CHAPTER 1 THE PROBLEM, ITS SETTING AND AN OVERVIEW OF THE STUDY

1.1 INTRODUCTION

For many years scientists have theorised about the origins of the Human Immunodeficiency Virus (HIV) and how it first appeared in the human population. Most scientists believe that HIV originated in other primates. In 1999, an international team of researchers reported that they had discovered the origins of HIV-1, the predominant strain of HIV in the developed world. A subspecies of chimpanzee native to west equatorial Africa had been identified as the original source of the virus. The researchers believe that HIV-1 was introduced into the human population when hunters became exposed to infected blood (Bradshaw *et al.* 2002:45).

1.2 PREVALENCE OF HIV/AIDS GLOBALLY

HIV is the virus that causes the disease Acquired Immunodeficiency Syndrome (AIDS). The HIV/AIDS epidemic in Sub-Saharan Africa (SSA) has already orphaned a generation of children, and it is projected that by 2010, 18 million African children under the age of 18 years are likely to be orphans (Andrews, Skinner & Zuma 2006: 269-276). The Joint United Nations Programme on HIV/AIDS (UNAIDS) estimates that globally more than 150 children per day are being infected with HIV (UNAIDS 2008:5-6).

Reporting on the latest status of the global HIV epidemic, the UNAIDS executive summary indicated that SSA remains most heavily affected by HIV, accounting for 67 percent of all people living with HIV and for 72 percent of AIDS deaths in 2007 (FAO & WHO 2002:1-2; UNAIDS 2003:3-87). The global epidemic is stabilised, but at an unacceptably high level: there were an estimated 33 million (30– 36 million) people

living with HIV in 2007 and the annual number of new HIV infections increased from 3.0 million to 3.5 million in 2001 and declined to 2,7 million in 2007 (UNAIDS 2008:5-6; Andrews *et al.* 2006:269-276). Not all HIV test results in children under the age of 15–18 months - give a clear result, however the Polymerase Chain Reaction (PCR) test give clear results. Children born to HIV positive women have HIV antibodies from their mother in their blood until this age (UNAIDS 2008:5-6).

1.3 DEFINITION OF HIV/AIDS

Many people do not really understand how HIV and AIDS are related, even though they often hear the two words being used together. Many people also refer to HIV as the "AIDS virus." Immunodeficiency indicates that the disease is characterized by a weakening of the immune system.

HIV is a virus. A virus is really nothing but a set of instructions for making new viruses, wrapped up in some fat, protein and sugar. Without living cells, a virus cannot do anything. It is like a brain with no body. In order to make more viruses and to do all of the other malicious things that viruses do, a virus has to infect a cell. HIV mostly infects T-cells, also known as CD4+ cells, or T-helper cells. These cells are white blood cells, which are active in the immune system in the body and help, to fight disease. After HIV enters the body, it piggybacks into a T-cell and works its way inside of that cell. Once inside the cell, HIV starts producing millions of diminutive viruses, which eventually destroy the cell and then continue to infect other cells. After the virus invades the T-cells, the T-cells can no longer properly fight infections. In other words, the higher the T-cell count in the body, the healthier a person's immune system is (Di Pentima 2005; UNICEF 2001; CFNI 2002:2-4). All of the drugs marketed to treat HIV work by interfering with this process (Grossman 2003:6).

HIV (human immunodeficiency virus) is the virus that causes AIDS and people with HIV are HIV infected. Some of these people will develop AIDS as a result of their HIV infection. People who are HIV+ have been tested and found to have signs of the human

immunodeficiency virus in their blood. HIV lives in blood and other body fluids that contain blood or white blood cells (Ferri 2006:2; UNICEF 2001:13; Di Pentima 2005).

1.3.1 Stages of HIV/AIDS

When speaking about HIV/AIDS and its effects, it essential to have in mind the different classifications of the disease. There are tow classifications, the World Health Organisation (WHO) and the Centers of Disease Control (CDC) (Robertson 2008).

The WHO system has 4 stages:

- Stage 1: HIV infection is asymptomatic and not categorized as AIDS. This stage of infection lasts for a few weeks and is often accompanied by a short flu-like illness. In up to about 20% of people the symptoms are serious enough to consult a doctor, but the diagnoses of HIV infection is frequently missed (WHO 2006; Robertson 2008).

- Stage 2: Includes min of mucountaneous manifestation and recurring upper respiratory tract infections. In the second stage, individuals are free from any symptoms of HIV test in performed, it will come back positive. While the individual is asymptomatic, the HIV in their blood is reproducing constantly. This stage lasts about ten years, but can be much longer or shorter depending on the individual (WHO 2006; Robertson 2008).

- Stage 3: Includes unexplained chronic diarrhoea for longer than a month, severe bacterial infections and Pulmonary tuberculosis. In this stage, the immune system has become so damaged by HIV that symptoms begin to appear. Symptoms are typically mild at first and then slowly become more severe. Opportunistic infections, infections that take advantage of the immune system's vulnerable state, begin to occur. These infections affect almost al the systems of the body and include both infections and cancers some common opportunistic

infections include tuberculoses, cytomegalovirus and shingles (WHO 2006; Robertson 2008).

- Stage 4: In the fourth and final stage, a person is diagnosed as having AIDS. To be diagnosed as having AIDS, a person has to exhibit certain opportunistic infections, such as HIV wasting syndrome, pneumocustic pneumonia, or Kaposi sarcoma. Once a person is diagnosed with AIDS, they can never return to a stage of HIV, even if the individual gets better (WHO 2006; Robertson 2008).

In the CDC classification system, AIDS is referring to the diseases associated with it and include all HIV+ people with a CD4 count below 200/ed of blood.

It is important to take this in account because the efficiency of a nutritional intervention will depend on the stage of the disease.

1.4 ROUTES OF TRANSMISSION OF HIV/AIDS

1.4.1 Adults

This virus may be passed from one person to another when infected blood, semen or vaginal secretions come into contact with an uninfected person's broken skin or mucous membranes. A mucous membrane is wet, thin tissue found in certain openings to the human body. These can include the mouth, eyes, nose, vagina, rectum, and opening of the penis (UNICEF 2001:18). People can be infected with HIV through:

- Unprotected sexual intercourse with an HIV-infected person. This includes vaginal or anal intercourse and oral sex with a man or woman without a condom or other barrier. Intercourse with a woman during her period or during outbreaks of genital sores or lesions (caused by herpes and other sexually transmitted diseases) can increase the risk of HIV transmission;

- Sharing drug injection equipment (needles and/or paraphernalia) or being accidentally pricked by needles or sharp objects contaminated with infected blood;

- Infected blood used in transfusions and infected blood products used in the treatment of certain diseases and disorders (like haemophilia), before March 1985. Since 1985, federally mandated screening of the blood supply has reduced the risk of transmission through this route to one in 255,000; and

- Transplanted organs from infected donors. Routine screening of organ donors also began in 1985 (UNAIDS 2005:5-8; International HIV/AIDS Alliance 2009).

HIV and AIDS are not transmitted through casual contact, that is, where no blood or body fluids are involved. HIV is passed from person to person. People do not "catch AIDS"; they "become infected with HIV" (Ferri 1994; UNAIDS 2003:19-39).

1.4.2 Children

Infected pregnant women can also pass HIV to their babies during pregnancy or delivery, as well as through breastfeeding. In developing countries, approximately one in every three children born to an HIV positive mother is infected with HIV. In developed countries, less than one child in fifty born to an HIV positive mother is infected because of health practices that included delivery by Caesarean Section, treatment with antiretroviral drugs and safe alternatives to breastfeeding (UNAIDS 2008:6).

A child may be suspected of having an HIV infection if it is born to a woman who is known to be HIV positive or if the child becomes ill. However, it is difficult to interpret HIV tests in children under the age of 15-18 months. Standard HIV tests detect antibodies to HIV. Children born to HIV positive women have HIV antibodies from

their mother in their blood until this age. These are called maternal antibodies. In a very few cases, these maternal antibodies are found in the blood of children older than 18 months. It is possible to detect HIV directly. However, these tests are very expensive and not widely available in developing countries. One of the tests used is the HIV Deoxyribonucleic acid (DNA) polymerase chain reaction (PCR). In the United States of America, children born to HIV positive mothers receive PCR tests at birth and again at 1-2 months and at 4-6 months. Two positive tests are taken as evidence of HIV infection. Two negative tests are evidence that the child does not have HIV infection. This can be confirmed using standard HIV antibody tests, which become negative after the age of about 18 months (UNAIDS 2009).

Children may also be infected with HIV through sex and unsafe health practices. Sexual spread of HIV is most common in older children/young people but can occur in younger children through sexual abuse. Unsafe health practices may also occur in the traditional health sector and include activities such as circumcision and ear piercing (UNAIDS 2009).

Most children in developing countries who have HIV infection do not know they are infected. There are many reasons for this, many of which apply also to adults also. For example, HIV tests may not be available, people (including children) may not see the benefit of having a test, particularly if the child or adult does not feel ill. However, UNAIDS reports that early awareness of HIV infection, combined with good care and support, can enhance survival and quality of life (UNAIDS 2009).

There are many issues to consider before testing a child for HIV. These are:

- HIV testing should be carried out only if it brings some clear benefits to the child such as better care and support;
- Counselling needs to be provided for children and their caregivers. The counselling provided should be appropriate for the age of the child;

- Most children who are HIV positive have been infected through mother-to-child transmission. Therefore, finding out that a child has an HIV infection means that the child's mother and the father may also be HIV positive; and
- HIV testing needs to be carried out in a way which ensures that results are kept confidential (UNAIDS 2009).

It is also possible to decide how severe a child's HIV infection is. This is particularly important when deciding whether or not to treat a child with antiretroviral drugs (UNAIDS 2009).

The HIV/AIDS pandemic is one of the greatest threats to the realisation of child rights in South Africa and more broadly, in SSA. South Africa currently has more people infected with HIV/AIDS than any other country in Africa with the highest rates of infection among women (Bradshaw, Johnson, Schneider, Bourne & Dorrington 2002: 48).

1.4.3 Compromised immunity

Many different people suffer from a compromised immune system. Although it is typically of those who suffer from HIV/AIDS and congenital diseases that affect the immune system first, anyone can run the risk of an improperly functioning immune system. AIDS and other diseases of the immune system very often lead to numerous serious infections. Those whose immune system is compromised for other reasons may only experience numerous colds and viruses (Hamilton 2009).

1.5 PREVALENCE OF HIV/AIDS IN SOUTH AFRICA

South Africa is currently experiencing one of the most severe HIV/AIDS epidemics in the world. The HIV/AIDS pandemic has been described as a series of waves: the first wave – the incidence of new infections – peaked in South Africa in 1998, at around 930 000 new infections per year. With the second wave the total number of people infected

was expected to peak at around 7 – 8 million people in 2006. The number of AIDS-related deaths in South Africa will peak around 2010, with the number of deaths exceeding 800 000 per year, resulting in the final wave – the children who have been orphaned (Bradshaw *et al.* 2002:48).

An estimated 5.3 million South Africans were HIV positive in 2003. In 2003 the Human Sciences Research Council (HSRC) released information on HIV prevalence and HIV-related risk behaviours. The study was based on a representative sample of more than 9,000 South Africans. Of the study population 12.1 percent were HIV positive. Nearly half of all men and over one-third of women over 15 years of age reported that they had changed their behaviour as a result of HIV/AIDS, including being faithful to one partner, reducing the number of sexual partners, abstinence and condom use. These behaviour changes may be related to strong prevention programmes implemented by a wide range of stakeholders, including the South African Government (SAG), nongovernmental organizations (NGOs), and the faith-based sector. Nevertheless, 2004 antenatal surveillance data reflect a continuing and significant increase in HIV/AIDS prevalence in South Africa (UNAIDS 2006:44; UNAIDS 2005:18).

A survey published in 2004 found that South Africans spent more time at funerals than they did having their hair cut, shopping or having barbecues. It also found that more than twice as many people had been to a funeral in the past month than had been to a wedding (UNAIDS 2004).

By the end of 2005, there were five and a half million people living with HIV/AIDS in South Africa, and almost 1,000 AIDS deaths occurring every day, according to UNAIDS estimates.

Based on the results of many surveys, including the household and antenatal studies, UNAIDS World Health Organization (WHO) made its own estimate of a prevalence of 18.8 percent in those aged 15-49 years old, at the end of 2005. UNAIDS/WHO high and

low estimates are 16.8 percent and 20.7 percent respectively (Noble 2006; South Africa HIV/AIDS Statistics 2005).

Table 1.1 Estimated HIV prevalence among South Africans aged two years and older, by sex, race and province (UNAIDS 2004)

Sex and race	**Number surveyed**	**Prevalence in %**
Male	6,342	16.5%
Female	9,509	13.3%
African	9,950	13.3%
White	1,173	0.6%
Coloured	3,382	1.9%
Indian	1,319	1.6%
National:	15,851	10.8%
Province	**Number surveyed**	**Prevalence in %**
KwaZulu-Natal	2,729	16.4%
Mpumalanga	1,224	15.1%
Free State	1,066	12.5%
North West	1,056	10.8%
Gauteng	2,430	10.7%
Eastern Cape	2,428	8.8%
Limpopo	1,570	8.0%
Northern Cape	1,144	5.2%
Western Cape	2,204	1.9%
Total:	15.851	10.7%

The results of a study undertaken in SA are depicted in Table 1.1, and suggest that KwaZulu-Natal (16.4%), Mpumalanga (15.1%) and Free State (12.5%) have the highest HIV/AIDS prevalence in the country. However, the relatively small sample sizes limit

precision, and in several cases the ranges of uncertainty overlap. According to Table 1.2 at the end of 2001, 69.5 percent of adults and children living with HIV/AIDS were at high risk and 33.5 percent at low risk (UNAIDS 2004).

Table 1.2 AIDS prevalence in South Africa (Adapted from UNAIDS 2004)

Number of Adults and Children Living with HIV/AIDS (at the end of 2001)	5,000,000
Total South African Population in 2001	43,792,000
Prevalence of Adult HIV infection (end of 2001): High risk Population: (Sex workers and clients, patients seeking treatment for a sexually transmitted infection, or others with known risk factors)	69.5%
Low risk Population: (Pregnant women, blood donors or others with no known risk factors)	33.5%

1.6 MALNUTRITION AMONGST HIV/AIDS INFECTED PEOPLE

A common consequence of HIV/AIDS infection is malnutrition and weight loss and these are used as diagnostic criteria for HIV/AIDS. Though studies on energy requirements in children can vary according to the type and duration of HIV-related infections, and whether there is weight loss along with acute infection. The relationship between HIV/AIDS and malnutrition and wasting is well described, with nutritional status compromised by reduced food intake, malabsorption caused by gastrointestinal involvement, increased nutritional needs as a result of fever and infection and increased nutritional losses. Malnutrition contributes to the frequency and severity of opportunistic infections seen in HIV/AIDS and nutritional status is a major factor in

survival. Failure to maintain body cell mass leads to death at 54 percent of ideal body weight. HIV-infected adults an average increase of 10 percent of energy intake is recommended to maintain growth. Based on clinical experience and existing guidelines to achieve cath-up growth in children immespective of HIV status, energy intakes for HIV-infected children experiencing weight loss need to be increased by 50 percent to 100 percent over established requirements for otherwise healthy uninfected children (WHO 2003:4). The effectiveness of nutrition intervention has been documented and counselling in dietary nutrition is considered critical in the treatment of HIV/AIDS particularly in view of the fact that drug treatment is inaccessible to many people living with the virus in Africa. Drugs affect the nutritional levels in the body (Kennedy & Macintyre 2003:6-7; Pewoz & Preble 2000:10-11).

Malnutrition can result from a loss of appetite due to depression, fatigue, illness or drug side effects. Without any obvious loss in a person's weight, it can persist undetected. Weight loss can be an obvious sign of malnutrition. It can begin and become severe during the course of HIV disease. Wasting is extreme weight loss, an unexplained loss of 10 percent or more of a person's normal weight. Some people report wasting despite having very high CD4+ cell counts. However, the risk of wasting and serious malnutrition increases dramatically when CD4+ cell counts fall below 100 (UNAIDS 2004:48).

The virus itself has an effect on the nutritional status of the person living with HIV/AIDS. The body reacts to the virus with an immune response, which uses more energy and nutrients. When the immune system is weakened by HIV/AIDS, other infections start to occur and every new infection raises the need for nutrients and energy (UNICEF 2001:8; CFNI 2002:13).

Malnutrition places added stress on an already weakened immune system and may complicate the treatment of the disease by affecting the ability of the intestinal tracts to

absorb drugs, not to mention its ability to absorb proteins, carbohydrates and fats (CFNI 2002: 13-14).

The following changes in metabolism may affect the nutritional status of the HIV/AIDS patient:

- Alterations in the function of the gastrointestinal tract and the ability to use food in an efficient way;
- Increased use of body fat stores;
- Recurrent fevers and infections causing a rise in metabolic rates; and
- Depletion of vitamin and mineral stores (FAO & WHO 2002:8).

1.7 NUTRITION AND HIV/AIDS

Nutrition can improve a person's ability to live a better life with HIV/AIDS. In general it proves difficult to stay nutritionally fit, but for someone who is HIV positive the task is even more challenging. Both HIV disease and HIV medication can have negative effects on the nutritional status, thereby decreasing the appetite. Unfortunately, keeping up with what is considered a healthy eating plan can be difficult. However, there are some general nutrition guidelines that enable people who are infected or HIV positive to stay healthy. These can be obtained by consulting a healthcare provider for recommendations and a nutritionist or dietician working with HIV positive people for tailored eating plans that include all important vitamins and minerals (Williams 2004).

Being infected with HIV/AIDS can make it difficult for a person to eat. Those with HIV/AIDS may have mouth infections, which make swallowing food painful. They may just feel too tired to eat. Anxiety and worries about food and nutrition as well as conditions like diarrhoea and nausea can also influence their appetite (UNICEF 2001:23-25; Wickwire 2006; CFNI 2002:14; Pewoz & Preble 2000:12).

Oral problems are very common in people living with HIV; more than a third of such people have oral conditions that arise because of their weakened immune systems. Even though combination antiretroviral therapy has made some oral problems less common, others such as sore and dry mouth and mouth ulcers occur more often with this type of treatment. These mouth problems can be painful, annoying, and lead to other problems (NIDCR 2005).

As indicated in Figure 1.1, HIV/AIDS lowers food intake as follows:

- Infections and illness lead to poor appetite. There is decreased intake owing to medication schedules that require the child to be without food (NPO) for a period of time before and after the medications are given, as well as potential problems with nausea, vomiting and mouth sores;
- Mouth and throat infections cause difficulties with eating. Altered intake results from oral infection with *Candida* (thrush.) Bear in mind that *Candida* can invade the oesophagus (throat), as well as the small intestine without being present in the mouth;
- Inability to tolerate fats and lactose (milk sugars);
- Some medicines cause a poor sense of taste as a side effect;
- Both the expense of treatment and the inability to work affect income, which leaves less money available for food;
- Depression, fear and anxiety contribute to the loss of appetite;
- Isolation may result from social prejudice against people with HIV/AIDS. Because food and eating is a social event, loneliness will affect the way a person eats; and

- In the late stage of the disease, people with HIV/AIDS may find it difficult to take care of them (UNICEF 2001; CFNI 2002 63-71; FAO & WHO 2002:10).

Some of the eating hints that are given for one of these problems may be in conflict with hints that are given for another. For example, one hint for gaining weight is to put gravy, butter or creamy sauces on your food. If you have diarrhoea, however, the gravy, butter or sauce could make it even worse (Wickwire 2006:2).

Continuous nutritional care can help to provide adequate intake of food and improve weight gain during periods of wellness (UNAIDS 2003: 12-14).

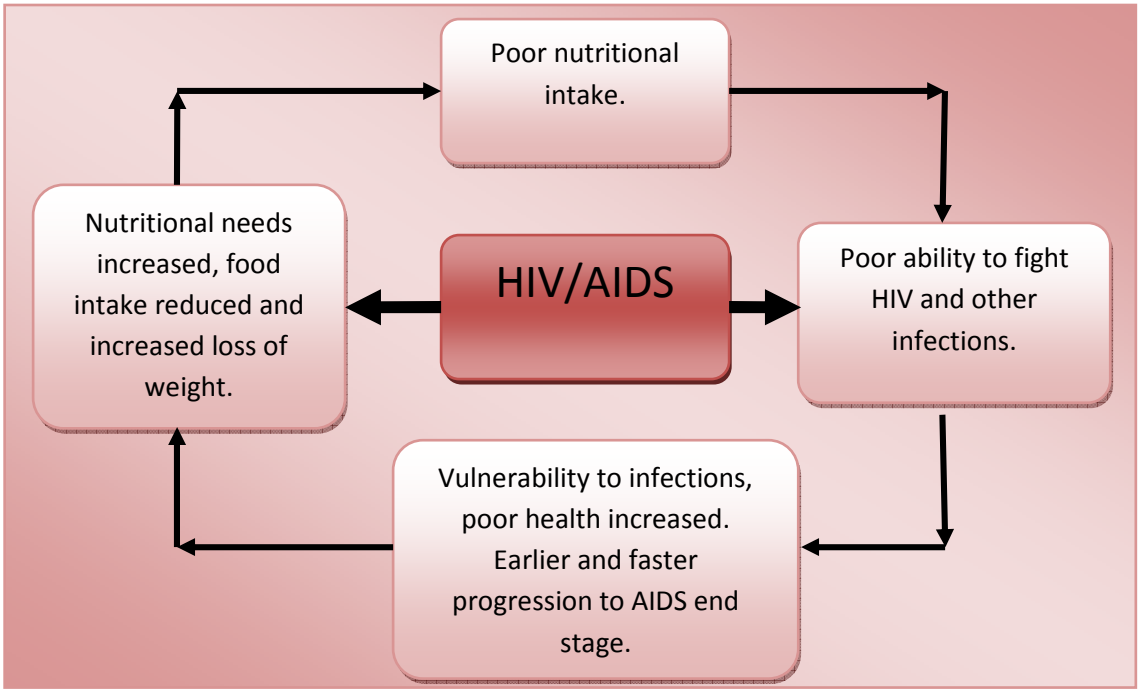

Figure: 1.1 The cycle of nutrition and HIV/AIDS (FAO & WHO 2002:5)

1.8 NUTRIENTS IMPORTANT IN COMPROMISED IMMUNITY

As mentioned in section 1.7, nutrition can affect the ability to survive with HIV/AIDS. Staying nutritionally fit is difficult for everyone, but for HIV positive people the task is even more challenging (CFNI 2002:16; Williams 2004; NICUS 2006).

Nutrition plays an important role in helping the immune system of our bodies to work well. The immune system is a natural part of the body that fights off germs, viruses, bacteria and other disease-causing organisms that we can come into contact with every day. When someone is infected with HIV, his immune system is being damaged. Eating correctly can help it fight back to the best of its ability and can also help the body stay stronger during any medical treatments that may be necessary (Wickwire 2006; UNAIDS 2008:4-7).

Good nutrition and weight maintenance are extremely important for people living with HIV/AIDS. The vitamins, nutrients and energy that nutritious foods provide can help stave off illness. Maintaining weight and preventing the loss of muscle mass or lean body mass improve general health and the ability of the body to fight disease (UNAIDS 2004:35-38).

It is important to increase vitamin and mineral intake (UNAIDS 2004:30). Vitamins and minerals are essential for maintaining health. They protect against opportunistic infection by ensuring that the lining of skin, lungs and gut remain healthy and that the immune system functions properly. Of special importance are vitamin A, vitamin C, vitamin E, certain B-group vitamins and minerals such as selenium, zinc and iron (FAO & WHO 2002:10-15; CFNI 2002:13-16). Research has confirmed that taking a multivitamin that includes vitamins B, C and E slows the progression of HIV disease (Williams 2004; CFNI 2002).

1.8.1 Energy requirements

Children cannot eat the same amount of food per meal than an adult can, even if they consume a lot of energy-dense food throughout the day. Children should therefore sustain energy requirements by eating small meals and healthy snacks spread over the day (FAO 1998:14). The Estimated Energy Requirement (EER) for healthy boys aged three to eight years is 7316 kJ and for healthy girls of the same age it is 6896 kJ. Boys aged nine to 13 years old require 9572 kJ while for girls of the same age the EER is 8698 kJ (Stanfield 1997:6-7; Evers 2002:1). However, the energy requirements are likely to increase by 10 percentage to maintain body weight and physical activity to asymptomatic HIV infected adults, and growth in asymptomatic children. During symptomatic HIV, and subsequently during AIDS, energy requirements increase by approximately 20 percent to 30 percent to maintain adult body weight. Energy intakes need to be increased by 50 percent to 100 percent over normal requirements in children experiencing weight loss. Energy requirements in children can vary according to the type and duration of HIV-related infections, and whether there is weight loss along with acute infection (WHO 2003:3-8).

1.8.2 Macronutrients.

1.8.2.1 Protein

Protein is one of the most important nutrients needed to build and maintain muscle, blood, organs, skin, bones and other tissues of the body. Protein can also be used to provide energy: excess protein will be converted to glucose and will be used in the body as energy, or will be stored in the body as fat. Body protein loss is due to poor dietary intake, malabsorption and metabolic changes. In the absence of adequate energy intake, body fat and protein are used as fuel sources, thus energy and protein metabolism cannot be separated within the context of clinical HIV/AIDS. During weight loss in HIV/AIDS

the proportion of body stores that are lost, be they protein fat or carbohydrate depends on the underlying nutritional state and the dietary intake (WHO 2003:5). Sources of protein that provide all nine essential amino acids in adequate amounts are meat, poultry, fish, eggs, milk, cheese and yogurt, and these sources are considered complete proteins because they have the essential amino acids. The other amino acids can be manufactured by the body, to synthesize specific structures for the indispensable amino acids. Plant protein sources like legumes grains, nuts and seeds as well as vegetables tend to be deficient in one or more of the essential amino acids and are called incomplete protein sources. In the absence of adequate dietary protein, growth will slow down and can even stop (Evers 2002:2; FNIC 2002; Stanfield 1997:75).

Protein serves as a major structural component of all cells in the body. Protein functions as enzymes, transport carriers and certain hormones. During the process of digestion and absorption in the body, protein is broken down into amino acids, which become the building blocks of structural and functional compounds (FNIC 2002; Stanfield 1997:6-7).

1.8.2.2 Fat

More than twice the amount of food energy of carbohydrates and protein are provided by oils and fats. Adding fat and oil is a good way to increase the energy intake of young children. Oil and fat found in foods is a source of n-6 and n-3 polyunsaturated fatty acids and its presence in the diet increases the absorption of fat-soluble vitamins and precursors such as vitamin A and pro-vitamin A carotenoids (Sandfield 1997:6-8; FNIC 2002).

Young children could receive between thirty to forty percent of their total daily energy intake from fat. Fat is also an important source of the fat-soluble vitamins. Dietary fat includes butter, margarine vegetable oils, whole milk, and visible fat on meat and

poultry products, invisible fat in fish, shellfish, some plant products such as seeds and nuts and bakery products (FAO 1998:7; FNIC 2002).

Abnormalities of lipid metabolism are also seen in HIV-positive patients, especially those receiving ARV (Antiretroviral) therapy. Fat oxidation increases in HIV-positive patients but carbohydrate oxidation is suppressed in AIDS, suggesting that more fat than carbohydrates is used as fuel saurce (WHO 2006).

1.8.2.3 Carbohydrates

Carbohydrates include sugar, starches and dietary fibre and are the major source of food energy. Foods rich in carbohydrates include rice, maize, wheat and other cereals, all types of root crops such as potatoes, legumes such as peas and beans, as well as many fruits and vegetables and sugars. It is suggested that the maximum intake of added sugars be limited to providing no more than 25 percent of energy (FAO 1998:5; FNIC 2002; Stanfield 1997:53).

1.8.3 Micronutrients

Minerals and vitamins are called micronutrients and smaller amounts are needed than for protein, fat and carbohydrates. Vitamins and minerals assist with all the body functions and form part of the body tissues and are very important in the body's immune system especially in the case of people living with HIV/AIDS (FAO 1998:9).

1.8.3.1 Vitamin A

The importance of vitamin A to immune functions and childhood infections and mortality, is plausible that vitamin A is beneficial in HIV infection. However, in vitro studies in different cell lines suggest that vitamin A may reduce and increase viral replication. Despite the lack of effect on plasma viral soled in adults, regular mega doses of vitamin A to HIV-positive children under five years of age have been shown to

reduce diarrhoea mobility, diarrhoea-and AIDS-specific mortality and all –cause mortality (WHO 2003:23).

Vitamin A is important for maintaining the health of the lining of skin, lungs and intestinal track. The function of vitamin A is to build and maintain healthy tissues, particularly eyes, skin, bones and tissues of the respiratory and digestive tracts. It is also important for the effective functioning of the immune system. Vitamin A deficiency increases the severity of diseases such as diarrhoea while infection will increase the loss of vitamin A from the body. Good vitamin A sources are dark green, yellow, orange and red vegetables and fruit. These include spinach, pumpkin, cassava leaves, green peppers, squash, carrots, amaranth, yellow peaches, apricots, papaya and mangoes. Vitamin A is also contained in red palm oil, yellow maize, orange and yellow sweet potatoes, egg yolks and liver. Dark coloured fruit and vegetables contain pigments called carotenoids, which can be converted to vitamin A (FAO & WHO 2002: Pewoz 2000:15-19; CFNI 2002:15-31; FAO 1998:9).

1.8.3.2 Vitamin C

Vitamin C helps to protect the body from infection and assists in recovery, and have been associated with reduced risk of HIV progression in observation studies (WHO 2003:24). It is also needed to increase absorption of dietary iron, to make collagen (connective tissue) which binds the body's cells together, and to serve as an antioxidant (FAO 1998:9). It is found particularly in citrus fruits such as oranges, grapefruit, lemons and mandarins. Guavas, mangoes, tomatoes and potatoes are also good sources of vitamin C (FAO & WHO 2002; Stanfield 1997:84).

1.8.3.3 Vitamin E

Vitamin E protects cells and aids resistance to infection due to their strong antioxidant properties, effect on the immune system. Vitamin E reduced the risk of adverse

pregnancy outcome, postnatal mother-to-child transmission and child mortality, child morbidity and progression to AIDS or death among adults. (WHO 2003:24). Foods containing vitamin E are green leafy vegetables, vegetable oil, peanuts and egg yolks (FAO & WHO 2002; Stanfield 1997:84).

1.8.3.4 Vitamin B-group

Vitamin B-group is necessary to keep the immune and nervous system healthy. The vitamin B complex assists in converting carbohydrates, fat and protein into energy and in building and repairing body tissue. Deficiencies of these vitamins can have serious effects including muscular weakness, paralysis; mental confusion nervous system disorders digestive problems, cracked and scaly skin, severe anaemia and heart failure (FAO 1998:9). These vitamins may be lost from the body through the use of certain medicines for the treatment of tuberculosis. Good food sources include white beans, potatoes, meat, fish, chicken, watermelon, maize, grains, nuts, avocados, broccoli and green leafy vegetables (FAO & WHO 2002).

1.8.3.5 Iron

Iron deserves special mention because both the effect of HIV infection on status and the effect of status and intake on HIV infection seem to be different from those of other micronutrients. Iron stores decline in early asymptomatic HIV infection probably because of impaired absorption but increase with advancing HIV infection as iron accumulates in macrophages and other cells. Iron may have adverse effects in HIV and other viral infections for example, iron increases and iron chelating reduces HIV replication in vitro studies (WHO 2003:24). Iron-deficiency anaemia is a widespread problem in many countries, especially among women and children. Iron is a major component of red blood cells and iron deficiency is the main cause of anaemia among children (WHO 2000). Good iron sources are green leafy vegetables, seeds, whole-grain

products, dried fruit, sorghum, millet, beans, alfalfa, red meat, chicken, liver, fish, seafood and eggs (FAO & WHO 2002).

1.8.3.6 Selenium

Selenium is an important mineral because it helps to activate the immune system. Good sources include whole grains such as whole meal bread, maize and millet and dairy products such as milk, yogurt and cheese. Meat, fish, poultry, eggs and other protein-rich foods are also good sources, as well as peanut butter, dried beans and nuts (FAO & WHO 2002).

1.8.3.7 Zinc

Zinc is a component of both structural and catalytic proteins of HIV; it is required for the activity of reverse transcript as and the production of infectious virus and may inhibit HIV replication through binding to the catalytic site of HIV protease. Given the considerable importance of zinc for immune functions and in the prevention of diarrhoea and respiratory tract infections, it plays a role in HIV infection. In fact, zinc in combination with other micronutrients considerable increased weight gain and seemed to increase survival during treatment for HIV (WHO 2003:25). Zinc is also important for the immune system. Zinc deficiency reduces the appetite. Sources include meat, fish, poultry, shellfish, whole-grain cereals, maize, beans, peanuts and milk and dairy products (FAO & WHO 2002; Pewoz & Preble 2000:15-19; CFNI 2002:15-31)

1.9 MOTIVATION FOR THIS STUDY

Malnutrition in children is particularly devastating because children are still growing and developing, placing even higher energy demands on their bodies and immune systems. All children, regardless of the stage of their infection, should be seen by a registered dietician (RD) for a thorough assessment and evaluation. It has been estimated that over 90 percent of children with HIV infection and AIDS will experience delayed growth.

The reason for this is multifactorial and includes poor socioeconomic conditions, poor nutritional intake, malabsorption and the disease itself (Zafonte 2002:8).

A proper balance of nutrients is required every day to maintain a well-nourished body. People who are HIV positive should learn how to balance their diet when they are asymptomatic (those who have tested positive for antibodies to HIV but have no other signs of sickness are referred to as "asymptomatic HIV positive" – preciously describe in the 4 stage of HIV, as stage one in the HIV cycle). During this period, the onset of AIDS may be delayed by adapting healthy eating habits. A variety of foods from the five food groups (the major food groups are; cereals, including breads, rice, pasta, noodles; vegetables and legumes; fruit; dairy products and meat) is needed to get the range of nutrients that the body needs (CFNI 2002:15). It is important for people diagnosed with HIV to eat healthily since HIV positive people are at a greater risk of developing health problems if they do not eat properly. The right balance of food will help prevent weight loss and tiredness (CFNI 2002:16-17).

Good nutrition is also essential to:

- Replace lost nutrients;
- Prevent tiredness, weight loss and malnutrition;
- Improve the functioning of the immune system and the body's ability to fight infection;
- Improve the way one feels;
- Improve strength, endurance and ability to respond well;
- Improve response to treatment and drugs;
- Decrease the risk of opportunistic infections;
- Shorten the length of hospital stays;
- Promote optimal body weight;
- Promote independence; and
- Provide as good a quality of life as possible (CFNI 2002: 23-24).

Poor nutrition due to poor food intake, increased nutrient usage by the body and loss of nutrients from the body weaken the immune system, which in turn decreases the ability of the body to fight off other infections. The weakened immune system results in repeated infections which can lead to poor nutrition and so the cycle continues (CFNI 2002:23-24).

Children tend to have a habit of nibbling/chewing on snacks with low nutritional value and high in carbohydrates and fat. Although these snacks are harmless to them it would be better, especially for HIV positive children, to eat snacks that are nutrient dense, because most of these children are in a poor nutritional state (Labadarios *et al* 2001:6).

For these reasons it was decided that a healthy snack food should be developed, bearing in mind the following guidelines suggested by WHO (WHO 2003) for people living with HIV/AIDS:

- Choose familiar and favourite foods and food items;
- Eat a variety of healthy foods more often;
- Make starchy foods the basis of each meal;
- Eat fruits and vegetables every day and dried peas and beans regularly as tolerated;
- Include some food from animals daily but use fats and oils in moderation; and
- Eat four or more times a day (CFNI 2002:30-32).

1.10 OBJECTIVES OF THE STUDY

As a result of the importance of healthy eating during compromised immunity conditions and because children tend to snack during the day, the main objective of this study was to develop a cost-effective and nutrient-dense snack food item for HIV/AIDS-affected children (children that are affected by HIV, for example being orphaned when family member dies as a result of HIV) in the Vaal region, aged 6-13 years, by using

locally available and affordable food items in order to improve the nutritional and health status of these children.

Specific objectives were to:

- perform analyses of nutritional challenges associated with children who are affected with HIV/AIDS or who have compromised immunity;
- conduct a baseline survey to determine dietary intake, food consumption patterns and the nutritional status of the target population; and
- to develop the snack food item by establishing criteria based on the following:
    - The results of the literature study and the results of the baseline survey.
    - Sensory analyses (for colour, flavour and taste) in order to evaluate the overall acceptability of the snack food item.
    - Tests of the shelf life of the snack food item.

1.11 STUDY POPULATION AND SCOPE

The study population included HIV/AIDS-affected children, both boys and girls, aged six to 13 years, attending an after care centre in Boipatong (Vaal region).

1.12 STRUCTURE OF THE DISSERTATION

In Chapter 1 the problem of HIV/AIDS infection is described as well as the prevalence globally and in SA. Chapter 2 follows with a literature synthesis regarding eating patterns of children, product development, and sensory evaluation. The methodology of this study is described in Chapter 3 and the results follow in Chapter 4. In Chapter 5 the conclusion and recommendations of this study are outlined.

The conceptual framework of the study is represented in Figure 1.2

1.13 CONCEPTUAL FRAMEWORK

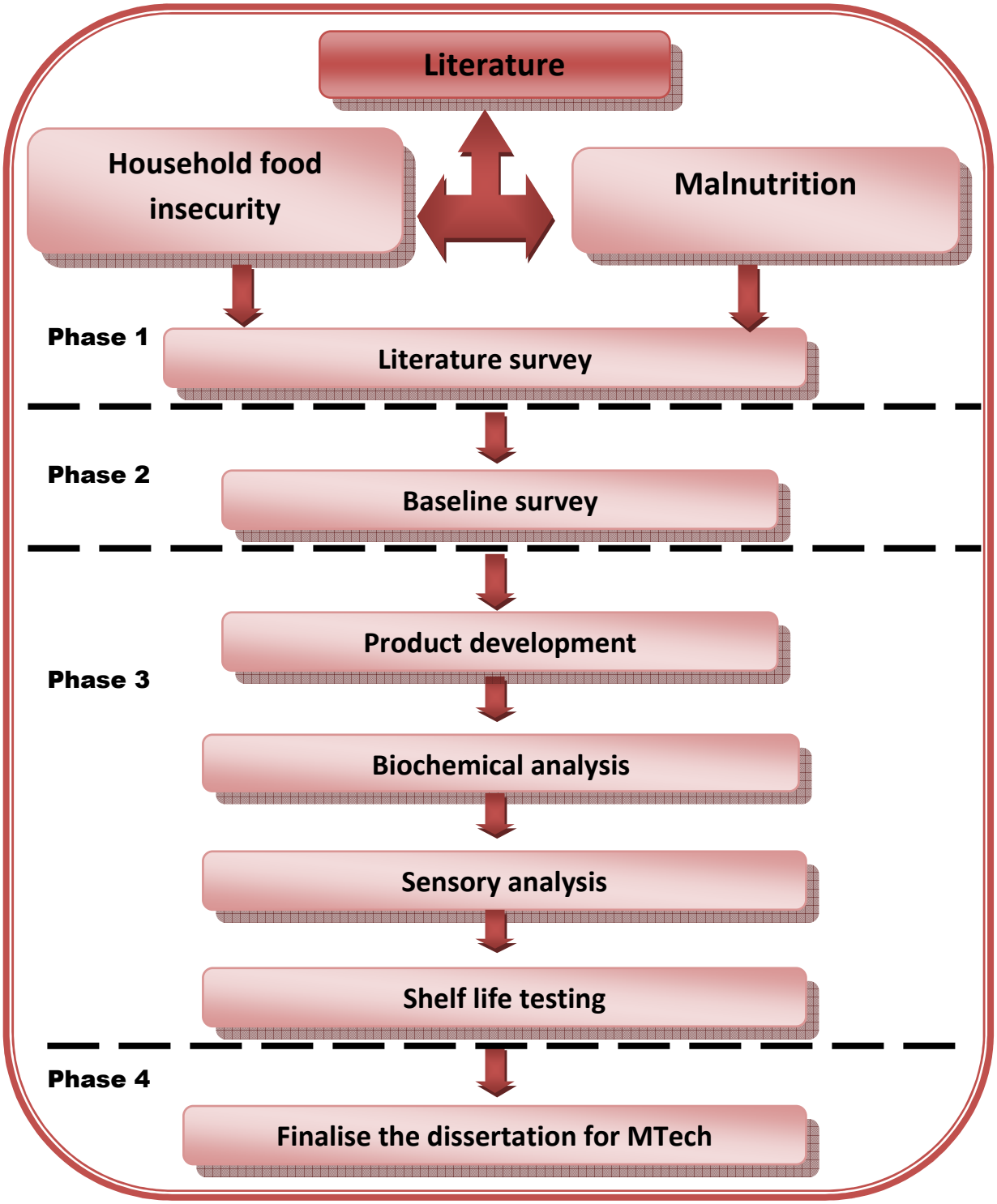

Figure 1.2 Conceptual framework