to hospital.

In relation to objectives 2 and 3 of this study the following findings are of relevance:

On admission to hospital, the 4% of children presenting with bleeding gums had levels below normal values for serum ferritin, and plasma retinol. The 4% of children presenting with oral herpes had levels below normal values for haematocrit, haemoglobin, serum ferritin and plasma retinol on admission and again at three months of hospitalization (excluding plasma retinol). Another 4% of children presenting with oral herpes which was recurrent throughout hospitalization, had serum ferritin, plasma retinol and zinc levels below normal values both on admission and at three months of hospitalization. The 4% of children presenting with oral thrush also presented with levels below the normal range for serum albumin, plasma retinol, zinc and vitamin C at admission, and at three months of hospitalization all levels were below normal values excluding vitamin C. The 13% of children presenting with angular cheilosis/stomatitis had levels below the normal range for vitamin C and serum retinol and zinc both on admission, and at three months of hospitalization, whereas the 8% of children presenting with oral complications only had levels below normal values for zinc only.

3.7 Oral Complications

A total of seven (29%) children presented with oral complications on admission and at three months hospitalization a total of 6 (25%) had oral complications (Table 15). Of these children, at admission the 4% presenting with oral complications had oral herpes, 4% presenting with oral thrush, another 4% had reflux (which may have indicated oesophageal candidiasis), and a further 4% presented with bleeding gums. The most commonly identified oral complication (13%) was stomatitis/angular cheilosis (Figure 10). Only 2 were asymptomatically colonized with *Candida* in the oral cavity. They also had dysphagia which could have been a result of oesophageal candidiasis. One of the two, also diagnosed with oral herpes, had recurrent episodes of the infection during the period in hospital. The other child had a recurring reflux motion on various occasions during hospitalization; the same child was diagnosed with *Candida* of the oral cavity.

Both at admission and at time of discharge, the likelihood of the occurrence of oral complications when a child was malnourished was greater than in normal children 62% and 54% respectively (Table 16). The risk of a malnourished child developing oral complications was 3.6 times (CI = 1.8 - 8.3) greater than in a normal child on admission, while the risk of a malnourished child developing oral complications at time of discharge was 2.2 times (CI= 0.7 - 4.9) greater risk than in a normal child.

Among the children that were not diagnosed with oral complications at all, the mean total protein intake was higher, with a marginal significance of $p=0.057$, than in the group of children presenting with oral complications (Figure 11). Other nutrients did not indicate any significant difference between children presenting with or without oral complications on admission. However, the children who presented with oral complications had moderate to severe immune suppression and all were malnourished, except in two children; one child whose CD4 count was unknown, while the other child, who had severe immune suppression, had normal nutritional status both on admission and at time of discharge. There was very little improvement in the nutritional status from time of admission and at time of discharge among the children presenting with or without oral complications (Table 15).

Table 15: The prevalence of oral complications in normal and malnourished children on admission and at discharge

Nutritional Status	Oral complication				Total	
	Yes		No			
	On Admission	At discharge	On Admission	At discharge	On Admission	At discharge
*Malnourished	6 (1.5%)	3 (.7%)	9 (2.2%)	10 (2.4%)	15 (62.5%)	13 (54.1%)
No *Malnutrition	1 (.2%)	3 (.7%)	8 (1.9%)	8 (1.9%)	9 (37.5%)	11 (45.8%)
Total	7 (29%)	6 (25%)	17 (70.8%)	18 (75%)	24 (100%)	24 (100%)

*Malnutrition using height and weight based anthropometric indicators

Table 16: A summary of the Nutritional Status of the Children who Presented with Oral Complications

			Nutritional Status	
Child	Type of oral complication of each child	CD4 count	Admission	At time of discharge
1	Oral herpes and stomatitis	Suppression	Stunted and underweight	Stunted and underweight
2	Bleeding gums	Suppression	Stunted and underweight	Stunted and underweight
3	Stomatitis	Severe suppression	Stunted and underweight	Stunted and underweight
4	Stomatitis	Severe suppression	Normal	Normal
5	Oral herpes	Unknown	Normal	Normal
6	Angular cheilosis	Severe suppression	Stunted and underweight	Underweight
7	Oral thrush	Moderate suppression	Stunted and underweight	Normal

Figure 10: Percentage of children presenting with oral complications on admission to hospital

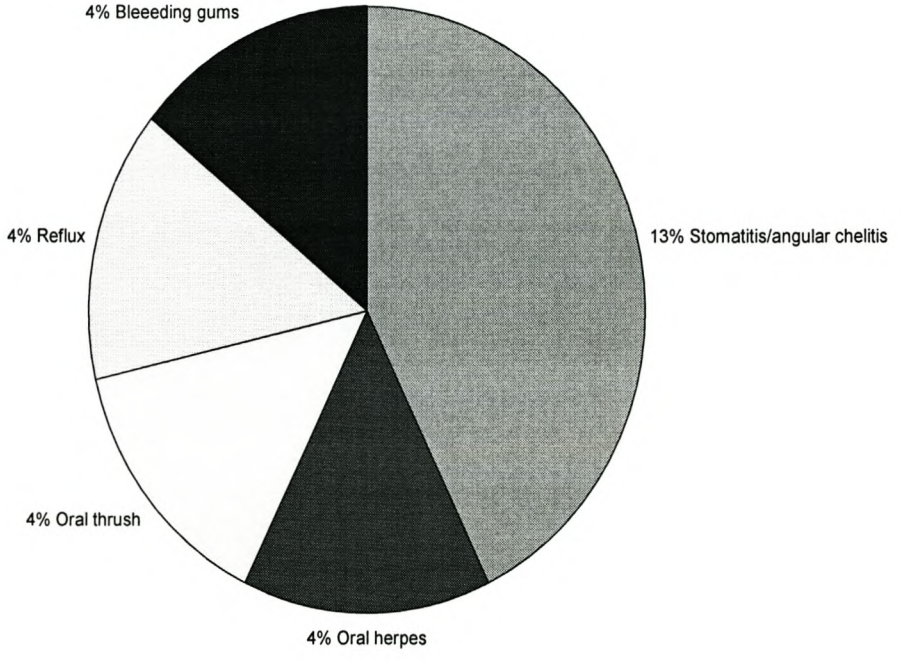
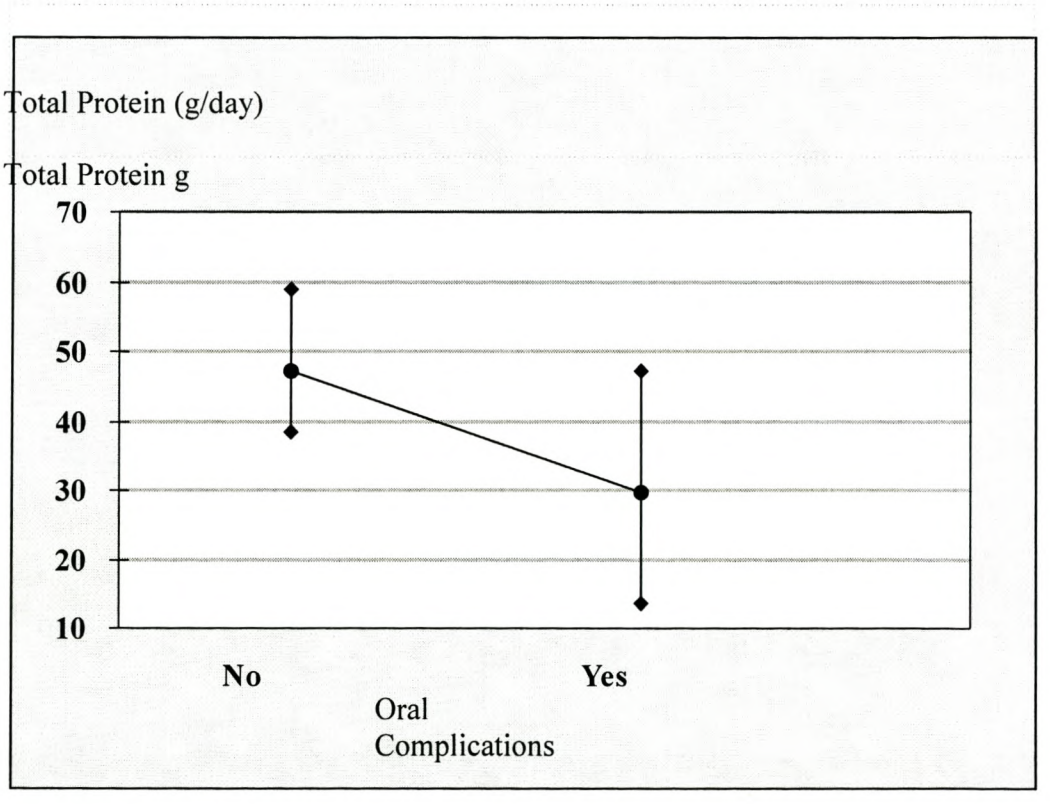


Figure 11: **The mean total protein intake in children presenting with oral complications vs those without oral complications at time of discharge**



*Vertical bars denote 0.95 Confidence Intervals
p= 0.0576

In relation to objective 1 of this study the following findings are found relevant:

There was very little improvement in the nutritional status from time of admission and at time of discharge among the children presenting with or without oral complications. All the nutrients did not indicate any significant differences between those with oral complications and those without, apart from the mean total protein intake that was marginally higher ($p=0.057$) at three months of hospitalization than on admission, in the group of children presenting with oral complications.

In relation to objective 2 of this study the following findings are found relevant:

All the children, except for two, who presented with oral complications had moderate to severe immune suppression and all were malnourished (using the height for age and weight for age indicators).

In relation to objective 3 of this study the following findings are found relevant:

As noted in the previous sections, all the children presenting with oral complications had levels below the normal ranges for serum ferritin, plasma retinol, vitamin C and zinc, and of these children one had recurrent oral herpes. These oral complications may indicate that as a result of dysphagia and odynophagia children had less interest in food.

CHAPTER 4: DISCUSSION

4 DISCUSSION

The aim of this study was to assess the nutritional status in cases of paediatric HIV and TB infection in association with oral complications. Findings judged strongly indicative of malnutrition, related to clinical status, height for age, weight for age, mid-upper arm circumference, visceral protein stores, and levels of serum albumin, retinol, zinc and vitamin A and C.

Despite the adequate meals received by the children studied during hospitalization, poor nutritional status was identified at clinical, anthropometric and biochemical levels, and malnutrition was common among the children presenting with oral complications as well as those who did not. Although this study found that nutritional status of the children barely improved during hospitalization, it cannot be ruled out that a longer period may have provided different results.

4.1 Socio-economic Factors

It is well documented that socio-economic and nutritional status are directly related. That is, people from low socio-economic backgrounds usually present with a high prevalence of nutritional deficiencies, and are also known to be vulnerable to infections and disease [3]. The subjects of the present study were from disadvantaged homes where the level of education of the parents/guardians was very low. Of the respondents, to a questionnaire that was administered, 58% were biological parents of the children studied, 21% were grandparents, and 21% were relatives of the child (Table 4). Given the demographic background of the respondents, it might be argued that the reliability of the data they supplied on the children's dietary history is questionable.

From the fact that the children studied were HIV positive and more than half of them were not living with their biological parents, it might be assumed that the children were exposed to poor nutritional conditions. Deterioration in their condition could result from neglect, a change in feeding practices such as termination of breastfeeding, and/or reduced food intake. As only 42% of the parents/guardians were employed, it is safe to assume that, as generally happens, the

ability to purchase the foods required to meet nutritional needs was lost at some point[78]. The children included in this study were also infected with TB, an illness which has been reported to account for up to 60% of underweight [18]. The present study found that a total of 63% of the children were underweight or stunted on admission or had a combination of stunting and underweight or stunting, underweight and wasting.

The literature indicates that malnutrition is a complex clinical syndrome that impacts on every aspect of metabolism and function in all tissues of the body, and malnutrition in combination with infection increases the risk of mortality by potentiating the adverse effects of infection [12,17,25,61]. This commonly occurs in situations where economic status is low [61]. In the context of the present study, those children in whom infection was advanced were more prone to oral complications and to malnutrition itself.

4.2 Anthropometric Measurements

Anthropometrics are physical measurements that provide an indirect assessment of body composition and development (Appendix 5). Measurements taken periodically and compared with previous measurements reveal patterns and indicate changes in an individual's status. The findings in this present study are strongly supportive of malnutrition with regard to height for age and weight for age using classifications based on the WHO international reference with SD.

Changes in z-score in the present study suggest there was very little catch-up growth in any of the anthropometric indicators (H/A, W/A and H/W). Stunting and underweight were the most common evidence of malnutrition both on admission and at time of discharge from hospital. These results are in line with the extensive literature that indicates that paediatric HIV-infection causes early and progressive decrements in attained linear growth and growth of mass[2,4,8]. Additionally, the literature indicates that HIV-infected children often fail to catch up on growth and, in developing countries, the burden of malnutrition is more severe in infected than in non-infected children [8,16,69].

The gastro-intestinal tract is a common target for dysfunction in HIV infection and diminished oral intake has been noted as a result of oral pharyngeal and oesophageal disease [12,27,30,55]. In the present study, all the children (but one) presenting with oral complications on admission to hospital were malnourished (using height and weight based anthropometric indicators). At time of discharge, half of those presenting with oral complications were malnourished (using height and weight based anthropometric indicators). These results lend support to the view that reduced intake is an important cause of growth failure and malnutrition.

The attrition of visceral proteins is known to be a factor in HIV associated malnutrition. The MUAC of 37% of the children on admission to hospital indicated a reduction in muscle mass. These anthropometric findings were confirmed by the low serum albumin levels that were noted in 45% and 41% of the children on admission and at 3 month follow-up respectively. However, it is also recognized that the low serum albumin levels could have been the result of infection.

4.3 Clinical

Clinical assessment requires knowledge and skill to identify signs and associated nutrient deficiency or toxicity. The problem with clinical assessment is that many signs are also non-specific and can reflect more than one deficiency or non-nutrition related pathology. It is essential that nutritional assessment include laboratory tests to confirm the existence of specific nutrient deficiencies.

All the children studied were not only HIV but TB-infected and, as a result 100% of them had respiratory infections. Events that occur as part of the inflammatory and immune response to infection include rapid lean body tissue losses. The findings of the present study support this statement, weight loss or FTT having been diagnosed in 67% and 50% of the children on admission to hospital and at 3 months hospitalization respectively.

That 50% of the children that presented with dry skin and skin rashes on admission may concur with dietary vitamin B12 deficiency in 8% of children, iron deficiency in 17%, and even with the protein intake of below 67% of RDA in 8% of the children. In addition, there was sub-optimal vitamin A dietary intake in 13% and 8% of the children on admission and during hospitalization

respectively. Potential iron deficiency indicated by smooth tongue may be supported by the fact that 17% and 13% of the children presented with sub-optimal iron RDA values on admission and during hospitalization respectively.

The literature reveals that approximately 50% of patients with HIV/AIDS experience diarrhoea at some point. Recurrent infection and chronic diarrhoea noted in 41% of the children could help to explain the poor uptake of nutrients at the time of admission to hospital. Additionally, research indicates that patients with AIDS and diarrhoea and wasting syndrome, almost certainly have a malabsorption syndrome. The chronic fever experienced by more than half of the children at time of admission to hospital could likely explain the lethargy and lack of interest in food noted in a quarter of the children at the time of admission.

Biochemically, serum ferritin and zinc levels that were below 67% of the RDA values in 17% of the children on admission may explain the chronic dermatitis noted in 33% of the children on admission, along with diarrhoea, and oral complications such as cheilosis.

4.4 Dietary Intake

There are a number of methods of assessing dietary intake but the two most frequently used are the FFQ and the 24-hour Recall methods. The FFQ places less burden on respondents than most other methods and is designed to obtain qualitative, descriptive information about the usual food intake pattern of food intakes.

Information obtained from these questionnaires may contain errors due to memory lapse between actual intake and recall. Mistaken estimates of portion size resulting from an inability to quantify accurately may lead to measurement errors [70]. Respondent bias is another source of error where parents/guardians may have a tendency of both to overestimate and underestimate (flat slope syndrome). Incidentally, memory lapse is recognized as unintentional omission [76].

It is important to recognize that food composition tables are potential sources of error in the

calculation of nutrient intake. Where different sets of food composition tables or nutrient database are used, discrepancies in nutrient composition values for similar food items are likely to occur [38]. The errors may also be a result of true random variability in the nutrient content of a food [76].

The literature indicates that independently of OI, HIV itself is often a cause of malnutrition, which in turn (as indicated by the NAIDS diagram) exacerbates OI [8,12,31]. True to this theory, the current study showed that malnutrition remained a problem throughout the period of hospitalization of HIV and TB infected children despite the balanced dietary intake. It may be speculated that most of the children were brought to hospital when the disease had progressed to an advanced stage and, as a result, nutritional intervention, as well as treatment were affected. This may support the theory that treatment and nutritional intervention are more effective at early stages of the disease. In light of the adequate diet received by the children during hospitalization, the prevalence of nutrients that were below 67% of the RDA (a level that identifies children at risk), cannot be attributed to poor intake. The trend towards levels below 67% of the RDA is possibly mediated by the acute-phase response, particularly because, as the literature suggests, the prognosis for recovery from acute or chronic illness is poorer in persons with lean and slender bodies than in those who are well nourished.

In the present study, the group complaining of oral problems had lower total protein intake levels on admission to hospital and during hospitalization. These findings concur with those of other researchers that oral complications affect overall intake due to odynophagia.

In childhood, the need for vitamins is increased. During infection and illness, there is an even greater demand for vitamin B_{12} and folic acid, which are required for normal DNA and RNA synthesis. In this study, 8% and 13% of the children had levels below 67% of the RDA for Vitamin B_{12} on admission and during hospitalization.

4.5 Biochemical

The low mean serum albumin levels that occurred in children in this study may have been aggravated by the presence of disease and infection. Low serum albumin levels have been shown to occur in individuals with disease [8,27,47]. Furthermore, deficiencies in iron and zinc affect serum albumin by reducing protein synthesis, and serum albumin levels do not reflect short term changes in protein status. The current study was conducted over a period longer than 3 months – a period long enough for changes in serum albumin levels to be noted if the disease were controlled.

Results of the study indicated that the group presenting with oral complications had lower haematocrit levels than the group without (although the difference was not significant). By the time of discharge, the levels had increased, which could have been a result of supplementation or increased intake. Despite research that indicates that Hb levels are reduced in chronic infection, inflammation and in PEM [11,21,31], 17% and 13% of the children studied remaining below the normal serum ferritin dietary values at admission and at time of discharge, respectively. The group presenting with oral complications had higher mean levels (no significance) than the group without. Serum ferritin levels were lower in children with oral complications, which indicated that their iron stores were low. These results are in line with literature that documents low iron status as a pre-disposing factor for *candidal* infection [15,29].

True to literature that shows that in PEM, CHI% is reduced [73], the results of this study indicate that children diagnosed with malnutrition (underweight and/or stunted) have reduced CHI%. Their stunting as a group suggests that their illness affected their development over the longer term.

Contrary to literature that indicates that inflammation and infection result in reduced plasma net levels and ultimately susceptibility to infections, vitamin A status was found in the present study to be at higher levels in the children with oral complications. However, it has been shown that vitamin A improves with supplementation [16,21,43,52], as was the case in this study where 13% of the children presented with levels below 67% of the RDA (indicating marginal vitamin A deficiency) on admission to hospital and 8% at discharge. On the other hand research conducted

by Rahman [61] has shown poor adherence to vitamin A supplementation in children infected with HIV.

Contrary to literature that shows that zinc levels correlate with serum albumin levels [10], this study found that in the group with oral complications zinc levels increased (at 3 month hospitalization), while serum albumin levels declined. However in the group without oral complications, there was correlation between the two indicators.

The results of this study concur with findings reported in current literature of a notable decline in vitamin C in stress, inflammation or disease [64]. Bleeding gums noted in 16% of the children studied could have been the result of vitamin C decline. Vitamin C levels were low among all the children, all of whom were infected with TB, and even lower among those children presenting with oral complications. These results mirror findings documented in the literature that nutritional deficiencies in HIV infection are intricately linked with immune function [2,6,10,17].

4.6 Oral Complications

Of great concern is the finding that nutritional status of HIV infected children, experiencing oral complications does not improve despite hospitalization. Moreover, the nutritional status of children without oral complications did not improve either. This concurs with documented research findings that malnutrition is not only a common and serious problem associated with HIV/AIDS, but that, where infections are present, nutritional problems cannot be dealt with in isolation.

Oral complications occurred in 29% and 25% of the children, in this study upon admission to hospital and at time of discharge, respectively. It was also found that children with oral complications expressed increased nutritional deficiencies (using height and weight anthropometric indicators) as compared with children without oral complications (Table 16). This situation is similar to other literature which indicates that as the disease progresses, HIV-infected individuals are more likely to develop oral lesions. Furthermore Mascarenhas and Smith [58] have documented that in relation to dental care, it appears that disparities between more and

less advantaged groups continue to exist along the lines of education, regardless of the overlying disease in the population. These conclusions, however, are likely to be influenced or driven by immune suppression.

In the present study, *Candida albicans* could be isolated from only 2 children (8%) with a positive culture out of a total study population of 24. These results conflict with those of authors who indicate that more than 50% of HIV infected individuals are likely to develop oral *candida* as the disease progresses. It could be that the present study did not survey patients long enough or that the study population was too small to establish such findings.

In the present study, 62% and 54% of children with oral complications were found to be malnourished on admission to hospital and at discharge respectively. Although not a significant difference, the improvement could be attributed to the balanced and much more frequent meals that the children received once admitted to hospital. Additionally, the study revealed that the risk of a severely malnourished child developing oral complications was 3.6 times (CI = 1.8 - 8.3) greater than in a mildly malnourished child on admission, while the risk of a severely malnourished child developing oral complications at time of discharge was 2.2 times (CI= 0.7 - 4.9) greater than in a mildly malnourished child.

Additionally, biochemical results indicated that the children with oral complications had levels below the normal values for serum ferritin, plasma retinol, vitamin C and zinc were, and so did the children without oral complications, with no significant significant difference.

The relatively small sample size is a limiting factor when it comes to interpreting results, but the size of the study population in the present study was large enough to provide direction for future research. For example, in light of findings that HIV-infected infants tend to die before 24 months of age, it is significant that the <23-month category was found to be the smallest (29%) category. It is interesting to note, meanwhile, that a study conducted by Guenter *et al.* [17] revealed that HIV infected individuals who are older have lower CD4 counts or more advanced malnutrition along with decreased length of survival. The results of the present study also indicate and validate previous observations that nutritional status declines with declining CD4 counts.

CHAPTER 5: CONCLUSIONS

5. CONCLUSIONS

Growth failure and malnutrition have long been known to complicate the course of HIV-infection and therefore influence the outcome of opportunistic infections such as oral complications. This study confirms that malnutrition is an important issue in the management of HIV-infected children with opportunistic illnesses. Inadequate energy, protein, vitamin and mineral intake due to poor dietary intake, nutrient diversion, poor absorption, increased nutrient requirements, high viral load, and increased opportunistic infections are all likely to contribute to delayed growth and development and to compromised immune function and treatment failure.

That the nutritional status of malnourished children infected with HIV and TB did not improve significantly during hospitalization and despite appropriate treatment of TB, indicates that intensive and complex nutritional interventions may be required. Nutritional status on admission to hospital is, meanwhile, remains a prognostic marker of disease progression.

CHAPTER 6: RECOMMENDATIONS

6. RECOMMENDATIONS

- Owing to the increased risk of growth failure and developmental delay and the effect on the entire body system, children should be referred for full nutritional evaluation as soon as possible after diagnosis of HIV infection.
- Curable causes of malnutrition such as candidiasis-related oropharyngeal pain and dysphagia should be treated and children maintained in satisfactory nutritional condition to enable them handle nutritional disorders related to episodes of opportunistic infections.
- Difficulties with chewing or swallowing particular to HIV infection should be addressed. Children with disrupted oral and oesophageal integrity may benefit from enteral tube feedings and aggressive treatment of the concurrent opportunistic illness may lead to improved growth and weight gain.
- Because nutritional deficiencies occur early in paediatric HIV disease, evaluation of growth and nutritional status should begin with the child born to a sero-positive mother. Dietary history and recall, height, weight, triceps skinfold thickness and arm muscle circumference should be performed every three months to detect subtle changes in growth and altered nutrient intake. Once diagnosis of malnutrition is established, oral intervention should begin.
- Given its high frequency among those attending AIDS clinics, malnutrition should be prevented, detected, monitored and treated from the early stages of HIV, using simple procedures that may improve chances of survival and quality of life.
- Nutrition intervention is necessary at all stages of HIV infection.
- It is important that underlying infections prompting wasting be treated.
- Efforts targeted at reducing mortality should address the treatment of infections as well as malnutrition.
- Owing to the inter-relationship of nutrition and HIV infection, early detection of the infection and proper management of diet cannot be overemphasised in addressing both inanition and quality of life. Companionship, encouragement, and individual dietary counselling - in conjunction with cautious administration of supplemental foods and

appetite enhancing drugs - may help to increase food intake, thus slowing the development of malnutrition, the introduction of opportunistic infection and the need for hospitalization.

- The use of more than one diagnostic test when feasible, is highly recommended. Greater sensitivity in detecting small changes in lean body mass or body cell mass can be obtained by using a combination of techniques such as anthropometrical measurements, clinical indicators and biochemical assessments.

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APPENDICES

Appendix 1

Socio-economic Questionnaire **Number.....**

Nutritional Factors Associated with Oral Lesions in HIV Disease and TB Infection

SECTION A

1) Personal Data

1.1 Name (patient)..... 1.4 Date.....
1.2 Date of birth..... 1.5 Age.....
1.3 Address..... 1.6 Sex.....
..... 1.7 Height.....
..... 1.8 Weight.....
..... 1.9 Usual weight.....
1.10 Relationship with patient.....

2) Socio-Economic Profile

2.1 Are you working? Yes No

2.2 If yes, occupation (tick one)

Employed	Self-employed	Other
1	2	3

2.3 Marital status (tick one)

Single	Married	divorced	separated	widowed	living together
1	2	3	4	5	6

2.4 Number of children living in your household, including the child (tick one)

1	2	3	4	5 or more

2.5 Level of formal education of respondent (tick one)

Primary	Matric	Tertiary	Basic Literacy
1	2	3	4

2.6 Are there any specific eating habits in your family that you think might affect the child's nutritional health. (ie.availability of sufficient food in household)
Explain.....
.....

3) Medical History of the patient

3.1 Date of last medical check-up.....

3.2 Reason for the check-up.....

3.3 Reason for coming in now.....
.....
.....

3.4 Date when was patient diagnosed HIV positive?.....

3.5 Place where diagnosed HIV positive.....

3.6 CD4 count (if known).....

3.7 Viral load (if known).....

3.8 Has the child been ill more than three times in the past year? Yes No

3.9 If yes what complications has the child had.....
.....
.....

3.10 Was patient treated by a doctor for those illnesses Yes No

SECTION B

4) Diet History

4.1 Is the child still breastfeeding? Yes No

4.2 If yes, is the child only breastfed? (breastmilk is only source of food) Yes No

4.3 If child still breastfeeding, how often do you breastfeed per day? (tick one)

<2 times	2-4 times	5-7 times	8-9 times	>9 times
1	2	3	4	5

4.4 Approximate time for each feed (tick one)

<10 mins	10-20 mins	20-30 mins	>30 mins
1	2	3	4

4.5 If no to 4.1, does the child drink milk? Yes No

4.6 If yes, what kind? (tick one)

Whole	Skim	Low-fat	Other
1	2	3	4

4.7 Is the child fed both breastmilk and formulas? Yes No

4.8 Is the child strictly formula fed? Yes No

4.9 If the child is given formula, which type?

Pelar Gon	Lacto Gen	Simil-ac	SMA	Infagro	Prege simil	Preemie	Prenan	Alfare	Infa soy	Isomil	Prosobee	Nan	S26
1	2	3	4	5	6	7	8	9	10	11	12	13	14

4.10 If yes to any of the above products, in what amounts?

<250ml (<cup)		250 ml (cup)		500 ml (2 cups)		750 ml (3 cups)		1 litre (4 cups)			>1litre (>4 cups)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14

4.11 If the child has been introduced to solid foods, at what age were they introduced?

1 month	2 months	3 months	4 or > months	Don't know
1	2	3	4	5

4.12 Does the child usually eat in between meals? Yes No Sometimes

4.13 If yes when

At pre-school	At creche	At primary school	Afternoon (after lunch)	Evening (after supper)
1	2	3	4	5

4.14 Would you say the child has a good appetite? Yes No Sometimes

4.15 If previous response is No or sometimes, give reasons for lack of appetite.....
.....
.....

4.16 Are there foods that the child does not eat for any particular reason.....
.....
.....

4.17 Does the child complain of pain in the:	gums	Yes	No	Sometimes
	teeth	Yes	No	Sometimes
4.18 Does the child have any difficulty with:	chewing	Yes	No	Sometimes
	swallowing	Yes	No	Sometimes
	nausea	Yes	No	Sometimes
	diarrhoea	Yes	No	Sometimes
	vomiting	Yes	No	Sometimes
	constipation	Yes	No	Sometimes
			Date in months (ago)	
4.19 Has the child previously had difficulty: and when	chewing	Yes	No	
	swallowing	Yes	No.....	
	nausea	Yes	No.....	
	diarrhoea	Yes	No.....	
	vomiting	Yes	No.....	
	constipation	Yes	No.....	

4.20 Has the child recently lost weight? Yes No

4.21 If yes, please explain how.....
.....
.....

4.22 Does the child take a vitamin/mineral supplement? Yes No

4.23 If yes

Description of drug	Dose	Frequency	Duration of intake
.....	.....	.....	.....

SECTION C

5) Drug History

5.1 Does the child have any health problems for which he/she is taking prescription medication at the present time? Yes No

5.2 If yes give details of the health problem.....
.....
.....

5.3 Description of drug	Dose	Frequency	Duration of intake
.....	.....	.....	.....

5.4 Is the child taking any other medication a doctor has prescribed? Yes No

5.5 If yes

Description of drug	Dose	Frequency	Duration of intake
.....	.....	.....	.....

5.6 Has the child taken any other medication within the past three months that a doctor has prescribed?
Yes No

5.7 If yes

Description of drug	Dose	Frequency	Duration of intake
.....	.....	.....	.....

5.8 Does the child take medication, prescribed by you for any reason? Yes No

5.9 If yes

Description of drug	Dose	Frequency	Duration of intake
.....	.....	.....	.....

Additional Comments.....
.....
.....
.....
.....
.....

Appendix 2

24 HOUR DIET RECALL RECORD

Patient's name ..... Date..... Patient #.....

Was yesterday a typical/routine for the child? Yes No If No, why not.....
(Carefully recall and list everything that the child ate and had to drink yesterday from the time they woke up, try and also recall the quantities of each item)

Measurements will include the following: 1tsp=1 teaspoon, 1tbsp=1 tablespoon, 1sp=1 serving spoon Thin, Med, Thick
1c=1cup (250ml) s=small, m=medium, l=large,
1tc= 1 teacup (180ml) enr=enriched, pl=plain, ns=no sugar
1 bwl=1 bowl

Milk sm=skim milk, wm=whole milk, bl=blend, con=condensed, nd=non diary **Bread** wh=white, br=brown, ww=wholewheat
Meat f=with fat, ft=fat trimmed **Oil/fat** b=butter,h=hard margarine, med=medium fat/light, pm=polyunsaturated, so=sunflower oil, wf=white fat, pb=peanut butter

FOOD ITEMS		CODE	QUANTITY (gm or ml)	B/FAST	SNACK	LUNCH	SNACK	DINNER	SNACK
Milk & milk products	Coffee	9513	Cup=180ml, mug=250ml						
	Tea	9514	Cup =180ml, mug = 250ml						
	Rooibos	9560	Cup =180ml, mug = 250ml						
	Sugar wh	9012	1 tsp =6g						
	Sugar br	9032	1h tsp =6g						
	Honey	9007	1 h tsp =15g 1h dsp =30g						
	Flavoured milk low fat	0071	Carton = 250g						
	Buttermilk	0001	1 tsp = 4g						
	Cheese cheddar	0010	1 dsp = 5g						
	Cream cheese	0013	1h tbs = 40g						
	Cheese spread	0018	1h tbs = 50g						
	Custard low fat milk	0076	1 dsp = 10 g						
	Custard whole milk	0004	½ c = 125g						
	Yogurt drink	0044	1 unit = 175 g						
	Yogurt fat free plain	0075	1 unit = 175g						
	Yogurt fruit low fat	9002	1 unit = 175g						
	Amasi/sour milk	0085							
	Maheu (liquid)	9562							
	Skim milk	0072	½ c = 125g, w cereal = 30g						
	Milk 2%	0069	½ c = 125g						

	FOOD ITEMS	CODE	QUANTITY (gm or ml)	B/FAST	SNACK	LUNCH	SNACK	DINNER	SNACK
	Milk whole evaporated	0003	1 tsp = 3g						
	Milk goat	0026							
	Breast milk	0029							
	Milk powder	0092							
	Milk soy	0025							
	Nesquik	0128	½ c = 60g						
	Ovaltine/milo/horlicks no sugar	0035	½ c = 125g						
	Milkshake – purchase	0086							
	Other (specify).....								
Cold drinks	Cold drinks – carbonated	9001	175, 300, 500g						
	Cold drinks diet & low-cal	9002	½ c =125g						
	Cold drink squash diluted	9002	1/2c =125ml						
	Other (specify).....								
Breakfast cereals	Breakfast cereal all bran	4035	½ c =25g						
	Corn flakes plain	4036	½ c = 20g						
	Sugar coated corn flakes	4218	½ c =20g						
	Fruit loops	4303	½ c =18g						
	Puffed wheat honey snacks	4221	½ c = 12g						
	Raisin bran	4217	½ c =45g						
	Rice krispies	4046	½ c =20g						
	Rusks homemade all bran	4228	40x40x30=25g, 80x28x30=30g						
	Rusks commercial	4206	Rectangle cut = 15g						
	Weetbix	4037	Std =25g						
	Meusli – honey crunch commercial	4122	½ c= 65g						
	Mabella cornrice	4315	½ c = 100g						
	Maltabella cooked	4034	½ c = 125g						
	Maizemeal crumble porridge	4256	½ c = 70g						
	Maizemeal soft porridge	4254	½ c = 125g						
	Maizemeal stiff porridge	4255	½ c = 125g						
	Maizemeal yellow	4079	½ c = 65g						
	Milk w pap full cream	0006	S=30g m=60g l=125g						
	Milk w pap 2%	0085	S=30g m=60g l=125g						
	Oats rolled cooked	4032	½ c = 125g						
	Sugar wh	9012	1 htsp =6g						

	FOOD ITEMS	CODE	QUANTITY (gm or ml)	B/FAST	SNACK	LUNCH	SNACK	DINNER	SNACK
	Sugar br	9032	1h tsp =6g						
	Honey	9007	1 h tsp =15g 1h dsp =30g						
	Other (specify).....								
Breads and rolls	Bread rolls white	4001	5mm = 20g, 10mm= 30g, 15mm =50g ½ loaf =400g						
	Bread rolls br	4002							
	Bread rolls ww	4003							
	Cream crackers	4022	56x60mm = 8g						
	Cream crackers ww	4243	70x65x6mm = 18g						
	Roti s oil	4199	Sm = 50g, lrg =150g						
	roti hm	4198	Sm = 50g, lrg =150g						
	Muffins plain	4266							
	Muffins bran	4265							
	Vetkoek homemade	4057	85x100x30mm =30g						
	Vetkoek ww	4148	85x80x42mm =100g						
	Pita bread	4274	155x10x70 = 70g						
	Pumpernickel bread	4091	105x80x4mm = 20g						
	Other (specify).....								
Spreads on bread	Butter	6502	5ml =5g, 1h dsp = 12g						
	Butro	6552							
	Margarine + hm	6515	5ml = 5g, 1l dsp = 12g						
	Chicken fat	6137	5ml = 5g, 1l dsp = 8g						
	Lard	6520	5ml = 5g						
	Olive oil	6138	5ml = 5g, 1l dsp= 8g						
	Peanut butter smooth	6519	5ml = 5g, 1l dsp= 8g						
	Marmite	9008							
	Fishpaste/jam	2567	1h tsp =15g, 1h dsp =30g						
	Meat paste	1512	5ml = 5g, 1l dsp = 10g						
	Liver spread/ paste	1517	1h ds = 28g						
	Sandwich spread	6551	1l tsp =5g, 1l dsp =15g						
	Syrup	1011	1 h tsp = 15g						
	Other (specify).....								
Eggs	Boiled	1001	M =4g, l=50g, xl= 155g						
	Fried in butter	1002	1 unit = 52g						
	Fried in s oil	1003	1 unit = 52g						

	FOOD ITEMS	CODE	QUANTITY (gm or ml)	B/FAST	SNACK	LUNCH	SNACK	DINNER	SNACK
	Fried in margarine	1012	1 unit = 52 g						
	Poached	1011	1 unit = 50g						
	Scrambled in butter	1021	1 unit = 65g						
	Scrambled in s oil	1024	1 unit = 65g						
	Omelette plain in s oil	1017	1 unit = 60g						
	Other (specify).....								
Cheese	Cheddar	0010	1 dsp = 5g						
	cream cheese	0013	5ml = 6g, 1 h tsp = 15g						
	Cottage – fat free	0017	5ml = 6g, 1 h tsp = 15g						
	cheese spread	0018	5ml = 5g, 1 h tsp = 15g						
	Cottage – creamed	0047	5ml = 6g, 1 h tsp = 15g						
	Other (specify).....								
Meat	Beef mince regular	1505	1h ds =25g						
	Beef roast w fat	1539	120x60x5mm =35g						
	Beef rumpsteak grilled	1538							
	Beef stew w veg	1638	½ c = 125g						
	Ham cooked can	1509	1 sl = 15g						
	Liver beef fried	1515	110x60x10mm = 80g						
	Liver chicken cooked	1567	1 u = 30g						
	Liver sheep fried	1550	110x60x10mm = 80g						
	Vienna sausage/canned sausage	1531	M =25g, lrg =35g						
	Luncheon meat beef	1612	70x55x5mm =20g						
	Meatball lean w egg	1653	30mm diam = 15g						
	Meatloaf lean mince	1615	70x55x15mm =5g						
	Muton stew w veg	1511	½ c = 125g						
	Polony	1514	home cut =4g, comm =16g						
	Pork chop	1602	115x80x20 = 110g						
	Salami	1543	54mm diam = 2g						
	Sausage roll	1634	53x35x27mm = 23						
	Sausage boerewors beef/pork	1526	S diam =30g, thick diam =90g						
	Bacon fried w fat	1510	Rasher = 10g						
	Chicken boil w skin 1521	1521	1h sp = 120g						
	Chicken fried (KFC)	1634	1h ls= 72g, ½ c = 75g						
	Chicken pie	1549	20 diam = 265g						

	FOOD ITEMS	CODE	QUANTITY (gm or ml)	B/FAST	SNACK	LUNCH	SNACK	DINNER	SNACK
	Chicken roast no skin	1545	Med breast = 110g						
	Tripe (ofal)	1546							
	Turkey roasted w skin	1579							
	Other (specify).....								
Fish	Cake fried commercial	2531	15mm diam = 50g						
	Paste	2567							
	Smoked	2569	115x32x17 = 52g						
	Pilchard in tomato	2557	½ c= 130g mashed						
	Salmon canned	2556	½ c=70g plain, ½ c=115g mayo						
	Sardine in tomato	2539	½ c=70g plain, ½ c=115g mayo						
	Sardine in oil	2560	75x25x15mm = 12g						
	Smoorsnoek	2525	½ c = 80g						
	Tuna salad	2506							
	Tuna canned in oil	2505	½ c plain =70g, ½ c shred =112g						
	Tuna canned in water	2501	Mayo on bread =115, ½ c= 95g						
	Other (specify).....								
Starch	Mabella cornrice	4315	½ c = 100g						
	Macaroni cheese +wht sauce	4176	½ c =115g						
	Spaghetti bolognaise reg mince	4060	½ c = 100g						
	Spaghetti can+tomato sauc	4058	½ c = 125g						
	Lasagne lean mince+cheese	4318	½ c = 120g						
	Maizemeal crumble porridge	4256	½ c = 70g						
	Maizemeal soft porridge	4254	½ c = 125g						
	Maizemeal stiff porridge	4255	½ c = 125g						
	Maizemeal yellow	4079	½ c = 65g						
	Milk w pap full cream	0006	S=30g m=60g l=125g						
	Milk w pap 2%	0085	S=30g m=60g l=125g						
	Maize/samp/rice cooked	4077	½ c = 65g						
	Maltabella cooked	4034	½ c = 125g						
	Rice fried	4311							
	Rice white cooked	4040	½ c = 65g						
	Samp and beans	4257	½ g = 125g						
	Chips								
	Other (specify).....								

FOOD ITEMS		CODE	QUANTITY (gm or ml)	B/FAST	SNACK	LUNCH	SNACK	DINNER	SNACK
Soups & legumes	Lentil + veg	3041	Ladle=130g, ½ c = 125g						
	Mushroom cream	3043	½ c = 125g						
	Split pea	3045	½ c = 130g						
	Onion powder	3044	Pack = 9g						
	Tomato cream	3048	½ c = 125g						
	Mixed veg	3049	½ c = 125g						
	Peas split cooked	3506	1h tbs = 25g						
	Peas green fresh/frozen	8026	1 h tbs = 30g						
	Peas cooked w butter	8075	1 h tbs = 20g						
	Beans green cooked w butter	8080	1 h tbs = 25g						
	Beans sugar cooked	3542	1 l dsp = 15g						
	Beans white kidney cooked	3513	1 l dsp = 15g						
	Chick peas dried cooked	3531	1 l dsp = 10g						
	Lentils split cooked	3509	1 l dsp = 15g						
	Three bean salad w sun oil	3525	1 h dsp = 25g						
	Sousboontjies (dried bean salad)								
	Stew:bean+potato+onion								
	Other (specify).....								
Vegetables	Broccoli cooked - floret	8007	S = 10g, m =20g l =35g						
	Broccoli raw	8008							
	Green peppers raw - chopped	8041	1 h tbs = 17g						
	Carrots cooked	8067	Baby s=3g m=6g l=12g						
	Carrots raw - grated	8015	1h tbs = 25g						
	Sweet potato baked w skin	8057	1 h tbs = 45g						
	Sweet potato cook w sugar	8243	1 h tbs = 50g						
	Potato mashed	8292	1 h tbs = 50g						
	Potato salad	8236	1 h tbs = 50g						
	Cabbage cooked – shredded	8066	1 h tbs = 30g						
	Raw cabbage – shredded	8010	1 h tbs = 15g						
	Asparagus canned/cook	8001	Whole s=12g m=15g l=25g						
	Beetroot cooked	8004	Whole s=60g m=90g l=160g						
	Beetroot salad	8005	1 h tbs = 25						
	Green bean curry boil								
	Sweetcorn boil								
	brinjal boil								

	FOOD ITEMS	CODE	QUANTITY (gm or ml)	B/FAST	SNACK	LUNCH	SNACK	DINNER	SNACK
	squash marrow								
	Other (specify).....								
Salad	Avocado								
	Mixed green no dressing								
	Cucumber raw/pickled								
	Potato salad +mayonnaise+egg	8247	1h dsp =35g, 1h tbs =45g						
	Other (specify).....								
Dressing	Salad dressing-mayonnaise	6513	1l dsp =15g, 1l ls = 65g						
	S/dressing homemade wm	6531	1l dsp =15g, 1l ls = 65g						
	S/dressing low oil	6534	1l dsp = 15g, 1l ls =65g						
	Sunflower oil	6536	1l tsp =4g, 1l dsp =8g						
	Other (specify).....								
Fruits & fruit juices	Apples raw fresh w skin	7001	S =80g m =150g l =220g						
	Apple juice	7080	250g						
	Apple dried	7074	1 med = 60g						
	Apricots raw fresh	7003	1 med = 35g						
	Apricots canned w syrup	7004	1 med = 35g						
	Apricots dried raw	7005	½ c = 3						
	Avocado raw	7132	¼ unit = 40g						
	Banana raw	7009	Mash 1h dsp = 28g, ½ c = 125g						
	Banana fried w sun oil	7087							
	Peaches raw	7036	1 med = 150g						
	Peaches raw dried	7039	1 med = 150g						
	Peaches canned w syrup	7038	1 med = 150g						
	Pears raw	7053	1 med = 165g						
	Pears canned	7054	S =100g m=165g l=220g						
	Grapes raw	7020	½ c = 90g						
	Grape juice	7098	250g						
	Pineapple raw	7052	85x3mm diam = 15						
	Pineapple canned	7132	½ c = 90g						
	Plums raw	7041	Med = 50g, lrg = 70g						
	Plums canned w syrup	7124	½ c = 125g						
	Prunes raw	7069	½ c = 100g						
	Prunes canned	7154	½ c = 125						
	Raisins seedless	7022	Handful = 27g, ½ c = 85g						

	FOOD ITEMS	CODE	QUANTITY (gm or ml)	B/FAST	SNACK	LUNCH	SNACK	DINNER	SNACK
	Grapefruit raw	7016	88mm di =90g, 100mm di =125g						
	Grapefruit canned	7017	½ c = 125g						
	Naartjie raw	7028	S=50g m=75g l=120g						
	Orange raw	7031	S=120g m=180g l=280g						
	Orange juice ceres	7113	250g						
	Guava raw	7021	S=50g m=95g l=130g						
	Guava juice	7024	½ c = 125g						
	Mango raw	7026	135mm diam = 350g						
	Mango canned	7108	½ c= 125g						
	Mango juice	7162	200ml						
	Fruit salad w sugar	7079	½ c = 165						
	Other (specify).....								
Sauces	Atchar mango	3004							
	Chutney fruit	3057	1l tbs=20g, 1h tbs = 60g						
	Chutney tomato	3001							
	Tomato sauce	3027	5ml= 5g, ½ c = 135g						
	Cheese sauce	3013	1htsp=7 1hdsp=17 1htbs=25g						
	Chocolate sauce commercial	3016	S=5g m=10g plenty= 15g						
	Other (specify).....								
Cake & cookies	Banana loaf wm, hm commerc	4164	90x75x10mm =40g						
	Bread raisin	4005	5mm=20 10mm=30g 15mm=40g						
	Cake butter plain home, hm	4288							
	Carrot cake plain, egg, s oil	4244	80x20x40mm=25g, +icing=40g						
	Cake chocolate plain hm	4277	75x75x20=50g						
	Cake w icing commercial	4103	115x65x10mm = 35g						
	Cookies plain commercial	4007	Average = 10g						
	Doughnut w jam	4024	60mm diam = 45g						
	Pancake/crumpet plain s oil	4302	70mm diam =25g, 170mm = 70g						
	Scone plain sm, s oil	4140	S =25g m=35g l=50g						
	Other (specify).....								

FOOD ITEMS		CODE	QUANTITY (gm or ml)	B/FAST	SNACK	LUNCH	SNACK	DINNER	SNACK
Puddings & sweets	Jelly/powder	9022	½ c = 110g						
	Sherbet	9055							
	Sweets/chocolate coated	9024	S =18g m=62g thick =108g						
	Chocolate assorted centres	9017	22x22x15mm = 10g						
	Candy/ fruit gum	9027	1 unit = 5g						
	Sweet/marshmallows	9028	1 unit coconut=10, plain=10g						
	Snack niknaks,ghost pop	4067	Sml pkt =14g, lrg pkt =150g						
	Pudding instant, sm	4133	½ c = 145g						
	Other (specify).....								
Infant foods	Cereal mixed –nestum 2	0503	½ c = 25g						
	Baby cereal dry purity	0511	½ c = 20g						
	Baby cereal rice dry purity	0531	½ c =20 g						
	First food jar fruit	0521							
	Infant dinner beef+veg dry	0510							
	Infant dinner chicken+veg	0509							
	Infant dinner mixed veg	0508							
	Junior cereal dry	0502							
	Junior food mix veg	0518							
	Strained food veg+meat jar	0515	1 unit = 125g						
	Strained food soup veg	0512							
	Strained food soup meat	0516							
	Other (specify).....								

Did this child go to bed hungry last night? Yes No Don't know

Did this child eat from the same pot as the rest of the family at the main meal yesterday? Yes No Don't know

Did this child eat from the same plate as the siblings, at the main meal yesterday? Yes No Don't know

Appendix 3

FOOD FREQUENCY QUESTIONNAIRE (FFQ)

For each item, indicate with a {√} the category that best describes the frequency with which each item is usually consumed by the child.

Food item		Code	Quantity	>than once/day	Once/day	3-6 times/ week	1 or 2 times/wk	Once/ month	Seldom	Never
Meats & cold cuts	Beef mince regular	1505	1h ds =25g							
	Beef roast w fat	1539	120x60x5mm =35g							
	Beef rumpsteak grilled	1538								
	Beef stew w veg	1638	½ c = 125g							
	Ham cooked can	1509	1 sl = 15g							
	Liver beef fried	1515	110x60x10mm = 80g							
	Liver chicken cooked	1567	1 u = 30g							
	Liver sheep fried	1550	110x60x10mm = 80g							
	Liver pate/spread/sausage	1517	1h ds = 28g							
	Luncheon meat beef	1612	70x55x5mm =20g							
	Meatball lean w egg	1653	30mm diam = 15g							
	Meatloaf lean mince	1615	70x55x15mm =5g							
	Muton stew w veg	1511	½ c = 125g							
	Polony	1514	home cut =4g, comm =16g							
	Pork chop	1602	115x80x20 = 110g							
	Salami	1543	54mm diam = 2g							
	Sausage roll	1634	53x35x27mm = 23							
	Sausage boerewors beef/pork	1526	S diam =30g, thick diam =90g							
	Bacon fried w fat	1510	Rasher = 10g							
Poultry	Chicken boil w skin 1521	1521	1h sp = 120g							
	Chicken fried (KFC)	1634	1h ls= 72g, ½ c = 75g							
	Chicken pie	1549	20 diam = 265g							
	Chicken roast no skin	1545	Med breast = 110g							
	Turkey roasted w skin	1579								
Eggs	Boiled	1001	M =4g, l=50g, xl= 155g							
	Fried in butter	1002	1 unit = 52g							
	Fried in s oil	1003	1 unit = 52g							
	Fried in margarine	1012	1 unit = 52 g							
	Poached	1011	1 unit = 50g							
	Scrambled in butter	1021	1 unit = 65g							
	Scrambled in s oil	1024	1 unit = 65g							
	Omelette plain in s oil	1017	1 unit = 60g							

Food item		Code	Quantity	>than 1/d	Once/day	3-6 times/ w	1-2 X / wk	Once/ mth	Seldom	Never
Gravies/ Sauces	Atchar mango	3004								
	Chutney fruit	3057	1l tbs=20g, 1h tbs = 60g							
	Chutney tomato	3001								
	Tomato sauce	3027	5ml= 5g, ½ c = 135g							
	Cheese sauce	3013	1htsp=7 1hdsp=17 1htbs=25g							
	Chocolate sauce commercial	3016	S=5g m=10g plenty= 15g							
Soup	Lentil + veg	3041	Ladle=130g, ½ c = 125g							
	Mushroom cream	3043	½ c = 125g							
	Split pea	3045	½ c = 130g							
	Onion powder	3044	Pack = 9g							
	Tomato cream	3048	½ c = 125g							
	Mixed veg	3049	½ c = 125g							
Fish	Cake fried commercial	2531	15mm diam = 50g							
	Paste	2567								
	Smoked	2569	115x32x17 = 52g							
	Pilchard in tomato	2557	½ c= 130g mashed							
	Salmon canned	2556	½ c=70g plain, ½ c=115g mayo							
	Sardine in tomato	2539	½ c=70g plain, ½ c=115g mayo							
	Sardine in oil	2560	75x25x15mm = 12g							
	Smoorsnoek	2525	½ c = 80g							
	Tuna salad	2506								
	Tuna canned in oil	2505	½ c plain =70g, ½ c shred =112g							
	Tuna canned in water	2501	Mayo on bread =115, ½ c= 95g							
Milk & milk product	Condensed skim sweeten	0032	1 tsp =8g							
	Cheese cottage low fat	0048	1 tsp = 4g							
	Buttermilk	0001	1 tsp = 4g							
	Cheese cheddar	0010	1 dsp = 5g							
	Custard low fat milk	0076	1 dsp = 10 g							
	Custard whole milk	0004	½ c = 125g							
	Yogurt drink	0044	1 unit = 175 g							
	Yogurt fat free plain	0075	1 unit = 175g							
	Yogurt fruit low fat	9002	1 unit = 175g							
	Amasi/sour milk	0085								
	Skim milk	0072	½ c = 125g, w cereal = 30g							
	Milk 2%	0069	½ c = 125g							
	Milk whole evaporated	0003	1 tsp = 3g							
	Milk goat	0026								
	Breast milk	0029								

	Food item	Code	Quantity	>than 1/d	Once/day	3-6 times/w	1-2 X / wk	Once/ mth	Seldom	Never
	Milk powder	0092								
	Milk soy	0025								
Baby Food	Cereal mixed –nestum 2	0503	½ c = 25g							
	Baby cereal dry purity	0511	½ c = 20g							
	Baby cereal rice dry purity	0531	½ c =20 g							
	First food jar fruit	0521								
	Infant dinner beef+veg dry	0510								
	Infant dinner chicken+veg	0509								
	Infant dinner mixed veg	0508								
	Junior cereal dry	0502								
	Junior food mix veg	0518								
	Strained food veg+meat jar	0515	1 unit = 125g							
	Strained food soup veg	0512								
	Strained food soup meat	0516								
Legumes	Peas split cooked	3506	1h tbs = 25g							
	Peas green fresh/frozen	8026	1 h tbs = 30g							
	Peas cooked w butter	8075	1 h tbs = 20g							
	Beans green cooked w butter	8080	1 h tbs = 25g							
	Beans sugar cooked	3542	1 l dsp = 15g							
	Beans white kidney cooked	3513	1 l dsp = 15g							
	Chick peas dried cooked	3531	1 l dsp = 10g							
	Lentils split cooked	3509	1 l dsp = 15g							
	Three bean salad w sun oil	3525	1 h dsp = 25g							
Vegetables	Broccoli cooked - floret	8007	S = 10g, m =20g l =35g							
	Broccoli raw	8008								
	Green peppers raw - chopped	8041	1 h tbs = 17g							
	Carrots cooked	8067	Baby s=3g m=6g l=12g							
	Carrots raw - grated	8015	1h tbs = 25g							
	Sweet potato baked w skin	8057	1 h tbs = 45g							
	Sweet potato cook w sugar	8243	1 h tbs = 50g							
	Potato mashed	8292	1 h tbs = 50g							
	Potato salad	8236	1 h tbs = 50g							
	Cabbage cooked – shredded	8066	1 h tbs = 30g							
	Raw cabbage – shredded	8010	1 h tbs = 15g							
	Asparagus canned/cook	8001	Whole s=12g m=15g l=25g							
	Beetroot cooked	8004	Whole s=60g m=90g l=160g							
	Beetroot salad	8005	1 h tbs = 25							

	Food item	Code	Quantity	>than 1/d	Once/day	3-6 times/w	1-2 X /wk	Once/mth	Seldom	Never
	Cauliflower cooked - floret	8023								
	Cauliflower raw	8138	S =30g m =60g l =115g							
	Corn on the cob cooked	8033	150x44mm = 135g							
	Celery cook	8084	1 h tbs = 25g							
	Celery raw	8139	Stalk s =30g m=60g l=115g							
	Tomato raw	8059	Slice 55x5mm diam = 10g, whole 56x38mm = 80g							
	Lettuce raw	8031	Leaf s =20g m =30g l =65g							
	Mix veg cook w butter frozen	8144	1h tbs = 35g							
	Mixed veg canned	8035	1 h tbs = 30							
Fruits & fruit juices	Apples raw fresh w skin	7001	S =80g m =150g l =220g							
	Apple juice	7080	250g							
	Apple dried	7074	1 med = 60g							
	Apricots raw fresh	7003	1 med = 35g							
	Apricots canned w syrup	7004	1 med = 35g							
	Apricots dried raw	7005	½ c = 3							
	Avocado raw	7132	¼ unit = 40g							
	Banana raw	7009	Mash 1h dsp = 28g, ½ c = 125g							
	Banana fried w sun oil	7087								
	Peaches raw	7036	1 med = 150g							
	Peaches raw dried	7039	1 med = 150g							
	Peaches canned w syrup	7038	1 med = 150g							
	Pears raw	7053	1 med = 165g							
	Pears canned	7054	S =100g m=165g l=220g							
	Grapes raw	7020	½ c = 90g							
	Grape juice	7098	250g							
	Pineapple raw	7052	85x3mm diam = 15							
	Pineapple canned	7132	½ c = 90g							
	Plums raw	7041	Med = 50g, lrg = 70g							
	Plums canned w syrup	7124	½ c = 125g							
	Prunes raw	7069	½ c = 100g							
	Prunes canned	7154	½ c = 125							
	Raisins seedless	7022	Handful = 27g, ½ c = 85g							
	Grapefruit raw	7016	88mm di =90g, 100mm di =125g							
	Grapefruit canned	7017	½ c = 125g							
	Naartjie raw	7028	S=50g m=75g l=120g							
	Orange raw	7031	S=120g m=180g l=280g							
	Orange juice ceres	7113	250g							
	Guava raw	7021	S=50g m=95g l=130g							

	Food item	Code	Quantity	>than 1/d	Once/day	3-6 times/w	1-2 X /wk	Once/mth	Seldom	Never
	Guava juice	7024	½ c = 125g							
	Mango raw	7026	135mm diam = 350g							
	Mango canned	7108	½ c= 125g							
	Mango juice	7162	200ml							
	Fruit salad w sugar	7079	½ c = 165							
Cereal & cereal products	Bread rolls white	4001	5mm = 20g, 10mm= 30g, 15mm =50g ½ loaf =400g							
	Bread rolls br	4002								
	Bread rolls ww	4003								
	Breakfast cereal all bran	4035	½ c =25g							
	Corn flakes plain	4036	½ c = 20g							
	Sugar coated corn flakes	4218	½ c =20g							
	Fruit loops	4303	½ c =18g							
	Puffed wheat honey snacks	4221	½ c = 12g							
	Raisin bran	4217	½ c =45g							
	Rice krispies	4046	½ c =20g							
	Rusks homemade all bran	4228	40x40x30=25g, 80x28x30=30g							
	Rusks commercial	4206	Rectangle cut = 15g							
	Lasagne lean mince+chees	4318	½ c = 120g							
	Mabella cornrice	4315	½ c = 100g							
	Macaroni cheese +wht sauce	4176	½ c =115g							
	Spaghetti bolognaise reg mince	4060	½ c = 100g							
	Spaghetti can+tomato sauc	4058	½ c = 125g							
	Maizemeal crumble porridge	4256	½ c = 70g							
	Maizemeal soft porridge	4254	½ c = 125g							
	Maizemeal stiff porridge	4255	½ c = 125g							
	Maizemeal yellow	4079	½ c = 65g							
	Milk w pap full cream	0006	S=30g m=60g l=125g							
	Milk w pap 2%	0085	S=30g m=60g l=125g							
	Maize/samp/rice cooked	4077	½ c = 65g							
	Maltabella cooked	4034	½ c = 125g							
	Oats rolled cooked	4032	½ c = 125g							
	Pizza cheese tomato olives	4193	10mm diam =50g, wedge=40g							
	Popcorn plain	4163	½ c = 8g							
	Rice fried	4311								
	Rice white cooked	4040	½ c = 65g							
	Samp and beans	4257	½ g = 125g							
	Banana loaf wm, hm commerc	4164	90x75x10mm =40g							
	Cake butter plain home, hm	4288								
	Carrot cake plain, egg, s oil	4244	80x20x40mm=25g, +icing=40g							

	Food item	Code	Quantity	>than 1/d	Once/day	3-6 times/ w	1-2 X /wk	Once/mth	Seldom	Never
	Cake chocolate plain hm	4277	75x75x20=50g							
	Cake w icing commercial	4103	115x65x10mm = 35g							
	Cookies plain commercial	4007	Average = 10g							
	Doughnut w jam	4024	60mm diam = 45g							
	Pancake/crumpet plain s oil	4302	70mm diam =25g, 170mm = 70g							
	Pudding instant, sm	4133	½ c = 145g							
	Scone plain sm, s oil	4140	S =25g m=35g l=50g							
	Snack niknaks,ghost pop	4067	Sml pkt =14g, lrg pkt =150g							
Nuts & seeds	Peanuts roasted salted	6007	Sml pkt = 30g, ½ c = 80g							
	Peanuts unsalted	6001	½ c = 80g							
Fats & oils	Butter	6502	5ml =5g, 1h dsp = 12g							
	Margarine + hm	6515	5ml = 5g, 1l dsp = 12g							
	Chicken fat	6137	5ml = 5g, 1l dsp = 8g							
	Lard	6520	5ml = 5g							
	Olive oil	6138	5ml = 5g, 1l dsp= 8g							
	Peanut butter smooth	6519	5ml = 5g, 1l dsp= 8g							
	Ice cream soft serve	6516	½ c =75g							
	Sorbet	6516	½ c =75g							
	Salad dressing-mayonnaise	6513	1l dsp =15g, 1l ls = 65g							
	S/dressing homemade wm	6531	1l dsp =15g, 1l ls = 65g							
	S/dressing low oil	6534	1l dsp = 15g, 1l ls =65g							
	Sandwich spread	6551	1l tsp =5g, 1l dsp =15g							
	Sunflower oil	6536	1l tsp =4g, 1l dsp =8g							
Sweets & sugar	Jam/marmalade+ pieces	9008	1h tsp = 15g, 1h dsp= 30g							
	Syrup golden	9011	1h tsp =15g							
	Jelly/powder	9022	½ c = 110g							
	Sherbet	9055								
	Sweets/chocolate coated	9024	S =18g m=62g thick =108g							
	Chocolate assorted centres	9017	22x22x15mm = 10g							
	Candy/ fruit gum	9027	1 unit = 5g							
	Sweet/marshmallows	9028	1 unit coconut=10, plain=10g							
	Sugar wh	9012	1 htsp =6g							
	Sugar br	9032	1h tsp =6g							
	honey	9007	1 h tsp =15g 1h dsp =30g							
	Tea	9514	Cup =180ml, mug = 250ml							
	Rooibos	9560	Cup =180ml, mug = 250ml							
	Coffee	9513	Cup =180ml, mug = 250ml							
	Carbonized beverage	9001	175ml, 300ml, 500ml							
	Cold drink squash diluted	9002	1/2c =125ml							

Appendix 4 Pre-test

Use of 24-Hour Recall and Food Frequency Questionnaire for Assessing Nutritional Patterns Among In-patient Children

A Food Frequency questionnaire (FFQ) and a 24-hour recall tool were designed and both validated for use in dietary intake of children at the Tygerberg Hospital. The purpose of the tools was to measure food intake among in-patient children. Ten subjects were selected randomly, six of them males, four of them females, their ages ranged from 2 to 9 years. The parents/caretakers of the ten subjects were questioned with both tools in order to describe the nutritional patterns of the patients. Table 1 below summarizes the particulars of the ten subjects.

A 225 item FFQ was initially administered to recall usual intake of subject's food intake, using the previous month as reference for recall. A second FFQ was repeated on an average of 75 days from the first one. For each item found, parents/caretakers were asked to indicate how often in the last month their child had eaten from a particular food group; once a day, more than once per day, 3-6 times a week, 1 or 2 times a week, once a month, seldom or never, were the listed categories.

A 24-hour diet recall was administered within the space of 5 to 11 days from the first recording of the FFQ (to the same parent/caretaker). Provisions in the 24-hour recall were made for serving size, and also for items that were not listed. Both tools incorporated pre-coded standardized coding for reporting items and established the detail needed for recalling during administration. Both tools had food items representing a range of food groups which children ate. The list of foods was the same in the 24-hour recall as in the FFQ. A second recording of the 24-hour recall was repeated on an average of 60 days from the first recording (of the 24-hour). The food items on both tools were the exact same as with the first round of questioning. One 24-hour recall was administered during the week while the other was administered on a weekend (day).

Baseline nutrient analysis was done using the MRC Foodfinder I programme which provided estimates that correlated with caloric intake for body mass index according to age and sex. The paired t-test using alpha 0.05 was conducted to attain p-values for comparing results of 24-hour recall results vs. FFQ for nutrient analysis. For relative validation, the mean of the two 24-hour recalls was used as the reference for comparison with the results of the two FFQs; energy, protein, fat, vitamin A, B_6, C, zinc and iron were looked at.

Table 1: Summary of subjects

Particulars of Patients					**Dates of Dietary Record**			
Patient #	**Age (yrs)**	**Sex**	**Weight (kg)**	**Height (m)**	**FFQ (1)**	**24 hr (1)**	**24 hr (2)**	**FFQ (2)**
001	8	M	25	1.26	23/10	31/10	15/12	20/12
002	4.7	M	19.4	1.12	17/10	26/10	16/12	21/12
003	5.9	F	16	1.0	08/11	13/11	14/12	18/12
004	5.3	M	16.1	.96	27/09	04/10	17/12	21/12
005	6.9	F	24	1.19	02/10	15/10	15/12	20/12
006	2.11	F	13.2	.90	20/09	27/09	13/12	19/12
007	7	F	21.5	1.17	26/10	01/11	28/12	30/12
008	7.2	M	20	1.11	31/10	04/11	15/12	22/12
009	9.3	M	30.1	1.23	15/09	22/09	16/12	21/12
010	5.1	M	15.5	1.05	22/09	27/09	14/12	19/12

Findings of the anthropometrical measurements indicated that when plotted on the physical growth chart 60% of the subjects were found to be below the 50th percentile. From these results it was difficult to ascertain whether the children were actually underweight for their age groups because the researcher did not have records to indicate whether they had been following that trend (below 50% ile), in which case, would indicate a "normal" growth trend, however these findings did indicate that the children weighed slightly less that about 50% of children of their ages. Additionally the results indicated that 70% of them fell way below the 50^{th} percentile for height for age, which indicated that they were short in height for their ages. Only three subjects were above the 75^{th} percentile for both weight for age and height for age. These results may indicate some nutritional deficiencies based on the height for age and weight for age indicators.

The following tables 2 and 3 illustrate the values of the different nutrients, obtained from both the 24-hour recall questionnaire and the FFQ details; the first and second rounds.

Table 2: Nutrient Analysis of 24-Hour Recall Records

24 Hour Record (1)									
Macronutrients					**Micronutrients**				
Patient #	**Kcal**	**Protein (gm)**	**Carbohy-drate (g)**	**Total Fat (gm)**	**Vit A (μg)**	**Vit C (mg)**	**Vit B_6 (mg)**	**Zinc (mg)**	**Iron (mg)**
001	1018	48.3	48	5	195	18	.31	6.5	6
002	1200	48.9	38	2	488	---	.43	7.4	3
003	1650	42.5	51	5	147	25	.9	7.6	3
004	1300	45.4	47	12	644	15	.54	8.8	4
005	1800	39.9	44	9	596	18	---	4.6	5
006	850	39	45	3	738	19	.50	8	3
007	1500	42.8	50	2	494	13	0	11	5
008	1950	51	47	13	511	15	.51	9.3	5
009	1900	58	55	5	532	20	.60	5.2	6
010	1610	53	38	11	554	14	.22	---	2

24 Hour Record (2)									
Macronutrients					**Micronutrients**				
Patient #	**Kcal**	**Protein (gm)**	**Carbohy-drate (g)**	**Total Fat (gm)**	**Vit A (μg)**	**Vit C (mg)**	**Vit B_6 (mg)**	**Zinc (mg)**	**Iron (mg)**
001	2000	51.5	50	12	225	16	.44	5	5
002	1350	47	48	18	460	15	0	6	4
003	1800	53	45	2	200	18	.51	5.5	3
004	1600	42	40	6	505	14	.42	6	3
005	2000	45.5	51	13	550	15	.5	4	5
006	900	40	40	9	665	18	.43	4.5	4
007	2000	53	55	17	404	14	.4	7	4
008	2100	50	45	2	485	14	.34	7	5
009	2200	48	58	15	502	18	.51	0	6
010	2300	49	51	23	530	15	.30	5	5
p-value	0.004 *	0.80	0.38	0.11	0.83	0.07	0.41	0.0006 *	0.61

* p= statistically significant

It may be noted that for nutrient analysis between 24-hour recall 1 and 2, there was only statistical difference for energy and zinc. These findings could be an indication that the 24-hour recall was able to capture an accurate estimate of dietary intake as there was no statistical difference in most of the nutrients other than two.

Table 3: Nutrient Analysis if Food Frequency Records

Food Frequency Record (1)									
Macronutrients					**Micronutrients**				
Patient #	**Kcal**	**Protein (gm)**	**Carbohy-drate (g)**	**Total Fat (gm)**	**Vit A (µg)**	**Vit C (mg)**	**Vit B_6 (mg)**	**Zinc (mg)**	**Iron (mg)**
001	1210	63.5	47	7	496	9	.54	7	6
002	1300	37.1	51	15	510	15	.4	7.7	4
003	1350	43	50	12	480	18	1	7	4
004	1210	45.4	45	2	554	14	.61	9	4
005	1600	35.4	45	11	517	17	.5	4.4	6
006	950	61.5	37	10	505	16	.53	9.6	3
007	1350	45.5	45	3	427	---	.5	10.5	5
008	1800	47.9	51	9	688	12	---	8.5	6
009	2000	66.5	65	16	390	16	.62	7	6
010	1550	41.9	49	12	666	13	.33	7	6

Food Frequency Record (2)									
Macronutrients					**Micronutrients**				
Patient #	**Kcal**	**Protein (gm)**	**Carbohy-drate (g)**	**Total Fat (gm)**	**Vit A (µg)**	**Vit C (mg)**	**Vit B_6 (mg)**	**Zinc (mg)**	**Iron (mg)**
001	1650	53	49	21	245	14	.51	6	6
002	1210	48.3	45	12	400	14	.42	6	4
003	1550	49	50	17	235	11	.3	6	4
004	1430	39.5	38	13	445	13	.4	6	5
005	1500	46	51	22	425	12	.32	4	3
006	1040	38	56	10	381	9	.24	5	3
007	1850	42.6	53	19	475	17	.11	9.5	4
008	1775	45	47	13	429	13	.32	7	4
009	2200	49	48	13	505	17	.41	5	5
010	1900	51.7	44	8	555	13	.61	5	5
p-value	0.025 *	0.51	0.90	0.06	0.016 4	0.28	0.07	0.001 *	0.08

* p= statistically significant

FFQ 1 and 2 indicated that there were significant changes noted for energy, vitamin A and zinc (Table 3). Tables 4 and 5 provide the averages of the nutrients analysed [that is 24 hour record (1) + (2) and FFQ (1) + (2)].

Table 4: Food Frequency Averages (1 and 2)

Patient #	Kcal	Protein (gm)	Carbohy-drate (g)	Total Fat (gm)	Vitamin A (µg)	Vitamin C (mg)	Vitamin B6 (mg)	Zinc (mg)	Iron (mg)
001	1430	58.2	48	14	370.5	11.5	.53	6.5	6
002	1255	85.4	49	13.5	455	14.5	.41	6.8	4
003	1450	46	50	14.5	357.5	14.5	.65	6.5	4
004	1320	42.4	41.5	7.5	499.5	13.5	.51	7.5	4.5
005	1550	40.7	48	16.5	471	14.5	.41	4.2	4.5
006	995	49.7	46.5	10	443	12.5	.38	7.3	3
007	1600	44	49	11	451	---	.31	10	4.5
008	1787.5	46.5	49	16	558.5	12.5	---	7.7	5
009	2100	57.7	56.5	14.5	447.5	16.5	.52	6	5.5
010	1725	46.8	46.5	10	610.5	13	.47	6	5.5
Total averages	1521	51.7	48.5	12.8	466.4	12.5	.46	6.3	4.7

Table 5: 24 Hour Recall Averages (1 and 2)

Patient #	Kcal	Protein (gm)	Carbohy-drate (g)	Total Fat (gm)	Vitamin A (µg)	Vitamin C (mg)	Vitamin B6 (mg)	Zinc (mg)	Iron (mg)
001	1509	49.9	49	8.5	210	17	.3	5.75	5.5
002	1275	47.9	43	10	474	---	.21	6.7	3.5
003	1725	47.8	48	3.5	173.5	30.5	.27	6.55	3
004	1450	43.7	43.5	9	574.5	14.5	.48	7.4	3.5
005	1900	42.7	47.5	11	573	16.5	---	4.3	5
006	875	39.5	42.5	6	702	18.3	.46	6.25	3.5
007	1750	47.9	52.5	9.5	449	13.5	.2	9	4.5
008	2025	50.5	46	17.5	498	13.8	.42	8.15	5
009	2050	53	56.5	10	517	19	.55	2.6	6
010	1955	51	44.5	17	542	14.5	.26	---	3.5
Total averages	1651	47.4	47.3	10.2	471.3	17.5	.36	6.3	4.3
P-value	0.02 *	0.31	0.25	0.13	0.9	0.04 *	0.04 *	0.13	0.20

* p=statistically significant

According to tables 4 and 5, it is clear there was statistical significance where energy, vitamins C and B6 were concerned. It may be assumed that the 24 hour recall was a better tool at analysing dietary intake for energy and vitamin C. It may also be presumed that the small sample size explained the lack of statistical significance in the other nutrients.

Table 6 derived the values from the total averages of tables 4 and 5 and put them alongside for comparison. When looking at the total averages, the table depicts a picture where there was not much of a difference between the two types of questionnaires, there seems to be a close correlation in nutrient analysis from both tools. A possible explanation for the close correlation could be that the information obtained from the FFQ may not have been a good reflection of what the children normally consumed, and this may have been due to an overestimation of dietary intake by the guardians/caretakers, particularly because the hospital diet possibly providing well balanced meals, and also assuming that the children were from impoverished communities.

Table 6: Comparison of Nutrient Analysis of the Averages of the 24 Hour Records and Food Frequency Records

Nutrient	24 hour (1 & 2)	FFQ (1 & 2)
Kcal	1651	1521
Protein (g)	47.4	51.7
Carbohydrate (g)	47.3	48.5
Total Fat (g)	10.2	12.8
Vitamin A (µg)	471.3	466.4
Vitamin C (mg)	17.5	12.5
Vitamin B6 (mg)	.4	.5
Zinc (mg)	6.3	6.3
Iron (mg)	4.3	4.7

Table 7 illustrates the averages of macronutrients which indicate that the 24 hour recall and FFQ recorded during the second rounds have slightly higher values than the 24 hour recall and FFQ taken on the first round. When looking at these changes it may be assumed that due to the time of year when the second 24-hour and FFQ were recorded, that season affected the increased values in the results, where the diet had changed.

Table 7: Averages of Nutrients (all 10 subjects)

Macronutrient	24 hour (1)	24 hour (2)	p-value	FFQ (1)	FFQ (2)	p-value
Kcal	1478	1825	0.04 *	1432	1611	0.02 *
Protein (g)	46.8	47.9	0.8	48.8	46.2	0.5
Carbohydrate (g)	46.3	48.3	0.3	48.5	48.1	0.9
Total fat (g)	6.7	11.7	0.1	9.7	14.8	0.06
Vitamin A (µg)	439.9	452.6	0.8	523.3	409.5	0.01 *
Vitamin C (mg)	17.4	15.7	0.07	14.4	12.8	0.28
Vitamin B6 (mg)	0.44	0.37	0.4	0.55	0.36	0.07
Zinc (mg)	7.6	5	0.0006 *	7.7	5.9	0.001 *
Iron (mg)	4.2	4.4	0.6	5	4.3	0.08

A t-test proved that there was only statistical difference where energy and zinc were concerned in both questionnaires. The FFQ showed a statistical difference for vitamin A. Interestingly enough the values for the total fat for both tools show a substantial difference appearing in the second rounds, yet the p-values indicate no statistical difference. From the results obtained in Table 7, it could also be assumed that upon admission to hospital, the children received Vitamin A supplementation, as noted in the dietary analysis of the second FFQ. On the contrary, it may be assumed that infection had taken its toll on the children, resulting in poor uptake of nutrients as noted by the reduced dietary Zinc levels.

Table 8: Percentage of Study Subjects Receiving the Recommended Daily Nutrients (and above)

Tool	Average of nutrients analysis in %						
	Kcal	Protein (g)	Iron (mg)	Vitamin C (mg)	Vitamin A (µmol)	Vitamin B6 (mg)	Zinc (mg)
24 Hour	30%	80%	0	0	70%	0	0
FFQ	10%	70%	0	0	80%	90%	0

The data obtained from the two questionnaires indicate that the studied subjects were not receiving the recommended daily nutrients, in particular iron, vitamin C and zinc (Table 8). It may also be noted that the 24 hour recall illustrates that the subjects did not receive any vitamin B6 from their diet, contrary to the FFQ which illustrates that 90% of the subjects received adequate vitamin B6 in their diet. This could indicate that the FFQ is a better tool at estimating nutrient intake over a period of time as opposed to the 24-Hour Recall.

The figures from table 8 imply that all the studied subjects had micro-nutrient deficiencies, namely iron, vitamin C and zinc. These deficiencies had a bearing on the growth of children and together with immune deficiencies and childhood infections (which the subjects were already expressing) could be an explanation for the weight for age that is below the 50^{th} percentile and the stunting. These deficiencies possibly arise from inadequate intake, while stunting also indicates a prolonged nutritional deficiency

In conclusion, having looked at all the results of the pre-test, and specifically table 8, it may be noted that there does not seem to be much of a difference between the two tools in terms of identifying a tool that is more capable than the other at providing a more effective nutrient analysis. If anything it may be of importance that both tools are not used independently, but rather used in conjunction in order to complement and substantiate each other.

Only subject number 3 indicated statistical changes (p-value 0.05) in the Kcal intake as noted by the FFQ and 24-hour Recall (Figure 1). The results indicated that there was also no statistical significance between the two types of questionnaires among all the study subjects with regards to carbohydrate intake (Figure 2).

Figure 1: Comparing Kcal intake between means of FFQ and 24 hour recall

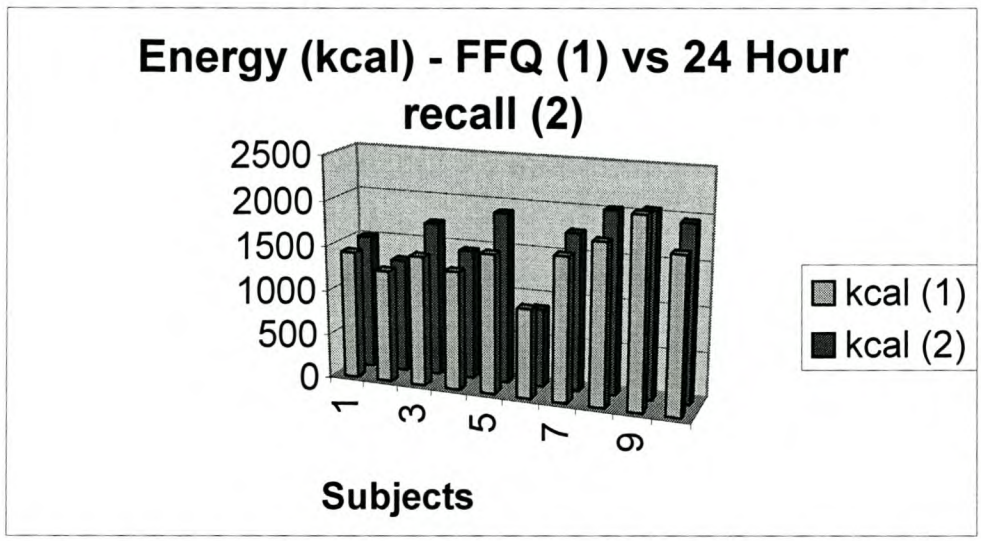
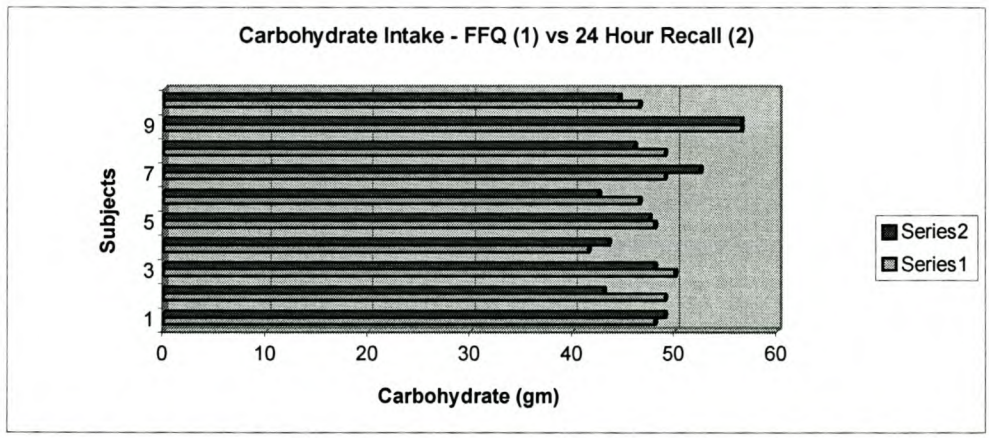


Figure 2: Comparing carbohydrate intake between means of FFQ and 24 hour recall



When looking at individual micronutrients, there was no statistical difference between the two types of questionnaires for Vitamin A intake among the study subjects (Figure 3). Additionally, the results of this pilot indicated that there was no statistical difference between the two types of questionnaires with regards to iron intake among all the study subjects (Figure 4)

Figure 3: A Comparison of Vitamin A Intake between the Averages of FFQ and 24-Hour Recall Data

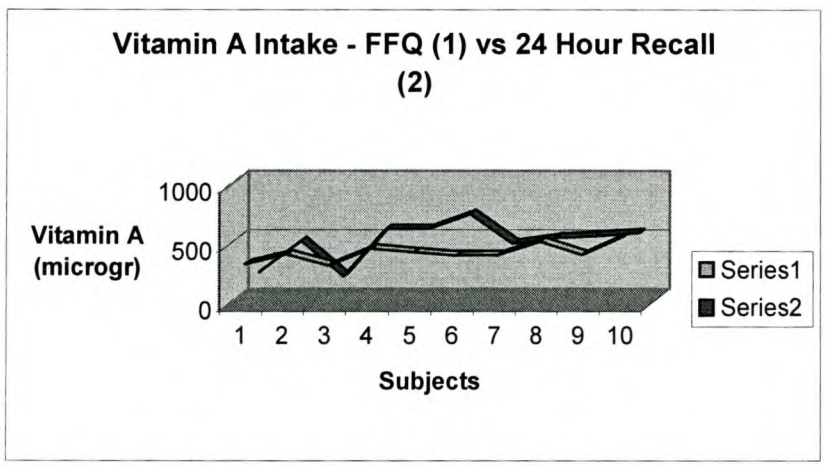
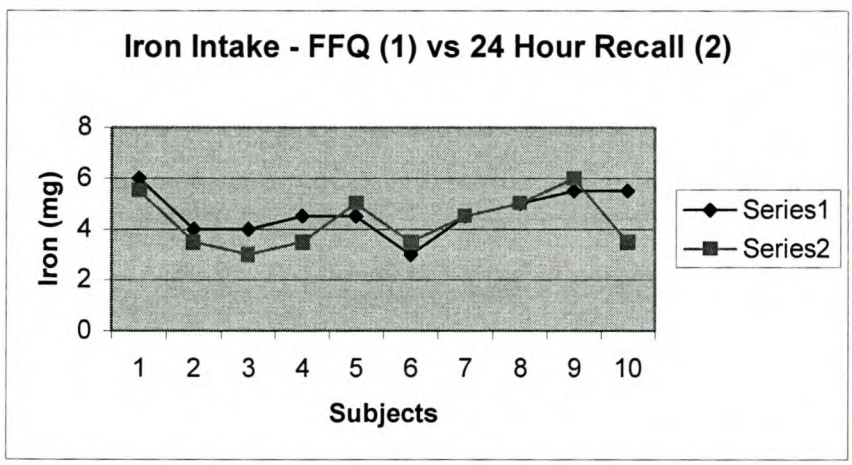


Figure 4: A Comparison of Iron Intake between the Averages of FFQ and 24-Hour Recall Data



Conclusion

It may be appreciated that the dietary analysis of this pre-test shows no statistical difference in the usage of the 24 hour recall and the FFQ. In a normal population such would not occur as the FFQ measures the intake over an extended period (a month) and a 24 hour recall records an individuals' intake of the previous 24 hours. Hence the dietary analysis of a 24 hour recall is not likely to be similar to a dietary analysis of a FFQ.

Having said that, and having obtained the results obtained in this pilot study, one could take into consideration that the study subjects in this case were from disadvantaged households, therefore it is possible that whatever they had consumed in the previous 24 hours could have been similar if not identical to the food items in the preceding month, that there has been very little variation in their diet for a long period.

Appendix 5 Nutritional Assessment Parameters (Clinical evaluation)

CLINICAL MEASURES AND PHYSICAL EVIDENCE OF NUTRITIONAL STATUS

AREA OF EXMINATION	SIGNS/SYMPTOMS	POTENTIAL NUTRIENT DEFICIENCY
HAIR	Loss, easily pluckable, lacklustre, reduced pigmentation, dull, sparse	Protein-energy Zinc Vitamin A and C
EYES	Drying of conjunctiva corneal, corneal vascularization, xeropthalmia, bitots spots, dullness, photophobia	Vitamin A, B complex Zinc Riboflavin
SKIN	Dry, scaling, Petechiae, ecchymoses (small haemorrhages), nose-lip dryness, Bilateral dermatitis, pigmentation, fine wrinkling, poor tissue turgor, oedema, tendency towards excessive bruising, pressure sores, poor wound healing, pallor	Vitamin A,C,K,B12 Zinc Iron Protein Water Folacin Niacin Essential fatty acids
GI TRACT	Nausea, vomiting, diarrhoea, mouth inflammation, cheilosis, tongue inflammation, magenta tongue, swollen and bleeding gums, fissured tongue, enlarged liver	Zinc Folate Iron Vitamin B12, C Protein Niacin
LIPS AND ORAL STRUCTURE	Angular fissures, cheilosis, Ageusia, dysgensia, swollen, spongy, bleeding gums	Vitamin B complex, C Iron Protein Niacin Zinc
TONGUE	Magenta tongue, fissuring, raw, smooth, swollen, sores, glossitis, large size, fiery red, pale, Atrophy lingual papillae	Vitamin B12 Iron Niacin Folacin
TEETH	Increased frequency tooth decay, loss of dental fillings, dental carries	Vitamin C Fluorine
GUMS	Spongy and bleed easily, recession of gums	Iron Zinc
NAILS	Spoon shaped, brittle, ridged, lined	Iron Protein (undernourishment)
EXTREMETIES (MUSCLE)	Subcutaneous fat loss, muscle wasting, oedema, osteomalacia, bone pain, rickets, weak thighs, muscular twitching, cramps	Vitamin D Protein –energy Kcalories Thiamin Sodium Potassium
NEUROLOGIC	Disorientation, confusion, nerve degeneration, poor coordination	Vitamin B12 Niacin Thiamin
OTHER	Fatigue, lassitude, apathy, depression, anorexia, growth retardation	Protein – energy Vitamin B12, C Folacin Potassium Iron

Appendix 6 Daily Food Intake Record

WEEK 1

Sunday			Monday			Tuesday			Wednesday		
Food item	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	Quantity
Breakfast											
Fruit juice			Fruit juice			Fruit juice			Fruit juice		
Wheet bix			Oats			Mielie meal			Oats		
Cheese			Boiled egg			Scrambled egg			Slice polony		
Other											
Lunch											
Fried chicken			Sausage			Tripe & beans			Cottage pie		
Yellow rice			Gravy			Curry			Rice		
Roast potato			Mash potato			Samp			Sweet carrots		
Sweet hubbard			Broccoli			Mixed veg			Gem squash		
Peas			Tomatoes			Beetroot					
Canned mixed fruit			Lettuce salad								
Custard											
Other											
Dinner											
Tomato soup			Fried chicken			Tomato soup			Beef soup		
Polony slice			Macaroni			Sausage roll			Braised pilchards		
Green salad			Cheese			Corn on cob			Rice		
			fruit			Tomato & onion -braised			Green salad		

Week 1 cont.d

Thursday			Friday			Saturday		
Food item	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**
Breakfast								
Fruit juice			Fruit juice			Fruit juice		
Mielie meal			Oats			Mielie meal		
Egg fried			Boiled egg			Polony slice		
Other								
Lunch								
Chicken stew			Meat balls			Cabbage stew		
Rice			Mash potatoes			Rice		
Pumpkin			Gem squash or butternut			Cucumber salad		
fruit			Vegetable					
Other								
Dinner								
Beef Soup			Chicken			Beef & pea bolognaise		
Braised pilchards			Polony smoor			Spaghetti		
Rice			Rice salad			Fruit		
Green salad			Baked beans					
			Banana salad					
Other								

WEEK 2

Sunday			Monday			Tuesday			Wednesday		
Food item	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	Quantity
Breakfast											
Fruit juice			Fruit juice			Fruit juice			Fruit juice		
Weet bix			Oats			Mielie meal			Oats		
cheese			Polony slice			Boiled egg			Polony slice		
Other											
Lunch											
Corned silverside			Green bean stew			Fried liver			Chicken stew		
Potato salad			Samp			Mash potato			Rice		
French salad			Fruit			Gem squash			Pumpkin		
Jelly						Lettuce & tomato salad			Beetroot salad		
custard											
Other											
Dinner											
Beef & bean soup			Chicken noodle			Beef & polony slice			Tomato & peas		
Fish cakes			Mince curry			Pilchard smoor			Meat loaf		
Savoury rice			Vet koek			rice			Cole slaw		
Peas									Pineapple slice		
Other											

Week 2 cont.d

Thursday			**Friday**			**Saturday**		
Food item	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**
Breakfast								
Fruit juice			Fruit juice			Fruit juice		
Mielie meal			Oats polony slice			Mielie meal		
Fried egg						Fried egg		
Other								
Lunch								
Tripe in tomato			Meat balls			Fried fish		
Rice			Gravy			Mash potato		
Marrow			Samp			Cabbage		
Nutmeg sauce			Sweet carrots			Mixed veg		
			Gr. beans					
Other			Fruit					
Dinner								
Chicken & veg soup			Tomato slice			Barley		
Sausage			steak & kidney stew			Spaghetti in tomato sauce		
Gravy			Sone			Cheese topping		
Boiled potato			batter					
Bean & banana								
salad								
Other								

WEEK 3

Sunday			**Monday**			**Tuesday**			**Wednesday**		
Food item	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	Quantity
Breakfast											
Fruit juice			Fruit juice			Fruit juice			Fruit juice		
Weet bix			Mielie meal			Oats			Mielie meal		
cheese			Scrambled egg			Polony slice			Boiled egg		
Other											
Lunch											
Roast beef			Fried fish			Beef & bean stew			Fried liver		
Sauce			Mash potato			Samp			Fried onions		
Roast potatoes			Green beans			Hubbard			Rice		
Carrot & pineapple			Chilli sauce			beetroot			Gem squash		
Sweet sauce			Tomato & lettuce						Cabbage		
Cucumber salad			salad								
Jelly custard											
Other											
Dinner											
Chicken soup			Beef mince			Tomato			Chicken		
Sausage rolls			Macaroni			Polony smoor			Spaghetti in tomato sauce		
Rice salad			pineapple			Boiled potato			Cheese topping		
Coleslaw						fruit			fruit		
Other											

Week 3 cont.d

Thursday			Friday			Saturday		
Food item	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**
Breakfast								
Fruit juice			Fruit juice			Fruit juice		
Oats			Mielie meal			Oats		
Polony slice			Boiled egg			Polony slice		
Other								
Lunch								
Chicken & potato			Tripe curry			Meat balls		
Rice			Rice			Samp		
Gem squash			Butternut			Mixed veg		
cabbage			Veg in season			Marrow/sauce		
			Cucumber salad					
Other			fruit					
Dinner								
Beef soup			Tomato			Chicken		
Viennas			Polony slices			Pilchard smoor		
Baked beans			Potato salad			Rice		
rice			Green salad			Fruit		
Other								

WEEK 4

Sunday			Monday			Tuesday			Wednesday		
Food item	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	Quantity
Breakfast											
Fruit juice			Fruit juice			Fruit juice			Fruit juice		
Weet bix			Mielie meal			Oats			Mielie meal		
cheese			Scrambled egg			Polony slice			Fried egg		
Other											
Lunch											
Chicken casserole			Tomato stew			Curry chicken			Fried fish		
Yellow rice			Samp			Rice			Mash potato		
Cauliflower			butternut			Hubbard			Green beans		
White sauce						Fruit			Carrots		
Fruit salad											
custard											
Other											
Dinner											
Beef soup			Chicken			Beef			Tomato		
sliced polony			Savoury mince			Sausage rolls			Meat loaf		
Noodle salad			Peas			Baked beans			Gem squash		
			Rice			Mash potato			rice		
			beetroot								
Other											

Week 4 cont.d

Thursday			Friday			Saturday		
Food item	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**
Breakfast								
Fruit juice			Fruit juice			Fruit juice		
Oats			Mielie meal			Oats		
Polony slice			Fried egg			Polony slice		
Other								
Lunch								
Bobotie			Tripe			Fried fish cakes		
Mince			Rice			Sweet potato		
Samp			butternut			Peas		
Mixed veg						Beetroot		
Other			fruit					
Dinner								
Beef soup			Chicken			Beef		
Chicken breyani			Spaghetti			Viennas		
Tomato salad			Cheese topping			Baked beans		
						Rice		
Other								

WEEK 5

Sunday			**Monday**			**Tuesday**			**Wednesday**		
Food item	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	Quantity
Breakfast											
Fruit juice			Fruit juice			Fruit juice			Fruit juice		
Weet bix			Mielie meal			Oats			Mielie meal		
cheese			polony			Scrambled egg			Fried egg		
Other											
Lunch											
Beef			Chicken			Meat balls			Fried liver		
Rice			Rice			Samp			Rice		
Fried potato			Gem squash			Mixed veg			Carrots & peas		
Pumpkin			Gr beans			Veg in season			Cucumber salad		
Broccoli											
Banana											
Custard											
Other											
Dinner											
Chicken soup			Beef			Tomato			Chicken		
Pilchard baked			Viennas			Steak & kidney			Polony & beans		
Mash or boiled potato			Spaghetti			Bake potato			Potato salad		
Salad			fruit			Scone topping					
						Green salad					
Other											

Week 5 cont.d

Thursday			**Friday**			**Saturday**		
Food item	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**	**Food item**	**Code**	**Quantity**
Breakfast								
Fruit juice			Fruit juice			Fruit juice		
Oats			Mielie meal			Oats		
Polony slice			Boiled egg			Polony slice		
Other								
Lunch								
Chicken curry			Tripe & beans			Sausage		
Rice			Samp			Mash potato		
beetroot			Hubbard squash			Marrow		
						Veg in season		
Other			fruit					
Dinner								
Beef soup			Tomato			Chicken		
Sausage roll			Macaroni & cheese			Mince curry		
Coleslaw			fruit			Peas		
tomato						Rice		
Other								

Appendix 7

Oral Examination Form

DATE: / /

Patient Details

Patients Name:
Address:.....
.....
.....

Hospital Number:.....
Date of Birth: / /
Male / Female: M F

General Medical History:

Relevant Medical History:

Current medication / Drug Treatment:.....
.....
.....
Date of Commencement.....

When diagnosed HIV Positive: / /
Where diagnosed HIV positive:.....
CD4 Count (if known):.....
Viral load (if known):.....
When diagnosed TB positive: / /
Where diagnosed TB positive.....
Details of previous episodes of TB and outcome:
.....
.....
.....
.....

Extra oral examination

Clinical Details

Swelling Y /N

Sinus Y /N

Lymphadenophy Y / N

Lips		Normal / Abnormal
Facial tissue		Normal / Abnormal
Muscles of Mastication		Normal / Abnormal

Intra oral examination

Lips and vermillion border & Labial mucosa		Normal / Abnormal
Commissure of mouth	Right	Normal / Abnormal
	Left	Normal / Abnormal
Buccal mucosa	Right	Normal / Abnormal
	Left	Normal / Abnormal
Mucobuccal fold	Right	Normal / Abnormal
	Left	Normal / Abnormal
Tongue	Ventrum	Normal / Abnormal
	Lateral	Normal / Abnormal
	Dorsum	Normal / Abnormal
Floor of mouth	Anterior	Normal / Abnormal
	Posterior	Normal / Abnormal
Hard Palate		Normal / Abnormal
Soft Palate		Normal / Abnormal
Pillar of Fauces	Right	Normal / Abnormal
	Left	Normal / Abnormal
Gingival tissues	Free	Normal / Abnormal
	Attached	Normal / Abnormal

CPITN Score

Additional clinical findings
.....
.....
.....

Candidal Infection

Clinical Details

Present Y / N

Lesion – single / multiple / wipes off
Site
Surface Appearance
Size
Consistency
Other associated lesions

Pseudomembranous Y / N

Erythematous Y / N

If palate involved
Pin point hyperaemia Y / N

Diffuse Hyperaemia Y / N

Granular Y / N

Hyperplastic Y / N

Plaque like

Nodular type

Median Rhomboid glossitis Y / N

Acute / chronic atrophic Y / N

Candida associated Angular cheilitis Y / N

Extra information:

History and examination taken by:
Name :

Signature :

Date :

Location :

Appendix 8

Expected 24-hour Creatinine Excretion of Normal Children

Age (months)	Height (cm)	24-hour Urinary Creatinine (mg)	Age (months)	Height (cm)	24-hour urinary Creatinine (mg)
7	68.0	90.44	43	100.4	281.2
8	69.6	96.05	44	101.0	283.81
9	71.2	101.82	45	101.6	287.53
10	72.5	107.30	46	102.2	290.25
11	73.8	112.91	47	102.8	292.98
12	75.2	118.82	48	103.4	295.72
13	76.3	123.61	49	104.0	299.52
14	77.4	128.48	50	104.5	303.05
15	78.5	132.66	51	105.1	305.84
16	79.6	137.71	52	105.6	308.35
17	80.7	142.84	53	106.2	311.17
18	81.8	147.24	54	106.7	313.70
19	82.8	156.49	55	107.1	318.09
20	83.7	159.03	56	107.4	322.20
21	84.7	165.16	57	107.7	325.25
22	85.6	171.20	58	108.0	329.40
23	85.6	177.53	59	108.4	333.87
24	87.5	183.75	60	108.7	336.97
25	88.5	189.39	63	110.0	359.64
26	89.0	194.02	66	112.2	379.24
27	89.8	198.46	69	113.2	384.88
28	90.5	203.62	72	114.1	390.22
29	91.5	209.54	75	115.9	399.86
30	92.1	213.67	78	117.2	407.86
31	92.8	219.94	81	186.6	431.70
32	93.5	226.27	84	120.0	456.00
33	94.1	231.49	87	121.5	477.50
34	94.8	237.95	90	123.0	499.38
35	95.5	244.48	93	124.5	527.88
36	96.2	250.12	96	126.0	556.92
37	96.8	256.52	99	127.5	586.50
38	97.4	259.08	102	129.0	616.62
39	98.0	263.62	105	130.5	
40	98.6	268.19	108	132.0	
41	99.2	272.80			
42	99.8	277.44			

Appendix 9 Consent Forms

INLIGTINGS- EN TOESTEMMING VORM

STUDIE VIR DIE BEPALING VAN VOEDINGSTATUS BY PERSONE MET ORALE LETSELS EN HIV/VIGS.
TYGERBERG HOSPITAAL

Verwysingsnommer:.....

VERKLARING DEUR OUER/VOOG VAN PASIËNT:

Ek, die ondergetekende .....
(ID .....) bevestig dat:

1. Ek .....(pasiënt naam) toelaat om deel te neem aan die bogenoemde navorsingsprojek, wat onderneem word deur die Departement Menslike Voeding, Universiteit Stellenbosch. Die projek is goedgekeur deur die Etiese Komitee van die Universiteit Stellenbosch, wat toegesien het dat dit voldoen aan internasionale standaarde rakende menseregte en ander etiese kwessies.

2. Daar aan my verduidelik is dat:

   2.1 Die doel van die projek is om die voedingstatus van kinders wat geïnfekteerd is met die HIV virus en presenteer met letsels in die mond-area, te bepaal.

   2.2 Ten minste 36 HIV positiewe kinders in die pediatriese sale aan die projek sal deelneem oor 'n periode van 6 maande.

   2.3 By toelating tot die hospitaal, daar van my verwag sal word om 'n vraelys oor die pasiënt se gesondheid en voedingstatus te voltooi. Die pasiënt sal dan die volgende ondergaan:

      1 Kliniese ondersoek deur 'n gekwalifiseerde tandarts vir die klassifikasie van die orale letsels.
      2 Kliniese ondersoek deur die navorser, bygestaan deur 'n gekwalifiseerde verpleegkundige, vir tekens van nutriënttekorte.
      3 'n Maksimum van 5ml (1teelepel) bloed sal aan die begin van die studie en weer na 3 maande van die pasiënt getrek word deur 'n gekwalifiseerde verpleegkundige. Hierdie bloed sal ontleed word vir bepaling van voedingstatus.
      4 Urine sal aan die begin van die studie en weer na 3 maande versamel word van die pasiënt vir bepaling van voedingstatus.
      5 Bepaling van gewig, lengte en liggaamsamestelling dew middel van veilige, nie-indringeende metodes.

2.1 Die ondersoeke aanleiding kan gee tot verbeterde voedingsintervensies ten einde uittering by HIV te voorkom, verligting van ongemak, voorkoming van die verspreiding van infeksies en die aanvang van behandelbare oorsake van wanvoeding in HIV positiewe kinders.

2.2 Alle inligting vertroulik hanteer sal word, maar dat dit wel gebruik sal word vir publikasie in 'n wetenskaplike joernaal, sonder om enige name te noem.

2.3 Ek toegang sal hê tot die data van die pasiënt gedurende en na die voltooiing van die studie, indien ek dit van die navorsers aanvra.

2.4 Ek mag weier dat die pasiënt deelneem aan die projek, en dat ek die pasiënt te enige tyd mag onttrek van die projek, en dat sulke aksies geensins die pasiënt se huidige of toekomste behandeling by hierdie hospitaal sal beïnvloed nie. Ek verstaan ook dat die navorser die pasiënt mag onttrek van die projek indien dit in die pasiënt se belang geag word deur hom/haar.

2.5 Deelname van die pasiënt aan hierdie projek geen addisionele koste vir die pasiënt sal inhou nie en dat die pasiënt nie vir deelname vergoed sal word nie.

3. Ek bevestig dat:

3.1 Die inligting hierbo vermeld aan my in Engels/Afrikaans/Xhosa verduidelik is deur ....., dat ek die taal goed magtig is, dat ek geleentheid gebied is om vrae te vra en dat al my vrae beantwoord is na my tevredenheid.

3.2 Ek is nie gedwing om die pasiënt toe te laat om deel te neem aan die projek nie en ek verstaan dat ek die pasiënt te enige tyd mag onttrek van die projek sonder om gepenaliseer te word.

3.3 Ek verstaan dat deelname aan die projek gratis is vir die pasiënt.

3.4 Ek is meegedeel dat ek die pasiënt se algemene praktisyn moet meedeel dat die pasiënt deelneem aan hierdie studie.

3.5 Ek is meegedeel dat die resultate van die studie oorhandig sal word aan die relevante persone wat kan besluit op toekomstige voedingsbehandeling van kinders met HIV infeksie en orale letsels.

3.6 Ek stem hiermee vrywillig in dat die bogenoemde pasiënt mag deelneem aan die projek.

Geteken/bevestig te Brooklyn Boshospitaal op ...../...../.....

....

Handtekening van ouer/voog **Handtekening van getuie**

VERKLARING DEUR/NAMENS DIE NAVORSER

Ek, ..., verklaar dat:

1. Ek die inligting in hierdie dokument aan ..... verduidelik het.
2. Ek hom/haar versoek het om vrae te stel in geval van enige onduidelikheid.
3. Die gesprek gevoer is in Engels/Afrikaans//Xhosa en geen vertaler is gebruik nie.

Geteken te Brooklyn Chest Hospitaal op ...../...../.....

....

Handtekening van navorser **Handtekening van getuie**

BELANGRIKE INLIGTING

Geagte ouer/voog,

Dankie vir u bereidwilligheid om die bogenoemde kind toe te laat om deel te neem aan die studie. Indien enige tyd gedurende die studie:

1. 'n noodgeval ontstaan van die navorsing,
2. u addisionele inligting verlang aangaande die studie, of
3. bogenoemde kind probleme ondervind wat verband hou met die studie, kontak asseblief me Phooko by die volgende telefoonnommer: 083 373 1933.

INFORMATION AND CONSENT FORM

STUDY ON NUTRITIONAL STATUS IN ORAL LESIONS IN HIV/AIDS TYGERBERG HOSPITAL

Reference number:.....

Statement made by patient's parent/guardian

I, the undersigned.....
(ID.....) confirm that:

1. I allow.....(patient's name) to participate in the above mentioned research project, which is undertaken by the department of Human Nutrition of the University of Stellenbosch. The project was approved by the Ethics Committee of the University of Stellenbosch, who ensured that it meets with international requirements regarding human rights and other ethical issues.

2. It was explained to me that:

   2.1 The aim of the project is to determine the nutritional status of children that are infected with the Human Immunodeficiency Virus and present with lesions of the oral cavity

   2.2 At least 36 HIV positive children in the paediatric ward will participate in the project over a period of 6 months

   2.3 Upon admission to the hospital I will be expected to fill in a questionnaire on the patient's health and nutritional status. The patient will then undergo the following:

      1 Clinical examination by a qualified dentist for classification of oral lesions
      2 Clinical evaluation for signs of nutritional deficiencies by the researcher with the assistance of a qualified nurse
      3 A maximum of 5ml (1tsp) of blood will be drawn from the patient by a qualified nurse, for investigations to determine the nutritional status at the beginning of the investigations and at three months thereafter
      4 Urine will be obtained from the patient for further analysis of nutritional status, at the beginning of investigations and at three months thereafter
      5 Safe non-invasive methods will be used to determine the patient's height, weight, body composition and muscle mass

2.4. It was further explained to me that the investigations might lead to improved nutrition interventions directed at preventing wasting in HIV, relieving discomfort, preventing the spread of infections and the onset of curable causes of malnutrition in HIV positive children.

2.5. I was informed that all information will be handled in a confidential manner, but that it may be used for publication in a scientific journal without revealing my name or the patient's name.

2.6. I will have access to data concerning the patient during or after completion of the project, should I request it from the researchers

2.7. I was informed that I may refuse participation of the patient in the project, and that I may withdraw the patient at any stage of the project, and that such a refusal or withdrawal will not in any way compromise the patient's current or future treatment at this hospital. I also understand that the researcher may withdraw the patient from the project if he/she considers it to be in the patient's best interest

2.8 I was informed that involvement of the patient in this project will bear no financial defaults/no additional costs to the patient or that the patient will be paid for participation

3 I confirm that:

3.1. The information given above, was explained to me in English/Afrikaans/ Xhosa by....., that I have a good command of the language, that I was given the opportunity to ask questions and that all my questions were answered to my satisfaction

3.2. I was not forced to allow the patient to participate in the project, and that I realize that I may withdraw the patient at any stage from the project without penalisation

3.3. I realise that participation in the project will be free of additional costs to the patient

3.4. I was informed that I should notify the general practitioner of the patient's participation in the study

3.5. I was informed that the results of the study will be submitted to the authorities in order to help them decide on the future management of nutrition in HIV infected children presenting oral lesions

3.6. I hereby voluntarily agree that the above mentioned patient participate in the project

Signed/confirmed at Brooklyn Chest Hospital on ...../...../.....

.....	.....
Signature of parent/guardian	Signature of witness

STATEMENT BY OR ON BEHALF OF THE RESEARCHER

I,..... Declare that:

1. I explained the information in this document to.....;
2. I requested him/her to ask questions should there be anything not clear;
3. This conversation was conducted in English/Afrikaans/Xhosa and that no interpreter was used.

Signed at Brooklyn Chest Hospital on...../...../.....

.....	.....
Researcher/Researcher's representative	Witness

IMPORTANT INFORMATION

Dear parent/guardian,

Thank you for allowing the above-mentioned child to participate in the study. If, during any time of the project:

1. an emergency arises from the research, or
2. you require any further information about the project, or
3. the above mentioned child experiences problems related to the project, please contact Ms. Phooko at the following telephone number: 083 373 1933

Appendix 10: **Immunologic categories for HIV-Infected Children Based on Age-specific CD4+ T-lymphocyte count**

Immunologic category	<12 months cells /μL	1-5 years cells/μL	6 – 12 years Cells/μL
No evidence of suppression	≥1,500	≥1,000	≥500
Evidence of moderate suppression	750 – 1,499	500 – 999	200 – 499
Severe suppression	<750	500	<200

Adopted from: MMWR Vol. 46 / No. RR 12

Appendix 11: Waterlow Classification of Malnutrition

	Normal	Mild	Moderate	Severe
Height for Age	>95	95-87	87-80	<80
Weight for Height	>90	90-80	80-70	<70

Classification of malnutrition is based on values that are percentages of normal for age.