

WHAT IS THE OPTIMUM DIET FOR ASYMPTOMATIC HIV-INFECTED PEOPLE (AHIV)? A PUBLIC HEALTH APPROACH

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“I will take you, one from a city and two from a family,
and I will bring you to Zion.

And I will give you shepherds according to My heart,
who will feed you with knowledge and understanding”.

Jer 3: 14 – 15

Thanks to GOD, my faithful and Heavenly Father,

This work is a blessing of His Gracious Love

His promises are true.

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ABSTRACT

TITLE

What is the optimum diet for asymptomatic HIV-infected people (AHIV)? A public health approach.

OBJECTIVE

The main aim of this thesis was to investigate the role of nutrition during “early” HIV-infection in African women.

METHODS

Data reported in this investigation formed part of two cross-sectional studies, the THUSA and Mangaung studies. The Mangaung study investigated women and, therefore, the sub-sample of the THUSA study was chosen accordingly. The data of the two studies were kept and analysed separately.

The investigation consisted of 1040 women from the THUSA study, aged between 15 and 90 years of which 120 (11.5%) were HIV infected. The Mangaung study comprised of 488 women aged between 25 and 44 years of which 248 (51%) women were infected. Demographic data, anthropometric measurements, health outcome variables and habitual nutrient intakes by a quantified food frequency questionnaire were used.

The SPSS statistical package (version 14.0; SPSS Inc, Chicago, Illinois, 2005) was used to analyze data. Descriptive statistics were done expressing variables as means, medians, standard deviations (SD), standard errors (SE) and confidence intervals (CI). An analysis of variance (ANOVA) was done to test for significance between the HIV-infected and non-infected groups in both studies. Partial correlations were done in the infected and non-infected groups to determine associations between dietary/ nutrient

intake, anthropometry and the biological health variables. In the THUSA study we controlled for age, education level, degree of urbanization and alcohol intake and in the Mangaung study for age, education level and alcohol intake. Nutrient intakes of both infected and non-infected women above and below median values as well as in the first and fourth quartile of total cholesterol (TC) and albumin distribution were compared to assess the role of nutrients in the observed decreases in TC and albumin of HIV-infected women.

RESULTS AND DISCUSSION

The dietary intakes of the HIV-infected women in both the studies did not differ significantly from the non-infected women. Total serum cholesterol, albumin, fibrinogen and blood pressure were significantly lower in the HIV-infected women in both the THUSA and Mangaung studies.

The non-infected THUSA women with lower serum cholesterol levels (than the median) had significantly lower intakes of percentage energy from fat (25.2 versus 26.4%, $p \leq 0.027$), percentage energy from total protein (11.6 versus 12.1%, $p \leq 0.000$), animal protein (25.6 versus 27.7g, $p \leq 0.005$), and significantly higher intakes of plant protein (32.2 versus 29.4g, $p \leq 0.002$) and fibre (16.9 versus 15.8g $p \leq 0.029$). There were no significant differences observed in the nutrient intakes in the infected women with serum cholesterol levels above and below the median. In the Mangaung study no significant nutrient intake differences were observed in both of the HIV-infected and non-infected women with lower and higher than the median TC levels.

In the THUSA study, higher intakes of fat (percentage energy) were close to significant (27.3 versus 24.5 %, $p \leq 0.053$) in the infected women with higher (than the median) albumin levels. In the non-infected group with higher albumin levels, significant differences were observed in percentage energy from fat (26.6 versus 24.9 %; $p \leq 0.001$) protein (12.2 versus 11.6 %; $p \leq 0.001$) and carbohydrate (62.8 versus 65.2%; $p \leq 0.000$). Higher intakes of saturated fat (SATFAT) (17.7 versus 16.1g, $p \leq 0.008$), monounsaturated fats (MUFAT) (19.3 versus 17.4g, $p \leq 0.004$) as well as higher intakes of animal protein (28.5 versus 24.4g, $p \leq 0.000$) were observed in the group with higher than the median levels of serum albumin. In the Mangaung study the HIV-infected women (with higher than the median serum albumin levels), had significantly higher

intakes of energy (13 275 versus 11 622 kJ, $p \leq 0.022$), polyunsaturated fatty acids (32.3 versus 17.3 g, $p \leq 0.036$), dietary cholesterol (412.9 versus 344.5 mg, $p \leq 0.043$) and plant protein (42.3 versus 35.3 g, $p \leq 0.008$). No differences were observed in the non-infected women.

The further analyses, comparing the dietary intakes in both studies of infected and non-infected women with TC and albumin levels in the first and fourth quartiles, showed that in the THUSA study, non-infected women with lower TC levels had significantly lower intakes of protein (% of total energy), total fat (% of total energy) and vitamin B₁₂ and significantly higher intakes of total energy (TE), plant protein, total carbohydrate, % TE from carbohydrate, dietary fibre, added sugar and thiamine. In the infected women saturated fatty acids (SATFAT), calcium and the fat ratio (polyunsaturated/saturated ratio) differed significantly between women with TC levels in the first and the fourth quartile. A significant higher intake of riboflavin was seen in the non-infected women from Margaung with TC levels in the fourth quartile, while significant higher intakes of energy, total protein, animal protein, total fat, SATFAT, MUFAT, total carbohydrate, phosphorus, chromium and iodine was seen in the infected women with TC levels in the fourth quartile. These results suggest that a more "westernized" diet with higher intakes of energy, and animal derived foods (SATFAT and calcium) could have protected against the detrimental decreases in TC observed in HIV infection. Significant differences were observed in the intakes in the non-infected THUSA women who had serum albumin in the first and fourth quartiles. Intakes in percentage energy from protein and fat, animal protein, total fat, SATFAT, MUFAT, calcium, zinc, vitamin C and fat ratio, were significantly lower in the women with albumin levels in the first quartile. Significantly higher carbohydrate intakes were observed in the women who had serum albumin levels in the first quartile. In the Margaung study, significant differences were seen in the intakes between infected women who had serum albumin levels in the first and fourth quartiles. Intakes of total energy, protein, fat, MUFAT, SATFAT, carbohydrate, magnesium, zinc, chromium, biotin, pantothenic acid and iodine were significantly lower in the infected women with serum albumin levels in the first quartile. In the non-infected women significantly lower intakes of calcium were observed in the group who had serum albumin levels in the first quartile compared to those who had serum albumin levels in the fourth quartile. These results also suggest that a more "westernized" diet was associated with higher albumin levels in HIV-infected women.

CONCLUSION

It is well known that nutrition has an integral part to play in the care of people living with HIV/AIDS (PLWHA). Maintaining proper nutrition, weight and immune function is thought to delay disease progression, prolong the asymptomatic phase and improve survival. These analyses suggest that the “prudent” diet generally regarded as an optimal diet for prevention of non-communicable diseases, may not be the optimal diet for PLWHA. The overall analyses therefore suggest that a more “westernized” diet, higher in fat and protein could be more beneficial to asymptomatic HIV-infected women compared to that of a more “prudent” diet. As these studies were not primarily designed to investigate HIV and nutrition, the role of a higher energy, fat and animal protein intake (“western” diet) in asymptomatic HIV warrants urgent investigation.

Keywords: HIV-infection, macronutrients, western diet, serum albumin, total cholesterol

OPSOMMING

TITEL

Wat is die optimale dieet vir asimptomatiese MIV-geïnfekteerde persone (AMIVP)? 'n Gemeenskapsgesondheidsbenadering.

DOEL

Die hoofdoel van die tesis was om die rol van voeding in "vroee" MIV-geïnfekteerde swart vroue te ondersoek.

METODE

Die data wat in hierdie ondersoek gerapporteer word, vorm deel van twee dwarsprofielstudies, die THUSA- en Mangaung-studies. Die Mangaung-studie het uit vroue bestaan en 'n sub-populasie is daarvolgens uit die THUSA-studie gebruik. Die data van die twee studies was apart gehou en geanaliseer.

Die ondersoek het bestaan uit 1040 vroue vanuit die THUSA-studie, waarvan 120 (11.5%) MIV-geïnfekteer was. Die Mangaung-studie het bestaan uit 488 vroue tussen die ouderdomme van 25 en 44 jaar waarvan 248 (51%) geïnfekteer was. Demografiese data, antropometriese metings, gesondheids-uitkomsveranderlikes en gewoontelike nutriëntinname gemeet met gekwantifiseerde voedselfrekwensie-vraelyste was gebruik.

Die SPSS statistiese dataprogram (14.0: SPSS Inc, Chicago, Illinois, 2005) was gebruik om die data te analiseer. Beskrywende statistiek was gedoen en veranderlikes is uitgedruk as gemiddeldes, mediane, standaardafwykings, standaardfoute en vertrouensintervalle. Veranderlike-variensieanalise (ANOVA) was gedoen om vir betekenisvolle verskille in die geïnfekteerde en nie-geïnfekteerde groepe in beide studies te toets. Parsiële korrelasies was gedoen om assosiasies tussen dieetinnames,

antropometrie en die biologiese gesondheidsveranderlikes te ondersoek. In die THUSA-studie was daar vir ouderdom, vlak van geletterdheid, vlak van verstedeliking en alkoholinnames gekontroleer, terwyl in die Mangaung-studie vir ouderdom, vlak van geletterdheid en alkoholinnames gekontroleer was. Die nutriëntinnames van beide geïnfekteerde en nie-geïnfekteerde vroue bokant en onder die mediaanwaarde sowel as in die eerste en vierde kwartiel van totale serumcholesterol (TC) en albumien is vergelyk om die rol van nutriënte in die TC- en albumienafnames van MIV-geïnfekteerde vroue verder te ondersoek.

RESULTATE EN BESPREKING

Die dieetinnames van die MIV-geïnfekteerde vroue in albei die studies het nie betekenisvol verskil van die nie-geïnfekteerde vroue nie. Totale serumcholesterol, albumien, fibrinogeen en bloeddruk was betekenisvol laer in die MIV-geïnfekteerde vroue in beide die THUSA- en Mangaung-studies.

Die nie-geïnfekteerde THUSA-vroue met 'n laer serumcholesterolvlak as die mediaan het betekenisvolle laer inname van persentasie energie van vet (25.2 teenoor 26.4%, $p \leq 0.027$), persentasie energie van totale proteïene (11.6 teenoor 12.1%, $p \leq 0.000$), dierlike proteïene (25.6 teenoor 27.7g, $p \leq 0.005$) en betekenisvolle hoër inname van plantproteïene (32.2 teenoor 29.4g, $p \leq 0.002$) en vesel (16.9 teenoor 15.8g $p \leq 0.029$) getoon. Daar was geen betekenisvolle verskille in die nutriëntinnames in geïnfekteerde THUSA-vroue met serumcholesterolvlakke bo en onder die mediaan waargeneem nie. In die Mangaung-studie was daar geen betekenisvolle verskille in die nutriëntinname in beide die geïnfekteerde en nie-geïnfekteerde vroue met serumcholesterolvlakke bo en onder die mediaan waargeneem nie.

In die THUSA-studie was die hoër inname van persentasie energie van vet (27.3 teenoor 24.5 %, $p \leq 0.053$) in die geïnfekteerde vroue met hoër albumienvlakke as die mediaan, bykans betekenisvol. In die nie-geïnfekteerde vroue met hoër albumienvlakke was betekenisvolle verskille in persentasie van vet (26.6 teenoor 24.9 %, $p \leq 0.001$), proteïene (12.2 teenoor 11.6 %; $p \leq 0.001$) en koolhidrate (62.8 versus 65.2%; $p \leq 0.000$) waargeneem. Hoër innames in versadigde vetsure (17.7 teenoor 16.1g, $p \leq 0.008$), mono-onversadigde vetsure (19.3 teenoor 17.4g, $p \leq 0.004$) en dierlike proteïene (28.5 teenoor

24.4g, $p \leq 0.000$) was in die groep met hoër albumienvlakke waargeneem. In die Mangaung-studie het die MIV-geïnfekteerde vroue (met albumienvlakke hoër as die mediaan) 'n betekenisvolle hoër inname getoon van energie (13 275 teenoor 11 622 kJ, $p \leq 0.022$), polionversadigde vette (32.3 teenoor 17.3 g, $p \leq 0.036$), dieetcholesterol (412.9 teenoor 344.5 mg, $p \leq 0.043$) en plantproteïene (42.3 teenoor 35.3 g, $p \leq 0.008$). Geen betekenisvolle verskille was in die nie-geïnfekteerde vroue waargeneem nie.

Die verdere analyses wat die dieetinnames in die geïnfekteerde en nie-geïnfekteerde vroue met serumcholesterol en albumienvlakke in die eerste en vierde kwartiele in albei die studies ondersoek het, het aangetoon dat in die THUSA-studie, die nie-geïnfekteerde vroue met laer cholesterolvlakke betekenisvolle laer innames van proteïen (% van totale energie), totale vet (% van totale energie) en vitamien B₁₂, en betekenisvolle hoër innames van totale energie, plantproteïene, totale koolhidrate, persentasie totale energie afkomstig van koolhidrate, vesel, suiker en tiamien gehad. In die geïnfekteerde vroue het die versadigde vet, kalsium en verhouding van polionversadigde tot versadigde vet (P/V verhouding) betekenisvol tussen die vroue met cholesterolvlakke in die eerste en vierde kwartiele verskil. Betekenisvolle hoër innames in riboflaviene was in die nie-geïnfekteerde Mangaung vroue met cholesterolvlakke in die vierde kwartiel waargeneem, terwyl betekenisvolle hoër innames in energie, totale proteïen, dierlike proteïen, totale vet, versadigde vetsure, mono-onversadigde vette, totale koolhidrate, fosfor, chroom en jodium in die geïnfekteerde vroue waargeneem is. Hierdie resultate suggereer dat nutriëntinnames afkomstig van dierlike voedsel in 'n meer 'westerse' dieet, kon beskerm teen nadelige afnames in TC tydens HIV-infeksie. Betekenisvolle verskille was waargeneem in die innames van die nie-geïnfekteerde THUSA-vroue met serumalbumienvlakke in die eerste en vierde kwartiel. Innames van persentasie energie afkomstig van proteïen en vet, dierlike proteïene, totale vet, versadigde vette, mono-onversadigde vette, kalsium, sink, vitamien C en vetverhouding was betekenisvol laer in die vroue met albumienvlakke in die eerste kwartiel. Betekenisvolle hoër koolhidraatinnames was waargeneem in die vroue wat albumienvlakke in die eerste kwartiel gehad het. In die Mangaung-studie was betekenisvolle verskille in die innames van die geïnfekteerde vroue met serumalbumienvlakke in die eerste en vierde kwartiele waargeneem. Innames van totale energie, proteïen, totale vet, mono-onversadigde vette, versadigde vette, koolhidrate, magnesium, sink, chroom, biotien, pantoteensuur en jodium was betekenisvol laer in die

geïnfekteerde vroue met serumalbumienvlakke in die eerste kwartiel. In die nie-geïnfekteerde vroue was betekenisvolle laer innames van kalsium waargeneem in die groep met serumalbumienvlakke in die eerste kwartiel in vergelyking met die vroue in die vierde kwartiel. Hierdie resultate ondersteun die waarneming dat 'n meer 'westerse' dieet kon beskerm teen dalings in albumien tydens MIV-infeksie.

GEVOLGTREKKING

Dit is welbekend dat voeding 'n integrale rol speel in die sorg van persone met MIV/VIGS. Die handhawing van korrekte voeding, gewig en immuunfunksie vertraag progressie van die siekte, verleng die asimptomatiese fase en verbeter die kanse op oorlewing. Hierdie analise stel voor dat die "omsigtige" dieet wat in die algemeen as 'n optimale diet in die voorkoming van nie-oordraagbare siekte beskou word, nie die optimale dieet vir persone met MIV/VIGS is nie. Die oorkoepelende analise stel dus voor dat 'n "westerse" dieet meer voordelig vir asimptomatiese MIV-geïnfekteerde vroue kan wees in vergelyking met 'n omsigtige diet. Omdat hierdie studies nie primêr ontwerp was om die rol van voeding in MIV/VIGS te ondersoek nie, regverdig die rol van 'n hoër energie-, vet- en dierlike proteïeninnames ("westerse" dieet) in asimptomatiese MIV dringende ondersoek.

Trefwoorde: MIV-infeksie, makronutriënte, westerse diet, serumalbumien, totale cholesterol.

LIST OF ABBREVIATIONS

ADA	American Dietetic Association
Alb	Albumin
ALP	Alkaline phosphatase
ALT	Alanine aminotransferase
ANOVA	Analyses of variance
AST	Aspartate aminotransferase
AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
ARV	Antiretrovirals
BMI	Body mass Index
CDC	Centers of Disease Control
Chol	Cholesterol
CI	Confidence interval
DAX	Discrete analyser
DBP	Diastolic blood pressure
DNA	Deoxyribonucleic acid
DRI	Dietary reference intakes
ELISA	Enzyme-linked immunosorbent assay
EDTA	Ethyldimethylacetic acid
FBG	Fibrinogen
GDP	Gross domestic product
HAART	Highly Active Antiretroviral Therapy
HBC	Home based care
HDL	High density lipoprotein
HIV	Human immunodeficiency virus
ILO	International Labour Office
IMF	International Monetary Fund

INP	Integrated Nutrition Programme
IT	Individual therapy
Kgbw	Kilogram body weight
LBM	Lean body mass
LDL	Low density lipoprotein
LD	Lactate dehydrogenase
MCT	Medium chain triglycerides
MRC	Medical Research Council
MS	Metabolic syndrome
MUFAT	Monounsaturated fatty acids
NCD	Non-communicable diseases
NRTI	Nucleoside reverse transcriptase inhibitor
PHC	Public health care
PHN	Public health nutrition
PI	Protein inhibitors
PLWHA	People living with HIV & AIDS
PMTCT	Prevention of mother to child transmission
PPY	Per patient year
PUFAT	Polyunsaturated fatty acids
QFFQ	Quantitative frequency food questionnaire
NCD	Non-communicable diseases
RDA	Recommended Dietary Allowance
RNA	Ribonucleic acid
SA	South Africa
SATFAT	Saturated fatty acids
SBP	Systolic blood pressure
SD	Standard deviation
SE	Standard error
TG	Triglycerides
THUSA	Transition and Health and during Urbanisation of South Africa

TNF	Tumour necrosis factor
TP	Targeted programmes
UL	Upper limit intakes
UNAIDS	The Joint United Nations Programme on HIV/AIDS
US\$	United States dollars
VLDL	Very low density lipoprotein
WHO	World Health Organization
ZAR	South African Rand

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Southern Africa is the epicentre of the worldwide AIDS pandemic. South Africa's epidemic is described as one of the worst in the world, with at least 5.5 million people living with HIV/AIDS (PLWHA). Regretfully, current data show no evidence of a decline and it is estimated that a staggering number of 380 000 people have succumbed to this pandemic in 2005 (UNAIDS, 2006: 3, 6&7). The pandemic is responsible for erasing social and health progress, it is reducing life expectancy by decades, slowing economic growth and deepening poverty (UNAIDS, 2004: 41). HIV infection is a devastating disease affecting not only individuals but the society at large. The current statistics highlight the urgency by which all potential interventions should be applied in order to curb the spread of the pandemic and also, enhance health and quality of life as well as life expectancy of affected individuals.

In developing countries with limited resources, optimal nutrition plays an integral role in the treatment of PLWHA. Maintaining proper nutrition and weight could delay the progression of disease, improve the quality of life and improve survival (Faintuch *et al.*, 2006:685; FAO, 2002:1). However, a downward spiral of inadequate nutritional intake exists in undernourished HIV-infected people, resulting in an inability to maintain weight and lean body mass. Accompanying micronutrient deficiencies and an increased susceptibility to opportunistic infections inevitably leads to accelerated disease progression (DOH, 2003:79). Studies have shown an increased mortality independent of immunodeficiency and viral load in patients with decreased nutritional status (Ockenga *et al.*, 2006:322).

1.2 PROBLEM STATEMENT

Already in the asymptomatic phase of HIV-infection, there are pronounced metabolic and endocrine changes taking place. Many studies have investigated the effect of nutrition on HIV and *visa a versa*. Current studies primarily focus on micronutrients, antioxidants, prevention of mother to child transmission (PMTCT) and highly active antiretroviral therapy (HAART). However, from the literature not many studies are focusing on asymptomatic HIV and more specifically, on the role of macronutrients in this phase of the disease. It is of utmost importance to prolong this phase as far as possible, especially in resource poor countries such as South Africa where antiretroviral therapy (ARV) are costly and not as readily accessible as needed.

The current Department of Health (South Africa) guidelines for PLWHA highlight the importance of good nutrition. They lobby for a more prudent diet with starchy foods being the basis of meals, while the guideline on protein states that meat and dairy products may be eaten daily. This thesis, therefore, investigates whether a more "prudent diet" would be the ideal diet in asymptomatic HIV, against the background of literature describing metabolic and endocrine changes taking place at the early stages of the infection.

1.3 AIMS AND OBJECTIVES OF THE STUDY

The main aim of this thesis was to investigate the role of nutrition during "early" HIV-infection in African women. The differences in biological health outcomes and the possible influences of nutrient intakes on these health variables were examined in two separate groups of HIV-infected and non-infected women. Anthropometric measurements, biochemical variables, markers and risk factors of nutritional status and non-communicable diseases (NCD) including the metabolic syndrome were measured to investigate possible relationships between dietary exposure and these health outcomes and risk factors.

The data reported in this investigation formed part of two cross-sectional studies, namely the THUSA and Mangaung studies, which were done in the North West and Free State provinces respectively. Permission to use data for this separate analysis was obtained from the two convenors of these studies (Prof. H.H. Vorster for the THUSA study and Dr. C. M. Walsh for the Mangaung study).

1.4 STRUCTURE OF THE THESIS

This thesis begins with acknowledgements and abstracts in both English and Afrikaans, followed by a list of abbreviations and tables.

The introductory chapter is followed by Chapter 2, which reviews the literature on nutrition of adults with HIV-infection and also the impact of the pandemic on society at large. The reason why this impact of HIV/AIDS on the economy, the labour force and other societal issues are discussed is to show possible benefits if the health and quality of life of infected people can be influenced by nutrition. The methodology is described in Chapter 3, and Chapter 4 shows the results of dietary exposure and relationships with health outcomes. Chapter 5 is the closing chapter in which the most relevant observations made from the study are discussed. These observations are summarized and recommendations for further research and practice are made.

1.5 THE ROLE OF THE RESEARCHER

Averalda van Graan, Ph.D. candidate and sole author of this thesis was responsible for the selection and organisation of the data as well as the statistical analysis of this investigation.

CHAPTER 2

LITERATURE REVIEW

THE IMPACT OF HIV /AIDS: AFFORDABILITY VERSUS HUMANITY, A DIFFICULT ACT TO BALANCE

2.1 INTRODUCTION

The following statements describe the seriousness of HIV/AIDS for individuals and societies:

- “HIV/AIDS is affecting more people in Eastern and Southern African countries than the fragile health systems of these countries can treat, demoralizing more children than what the educational systems can inspire, creating more orphans than communities can care for, wasting families and threatening food systems. The HIV/AIDS epidemic is increasingly driven by and contributes to factors that also create malnutrition - in particular, poverty, emergencies and inequalities” (WHO, 2005b:1).
- “The raging global AIDS pandemic has become the most devastating health crisis of the last century” (Bos & Postma, 2001:19).
- “It has been described as a new type of global emergency and an unprecedented threat to human development” (UNAIDS, 2004: 7).

2.2 EPIDEMIOLOGY OF HIV/AIDS

At the end of 2005, it was estimated that 33.4 to 46.0 million people were living with HIV worldwide. New infections are estimated at 4.1 million and deaths due to AIDS at a

staggering 2.8 million. Africa remains the epicentre of the pandemic. South Africa's epidemic is described as one of the worst in the world and regrettably data show no evidence of decline (UNAIDS, 2006: 6&7). According to the South African National HIV and Syphilis prevalence survey of the Department of Health, 5.54 million people are living with HIV and the estimated prevalence rate has increased to 30.3% in 2005 from 29.5% the previous year (Department of Health, 2006: 10).

2. 3 AETIOLOGY AND PATHOGENESIS OF HIV/AIDS

- **The basics of Human Immunodeficiency Virus (HIV)**

The Human immunodeficiency virus (HIV) belongs to the subfamily of lentiviruses of the human lymphotropic retrovirus. Retroviruses are distinguished from the other RNA viruses by the possession of the reverse transcriptase enzyme, which enables viral RNA to be transcribed into DNA, allowing incorporation into the host cell genome. It is this interrelationship between HIV and the host immune system that forms the basis of the pathogenesis of the disease (Kumar & Clark, 2002:60).

Although HIV is found in a wide range of body fluids and tissues, the majority of infections are transmitted via semen, cervical secretions and blood. Modes of transmissions include vaginal and anal sexual intercourse, mother-to-child transmission (during birth or breastfeeding), contaminated blood, blood products, organ donations and through the use of contaminated needles, needle stick injuries, intravenous drug misuse and injections (Kumar & Clark, 2002: 131-133).

The infection begins with the attachment of HIV virions to the cell surface of CD4⁺ T lymphocytes mediated by an interaction between the extracellular HIV envelope glycoprotein, gp120, with the chemokine co-receptors CCR5 and CXCR4, which is responsible for HIV entry into cells (Sierra *et al.*, 2005: 235; Kumar & Clark, 2002:133). Glycoprotein 41 binds with cell chemokines causing receptor fusion, the uncoating of viral RNA and production of DNA copies from both RNA templates. The polymerase enzyme from the host cell leads to the formation of double stranded, unintegrated circularized DNA. This virally encoded DNA is then inserted into the host cell genome (integration). Regulatory proteins control the transcription of proviral DNA to viral

mRNA; the virus is re-assembled in the cytoplasm (translation and assembly) and budded out of the host cell (Kumar & Clark, 2002:133).

The major cause for AIDS progression in HIV-1 infected patients is the decline of CD4⁺ T lymphocytes. These cells are the primary targets for HIV and act as the crucial site for the induction of specific humoral and cell-mediated immune responses. Slow and continuous depletion of CD4⁺ T lymphocytes during the course of infection leads to damage of the immune system and, therefore, to an increased vulnerability to opportunistic infections that ultimately lead to death (Sierra, *et al.*, 2005:237).

- **The Stages of HIV infection and progression to AIDS**

HIV/AIDS surveillance is used to monitor temporal, geographical and risk-group trends as well as to estimate the burden of HIV/AIDS-related diseases. Surveillance definitions were introduced in 1982 and a number of classification and staging systems have been proposed of which the CDC (Centers for Disease Control and Prevention) are most widely used. The CDC disease classification system is based on immunological, clinical and virological parameters and is frequently used for clinical purposes (WHO, 2005c:2). This classification combines three categories of CD4⁺ counts with three symptom categories. These are as follows for adults (Table 2.1):

Table 2.1: 1993 Revised classification system for HIV infection in adults and AIDS surveillance case definition (CDC, 1992)

CD4+ T-cell categories		A	B	C
Absolute number	Percentage	Asymptomatic Acute (primary) HIV or PGL	Symptomatic, not A or C conditions	AIDS indicator conditions
≥500 / μL	≥29%	A ₁	B ₁	C ₁
200 – 499 / μL	14-28%	A ₂	B ₂	C ₂
<200 / μL	<14%	A ₃	B ₃	C ₃

PGL: persistent generalized lymphadenopathy

Aids indicator conditions includes: Bacillary angiomatosis, Candidiasis, Herpes zoster, Idiopathic thrombocytopenic purpura, Cryptosporidiosis, Kaposi's sarcoma, Lymphoma and Pneumocystis carinii pneumonia (CDC, 1992).

2. 4 BURDEN OF HIV

HIV infection is a devastating disease affecting not only individuals but the society at large. The enormity of the problem is clear, looking at global and specifically South African statistics. There is a pressing urgency that all potential interventions should be applied to curb its spread, to enhance health and to improve quality of life as well as life expectancy of the infected persons. In countries with high prevalence of HIV, the epidemic is erasing decades of health, economic and social progress; it is reducing life expectancy by decades, slowing economic growth, deepening poverty and contributing to and increasing chronic food shortages (UNAIDS, 2004: 41). This burden of HIV/AIDS will now be discussed in more detail (sections 2.4.1 – 2.4.5).

2.4.1 LIFE EXPECTANCY

AIDS is one of the leading causes of mortality among adults and has reversed gains in life expectancy and improvements in child mortality in many countries (Epstein, 2004:1). In the absence of drug therapy, the survival rate is estimated at 10 years, which will result in radical changes in the size and structure of the population in many of the world's poorest countries.

Most diseases affect the very young, the old or weak. However, sexually transmitted HIV affects young adults, which has far-reaching socio-economic consequences in countries where mortality rates among adults are high. Households, families and communities are devastated and formal and informal mechanisms of social support are eroded (Epstein, 2004:2).

Life expectancy at birth is one of the most shocking markers of the demographic effect of AIDS mortality. In developing countries life expectancy was chronically low due to high infant mortality. Measures were taken to alleviate the common causes of infant mortality,

which saw life expectancy rates climbing (Epstein, 2004:27; UNAIDS, 2004:42). Unfortunately, due to AIDS, mortality among younger adults and the life expectancy in many Sub-Saharan African countries are now estimated to be cut in half (Epstein, 2004:27).

Countries such as South Africa, Namibia and Botswana, with adult HIV prevalence over 20%, are estimated to have lost 24 – 42 years of life expectancy at birth due to AIDS mortality. These countries would have approached or exceeded life expectancies of 70 years at 2015 in the absence of AIDS, but life expectancy is now projected to be at 35 years in Botswana, 38.5 years in Namibia and 44.5 years in South Africa (Epstein, 2004:27).

As mortality increases among the 15-49 year old group, the population structures of countries with high HIV prevalence are likely to change and the socioeconomic implications are not yet clear. The dramatic rise in adult mortality, however, will have profound and far-reaching effects such as an increase in the demand for cost of social services, decrease in the labour force, increase in orphans and other vulnerable children, and changes in households' composition (Epstein, 2004:31).

2.4.2 PRESSURES ON HOUSEHOLDS

The most devastating and immediate impact of HIV can be seen at household level (Veenstra & Whiteside, 2005: 201). An enormous burden is placed on households due to expenditures for medical care, treatment of opportunistic infections, loss of income, depletion of savings, funeral expenses and care for the infected (Arndt & Lewis, 2000:3; Epstein, 2004: 31; Greener, 2004: 167).

HIV/AIDS affects households' income during the illness of an HIV-infected household member, especially in cases where the infected person's income depends on his or her productivity. In cases where the individual works in the formal private or public sector, provisions for sick leave and disability benefits may mitigate the loss (Greener, 2004: 1710; UNAIDS, 2004:44). If the HIV-infected household member is the breadwinner and becomes ill to the extent that working is no longer possible, the income of the household

is severely affected, especially when they do not have these benefits (ILO: 2004, 11; UNAIDS, 2004:45). Furthermore, these households face additional costs of medical treatment for the infected member when symptoms start to develop and illness becomes more frequent. Further costs include that of a funeral when the ill member dies (Greener, 2004: 1710).

These resulting hardships lead to the selling of assets to cover urgent expenses and the entering of other members of the household to the labour force, which involves withdrawing children from school (UNAIDS, 2004:52; ILO, 2004:11). This switch from school to job is particularly damaging. It compromises future education and has the potential to increase poverty when these children of parents who die of HIV/AIDS are endowed with less "human capital" and receive lower salaries. Furthermore, it leads to a reduction in the potential "human capital" available to the economy as a whole (ILO, 2004:11) and a growing number of AIDS orphans (UNAIDS, 2004: 61).

2.4.3 LABOUR FORCE

According to the International Labour Office (2004:5), the projected number of HIV-infected, working-age men and women in the Sub-Saharan region is estimated at 25 million of which 3.7 million are living in South Africa (ILO, 2004:4).

As HIV/AIDS often affects people in their prime productive and reproductive years, HIV/AIDS-induced mortality and morbidity can result in significant economic losses and the reduction in numbers of the labour force (Liu, Guo & Smith, 2004: 1182; Epstein, 2004: 36). It means that fewer people live to an advanced age, reducing the pool of more experienced individuals who would qualify for leading positions in society and the economy (Ciccio, 2004: 55; Epstein, 2004: 36). This will affect the quality of the workforce when these workers are replaced by younger less-experienced men and women (UNAIDS, 2004:56).

HIV/AIDS impacts on businesses of all sizes, depending on the prevalence of HIV amongst the workforce and the level of types of skills of those that are infected. When the most productive workers in the labour force are those who are better educated and

thus more difficult to replace, the impact on a business can be severe. When it is high-level managers who are infected, the strategic management of such a business may be affected. When it is key management staff that is lost to AIDS, the competitiveness of such a business can diminish which can lead to the failure of the business (ILO, 2004: 12).

2.4.4 ECONOMY

The adverse impact of HIV/AIDS on the economy is becoming increasingly evident. Growth rates are slowing down in countries with high prevalent rates and manpower losses are mounting (Husain & Badcock-Walters, 2002:84). Through its impact on mortality and morbidity, changes in demographics occur. HIV/AIDS affects all levels of an economy and society. It affects individuals, households, small and large businesses as well as different levels and activities of government (Haacker, 2004: 64).

HIV affects income and levels of expenditure. It erodes the savings capacity of households, formal and informal enterprises as well as that of the government. Over time the rates of savings are reduced which lead to diminished investment and the slowing of growth. This places constraints on employment which lead to overall impoverishment (ILO, 2004:10).

Estimates of the economic impact of HIV/AIDS indicate that the pandemic reduces the average annual growth domestic product (GDP) growth rate by 0.9% per annum, and in the case of the most affected countries in the African region, a decline of 1.1 to 2% (ILO, 2004:13; UNAIDS 2004:41). These studies, however, do not account for the significant cost involved in replacing workers, the impact on networks, organisations and institutions, which weaken the transfer of information and expertise. When these factors are taken into account the losses in economic growth due to HIV/AIDS are substantially more and the effects thus more serious than conventional estimates of impact on GDP can convey (ILO, 2004: 13).

Its broad economic impact makes HIV/AIDS become a major issue for macroeconomic analysis and policies to prevent the spread of the virus. It has direct implications for key

economic indicators such as economic growth, income per capita and economic development in general (Haacker, 2004: 41).

There is consensus in the literature that HIV/AIDS has a sizable economic cost, primarily due to the increase in welfare benefits, lost productivity, increased absenteeism, loss of experience and vital skills, higher labour turnover rates, higher recruitment and training cost and higher employee benefit costs (Haacker, 2004, 58; Liu, Guo & Smith, 2004: 1181).

- **Personnel Expenses/Benefits**

For most companies the important costs associated with HIV/AIDS are monetary, including the medical and death-related benefits, which add to the personnel expenses. It includes medical care cost, such as health care insurance, preventative measures, screening, sick leave, funeral cost, disability pensions as well as payment to health care professionals on the payroll and death-related benefits paid to surviving spouses and dependent children (Arndt & Lewis, 2000:3; ILO, 2004:17; Haacker, 2004: 53). The largest costs to companies are disability pensions and pensions to surviving dependents, followed by productivity losses, sick leave and absenteeism. In the absence of successful prevention measures to contain the number of new infections, company profits, salary levels and benefit levels will not be sustainable (Haacker, 2004: 52).

Companies also invest in job-specific training to enhance skills of employees, but with the increased mortality the returns of such investment will decline, which could lead to companies reducing the investment in training (Haacker, 2004:57).

- **Personnel turnover**

The core of the problem for employers is the loss of skilled workers with job-specific competence, organisational experience and collective acquired knowledge due to HIV/AIDS (ILO, 2004; 18).

HIV affects the availability of employees with specific qualifications as well as the returns of companies when investing in skills development. An employer may be able to replace a worker who has died but it leads to shrinkage in the aggregate supply of labour. This

results in the rising in wages for workers with specific skills or the replacing of workers with less skills and experience (Haacker, 2004:56).

It also has indirect implications for the cost of recruitment to replace employees lost to AIDS and to train their successors. This leads not only to direct financial cost but accrues indirect costs such as managerial time devoted to hiring and training new staff as well as the loss in productivity related to these tasks (Haacker, 2004: 51).

- **Productivity**

Long before the last stage of illness and the death of an employee, the infected individual's health becomes impaired, leading to increased need for medical attention and home care. This rise in morbidity results in an increase in sick leave and absenteeism as well as declines in productivity on the job. The impact of decreased productivity will depend on the basis personnel are employed. When employees receive fixed salaries, companies bear most of the cost, whereas temporary workers bear the cost when their productivity declines (Epstein, 2004:37; Haacker, 2004: 51; ILO, 2004:11).

Productivity is furthermore dampened by the loss of technical and experienced workers when staff turnover demands that less skilled workers be taken on (ILO, 2004:11). Workers usually need time to adjust to a new work environment to become fully productive and the time needed is estimated at 5 days for unskilled workers, 20 days for skilled workers and 60 days for managers (Haacker, 2004: 57).

- **Investment**

Losses in productivity and reduced production lead to a decline in profitability and to downsizing with subsequent job losses. This results in reduced tax revenues and investment capital, creating conditions that act as disincentives for foreign investment (ILO, 2004: 12).

As expenditure is shifted toward HIV/AIDS-related activities, aggregate savings are likely to decline, leaving fewer resources available for investment and at the same time increased production costs and deteriorating economic prospects make investment in

the countries most affected by the pandemic less attractive (Haacker, 2004: 42; Rosen *et al.*, 2004).

These significant economic impacts can be modified through prevention and treatment interventions. The merits of a holistic approach to tackling the HIV/AIDS epidemic have been acknowledged and this is likely to be successful in reducing the economic impact in the long term (Veenstra & Whiteside, 2005: 203).

2.4.5 IMPACT ON THE HEALTH SECTOR

The effective functioning of the public health sector is increasingly threatened by the HIV pandemic (ILO: 2004, 20) as the demands of HIV/AIDS increase and the capacity for service delivery is reduced (Veenstra & Whiteside, 2005: 206). With the spread of the epidemic the demands on the public health service continuous to rise sharply, while health personnel are also affected by HIV/AIDS.

HIV-related public hospital admissions in South Africa amounted to 24% in the year 2000 (Badri *et al.*, 2006:49). Reported occupancy rates of hospital beds by HIV/AIDS patient's are estimated to be between 30 and 70 percent, indicating that HIV/AIDS absorbs much of the existing capacities of health services at this stage, which furthermore increases the workload (Cicció, 2004: 56; Haacker, 2004:63) . Even with the fall in antiretroviral therapy (ART), prices and international support to assist low-income countries, for many of these countries meeting the potential demands in expanding health facilities remains a serious challenge (Haacker, 2004:63) as the health sectors are experiencing enormous financial, organisational and personnel pressure (ILO: 2004, 20).

In those countries most affected by HIV/AIDS, the burden is not only due to the actual care of ill persons who are infected but comprises additional responsibilities such as surveillance, blood safety management and monitoring, voluntary counseling and testing, delivery and monitoring of treatment, planning and management of prevention strategies, as well as the increased mortality and morbidity of workers within the health sector (ILO: 2004, 20).

The most critical pressure point in the system is among the health care workers themselves in the manifestation of numbers of workers with HIV/AIDS, the working conditions, workload, additional training, as well as the fear and risk of becoming infected. Stressors that health care workers face include, inadequate HIV/AIDS specific knowledge and skills, heavy patient loads, high turnover of staff, generalised staff shortages, low salaries and insufficient medicines and medical supplies, which lead to low morale and stress-related illnesses (Cicció, 2004:56; ILO, 2004:20-22). It furthermore contributes to increased absenteeism and vacancies, increasing the workload of remaining staff causing emotional exhaustion and burnout (Cicció, 2004:56; UNAIDS, 2004:54).

Appropriate planning is, therefore, of utmost importance to maintain and strengthen the health systems in the HIV context (Veenstra & Whiteside, 2005: 206), which needs political and social will, commitment and drive.

2.5 THE BURDEN OF TREATMENT OF INFECTED PEOPLE

The lack of antiretroviral therapy is seen as a global health emergency (WHO, 2003b:6). Many have no access to treatment which can restore health and quality of life through maximal and durable suppression of viral load, restoration and/or preservation of immunological function and reduction of HIV-related morbidity and mortality (Liu, Guo & Smith, 2004: 1182). Mortality rates for 15-49 year olds living with HIV in low and middle-income countries are 20 times greater than the death rates of those people living with HIV in industrialized countries, reflecting the stark differences due to access to anti-retroviral therapy (UNAIDS, 2004:41).

A comprehensive, extraordinary multi-sectoral response in affected countries is, therefore, needed to tackle the devastating epidemic adequately (WHO, 2003b:6; UNAIDS, 2004: 41). In response, in 2003, the World Health Organisation (WHO) developed the 3 by 5 initiative, which was a detailed strategy to get 3 million people treated by 2005 (WHO, 2003b: 6). According to the WHO (2005e:13), progress has been made, as the current total coverage is estimated to be 15% (700 000), compared to a

previously estimated percentage of 7% (400 000) in 2003. The coverage in Sub-Saharan Africa has increased from 2% (100 000) to 11% (310 000) from 2003 to June 2005.

Cost estimates for this initiative, according to WHO/UNAIDS for the year 2004 to 2005, could range between US\$ 4.5 and 5.5 billion, depending on coverage percentage and the cost of medication. These costs represent the total resources needed to reach the targets set in the 3 by 5 initiative, including patient costs such as testing, counseling, condom distribution, antiretroviral medication, treatment and prophylaxis of opportunistic infections, palliative care as well as laboratory tests. Furthermore, it includes programme costs such as training of health care personnel and lay volunteers, supervision, monitoring, capacity increasing activities for drug distribution, recruitment of personnel, universal precautions, post exposure prophylaxis and purchasing of CD4 measuring equipment. ARV drugs (35%), treatment of opportunistic infections (20%) and palliative care (14%) account for the largest percentages of these costs (WHO/UNAIDS, 2003:2).

South African treatment costs, at different coverage percentages from 20 to 100%, range from 6.6 to 7.9 billion Rand via phased implementation for 2005 up to 8.2 to 16.9 billion in 2010. An additional 550 to 570 million Rand per year will be needed for the rest of the decade for a comprehensive prevention programme (Alcorn, 2003).

However, large savings were brought about through the reduction in prices of triple ART which has dropped to US\$ 132 (Alcorn, 2003) or US\$ 181 (Badri *et al.*, 2006:48) per patient per year, which amounts to a reduction of 50% lower than previous prices offered (Alcorn, 2003). In addition, agreements have been reached with leading medical technology companies on reduction in the price of HIV/AIDS laboratory tests, which will cut costs of key tests by up to 80%, which could mean savings of up to \$300 million in South Africa (Clinton Foundation Press Release, 2004). These two agreements will reduce the current treatment cost of testing and treatment from US\$800 to approximately US\$250 per patient per year.

Expenditure on prevention and treatment can be interpreted as a form of investment. When health services are extended, it does incur additional cost, but the expenditures may produce savings when the number of employees contracting the virus is reduced and the morbidity and mortality for those who do become infected is delayed (Haacker,

2004:55). There is evidence of substantial direct cost savings because of the reduced number of hospitalizations and opportunistic infections as well as indirect costs such as productivity losses associated with morbidity due to ARV therapy (Cicció, 2004:58).

2.6 METABOLIC AND ENDOCRINE ABNORMALITIES DURING HIV INFECTION

ARV therapy is associated with changes in the metabolism and endocrine function, the primary HIV infection itself, as well as the coinciding secondary opportunistic infections. These changes should guide and influence the nutritional management of people living with HIV/AIDS.

2.6.1 CHANGES IN ENERGY METABOLISM

Activation of the immune system creates an increased demand for energy and for biosynthesis of functional molecules to respond to the infection. The body's reserves may be mobilized during infections altering whole body metabolism which affects nutrient status and body composition (Calder, 2005).

The causes of weight loss and wasting of HIV infected persons are multi-factorial. The major contributing factors include poor food intake, malabsorption, increased utilization or excretion, metabolic irregularities, hypogonadism, uncontrolled opportunistic infection, excessive cytokine production, lack of physical activity, side effects of drug therapies (Faintuch *et al.*, 2006:684; Fenton & Silverman, 2000:899; Gloeckner & Kaisth, 1997:128; Grinspoon & Mulligan, 2003:S69), socioeconomic status and access to care (Green, 1995: 198; Mangili *et al.*, 2006:838).

The major causes of inadequate intake include anorexia secondary to medication, depression, infection, nausea, vomiting, diarrhoea, dyspnea, fatigue, neurological disease (Fenton & Silverman, 2000:1044), taste disturbances, early satiety and dysphagia (Paton *et al.*, 2005:329). Malabsorption occurs throughout the disease process and could be due to villous atrophy, specific enzyme deficiencies in the

intestinal mucosa, intestinal cell maturation defects, the effect of opportunistic infections, altered intestinal transit, increased gut permeability, autonomic neuropathy and gastrointestinal pathogens (ADA, 2004: 1427).

Studies in adults show that HIV-infected adults have greater energy needs than uninfected adults. In asymptomatic HIV-infected adults the resting energy needs increase by 10%. In cases of more advanced disease and at the time of secondary infections the energy needs could be increased by 20 to 30% (Paton *et al.*, 2005:239; WHO, 2005b: 4). Others recommend that requirements do not differ from other patient groups (Ockenga *et al.*, 2006: 326). Total energy expenditure is reduced in the HIV-infected adults (Heijligenberg *et al.*, 1997:1324) and could be due to decreased activity levels as fatigue and lethargy are common symptoms in HIV infection. It could be because of physical correlates of the decreased voluntary energy expenditure (Kotler, 1999).

In asymptomatic HIV infection, energy intake appears to be normal or increased by 10 - 15% (Crenn *et al.*, 2004:2304) and could be in attempt to compensate for occult malabsorption. Energy intake varies much more in later stages of HIV disease, depending on the presence or absence of disease complications and secondary infections (Paton *et al.*, 2005:328 & 329). Despite increased proinflammatory cytokines, hypermetabolism and poor energy balance without fever or opportunistic infections, HIV-infected patients may compensate for the deficits for long periods by means of hyperphagia (Faintuch *et al.*, 2006:685). Maintaining adequate intake is, therefore, important in the management of HIV (Macallan, 2001:37), and energy-dense ready-to-use food (Sadler *et al.*, 2006:6), oral supplements, tube feeding (Paton *et al.*, 2005:330) and drug therapy could be used in the treatment of anorexia (Sellmeyer & Grunfeld, 1996: 527).

2.6.2 CHANGES IN PROTEIN METABOLISM

Muscle wasting is a serious clinical problem in HIV infection. Loss of metabolically active lean tissue is associated with increased mortality, accelerated disease progression, loss of muscle protein mass and impairment of strength and functional status (Grinspoon &

Mulligan, 2003:S69). Depletion of muscle mass and body cell mass may occur relatively early in the course of the disease (Faintuch *et al.*, 2006:684).

The effect of HIV infection on protein metabolism, turnover and requirements is unclear. Studies have had varied outcomes, some reported increased protein turnover rates in HIV-infected patients (Crenn *et al.*, 2004:2304 & Macallan, 2001: 37), some reduced protein turnover (Paton *et al.*, 2005:329), while others reported normal protein turnovers (Macallan *et al.*, 1995: 818). These differences could be attributed to the different metabolic situations that occur in the stages of HIV-infection and cycles of opportunistic infections (Faintuch *et al.*, 2006:688). The increase in protein turnover could be the result of the increased resting metabolic rate (RMR) (Crenn *et al.*, 2004:2301-2303). There are indications that in HIV-infection in cases of decreased energy intake, protein stores are more readily catabolized than fat stores (Sellmeyer & Grunfeld, 1996:527; Kotler, 1999). Studies furthermore indicate that increased intake predominately produced increased body fat and little increase in lean body mass (Sellmeyer & Grunfeld, 1996:527; Macallan, 2001:37).

The importance of lean body mass (LBM) in prognostic outcome has been reported in many studies (Macallan, 2001:37). Thus, the aim of treatment is to increase lean body mass to improve quality of life and thereby improve physical functioning and increase survival (Paton *et al.*, 2005:330). The prevention or restoration of lean tissue is the rationale behind the use of therapies such as growth hormone (Macallan, 2001:37), and anabolic steroids (Sellmeyer & Grunfeld, 1996:527). Adverse effects have been recorded in some of these studies. The long term effects of use are not yet known. The fact that all the studies were conducted in patients before the introduction of highly active antiretroviral therapy (HAART), the efficacy of anabolic steroids in conjunction with modern drugs needs to be investigated (Ockenga *et al.*, 2006: 325).

2.6.3 CHANGES IN LIPID METABOLISM

Various changes in fat metabolism have been documented. There is evidence of increased lipid oxidation, increased fasting triglyceride levels, decreased triglyceride clearance, decreased lipoprotein lipase activity and increased hepatic lipogenesis.

These changes are thought to be the result of increased cytokine activity related to HIV-infection (Paton *et al.*, 2005:329; Sellmeyer & Grunfield, 1996:526).

Earlier studies before HAART showed markedly elevated triglycerides levels and lower total cholesterol levels in patients with advanced HIV disease. Lower high-density lipoprotein (HDL) cholesterol was observed in the early stages of infection and seemed to remain low as the disease progresses (Mulligan, 2003:66). Plasma cholesterol and low-density lipoprotein (LDL) are also decreased in both asymptomatic HIV infection and AIDS. The elevation in triglycerides appears to be due to an increased level of very low density lipoproteins (VLDL) (Sellmeyer & Grunfield, 1996:526). The secretion of tumour necrosis factor (TNF) is enhanced in HIV-infected patients and may underpin changes such as cytokine cascade activation, inflammatory status, acute-phase response, fever, lethargy, and wasting. Hypertriglyceridemia and fatty acid aberrations have been attributed to the inhibition of the activity of lipoprotein lipase due to TNF and some interleukins (Faintuch *et al.*, 2006:687). Increases in triglycerides, total cholesterol, low-density lipoprotein (LDL) and very low-density lipoprotein and decreases in HDL have been associated with protease inhibitors (Calza *et al.*, 2003:89; Mulligan, 2003:66; Wanke *et al.*, 2002:250).

The most prominent changes in metabolism and some fat-distribution abnormalities are more likely to occur in patients receiving HAART (Smith, 2002:S123). Body shape changes and increases of central obesity have been reported in patients with HIV (McDermott *et al.*, 2001:679; Kotler, 1999; Wanke *et al.*, 2002: 250). Changes include subcutaneous fat atrophy and visceral fat accumulation in the abdomen, dorsocervical, and supraclavical regions (buffalo hump) as well as breast enlargement and lipoma (Abourjaily & Small, 2000: 237; Wanke *et al.*, 2002:248 & 250).

Suggested approaches to the management of HIV-associated lipodystrophy include a first-line approach of diet and exercise therapy (Hadigan, 2003:S101), insulin-sensitizing and lipid-altering agents, switching ART, cosmetic surgery, anabolic steroids, growth hormone and addressing life style changes like cessation of smoking and reducing alcohol intake (Calza *et al.*, 2003: 93; Calza *et al.*, 2004: 12; Macallan, 2001:40; Wanke *et al.*, 2002:252). Recommended dietary modifications report a diet low in saturated fat and high dietary fibre (Hadigan, 2003:S103). Drug therapy for dyslipidaemia in HIV-

infected persons receiving HAART could be problematic due to possible drug interactions, toxicity, intolerance and decreased patient adherence to multiple drug regimes (Calza *et al.*, 2003:94).

2.6.4 CHANGES IN CARBOHYDRATE METABOLISM

Earlier studies showed no evidence of insulin resistance or glucose intolerance in HIV. However, more recent post-HAART studies seem to indicate suppressed insulin-stimulated glucose uptake, insulin resistance, hyperglycaemia (Mulligan, 2003:68 - 69), and a rise of diabetes in patients infected with HIV (Calza *et al.*, 2003: 91). In symptomatic HIV-infected men higher rates of insulin clearance and increased sensitivity of peripheral tissues to insulin were seen (Melchior, 1999:868; Sellmeyer & Grunfield, 1996:526). Recent studies showed that with patients' not receiving HIV treatment, it appears that insulin sensitivity and rates of insulin clearance are increased (Paton *et al.*, 2005:329).

Results of studies on the role of protein inhibitors (PI) affecting glucose homeostasis vary between the directly affecting effect (Wanke *et al.*, 2002:250) and still being unclear (Mulligan, 2003:68-69). Appropriate treatment of altered metabolism of carbohydrate includes dietary intervention depending on individual BMI and lipid alterations, a physical exercise programme, the use of insulin sensitising drugs and, where the therapeutic goals are not met, the use of insulin therapy similar to other diabetic patients (Gomez-Candela *et al.*, 2002).

2.6.5 LACTIC ACIDOSIS

Lactic acidosis is a potentially fatal condition and is often accompanied by rapid weight loss, abdominal pain and fatigue (Grinspoon & Mulligan, 2003: S70). This condition has been described in HIV-infected individuals receiving nucleoside reverse transcriptase inhibitor (NRTI) therapy. The clinical presentation of lactic acidosis is typically non-specific and often begins with symptoms like nausea and vomiting and abdominal pain

(Paton *et al.*, 2005:334), but can progress to serious conditions such as liver damage (Wanke *et al.*, 2002:250), dyspnea and cardiac arrhythmia that could lead to death. Laboratory abnormalities may include elevated serum lactate, widening of anion gap, and elevated levels of hepatic transaminases and creatine kinase (Smith, 2002:S125). Management of lactic acidosis includes the discontinuation of ART, supportive care and the correction of acidosis. Other interventions which have not been proven may include the use of coenzyme Q10, riboflavin, L-carnitine (Smith, 2002:S125), riboflavin, thiamine and vitamin C (Paton *et al.*, 2005:334).

2.6.6 ENDOCRINE AND BONE ABNORMALITIES

Many alterations in endocrine function have been reported in HIV/AIDS, which may result from opportunistic infections, neoplasms or adverse effects of medications (Sellmeyer & Grunfield, 1996).

Insulin resistance has been mentioned before, which could lead to the development of type 2 diabetes mellitus in patients receiving HAART. Other abnormal hormone profiles that are reported include increased plasma leptin concentrations (Pinzone *et al.*, 2005: RC1; Yarasheski, 1997:303), alterations in hypophyseal-pituitary-adrenal axis activity, hypogonadism, hypertension, hypocortisolaemia and loss of the cortisol normal diurnal periodicity, hypotestosteronaemia and thyroid dysfunction including hypothyroidism or thyroiditis and thyrotoxicosis (Calza *et al.*, 2003:90; Kotler, 1999). At present there is not sufficient evidence to support nutritional therapeutic treatment.

HIV-infected individuals may experience a progressive loss of bone mineral density leading to a lower bone mineral density expected for their age. This could lead to osteopenia or osteoporosis. The causes are still unclear. They may have multiple risk factors including female gender, age, history of weight loss, low body mass index, steroid use, use of nucleoside reverse transcriptase inhibitor, and smoking (ADA, 2004: 1433; Fausto *et al.*, 2006: 893). McDermott *et al.* (2005:1662) investigated the use of HAART in body composition and found HAART use with zidovudine associated with bone loss and evident differences in bone mineral content in men using HAART

(McDermott *et al.*, 2001:682). Contradictory to these findings, Fausto *et al.* (2006:895 & 896), report no significant differences between HAART-treated and naïve patients.

Treatment is based on reducing the modifiable risk factors and monitoring bone density. Risk factors could be addressed by maintaining an optimal weight and preventing rapid weight loss, reducing or discontinuing smoking, alcohol and caffeine consumption, reducing or balancing the consumption of foods and beverages high in phosphoric acid with protein rich foods, adjusting HAART to minimize side-effects, engaging in regular weight-bearing exercise and eating calcium and vitamin D rich foods (ADA, 2004:1433).

2.7 NUTRITION AND HIV/AIDS

Foods, nutrients, phytochemicals and herbs and spices cannot cure HIV/AIDS and cannot replace ART. However, in developing countries with limited resources, optimal nutrition plays a key role in the treatment of PLWHA. Good nutrition can assist in maintaining and improving the nutritional status of a person with HIV/AIDS, delay the progression of the disease and thus improve the quality of life (FAO, 2002:1).

Nutritional management is an integral part of the care for people living with HIV/AIDS (Nerad *et al.*, 2003:S52) and it has been well documented that HIV and nutrition are inextricably interrelated (FANTA, 2001). HIV progressively weakens the immune system and malnutrition increases the susceptibility to infections (WHO, 2005a). Therefore, HIV-infected patients may be at nutritional risk at any point in the duration of the illness (Nerad *et al.*, 2003:S52). A downward spiral of inadequate nutritional intake exists in undernourished HIV-infected people. They have an inability to maintain weight and lean body mass, have accompanying micronutrient deficiencies and an increased susceptibility to opportunistic infection, leading to accelerated disease progression (DOH, 2003:79).

Although the optimum diet for PLWHA is not clear, it is generally thought that a good and balanced diet that provides the full range of essential nutrients is important to the health of people infected with HIV. It can assist to bolster the immune system, boost energy

levels and maintain body weight and well-being (WHOa, 2005). Decreased nutritional status in HIV-infected patients is associated with increased mortality, independently of immunodeficiency and viral load (Ockenga *et al.*, 2006:322). The relationship between HIV/AIDS and malnutrition presents a vicious cycle of immune dysfunction, infectious disease and malnutrition (Piwoz & Preble, 2000:8). Nutrition interventions can increase quality of life, assist in symptom management, support medication therapy and improve resistance against infections and complications (ADA, 2004:1434).

2.7.1 NUTRIENT REQUIREMENTS IN HAART-NAÏVE INDIVIDUALS

2.7.1.1 MACRONUTRIENTS

Adequate energy, protein and micronutrient intakes are essential for the maintenance and restoration of malnutrition-related immune dysfunction (ADA, 2004:1426). The present recommendations regarding macronutrient intakes will be briefly reviewed, after which the potential role of micronutrients will receive attention.

- Protein

A WHO consultation on nutrition and HIV/AIDS reports that there is no clear evidence to support an increased protein intake over and above the required 12 – 15% of total energy intake in a balanced diet (WHO, 2005b: 4). Other recommendations include those of Ockenga *et al.* (2006:326) who recommends a target for protein intake at 1.2g/kgbw/day in stable phases of HIV disease, an increase to 1.5g/kgbw/day during acute illness, 1.0 – 1.4g/kg for maintenance and 1.5 – 2.0 g/kg for repletion. Protein restriction is indicated only in persons with severe renal or hepatic disease (Fenton & Silverman, 2004: 1049).

- Fat

No evidence exists that total fat needs are increased beyond normal requirements, due to HIV-infection (WHO, 2003a). In individuals with malabsorption and diarrhoea, the use of low-fat diets could assist in the management of the symptoms. The use of more readily absorbed medium-chain triglycerides (MCT) is considered to be better than long-

chain triglycerides in reducing abdominal symptoms and number of stools. In cases of dyslipidemia, guidelines for lipid restriction should be followed (Fenton & Silverman, 2004: 1049). The THUSA study (Oosthuizen *et al.*, 2006) reported a positive correlation between PUFA-intake and raised liver enzymes in asymptomatic infected men and women. The reasons are not clear, but it was suggested that oxidation of the polyunsaturated fatty acids may be detrimental to infected persons.

- Fluids and electrolytes

Fluid needs are similar to that of the general population and could be calculated to be 30 – 35 ml/kg per day for adults. Additional fluid and the replacement of electrolytes are needed in cases of vomiting, diarrhoea, night sweats and fever.

2.7.1.2 MICRONUTRIENTS

Several nutrition deficiencies are associated with impaired immune function and are, therefore, investigated as potential role players in HIV/AIDS (Woods & Gorbach, 1999:99). Evidence is particularly strong in favour of antioxidants such as selenium, zinc, vitamin A (Faintuch *et al.*, 2006:686; Semba *et al.*, 1996:916), vitamin E, vitamin C, and carotenoids (Allard *et al.*, 1998a:143).

It has been well established that some micronutrients play essential roles in immune function (Green, 1995:206; Semba & Tang, 1999:185) and that marginal-to-deficient vitamin and mineral status are associated with adverse outcomes (Nerad *et al.*, 2003:S53). The most widely documented nutrients documented to play a role include: vitamins A, C, E, thiamine, riboflavin, B₆, B₁₂, folic acid, zinc, iron (Tang *et al.*, 1996:1244) and selenium (Baum *et al.*, 2000:S69). In vitamin A deficiency cellular immunity and lysozyme activity may be disturbed (Tomkins & Watson, 1989). Vitamin A plays a central role in normal cell differentiation and cell recognition (Tang *et al.*, 2005:848), lymphocyte proliferation responses, circulating CD4⁺ T-cells, antibody responses, the maintenance of mucosal epithelia (Semba *et al.*, 1996:916) and is a potent antioxidant (Garland & Fawzi, 1999:1261). Vitamin E is the most important lipid-

soluble antioxidant, protects against unsaturated phospholipids from oxidative degradation and is an important component of cellular antioxidant defence system (Tang *et al.*, 2005:848). Vitamin B6 has a direct effect on the immune system through its role in protein and nucleic acid synthesis and a deficiency restricts proliferation of lymphocytes, while vitamin C can function as both an intracellular and extracellular antioxidant (Garland & Fawzi, 1999:1264) and has a positive effect on host defence (Field *et al.*, 2002:22).

Selenium has a major function as part of glutathione peroxidase, prevents oxidative damage (Tang *et al.*, 2005:848) and has the ability to enhance the clonal expansion of immunocompetent cells (Field *et al.*, 2002:23). Zinc plays a role in the growth, development and function of neutrophils, macrophages, natural killer cells, and B and T-lymphocytes, and functions as an antioxidant (Shankar & Prasad, 1998:447S). Deficiency, therefore, could be associated with impairment in cellular immunity (Tomkins & Watson, 1989), which leads to reduced lymphocyte counts and T-lymphocyte killer activities, loss of T-lymphocyte function, and depressed humoral and cell-mediated immunity (Tang *et al.*, 2005:848). The antioxidants have received much attention due to the fact that HIV infection is thought to lead to increased oxidative stress, which could in turn lead to faster progression of the disease (Garland & Fawzi, 1999:1259). Iron deficiency could lead to the reduction of cellular immunity and bactericidal activity (Tomkins & Watson, 1989).

Micronutrient deficiencies are common in HIV-infected people and in cases of diet inadequacy, the deficiency is more pronounced in individuals with advanced HIV disease (Irlam *et al.*, 2005:2). Several observational studies have reported faster disease progression and mortality due to micronutrient deficiencies (Austin *et al.*, 2006:1267; Jiamton *et al.*, 2003:2462; Semba & Tang, 1999:181&182; Tang *et al.*, 1997a:613; Tang *et al.*, 1997b:345), while in other cases higher intakes are associated with delayed disease progression and survival (Austin *et al.*, 2006:1274; Fawzi *et al.*, 2004:23; Tang *et al.*, 1996:1247).

Semba and Tang (1999:182) describe the relationship between micronutrient deficiencies and HIV to be a vicious cycle whereby insufficient intake, malabsorption and diarrhoea, impaired storage and altered metabolism lead to micronutrient deficiencies

and immunosuppression. This then relates to increased HIV replication, progression of disease and increased morbidity. The impaired immune function which results from a lack of essential micronutrients, could contribute to the depletion and dysfunction of CD4⁺ cells as well as increasing host susceptibility to other infections, which in turn increases viral replication and quickens disease progression (Friis, 2006:1850). Other possible reasons given for disease progression are, increased oxidative stress enhanced viral replication and reduction in circulating T-lymphocytes (Allard *et al.*, 1998b:1653; Friis, 2006:1850; Jiamton *et al.*, 2003:2462). Oxidative stress could promote HIV gene activation and viral replication (Baum *et al.*, 2000:S69), where the reactive oxygen intermediates cause the release of necrosis factor-kappa B (NF- κ B) which is involved in the transcription of HIV-1 (Semba & Tang, 1999:185).

Several studies have documented lower plasma levels of many vitamins and minerals in HIV-infected individuals. Micronutrients that have been shown to have low plasma levels include vitamin A, C, E and B₁₂, iron, selenium and zinc (Allard *et al.*, 1998a:143; Baum *et al.*, 2000:S69; Fawzi *et al.*, 2005b:938; Langi *et al.*, 2003:595; Moyle, 2002:13; Semba *et al.*, 1996:920; Semba *et al.*, 2001:496; Stephensen *et al.*, 2006: 870; Tang *et al.*, 1997(a):613; Tang *et al.*, 1997(b): 345; Visser *et al.*, 2003:480).

Semba *et al.* (1996: 919) suggest vitamin A deficiency to be associated with T-cell subpopulation abnormalities and Langi *et al.* (2003:595) reports vitamin A deficiency to be associated with a significantly elevated risk of death. Studies by Tang *et al.* (1997a:613) report no relationship between retinol and disease progression in vitamin A-replete subjects and slower disease progression with higher vitamin E serum levels. Faster disease progression with low serum levels of vitamin B₁₂ were reported by Singhal and Austin (2002: 63) and Tang *et al.* (1997b:345). Plasma α -tocopherol concentrations were not depressed and no association was found with HIV infection in a study by Stephensen *et al.* (2006:874 & 876). Visser *et al.* (2003:475) reported weak positive associations between CD4⁺ lymphocyte count and plasma levels of retinol and zinc, but no significant association between low retinol and zinc levels and low CD4⁺ counts.

Studies on zinc have provided conflicting results on the role of zinc status in HIV disease progression (Kupka & Fawzi, 2002:69). Walter *et al.* (1990:1597) reported normal serum

zinc levels, while several other studies showed lower serum zinc levels (Beach *et al.*, 1992:1552; Graham *et al.*, 1991: 976; Libanore *et al.*, 1987). Tang *et al.* 1996:1247 & 1253 reported a protective effect at lower intake levels, but adverse outcomes at higher intakes. The evidence from studies is mixed but it appears that low blood zinc levels are a common manifestation in HIV disease and may correlate with the stage of disease (Kupka & Fawzi, 2002:70).

Studies on iron have had mixed outcomes. Gordeuk *et al.* (2006:739), Jacobus (1996), and Salmon–Ceron *et al.* (1995) have raised the possibility that high iron status could adversely influence the outcome of HIV-infection, while Semba *et al.* (2001:496) reported that iron status was not related to markers of HIV disease severity. Salomé and Grotto (2002:365) found lower CD4+ T-lymphocyte counts in patients with anemia and O'Brien *et al.* (2005:219) and Belperio and Rhew (2004:27) have shown anaemia to be an independent predictor of mortality and disease progression. Walsh *et al.* (2004:S174) reported HIV status to be associated with lower haematocrit and erythrocyte count values.

It should, however, be kept in mind that the interpretation of serum micronutrient levels should be done with care as many trace elements and vitamins are acute phase reactants. In the presence of acute and chronic infection, nutrient metabolism is altered and shifts between body compartments of certain nutrients occur, which could cloud the interpretation of micronutrient levels in HIV/AIDS (Tang *et al.*, 2005:848). It is, therefore, necessary to distinguish between micronutrient status and serum levels (Friis & Michaelsen, 1998:157). Unfortunately, these observational studies of micronutrient deficiencies in HIV/AIDS subjects have not been sufficiently followed by intervention studies to show benefits of increased micronutrient intakes in these subjects. Studies that have examined micronutrient interventions are discussed in the following section.

2.7.1.3 MICRONUTRIENT SUPPLEMENTS

There is emerging evidence that high-quality therapeutic food of a high energy density and optimal balance of micronutrients may prolong productive life and increase the time

to AIDS-defining illness and death (Sadler *et al.*, 2006:6) Therefore, nutrient supplementation has been suggested in resource-limited settings (ADA, 2004:1431). Daily multivitamin supplements have shown promising results and were found to reduce the risk of HIV disease progression among men and women, as well as in cases of micronutrient deficiencies (Faintuch *et al.*, 2006:686; Fawzi *et al.*, 2005a:938; Kanter *et al.*, 1999:252). Fawzi *et al.* (2004:23) recommend daily multivitamin supplements, as they could provide an important low-cost intervention to adults in the earlier phases of the disease to prolong the time before antiretroviral therapy.

Some supplementation studies have investigated different nutrients across different stages of the disease in relation to different clinical and health outcomes from pregnancy, through to adulthood. This section on micronutrient intervention trials, will focus on adult men and women.

- Multivitamin supplement

The effect of a daily multi-micronutrient supplement was evaluated by Jiamton *et al.* (2003:2467). The impact of a high-dose multiple micronutrient supplementation was examined. It provided 21 different nutrients at dosages higher than the recommended daily allowances. This study reported a reduction in mortality rates in groups which had low CD4+ counts.

A randomized trial done by Fawzi *et al.* (2004:23) showed reductions in relative risk of death, higher CD4+ and CD8+ cell counts as well as lower viral loads due to multivitamin supplementation. Austin *et al.* (2006:1266) has shown that a supplement of multivitamins, trace elements and natural mixed carotenoids increased serum carotene levels and improved survival.

- B-group vitamins, vitamin A and β -carotene

Semba *et al.* (1995:1196) and Tang *et al.* (1996:1247) reported that higher total intakes of thiamine, riboflavin, vitamin B₆ and niacin and the 3rd quartile of β -carotene were

associated with slower progression to AIDS. Total intake of all the B vitamins showed a trend toward increased survival, while vitamin A and β -carotene showed a U-shaped relation between intake and survival, suggesting that excessive intake may diminish the protective effect of intakes at moderate levels of intake. Supplemental use of thiamine and riboflavin at levels 5 or more times the recommended dietary allowances (RDA) were significantly associated with a reduction in mortality, compared to supplementation at lower rates of supplementation. Use of vitamin B₆ at twice the RDA was associated with a significant survival compared to lower rates of supplementation.

- Antioxidants

Allard *et al.* (1998b:1653 & 1658) investigated the use of supplemental antioxidants and reported oxidative stress to be significant higher in HIV-infected individuals. Supplementation of vitamins A, C and E resulted in the reduction of oxidative stress (Jaruga *et al.*, 2002:419). Similar findings were reported by Allard *et al.* (1998a:143) who have shown a trend towards lowering viral load and decreased oxidative stress with antioxidant supplementation.

Some other studies have also shown positive results, but controversy remains. The effect of antioxidant supplementation on viral load and reactive oxygen species reported improved measures of oxidative defence, but no other benefits of a high-dose supplement (Batterham *et al.*, 2001:107).

Kelly *et al.* (1999:494) investigated the effect of vitamin A, C, E and selenium supplementation on diarrhoea-wasting in HIV. They reported that serum levels of vitamins A and E were powerful predictors of early mortality, but that the supplementation did not reduce time with diarrhoea or mortality.

- Single micronutrient interventions

Several single micronutrient studies were done. Beaten *et al.* (2004:1468) studied the effect of vitamin A supplementation on genital shedding of herpes simplex in HIV-1

infected women and found no statistical significant effects. A study by Tang *et al.* (1996:1248) reported a U-shaped relation between vitamin A intake and progression to AIDS and death, while Semba *et al.* (1998:611) showed that there was no influence on viral load. Humphrey *et al.* (1999:44) reported no evidence of clinical or immunologic adverse events after a single high-dose of vitamin A. In a South African study, Kanter *et al.* (1999:252) have shown that daily vitamin B complex supplementation was associated with significant lower risks of disease progression.

The impact of selenium supplementation was investigated by Burbano *et al.* (2002:483) who indicated supplementation to be beneficial to decrease hospitalizations and thus cost of treatment in HIV-infected patients. Similarly, Delmas-Beauvieux *et al.* (1996) reported that selenium supplementation protected against oxidative stress in HIV infection. Fawzi *et al.* (2005b:164) evaluated the effect of zinc supplementation and showed a likelihood of negative effects on haemoglobin concentrations. They concluded that there is no compelling evidence to support prenatal zinc supplementation. Coovadia and Bobat (2002:186) also suggest that there is no firm and consistent evidence that zinc supplementation may be of benefit in improving health or ameliorating disease. Tang *et al.* (1996: 1248) showed that zinc supplementation of any amount was associated with a significant increased risk of mortality. Olsen *et al.* (2004) investigated the effect of a low dose of elemental iron and reported that there was no effect on viral load.

- General remarks: micronutrient supplementation

Results from research done on micronutrients have been contradictory and conflicting (Green, 1995:206&207). Therefore, conclusive evidence is lacking. Many studies have reported positive clinical outcomes due to supplementation while others have shown that some micronutrients hasten disease progression. A recent meta-analysis done by Irlam *et al.* (2005:1) showed that there was no conclusive evidence of a reduction in morbidity or mortality in HIV-infected adults with the use of micronutrient supplementation. Moreover, micronutrient supplementation showed higher levels of genital HIV-1 shedding in a study done by McClelland *et al.* (2004:1657) and suggests that the

potential benefit of supplementation should be considered in relation to the potential increased infectivity.

A major problem in interpreting research results from micronutrient intervention studies for application is the heterogeneity of interventions, study designs, subjects participating (stage of HIV/AIDS) as well as the variety of health outcomes measured.

In the absence of sufficient evidence and clear guidelines regarding optimal dietary and supplement intake of micronutrients to be given to patients, clinicians are guided by different recommendations. The WHO (2005a) promotes and supports adequate dietary intake through a balanced and healthy diet and recommends nutritional supplementation at RDA levels. The American Dietetic Association (ADA) 2004:1431, suggests that supplementation be based on levels described in the Dietary Reference Intakes (DRI's), and below the known upper limits (UL's) of safety.

It is clear that much further investigation is warranted, especially regarding specific micronutrient requirements, optimal supplementation at different stages of the disease, as well as clinical benefits and adverse effects. Until such time, the caretaker's prudent guideline should be: "first do no harm".

At this stage it seems that if PLWHA are micronutrient deficient, a food-based approach to correct these deficiencies should be the first choice, followed by a supplement at recommended levels if necessary.

2.8 PUBLIC HEALTH VERSUS THERAPEUTIC NUTRITION INTERVENTION

The rationale for providing nutritional support to HIV and AIDS patients is based upon the assumption that nutrition status can be improved and that these improvements may have clinical benefits (Kotler, 1999). Efforts to optimize nutritional status, including medical nutrition therapy, assurance of food and nutrition security and nutrition

education are essential components of the total health care of PLWHA throughout the continuum of care (ADA, 2004:1425).

Figure 2, is a conceptual framework by Vorster (2007:564), which explains how targeted nutrition interventions could assist in improving nutritional status and, therefore, influence the outcomes of PLWHA.

This framework illustrates that underdevelopment, poverty and malnutrition (Sadler *et al.*, 2006: 6) and the social dimensions of the disease could create ideal circumstances for the spread of the pandemic. Food and nutrition insecurity can lead to survival strategies that could expose populations to increased risk through migration to urban slums, lack of infrastructure such as health care services, and involvement in sex trade (ADA, 2004:1426). These factors are proposed to be addressed by development programmes and public health nutrition (PHN) interventions while the biological aspects of the infection could be addressed through individualised therapeutic nutrition interventions (Vorster, 2007:564). The principles of PHC should be used as the guiding principles.

Section A of the framework indicates how a cycle of underdevelopment, nutrition insecurity, undernutrition, lack of education, poverty (ADA, 2004:4125; WHO, 2005a), inequity and lack of coping skills could lead to a lack of knowledge about HIV/AIDS, high risk behaviours and an increase in exposure to the virus. Furthermore, undernutrition leads to a compromised immune system, damage to epithelial barriers, increased susceptibility and a decreased resistance to opportunistic infections (Melchior, *et al.*, 1999:865; Tomkins & Watson, 1989). Together all these factors increase the risk of HIV transmission.

The development of HIV will further aggravate the problem by worsening nutrition status (Green, 1995:204) and thus has an impact on all the factors which contribute to poverty. The public health nutrition interventions needed should form a part of other development, health and education programmes and be targeted at specific groups.

The aims should be to educate people about HIV/AIDS, to promote preventative behaviour, to optimize nutrition status, immunity and resistance to infections and overall

to decrease the transmission of the virus. The approach, focus and content of programmes should be designed to fit specific needs.

Section B of the framework focuses on HIV infection. The PHN interventions proposed during the progression of the infection should include specific nutritional guidelines to PLWHA as well as food aid programmes to assist people struggling with hunger and food insecurity (ADA, 2004:1426).

Individualised therapeutic nutrition intervention (ADA, 2004:1425) is required due to wasting caused by the effect of the virus on reduced food intake and absorption, the increase in nutrient requirements and losses (Green, 1995:197-198) as well as the deterioration of immune function. The aims should be to provide the people in need with food and supplements (ADA, 2004:1426), to increase intake by treating anorexia and wasting, to strengthen the immune system, and slow the progression of HIV to AIDS.

Section C of the framework shows that when AIDS develops and is left untreated, it will further lead to malnutrition, wasting, secondary infections and eventually death. Treatment with HAART and individualised nutrition therapy will slow the progression of the disease, decrease viral loads, improve immune function, improve quality and prolong life (Faintuch *et al.*, 2006:685; Ockenga *et al.*, 2006:322). The aims of nutrition therapy during AIDS will be to address wasting, improve nutritional status, prevent secondary infections, address side effects of drug therapy and improve immune function (Ockenga *et al.*, 2006: 322&323), maintain and expand nutrition knowledge and to correct metabolic abnormalities (Fenton & Silverman, 2004:1046). All patients should be educated and have a written dietary and life style guideline regarding food safety, adequate and balanced nutrition and the use of fortified foods and nutrient supplements (ADA, 2004:1426). At later stages of the disease home-based care (HBC) could be seen as a way forward for caring and supporting PLWHA and should include the treatment for common complications associated with AIDS (WHO, 2004a:11), such as malnutrition and infections, as well as the provision of energy-dense, ready-to-use food and supplementation (Sadler *et al.*, 2006:9). The goal of HBC is then to provide accessible, effective, efficient and comprehensive health care to meet the health care needs of individuals, families and communities in their local settings (WHO, 2004a:3&4).

Conceptual framework

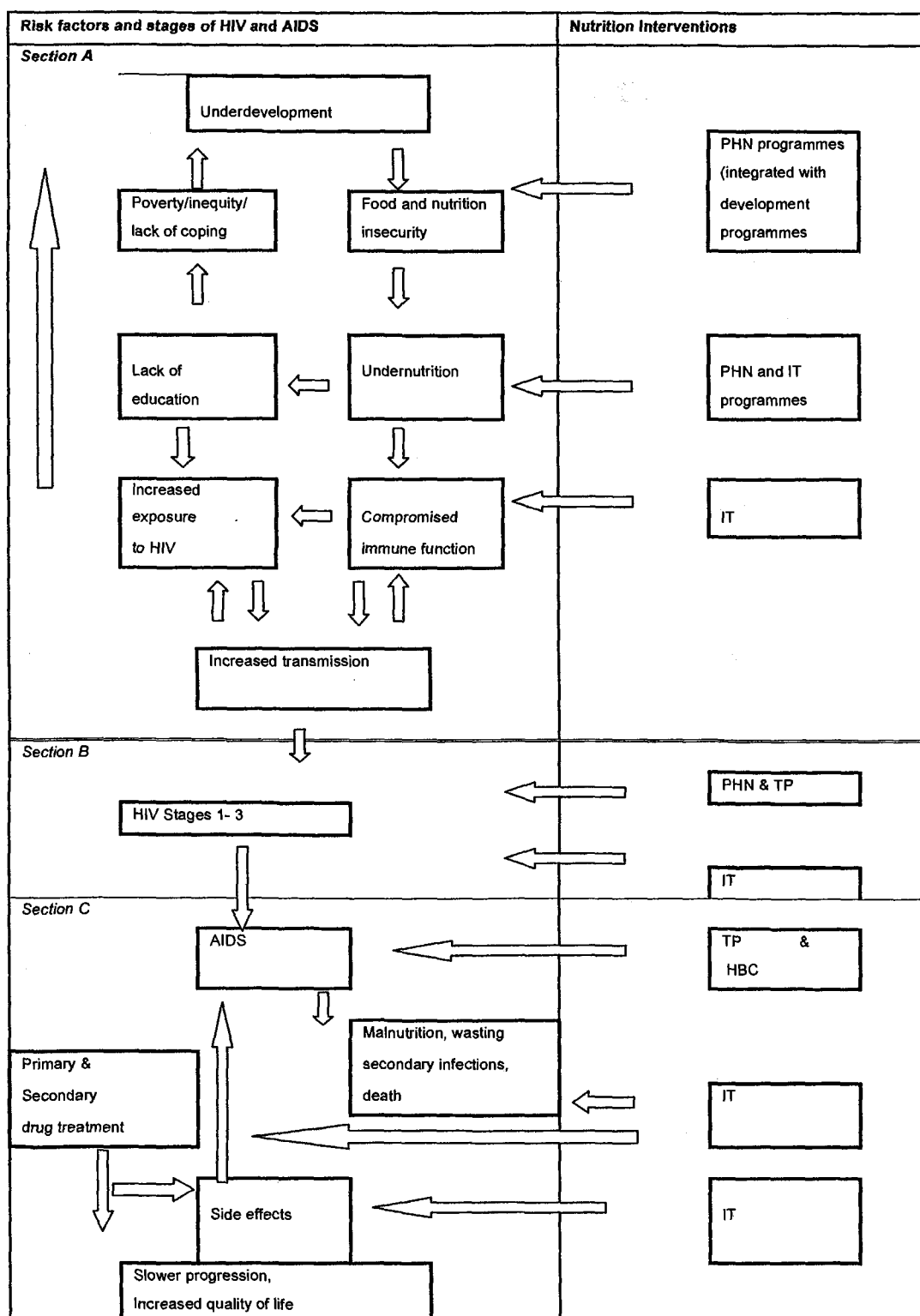


Fig. 2: Adapted from Vorster (2007:564)

PHN: primary Health Nutrition; IT: Individual Therapy; TP: Targeted nutrition programmes; HBC: Home based care

2.8.1 PUBLIC HEALTH NUTRITION INTERVENTIONS

Two main types of public health nutrition interventions are needed to address the nutrition problems associated with HIV and AIDS. The first are integrated programmes aimed at optimising nutrition status of whole populations, communities and groups of people. The second are targeted programmes that address specific needs of people living with HIV/AIDS.

- **INTEGRATED NUTRITION PROGRAMMES**

These general programmes form part of policies, strategies and services within countries, aimed at improving the nutritional status of all people and are based on the specific existing nutritional problems of a country. In developing countries these programmes would usually address food and nutrition insecurity and undernutrition. In South Africa this would include the Integrated Nutrition Programme (INP).

- **TARGETED PUBLIC HEALTH NUTRITION PROGRAMMES**

Targeted public health nutrition programmes are the programmes and efforts that address specific nutrition problems such as HIV/AIDS. An essential element of these programmes would be the education of PLWHA. All patients at all levels of risk should be educated about topics such as understanding the disease, the influence on nutritional status and food choices to be made in managing complications (Nerad *et al.*, 2003:S57 & S57). The WHO and South African Government (Department of Health, South Africa, 2001) have developed a guideline on nutrition for PLWHA. Furthermore, HIV/AIDS patients are treated within the Wellness Programme and during the latter stages of the disease through HBC. Individual nutrition intervention in these programmes entails individual nutritional consultation and monthly food parcels as well as micronutrient supplementation.

2.8.2 INDIVIDUALIZED, THERAPEUTIC NUTRITION INTERVENTIONS

Progression of the disease warrants individualized, therapeutic interventions due to the relatively long natural history of HIV, the cycles of opportunistic infection, acute complications and apparent remissions (Faintuch *et al.*, 2006:688).

Although there are no generally accepted standards of care for nutrition and HIV infection (Kotler, 1999), the aims of such nutritional interventions should include to improve nutritional status, decrease functional impairment from undernutrition such as muscular fatigue and work incapacity, improve tolerance to ART, alleviate gastrointestinal symptoms and improve quality of life (Ockenga *et al.*, 2006: 322&323).

The standard components of medical nutrition therapy should be followed. This includes referral, assessment, intervention and outcomes evaluation (Gasparis & Tassiopoulos, 2001:981; McKinley *et al.*, 1994:1014; Nerad *et al.*, 2003:S56). The nutrition assessment should be performed as part of the multi-disciplinary baseline measurements with regular follow-up as part of the outcomes evaluation. Nutritional assessment should include anthropometric, biochemical, clinical, and dietary evaluation, which will form the basis of the nutrition care plan (ADA, 2004:1428). The most critical baseline anthropometric measurements are baseline weight and height (Knox *et al.*, 2003:S64&S65). Frequent measures of body weight should be done and greater sensitivity for detecting small changes in lean body mass or body cell mass can be obtained using more sophisticated techniques such as bioelectrical impedance analysis (Kotler, 1999).

Key areas in the clinical assessment entails physical appearance, evaluation of opportunistic infections, difficulties with chewing or swallowing, occurrence of diarrhoea symptoms, gastrointestinal distress or malabsorption, use of herbal supplements, functional status, physical activity and medication use (Knox *et al.*, 2003:S65; Walsek *et al.*, 1997:72). Principles of nutrient-drug interactions and toxicity should always be kept in mind. (ADA, 2004: 1430). Nutritional risk factors are important and, therefore, assessment of social, psychological and financial resources that may affect the ability to obtain, prepare and eat food should be addressed (Knox *et al.*, 2003: S65).

Nutrition counselling is seen as a part of intervention and could improve health outcomes. It is an integral part of HIV care at any stage of the disease (Dowling, 1990:823; McKinley *et al.*, 1994:1014; Rabeneck *et al.*, 1998:438; Schwenck *et al.*, 1994:212). Patients could be counselled on the following nutrition-related issues: lifestyle, nutrition interactions, management of symptoms, food safety, life skills and socioeconomic issues (ADA, 2004: 1430; Nerad *et al.*, 2003:S52). In cases of drug therapy, for successful treatment ongoing counselling is needed, with manipulation of the diet to enhance drug levels, ensure optimal availability of drugs and to improve compliance (Kruse, 1998).

As already mentioned, goals for nutrient intake should focus on food first and additional intake in other forms (supplementation) only considered when a food-based approach could not rectify deficiencies (ADA, 2004:1431). Oral supplementation is seen as the simplest way to increase intake when conventional foods alone do not provide the necessary requirements. Enteral feeding should be considered if patients cannot eat, but still have a functional gut (Green, 1995:204) and parenteral nutrition when the small-intestine is inaccessible or non-functional (Gasparis & Tassiopoulos, 2001:982; Paton *et al.*, 2005:331). Regular follow-up is essential.

In South Africa the existing integrated nutrition programme includes the National Emergency Food Programme which addresses the alleviation of food insecurity. It also includes a nutrition supplementation intervention, which provides supplementation in the form of supplement meals and micronutrients for all patients who are in need (DOH, 2003:79). Nutrition intervention depends on food security. In the case of food security, nutritional counselling, appropriate information material and a monthly supply of nutritional supplement is given. In cases where there is food insecurity nutritional counselling, appropriate material, a monthly supply of nutritional supplement as well as monthly supply of supplementary meals are given. These individuals will also be referred to the Department of Social Development for enrollment in the National Emergency Food Programme (DOH, 2003:80).

Comprehensive nutritional counselling is given to all people attending service points and includes counselling and information material on healthy eating and lifestyle, food

preparation and coping with infection. Topics covered are weight maintenance, food safety, food strategies and appropriate recipes (DOH, 2003:83).

In the 2003/2004 financial year an amount of R7 million was made available for the purchasing of nutritional supplements, which entails an enriched product providing 100% of the recommended dietary allowances (RDA) of all the vitamins, minerals and trace elements in one to two servings per day (DOH, 2004). The cost of the meal is estimated at R56.40 per person per month, and the vitamin supplement at R40 for adults and R60 for paediatric patients per month. The total costs of nutritional support and the supplementation is estimated at R532 million for the year 2006/07. Clearly, the Government must have a much greater financial commitment to ensure that PLWHA are food secure.

2.9 DISCUSSION: REVISITING THE PROBLEM

The dilemma of the HIV pandemic in South Africa (and other developing countries) is to reach a humane balance between the rising prevalence, the costs not to treat, and the extent to which to treat, measured against the backdrop of monetary limitations.

It can be seen that the impact and burden due to the HIV/AIDS epidemic is one of the greatest challenges and most important health crises of the last century, but it is the mortality figures that highlight the unprecedented threat to human development (UNAIDS, 2004:7).

Although reliable statistics on HIV/AIDS deaths are not available (Dorrington *et al.*, 2001:5), recent estimated data indicate its shattering dimensions. It is estimated that South Africa lost 165 859 lives to AIDS in 2000 (MRC, 2003), and between 270 000 and 520 000 lives in 2003 (UNAIDS, 2004). Furthermore, the death of parents leaves children orphaned and destitute. The numbers are staggering as it is estimated that 2.2 million South African children (12% of all children) are orphaned. The impact on their lives cannot be calculated in monetary value.

According to WHO (2005c), the adult (15 – 49 yrs) prevalence rate is estimated between 17.8 and 24.3% and 5.4 in children 2 – 18 years. South African statistics estimate prevalence rate of 16.2% in adults and 3.3% for children (2 – 14 yrs) (HSRC Press, 2005). Prevalence rate among pregnant women is increasing and estimated at 29.5% (Department of Health, 2004:17). The highest prevalence rates are seen in females between the ages of 25 – 29 years (33.3%) and for males between age 30 – 39 (23.3%). The provinces most affected are KwaZulu-Natal (16.5%), Mpumalanga (15.2%) and the Free State (12.6%) and those least affected are the Northern Cape (5.4%) and Western Cape (1.9%) (HSRC Press, 2005). The latest data that could be found (DOH, 2004:13) indicate that in Aug/Sept 2004 there were more people on treatment in the Western Cape (n = 4324) even though this is the province with the lowest prevalence. If statistics of the Free State Province are compared to that of the Western Cape it shows that the province with the 3rd highest prevalence has the 3rd lowest number of people on treatment. These disparities need attention, focus and making areas of high prevalence a priority.

As the primary impact of HIV service delivery would be the burdened health care facilities, this should be the main focus of additional and increased funding. The South African government has demonstrated a high degree of political commitment in tackling the epidemic by committing substantial financial and institutional resources. The health budget has increased, the health care system has undergone transformation and plans were drawn up to provide ART to 1.4 million people by 2008 (WHO, 2005e:2). Indications are that the treatment gaps will narrow further, however, not at the pace required to contain the epidemic effectively (UNAIDS, 2005:5).

The number of people living with HIV/AIDS in South Africa is estimated between 4.3 and 6.0 million people of whom 837 000 are estimated to be in need of ART (WHO, 2005e). The WHO 3 by 5 initiative calculated an ART treatment target of 375 000 in need for 2005, but it is estimated that 44 600 people were receiving treatment in March 2005, thus reaching only 11.9% of people in need. In addition, it is estimated that 60 000 people are receiving treatment through the private sector (WHO, 2005e), increasing the coverage to 27.9%. This amounts to 12.5% of people in need as the estimated number is 837 000. This is a clear indication of the large short-fall and the enormity of the problem as indicated in figure 2.1.

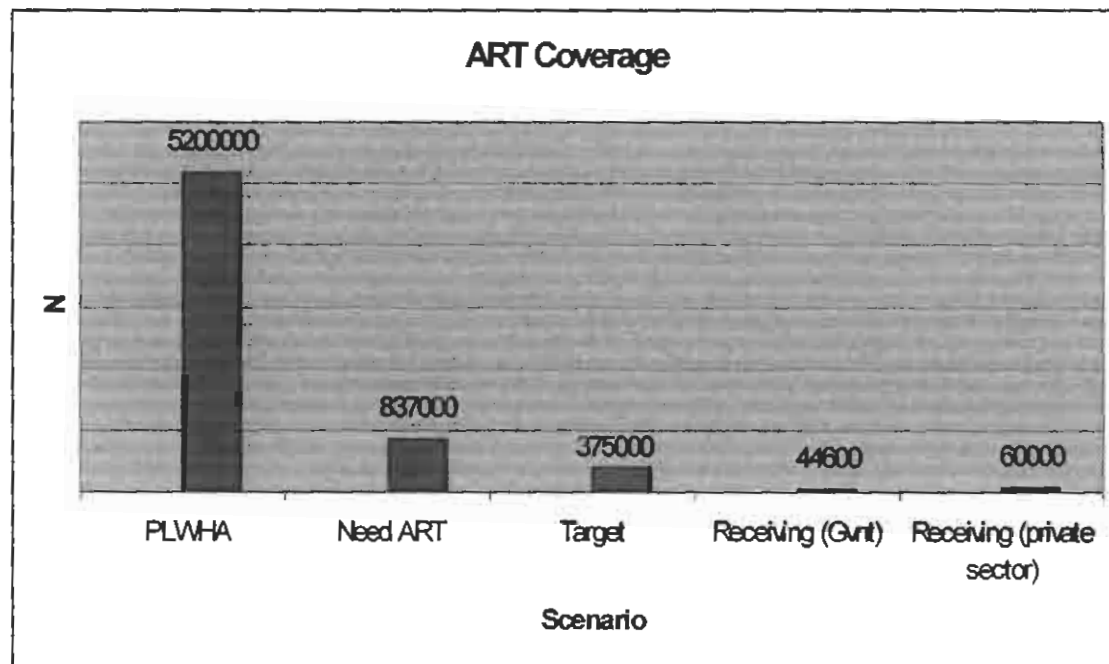


Fig 2.1: ART Coverage (South Africa)

Adapted from: WHO, 2005c:2

The average cost per patient year (PPY) for people with AIDS on treatment was South African Rand (ZAR) 9 199 (for higher priced drugs) and ZAR 5 861 (for lower priced drugs) compared to ZAR 21 401 for those not on treatment. In patients without AIDS, the average cost PPY for those on treatment was ZAR 8 049 (low cost drugs) and ZAR 4 821 compared to ZAR 5 776 for people not on treatment. The cost effectiveness ratios, however, were sensitive to the price of HAART (Badri *et al.*, 2006:48).

The magnitude of the challenge becomes clear when looking at estimated costs required supporting the scale-up of ART for the year 2004-2005 to meet the 3 by 5 target as shown in figure 2.2. According to WHO (2005e), ZAR 6.38 - 6.75 billion (January 2006, US\$1 = ZAR 6.08) is needed for scaling up the programme, leaving an estimated shortfall of ZAR 4.86 - 5.23 billion. These costs are alarming, measured against the backdrop of the National budget of SA of ZAR 8.82 billion for Health Services in the country for the same year (South African Government, 2005: iii). The ART scale-up

alone thus leaves a shortfall of 55 – 59% of the Total Health Budget for that financial year.

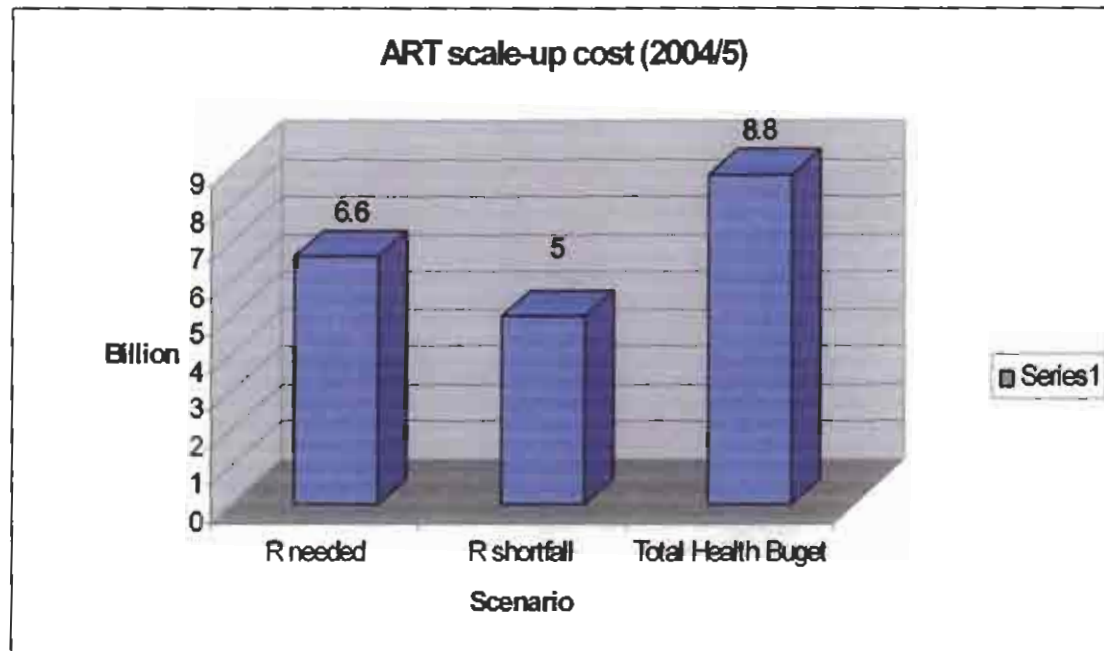


Fig 2.2: ART scale-up cost
(South African Government, 2005: iii)
(Adapted from: WHO, (2005c:2)

The challenge becomes greater when a new year brings new targets to reach: 1.4 million people by 2008. This bleak scenario leaves some burning questions: how achievable are the set targets, given that some of the other African countries are more poverty stricken; how to overcome the monetary deficits, and is the country committed enough? Regretfully these figures reflect the incapacity: failing people, families, communities, and the country at large.

The impact and burden of HIV/AIDS is unthinkable, the resources scarce and limited. This should instill respect for the difficult and enormous challenges it poses to the world, South Africa, the government and its citizens.

2.10 CONCLUSION: A ROLE FOR NUTRITION

As mentioned above, the HIV/Aids pandemic is vast and regrettably continues to expand in the midst of scarcity of resources. The pandemic is an extraordinary kind of crisis that requires an exceptional response that remains flexible, creative, energetic and vigilant (UNAIDS, 2004:13).

The impact of HIV/AIDS in a country depends on the government's policies and its actions to fight the pandemic and mitigate its impact. Policies that address the incidence of new infections and improve the health status of PLWA through prevention campaigns and improved access to treatment will reduce the adverse affects and impact (Haacker, 2004: 64). Treatment programmes should be provided to extend the working life of working individuals who are infected (ILO, 2004: 6).

The above review of the literature indicated that although the exact or optimal diet and nutrient combinations for PLWHA are far from clear, nutrition has a direct and indirect role to play in decreasing the transmission of the disease, in slowing the progression from HIV to Aids, in treating the secondary infections of AIDS, in alleviating side-effects of ARV treatment and to improve quality of life.

One of the greatest problems is the fact that HIV has many faces as it is heterogeneous in its staging, types of opportunistic infections, host differences and multi medications used for its treatment. Therefore, no single set of standard protocols can be used for individual successful nutrition intervention.

In the asymptomatic phase already there are metabolic and endocrine changes taking place and as the disease progresses, changes are more pronounced and with the event of introducing HAART, the picture becomes less clear on the effect it has on the individual and their nutritional status in the long term. Many studies have investigated the effect of nutrition on HIV and *visa a versa*. However, it is a difficult task to formulate concise nutrition recommendations given the diverse and contradictory results of these studies, making it difficult for clinicians to practice sound evidence based nutritional care.

Nevertheless, the WHO (2005d & 2003a) guidelines suggest the following: that in the asymptomatic HIV infected, resting energy expenditure is increased by 10% and between 20 – 50% in advanced disease. Protein requirements are not increased above the normal requirements of 12 – 15% of the total energy intake. There is no evidence that fat requirements should be increased beyond the normal requirements. Micronutrient supplementation recommendations are set at the RDA as for the normal population. Furthermore, promotion of a good balanced diet is seen as the basis of nutritional care and supplementation should be considered to meet increased nutritional requirements. Micronutrient supplementation over and above the UL is not recommended (ADA, 2004). Evidence exists that nutrient supplementation with vitamin A, zinc and iron, could produce adverse outcomes in HIV-infected populations (WHO, 2003a). Further research is, therefore, needed to elucidate the role of micronutrients on the course of HIV disease, accompanying opportunistic infections and drug therapy, the preventative and therapeutic role of supplementation as well as the optimal dosages that are needed. Therefore, clinicians responsible for the nutritional care of the HIV-infected should be guided by the rule of “first do no harm”.

Nutrition is indispensable in the overall treatment of HIV. It is, therefore, important that the nutritional needs of HIV-infected people should be addressed across all the different stages of HIV-infection, on a public health as well as on individual level. Nutrition intervention programmes should be integrated and should form part of larger development programmes to address not only the primary nutritional needs, but also the larger social problems related to the disease, which all aggravate the problem and decrease quality of life for those infected.

It is costly to ignore prevention and to fail to provide care, support and treatment for persons infected with HIV. Comprehensive approaches to HIV/AIDS are not cost-free, but the cost of inaction is far greater (ILO, 2004: 6).

The objective of the present study was, therefore, to assess the relationships between dietary intakes and health outcomes of HIV-infected women, in an attempt to identify those nutrients, and combinations of nutrients and their food sources that are associated with good nutrition and better health outcomes of women in the early stages of HIV-infection.

CHAPTER 3

METHODS

3.1 INTRODUCTION

The main purpose of this analysis was to examine the differences in biological health variables and the possible influences of nutrient intakes on these health variables in asymptomatic HIV-infected and non-infected women. The data reported in this analysis formed part of two larger studies, namely the THUSA (Transition and Health and during Urbanisation of South Africa) and Mangaung studies, which were done in the North West and Free State Provinces, respectively.

3.2 STUDY POPULATIONS AND STUDY DESIGN

For purposes of this investigation, data from the THUSA and Mangaung studies were analysed. In the Mangaung study, the study population consisted of women only. Therefore, a sub-sample was drawn from the total study population in the THUSA study comprising of women only.

THUSA was a cross-sectional, comparative study of "apparently healthy" African people residing in the North West Province. Subjects were recruited using stratified sampling from 37 randomly selected sites, representing five levels of urbanisation. The Mangaung study was also a cross-sectional study, conducted in Mangaung, Free State Province, where women were randomly selected from both informal and formal settlements. However, Mangaung can be regarded as an urban setting while the THUSA study involved both urban and rural subjects.

The data of the two studies were kept separate and analysed as such, due to differences in selection criteria used, variables that were investigated, methodologies and laboratories used for biochemical analyses. Therefore, for this investigation the two studies are handled as two separate case studies. The studies will be referred to as the THUSA and Mangaung studies/ women, consisting of 1040 women between the ages of 15 and 90 years and 488 women between the ages of 25 and 45 years, respectively.

Exclusion criteria in the studies were as follows: In the THUSA study pregnant and /or lactating women, temperatures above 37.5°C, acute and chronic illness, use of chronic medication, inebriation, visiting and fasting less than 8 hours. In the Mangaung study age younger than 25 and older than 44 years, pregnant women and subjects not fasting from 22:00 the night prior to data collection. The THUSA study included “apparently healthy” volunteers while the random sample of 25 – 44 year old women from the Mangaung women may have been suffering from chronic conditions.

3.3 DATA COLLECTION

In both studies data were collected by trained investigators by means of a variety of validated research methods as indicated in Table 3.1, as reported by Vorster *et al.* (2000:505) for the THUSA study and Hattingh (2005:260) for the Mangaung study. The two studies used the same quantitative food frequency questionnaire that was developed and validated for the African population in South Africa (MacIntyre *et al.*, 2000:53). The South African Medical Research Council food composition programme (Foodfinder) was used to calculate nutrient intakes. In the present analyses, the potential role of nutrients (and not particular foods) was evaluated. However, the combination of nutrients and specifically the energy distribution of the diet were used to depict a “prudent” or “western” diet in the result and discussion chapters.

Table 3.1 Data collected and experimental methods used

Data and variables	Experimental method	
	THUSA study	Mangaung study
Demographic data	Individual interview and questionnaire	Individual interview and questionnaire
Anthropometric measurements		
Weight	Calibrated electronic scale (Precision Health Scale); Underclothes	Calibrated electronic scale; (770 Seca, Bizerba 75860); Examination gown, no shoes
Height	Anthropometer (Invicta, 1465, UK); Correct position; no shoes and headgear	Stadiometer; barefoot; flat surface; head in line of Frankfort plane
Waist	Non-stretchable, flexible tape measure; narrowest area; anatomical position	Non-elastic, flexible tape; Minimal abdominal circumference; midway between lower rib and iliac crest
Hip	Non-stretchable, flexible tape measure; largest circumference; anatomical position	Non-elastic, flexible tape; widest circumference over the great trochanters
Calculations of indices		
Body mass index (BMI)	Weight (kg)/Height (m) ²	Weight (kg)/Height (m) ²
Waist-hip-ratio (WHR)	Waist circumference (cm) / hip circumference (cm)	Waist circumference (cm) / hip circumference (cm)
Health outcome indicators		
Serum (S) – protein & albumin	DAX Profile (Discrete analyser, Technicon DAX 48)	Boehringer Mannheim Hitachi 902 analyser; Roche Diagnostics GmbH, Mannheim
S - albumin	DAX Profile (Discrete analyser, Technicon DAX 48)	Boehringer Mannheim Hitachi 902 analyser; Colorimetric endpoint method; Roche Diagnostics GmbH, Mannheim
S – liver enzymes	DAX profile; ALP; GGT, AST, LD	Was not done in study
S – lipogram	(DAX; discrete analyser, Technicon DAX 48); S - total cholesterol; S - High density lipoprotein; S- Low density lipoprotein; S- triglycerides	S – total cholesterol Enzymatic colorimetric; CHOD-PAP method (Roche Diagnostics GmbH, Mannheim); S – triglycerides Enzymatic colorimetric GPO-PAP method (Roche Diagnostics GmbH, Mannheim)

S - glucose	Fasting glucose concentration; DAX profile (Discrete analyser, Technicon DAX 48) Serum glucose at 120 min; Peridochrom ® glucose GAD-PAP method	Enzymatic colorimetric (Roche Diagnostics GmbH, Mannheim); Boehringer Mannheim Hitachi 902 automatic chemistry analyzer
S - insulin	Insulin concentrations; I-Insulin- RIA Kit ; Immuno Biological Laboratories (IBL); radioactivity 125I-Insulin; Packard Cobra auto gamma counter; model B5003	DRG insulin ELISA enzyme immunoassay; DRG Diagnostics
Plasma- fibrinogen	Plasma; Automatic Coagulation Laboratory Analyser (ACL 200 ™)	Clauss method; fibrinometer (Pathtec, Marburg); Multifibren ®
S - ferritin	Measured by MRC Tygerberg, Cape Town, Colorimetric method, Boehringer Mannheim	Immunoturbidimetric Immunoassay (Randox)
S- lymphocytes	Was not done in study	Part of full blood count; ADTA blood; Coulter Microdiff 18 cell Counter
Systolic blood pressure (BP)	Mercury sphygmomanometer (Tycos, USA); seated ≥ 10 min; first Korotkoff sound heard	Medical practitioner; Mercury sphygmomanometer; standard technique (first Korotkoff sound heard)
Diastolic BP	Trained nursing sister; Mercury sphygmomanometer (Tycos, USA); seated ≥ 10 min; disappearance of Korotkoff sound	Medical practitioner; Mercury sphygmomanometer; standard technique (disappearance of Korotkoff sound)
Dietary / Nutrient intake	Quantitative Food Frequency Questionnaire (QFFQ); photo book; analysed using the MRC Food finder program	The same Quantitative Food Frequency Questionnaire (QFFQ); household measures; analysed
HIV-infection	Enzyme-immunological method; (Enzymun-Test ®, anti-HIV 1+2+subtype Ø, Boehringer Mannheim)	Microparticle Enzyme immunoassay; Human Immunodeficiency Viruses (HIV- 1/HIV-2); (Recombinant Antigens and Synthetic Peptides reagent pack; (Abbott)

- Blood sampling

In the THUSA study the blood sampling was carried out by trained professional nurses between 08:00 and 11:00 am, to control for environmental temperature and circadian rhythms. A sterile disposable infusion set (Johnson & Johnson, 21G, 19 mm) was used to draw a total of 75 ml blood, which included:

- 5 ml citrated plasma for the analysis of fibrinogen (sodium citrate 0.11 mol/L; Ph4.5-4.8)
- 5 ml fluoride serum for fasting glucose analysis
- 10 ml serum each for analysis of lipids, minerals and other metabolites
- The samples for serum were left at room temperature to clot and then centrifuged at 3000rpm for 10 minutes and kept on ice
- The samples were divided into marked Ependorff tubes and stored at -20° C in a freezer and transferred to the laboratory and stored in a bio freezer at -84°C for later analyses.

In the Mangaung study blood samples were collected by a qualified nursing sister. The following was used and executed:

- Vacutainer System needles (21G x 38 mm), preptic swabs
- 10 ml Vacutainer tubes (BD, TM, Plymouth, UK)
- 10 ml Vacutainer Ethyldimethylacetic acid (EDTA) tubes
- 10 ml citrated blood (Saarchem, South Africa) in a 0.1. molar sodium phosphate buffer which was used for the preparation of platelet-free plasma and centrifuged twice at 2800 x g for 10 minutes
- The serum samples were prepared using 5 ml whole blood, left to clot at room temperature
- Samples were then centrifuged at 3360 rpm for 20 min and stored at -72 °C.

3.4 STATISTICAL ANALYSIS

The statistical analyses were done by the researcher, guided by Prof. B Margetts (co-promoter). Prof. C Doak guided the analyses of the metabolic syndrome variables.

SPSS statistical package (version 14.0; SPSS Inc, Chicago, Illinois, 2005) was used to analyze data. The Mangaung study investigated women and, therefore, the sub-sample of the THUSA study was chosen accordingly. In both studies only data that were not normally distributed were transformed logarithmically and in cases where data could not be transformed, non-parametric tests were done. Descriptive statistics were done expressing variables as means, medians, standard deviations (SD), standard errors (SE), confidence intervals (CI), as well as minimum and maximum values for the different variables.

An analysis of variance (ANOVA) was done to test for significance between the HIV-infected and non-infected groups in both studies. In both studies partial correlations were done in the infected and non-infected groups to determine associations between dietary/nutrient intake, anthropometry and the biological health variables. In the THUSA study the following was controlled for: age, education level, stratum (level of urbanization) and alcohol intake and in the Mangaung study for age, education level and alcohol intake. Correlation coefficient values ≥ 0.3 were interpreted as a medium effect at a significant level where $p \leq 0.005$.

In both the studies the Chi-square test was done to test for significance between the two groups in markers for metabolic syndrome that were categorized using determinants and cut-off points from literature, as shown in Chapter 4.

3.5 ETHICAL STATEMENT

Ethics approval for both studies was obtained by the respective Ethics Committees. The THUSA study was approved by the Ethics Committee of the PU for CHE (HHK 4M5-95)

and the Mangaung study by the University of the Free State (ETOVS02/00). Informed written consent was obtained from all the participating volunteers.

The North-West Department of Health approved the THUSA study protocol in 1995. They insisted, however, that no testing for HIV infection should be done, since the researchers lacked the capacity to counsel subjects. The subjects were, therefore, informed about HIV infection and advised to have themselves tested at the nearest health facility (hospital, clinic or private practice).

In the THUSA study, additional approval was granted by the Ethics Committee for anonymous HIV testing after the study was completed. In the Mangaung study, subjects were informed that HIV testing was part of the study design and were given the option to be informed of their status or not. Subjects who opted to be informed and who tested positive were referred to a medical practitioner for further counselling. Total anonymity was ensured.

CHAPTER 4

RESULTS

4.1 INTRODUCTION

The main objective of this thesis is to describe the role of nutrition during HIV infection in African women. To reach this goal, the relationships between dietary exposures (nutrient intakes) and health outcomes of two groups of infected women and appropriate controls were examined. The women participated in the THUSA and Mangaung studies, as indicated in Chapter 3. It was also mentioned in Chapter 3 that the two data sets could not be combined, because of differences in methodology, inclusion criteria and the health variables selected to be measured. Therefore, the results from these two data sets are presented here as two separate case studies, in separate tables, but with similar objectives. Where appropriate, results of the two studies will be compared.

In the following sections of this chapter, observed prevalences of HIV-infection, the anthropometric results, nutrient intakes, measured health outcome variables, as well as relationships between nutrient intakes and health outcomes of the HIV-infected women and non-infected controls will be reported. Explanations for some of the observations will be given in this chapter, since the discussion (Chapter 5) will focus on the relationship between dietary exposures and health outcomes. The use of the terms infected and non-infected refers to HIV infection.

4.2 HIV PREVALENCE IN THE STUDY GROUPS

Table 4.1: HIV prevalence in the study populations

Study population	HIV-infected		HIV non-infected		Total
	N	%	N	%	
THUSA	120	11.5	920	88.5	1,040
Mangaung	249	51.0	239	49.0	488

Table 4.1 shows that 120 (11.5%) of the 1040 women recruited in the THUSA study tested positive for the HI virus, while 249 (51.0%) of the 488 women who participated in the Mangaung study were infected. There are a number of possible reasons for this difference.

- In the THUSA study, apparently healthy volunteers were recruited from 37 different rural, semi-urban and urban sites in the North West Province. In the Mangaung study, subjects were only from an urban area in Bloemfontein, the Capital of the Free State Province, on one of South Africa's main trucking routes (IMF, 2006:119). The THUSA study showed higher prevalences in the urban than rural areas (Vorster *et al.*, 2005:483).
- In the THUSA study, infected women were apparently healthy, not knowing that they were infected and had no symptoms of disease. In the Mangaung study, a random sample of 500 women, 20 subjects per day, were recruited by fieldworkers in a mainly urban area near Bloemfontein. It is possible that these women who did not feel well or had disease symptoms were more amenable and eager to participate in a medically orientated study (subjectively seeking help).
- A third reason may be related to age: the THUSA study recruited subjects from 15 years and older. It is possible that subjects at the lower and higher end of the age scale were not as sexually active as those in the middle. In the Mangaung study, the inclusion criterion was 25 to 44 years of age. This is an age group of subjects which were probably more sexually active and at higher risk for infection than the very young or old. Tables 4.2.1 and 4. 2.2 show that in both studies, the mean age of the infected subjects was slightly but significantly lower than non-infected controls (34.8 versus 38.2 and 32.4 versus 35.2 years).
- The THUSA study was completed in the year 2000 and the Mangaung study two years later, which could partly explain the higher prevalence as statistics have shown an increase in prevalence rates of HIV in the country (DOH, 2006).

It is clear that factors such as urbanization, age and possible availability and willingness to participate because of not feeling well may be responsible for the higher prevalence of HIV in the Mangaung study. It should be noted that this possible bias does not make comparisons of HIV infected and non-infected women invalid. But it does emphasize that these prevalences of HIV were particular to the two studies and do not in any way reflect national prevalences of infection. It also emphasizes that it is possible that the

progression of HIV in the Manguang study could have been more advanced towards AIDS than in the THUSA study.

All these factors show that the two studies should not be combined and that care should be taken when interpreting and comparing data from them.

4.3 ANTHROPOMETRIC VARIABLES

Tables 4.2.1 and 4.2.2 compare the nutritional anthropometric variables of infected and non-infected women in the two studies. In the THUSA study, the slightly higher body mass, BMI and waist circumference of non-infected women were not significant. In the Manguang study, these differences were highly significant, supporting the argument in 4.2 that the women in the Manguang study were probably at a more advanced stage of HIV progression than those in the THUSA study. The mean BMI's of the control (non-infected) women in the two data sets were virtually the same (27.0 and 27.2 kg/m² respectively), while the mean BMI of the infected women in the Manguang study was slightly lower (26.1 and 25.7 kg/m² respectively).

Table 4.2.1 Anthropometry of the THUSA women

Variable	HIV Status	Mean	SD	SE	95% Confidence Interval for Mean		Min	Max	p
					Lower Bound	Upper Bound			
Age	Infected	34.8	12.7	1.2	32.5	37.1	15.0	69.0	0.014
	Uninfected	38.2	14.3	0.5	37.3	39.1	15.0	90.0	
Mass (kg)	Infected	65.4	15.0	1.4	62.7	68.1	36.3	109.6	0.360
	Uninfected	66.9	17.4	0.6	65.8	68.1	32.8	127.4	
BMI	Infected	26.1	5.6	0.5	25.1	27.1	15.4	40.0	0.168
	Uninfected	27.0	7.0	0.2	26.6	27.5	14.2	53.6	
Waist-Min (cm)	Infected	76.8	11.3	1.0	74.8	78.9	54.8	114.8	0.256
	Uninfected	78.3	13.4	0.4	77.4	79.2	38.3	130.2	
Waist hip ratio	Infected	0.8	0.1	0.0	0.7	0.8	0.6	0.9	0.649
	Uninfected	0.8	0.1	0.0	0.8	0.8	0.4	1.0	

Table 4.2.2 Anthropometry of the Mangaung women

Variable	HIV Status	Mean	SD	SE	95% CI		Min	Max	p
					Lower Bound	Upper Bound			
Age	Infected	32.4	5.1	0.3	31.7	33.0	25.0	44.4	0.000
	Uninfected	35.2	6.3	0.4	34.4	36.0	25.0	45.0	
Mass (kg)	Infected	62.9	13.9	0.9	61.1	64.6	32.8	111.9	0.004
	Uninfected	66.6	15.2	1.0	64.7	68.6	36.7	126.1	
BMI	Infected	25.7	5.5	0.4	25.0	26.4	12.4	47.2	0.006
	Uninfected	27.2	6.2	0.4	26.4	28.0	16.4	53.8	
Waist-Min (cm)	Infected	77.2	11.3	0.7	75.8	78.6	55.0	114.0	0.001
	Uninfected	80.6	11.8	0.8	79.1	82.1	61.0	124.0	
Waist hip ratio	Infected	0.7	0.1	0.0	0.7	0.8	0.6	1.1	0.027
	Uninfected	0.8	0.1	0.0	0.8	0.8	0.6	1.0	

4.4 NUTRIENT INTAKES

The mean nutrient intakes of the infected and non-infected women from the THUSA study are shown in Table 4.3.1 and those of the Mangaung women in Table 4.3.2. The percentages of energy contributed by the different macronutrients are illustrated in Figure 4.1.

• Total energy intakes

In both data sets the infected women had slightly, but not significantly higher total energy intakes. Energy intakes calculated from the reported dietary intakes were substantially higher in the Mangaung-study. The HIV-infected group in Mangaung took in approximately 3.8 Mega Joules more than those in the THUSA study. The difference in non-infected women was 3.7 Mega Joules. There are two possible reasons for these differences: it could be a methodological difference in applying the same food-frequency questionnaire, (in the THUSA study photo books were used, while household food measures were used in the Mangaung study), or it could be a real difference with urbanized women in Mangaung being more food secure and eating more than those in the THUSA study, which also included poorer, food insecure women from rural areas.

- *Energy distribution*

Energy distribution of the diets in Figure 4.1 clearly indicates that the women in the Mangaung study followed a more westernized, urban diet with a higher fat content (THUSA 26%; Mangaung 32%), more animal-derived than plant proteins (the THUSA women had more plant than animal-derived proteins in their diet) and less carbohydrate (THUSA 65 and 64%; Mangaung 52 and 53%). These are typical changes described in the nutrition transition of Africans (Vorster *et al.*, 1999:341).

- *Dietary fibre and sugar intakes*

The Mangaung women had more fibre in their diet (approximately 24g per day compared to the 17 and 16g per day of the THUSA women: Table 4.3.1). This is probably related to a higher intake of fruit and vegetables (because total carbohydrate, largely contributed by maize porridge, was lower). The mean sugar intakes of infected women in both studies were slightly, but not significantly higher than that of non-infected women. The women from Mangaung consumed a mean of approximately 80 grams of sugar per day, compared to the 52-56 grams of the THUSA women. The higher sugar intake of the Mangaung women reflects higher total dietary intakes as well as the more westernized diet of urban women).

- *Alcohol intakes*

In both studies, infected women reported a higher alcohol intake than non-infected women. In the THUSA study, mean intakes of 3.8 and 2.7 grams of alcohol per day for the two groups respectively, was not significant. In the Mangaung study, the difference between the 6.2 g/d of infected women compared to the 3.7 g/d of non-infected women was significant ($p = 0.025$). None of these studies were designed to assess whether the higher alcohol intake in infected women was a contributing cause of infection by changing behaviour that increased risk of infection, or whether it was a consequence of infection – women drinking more “to feel better”. In the THUSA study the latter was probably not true, because the women did not know they were infected.

- *Micronutrient intakes*

Tables 4.3.1 and 4.3.2 show that as can be expected, the micronutrient intakes of the Mangaung women were higher than those of the THUSA women because they

reported overall higher dietary intakes. Nevertheless, the mean intakes of calcium and folic acid of the Mangaung women did not reach the recommended intakes of the WHO, while the THUSA women's mean intakes of calcium, iron, vitamins B₃, B₆, folic acid and ascorbic acid were lower than recommended levels. The tables do not show how many of the women did not reach these recommended levels. It is clear that the micronutrient quality of the diet of both groups was not optimal and that the assumed nutrition transition observed in the Mangaung women resulted in improved micronutrient intakes.

This observation is supported by an analysis of the THUSA subjects (Vorster *et al.*, 2005:485) that showed an improvement of micronutrient status of urban subjects compared to those in rural areas.

- *Type of dietary fat and cholesterol intake*

Tables 4.3.1 and 4.3.2 also show mean intakes in gram of the saturated (SAFAT), monounsaturated (MUFAT) and polyunsaturated (PUFAT) fatty acids, as well as dietary cholesterol. Intakes of all three types of fat were almost double in the Mangaung women (94 and 87 g/d compared to 51 and 49 g/d of the THUSA women). Each type of fat contributed about a third of total fat intake, with intakes of MUFATs slightly higher in all groups. Dietary cholesterol intakes of the THUSA women were below the recommended 300 mg/d for prevention of NCDs (Wolmerans & Oosthuizen, 2001:S48), while those of the Mangaung women were 370 and 349 mg/d.

Table 4.3. 1: Nutrient intakes of the THUSA women

Nutrient	HIV Status	Mean	SD	SE	95% CI		Min	Max	p
					Lower Bound	Upper Bound			
*WHO Rec/d									
Total energy	Infected	8,384	3,153	289	7,812	8,957	2,195	19,190	0.131
Kilo Joules	Non-infected	7,933	3,053	102	7,732	8,133	514	20,525	
Total protein	Infected	59.0	21.4	2.0	55.1	62.8	23.4	149.1	0.565
g	Non-infected	57.7	22.1	0.7	56.3	59.2	1.9	188.8	
% Energy	Infected	11.6	2.1	0.2	11.2	12.0	7.7	19.6	0.164
from protein	Non-infected	11.9	2.2	0.1	11.8	12.0	5.9	21.3	
Plant protein	Infected	32.5	14.5	1.3	29.9	35.2	5.8	81.8	0.154
g	Non-infected	30.6	13.7	0.5	29.7	31.5	1.8	89.8	
Animal protein	Infected	26.2	14.8	1.4	23.5	28.9	2.5	67.9	0.612
g	Non-infected	26.9	16.1	0.5	25.9	28.0	0.1	132.7	
Total fat	Infected	56.6	27.9	2.6	51.5	61.7	14.4	173.8	0.327
g	Non-infected	54.1	25.6	0.9	52.4	55.8	2.6	195.0	
% Energy	Infected	25.5	7.0	0.6	24.3	26.8	9.7	39.7	0.620
From fat	Non-infected	25.9	7.5	0.3	25.4	26.4	2.2	47.0	
SFA	Infected	17.8	9.7	0.9	16.1	19.6	3.6	52.6	0.370
g	Non-infected	17.0	9.0	0.3	16.4	17.6	0.6	65.2	
MUFA	Infected	19.1	10.3	0.9	17.2	20.9	4.6	62.7	0.500
g	Non-infected	18.4	9.4	0.3	17.8	19.0	0.8	67.1	
PUFA	Infected	14.4	7.6	0.7	13.0	15.8	3.4	48.3	0.211
g	Non-infected	13.5	6.9	0.2	13.1	14.0	1.0	66.3	
Cholesterol	Infected	279.5	190.7	17.5	244.9	314.1	11.0	1,021.0	0.821
mg	Non-infected	284.0	204.2	6.8	270.6	297.4	1.0	1,791.0	
Carbohydrate	Infected	311.0	130.7	12.0	287.2	334.7	58.2	765.8	0.151
Total g	Non-infected	292.6	130.9	4.4	284.0	301.2	17.9	934.1	
% Energy	Infected	64.5	9.4	0.9	62.8	66.2	40.2	85.9	0.477
carbohydrate	Non-infected	63.8	10.0	0.3	63.2	64.5	35.4	88.4	
FIBRE	Infected	17.3	8.2	0.7	15.8	18.7	2.3	41.7	0.168
g	Non-infected	16.2	7.5	0.3	15.8	16.7	0.7	59.2	
Added sugar	Infected	55.7	47.9	4.4	47.0	64.4	0.2	240.8	0.395
g	Non-infected	51.7	47.6	1.6	48.6	54.8	0.5	383.0	
Calcium	Infected	405.4	212.8	19.5	366.8	444.0	61.0	1,226.0	0.925
1000 mg*	Non-infected	407.6	245.8	8.2	391.5	423.8	2.0	1,928.0	
Vitamin B12	Infected	4.8	4.7	0.4	4.0	5.7	0.2	24.2	0.992
2.4 µg*	Non-infected	4.8	5.1	0.2	4.5	5.1	0.1	40.7	
Iron	Infected	8.9	4.3	0.4	8.1	9.7	2.3	30.6	0.345
19.6 - 58.5 mg*	Non-infected	8.5	4.1	0.1	8.2	8.8	0.2	30.0	
Zinc	Infected	8.2	3.4	0.3	7.5	8.8	2.6	20.6	0.584
3.0 - 9.8 mg*	Non-infected	8.0	3.5	0.1	7.7	8.2	0.2	31.9	
Magnesium	Infected	303.9	128.7	11.8	280.5	327.2	100.0	759.0	0.188
220 mg*	Non-infected	287.6	125.9	4.2	279.4	295.9	16.0	1,113.0	
Vitamin A	Infected	741.4	576.7	52.9	636.7	846.1	53.0	3,028.0	0.746
500 µg*	Non-infected	764.1	731.0	24.4	716.1	812.0	8.0	6,370.0	

Table 4.3.1: THUSA women - Dietary intake (Cont.)

Nutrient	HIV Status	Mean	SD	SE	95% CI		Min	Max	p
					Lower Bound	Upper Bound			
*WHO Rec/d									
Thiamin	Infected	1.1	0.5	0.0	1.0	1.2	0.3	4.0	
1.1 mg *	Non-infected	1.1	0.5	0.0	1.0	1.1	0.1	3.2	0.356
Riboflavin	Infected	1.3	0.7	0.1	1.2	1.5	0.4	4.9	
1.1 mg*	Non-infected	1.3	0.7	0.0	1.3	1.4	0.1	5.1	0.917
Niacin	Infected	12.9	6.2	0.6	11.8	14.1	3.1	41.9	
14 mg*	Non-infected	12.3	6.0	0.2	11.9	12.7	0.7	42.7	0.291
Vitamin B6	Infected	1.0	0.6	0.1	0.9	1.2	0.3	4.3	
1.3 mg*	Non-infected	1.0	0.5	0.0	1.0	1.0	0.0	4.2	0.412
Folic acid	Infected	197.1	80.5	7.4	182.5	211.7	47.0	472.0	
400µg*	Non-infected	192.1	82.1	2.7	186.7	197.5	3.0	574.0	0.527
Vitamin C	Infected	40.0	46.7	4.3	31.5	48.5	4.0	345.0	
45 mg*	Non-infected	38.8	42.0	1.4	36.0	41.5	1.0	410.0	0.760
Pantothenic acid	Infected	3.6	1.4	0.1	3.3	3.8	1.3	7.7	
5.0 mg*	Non-infected	3.5	1.5	0.0	3.4	3.6	0.1	11.6	0.557
Biotin	Infected	21.9	10.7	1.0	19.9	23.8	5.4	59.6	
30µg*	Non-infected	21.6	11.9	0.4	20.8	22.4	0.7	102.7	0.793
Vitamin D	Infected	4.3	3.5	0.3	3.6	4.9	0.1	17.1	
5µg*	Non-infected	4.3	3.8	0.1	4.0	4.5	0.0	34.2	0.958
Vitamin E	Infected	10.7	6.0	0.6	9.6	11.8	1.9	36.9	
7.5 mg*	Non-infected	10.2	5.8	0.2	9.8	10.5	0.7	53.8	0.383
ALCOHOL	Infected	3.8	10.2	0.9	2.0	5.7	0.0	57.9	
	Non-infected	2.7	10.7	0.4	2.0	3.4	0.0	136.6	0.299

* WHO (2004b) Rec/d nutrient intakes per day: World Health Organization's recommendations for nutrient intakes per day

SFA: Saturated Fatty Acids; MUFA : Monounsaturated fatty acid; PUFA: Polyunsaturated fatty acids

Table 4.3.2: Nutrient intakes of the Manguang women

Nutrient	WHO Rec/d	HIV Status	Mean	SD	SE	95% CI		Min	Max	p
						Lower Bound	Upper Bound			
Total energy kJ		Infected	12,239	5,502	349	11,552	12,926	1,670	34,475	0.181
		Non-infected	11,589	5,199	336	10,927	12,252	2,514	35,312	
Total protein g		Infected	88.0	43.2	2.7	82.6	93.4	8.0	276.0	0.372
		Non-infected	84.6	40.4	2.6	79.4	89.7	10.4	295.5	
% Energy from protein		Infected	12.3	2.4	0.2	12.0	12.6	5.9	21.6	0.487
		Non-infected	12.5	2.4	0.2	12.2	12.8	7.0	24.2	
Plant protein g		Infected	38.0	20.2	1.3	35.4	40.5	2.9	126.1	0.470
		Non-infected	36.7	19.1	1.2	34.2	39.1	4.7	115.9	
Animal protein g		Infected	46.6	28.9	1.8	43.0	50.2	0.0	209.3	0.537
		Non-infected	45.1	26.4	1.7	41.7	48.5	4.1	163.3	
Total fat g		Infected	103.4	55.5	3.5	96.5	110.4	12.4	371.2	0.196
		Non-infected	97.2	51.1	3.3	90.7	103.7	16.8	318.3	
% Energy from fat		Infected	31.8	7.9	0.5	30.8	32.7	7.8	54.4	0.816
		Non-infected	31.6	7.8	0.5	30.6	32.6	10.2	53.6	
SFA g		Infected	29.5	17.1	1.1	27.3	31.6	3.8	122.2	0.446
		Non-infected	28.3	15.5	1.0	26.4	30.3	4.5	100.5	
MUFA g		Infected	33.8	18.9	1.2	31.4	36.1	3.9	132.9	0.401
		Non-infected	32.4	17.8	1.2	30.1	34.7	4.0	103.3	
PUFA g		Infected	29.5	17.6	1.1	27.3	31.7	2.7	103.5	0.102
		Non-infected	27.0	16.5	1.1	24.9	29.1	2.7	133.6	
Cholesterol mg		Infected	370.0	258.8	16.4	337.7	402.3	3.3	1,480.0	0.365
		Non-infected	349.1	250.2	16.2	317.2	381.0	18.7	1,928.8	
Total Carbohydrate g		Infected	371.9	174.1	11.0	350.2	393.7	51.3	1,091.8	0.300
		Non-infected	355.7	171.0	11.1	333.9	377.5	83.7	1,052.6	
% Energy carbohydrate		Infected	51.9	7.9	0.5	50.9	52.9	33.0	79.7	0.433
		Non-infected	52.5	8.4	0.5	51.4	53.5	31.3	76.9	
FIBRE g		Infected	24.2	13.0	0.8	22.6	25.9	1.5	85.4	0.544
		Non-infected	23.5	12.6	0.8	21.9	25.1	3.5	72.3	
Added sugar g		Infected	81.2	48.2	3.1	75.2	87.3	0.6	259.7	0.757
		Non-infected	79.9	50.9	3.3	73.4	86.3	3.4	296.9	
Calcium 1000 mg*		Infected	777.4	484.0	30.7	717.0	837.8	74.0	2,890.3	0.050
		Non-infected	695.2	438.8	28.4	639.2	751.1	72.8	2,787.9	
Vitamin B12 2.4 µg*		Infected	7.0	6.3	0.4	6.2	7.8	0.1	50.2	0.092
		Non-infected	6.1	5.4	0.4	5.4	6.8	0.2	41.1	
Iron 19.6 - 58.5 mg*		Infected	14.9	11.0	0.7	13.5	16.2	2.2	73.1	0.043
		Non-infected	13.1	7.3	0.5	12.2	14.1	2.1	50.2	
Zinc 3.0 - 9.8 mg*		Infected	11.1	5.6	0.4	10.4	11.8	0.5	38.0	0.548
		Non-infected	10.8	5.6	0.4	10.1	11.5	1.3	36.5	

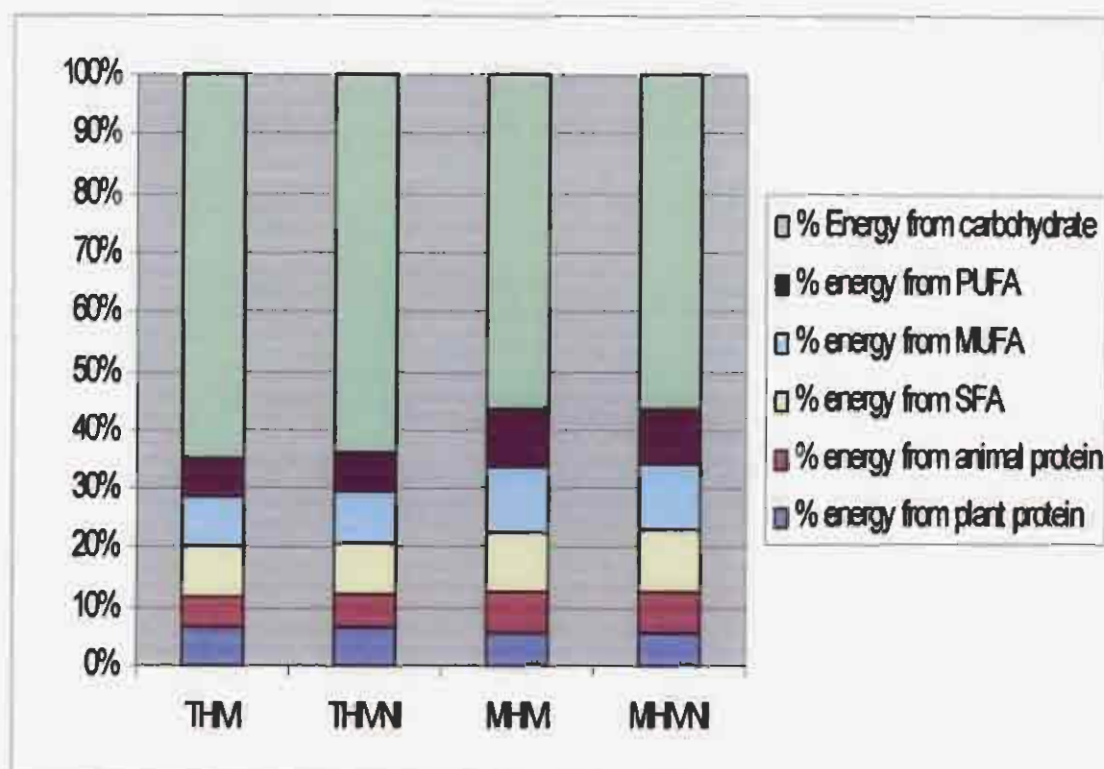
Table 4.3.2: Nutrient intakes of the Mungaung women (Cont.)

Nutrient	HIV Status	Mean	SD	SE	95% CI		Min	Max	p
					Lower Bound	Upper Bound			
WHO Rec/d									
Magnesium 220 mg*	Infected	414.8	197.7	12.5	390.1	439.4	40.2	1,364.9	
	Non-infected	389.5	183.1	11.8	366.1	412.8	73.1	1,243.4	0.144
Vitamin A 500 µg*	Infected	939.3	819.7	51.9	837.0	1,041.6	48.8	5,933.8	
	Non-infected	937.5	785.9	50.8	837.3	1,037.6	99.9	5,197.8	0.980
Thiamin 1.1 mg *	Infected	1.8	1.1	0.1	1.7	1.9	0.3	10.3	
	Non-infected	1.7	0.8	0.1	1.5	1.8	0.3	4.7	0.076
Riboflavin 1.1 mg*	Infected	2.6	2.8	0.2	2.2	2.9	0.2	37.7	
	Non-infected	2.3	1.6	0.1	2.1	2.5	0.3	9.7	0.190
Niacin 14 mg*	Infected	22.7	14.5	0.9	20.9	24.5	4.2	106.1	
	Non-infected	20.6	10.7	0.7	19.3	22.0	2.2	62.0	0.071
Vitamin B6 1.3 mg*	Infected	1.7	1.3	0.1	1.5	1.8	0.3	12.0	
	Non-infected	1.5	0.8	0.0	1.4	1.6	0.2	4.0	0.030
Folic acid 400µg*	Infected	286.9	201.4	12.8	261.8	312.1	31.1	1,525.3	
	Non-infected	265.3	145.4	9.4	246.8	283.9	38.0	941.2	0.176
Vitamin C 45 mg*	Infected	81.6	123.8	7.8	66.2	97.1	3.6	1,424.4	
	Non-infected	76.9	126.1	8.2	60.8	92.9	3.2	1,690.7	0.673
Pantothenic acid 5.0 mg*	Infected	6.3	3.4	0.2	5.9	6.7	0.4	21.6	
	Non-infected	6.1	3.1	0.2	5.7	6.5	0.7	17.6	0.527
Biotin 30µg*	Infected	42.6	33.4	2.1	38.4	46.8	1.9	325.1	
	Non-infected	39.0	25.1	1.6	35.8	42.2	5.0	167.2	0.180
Vitamin D 5µg*	Infected	6.1	4.8	0.3	5.5	6.7	0.0	36.3	
	Non-infected	5.2	4.1	0.3	4.7	5.8	0.3	31.8	0.038
Vitamin E 7.5 mg*	Infected	17.9	12.5	0.8	16.3	19.5	0.8	74.4	
	Non-infected	16.6	11.4	0.7	15.2	18.1	2.1	92.6	0.234
ALCOHOL	Infected	6.2	15.1	1.0	4.3	8.1	0.0	117.0	
	Non-infected	3.7	8.6	0.6	2.6	4.8	0.0	92.6	0.025

* WHO (2004:b) Rec/d nutrient intakes per day: World Health Organization's recommendations

for nutrient intakes per day

SFA: Saturated Fatty Acids; MUFA : Monounsaturated fatty acid; PUFA: Polyunsaturated fatty acids



THIVI: THUSA HIV-infected; THIVNI: THUSA non-infected; MHIVI: Mangaung HIV-infected; MHIVNI: Mangaung HIV-non-infected

Fig. 4.1: The percentages of energy contributed by the different macronutrients in the THUSA and Mangaung women

4.5 HEALTH OUTCOME VARIABLES

Tables 4.4.1 and 4.4.2 describe the selected biochemical and physiological health outcomes of the four groups of participating women. Unfortunately, not all variables were measured in both studies (as mentioned in Chapter 3). The selection was based on those variables that will indicate nutrition and health status (total protein and albumin), risk factors for chronic diseases (serum total cholesterol, triglycerides, glucose, insulin and blood pressure), acute phase proteins (plasma fibrinogen and serum ferritin), and liver enzymes in the THUSA study and lymphocytes in the Mangaung study. In two instances, namely total serum protein and fasting serum insulin, there were large differences in mean values between the studies, suggesting possible methodological influences.

- *Total serum protein and albumin*

In the THUSA study, as well as in the Mangaung study, mean total serum protein increased significantly in infected women compared to non-infected women, respectively (78.5 and 73.6 g/L in the THUSA study and 94.5 and 85.7 g/L). The opposite results were seen in the mean serum albumin levels, where infected women had significantly lower albumin levels than non-infected women (40.2 and 43.0 g/L in the THUSA study and 41.3 - 43.8 g/L in the Mangaung study).

- *Serum lipids*

Serum triglyceride levels (TG) of all four groups were similar, in normal ranges, and did not differ significantly (mean values varied from 1.1 to 1.3 mmol/L).

In both the THUSA and Mangaung studies, the infected women had a significantly lower mean serum TC than non-infected women (3.9 versus 4.3 mmol/L, $p \leq 0.0001$ and 4.41 versus 4.71 mmol/L, $p \leq 0.01$). Table 4.4.1 indicates that in the THUSA study, the difference in TC was because of differences in both HDL-C and LDL-C. These results have been examined by additional analyses (Tables 4.6.1 and 4.6.2) and will be discussed in Chapter 5.

- *Glucose and insulin*

The differences in mean glucose and insulin levels between infected and non-infected women in both studies were small and not significant.

- *Blood pressure*

Mean systolic and diastolic blood pressure of HIV-infected women were lower in both studies: significant for systolic pressure in both studies and for diastolic pressure in the Mangaung study.

- *Acute-phase markers*

Mean plasma fibrinogen was lower in infected subjects (significant in the Mangaung study). It could have been expected that the differences between infected and non-infected women of this acute-phase protein should have been indicative of an infectious, inflammatory response state. This was not the case. The mean levels of all four groups were higher than the 2.0-2.5 g/L regarded as the normal range. However, Vorster *et al.* (1998;169) have shown that plasma fibrinogen level of Africans are higher than that of Caucasians, and James *et al.* (2000: 383) that in the THUSA study, the higher fibrinogen levels of women were associated with obesity and micronutrient undernutrition. Raised plasma fibrinogen levels are also associated with an increased risk of cardiovascular disease (Rudnicka *et al.*, 2006:2405). In the Mangaung study, the decrease of 0.28 g/L in mean fibrinogen could have been the result of weight loss which is a known determinant of plasma fibrinogen (Vorster *et al.*, 1998).

- *"Liver enzymes"*

Table 4.4.1 shows that in the THUSA study, all circulating liver enzymes were higher in the infected women, significant for ALT and ASP, indicating that even in early, asymptomatic HIV infection, liver damage and consequent increases in serum liver enzymes are observed.

- *Lymphocytes*

The mean lymphocytes levels in the infected women of the Mangaung study were significant lower in the infected group (2.11 compared to 2.36 x10⁹/L).

Table 4.4.1: Health Outcome variables of the THUSA women

Women										
Variable	HIV Status	Mean	SD	SE	95% CI		Min	Max	p	*Normal
					Lower Bound	Upper Bound				Ranges
Proteins to indicate nutritional status										
S-Prot	Infected	78.5	10.2	0.9	76.7	80.4	62.0	119.8	0.000	66 - 79
	Uninfected	73.6	6.2	0.2	73.2	74.0	43.1	93.3		g/L
S-Alb	Infected	40.2	4.9	0.5	39.3	41.1	23.2	51.3	0.000	39 - 50
	Uninfected	43.0	4.0	0.1	42.7	43.3	24.9	57.2		g/L
Liver damage markers										
S-ALP	Infected	72.5	29.9	2.8	67.0	78.0	31.2	226.9	NS	38-102
	Uninfected	72.0	25.3	0.9	70.3	73.7	25.1	261.3		IU/L
S-GGT	Infected	32.4	35.2	3.3	26.0	38.9	5.6	236.0	NS	8 - 32
	Uninfected	29.0	30.3	1.0	27.0	31.0	0.0	286.6		IU/L
S-ALT	Infected	14.4	22.0	2.0	10.4	18.5	2.0	189.7	0.013	6-32
	Uninfected	11.0	9.9	0.3	10.3	11.6	0.1	120.2		IU/L
S-AST	Infected	23.7	15.9	1.5	20.8	26.6	9.9	111.0	0.000	9-34
	Uninfected	19.1	11.8	0.4	18.3	19.9	6.7	159.9		IU/L
S-LD	Infected	140.1	37.6	3.5	133.2	147.1	32.4	245.2	NS	
	Uninfected	135.1	34.4	1.2	132.8	137.4	43.1	484.2		
Non-communicable disease risk factors										
Tot Chol	Infected	3.90	1.00	0.10	3.70	4.10	1.80	6.60	0.000	3.4- 5.4
	Uninfected	4.3	1.1	0.0	4.2	4.4	1.9	8.8		mmol/L
HDL	Infected	1.0	0.3	0.0	1.0	1.1	0.5	2.5	0.000	>1.0
	Uninfected	1.2	0.3	0.0	1.1	1.2	0.4	2.7		mmol/L
LDL	Infected	2.5	0.9	0.1	2.3	2.7	0.5	5.3	NS	<3.5
	Uninfected	2.7	1.0	0.0	2.6	2.8	0.6	7.6		mmol/L
S-TG	Infected	1.1	0.5	0.0	1.0	1.1	0.4	2.7	NS	0.3 - 1.5
	Uninfected	1.2	0.7	0.0	1.1	1.2	0.3	8.7		mmol/L
S-Glucose	Infected	4.6	0.7	0.1	4.4	4.7	3.0	6.5	NS	≤7.1.
	Uninfected	4.8	2.0	0.1	4.7	5.0	2.7	34.6		mmol/L
S-Insulin	Infected	25.1	27.6	3.0	19.2	30.9	6.3	220.4	NS	10 - 25.0
	Uninfected	26.0	21.8	0.9	24.2	27.7	1.8	225.2		µU/l
SBP	Infected	122.1	16.6	1.5	119.1	125.1	90.0	180.0	0.005	140
	Uninfected	128.0	22.2	0.7	126.6	129.5	75.0	260.0		mmHg
DBP	Infected	77.0	11.2	1.0	74.9	79.0	56.0	110.0	NS	90
	Uninfected	78.8	13.7	0.5	77.9	79.7	50.0	142.0		mmHG
Infection markers										
S-FBG	Infected	3.5	1.2	0.1	3.3	3.8	1.3	8.1	NS	2.5 3.0
	Uninfected	3.6	1.1	0.0	3.6	3.7	0.6	10.3		g/L
S-Ferritin	Infected	67.9	69.5	6.3	55.4	80.5	1.0	280.0	NS	20 - 250
	Uninfected	80.7	108.7	3.6	73.6	87.9	0.3	825.9		µg/l

* As given by Institute for Pathology, University of Pretoria

Prot: protein; Alb: albumin; ALP: alkaline phosphatase; GGT: gamma glutamyltranspeptidase;

ALT: alanine aminotransferase; AST: aspartate aminotransferase; LD: lactic dehydrogenase

Chol: cholesterol; FBG: fibrinogen; SBP: systolic blood pressure; DBP: diastolic blood pressure

Table 4.4.2: Health outcome variables of the Mangaung women

Variable	HIV Status	Mean	SD	SE	95% CI		Min	Max	p	*Normal
					Lower Bound	Upper Bound				Ranges
Proteins to indicate nutritional status										
S-Prot	Infected	94.49	18.38	1.16	92.20	96.79	65.00	206.00	0.000	66 - 79 g/L
	Uninfected	85.72	16.67	1.08	83.59	87.85	67.00	204.00		
S-Alb	Infected	41.34	8.56	0.54	40.27	42.41	19.80	96.60	0.000	39 - 50 g/L
	Uninfected	43.78	7.90	0.51	42.77	44.79	32.60	106.20		
Non-communicable disease risk factors										
S-Tot chol	Infected	4.41	1.28	0.08	4.25	4.57	2.00	10.60	0.010	3.4- 5.4 mmol/L
	Uninfected	4.71	1.28	0.08	4.54	4.87	2.40	11.00		
S -TG	Infected	1.11	0.53	0.03	1.05	1.18	0.37	3.75	NS	0.3 - 1.5 mmol/L
	Uninfected	1.25	1.03	0.07	1.12	1.38	0.38	9.68		
S- glucose	Infected	4.53	1.30	0.08	4.37	4.70	1.41	10.50	NS	≤7.1. mmol/L
	Uninfected	4.65	1.67	0.11	4.44	4.86	1.69	18.01		
S-insulin	Infected	11.38	15.60	0.99	9.42	13.33	1.00	115.00	NS	10 - 25.0 μU/l
	Uninfected	11.27	13.84	0.90	9.51	13.04	1.00	80.00		
SBP	Infected	123.59	19.19	1.22	121.20	125.99	70.00	200.00	0.000	140 mmHg
	Uninfected	135.79	23.81	1.54	132.76	138.83	90.00	240.00		
DBP	Infected	82.18	18.20	1.15	79.90	84.45	10.00	280.00	0.001	90 mmHg
	Uninfected	86.96	13.62	0.88	85.22	88.69	50.00	140.00		
Infection markers										
S -FBG	Infected	3.25	0.86	0.06	3.14	3.36	1.20	5.62	0.001	2.5 3.0 g/L
	Uninfected	3.53	0.94	0.06	3.40	3.65	1.14	5.82		
S-ferritin	Infected	87.83	66.16	5.57	76.81	98.84	7.31	644.32	0.023	20 - 250 μg/l
	Uninfected	83.38	87.22	7.40	68.75	98.01	11.18	559.35		
Lymphocytes	Infected	2.11	0.65	0.04	2.03	2.20	0.50	4.50	0.000	0.8 - 3.3 x 10 ⁹ / L
	Uninfected	2.36	0.64	0.04	2.28	2.45	0.90	5.00		

* As given by Institute for Pathology, University of Pretoria

Prot: protein; Alb: albumin Chol: cholesterol; FBG: fibrinogen; SBP: systolic blood pressure;

DBP: diastolic blood pressure;

4.6 RELATIONSHIPS BETWEEN DIETARY INTAKES AND HEALTH OUTCOME VARIABLES

Despite the small numbers of the four groups examined in this analysis, an attempt was made to correlate dietary (nutrient) intakes with health outcome variables, based on the high and highly significant correlations found in the THUSA study (Vorster *et al.*, 2004:1055).

Significant ($p \leq 0.05$) correlations were only observed in the infected women of the THUSA-study, and are shown in Table 4.5. Total fat intake and the fat soluble vitamins D and E, correlated positively with total serum protein. Percentage energy from protein correlated negatively with the liver enzyme, lactate dehydrogenase, while plant protein correlated positively with this enzyme, indicating that the negative (and therefore “beneficial”) correlation of percentage protein was possibly because of a beneficial effect of animal protein. This important observation, supporting the suggestion that animal-derived foods are beneficial in the diets of HIV-infected subjects (Vorster *et al.*, 2004:1061 & 1063) will be discussed in Chapter 5.

The significant correlation between intakes of energy, protein, carbohydrate and added sugar with serum glucose are not unexpected, given the known relationships between diet and blood (serum) glucose (Cataldo *et al.*, 2003: 122–124).

It is, however, unexpected that these relationships were only observed in the infected subjects participating in the THUSA study which was the smallest group (see Table 4.1).

Table 4.5 Correlations between dietary intakes and health outcome variables in the THUSA women

HIV- infected			
Variables		R	p
Biological	Diet		
S-Prot	Total fat	0.303	0.009
S-Prot	Vit D	0.313	0.007
S-Prot	Vit E	0.304	0.009
S-LD	% energy from protein	-0.335	0.004
S-LD	Plant protein	0.303	0.009
S-Glk	Total energy	0.349	0.002
S-Glk	Total protein	0.327	0.005
S-Glk	Plant protein	0.362	0.002
S-Glk	Total carbohydrate	0.337	0.003
S-Glk	Added sugar	0.388	0.001
DBP	Cholesterol	0.353	0.002
DBP	Biotin	0.303	0.009

S: serum; Prot: protein; LD: lactic dehydrogenase;
 Glk: glucose; DBP: diastolic blood pressure

4.7 DIETARY INTAKES AND SERUM TOTAL CHOLESTEROL

In Tables 4.6.1 and 4.6.2, mean macronutrient intakes of infected and non-infected women with TC levels above and below the median level are given. The purpose of this analysis was to examine possible dietary contributions to the drop in TC levels in infected women participating in the two studies.

In Table 4.6.1 the nutrient intakes of infected and non-infected women in the THUSA study with TC levels above and below the median are compared. The non-infected women with lower serum cholesterol levels had significantly lower intakes of percentage energy from fat, percentage energy from total protein and animal protein, and significantly higher intakes of plant protein and fibre. It is important to note that even with such low TC levels (median 4.13 mmol/L), this "cholesterol lowering" effect of the diet can still be observed. The table further shows that these significant differences disappeared in the HIV infected women, suggesting that HIV infection in the THUSA

study was responsible for the lower TC levels of the infected women or that the effects of the virus were greater than that of the diet.

To follow this up, nutrient intakes of infected and non-infected women with TC levels in the first and fourth quartile were also compared. Table 4.6.1.1 shows that in the non-infected THUSA women, there were 10 dietary intake values which differed significantly between the first and fourth quartile. Non-infected women participating in the THUSA study, with the lower TC levels had significantly lower intakes of protein (% of total energy), total fat (% of total energy) and vitamin B₁₂ and significantly higher intakes of total energy (TE), plant protein, total carbohydrate, % of TE from carbohydrate, dietary fibre, added sugar and thiamin. Except for TE and added sugar, these dietary differences are known to be associated with lower TC levels (Wolmerans & Oosthuizen, 2001:S48).

In the infected women (Table 4.6.1.1) saturated fat (SATFAT), calcium and the fat ratio (polyunsaturated/saturated (P/S) ratio) differed significantly between women in the first and the fourth quartile. These differences suggest that a diet high in saturated fat, low P/S ratio and calcium was associated with the higher TC levels in the infected women. This diet would contain more animal derived foods such as meat (source of SATFAT) and milk (source of calcium).

Table 4.6.2 shows that there were no significant nutrient intake differences in the HIV-infected and non-infected women from Mangaung with lower and higher than the median TC levels. HIV infection was associated with lower TC levels in these women, but it seems that dietary intakes could not differentiate between those with levels greater or lower than the median level in both the infected and non-infected women.

A comparison of women from Mangaung with TC levels in the first and fourth quartiles (Table 4.6.2.2) confirmed little effect of diet on TC levels in the non-infected women. However, in the infected women, those with the higher TC levels (fourth quartile) had significantly higher mean intakes of energy, total protein, animal protein, total fat, SATFAT, MUFAT, total carbohydrate, phosphorus, chromium and iodine. These intakes are, as in the diet of the THUSA women, commensurate with a diet higher in animal-derived foods.

Table 4.6.1. Mean ($\pm$ SD) on nutrient intakes of HIV-Infected and non-infected THUSA women with total serum cholesterol above and below median value

Nutrient	HIV-infected					HIV-non-infected				
	TC ≥ Median		TC < Median		p	TC ≥ Median		TC < Median		p
	n = 44		n = 72			n = 438		n =413		
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Total energy (kJ)	8,332	3,184	8,451	3,183	0.846	7,723	3,091	8,208	3,034	0.021
% energy from fat	25.5	6.8	25.3	7.1	0.851	26.4	7.6	25.2	7.5	0.027
SATFAT (g)	18.6	10.2	17.2	9.4	0.444	17.1	9.5	16.9	8.4	0.672
MUFAT (g)	19.2	11.6	18.8	9.6	0.842	18.4	9.9	18.4	8.8	0.924
PUFAT (g)	13.5	7.4	14.9	7.9	0.336	13.2	6.7	14.0	7.1	0.093
% energy from protein	11.8	2.1	11.4	2.1	0.348	12.1	2.2	11.6	2.1	0.000
Plant protein (g)	33.1	15.9	32.4	13.8	0.788	29.4	13.5	32.3	14.0	0.002
Animal protein (g)	26.0	14.5	25.5	14.6	0.868	27.7	17.0	25.6	14.6	0.055
% energy from carbohydrate	64.3	9.4	65.0	9.4	0.707	63.0	9.9	65.0	10.0	0.003
Added sugar (g)	52.9	35.9	54.3	42.5	0.856	47.9	42.8	55.4	49.6	0.018
Dietary fibre (g)	18.2	9.1	16.7	7.6	0.324	15.8	7.4	16.9	7.8	0.029
Dietary cholesterol (mg)	255.5	153.5	288.1	210.0	0.375	289.9	207.3	276.8	205.6	0.356

TC - total cholesterol; Median = 4.13 mmol/L

Table 4.6.2. Mean ($\pm$ SD) on nutrient intakes of HIV-Infected and non-infected Manguang women with total serum cholesterol above and below median value

Nutrient	HIV-infected					HIV-non-infected				
	TC ≥ Median		TC < Median		p	TC ≥ Median		TC < Median		p
	n =123		n= 126			n =140		n = 98		
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Total energy (kJ)	12,614	5,881	11,873	5,101	0.289	11,348	5,355	11,975	4,983	0.361
% energy from fat	31.7	7.6	31.8	8.1	0.945	31.7	7.9	31.5	7.8	0.840
SATFAT (g)	30.4	17.7	28.6	16.4	0.414	27.9	16.0	29.0	14.9	0.588
MUFAT (g)	35.1	20.5	32.5	17.1	0.276	32.1	18.4	33.0	17.0	0.696
PUFAT (g)	29.9	17.0	29.2	18.2	0.771	26.8	17.5	27.4	15.0	0.803
% energy from protein	12.2	2.3	12.4	2.5	0.557	12.4	2.1	12.5	2.8	0.849
Plant protein (g)	39.5	21.4	36.4	18.9	0.225	83.4	43.2	86.5	36.3	0.808
Animal protein (g)	48.2	31.3	45.1	26.3	0.410	44.0	27.3	46.6	25.2	0.450
% energy from carbohydrate	52.3	7.9	51.5	8.0	0.429	52.1	8.0	52.9	9.0	0.482
Added sugar (g)	82.4	48.5	80.1	48.0	0.429	74.8	48.0	86.8	54.5	0.074
Dietary fibre (g)	25.1	13.4	23.4	12.7	0.285	23.7	13.1	23.5	11.9	0.918
Dietary cholesterol (mg)	368.6	276.3	371.4	241.6	0.934	348.2	256.0	351.5	244.1	0.921

TC - total cholesterol; Median = 4.3mmol/L

Table 4.6.1.1 Comparison of mean (SE) dietary intakes, which differed significantly ($p < 0.05$) in HIV-infected and non-infected THUSA women with total serum cholesterol in the first and fourth quartile

Nutrient	HIV-infected					HIV-non-infected				
	TC 1 st quartile		TC 4 th quartile		p	TC 1 st quartile		TC 4 th quartile		p
	Mean	SE	Mean	SE		Mean	SE	Mean	SE	
SATFAT (g)	16.99	1.56	22.70	2.18	.037	16.915	.642	17.293	.616	NS
Calcium (mg)	377.37	37.07	509.19	51.78	.043	414.58	17.44	415.77	16.75	NS
Fat ratio	.95	.06	.67	.08	.004	.91	.03	.86	.02	NS
Total energy (kJ)	8318.8	512.87	8787.33	716.63	NS	8323.72	206.32	7510.04	198.15	.011
% energy from protein	11.12	.31	11.56	.43	NS	11.51	.15	12.21	.15	.001
Plant protein (g)	33.16	2.32	33.86	3.24	NS	33.66	.96	28.64	.92	.000
% energy from fat	24.77	1.06	26.81	1.49	NS	24.67	.53	26.58	.50	.009
Total carbohydrate (g)	317.49	19.88	319.93	27.65	NS	320.18	8.98	273.35	8.62	.000
% energy from carbohydrate	65.88	1.44	63.37	2.01	NS	65.78	.69	62.61	.67	.001
Fibre (g)	17.1	1.27	18.35	1.77	NS	17.59	.53	15.59	.51	.008
Added sugar (g)	52.04	6.03	54.29	8.43	NS	56.22	3.20	47.34	3.07	.046
Vit B ₁₂ (µg)	3.92	.68	5.15	.95	NS	4.45	.41	5.76	.39	.021
Thiamin (mg)	1.08	.09	1.24	.13	NS	1.13	.03	1.03	.03	.036

TC 1st quartile (3.44mmol/L); TC 4th quartile (4.84mmol/L)

TC: total cholesterol; SATFAT; saturated fatty acids

Table 4.6.2.2 Comparison of mean (SE) dietary intakes, which differed significantly ($p < 0.05$) in HIV-infected and non-infected Mangaung women with total serum cholesterol in the first and fourth quartile

Nutrient	HIV-infected					HIV-non-infected				
	TC 1 st quartile		TC 4 th quartile		p	TC 1 st quartile		TC 4 th quartile		p
	Mean	SE	Mean	SE		Mean	SE	Mean	SE	
Riboflavin (mg)	2.40	.42	3.57	.47	NS	1.81	.22	2.46	.17	.020
Total energy (kJ)	11869.59	721.10	14166.50	811.42	.036	10810.06	791.10	11379.67	601.94	NS
Total protein (g)	84.65	5.64	102.16	6.34	.041	79.79	6.51	85.37	4.95	NS
Animal protein (g)	44.55	3.70	56.44	4.15	.034	42.38	4.30	46.22	3.27	NS
Total fat (g)	99.0	7.02	122.96	7.90	.025	86.93	7.85	97.49	5.97	NS
SATFAT (g)	27.82	2.23	35.71	2.51	.020	25.58	2.38	28.38	1.81	NS
MUFAT (g)	32.30	2.33	40.10	2.62	.028	28.79	2.75	32.73	2.09	NS
Total carbohydrate (g)	358.23	22.80	428.31	25.62	.043	341.40	25.20	339.66	19.17	NS
Phosphorus (mg)	1423.80	90.36	1712.14	101.56	.036	1293.24	104.42	1388.55	79.45	NS
Chromium (μ g)	46.60	4.11	59.80	4.62	.035	43.46	5.17	49.49	3.93	NS
Iodine (μ g)	43.21	3.90	55.33	4.38	.041	39.60	4.80	43.50	3.61	NS

TC 1st quartile (3.7 mmol/L); TC 4th quartile (5.1 mmol/L)

SATFAT: saturated fatty acid; MUFAT: monounsaturated fatty acids

4.8 DIETARY INTAKES AND SERUM ALBUMIN

Tables 4.7.1 and 4.7.2, show the mean macronutrient intakes of infected and non-infected women with serum albumin levels above and below the median level. This analysis was done to examine whether there were possible dietary contributions to the drop in serum albumin levels in the HIV infected women in the two studies.

In Table 4.7.1 the nutrient intakes of infected and non-infected THUSA women with serum albumin levels above and below the median are compared. In the non-infected group with higher albumin levels, significant differences were observed in percentage energy from fat (26.6 versus 24.9%; $p \leq 0.001$) protein (12.2 versus 11.6%; $p \leq 0.001$) and carbohydrate (62.8 versus 65.2%; $p \leq 0.000$). The group with the higher albumin levels had higher intakes from percentage energy from fat and protein and lower intakes from carbohydrate. Higher intakes of SATFAT, MUFAT as well as higher intakes of animal protein (statistical significant) were observed in the group with higher than the

median levels of serum albumin. In the infected group, differences of intakes of fat as a percentage of energy were close to significant ($p \leq 0.053$) with those with higher albumin levels having the greater intake (27.3 versus 24.5%).

Table 4.7.2 shows that the HIV-infected women with higher serum albumin levels in the Mangaung study had significant higher energy (13 275 versus 11 622kJ; $p \leq 0.022$), PUFA (32.3 versus 17.3g; $p \leq 0.036$), dietary cholesterol (412.9 versus 344.5 mg; $p \leq 0.043$) and plant protein (42.3 versus 35.3g; $p \leq 0.008$) intakes. No significant different intakes were observed between the uninfected high or low albumin levels.

Although none of the other, (than described above), macronutrient intakes were significantly different in the high and low albumin HIV infected group in both the THUSA and Mangaung studies, all the macronutrient intakes were higher with only plant protein and percentage energy from carbohydrate being lower in the THUSA group, and percentage energy from protein in the Mangaung group.

As in the case of total serum cholesterol levels, the mean intakes of infected and non-infected women with albumin levels in the first and fourth quartiles were also compared (Tables 4.7.1.1 and 4.7.1.2).

Table 4.7.1.1 shows that significant differences were observed in the intakes in the non-infected THUSA women who had serum albumin in the first and fourth quartiles. Significantly lower intakes in percentage energy from protein and fat, animal protein, total fat, SATFAT, MUFAT, calcium, zinc, vitamin C and fat ratio, were seen in the first quartile. Significantly higher carbohydrates intakes were observed in the women who had serum albumin levels in the first quartile.

In table 4.7.2.2 significant differences were seen in the intakes between infected women who had serum albumin levels in the first and fourth quartiles. Significantly lower intakes of total energy, protein, fat, MUFAT, SATFAT, carbohydrate, magnesium, zinc, chromium, biotin, pantothenic acid and iodine were seen in the infected women with serum albumin levels in the first quartile. In the non-infected women significantly lower intakes of calcium were observed in the group who had serum albumin levels in the first quartile compared to those who had serum albumin levels in the fourth quartile.

These findings support those in Tables 4.7.1 and 4.7.2, suggesting that women who followed a diet with more animal-derived products, providing the saturated fat and micronutrients, had higher albumin levels.

Table 4.7.1. Mean ($\pm$ SD) on nutrient intakes of HIV-Infected and non-infected THUSA women with total serum albumin above and below median value

Nutrient	HIV-infected					HIV-non-infected				
	S-Alb ≥ Median		S-Alb < Median		p	S-Alb ≥ Median		S-Alb < Median		p
	n = 34		n = 82			n=451		n=400		
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Total energy (kJ)	8,297	3,591	8,450	3,001	0.814	7,908	2,997	7,965	3,109	0.789
% energy from fat	27.3	7.6	24.5	6.6	0.053	26.6	7.3	24.9	7.7	0.001
SATFAT (g)	18.9	10.7	17.2	9.2	0.392	17.7	9.0	16.1	8.5	0.008
MUFAT (g)	20.5	12.6	18.3	9.3	0.307	19.2	9.7	17.4	8.6	0.004
PUFAT (g)	15.1	8.2	14.1	7.5	0.529	13.6	6.5	13.6	7.2	0.931
% energy protein	11.9	2.4	11.4	2.0	0.267	12.1	2.2	11.6	2.1	0.001
Plant protein (g)	32.0	17.3	33.0	13.4	0.747	30.0	13.2	31.6	14.5	0.112
Animal protein (g)	27.5	15.0	25.0	14.4	0.404	28.5	16.4	24.4	14.1	0.000
% energy from carbohydrate	62.3	10.4	65.8	8.8	0.575	62.8	9.6	65.2	10.3	0.000
Added sugar (g)	54.4	38.8	53.5	40.7	0.910	49.7	44.1	53.0	48.6	0.304
Dietary fibre (g)	17.4	9.5	17.2	7.7	0.912	16.2	7.3	16.3	7.8	0.795
Dietary cholesterol (mg)	306.6	190.1	262.9	190.4	0.262	274.1	174.2	292.3	235.1	0.197

S-alb: serum albumin; SATFAT: saturated fatty acids; MUFAT: monounsaturated fatty acids; PUFAT: polyunsaturated fatty acids
Median = 42.7

Table 4.7.2. Mean ($\pm$ SD) on nutrient intakes of HIV-Infected and non-infected Mangaung women with total serum albumin above and below median value

Nutrient	HIV-infected					HIV-non-infected				
	S-Alb ≥ Median		S-Alb < Median		p	S-Alb ≥ Median		S-Alb < Median		p
	n = 93		n= 156			n=87		n=150		
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Total energy (kJ)	13,275	5,908	11,622	5,166	0.022	11,668	5,382	11,490	4,942	0.800
% energy from fat	31.9	8.6	31.7	7.5	0.864	31.8	7.8	31.1	7.7	0.478
SATFAT (g)	31.7	18.6	28.2	16.0	0.117	29.3	16.9	26.7	12.8	0.215
MUFAT (g)	36.4	20.1	32.2	18.0	0.094	33.0	19.2	31.3	15.1	0.469
PUFAT (g)	32.6	17.7	27.7	17.3	0.036	27.8	18.3	25.5	12.6	0.313
% energy protein	12.2	2.5	12.4	2.4	0.567	12.4	2.1	12.6	2.9	0.541
Plant protein (g)	42.3	22.8	35.3	18.0	0.008	37.0	19.5	36.5	18.8	0.849
Animal protein (g)	50.0	33.4	44.6	25.7	0.155	45.8	28.0	44.2	23.7	0.657
% energy from carbohydrate	52.4	8.5	51.6	7.6	0.446	52.3	8.1	52.8	9.0	0.649
Added sugar (g)	83.5	46.3	79.9	49.4	0.569	79.9	52.9	79.5	48.3	0.953
Dietary fibre (g)	27.0	14.6	22.6	11.8	0.010	23.6	12.9	23.7	12.3	0.940
Dietary cholesterol (mg)	412.9	302.1	344.5	226.4	0.043	354.0	257.9	343.5	239.9	0.757

S-alb: serum albumin; SATFAT: saturated fatty acids; MUFAT: monounsaturated fatty acids; PUFAT: polyunsaturated fatty acids
Median =41.35

Table 4.7.1.1 Comparison of mean (SE) dietary intakes, which differed significantly ($p < 0.05$) in HIV-infected and non-infected THUSA women with serum albumin in the first and fourth quartile

Nutrient	HIV-infected					HIV-non-infected				
	S-alb 1 st quartile		S-alb 4 th quartile		p	S-alb 1 st quartile		S-alb 4 th quartile		p
	Mean	SE	Mean	SE		Mean	SE	Mean	SE	
TOT TRANF	1.19	.22	2.35	.43	.018	1.05	.08	1.81	.078	.000
% energy from protein	11.28	.25	10.72	.50	NS	11.42	.15	12.31	.14	.000
Animal protein (g)	25.9	2.26	28.11	4.42	NS	23.28	1.10	29.17	1.03	.000
Total fat (g)	58.28	4.15	71.22	8.13	NS	50.66	1.85	56.72	1.73	.017
% energy from fat	24.45	.91	27.09	1.79	NS	24.21	.54	27.40	.51	.000
SATFAT (g)	17.88	1.45	23.13	2.83	NS	15.65	.64	18.01	.60	.007
MUFAT	19.61	1.56	24.67	3.05	NS	16.68	.68	19.74	.64	.001
Total carbohydrate (g)	329.81	17.23	362.37	33.74	NS	305.92	9.17	277.75	8.59	.025
% energy from carbohydrate	65.96	1.20	64.15	2.35	NS	66.21	.72	61.76	.67	.000
Calcium (mg)	385.67	30.92	460.83	60.54	NS	364.82	16.17	423.09	15.14	.009
Zinc (mg)	8.58	.53	9.19	1.05	NS	7.46	.26	8.43	.24	.006
Vit B ₆	1.16	.08	1.20	.16	NS	.94	.04	1.05	.04	.038
Vit C	45.17	8.53	55.33	16.69	NS	32.58	2.82	44.23	2.64	.003
Fat ratio	.94	.05	.80	.11	NS	.94	.03	.85	.02	.007

S-alb 1st quartile (40.22g/L); S-alb 4th quartile (45.37 g/L)

S – alb: serum albumin; TOT TRANF: total trans- fatty acid; SATFAT: saturated fatty acid; MUFAT: monounsaturated fatty acids

Table 4.7.2.2 Comparison of mean (SE) dietary intakes, which differed significantly ($p < 0.05$) in HIV-infected and non-infected Mangaung women with total serum albumin in the first and fourth quartile

Nutrient	HIV-infected					HIV-non-infected				
	S-alb 1 st quartile		S-alb 4 th quartile		p	S-alb 1 st quartile		S-alb 4 th quartile		p
	Mean	SE	Mean	SE		Mean	SE	Mean	SE	
Calcium (mg)	734.12	47.81	819.18	70.85	NS	629.70	60.65	824.90	53.23	.017
Riboflavin (mg)	2.34	.30	3.41	.45	NS	1.89	.19	2.57	.17	NS
Total energy (kJ)	11605.04	552.71	13844.92	819.07	.025	11240.81	725.03	11759.52	636.32	NS
Total protein (g)	84.16	4.44	100.36	6.58	.043	82.24	5.79	86.81	5.08	NS
Plant protein (g)	35.21	1.94	44.05	2.87	.012	34.54	2.62	37.67	2.30	NS
Total fat (g)	96.62	5.55	121.86	8.23	.012	91.43	7.00	100.32	6.12	NS
MUFAT (g)	31.55	1.88	39.46	2.79	.020	30.89	2.41	33.12	2.11	NS
PUFAT (g)	27.23	1.72	36.27	2.55	.004	24.95	2.11	27.54	1.85	NS
Total carbohydrate (g)	351.95	17.00	411.82	25.19	.051	351.07	23.52	357.34	20.64	NS
Fibre (g)	23.07	1.30	28.21	1.92	.028	22.90	1.76	23.95	1.54	NS
Magnesium (mg)	394.74	20.00	468.55	29.57	.040	375.04	25.42	397.79	22.31	NS
Zinc (mg)	10.71	.58	12.81	.86	.045	10.27	.77	11.02	.67	NS
Chromium (µg)	44.91	3.26	57.33	4.83	.035	46.95	4.78	51.35	4.19	NS
Iodine (µg)	43.32	3.12	56.67	4.63	.018	44.71	4.48	45.63	3.93	NS
Pantothenic acid (mg)	6.09	.34	7.35	.51	.043	6.39	.45	6.05	.39	NS
Biotin (µg)	40.63	3.56	55.38	5.27	.022	38.39	3.59	41.08	3.15	NS

S-alb 1st quartile (38.9g/L); S-alb 4th quartile (43.9 g/L)

S – alb: serum albumin; SATFAT: saturated fatty acid; MUFAT: monounsaturated fatty acids

4.9 METABOLIC SYNDROME AND RISK OF NCDS

The percentages of infected and non-infected women with risk factors and markers of the metabolic syndrome (MS) and other non-communicable diseases (NCDs) are shown in Tables 4.8.1 and 4.8.2. The cut-off values to categorize these women are also shown in the Table (4.8.1 and 4.8.2) and are those usually used (Laquatra, 2004:569) for similar studies.

In the THUSA study, more infected than non-infected women had low HDL-levels (82.1 versus 71.1%). In the Mangaung study, more infected than uninfected women had blood glucose levels ≥ 6.1 mmol/L. Except for waist-hip ratio and plasma fibrinogen, more infected women in the Mangaung study had risk factors for the MS and NCDs than the women in the THUSA study.

These results indicate that substantial percentages of the non-infected women in both studies had at least one risk factor or marker for MS and NCDs, that these percentages, decreased with HIV infection, and that the THUSA women had lower prevalences of these risk factors and markers.

Table 4.8.1: the prevalence (%) of THUSA women with risk factors for the metabolic syndrome and NCD's

Variable	Infected	Non-infected	Difference	X 2	p	*Cut off values
Metabolic syndrome						
Large waist	17.8%	23.4%	5.6%	1.886(b)	NS	>88 cm
High TG	10.3%	15.3%	5.0%	2.038(b)	NS	>1.695 mmol/l
High BP	11.0%	20.4%	9.4%	5.894(b)	0.015	> 135/85 mmHg
High Glucose	4.3%	6.4%	2.1%	.793(b)	NS	>6.1mmol/l
Low HDL	82.1%	71.1%	-10.9%	6.179(b)	0.013	<1.295 mmol/l
NCD's						
High BMI	49.2%	54.3%	5.2%	1.115(b)	NS	>25
Large waist hip ratio	24.6%	28.6%	4.1%	.850(b)	NS	>0.8
High Tot Chol	10.3%	18.4%	8.1%	4.652(b)	0.031	> 5.2 mmol/l
High FBG	42.4%	48.1%	5.8%	1.389(b)	NS	>3.5g/L

* Mahan & Escott-Stump;

TG: triglycerides; BP: blood pressure; HDL: high density lipoprotein; BMI: body mass index

NCD's: non-communicable diseases; Tot chol: total cholesterol; FBG: fibrinogen

Table 4.8.2: the prevalence (%) of Mangaung women with risk factors for the metabolic syndrome and NCD's

Variable	Infected	Non-infected	Difference	X ²	p	*Cut off values
Metabolic syndrome						
Large waist	17.7%	23.4%	5.8%	2.484	NS	>88 cm
High TG	12.0%	16.0%	3.9%	1.555	NS	>1.695 mmol/l
High BP	16.1%	30.5%	14.5%	14.369	0.000	>135/85 mmHg
High Glucose	9.2%	8.8%	-0.4%	.025	NS	>6.1mmol/l
NCD's						
High BMI	49.4%	55.6%	6.3%	1.911	NS	>25
Large waist hip ratio	19.7%	28.5%	8.8%	5.150	0.023	>0.8
High Tot Chol	18.5%	26.1%	7.6%	4.047	0.044	> 5.2 mmol/l
High FBG	33.9%	48.5%	14.6%	10.060	0.002	>3.5g/L

* Mahan & Escott -Stump;

TG: triglycerides; BP: blood pressure; NCD's non-communicable diseases; BMI: body mass index

Tot chol: total cholesterol; FBG: fibrinogen

CHAPTER 5

DISCUSSION

5.1 LIMITATIONS AND APPROACH OF THE ANALYSIS

Both the THUSA and Mangaung randomized, cross-sectional, observational, studies were designed to examine the relationships between dietary exposures and selected health outcomes in black South Africans. In the THUSA study, the focus was on the effect of urbanization on these relationships (Vorster *et al.*, 2005). However, the realization that some of the recruited subjects may be infected with HIV and permission to test anonymously for infection, resulted in an unique, apparently healthy group of subjects who were infected but had no knowledge or symptoms of the infection. In the Mangaung study, the focus was on HIV prevalence amongst women in an identified urban area, and the effect of HIV on nutritional status. In the respective studies, the non-infected women were recruited at the same time, same settings and using the same inclusion and exclusion criteria as in the cases of the infected women. They can, therefore, be regarded as suitable controls. These two studies together examined 369 infected and 1528 non-infected women.

Because these studies were cross-sectional, observed relationships between nutrient intakes and health outcomes in the infected and non-infected women can only suggest possible links between diet and health. To unravel causal relationships, follow-up intervention studies that are designed to examine specific hypotheses are necessary.

The relatively small size of the two groups of infected women is also a limitation, because especially in the infected women, nutrient intakes could have been influenced by the infection.

In both infected and non-infected women, nutrient intakes are not the only determinant of the health outcome variables measured. Furthermore, it is rare that a specific health outcome variable can be related to a specific nutrient consumed or not consumed

(except in rare vitamin deficiency syndromes). Nutrients interact and work synergistically to influence health (Cataldo *et al.*, 2003:7).

In this analysis, we therefore followed the approach used in the THUSA-study (James *et al.*, 2000; Vorster *et al.*, 2004; Vorster *et al.*, 2005) in looking at dietary influences on health more holistically, integrating single nutrient effects. In the following discussion, the diets followed by the participating subjects, will be categorised as either “prudent” (low in fat, high in carbohydrate, plant protein and fibre) or “westernized” (high in fat and animal-derived proteins and low in total carbohydrate).

5.2 MOST RELEVANT OBSERVATIONS

The salient and relevant observations (from Chapter 4) can be summarized as follows:

- The Mangaung study population showed a higher prevalence of HIV infection than the THUSA study
- The Mangaung subjects were all recruited from an urban setting, while the THUSA subjects also included rural women
- The THUSA study recruited “apparently” healthy subjects and tested anonymously for HIV infection
- Significant differences in weight, BMI, waist and waist-hip-ratio’s were seen between the infected and non-infected groups in the Mangaung study
- It is conceivable (and therefore assumed for this discussion) that the THUSA subjects were in a very early stage of the disease – probably not as far advanced or progressed as the infected women from Mangaung
- The diet followed by the infected and non-infected women from Mangaung was much more “westernized” than the predominant “prudent” diet of the THUSA women (more energy, fat, animal-derived protein and less plant protein and total carbohydrate, but more sugar)
- Dietary intakes between the HIV-infected and non-infected women in both the THUSA and Mangaung studies did not differ significantly, with the exception of calcium, iron, and vitamins D and B₆.

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- Infected and non-infected Mangaung women had higher micronutrient intakes with deficiencies observed in calcium and folate intakes, while the women in
 - The THUSA-study had mean intakes less than those recommended of calcium, iron, vitamins, B₃, B₆, folic acid and ascorbic acid
 - Infected women in both studies reported higher alcohol intakes
 - HIV-infection was associated with higher serum total protein levels in both the THUSA and Mangaung studies, because of an expected increase in serum globulins
 - HIV-infection was associated with lower circulating albumin levels in both studies
 - HIV-infection was associated with decreased total serum cholesterol in both studies
 - HIV-infection was associated with lower systolic blood pressure in both studies
 - Significant Spearman correlations were only observed in the HIV-infected women of the THUSA study. The negative correlation between percentage energy from protein and serum LD, accompanied by a positive correlation between plant protein and serum LD, suggests that animal protein may have a beneficial effect on serum LD
 - Significant differences were seen in the macronutrient intakes in the non-infected THUSA women with TC levels above and below the median and not in the infected group
 - When the mean dietary intakes of infected women with TC levels in the first and fourth quartiles were compared, those with the lower TC levels, had significantly lower intakes of SATFAT and calcium and a higher P/S ratio than those with the higher levels, suggesting that a diet rich in SATFAT and calcium sources (meat and milk products) may protect against the observed drop in TC levels with HIV infection
 - In the non-infected group of the THUSA study, dietary factors known to be associated with TC (percentage energy from macronutrients) differed significantly between those with TC levels above and below the median
 - Intakes of dietary cholesterol did not differ between infected and non-infected subjects with TC levels above and below the median in both studies
-

- However, the infected women in the Mangaung study with the higher TC levels (fourth quartile compared to the first) also showed higher intakes of energy, total protein, animal protein, total fat, SATFAT, MUFAT, total carbohydrate, phosphorus, chromium and iodine
- In the non-infected THUSA women significant differences were seen in the macronutrient intakes of women with serum albumin values above and below the median and not in the infected group
- Significant differences in macronutrient intake were observed in the Mangaung infected group with serum albumin levels above and below the median but not in the non-infected group
- Comparison of mean dietary intakes of infected and non-infected women in both studies with albumin levels in the first and fourth quartiles showed that infected women in the fourth quartile had significantly higher intakes of total fat, energy, total protein and several associated minerals
- HIV-infection was associated with fewer women having risk factors or markers for the metabolic syndrome and NCDs
- The changes in health outcome variables with HIV infection were remarkably similar in the two studies.

5.3 DISCUSSION

The overall objective of this study was to examine the role of nutrition in asymptomatic infected and non-infected women. Differences in anthropometry, biological health variables as well as the possible influences of nutrient intakes on these health variables were examined to reach the objective.

The major observations in this analysis of the two studies are that the decreases in total serum cholesterol, albumin, fibrinogen and blood pressure observed during the HIV infection were not totally “prevented” by the dietary intakes of these women (In the healthy non-infected women of the THUSA study known effects of the diet on TC were seen). These decreases are thought to be detrimental (as will be discussed below) and could have been a direct result of the HI virus (Sellmeyer & Grunfield, 1996:52), or a result of weight loss (Cataldo *et al.*, 2003:638). The absence of significant differences in

anthropometric variables between infected and non-infected women of the THUSA study, argues against the latter, suggesting that the HI virus influences metabolism by other more direct mechanisms than weight loss.

Current nutritional guidelines from the World Health Organization (WHO) and Department of Health (DOH) regarding the macronutrient requirements for PLWHA, specifically during the asymptomatic phase, are broad and not very specific. As mentioned, WHO states that the resting energy expenditure is increased by ten percent, and that protein and fat requirements are similar to the requirements of normal, healthy individuals (WHO, 2003a). The Department of Health underwrites the WHO guidelines by lobbying for a more prudent diet with starchy foods being the basis of meals and that meat and dairy products may be eaten daily. In this investigation there were no significant differences in the overall dietary intakes between the infected and non-infected women in both the THUSA and Mangaung studies. The dietary intakes fell within the guidelines as recommended by the WHO and DOH.

In the THUSA study population, no significant differences were observed in the anthropometry between the infected and non-infected groups, but differences were significant in the Mangaung group, as was shown by a previous study (Dannhauser *et al.*, 1999:165). In the both the THUSA and Mangaung women, significant differences were observed in most of the health variables, suggesting that the HI virus had a larger effect on these health outcomes than the diet or that the diet that was consumed was inadequate. The main observations that could thus be drawn are that the HI virus already has an effect on health outcomes in the asymptomatic phase and/or that the diet that was consumed was not adequate to support the declining health outcomes.

In the literature it has been well described that the activation of the immune system as in the case of HIV infection creates an increased demand for energy and that the body's reserves are mobilized altering whole body metabolism (Calder, 2005). It affects nutrient status and body composition (Calder, 2005; Faintuch *et al.*, 2006:684) as was observed in the anthropometric parameters in both the THUSA and Mangaung women, even though the decline in the parameters in the infected women was only significant in the Mangaung group. It is important and a well known fact that weight loss and loss of lean body mass are independent risks in the progression of the disease and overall survival

(Cominelli *et al.*, 2002; Macallan, 2001:37; Paton *et al.*, 2005:330) and should be prevented through treatment as far as possible.

Significant differences were seen in most of the health outcome variables between the infected and non-infected women in both the THUSA and Mungaung women. Similarities from the most relevant observations in the THUSA and Mungaung women were the significant differences between the infected and non-infected woman in the serum total cholesterol and serum albumin levels which have been described in other studies (Mehta *et al.*, 2006:14; Sellmeyer & Grunfield, 1996:526; Shor-Posner *et al.*, 2000). Serum albumin is not only a crude measure of nutrition depletion (Thomas, 1994:55), but a non-specific marker of mortality in numerous medical conditions (Feldman *et al.*, 2003: 66). In HIV, decreasing serum albumin levels are associated with a poor prognosis (Feldman *et al.*, 2000: 863; Feldman *et al.*, 2003: 66) and HIV progression (Mehta *et al.*, 2006:14). The health effects of low serum cholesterol in asymptomatic HIV have not received much attention, but Shor-Posner *et al.* (2000) reported associations between low serum cholesterol levels and depressed mood level from a small study and Floris-Moore *et al.* (2006:421) reported that higher CD4 lymphocyte counts were associated with higher serum lipid levels.

The analyses that were done on nutrient intakes (macronutrients) and the health variables (serum albumin and total cholesterol) to investigate the role of nutrition support these suggestions. In the THUSA women significant differences were seen in the non-infected women with serum cholesterol levels above and below the median, but not in the infected women, while no differences were observed in the Mungaung women in either the infected or non-infected groups. Similar findings were seen in the analyses of serum albumin levels above and below the median, where significant differences were observed in the non-infected women in the THUSA group, while significant differences in percentage fat intakes were observed in the infected THUSA women. In the Mungaung women significant differences were seen in the nutrient intakes of energy, PUFAT, plant protein, and dietary cholesterol in infected women with albumin levels above and below the median.

However, when infected women with TC and albumin levels in the first quartile were compared with those in the fourth quartile of both studies, it was observed that those in the fourth quartile had significantly higher intakes of nutrients associated with and animal-derived diet: such as animal protein, SATFAT, low P/S ratio, calcium, zinc, and other minerals and trace elements.

The analysis investigating the possible role of diet on serum total cholesterol, (although not statistically significant but suggestive of a trend), are in accordance with a large body of evidence and knowledge that a diet higher in carbohydrate and lower in protein and fat is associated with lower serum cholesterol levels (Cataldo *et al.*, 2003:637), which constitutes a more prudent diet. Although the total cholesterol levels of the infected women fell within the normal references ranges, it was statistical significant different from the uninfected group. Investigating the role of the diet on serum albumin (above and below mean) with the further analysis showed a trend of higher macronutrient intakes and accompanying higher serum albumin levels. The higher intakes of energy (THUSA women), dietary fat, PUFAT, plant protein and dietary cholesterol (Mangaung women) were significant in the infected women with serum albumin levels above the median. These findings as well as the correlation that showed a medium effect in the THUSA women suggest that higher intakes of fat, protein (plant and animal) as well as higher energy intake could be beneficial to optimise serum albumin levels. This dietary pattern could be interpreted as a more "Western type" diet.

The overall analyses, therefore, suggests that a more "westernized" diet could be more beneficial to asymptomatic HIV-infected women compared to that of a more "prudent" diet. The effects of ARV treatment have been widely published and it is broadly accepted that a more prudent diet should be the dietary intervention of choice at that stage of the disease. Findings of this study suggest that a more "prudent" should not be regarded as the optimal diet for asymptomatic HIV-infected individuals. The results of this analysis support those of another approach, which also indicated that a diet with more animal products were associated with less liver damage (lower circulatory liver enzymes) in infected persons (Vorster *et al.*, 2004:1063).

5.4 CONCLUSIONS AND RECOMMENDATIONS

Current statistics show that South Africa is one of the countries that is the hardest hit by the HIV pandemic. Furthermore South Africa is a developing country that has a scarcity of resources. Unfortunately the HIV prevalences are increasing, ARV treatment targets are lagging behind and the impact of HIV/AIDS is worsening. It is, therefore, important to ease the burden of the disease by all means possible. From the literature it is well known that nutrition has an integral part to play in the care of PLWHA. Maintaining proper nutrition, weight and immune function is thought to delay disease progression, prolong the asymptomatic phase and improve survival.

From the analysis in this thesis it seems that the “prudent” diet generally regarded as an optimal diet to prevent NCDs, may not be the optimal diet for PLWHA. As these studies were not primarily designed to investigate HIV and nutrition, the role of a higher energy, fat and protein intake (Western diet) in asymptomatic HIV warrants urgent investigation. This is of public health importance as South Africa’s current public health nutritional guidelines, which are based on guidelines from the WHO, promote a healthy diet which underwrites a more prudent diet. “Effective” macronutrient supply can improve survival of infected individuals (Macallan, 1999:743) and it is, therefore, of utmost importance to establish clear guidelines on the type of macronutrient requirements for asymptomatic individuals to prolong this phase of the illness and delay onset of disease progression.

This analysis did not focus on micronutrients. The fact that so many of these women suffered from low micronutrient intakes, suggests that public health programmes to alleviate micronutrient malnutrition in all women should be a high priority in South Africa.

The present mandatory fortification of staple foods, maize meal and bread flour is a step in the right direction. However, the observed “beneficial” effects of animal-derived foods during HIV-infection argue for fortification of some of the more affordable and culturally-sensitive animal derived products with micronutrients.

In conclusion, this investigation and analysis also support the findings of a recent ASSAf, (Academy Of Science Of South Africa) (2007) report which recommends the following

aspects as guiding principles for policy and practice: that the nutritional care of HIV-infected people should focus on a diversified diet including available, affordable and traditional foods, which could be complemented with an acceptable macronutrient supplement and multivitamin supplementation at RDA levels for HIV-infected women; the necessity of an optimum nutrition to prevent the spread of HIV at the population level as well as at an individual level to improve health, quality of life and to assist with drug treatment. ASSAf, furthermore, recommends the urgent investigation of nutritional support in HIV-infection by means of well-designed, informative, clinical and epidemiological studies.

REFERENCES

- ABOURJAILY, P. & SMALL, F. 2000. HIV-associated disorders in fat distribution and lipid metabolism. *Nutrition in clinical care*, 3(4): 237-243.
- ALLARD, J.P., AGHDASSI, E., CHAU, J., SALIT, I. & WALMSLEY, S. 1998a. Oxidative stress and plasma antioxidant micronutrients in humans with HIV infection. *American journal of clinical nutrition*, 67:143-147.
- ALLARD, J.P., AGHDASSI, E., CHAU, J., TAM, C., KOVACKS, C.M., SALIT, I.E. & WALMSLEY, S.L. 1998b. Effects of vitamin E and C supplementation on oxidative stress and viral load in HIV infected subjects. *AIDS*, 12:1653-1659.
- ALCORN, K. 2003. Clinton Foundation secures triple HIV therapy for \$132 a year. *AIDS Map*, October 24. [Web:] <http://www.aidsmap.com/en/news/D5BEFDA2-5815-48E2-8755-D726916493C0.asp> [Date of access: 5 Sept. 2005].
- (ADA) AMERICAN DIETETIC ASSOCIATION. 2004. Position of the American Dietetic Association and Dietitians of Canada: Nutrition intervention in the care of persons with human immunodeficiency virus infection. *Journal of the American Dietetic Association*, 104(9):1425-1441.
- ARNDT, C. & LEWIS, J.D. 2000. The macro implication of HIV/AIDS in South Africa: a preliminary assessment. World Bank, Africa Region Working Paper Series. Number 9, December 2000. [Web:] http://www-wds.worldbank.org/servlet/WDSCContentServer/WDSP/IB/2001/11/22/000094946_01090804014855/Rendered/PDF/multi0page.pdf [Date of access: 23 Jan. 2006].
- (ASSAf) Academy of Science of South Africa. 2007. Knowing and helping. Report on nutritional influences on human immunity with special reference to HIV infection and active TB in South Africa. Pretoria. 370 p.

- AUSTIN, J., SINGHAL, N., VOIGHT, R., GILL, M.J., WALMSLEY, S., SALIT, I., GILMOUR, J., SCHLECH III, W.F., CHOUDHRI, S., RACHLIS, A., COHEN, J., TROTTIER, S., TOMA, E., PHILLIPS, P., FORD, P.M., WOODS, R., SINGER, J., ZAROWNY, D.P. & CAMERON, D.W. 2006. A community randomized controlled clinical trial of mixed carotenoids and micronutrient supplementation of patients with acquired immunodeficiency syndrome. *European journal of clinical nutrition*, 60:1266-1276.
- BADRI, M., MAARTENS, G., MANDALIA, S., BEKKER, L., PENROD, J.R., PLATT, R.W., WOOD, R. & BECK, E.J. 2006. Cost-effectiveness of highly active antiretroviral therapy in South Africa. *Public library of science medicine*, 3(1):48-56. [Web:] http://medicine.plosjournals.org/archive/1549-1676/3/1/pdf/10.1371_journal.pmed.0030004-L.pdf [Date of access: 31 Jan. 2006].
- BAETEN, J.M., MCCLELLAND, R.S., COREY, L., OVERBAUGH, J., LAVREYS, L., RICHARDSON, B.A., WALD, A., MANDALIYA, K., BWAYO, J. J. & KREISS, J.K. 2004. Vitamin A supplementation and genital shedding of herpes simplex virus among HIV-1 infected women: a randomized control trial. *The journal of infectious diseases*, 189:1466-471.
- BATTERHAM, M., GOLD, J., NAIDOO, D., LUX, O., SADLER, S., BRIDLE, S., EWING, M. & OLIVER, C. 2001. A preliminary open label dose comparison using an antioxidant regimen to determine the effect on viral load and oxidative stress in men with HIV/AIDS. *European journal of clinical nutrition*, 55(2):107-114.
- BAUM, M.K., MIQUEZ-BURBANO, M.J., CAMPA, A. & SHOR-POSNER, G. 2000. Selenium and interleukins in persons infected with human immunodeficiency virus type 1. *The journal of infectious diseases*, 182(Supplement 1):S69 -73.
- BEACH, R.S., MANTERO-ATIENZA, E., SHOR-POSNER, G., JAVIER, J.J., SZAPOCZNIK, J., MORGAN, R., SAUBERLICH, H.E., CORNWELL, P.E., EISDORFER, C. & BAUM, M.K. 1992. Specific nutrient abnormalities in asymptomatic HIV-1 infection. *AIDS*, 6(7):701-708, Dec. 6.

BELPERIO, P.S. & RHEW, D.C. 2004. Prevalence and outcomes of anemia in individuals with human immunodeficiency virus: a systematic review of the literature. *The American journal of medicine*, 116(7) Suppl 1:27-43.

BOS, J.M. & POSTMA, M.J. 2001. The economics of HIV vaccines. *Pharmacoeconomics*, 19(9): 937-946.

BURBANO, X., MIGUEZ-BURBANO, M.J., McCOLLISTER, K., ZHANG, G., RODRIGUEZ, A., RUIZ, P., LECUSAY, R. & SHOR-POSNER, G. 2002. Impact of a selenium chemoprevention clinical trial on HIV-infected participants. *HIV clinical trials*, 3(6):438-491.

CALDER, P.C. 2005. Editorial. Special issue. Institut Pasteur Euroconferences. Nutrition, immune functions and health. Paris, June 9-10.

CALZA, L., MANFREDI, R. & CHIODO, F. 2003. Hyperlipidaemia in patients with HIV-1 infection receiving highly active antiretroviral therapy: epidemiology, pathogenesis, clinical course and management. *International journal of antimicrobial agents*, 22: 89-99.

CALZA, L., MANFREDI, R. & CHIODO, F. 2004. Dyslipidaemia associated with antiretroviral therapy in HIV-infected patients. *Journal of antimicrobial chemotherapy*, 53: 10-14.

CATALDO, C.B., DeBRUYNE, L.K., WHITNEY, E.N. 2003. Nutrition and diet therapy. Belmont : Wadsworth/Tomson Learning. 732 p.

(CDC) Centers for Disease Control and Prevention. 1992. Recommendations and Reports 41(RR-17). 1993 Revised classification system for HIV infection and expanded surveillance case definition for AIDS among adolescents and adults. [Web:] <http://www.cdc.gov/mmwr/preview/mmwrhtml/00018871.htm> [Date of access: 15 May 2007].

CICCIO, L. 2004. ARV treatment in poor settings: the state of the art. *Health policy and development*, 2(1):52-61.

CLINTON FOUNDATION PRESS RELEASE. 2004. Clinton Foundation announces landmark agreement on major reduction in prices of HIV/AIDS lab test. January, 15. [Web:] <http://www.clintonpresidentialcenr.org> [Date of access: 5 Sep. 2005].

COMINELLI, S., RAGUSO, C.A., KARSEGARD, L., HIRSCHHEL, B., GAILLARD, R., GENTON, L & PICHARD, C. 2002. Weight-losing HIV-infected patients on recombinant human growth hormone for 12 wk: a national study. *Nutrition*, 18:583-586.

COOVADIA, H.M. & BABAT, R. 2002. Zinc deficiency and supplementation in HIV/AIDS. *Nutrition research*, 22(1-2):179-191.

CRENN, P., RAKOTOANBININA, B., RAYNAUD, J., THULLIER, F., MESSING, B. & MELCHIOR, J. 2004. Hyperphagia contributes to the normal body composition and protein-energy balance in HIV-infected asymptomatic men. *Journal of nutrition*, 134: 2301-2306.

DANNHAUSER, A., VAN STADEN, A.M., VAN DER RYST, E., NEL, G., MARAIS, N., ERASMUS, E., ATTWOOD, E.M., BARNARD, H.C. & LE ROUX, G.D. 1999. Nutritional status of HIV-1 seropositive patients in the Free State Province of South Africa: anthropometric and dietary profile. *European journal of clinical nutrition*, 53(3):165-173.

DELMAS-BEAUVIEUX, M.C., PEUCHANT, E., COUCHOURON, A., CONSTANS, J., SERGEANT, C., SIMONOFF, M., PELLEGRIN, J.L., LENG, B., CONRI, C. & CLERC, M. 1996. The enzymatic antioxidant system in blood and glutathione status in human immunodeficiency virus (HIV)-infected patients: effects of supplementation with selenium or beta-carotene. *American journal of clinical nutrition*, 64(1):101-107.

(DOH) DEPARTMENT OF HEALTH. 2001. South African national guidelines on nutrition for people living with TB, HIV/AIDS and other chronic debilitating conditions. South Africa. Pretoria: Government Printer. 28 p.

(DOH) DEPARTMENT OF HEALTH. 2003. Operational plan for Comprehensive HIV and AIDS Care, Management and Treatment for South Africa. 19 November, 2003.

[Web:] <http://www.info.gov.za/otherdocs/2003/aidsplan.pdf> [Date of access: 28 Jul. 2006].

(DOH) DEPARTMENT OF HEALTH. 2004. Monitoring review. Progress report on the implementation of the Comprehensive HIV and AIDS Care, Management and Treatment Programme. Issue 1. [Web:] <http://www.doh.gov.za/docs/hivaids-progressrep.html> [Date of access: 28 Jul. 2006].

(DOH) DEPARTMENT OF HEALTH. 2006. National HIV and Syphilis Prevalence Survey South Africa 2005. [Web:] <http://www.doh.gov.za/docs/reports-f.html> [Date of access: 28 Jul. 2006].

DORRINGTON, R., BOURNE, D., BRADSHAW, D., LAUBSCHER, R. & TIMAEUS, I.M. 2001. The impact of HIV/AIDS on adult mortality in South Africa. MRC Technical Report. Cape Town : MRC. 55 p.

DOWLING, S., MULCAHY, F. & GIBNEY, M.J. 1990. Nutrition in the management of HIV antibody positive patients: A longitudinal study of dietetic out-patient advice. *European journal of clinical nutrition*, 44:823-829.

EPSTEIN, B.G. 2004. The demographic impact of HIV/AIDS. (*In* Haacker, M., ed. The macroeconomics of HIV/AIDS. International Monetary Fund Book Forum.) [Web:] <http://www.imf.org/external/pubs/ft/AIDS/eng/index.htm> [Date of access: 23 Jan. 2006].

FAINTUCH, J., SOETERS, P. B. & OSMO, H G. 2006. Nutritional and metabolic abnormalities in pre-AIDS HIV infection. *Nutrition*, 22:683-690.

FAUSTO, A., BONGIOVANNI, M., CICONI, P., MENICAGLI, L., LIGABO, E.V., MELZI, S., BINI, T., SARDANELLI, F., CORNALBA, G., d' ARMINIO MONFORTE, A. 2006. Potential predictive factors of osteoporosis in HIV-positive subjects. *Bone*, 38: 892-897.

FAWZI, W.W., MSAMANGA, G.I., SPIEGELMAN, D., WEI, R., KAPIGA, S., VILLAMOR, E., MWAKAGILE, D., MUGUSI, F., HERTZMARK, E., ESSEX, M. & HUNTER, D. 2004.

A randomized trial of multivitamin supplements and HIV progression and mortality. *The New England journal of medicine*, 351:23-32.

FAWZI, W., MSAMANGA, G., SPIEGELMAN, D. & HUNTER, D. 2005a. Symposium: Women's voices, women's choices: The challenges of nutrition and HIV/AIDS. *Journal of nutrition*, 135:938-944.

FAWZI, W.W., VILLAMOR, E., MSAMANGA, G., ANTELMAN, G., ABOUD, S., URASSA, W. & HUNTER, D. 2005b. Trial of zinc supplements in relation to pregnancy outcomes, hematologic indicators, and T cell counts among HIV-1-infected women in Tanzania. *American journal of clinical nutrition*, 81:161-167.

FELDMAN, J.G., BURNS, D.N., GANGE, S.J., BACHETTI, P., COHEN, M., ANASTOS, K., NOWICKI, M., DELAPENA, R. & MIOTTI, P. 2000. Serum albumin as a predictor of survival in HIV-infected women in the Women's Interagency HIV Study. *AIDS*, 14:863-870.

FELDMAN, J.G., GANGE, S.J., BACCHETTI, P., COHEN, M., YOUNG, M., SQUIRES, K.E., WILLIAMS, C., HOLDWASSER, P. & ANATOS, K. 2003. Serum albumin is a powerful predictor of survival among HIV-1 infected women. *Journal of acquired immune deficiency syndromes*, 33(1):66-73.

FENTON, M. & SILVERMAN, E. 2004. Medical nutrition therapy for human immunodeficiency virus (HIV) disease. (In Mahan, L. K. & Escott-Stump, S., eds. Krause's food, nutrition, & diet therapy. 11th ed. Philadelphia : Saunders. p. 1027-1055.)

FIELD, C.J., JOHNSON, I.R. & SCHLEY, P.D. 2002. Nutrients and their role in host resistance to infection. *Journal of leukocyte biology*, 71:16-32.

FLORIS-MOORE, M., HOWARD, A.A., LO, Y., ARNSTEN, J.H., SANTORO, N. & SCHOENBAUM, E.E. 2006. Increased serum lipids are associated with higher CD4 lymphocyte count in HIV-infected women. *HIV medicine*, 7(7):421-430.

(FAO) FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. 2002. Living well with HIV/AIDS. A manual on nutritional care for people living with HIV/AIDS. Rome : FAO. 97 p.

(FANTA) FOOD AND NUTRITION TECHNICAL ASSISTANCE PROJECT. 2001. HIV/AIDS: a guide for nutrition, care and support. Washington: Academy for Educational Development.

FRIIS, H. & MICHAELSEN, K.F. 1998. Micronutrients and HIV infection: a review. *European journal of clinical nutrition*, 52:157-163.

FRIIS, H. 2006. Micronutrient interventions and HIV infection: a review of current evidence. *Tropical medicine and international health*, 11(12):1849-1857.

GARLAND, M. & FAWZI, W. 1999. Antioxidants and progression of human deficiency virus (HIV) disease. *Nutrition research*, 19(8):1259-1276.

GASPARIS, A.P. & TASSIOPOULOS, A. 2001. Nutritional support in the patient with HIV infection. *Nutrition*, 17(11-12):981-982.

GLOECKER, J.W. & KAISTH, S. K. 1997. Nutritional care of HIV-positive individuals. *American journal of health studies*, 13(3):128-132.

GOMEZ-CANDELA, C., DE COS BLANCO, A.I., MATEO, R., CASTRO, E., LORENZO, A. & POLO, R. 2002. Changes in carbohydrate metabolism in the HIV/AIDS patient. *Nutricion Hospitalaria*. Abstract [Web:] <http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=pubmed&cmd=Retrieve&dopt=A> [Date of access: 17 Jul. 2006].

GORDEUK, V.R., ONOJOBI, G., SCHNEIDER, M.F., DAWKINS, F.W., DELAPENHA, R., VOLOSHIN, Y., VON WYL, V., BACON, M., MINKOFF, H., LEVINE, A., COHEN, M. & GREENBLATT, R.M. 2006. The association of serum ferritin and transferrin receptor concentrations with mortality in women with human immunodeficiency virus infection. *Disorders of iron metabolism*, 91(6):739-743.

-
- GRAHAM, N.M., SORENSEN, D., ODAKA, N., BROOKMEYER, R., CHAN, D., WILLET, W.C., MORRIS, J.S. & SAAH, A.J. 1991. Relationship of serum copper and zinc levels to HIV-1 seropositivity and progression to AIDS. *Journal of acquired immune deficiency syndrome*, 4(10):976-980.
- GREEN, C.J. 1995. Nutritional support in HIV infection and AIDS. *Clinical nutrition*, 14:197-212.
- GREENER, R. 2004. The impact of HIV/AIDS on poverty and inequality. (In Haacker, M., ed. The macroeconomics of HIV/AIDS. International Monetary Fund Book Forum.) [Web:] <http://www.imf.org/external/pubs/ft/AIDS/eng/index.htm> [Date of access: 23 Jan. 2006].
- GRINSPOON, S. & MULLIGAN, K. 2003. Weight loss and wasting in patients infected with human immunodeficiency virus. *Clinical infectious diseases*, 36(Suppl 2): S69-78.
- HAACKER, M. 2004. HIV/AIDS: the impact on the social fabric and the economy. (In Haacker, M., ed. The macroeconomics of HIV/AIDS. International Monetary Fund Book Forum.) [Web:] <http://www.imf.org/external/pubs/ft/AIDS/eng/index.htm> [Date of access: 23 Jan. 2006].
- HADIGAN, C. 2003. Dietary habits and their association with metabolic abnormalities in human immunodeficiency virus-related lipodystrophy. *Clinical infectious diseases*, 37(Suppl 2):S101-104.
- HATTINGH, Z. 2005. The health and nutritional status of HIV positive women (25 – 44 years) in Mangaung. Bloemfontein :UOFS. (Thesis – PhD Nutrition). 467 p.
- HEIJLIGENBERG, R., ROMIJN, J.A., WESTERTERP, K.R., JONKERS, C.J., PRINS, J.M. & SAUERWEIN, H.P. 1997. Total energy expenditure in human immunodeficiency virus-infected men and healthy controls. *Metabolism*, 46(11): 1324-1326.
-

HUMPHREY, J.H., QUINN, T., FINE, D., LEDERMAN, H., YAMINI-ROODSARI, S., WU, L.S., MOELLER, S. & RUFF, A.J. 1999. Short-term effects of large-dose vitamin A supplementation on viral load and immune response in HIV-infected women. *Journal of acquired immune deficiency syndromes and human retrovirology*, 20(1):44-51.

HSRC PRESS. 2005. South African National Prevalence, HIV incidence, Behaviour and Communication survey. [Web:] <http://www.hsrbpress.ac.za> [Date of access: 27 Jan. 2006].

HUSAIN, I.Z. & BADCOCK-WALTERS, P. 2002. Economics of HIV/AIDS impact mitigation: Responding to problems of systemic dysfunction and sectoral capacity. (In IAEN – International AIDS-Economic Network. State of the art: AIDS and economics, July 2002:84-95). [Web:] <http://www.policyproject.com/pubs/other/SOTAecon.pdf> [Date of access: 5 Sep. 2005].

IRLAM, J.H., VISSER, M.E., ROLLINS, N. & SIEGFRIED, N. 2005. Micronutrient supplementation in children and adults with HIV infection. *Cochrane Database systematic reviews*, 2005 Oct 19(4):CD003650.

(ILO) INTERNATIONAL LABOUR OFFICE. 2004. HIV/AIDS and work: global estimates, impact and response. The ILO programme on HIV/AIDS and the World of Work. [Web:] http://data.unaids.org/Cosponsors/ILO/ilo_hiv-aidsglobalestimates2004_en.pdf [Date of access: 9 May 2007].

(IMF) INTERNATIONAL MONETARY FUND. 2006. Post-apartheid South Africa: the first ten years. [Web:] <http://www.imf.org/external/pubs/nft/2006/soafrica/eng/pasoaf/sach7.pdf> [Date of access: 9 May 2007].

JACOBUS, D.P. 1996. Randomization to iron supplementation of patients with advanced human immunodeficiency virus disease – an inadvertent but controlled study with results important for patient care. *Journal of infectious diseases*, 173:1044-1045.

JAMES, S., VORSTER, H.H., VENTER, C.S., KRUGER, H.S., NELL, T.A., VELDMAN, F.J., & UBBINK, J.B. 2000. Nutritional status influences plasma fibrinogen concentration: evidence from the THUSA survey. *Thrombosis research*, 98:383-394.

JARUGA, P., JARUGA, B., GACKOWSKI, D., OLCZAK, A., HALOTA, W., PAWLOWSKA, M. & OLINSKI, R. 2002. Supplementation with antioxidant vitamins prevents oxidative modification of DNA in lymphocytes of HIV-infected patients. *Free radical biology & medicine*, 32(5):414-420.

JIAMTON, S., PEPIN, J., SUTTENT, R., FILTEAU, S., MAHAKKANUKRAUH, B., HANSHAOWORAKUL, W., CHAISILWATTANA, P., SUTHIPINITTHARM, P., SHETTY, P. & JAFFAR, S. 2003. A randomized trail of the impact of multiple micronutrient supplementation on mortality among HIV-infected individuals living in Bangkok. *AIDS*, 17(17):2416-2469.

KANTER, A.S., SPENCER, D.C., STEINBERG, M.H., STOLTYSIK, R., YARNOLD, P.R. & GRAHAM, N.M. 1999. Supplemental vitamin B and progression to AIDS and death in black South African patients infected with HIV. *Journal of acquired immune deficiency syndrome*, 21:252-253.

KELLY, P., MUSONDA, R., KAFWEMBE, E., KAETANO, L., KEANE, E. & FARTHING, M. 1999. Micronutrient supplementation in AIDS diarrhoea-wasting syndrome in Zambia: a randomized controlled trial. *AIDS*, 13:495-500.

KNOX, T.A., ZAFONTE-SANDERS, M., FIELDS-GARDNER, C., MOEN, K. & JOHANSEN, D. 2003. Assessment of nutritional status, body composition, and human immunodeficiency virus-associated morphological changes. *Clinical infectious diseases*, 36(Suppl 2):S63-S68.

KOTLER, D.P. 1999. Nutrition and wasting in HIV infection. CME. Available: Medscape. [Web:] http://www.medscape.com/viewprogram/667_pnt [Date of access: 6 Feb. 2007].

- KRUSE, L.M. 1998. Nutritional assessment and management HIV disease patients. Available: Medscape. [Web:] [http:// www.medscape.com/viewarticle/416686_print](http://www.medscape.com/viewarticle/416686_print) [Date of access: 6 Feb. 2007].
- KUMAR, P. & CLARK, M. 2002. Clinical medicine. 5th ed. Edinburgh : W. B. Saunders. 1446 p.
- KUPKA, R. & FAWZI, W. 2002. Zinc nutrition and HIV infection. *Nutrition reviews*, 60(3):69-79.
- LANGI, P., SEMBA, R.D., MUGERWA, R.D. & WHALEN, C.C. 2003. Vitamin A deficiency and increased mortality among human immunodeficiency virus-infected adults in Uganda. *Nutrition research*, 23:595-605.
- LAQUATRA, I. 2004. Nutrition for weight management. (In Mahan, L. K. & Escott-Stump, S., eds. Krause's food, nutrition, & diet therapy. 11th ed. Philadelphia : Saunders. p. 558 – 593.)
- LIBANORE, M., BIOCCHI, R., RAISE, E., SIGHINOLFI, L., BEDETTI, A., MAONTANARI, P., FAGIOLI, F., SCHIATTONE, M.L. & GHINELLI, F. 1987. Zinc and lymphocyte subsets in patients with HIV infection. *Minerva Medica*, 78(24):1805-1812, 31 Dec. (Abstract).
- LIU, G.G., GUO, J.J & SMITH, S.R. 2004. Economic costs to business of the HIV/AIDS epidemic. *Pharmacoeconomics*, 22(18):1181-1194.
- MACALLAN, D.C. 1999. Nutrition and immune function in human immunodeficiency virus infection. *Proceedings of the Nutrition Society*, 58:743-748.
- MACALLAN, D.C. 2001. Metabolic syndromes in human immunodeficiency virus infection. *Hormone research*, 55 (Suppl 1):36-41.
- MACALLAN, D.C., MCNURLAN, M. A., MILNE, E., CALDER, G.A., GARLICK, P.J. & GRIFFIN, G.E. 1995. Whole-body protein turnover from leucine kinetics and the

response to nutrition in human immunodeficiency virus infection. *American journal of clinical nutrition*, 61:818-826.

MACINTYRE, U.E., VENTER, C.S. & VORSTER, H.H. 2000. A culture-sensitive quantitative food frequency questionnaire used in an African population: 1. Development and reproducibility. *Public Health Nutrition*, 4(1):53-62.

MANGILI, A., MURMAN, D.H., ZAMPINI, A.M. & WANKE, C. A. 2006. Nutrition and HIV infection: review of weight loss and wasting in the era of highly active antiretroviral therapy from the nutrition for healthy living cohort. *Clinical infectious disease*, 42:836-842.

McCLELLAND, R.S., BAETEN, J.M., OVERBAUGH, J., RICHARDSON, B.A., MANDALIYA, K., EMERY, S., LAVREY, L., NDINYA-ACHOLA, J.O., BANKSON, D.D., BWAYO, J.J. & KREISS, J. K. 2004. Micronutrient supplementation increases genital tract shedding of HIV-1 in women: results of a randomized trial. *Journal of acquired immune deficiency syndromes*, 37(5):1657-1663.

McDERMOTT, A.Y., SHEVITZ, A.H., KNOX, T., ROUBENHOFF, R., KEHAYIAS, J. & GORBACH, S. 2001. Effects of highly active antiretroviral therapy on fat, lean, and bone mass in HIV-seropositive men and women. *American journal of clinical nutrition*, 74: 679-686.

McDERMOTT, A.Y., TERRIN, N., WANKE, C., SKINNER, S., TCHETGEN, E. & SHEVITZ, A.H. 2005. CD4+ cell count, viral load, and highly active antiretroviral therapy use are independent predictors of body composition alterations in HIV-infected adults: a longitudinal study. *Clinical infectious diseases*, 41:1662-1670.

McKINLEY, M.J., GOODMAN-BLOCK, J., LESSER, M.L. & SALBE, A.D. 1994. Improved body weight status as a result of nutrition interventions in adult HIV-positive patients. *Journal of the American Dietetic Association*, 94:1014-1017.

MEHTA, S.H., ASTEMBORSKI, J., STERLING, T.R., THOMAS, D.L. & VLAHOF. 2006.

Serum albumin as a prognostic indicator for HIV disease progression. *Aids research and human retroviruses*, 22(1):14-21.

MELCHIOR, J., NIYONGABO, T., HENZEL, D., DURACK-BROWN, I., HENRI, S. & BOULIER, A. 1999. Malnutrition and wasting, immunodepression, and chronic inflammation as independent predictors of survival in HIV-infected patients. *Nutrition*, 15:865-869.

MOYLE, G. 2002. Anaemia in persons with HIV infection: prognostic marker and contributor to morbidity. *AIDS review*, 4(1):3-20.

(MRC) MEDICAL RESEARCH COUNCIL. 2003. Initial estimates from the South African National Burden of Disease Study, 2000. MRC Policy Brief No.1. Cape Town : MRC.

MULLIGAN, K. 2003. Metabolic abnormalities in patients with HIV infection. *Journal of the International Association of Physicians in AIDS Care*, 2(2): 66-74.

NERAD, J., ROMEYN, M., SILVERMAN, E., ALLEN-REID, J., DIETERICH, D., MERCHANT, J., PELLERTIER, V. A., TINNERELLO, D. & FENTON, M. 2003. General nutrition management in patients infected with human immunodeficiency virus. *Clinical infectious diseases*, 36 (Suppl 2):S52-62.

OCKENGA, J., GRIMBLE, R., JONKERS-SCHUIJTEMA, C., MACALLAN, D., MELCHOIR, J.C., SAUERWEIN, H.P., SCHWENK, A. & SÜTTMANN, U. 2006. ESPEN Guidelines on enteral nutrition: wasting in HIV and other chronic infectious diseases. *Clinical nutrition*, 25:319-329.

O'BRIEN, M., KUPKA, R., MSAMANGA, G.I., SAATHOFF, E., HUNTER, D. & FAWZI, W. 2005. Anemia is an independent predictor of mortality and immunologic progression of disease among women with HIV in Tanzania. *Journal of acquired immune deficiency syndromes*, 40(2):219-225.

- OLSEN, A., MWANIKI, D., KRARUP, H. & FRIIS, H. 2004. Low-dose iron supplementation does not increase HIV-1 load. *Journal of acquired immune deficiency syndromes*, 36(1):637-638.
- OOSTHUIZEN, W., VAN GRAAN, A., KRUGER, A. & VORSTER, H.H. 2006. Polyunsaturated fatty acid intake is adversely related to liver function in HIV-infected subjects: the THUSA study. *American journal of clinical nutrition*, 83:1193-1198.
- PATON, N., GASSULL, M. & CABRÉ, E. 2005. Infectious diseases. (In Gibney, M.J., Elia, M., Ljungqvist, O. & Dowsett, J., eds. *Clinical nutrition*. Oxford : Blackwell Science. p.325 -344.)
- PINZONE, J.J., FOX, M.L., SASTRY, M.K., PARENTI, D.M. & SIMON, G.L. 2005. Plasma leptin concentration increases early during highly active antiretroviral therapy for acquired immunodeficiency syndrome, independent of body weight. *Journal of endocrinological investigation*, 28(3):RC1- RC3.
- PIWOZ, E.G. & PREBLE, E.A. 2000. HIV/AIDS and nutrition: a review of the literature and recommendations for nutritional care and support in Sub-Saharan Africa. SARA project. [Web:] http://pdf.usaid.gov/pdf_docs/PNACK673.pdf [Date of access: 28 Nov. 2006].
- RABENECK, L., PALMER, A., KNOWLES, J.B., SEIDEHAMEL, R.J., HARRIS, C.L., MERKEL, K.L., RISSER, J. M. H. & AKRABAWI, S.S. 1998. A randomized controlled trial, evaluating nutritional counselling with and without oral supplementations in malnourished HIV-infected patients. *Journal of the American Dietetic Association*, 98:434-438.
- ROSEN, S., VINCENT J.R., MACLEOD, W., FOX, M., THEA, D.M., SIMON, J.L. 2004. The cost of HIV/AIDS to businesses in Southern Africa. *AIDS*, 18(2):317-324.
- RUDNICKA, A.R., MT-ISA, S. & MEADE, T.W. 2006. Associations of plasma fibrinogen and factor VII clotting activity with coronary heart disease and stroke: prospective cohort

study from the screening phase of the Thrombosis Prevention Trial. *Journal of thrombosis and haemostasis*, 4(11):2405-2410.

SADLER, K., BAHWERE, P., GUERRERO, S. & COLLINS, S. 2006. Community-based therapeutic care in HIV-infected populations. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 100:6-9.

SALMON-CERON, D., FONTBONNE, A., SABA, J., MAY, T., RAFFI, F., CHIDIAC, C., PATEY, O., ABOULKER, J.P., SCHWARTZ, D. & VILDE, J.L. 1995. Lower survival in AIDS patients receiving dapsone compared with aerosolized pentamidine for secondary prophylaxis of pneumocystis carinii pneumonia. *Journal of infectious diseases*, 172:656-664.

SALOMÉ, M.A. & GROTTTO, H.Z.W. 2002. Human immunodeficiency virus-related anemia of chronic disease: relationship to hematologic, immune, and iron metabolism parameters, and lack of association with serum interferon- λ levels. *AIDS patient care and STDs*, 16(8):361-365.

SCHWENK, A., BÜRGER, B., OLLENSCHLÄGER, G., STUTZER, H., WESSEL, D. DIEHL, V. & SCHRAPPE, M. 1994. Evaluation of nutritional counselling in HIV-associated malnutrition. *Clinical nutrition*, 13:212-220.

SELLMEYER, D.E. & GRUNFIELD, C. 1996. Endocrine and metabolic disturbances in human immunodeficiency virus infection and the acquired immune deficiency syndrome. *Endocrine reviews*, 17(5):518-532.

SEMBA, R.D., CAIAFFA, W.T., GRAHAM, N.M., COHN, S. & VLAHOF, D. 1995. Vitamin A deficiency and wasting as predictors of mortality in human immunodeficiency virus-infected injection drug users. *The journal of infectious diseases*, 171:1196-1202.

SEMBA, R.D., PARK, S., ROYAL, W. & GRIFFIN, D.E. 1996. Vitamin A deficiency and T-cell sub-populations in HIV-infected adults. *Nutrition research*, 16(6):915-923.

- SEMBA, R.D., LYLES, C.M., MARGOLICK, J.B., CAIAFFA, W.T., FARZADEGAN, H., COHN, S. & VLAHOV, D. 1998. Vitamin A supplementation and human immunodeficiency virus load in injection drug users. *The journal of infectious diseases*, 177(3):611-616.
- SEMBA, R.D. & TANG, A.M. 1999. Micronutrients and the pathogenesis of human immunodeficiency virus infection. *British journal of nutrition*, 81:181-189.
- SEMBA, R.D., TAHA, T.E., KUMWENDA, N., MTIMAVALLYE, L., BROADHEAD, R., MIOTTI, P.G. & CHIPHANGWI, J.D. 2001. Iron status and indicators of human immunodeficiency virus disease among pregnant women in Malawi. *Clinical infectious diseases*, 32:1496-1499.
- SHANKAR, A.H. & PRASAD, A.S. 1998. Zinc and immune function: the biological basis of altered resistance to infection. *American journal of clinical nutrition*, 68 (suppl 2):S447-S463.
- SHOR-POSNER, G., MIGUEZ-BURBANO, M.J., LECUSAY, R., WILKIE, F., QUESADA, J., RINCON, H. & BAUM, M.K. 2000. Neuropsychiatric consequences of hypocholesterolemia in HIV disease. International Conference on AIDS Education, Jul 9-14; abstract no. TuPeB3177. [Web:] <http://gateway.nlm.nih.gov/MeetingAbstracts/102239087.html> [Date of access: 14 May 2007].
- SIERRA, S., KUPFER, B. & KAISER, R. 2005. Basics of the virology of HIV-1 and its replication. *Journal of clinical virology*, 34:233-244.
- SINGHAL, N. & AUSTIN, J. 2002. A clinical review of micronutrients in HIV infection. *Journal of the International Association of Physicians in AIDS Care*, 1(2):63-75.
- SMITH, K.Y. 2002. Selected metabolic and morphologic complications associated with highly active antiretroviral therapy. *The journal of infectious diseases*, 185(Suppl 2): S123-127.

SOUTH AFRICAN GOVERNMENT. 2005. National budget 2005. [Web:] <http://www.capegateway.gov.za/eng/pubs/budgets/2005/100514> [Date of access: 23 Jan. 2006].

STEPHENSON, C.B., MARQUIS, G.S., JACOB, R.A., KRUIZICH, L. A., DOUGLAS, S.D. & WILSON, C.M. 2006. Vitamin C and E in adolescents and young adults with HIV. *American journal of clinical nutrition*, 83:870-879.

TANG, A.M., GRAHAM, N.M. & SAAH, A.J. 1996. Effects of micronutrient intake on survival in human immunodeficiency virus type 1 infection. *American journal of epidemiology*, 143:1244-1256.

TANG, A.M., GRAHAM, N.M., SEMBA, R.D. & SAAH, A.J. 1997a. Association between serum vitamin A and E levels and HIV-1 disease progression. *AIDS*, 11: 613-620.

TANG, A.M., GRAHAM, N.M., CHANDRA, R.K. & SAAH, A. J. 1997b. Low serum vitamin B-12 concentrations are associated with faster human immunodeficiency virus type 1 (HIV-1) disease progression. *Journal of nutrition*, 127:345-351.

TANG, A.M., LANZILLOTTI, J., HENDRICKS, K., GERRIOR, J., GHOSH, M., WOODS, M. & WANKE, C. 2005. Micronutrients: current issues for HIV care providers. *AIDS*, 19(9):847-861.

THOMAS, B. 1994. Manual of dietetic practice. 2nd ed. Cambridge : Blackwell Science. 738 p.

TOMKINS, A. & WATSON, F. 1989. Malnutrition and infection: a review. Nutrition Policy Discussion Paper No. 5. United Nations Administrative Committee on Coordination – Sub-committee on Nutrition (ACC/SCN). [Web:] <http://www.unsystem.org/SCN/archives/npp05/begin.htm>. [Date of access: 28 Nov. 2006].

(UNAIDS) The Joint United Nations Programme on HIV/AIDS. 2004. Global summary of the HIV/AIDS epidemic. [Web:] http://www.unaids.org/wad2004/EPIupdate2004.html_en/epi04_02_en.htm [Date of access: 7 Apr. 2005].

UNAIDS/WHO. 2005. AIDS epidemic update. Special report on HIV prevention. 56 p. [Web:] http://www.unaids.org/epi/2005/doc/EPIupdate2005.pdf_en/epi-update2005_en.pdf [Date of access: 28 Nov. 2006].

UNAIDS/WHO. 2006. Aids epidemic update. December 2006. [Web:] http://data.unaids.org/pub/EpiReport/2006/2006_EpiUpdate_en.pdf [Date of access: 28 Nov. 2006].

VEENSTRA, N. & WHITESIDE, A. 2005. Economic impact of HIV. *Best practice & research clinical obstetrics and gynaecology*, 19(2):197-210.

VISSER, M.E., MAARTENS, G., KOSSEW, G. & HUSSEY, G.D. 2003. Plasma vitamin A and zinc levels in HIV-infected adults in Cape Town, South Africa. *British journal of nutrition*, 89:475-482.

VORSTER, H.H., JERLING, J.C., STEYN, K., BADENHORST, C.J., SLAZUS, W., VENTER, C.S., JOOSTE, P.L. & BOURNE, L.T. 1998. Plasma fibrinogen of black South Africans: the BRISK study. *Public health nutrition*, 1(3):160-176.

VORSTER, H.H., BOURNE, L.T., VENTER, C.S., OOSTHUIZEN, W. 1999. Contribution of nutrition to the health transition in developing countries: a framework for research and intervention. *Nutrition reviews*, (57)11:341-349.

VORSTER, H.H., WISSING, M.P., VENTER, C.S., KRUGER, H.S., MALAN, N.T., DE RIDDER, J.H., VELDMAN, F.J., MARGETTS, B.M. & MACINTYRE, U. 2000. The impact of urbanization on physical, physiological and mental health in Africans in the North West Province of South Africa: the THUSA study. *South African journal of science*, 96:505-514.

-
- VORSTER, H.H., KRUGER, A., MARGETTS, B.M., VENTER, C.S., KRUGER, H.S., VELDMAN, F.J. & MACINTYRE, U.E. 2004. The nutritional status of asymptomatic HIV-infected Africans: directions for dietary intervention? *Public health nutrition*, 7(8):1055-1064.
- VORSTER, H.H., VENTER, C.S., WISSING, M.P. & MARGETTS, B. 2005. The nutrition and health transition in the North West Province of South Africa: a review of the THUSA (Transition and Health during Urbanisation of South Africans) study. *Public health nutrition*, 8(5):480-490.
- VORSTER, H.H. 2007. Nutrition and HIV and AIDS. (In Mann, J. & Truswell, S., eds. *Essentials of human nutrition*. 3rd ed. Oxford: Oxford University Press. p. 640.)
- WALSEK, C., ZAFONTE, M. & MUIR BOWERS, J. 1997. Nutritional issues and HIV/AIDS: assessment and treatment strategies. *Journal of the Association of Nurses in AIDS Care*, 8(6):71-80.
- WALSH, C., HATTINGH, Z., BESTER, I. & VELDMAN, D. 2004. Iron status of HIV-positive women (25 – 44 years) in Mangaung, South Africa. *Asia Pacific journal of clinical nutrition*, 13(Suppl):S174.
- WALTER, R.M., OSTER, M.H., LEE, T.J., FLYNN, N. & KEEN, C.L. 1990. Zinc status in human immunodeficiency virus infection. *Life sciences*, 46(22):1597-1600. (Abstract).
- WANKE, C.A., FALUTZ, J.M., SHEVITZ, A., PHAIR, J.P. & KOTLER, D.P. 2002. Clinical evaluation and management of metabolic and morphologic abnormalities associated with human immunodeficiency virus. *Clinical infectious disease*, 34:248-259.
- WOLMERANS, P. & OOSTHUIZEN, W. 2001. Eat fats sparingly – implications for health and disease. *South African journal of clinical nutrition*, 14(3):S48-S55.
- WOODS, M.N. & GORBACH, S.L. 1999. Dietary considerations in HIV and AIDS. *Nutrition in clinical care*, 2(2):95-102.
-

(WHO) WORLD HEALTH ORGANIZATION. 2003a. Nutrient requirements for people living with HIV/AIDS. Report of a technical consultation. Geneva, 13 - 15 May 2003. [Web:] http://www.who.int/nutrition/publications/Content_nutrient_requirements.pdf [Date of access: 5 Apr. 2005].

(WHO) WORLD HEALTH ORGANIZATION. 2003b. Treating 3 million by 2005. Making it happen: the WHO strategy. WHO Library Cataloguing-in-Publication [Web:] <http://www.who.int/3by5/publications/documents/en/3by5StrategyMakingItHappen.pdf> [Date of access: 31 Aug. 2005].

WHO/UNAIDS. 2003. Estimated cost to reach the target of 3 million with access to antiretroviral therapy by 2005 ("3by5"). [Web:] www.who.int/entity/3by5/publications/documents/en/cost_of_3by5.pdf [Date of access: 31 Aug. 2005].

(WHO) WORLD HEALTH ORGANIZATION. 2004a. Comprehensive community- and home-based health care model. SEARO regional publication, no 40. [Web:] http://www.searo.who.int/LinkFiles/Publications_Healthcaremodel.pdf. [Date of access: 23 Jan. 2007].

(WHO) WORLD HEALTH ORGANIZATION. 2004b. Vitamin and mineral requirements in human nutrition. 2nd ed. [Web:] <http://www.who.int/publications/2004/924154612s.pdf> [Date of access: 26 Feb. 2007].

(WHO) WORLD HEALTH ORGANIZATION. 2005a. AIDS treatment, nutrition and food supplements. WHO fact sheet. 30 March 2005. [Web:] <http://www.who.int/3by5/mediacentre/fsFood/en/print.html> [Date of access: 5 Apr. 2005].

(WHO) WORLD HEALTH ORGANIZATION. 2005b. Consultation on nutrition and HIV/AIDS in Africa. Durban, South Africa. Participants' statement, 10 – 13 April 2005.

(WHO) WORLD HEALTH ORGANIZATION, 2005c. Interim WHO clinical staging of HIV/AIDS and HIV/AIDS case definitions for surveillance. African Region, 2005. [Web:] <http://www.who.int/hiv/pub/guidelines/clinicalstaging.pdf>. [Date of access: 7 Apr. 2005].

(WHO) WORLD HEALTH ORGANIZATION. 2005d. Nutrition and HIV/AIDS. Executive Board, 116th session, EB116/12. 12 May 2005. [Web:] http://www.who.int/gb/ebwha/pdf_files/EB116/B116_12-en.pdf. [Date of access: 15 Nov. 2006].

(WHO) WORLD HEALTH ORGANIZATION. 2005e (i & ii). Progress on global access to HIV antiretroviral therapy: an update on "3 by 5". WHO Library Cataloguing-in-Publication Data. [Web:] <http://www.who.int/3by5/support/june2005>. [Date of access: 15 Nov. 2006].

YARASHESKI, K.E., ZACHWIEJA, J.J., HORGAN, M.M., POWDERLY, W.G., SANTIAGO, J.V. & LANDT, M. 1997. Serum leptin concentrations in human immunodeficiency virus-infected men with low adiposity. *Metabolism: clinical and experimental*, 43(3): 303-305.

ADDENDUM



Potchefstroomse Universiteit
vir Christelike Hoër Onderwys

The THUSA project:

information for participating clinic sisters

Dear Sister

Thank you for being willing to help us in organising this very important project. We are sure that the project will contribute to improved health of all the people of the North West Province.

The aim of the project is to get enough information regarding level of urbanisation, eating patterns, life-style and certain health indicators, to plan appropriate health and nutrition intervention strategies.

For the baseline survey, which will be done from February 1996 to March 1997, we need 2500 subjects who must be representative of the African population of the North West. These subjects will be drawn in matched groups from randomly selected traditional rural areas, from farms, from squatter camps, from urban towns and cities and also from professional people. Therefore, 500 subjects from 5 different levels of urbanisation. To control for seasonal influences, we will examine only a quarter of each group ($\pm$ 128 subjects) during a specific visit. A visit will be from a Monday morning 08:00 to Friday afternoon 12:00. During each visit, we would like to get subjects from 4 different areas or points (around a clinic for example). Therefore, 32 subjects from four different places in your area. In total, the 128 subjects measured during our visit to your area, must include:

- 64 men, aged 15-65
- 64 women, aged 15-65

We would appreciate it if the ages are evenly distributed, as follows:

12 or 13 men or women in each 10 year span: 15-25; 25-35; 35-45; 45-55; 55-65.

- 1 To help us to set up the survey in your area. We will visit you for final arrangements at least two weeks before the field visit (survey) date. You must please help to identify the places where we can get subjects to participate.
 - 2 We would need 2 or 3 rooms either in a clinic, hospital, school or other building to work in. If possible, also $\pm$ 5 tables and 10 chairs.
- A nurse or another leader in the community to help with the motivation and recruitment of healthy subjects. In other words, to explain the project to the subjects in their mother-tongue and to get signed informed consent to take a blood sample. To ask subjects to bring their ID with them.
 - A nurse (one or more) to help with the taking of the blood samples. We will show the nurse exactly how the sample should be taken. We will centrifuge the sample and do all other measurements ourselves.
 - Please note, we **will not test for HIV or AIDS**. Sterilised disposable needles, syringes and gloves will be used.
 - Additional subjects for every diabetic and people suffering from diseases will have to be recruited.
 - If possible, a nurse to assist with the blood pressure measurements.
 - We have motivated for funds to pay an honorarium to all helpers. If these funds realise, we plan to pay R10 per hour per helper.

We will visit your area on the following dates:

..... for preliminary talks and arrangements of main visit

..... for actual survey

- While in your area, we will be staying at
- Please call (0148) 299 2481 or 299 2469 for further information.

Kind regards

PROF HH VORSTER



Potchefstroomse Universiteit
vir Christelike Hoër Onderwys

The THUSA project:

information for participating subjects

- **What is the THUSA project?**

THUSA stands for Transition, Health and Urbanisation of South Africans. In the project the effects of a change in eating patterns and life-style on health during the movement from rural to urban areas will be monitored. The main aim is to plan appropriate interventions that will ensure good health for all. During the baseline survey from February 1996 to March 1997, health indicators and eating patterns of Africans living in remote rural areas, on farms, in squatter camps and established towns and cities in the North West Province will be measured.

- **Why is the project so important?**

In all developing countries, the transition from rural to urban life-styles has been characterised by an increase in the diseases of overnutrition such as obesity, diabetes, high blood pressure, stroke, heart disease and certain forms of cancer. We know that it is possible to alleviate **hunger** and **undernutrition** and at the same time to **prevent** overnutrition, if people are helped to make the right food choices.

In this project we want to analyse the situation in the North West so that our Department of Health and Developmental Social Welfare will know which strategies to follow to ensure optimal nutrition and health for all. Therefore, by participating in this project, you will help all the people of the North West.

- **What will be measured in the project?**

- ♦ Eating and drinking habits - food and nutrient intakes
- ♦ Socio-economic background
- ♦ Medical history
- ♦ Activity levels
- ♦ Smoking habits
- ♦ Weight, height, waist, hip and arm measurements
- ♦ Clinical signs of malnutrition (appearance of hair, skin, eyes, thyroid)
- ♦ Blood sample: markers of nutritional status and disease. Please note, **NO** HTV or AIDS testing
- ♦ Urine sample: excretion of minerals
- ♦ Blood pressures
- ♦ Diabetes

- **Who may participate?**

Healthy Africans living in the North West Province who are between 15 and 65 years of age. People will be asked to participate and may refuse. Therefore, only **volunteers** will be asked to sign the informed consent form to participate.

- **What are the benefits for you?**

Many health and nutritional status indicators of yourself will be measured. You will receive feedback during which a member of the investigation team will explain your health risk to you. You will receive dietary advice and will be referred to your clinic or doctor if necessary.

- **What do we expect from you?**

- ◆ Please bring your ID; we need to know your birth date.
- ◆ We will appreciate it if you will report fasting on the day of your participation. It means that for 10 - 12 hours before your blood sample is taken, you must not eat or drink anything but pure water.
- ◆ You will be asked to sign a form giving consent to participate in the project.
- ◆ We will ask you a number of questions regarding your health, age, income, family, smoking and drinking habits, etc.
- ◆ Then you will receive a **number** for the project.
- ◆ You will be weighed and measured.
- ◆ We will take your blood pressure to determine stroke risk.
- ◆ You will be asked to give us a urine sample
- ◆ We will then take a blood sample with a thin, sterilised butterfly needle and a number of small sterile syringes.
- ◆ Your temperature will be taken (orally).
- ◆ Your finger will be pricked twice to measure blood sugar. You will also be asked to drink a sugar cool drink.
- ◆ You will be questioned in detail about your eating habits.
- ◆ Every third person will be asked to participate in a blood pressure project.
- ◆ You will receive journals to read while you wait!
- ◆ If you have any questions about the project, please do not hesitate to ask any one of the field workers.

Thank you for your participation!

ESTÉ VORSTER

THUSA PROJECT : PU FOR CHE
RECRUITMENT AND INFORMED CONSENT FORM

Title of the project: Nutritional and health status of Africans in transition

Name: No.....

Address:

Tel no:

Age:

Are you pregnant?

Are you lactating?

Do you suffer from diabetes? hypertension? Other disease?.....

When did you have your last meal?

.....
or anything but water to drink?

INFORMED CONSENT

I, the undersigned
(full names in print), have read the details of the project or, have listened to the oral explanation thereof, and declare that I understand it. I have had the opportunity to discuss relevant aspects with the researcher and declare that I voluntarily participate in the project. I hereby give consent to participate in the project.

.....
Signature of volunteer

Witnesses

.....
Signed at on

For subjects under the age of 21, signed consent of a parent or legal guardian is necessary.

I, ... (full names) the parent/legal guardian of the person named above, hereby consent that he/she may participate in the THUSA project.

Signature Date

Relationship



Potchefstroomse Universiteit
vir Christelike Hoër Onderwys

The THUSA project:

information for participating clinic sisters

Subject name: Subject no:

STATION 1	Demographic questionnaire	
STATION 2	Dietary questionnaire	
STATION 3	Anthropometry: Weight kg height m waist cm hip cm triceps mm sub-scapula mm	
STATION 4	Clinical signs: thyroid hair skin eyes Blood pressure Oral temperature Blood samples: 1 4 2 5 3 6	mm Hg ° C
STATION 5	Urine sample	
STATION 6	Finger prick glucose + ...	mmol/L.....
STATION 7	Reproductive questionnaire (only women)	
STATION 1	Check/Control signature	



Potchefstroomse Universiteit vir Christelike Hoër Onderwys

Subject number

Date

Place

Interviewer

D	M	Y

Home address

Sex	Male	1
	Female	2

Age			
Date of birth	D	M	Y

First Language	Tswana	1
	Afr	2
	Eng	3
	Xhosa	4
	Zulu	5
	Other	6

Second Language	Tswana	1
	Afr	2
	Eng	3
	Xhosa	4
	Zulu	5
	Other	6

What is your marital status?	Never married	1
	Married	2
	Divorced	3
	Widowed	4

Do you suffer from:	High blood	Yes	1
		No	2
	Diabetes	Yes	1
		No	2
	CHD	Yes	1
		No	2
	Stroke	Yes	1
		No	2

Does anyone in your family suffer from:	High blood	Yes	1
		No	2
	Diabetes	Yes	1
		No	2
	CHD	Yes	1
		No	2
	Stroke	Yes	1
		No	2

Do you take medicine regularly?	Yes	1
	No	2
If yes - what do you take?		

Do you snuff?	Yes	1
	No	2
Do you smoke?	Yes	1
	No	2
If no - have you smoked regularly before?	Yes	1
	No	2
If yes - what do you smoke?	Cigarettes	1
	Tobacco/pipe	2
	Other	3
If other - describe		
How much do you smoke?	per day	
	per week	
For how long have you been smoking (years)		
Calculate pack years		

What is your highest qualification?	None	1
	< St.6	2
	St. 6-8	3
	St. 6-8 + trade	4
	St. 9-10	5
	St. 9-10 + trade	6
	St. 9-10 + academic	7

What is your occupation?	
--------------------------	--

Do you have a job at the moment?	Yes	1
	No	2

If yes - what kind of job?	
----------------------------	--

On which days of the week do you work?	Irregular (piece work)	1
	Part time (1-4 days)	2
	Full time (5-6 days)	3

How much money do you earn? Is it between...	R0-100	
	R101-500	
	R501-1000	
	R1000-2000	
	R2000-3000	
	R3000+	

What is the source of this income?	
------------------------------------	--

Do you receive any additional pensions?	Yes	1
	No	2

How much pension do you receive per month?

<i>Interviewer - Re-evaluate final income category</i>	R0-100	1
	R101-500	2
	R501-1000	3
	R1000-2000	4
	R2000-3000	5
	R3000+	6

Who else contributes money to your household? How much?

Yes	1
No	2

Who else contributes other resources eg. food,
sharing work/chors to your household? - specify!

Yes	1
No	2

Does any member of your household have the right to use any property as his/her own?	Yes	1
	No	2

What type of property? _____

How do you use it? _____

Please name the members of your household

Member	Age	Education	Present job

What type of house do you live in?	Traditional	1
	Mokuku	2
	Brick house	3
	Other	4
Specify other		

Do you share a toilet with other households?	Yes	1
	No	2

What type of toilet do you have?	Communal	1
	None	2
	Bucket system	3
	Outside longdrop	4
	Outside chemical	5
	Outside water flush	6
	Inside water flush	7

Where do you get your drinking water from?	Fountain, river	1
	Communal tap	2
	Tap on premises	3
	Tap in house	4
	Other	5
If other specify		

Do you have access to electricity inside your house?	Yes	1
	No	2

What type of stove do you have?	None	1
	Coal/wood	2
	Gas or paraffin	3
	Electric	4

What type of fridge do you have?	None	1
	Paraffin	2
	Gas	3
	Electric	4

How long have you been living here? (years)	
---	--

Where did you live before coming here?	Rural area	1
	Farm	2
	Squatter camp	3
	Township	4

GRAAD VAN AKKULTURASIE:**ONDERVRAER:****DATUM**

Studienommer:				
Area:				

INSTRUKSIES: Omkring die nommer langs die proefpersoon se antwoord.

1. Was jy in hierdie area gebore?

JA	1	NE	2
		E	

1.1. Indien NEE: Hoe lank bly jy al in hierdie area?

< 1 jaar	1
1 - 2 jare	2
3 - 5 jare	3
6 - 10 jare	4
11 - 15 jare	5
16 - 20 jare	6
>20 jare	7
Nie van toepassing	8

Instruksie: Indien proefpersoon Nee op vraag 1 geantwoord, of vir 10 jaar of minder in die area gebly het, vra vrae 2.1 en 2.2**Indien proefpersoon in die area gebore was of vir meer as 10 jaar in die area gebly het, gaan direk na vraag 3 (platteland of plase) of vraag 4 (dorps en stadsgebiede)**

2.1 Waar het jy laaste gebly, voordat jy na hierdie area gekom het?

--	--

2.2 Watter tipe area was dit?

Platteland	1
Wit eienaar se plaas	2
Afrikaan eienaar se plaas	3
Plakkerkamp	4
Dorp, Stad 'Township'	5
Nie van toepassing	6

3. Moet deur proefpersone in plakker en dorpsgebiede beantwoord word:

3.1 Woon familie van jou in plattelandse dorpe of op plase?

Ja	Nee	Weet nie
1	2	3

Indien JA, vra 3.2 en 3.3

3.2 Wanneer het jy laas besoek by hulle afgele?

minder as 1 jaar gelede	1
1 - 2 jare gelede	2
3 - 4 jare gelede	3
5 of meer jare gelede	4
Nooit	5
Nie van toepassing	6

3.3 Hoe veel keer per jaar (van Kersfees tot Kersfees) lê jy besoek by hulle af?

1 - 3	1
4 - 6	2
7 - 9	3
10 - 12	4
meer as 12	5
Nooit	6
Nie van toepassing	7

4. Moet deur proefpersone in plattelandse dorpe en op plase beantwoord word:

4.1 Het jy familie wat in dorpsgebiede bly?

Ja	Nee	Weet nie
1	2	3

Indien JA, vra 4.2 en 4.3.

4.2 Wanneer het jy laas besoek by hulle afgelê?

minder as 1 jaar gelede	1
1 - 2 jare gelede	2
3 - 4 jare gelede	3
5 of meer jare gelede	4
Nooit	5
Nie van toepassing	6

4.3 Hoe veel keer per jaar (van Kersfees tot Kersfees) le jy besoek by hulle af?

1 - 3	1
4 - 6	2
7 - 9	3
10 - 12	4
meer as 12	5
Nooit	6
Nie van toepassing	7

STUDIENOMMER _____ DEEL I

INSTRUKSIE: Skryf die proefpersoon se antwoord in die blokke langs die vraag OF omkring die nommer langs die proefpersoon se antwoord.

VOORBEELD:

1. Hoeveel maaltye het jy gister geëet? Gister=Maan1 Dins2 Woens3 Don4 Vry5 Sat6 Son7				
2.1.1 Omtrent hoe laat het jy jou eerste maaltyd geëet?				
2.1.2 Waar het jy die maaltyd geëet? Huis Werk Ander spesifiseer _____ Nie van toepassing				

Beantwoord asseblief die volgende vrae:

1. Hoeveel maaltye het jy gister geëet? Gister=Maan1 Dins2 Woens3 Don4 Vry5 Sat6 Son7				
2.1.1 Omtrent hoe laat het jy jou eerste maaltyd geëet?				
2.1.2 Waar het jy die maaltyd geëet? Huis Werk Ander spesifiseer _____ Nie van toepassing				1 2 3 4
2.2.1 Omtrent hoe laat het jy jou tweede maaltyd geëet?				
2.2.2 Waar het jy die maaltyd geëet? Huis Werk Ander spesifiseer _____ Nie van toepassing				1 2 3 4
2.3.1 Omtrent hoe laat het jy jou derde maaltyd geëet?				
2.3.2 Waar het jy die maaltyd geëet? Huis Werk Ander spesifiseer _____ Nie van toepassing				1 2 3 4
2.4.1 Omtrent hoe laat het jy jou vierde maaltyd geëet?				

5. Hoe dikwels eet jy by restaurante, 'steak houses', Wimpy, kafees, 'fast-food' winkels, wegneem plekke, padkafees?

Daagliks

1

Weekliks

2

Maandeliks

3

Selde

4

Nooit

5

5.1 INDIEN DAAGLIKS, WEEKLIKS OF MAANDELIKS, Waar eet jy en wat eet jy gewoonlik?

Plek (Naam en beskrywing)

VOEDSEL GEËET

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
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2.3.2 Waar het jy die maaltyd geëet?				
Huis			1	
Werk			2	
Ander spesifiseer _____			3	
Nie van toepassing			4	
2.5 Eet jy hierdie hoeveelheid maaltye op meeste weksdae?	JA 1	NEE 2		
INDIEN NEE:				
2.5.1 Hoeveel maaltye eet jy gewoonlik per weksdag?				
2.6 Eet jy jou maaltye op meeste weksdae op omtrent dieselfde tyd as bo?	JA 1	NEE 2		
INDIEN NEE:				
2.6.1 Omtrent hoe laat eet jy jou eerste maaltyd gewoonlik?				
2.6.2 Waar eet jy die maaltyd gewoonlik?				
Huis				1
Werk				2
Ander spesifiseer _____				3
Nie van toepassing				4
2.6.3 Omtrent hoe laat eet jy gewoonlik jou tweede maaltyd?				
2.6.4 Waar eet jy gewoonlik die maaltyd?				
Huis				1
Werk				2
Ander spesifiseer _____				3
Nie van toepassing				4
2.6.5 Omtrent hoe laat eet jy jou derde maaltyd?				
2.6.6 Waar eet jy die maaltyd gewoonlik?				
Huis				1
Werk				2
Ander spesifiseer _____				3
Nie van toepassing				4
2.6.7 Omtrent hoe laat eet jy gewoonlik jou ander maaltye?				
2.6.8 Waar eet jy gewoonlik die maaltye?				
Huis				1
Werk				2
Ander spesifiseer _____				3
Nie van toepassing				4

3. Het jy gister enigiets geëet of gedrink voor, tussen of na maaltye ?			J 1	N 2
3.1 INDIEN JA: Wat het jy geëet of gedrink en waar en wanneer het jy dit geëet of gedrink?				
Tipe voedsel:	Wanneer? (vroeg oggend, oggend, middag, aand)	Waar?		
INSTRUKSIE: Indien proefpersoon JA op vraag 3 geantwoord het, vra 3.2, indien NEE, VRA 3.3				
3.2 Eet of drink jy enigiets voor, tussen of na maaltye op meeste dae?			JA 1	NEE 2
3.3 Alhoewel jy niks tussen maaltye gister geëet het, eet of drink jy gewoonlik iets tussen maaltye?			JA 1	NEE 2
3.3.1 Indien JA, wat eet of drink jy gewoonlik tussen maaltye, en waar en wanneer eet jy dit?				
Tipe voedsel	Waar?	Wanneer?		

4

. Hoe word kos gewoonlik in jou gesin bedien?

Moeder bedien almal op individuele borde	1
Elke bedien hom/haarself om individuele borde	2
Vader bedien almal op individuele borde	3
Volwassenes bedien vir hulself, en skep vir kinders in	4
Almal eet uit 'n gemeenskaplike skottel	5
Volwassenes en kinders eet uit aparte gemeenskaplike skottels	6
Volwassesnes eet uit borde, kinders eet uit 'n gemeenskaplike bord	7

Ander Beskryf bv woon alleen of in 'n koshuis

8

5. Hoe dikwels eet jy by restaurante, 'steak houses', Wimpy, kafees, 'fast-food' winkels, wegneem plekke, padkafees?

Daaglik	1
Weeklik	2
Maandelik	3
Selde	4
Nooit	5
5.1 INDIEN DAAGLIK, WEEKLIK OF MAANDELIK, Waar eet jy en wat eet jy gewoonlik?	
Plek (Naam en beskrywing)	VOEDSEL GEËET

VOEDSEL	BESKRYWING	HOEVEEL- HEID	HOEVEEL KEER GREET				KODE	EVED/DAG
			Per dag	Per week	Per maand	Selds Nooit		
Indien JA, hoeveel suiker?							9012	
Ontbyt graankos	Handelsnaam van graankosse tans in die huis: Weet nie__							
Gooi jy melk oor jou ontbytgraan? JA 1 NEE 2 INDIEN JA, watter tipe melk (volroom vars, suur, vetvry, 2%, melk mengsel) _____ INSTRUKSIE: Wys die proefpersone die voorbeelde								
INDIEN JA, hoeveel melk?								
Gooi jy suiker oor jou ontbytgraan? JA 1 NEE 2								
Indien JA, hoeveel suiker?							9012	
Stampmielies	Gekoop Self gemaak Met vet Sonder vet						4077 4073	
Stampmielies met droë boontjies							A014	
Is die hoeveelheid stampmielies en bone dieselfde as op die foto? JA 1 NEE 2 Indien NEE, gebruik jy meer bone as op die foto of minder? MEER 1 MINDER 2								
Stampmielies met grondboontjies							A013	
Is die hoeveelheid stampmielies en grondboontjies dieselfde as op die foto? JA 1 NEE 2 Indien NEE, gebruik jy meer grondboontjies as op die foto of minder? MEER 1 MINDER 2								
Rys	Wit Bruin Mielierys						4040 4134 4043	
Pastas	Macaroni Spaghetti Ander:						4062	
Jy is baie behulpzaam. Kan ek jou nou uitvra oor vleis? HOENDER, ROOIVLEIS EN VIS Hoeveel keer in die week eet jy rooivleis, hoender, vis of soya produkte? _____ Eet jy hoender? JA 1 NEE 2 INDIEN JA, Waar kry jy jou hoender vandaan? (Mag meer as een antwoord gee)								1 2 3 4 5 6
Hoender:	Hoe maak jy hoender gaar?							
	Gekook, niks bygevoeg						1521	
	Gebraai: in deeg/krummels							
	sonder deeg/krummels						1520	
	Gerooster							

VOEDSEL	BESKRYWING	HOEVEEL- HEID	HOEVEEL KEER GEEET				KODE	HVHD/DAG
			Per dag	Per week	Per maand	Salda Nooit		
	Bredie Watter groente sit jy gewoonlik by?						A002	
Eet jy die hoender se vel?			Altyd 1	Soms 2	Nooit 3			
Hoenderbeen- bredie							A003	
Hoenderpote	Met vel Sonder vel						A004 1609	
Hoender afval	Hoe maak jy dit gaar?						1610	
Waar kry jy jou rooivleis vandaan? (Mag meer as een antwoord) Winkel/supermark/'spaza' Werkgewer Slag eie Geskenke Ander spesifiseer: Eet nie rooivleis							1 2 3 4 5 6	
Rooivleis	Hoe hou jy van vleis? Met vet Sonder vet							
Beesvleis	Hoe maak jy beesvleis gaar?							
	Gebraai met been							
	Gebraai sonder been							
	Gestowe met been						A001	
	Gestowe sonder been						A001	
	Gerooster met been							
	Gerooster sonder been							
	Gemaal						1571	
Skaapvleis	Hoe maak jy skaapvleis gaar?							
	Gebraai met been							
	Gebraai sonder been							
	Gestowe met been						1511	
	Gestowe sonder been						1511	
	Gerooster met been							
	Gerooster sonder been							
	Gemaal						1571	
Varkvleis	Hoe maak jy varkvleis gaar?							
	Gebraai met been							
	Gebraai sonder been							
	Gestowe met been							
	Gestowe sonder been							

VOEDSEL	BESKRYWING	HOEVEEL- HEID	HOEVEEL KEER GREET				KODE	EVED/DAG
			Per dag	Per week	Per maand	Selde Nooit		
	Gerooster met been							
	Gerooster sonder been							
	Gemaal						1598	
Afval	Derms: gekook, niks bygevoeg							
	Gestowe met groente							
	Maag						1546	
	Hart						1565	
	Longe							
	Lewer						1515	
	Niertjies						1518	
Watter groente word gewoonlik by die bredies bygevoeg								
Wors	Gebraai Gerooster						1526	
Spek vleis							1501	
Koue vleis	Polonie						1514	
	Ham						1564	
	Weenseworsies						1531	
	Ander - spesifiseer							
Vleispastei	Tuisgemaak Gekoop						1548	
Blikkies vleis	'Bully beef' Ander Wys voorbeelde						1535	
Hamburger	Tuisgemaak Gekoop						A015	
Droë bone/ertjies/ lensies	Hoe maak jy dit gaar?							
Sojaprodukte bv Toppers	Handelsname van sojaprodukte wat gebruik word: Weet nie____ Wys voorbeelde						3527	
Sardyne in tamatie/chilli sous	Heel						2503	
	Fyngemaak met gebraaide uie						A005	
Gebraaide vis	Met deeg/krummels						2509	
	Sonder deeg/krummels						2523	
Ander ingemaakte vis	Tuna Gepekeld vis Ander:						2547	

VOEDSEL	BESKRYWING	HOEVEEL- HEID	HOEVEEL KEER GEET				KODE	EVED/DAG
			Per dag	Per week	Per maand	Selde Nooit		
Viskoekies	Tuisgemaak Bevrore (gevrore) Gekoop						2531	
Eiers	Gekook/ geposjeer Roereier Gebraai						1001 1003	

ONS KOM NOU BY GROENTE EN VRUGTE

Waar kry jy jou groente vandaan? (Mag meer as een antwoord)

Eie groente tuin	1
Werkgewer/ werkgewer se plaas	2
Eie plaas	3
Winkel/Supermark/ groentewinkel	4
Smous	5
Veld (bv morogo)	6
Geskenke	7
Ander spesifiseer	8

Hoeveel keer in die week eet jy groente? _____

VOEDSEL	BESKRYWING	Hoeveel- heid	HOEVEEL KEER GEET				KODE	HVD/DAG
			Per dag	Per week	Per maand	Selde Nooit		
Kool	Hoe maak jy kool gaar?							
	Gekook, niks bygevoeg						8066	
	Gekook met aartappel, ui en vet						A006	
	Gebraai, niks bygevoeg						A007	
	Gekook dan gebraai met aartappel en uie						A006	
	ander: Weet nie:							
Spinasie/ morogo/ ander groen blaargroente	Hoe maak jy spinasie gaar?							
	Gekook, niks bygevoeg						8071	
	Gekook, vet bygevoeg							
	Gekook met uie, tamatie en vet						A011	
	Gekook met uie, tamatie en aartappel							
	Gekook met grondboontjies							
	Ander: Weet nie:							

VOEDSEL	BESKRYWING	Hoeveel- heid	HOEVEEL KEER GEEET				KODE	HVD/DAG
			Per dag	Per week	Per maand	Selde Nooit		
Tamatie en uie sous	Tuisgemaak met vet -sonder vet						A012 A016 8221	
	Ingemaak {Is dit die hoeveelheid pap wat jy eet? Hoeveel meer of minder? }							
Pampoen	Hoe kook jy pampoen?							
	Gaargemaak in vet en suiker						A010	
	Gekook, bietjie suiker en vet						A009	
	Ander _____ Weet nie _____							
Wortels	Hoe kook jy wortels?							
	Gekook met suiker en vet						8129	
	- met aartappel en uie						A008	
	Rou, slaai						8015	
	Ander _____ Weet nie _____							
Mielies/ suikermielies	Hoe eet jy mielies? Aan stronk met vet - sonder vet						8033	
	Van die stronk af met vet sonder vet						8261	
Beetslaai	Tuisgemaak Gekoop						8005	
Aartappels	Hoe maak jy aartappels gaar?							
	Gekook/gebak met skil						8046	
	- sonder skil						8045	
	Fyngedruk							
	Gebraai						8189	
	Skyfies						8048	
	Slaai Ander spesifiseer:						8226	
	Weet nie _____							
Patats	Hoe maak jy patats gaar?							
	Gekook/gebak met skil sonder skil						8057 8214	
	Fyngedruk met vet en suiker							
	Ander spesifiseer: Weet nie _____							

VOEDSEL	BESKRYWING	Hoeveelheid	HOEVEEL KEER GEEET				KODE	EVD/DAG
			Per dag	Per week	Per maand	Selde Nooit		
Slaai groente	Rou tamatie,						8059	
	Blaarslaai						8031	
	Komkommer						8025	
Ander groente	Spesifiseer:							

VRUGTE

Hou jy van vrugte?

JA 1

NEE 2

Hoeveel keer in 'n week of in 'n maand eet jy vrugte? _____

Waar kry jy jou vrugte vandaan?

Eie vrugte bome	1
Werkgewer/werkgewer se plaas	2
Eie plaas	3
Winkel/supermark/groentewinkel	4
Smous	5
Veld	6
Geskenke	7
Ander spesifiseer	8

VOEDSEL	BESKRYWING	Hoeveelheid	HOEVEEL KEER GEEET				KODE	EVD/DAG
			Per dag	Per week	Per maand	Selde Nooit		
Appels/Pere	Vars						7001	
	Geblikte pere						7054	
Piesangs							7009	
Lemoene / naartjies							7031	
Druie							7020	
Perskes	Vars						7036	
	Geblikte perskes						7038	
Appelkose	Vars						7003	
	Geblikte perskes						7004	
Mango's	Vars						7026	
Koejawels	Vars						7021	
	Geblikte koejawels						7023	
Indien proefpersoon geblikte vrugte eet: Eet jy vla saam met die geblikte vrugte?								
ALTYD 1 SOMS 2 NOOIT 3								
Vla	Tuisgemaak Langlewe (Ultramel)						0004	
Wildevrugte/ bessies	Stamvrugte Noem-noem Klappers Maroelas Nastergals Ander -spesifiseer						7070	

VOEDSEL	BESKRYWING	Hoeveelheid	HOEVEEL KEER GEET				KODE	EVD/DAG
			Per dag	Per week	Per Selds maand	Nooit		
Gedroogte vrugte	Tipes:							
Ander vrugte:								
BROOD EN BROODSMER								
Brood Broodrolle	Wit						4001	
	Bruin						4002	
	Volgraan						4003	
Smeer jy enigiets op die brood? Altyd 1 Soms 2 Nooit 3 Indien ALTYD of SOMS, wat smeer jy op?								
Margarien	Wat is die handelsnaam van die margarien wat jy tans gebruik? _____ Weet nie ____ Wys voorbeelde							
Botter	Wat is die handelsnaam van die botter wat jy tans gebruik? _____ Tuisgemaak Weet nie ____						6502	
Grondboontjie botter							6509	
Konfy/stroop/ heuning							9008	
Marmite/Fray Bentos ens							9501	
Vis/vleis smeer							1512	
Kaas	Tipe:							
Atjar							A017	
Polonie							1514	
Ander smere:	Spesifiseer:							
Kluitjie							4001	
Vetkoek							4057	
Provita, kraak- beskuitjies								
VETTE: Watter vette gebruik jy en waarmee saam gebruik jy dit?								

VOEDSEL	BESKRYWING	Hoeveelheid	HOEVEEL KEER GEEET				KODE	EVD/DAG
			Per dag	Per week	Per Salde maand	Nooit		
Margarien	Waar gebruik op brood met groente Hoeveelheid lepels ___per nommer gesinslede___ ander-spesifiseer							
Botter	Waar gebruik: op brood met groente ander-spesifiseer Hoeveelheid lepels ___per nommer gesinslede___							
Holsum /plantvette	Waar gebruik: Hoeveelheid lepels ___per nommer gesinslede___						6508	
Olie	Waar gebruik: Hoeveelheid lepels ___per nommer gesinslede___						6510	
Uitgebraaide vet	Waar gebruik: Hoeveelheid lepels ___per nommer gesinslede___							
Gemengde vet (makhuru)	Waar gebruik: Hoeveelheid lepels ___per nommer gesinslede___							
Niervet	Waar gebruik: Hoeveelheid lepels ___per nommer gesinslede___						6520	
Mayonnaise/ slaaisous	Hoeveelheid lepels ___per nommer gesinslede___						6573	
Room	Vars/Langlewe/ geblik 'Orley whip'						6503	
DRANKE								
Tee							9514	
Suiker/koppie tee							9012	
Melk/koppie tee	Watter tipe melk gebruik jy in jou tee?							
	Vars/anglewe volroom						0006	
	Vars/anglewe 2%							
	Vars/anglewe vetvry						0072	
	Volroommelkpoeier naam_____						0009	

VOEDSEL	BESKRYWING	Hoeveelheid	HOEVEEL KEER GEËET				KODE	HVD/DAG
			Per dag	Per week	Per Selds maand	Nooit		
	Afgeroomde melkpoeier naam _____						0008	
	Melkmengsel naam _____						0068	
	Verromer naam _____						0039	
	Gekondenseerde melk						0002	
	Ingedampte melk						0003	
	Geen							
Koffie							1513	
Suiker/koppie koffie							9012	
Melk/koppie koffie	Watter tipe melk gebruik jy in jou koffie? Vars/langlewe volroom						0006	
	Vars/langlewe 2%						0072	
	Vars/langlewe vetvry						0009	
	Volroommelkpoeier naam _____						0008	
	Afgeroomde melkpoeier naam _____						0068	
	Melkmengsel naam _____						0039	
	Verromer naam _____						0002	
	Gekondenseerde melk						0003	
	Ingedamptemelk							
	Geen							
Melk as sulks	Vars/langlewe volroom						0006	
	Vars/langlewe 2%						0072	
	Vars/langlewe vetvry						0009	
	Suurmilk(maas)						0008	
	Volroommelkpoeier naam _____						0068	
	Afgeroomde melkpoeier naam _____						0039	
	Melkmengsel naam _____						0002	
	Gekondenseerde melk						0003	
	Ingedampte melk							
Melkdranke	Nestle Milo Ander:							
Yoghurt	Drink yoghurt						0044	
	Dik yoghurt						0020	

VOEDSEL	BESKRYWING	Hoeveel- heid	HOEVEEL KEER GEEST				KODE	EVD/DAG
			Per dag	Per week	Per Salde maand	Nooit		
Beskuitjies	Tipe							
Koeke en terte	Tipe							
Skons							4029	
Beskuit							4160	
Southappies	Vleisrolletjies Samcosas Beskuitjies bv Bacon kips Ander spesifiseer:						1534 4196 4162	
POEDINGS:								
Ingemaakte vrugte	Tipe:							
Jellie							9004	
Vla	Tuisgemaak Langlewe (Ultramel)						0004	
Gebakte poeding							4181	
Kitspoeding							4066	
Roomys Sorbet							6507 6516	
Ander spesifiseer:								
SOUSE / GEURMIDDELS:								
Atjar							A017	
Tamatiesous Worcestersous							9505	
Blatjang							9524	
Piekels							8176	
Pakkies sop							4069	
Ander:								
INSERTE:								
Sprinkane								
Mopani wurms								
Ander:								
WILDE VOELS OF DIERE (Gejag in landelike gebiede of op plase)								

VOEDSEL	BESKRYWING	Hoeveelheid	HOEVEEL KEER GEËET				KODE	HVD/DAG
			Per dag	Per week	Per Selds maand	Nooit		
ALLERLEI: Noem asseblief enige ander voedsel wat meer as een/twee keer per week geëet word waaroor ons nie gepraat het nie.								

SOUT GEBRUIK :

Die volgende paar vrae is om uit te vind of jy sout gebruik, waar jy dit gebruik en hoeveel gebruik.

Voeg jy sout by kos terwyl dit gaargemaak word?

Altyd	Soms	Nooit	Weet nie
1	2	3	4

Voeg jy sout by kos nadat dit gaargemaak is?

Altyd	Soms	Nooit
1	2	3

Hou jy van souterige kosse soos gesoute grondboontjies, aartappelskyfies ens?

Baie lief daarvoor	Hou daarvan	Hou nie baie daarvan, eet dit soms	Eet dit nooit
1	2	3	4

BÊRE VAN VOEDSEL:

Bêre jy voedsel van een maaltyd om tydens 'n volgende maaltyd te eet?

Altyd	Soms	Nooit
1	2	3

Indien ALTYD of SOMS, watter voedsel bêre jy?

Eet jy hierdie oorskiet kosse koud of maak jy dit warm?

VOEDSEL	Her-verhit	Koud

Gebruik jy enige van die volgende?

	Naam van produk	Hoeveelheid /dag
	Vitamiene/vitamiene & minerale	
	Tonikums	
	Gesondheidskosse	
	Liggaamsbou-preparate	
	Dieetvesel supplement	
	Ander: spesifiseer	

DANKIE VIR U SAMEWERKING EN GEDULD!

TOTSIENS!



Potchefstroomse Universiteit vir Christelike Hoër Onderwys

QUESTIONNAIRE 3

THUSA PROJECT

NO

ALL THE INFORMATION OF THIS QUESTIONNAIRE IS

CONFIDENTIAL

- Are you using any form of contraceptive No - 1/Yes - 2
- If yes, state type
 - IUD
 - Condoms
 - Other
 - Pill
 - Injection
- If 4 or 5 state product name
- At what age did you start using contraceptives
Duration of using
- Has your method of contraceptive changed during this time N-1/Y-2
- If yes, how and when
- At what age did you experience your first menstruation
 1. ≤ 12
 2. 13-14 16
 3. ≥ 17
- What is the date of the first day of your last menstruation
day mo
- How many days between menstruation
Phase at present

9. How old were you when your first child were born

1. ≤ 24
2. 25-29
3. ≥ 30

10. Have you experience your menopause No - 1/ Yes - 2

11. If yes, at what age

1. Pre
2. < 50
3. > 50

12. Have you had a historectomy No-1/ Yes - 2

13. If yes, at what age

1. ≤ 24
2. 25-29
3. ≥ 30

14. How many children do you have

15. What are the ages of your youngest and oldest

Youngest
Oldest

16. How many of your children were breast fed

17. How long did you breast fed each child

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.

18. Have you had any previous problems with your breasts N-1/Y-2

19. If yes, state what

20. Do you have a family history of breast problems No - 1/ Yes - 2



Potchefstroomse Universiteit
vir Christelike Hoër Onderwys

The THUSA project:

feedback to participants

Dear Participant

No.

Name:.....

Your tests have shown that

- Everything measured were normal, no signs of disease
- You must see your clinic or doctor to check for:
 - goitre
 - high blood pressure
 - blood sugar (diabetes)
 - anaemia
 - heart disease
- You must try to loose weight.....
- You must include more of the following foods in your diet.....
.....
.....
.....

Thank you for participating in this project.

APPENDICES

APPENDIX A

CONSENT FORM

NUTRITIONAL HEALTH OF WOMEN (25-44 YEARS) IN MANGAUNG, 2000

Ethics committee reference number: 02/00

Declaration by or on behalf of the participant:

Respondent number

I, the undersigned, ...

???

[ID.....]

.....(address)

A confirm that:

1. I have been asked to participate in the above-mentioned research survey carried out by the Technikon Free State and University of the Orange Free State
2. It has been explained to me that:
 - 2.1 The purpose of the research survey is to collect information on usual food intake, activity level, attitude towards health, risk for developing illnesses related to eating habits and lifestyle of women in the ages 25 to 45 years in Mangaung. The information collected will be used to determine nutritional problems and to develop solutions for these problems.
 - 2.2 In order to collect this information I have been told that I will be asked a number of questions regarding:
 - general background information;
 - the types and amounts of foods I eat and how often I eat these foods;
 - how active I am every day;
 - my attitude towards leanness and fatness;
 - 2.3 I also understand that a medical doctor will perform a free medical examination and that blood samples will be drawn by a registered nurse. One of these blood samples will include a test for HIV-AIDS. I also agree to be weighed and measured. I will not eat or drink anything after 10:00 of the evening preceding the research day. I will bring a list of the medication that I usually use with me on the research day.
 - 2.4 I have been told that this information will be collected from over 500 women in Mangaung and I will only be asked these questions once. The measurements and blood samples will also be taken once only.

- 2.5 I have been told that it will not take more than one day to collect the information.
3. I have been told that the measurements will not cause any harm to me in any way.
4. It was also explained to me that by participating in the research survey I will help other women in the country.
5. It was also explained to me that the information will be kept confidential but that it will be used anonymously for making known the findings to other scientists.
6. I understand that I will have no direct access to the results of the survey but I can contact the researcher who will inform me of the findings.
7. It was also clearly explained to me that I can refuse to participate in this research survey. If I refuse, it will not be held against me in any way.
8. The information in this consent form was explained to me by(name of interviewer) in(language) and I confirm that I have a good command in this language and understood the explanations. I was also given the opportunity to ask questions on things I did not understand clearly.
9. No pressure was applied on me to take part in this research survey.
10. Finally, after completion of my participation in this research survey I will receive a payment of R40. I will be responsible for my own transport home.

B I hereby agree voluntarily to take part in this research survey.

Signed/confirmed at on 2000

.....
Signature or hand mark of
Participant

.....
Signature or hand mark of
Witness

APPENDIX C

Nutritional Health of Women (25-44yrs) in Mangaung, 2000

Anthropometry

Name: _____

Respondent number: _____

--	--	--

 1-3

Measurer (interviewer): _____

--	--

 4-5

Weight (kg): _____

--	--	--	--	--

 6-10

Height (m): _____

--	--	--	--

 11-14

Circumferences (cm):

Upper-arm: _____

Waist: _____

Hip: _____

 15-18
19-23
24-28

Bio-impedance:

Age (yrs): _____

Elbow width (cm): _____

Bodystat count: _____

 29-30
31-33
34-36

Frame size

1. Small
2. Medium
3. Large

--

 37

% Fat: _____

% Lean mass: _____

 38-41
42-45

APPENDIX D

NUTRITIONAL HEALTH OF WOMEN (25-44 YRS) IN MANGAUNG, 2000
--

Name: _____

Respondent number: _____

Interviewer: _____

			1-3
			4-5

QUANTITATIVE FOOD FREQUENCY QUESTIONNAIRE

Greeting

Thank you for giving up your time to participate in this survey. We would like to find out what women 25 to 44 years of age and living in the Free State, usually eat and drink. This information is important to know as it will tell us whether you eat the right foods, and if you are healthy.

Please think carefully about the food and drinks you have consumed during the past 6 months. I will now go through a list of foods and drinks with you and I would like you to tell me:

- if you eat these particular foods,
- how the food is prepared,
- how much of the food you eat at a time, and
- how many times a day you eat it and if you do not eat it every day, how many times a week or a month it is eaten?

To help you to describe the amount of a food, I will show you pictures or models of different amounts of the food. Please say which picture or model is the closest to the amount eaten, or if it is smaller, between sizes or bigger than the pictures or models. Amounts can also be reported as cups (c), tablespoons (T) or teaspoons (t).

- **THERE ARE NO RIGHT OR WRONG ANSWERS.**
- **EVERYTHING YOU TELL ME IS CONFIDENTIAL.**
- **IS THERE ANYTHING YOU WANT TO ASK NOW?**
- **ARE YOU WILLING TO GO ON WITH THE QUESTIONS?**
- **ENCIRCLE APPROPRIATE ANSWER**

Do you follow any special diet?

YES (1) NO (2)

	6
	7

If yes, please specify (encircle appropriate answer)

1. Diabetic diet

2. Slimming diet

3. Allergies

4. Other (Specify) _____

- Do you use salt in your food?

YES (1)

NO (2)

DON'T KNOW (3)

	8
--	---

- Are other, flavoured salts e.g. Aromat used in your food? YES (1) NO (2) DON'T KNOW (3)

Please specify _____

- Do you use beef/ chicken stock in your food? YES (1) NO (2) DON'T KNOW (3)

- Do you use any dietary supplements? YES (1) NO (2) DON'T KNOW (3)

- If yes, please specify the type (name), how often, and how much:

Vitamins: _____

Minerals: _____

Protein: _____

Energy: _____

Other: _____

			12-14
			15-17
			18-20
			21-23
			24-26

EATING PATTERNS: (FREQUENCY OF EATING)

PLEASE INDICATE WHICH OF THE FOLLOWING BEST DESCRIBES THE EATING PATTERN YOU USUALLY FOLLOW (MARK ONLY ONE):

- 1. More than three meals with eating between meals
- 2. Three meals with eating between meals
- 3. Three meals with no eating between meals
- 4. Two meals with eating between meals
- 5. Two meals with no eating between meals
- 6. One meal with eating between meals
- 7. One meal with no eating between meals
- 8. Nibble the whole day, no specific meals
- 9. Others (Please specify): _____

☐ 27

DO YOU EAT BREAKFAST:

- 1. Regularly (≥ 4 times a week)
- 2. Sometimes (1 – 3 times a week)
- 3. Never

☐ 28

HOW OFTEN DO YOU EAT AT THE FOLLOWING PLACES AWAY FROM HOME?

Family	1. Never	2. > once/week	3. Weekly	4. Monthly	5. > once a month		29
Friends	1. Never	2. > once/week	3. Weekly	4. Monthly	5. > once a month		30
Café	1. Never	2. > once/week	3. Weekly	4. Monthly	5. > once a month		31
Restaurant, Fast food	1. Never	2. > once/week	3. Weekly	4. Monthly	5. > once a month		32
Other, specify _____	1. Never	2. > once/week	3. Weekly	4. Monthly	5. > once a month		33

Do you drink coffee with your meals?

 34

- 1. Yes
- 2. No

If yes, at which meals

Breakfast	1. Yes	2. No		35
Lunch	1. Yes	2. No		36
Supper	1. Yes	2. No		37
Snacks	1. Yes	2. No		38

Do you drink tea (except Rooibos) with your meals?

 39

- 1. Yes
- 2. No

If yes, at which meals

Breakfast	1. Yes	2. No		40
Lunch	1. Yes	2. No		41
Supper	1. Yes	2. No		42
Snacks	1. Yes	2. No		43

With how many meals per day do you eat meat, fish or poultry?

 44

- 1. One meal
- 2. Two meals
- 3. All meals
- 4. None

Do you eat fresh fruit and/or vegetables with the following meals?

Breakfast

1. Yes 2. No

Lunch

1. Yes 2. No

Supper

1. Yes 2. No

Snacks

1. Yes 2. No

	45
	46
	47
	48

SUMMARY OF FOOD FREQUENCY QUESTIONNAIRE

FOOD	CALCULATIONS	CODE	AMOUNT PER DAY (g)									
												(1-8)
												(9-16)
												(17-24)
												(25-32)
												(33-40)
												(41-48)
												(49-56)
												(57-64)
												(65-72)
												(73-80)
												(1-8)
												(9-16)
												(17-24)
												(25-32)
												(33-40)
												(41-48)
												(49-56)
												(57-64)
												(65-72)
												(73-80)
												(1-8)
												(9-16)
												(17-24)
												(25-32)
												(33-40)
												(41-48)
												(49-56)
												(57-64)
												(65-72)
												(73-80)
												(1-8)
												(9-16)
												(17-24)
												(25-32)
												(33-40)
												(41-48)
												(49-56)
												(57-64)
												(65-72)
												(73-80)
												(1-8)
												(9-16)
												(17-24)
												(25-32)
												(33-40)
												(41-48)
												(49-56)
												(57-64)
												(65-72)
												(73-80)

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/DAY
			Per day	Per week	Per month	Seldom/ Never		
Maize-meal porridge	Stiff (pap)						3400	
Maize-meal porridge	Soft (slappap)						3399	
Maize-meal porridge	Crumbly (phutu)						3401	
Sour porridge	Specify ratio Mabella/Maize						3399	
Mabella porridge	Stiff, coarse, fine						3437	
Mabella porridge	Soft, coarse, fine						3437	
Oats porridge	Brand name:						3239	
Breakfast cereals	Puffed Wheat, plain						3325	
	Corn Flakes, plain						3243	
	Weet Bix						3244	
	Puffed Rice, sweet						3372	
	Specify types usually eaten _____							
	Brand names of cereals available at home now: _____							
Milk on porridge or cereal: Circle type usually used	None							
	Whole/fresh						2718	
	Sour						2787	
	2% fat						2772	
	Fat free/skimmed						2775	
	Milk blend						2771	
	Soy milk						2737	
	Condensed (whole, sweet)						2714	
	Condensed (skim, sweet)						2744	
	Evaporated whole						2715	
	Evaporated low fat						2827	
	Non-dairy creamer						2751	
Is sugar added to porridge or cereal? (Tick box)	None ☐						3989	
	White ☐						4005	
	Brown ☐						3988	
	Syrup ☐						3988	
	Honey ☐						3984	
	Sweetener: type _____							
Is fat added to porridge or cereal? (Tick box)	None ☐						3479	
	Animal fat (butter) ☐						3484	
	Hard margarine ☐						3496	
	Soft margarine ☐						3507	
	Oil ☐						3485	
	Peanut Butter ☐							
Samp/Maize rice	Bought						3250	
	Self ground						3725	
Samp and beans	Specify ratio (1:1)						3402	
Samp and peanuts	Specify ratio							
Rice: specify brands names:	White						3247	
	Brown						3315	
	Sorghum rice						3437	
Stamped wheat							3249	
Pastas	Macaroni						3262	
	Spaghetti						3262	
	Spaghetti in tomato sauce						3258	
	Other: _____							

HOW MANY TIMES A WEEK DO YOU EAT PORRIDGE OR BREAKFAST CEREAL AT ANY TIME OF THE DAY (NOT ONLY BREAKFAST)? _____

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/DA Y
			Per day	Per week	Per month	Seldom/ Never		
Bread/Bread rolls Bread slices: thin Medium, thick	White						3210	
	Brown						3211	
	Whole wheat						3212	
Other breads	Specify types e.g. Raisin Maize meal Sweetcorn Rye Other						3214 3278 3379 3213	
Pizza (specify toppings) Hot Dogs(specify sausage) Hamburgers (specify meat)	Cheese, tomato & onion _____ _____ _____ _____						3353	
Are any the following spreads used on bread? Fat spreads (Tick box)	Butter ☐ Butro ☐ Animal fat (beef tallow) ☐ Lard ☐ Hard margarine (brick) ☐ Soft margarine (light) ☐ Cooking Fat ☐						3479 3523 3494 3495 3484 3496 3516	
Peanut butter							3485	
Sweet spreads	Jam Syrup Honey						3985 3988 3984	
Marmite/ OXO/ Bovril							4030 4029 4029	
Fish paste Meat paste							3109 2917	
Cheese	Specify types: Cottage low-fat cheese Cream cheese Gouda Cheddar Other: _____						2760 2725 2723 2722	
Cheese spreads	Low fat Full fat Specify types						4310 2730	
Atchar							3117	
Other spreads: (Specify types)	_____ _____							
Dumpling							3210	
Vetkoek							3257	
Provita Crackers (refined) Crackers (whole wheat)							3235 3331 3391	

Rusks <i>Home-made:</i>	Bran						3330	
	Buttermilk						3329	
	White						3364	
	Boerebeskuit, white						3364	
	All-bran						3380	
	Raisins						3380	
	Buttermilk, white						3215	
	Buttermilk, whole wheat						3255	
	Other							
Scones							3237	
Muffins	Plain						3408	
	Bran						3407	

HOW MANY TIMES A DAY DO YOU EAT BREAD? _____

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/D AY
			Per day	Per week	Per month	Seldom/ Never		
Chicken Do you eat the chicken with the skin? Yes ☐ No ☐	Boiled: with skin						2926	
	without skin						2963	
	Fried: in batter/crumbs						3018	
	Fried, but not coated						2925	
	Roasted/grilled with skin						2925	
	without skin						2950	
Chicken bones stew							A003	
Chicken heads, raw							2999	
Chicken stew, with veg. & skin							3005	
Chicken feet, raw							2997	
Chicken offal	Giblets						2998	
Chicken pie	Commercial						2954	
	Home-made						2954	
Red meat: Beef	Fried/grilled: with fat						2908	
	without fat						2959	
	Stewed/boiled: with fat						3006	
	without fat						2909	
	Mince with tomato and onion						2987	
Red meat: Mutton	Fried/grilled: with fat						2927	
	without fat						2934	
	Stewed/boiled: with fat						3040	
	without fat						2916	
Red meat: Pork	Fried/grilled: with fat						2930	
	without fat						2977	
	Stewed/boiled: with fat						3046	
	without fat						3045	
Red meat: Goat	Fried/grilled: with fat						4281	
	without fat							
	Stewed/boiled: plain with veg						4281	
							4282	
Offal: Specify type:	Intestines: boiled, nothing added						3003	
	"Vetderm" fried						3003	
	Stewed with vegetables							
	Liver						2955	
	Kidney						2956	
	Tripe "pens" trotters, head						3003	
	Pluck (lungs, heart, gullet)						3019	

Specify vegetables used in meat stews (only if not mentioned elsewhere)								
Wors / sausage	Fried						2931	
Bacon							2906	
Cold meats	Polony						2919	
	Ham						2967	
	Vienna's canned						2936	
	Russian						2948	
	Frankfurter						2937	
	Other (specify)							
Canned meat	Bully beef						2940	
	Other (specify)							
Meat pie	Bought						2939	

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/D AY
			Per day	Per week	Per month	Seldom/ Never		
Legumes: specify dried beans/peas/ Lentils	Stews & curries (specify)						3157	
	Soups Salad						3174	
Baked beans							3176	
Soya products e.g. Toppers/ Imana	Brands at home now Don't know _____ Show examples						3196	
Fried fish (fresh or frozen fried in sun oil)	With batter/crumbs						3072	
	Without batter/crumbs						3060	
Fresh water fish Specify type	Specify cooking method Medium fat, batter, fried						3094	
Canned fish:								
Pilchards	In brine						3055	
	In tomato sauce						3102	
	Mashed with fried onion						A005	
Sardines	In oil						3087	
	In tomato sauce						3087	
Tuna	In oil						3093	
	In brine						3054	
Mackerel							3113	
Salmon							3101	
Pickled fish/curried							3076	
Do you remove fish bones before eating canned fish	YES ☐ NO ☐							
Fish cakes Specify canned or other	Fried: oil/butter/margarine, commercial						3080	
Salted dried fish							3077	

Eggs	Boiled/poached						2867	
	Scrambled in: oil						2889	
	butter						2886	
	margarine						2887	
	Fried in: oil						2869	
	butter						2868	
	margarine						2877	
	bacon fat						2870	
	Curried						2902	

HOW MANY TIMES A WEEK DO YOU EAT MEAT _____

BEANS _____

CHICKEN _____

FISH _____ AND

EGGS _____ ?

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		
Cabbage	Boiled, nothing added						3756	
	Boiled with potato and onion and fat						3813	
	Fried, in margarine (nothing added)						3810	
	Fried, in oil (nothing added)						3912	
	Boiled, then fried with potato, onion						A006	
	Other:							
Spinach/morogo/im fino/other green leafy vegetables: List names	Boiled, nothing added						3913	
	Boiled fat added (margarine)						3898	
	Boiled with onion/tomato and fat						A011	
	-onion & potato (margarine)						3901	
	- onion, tomato & potato							
	- with peanuts							
	Other:							
Tomato and onion 'gravy'/relish/chow	Home made -with fat without fat						3910 3925	
	Canned						4129	
Pumpkin Specify type:	Cooked in fat & sugar						A010	
	Boiled, little sugar and fat						A010	
	Boiled						4164	
_____	Other:							
Carrots	Boiled, sugar & fat						3819	
	Boiled, nothing added						3757	
	Boiled, potato, onion, no fat						3934	
	Boiled, potato, onion, margarine						3822	
	Boiled, with sugar						3818	
	With potato/onion						3934	
	Raw, salad (orange juice)						3711	
	Chakalaka							

	Other:							
Mealies/Sweet corn	On cob						3725	
	Off cob -creamed sweet corn						3726	
	Off cob whole kernel						3942	
Beetroot	Cooked						3698	
	Salad (bought or home-made)						3699	
Potatoes	Boiled with skin						4155	
	- without skin						3737	
	Baked in skin(flesh and skin)						3736	
	- in skin (flesh only)						3970	
	Mashed - skim milk, margarine						3875	
	Mashed - whole milk, margarine						3876	
	Roasted in beef fat						3878	
	French fries/potato chips (oil)						3740	
	Salad (mayonnaise and egg)						3928	
	Other:							
Sweet potatoes	Boiled with skin						3748	
	without skin						3903	
	Baked with skin						3748	
	- without skin						3903	
	Mashed						3903	
	Other:							
Peas	Green, frozen						4146	
	Green, frozen with sugar						3720	
	With sugar and butter						3859	
	Tinned peas						4149	
Green peppers	Raw						3733	
	Cooked (stew with oil)						3865	
Brinjal/egg plant	Cooked						3700	
	Fried in oil						3802	
	Stew (oil, onions, tomato)						3798	
Mushrooms	Raw						3842	
	Sautéed in brick margarine						3839	
	Sautéed in oil						3841	
Onions	Sauteed in sun oil						3730	
	Sauteed in margarine						3844	
Salad vegetables	Raw tomato						3750	
	Lettuce						3723	
	Cucumber						3718	
	Avocado's						3656	
Green Beans	Boiled, nothing added						3696	
	Cooked, potato, onion, margarine						3792	
	Cooked, potato, onion, no fat						3933	
Cauliflower	Boiled							
Other vegetables; specify	_____							

If you fry veg or add fat specify type of fat usually used	Butter	☐						3479	
	Butro	☐						3523	
	Animal fat (beef tallow)	☐						3494	
	Lard	☐						3495	
	Hard margarine (brick)	☐						3484	
	Soft margarine (tub)	☐						3496	
	Soft margarine (light)	☐						3524	
	Sunflower oil	☐						3507	

HOW MANY TIMES A WEEK DO YOU EAT VEGETABLES? _____

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		
Mayonnaise/salad dressing	Mayonnaise: bought						3488	
	home-made						3506	
	Cooked salad dressing						3503	
	Salad dressing low-oil						3505	
	Salad dressing French						3487	
	Oil: Olive						3509	
	Sunflower						3507	
	Canola						4280	
Apples	Fresh						3532	
	Canned, unsweetened						4216	
Pears	Fresh						3582	
	Canned, in syrup						3583	
Bananas							3540	
Oranges							3560	
Naartjie							3558	
Grapes							3550	
Peaches	Fresh						3565	
	Canned, in syrup						3567	
Apricots	Fresh						3534	
	Canned, in syrup						3535	
Mangoes	Fresh						3556	
Pawpaw	Raw						3563	
Pineapple	Raw						3581	
	Canned (syrup)						3648	
Guavas	Fresh						3551	
	Canned (syrup)						3553	
Watermelon							3576	
Spanspek	Orange flesh						3541	
	Green flesh						3575	
Wild fruit/berries (Specify types)	_____							

Dried fruit (also as snacks)	Raisins						3552	
	Prunes (raw)						3596	
	Prunes (cooked with sugar)						3564	
	Peaches (raw)						3568	
	Peach (cooked with sugar)						3569	
	Apples (raw)						3600	
	Dried fruit sweets						3995	
	Other							

Other fruit							

HOW MANY TIMES A WEEK DO YOU EAT FRUITS? _____

WE NOW WILL ASK YOU QUESTIONS ABOUT WHAT YOU USUALLY DRINK

BEVERAGES	DESCRIPTION	AMOUNT USUALLY TAKEN	TIMES TAKEN				CODE	AMOUNT/ DAY	
			Per day	Per week	Per month	Seldom/ Never			
Water							4042		
Tea	Ceylon						4038		
	Rooibos						4054		
Coffee							4037		
Sugar per cup of tea or coffee	White						3989		
	Brown						4005		
Milk per cup of tea or coffee What type of milk do you put in tea and/or coffee?	Fresh/long life whole						2718		
	Fresh/long life 2% Goat						2772 2738		
	Fresh/long life/fat free (skimmed)						2775		
	Whole milk powder, reconstituted Specify brand: _____						2831		
	Skimmed milk powder, reconstituted Specify brand: _____						2719		
	Milk blend, reconstituted Specify brand: _____						2771		
	Whitener/non-dairy creamer Specify brand: _____						2751		
	Condensed milk (whole)						2714		
	Condensed milk (skim)						2744		
	Evaporated milk (whole)						2715		
	Evaporated milk (low-fat)						2827		
	None								
	Milk as such: What type of milk do you drink as such?	Fresh/long life/whole						2718	
		Fresh/long life/2%						2772	
Fresh/longlife/fat free (skimmed)							2775		
Goat							2738		
Sour / Maas							2787		
	Buttermilk						2713		

BEVERAGES	DESCRIPTION	AMOUNT USUALLY TAKEN	TIMES TAKEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		
Milk drinks Specify brands, including milk supplements and type of milk used	Nestle Nesquik						4287	
	Milo						2735	
	Flavoured milk						2774	
	Other							
Yoghurt	Drinking yoghurt						2756	
	Thick yoghurt, plain, fruit						2732	
Squash	SixO						3990	
	Oros						3982	
	Lecol with sugar						3982	
	-artificial sweetener						3990	
	Kool Aid						3982	
	Other _____							
Fruit juice	Fresh/Liquifruit/Ceres/						2866	
	"Tropica"/ mixtures with milk						2791	
Fruit syrups	Average						2865	
	Guava syrup						2864	
Fizzy drinks Coke, Fanta	Sweetened						3981	
	Diet						3990	
Mageu/Motogo							4056	
Alcoholic beverages such as Sorghum beer	Sorghum beer Specify:						4039	
Other , specify:	Beer average						4031	
	Wine						4033	
	Cider						4057	

PLEASE INDICATE WHAT TYPES AND AMOUNTS OF SNACKS, PUDDINGS AND SWEETS YOU EAT:

FOODS	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		
Potato crisps/chips							3417	
Peanuts	Roasted, unsalted						3452	
	Roasted, salted						3458	
Cheese curls: Niknaks etc.	Average						3267	
	Savoury						3418	
Popcorn	Plain (no salt and butter)						3332	
	Plain (salt and butter added)						3359	
	Sugar coated							
Raisins (seeds)							4231	
Chocolates	Milk						3987	
	Kit Kat						4024	
	Peppermint crisp						3997	
	Specify types and names							
Candies	Sugus, gums, hard						3986	
	sweets (specify) Peppermint						4004	

Sweets	Toffees Hard boiled Fudge, caramels (specify)						3991 3986 3991	
Biscuits/cookies	Specify type Home made plain Shortbread, butter Commercial, plain Commercial with filling						3233 3296 3216 3217	
Cakes & tarts	Chocolate, plain						3419	
Pancakes/ crumpets							3344	
Koeksisters							3231	
Savouries	Sausage rolls Samoosas - vegetable Samoosa - mutton Biscuits e.g. bacon kips Other: _____						2939 3414 3355 3331	
Pudding: jelly							3983	
Baked pudding	Plain batter						3429	
Instant pudding	Skim milk Whole milk						3314 3266	
Ice cream	Commercial regular Commercial rich Soft serve Sorbet Ice lollies Chocolate coated individual ice creams (e.g. Magnum)						3483 3519 3518 3491 3982	
Custard	Home made, whole milk Ultramel						2716 2716	
Cream	Fresh						3520/ 3480	
Other puddings (Specify):	_____							

HOW MANY TIMES A WEEK DO YOU EAT SNACK FOODS? _____

SAUCES / GRAVIES / CONDIMENTS

FOODS	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		
Tomato Sauce							3139	
Worcester sauce							4309	
Chutney	Fruit						3168	
	Tomato						3114	
Pickles							3866	
Packet soups							3158	
Beef/chicken stock							4029	
Others:								

WILD BIRDS, ANIMALS, INSECTS OR FRUITS AND BERRIES (hunted or collected in rural areas or on farms: (specify)								

- PLEASE MENTION ANY OTHER FOODS YOU EAT MORE THAN ONCE EVERY TWO WEEKS WHICH WE HAVE NOT TALKED ABOUT AND OR FOODS EATEN IN OTHER HOMES OR PLACES DURING THE PAST WEEK

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		

- ARE THERE ANY FOODS THAT YOU EAT WHICH WE HAVEN'T TALKED ABOUT?
PLEASE LIST THEM.

FOODS	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		

**THANK YOU FOR YOUR CO-OPERATION AND PATIENCE.
GOOD BYE!**

**ADAPTED FROM THE QUESTIONNAIRES OF THE THUSA STUDY (WITH
ACKNOWLEDGEMENT TO THE RESEARCH GROUP OF PUCHO) AND THE
NATIONAL FOOD CONSUMPTION SURVEY**

APPENDIX E

PHYSICAL ACTIVITY OF WOMEN (25 – 44 YRS) IN MANGAUNG

MARK THE APPROPRIATE BOX WITH AN 'X' OR WRITE IN THE APPROPRIATE ANSWER

Name: _____
 Respondent number: _____
 Interviewer number: _____

1. What is your main occupation ?

2. Is your workplace away from home?
 IF NO, OR UNEMPLOYED GO TO
 QUESTION 20

Yes (1)	No (2)
---------	--------

3. How many days per week do you work?

4. How long per day do you work?(min)

5. At work I sit .

Yes (1)	No (2)
---------	--------

6. IF YES, how long?(min)

7. At work I walk.

Yes (1)	No (2)
---------	--------

8. IF YES, how long?(min)

9. At work I lift heavy loads.

Yes (1)	No (2)
---------	--------

10. IF YES, how long?(min)

11. At work I am tired.

Yes (1)	No (2)
---------	--------

12. IF YES, how long?(min)

13. At work I sweat as a result of the
 work I do.

1. never	2. seldom	3. some- times	4. often	5. alway s
----------	-----------	-------------------	----------	---------------

14. How do you get to work?

1. walk	2. cycle	3. bus	4. taxi	5. car
---------	----------	--------	---------	--------

15. If by bus or taxi how long does it take you to
 walk to the bus or taxi rank(mins)

16. If you walk to work, what is your usual
 pace?

1. casua l strolling	2. fairly brisk	3. bris k	4. fast
----------------------------	--------------------	--------------	---------

17. How long do you take to get to walk to
 work?(min)

1-3
4-5

6-7

8

9-10

11-13

14

15-17

18

19-21

22

23-25

26

27-29

30

31

32-34

35

36-38

18 If you cycle, what is your usual pace?

1. casual cycling	2. fairly brisk	3. brisk	4. fast
-------------------	-----------------	----------	---------

39

19. How long do you take to get to cycle to work? (min)

40-42

20. How long do you work at home? (min)

43-45

21. At home I sit .

Yes (1)	No (2)
---------	--------

46

22. IF YES, how long?(min)

47-49

23. At home I walk.

Yes (1)	No (2)
---------	--------

50

24. IF YES, how long?(min)

51-53

25. At home I lift heavy loads.

Yes (1)	No (2)
---------	--------

54

26. IF YES, how long?(min)

55-57

27. At home I am tired.

Yes (1)	No (2)
---------	--------

58

28. IF YES, how long?(min)

59-61

29. At home I sweat as a result of the things I do at home

1. Never	2. Seldom	3. Some-times	4. Often	5. Always
----------	-----------	---------------	----------	-----------

62

30. If you walk at home, what is your usual pace?

1. casual strolling	2. fairly brisk	3. brisk	4. fast
---------------------	-----------------	----------	---------

63

31. How long do you walk outside your home? (min)

64-66

32. At home I cycle?
IF NO, GO TO QUESTION 35

Yes(1)	No(2)
--------	-------

67

33. If you cycle, what is your usual pace?

1. Casual cycling	2. Fairly brisk	3. Brisk	4. Fast
-------------------	-----------------	----------	---------

68

34. How long do you cycle?(min)

69

35. Do you climb stairs often?
IF NO GO TO QUESTION 38

Yes (1)	No(2)
---------	-------

70

36. If yes, how many flights of stairs do you climb per day? (1 flight = 10 steps)

71-73

37. How many days per week do you climb the steps?	_____	☐	74		
38. Do you play sport? IF NO GO TO QUESTION 42	<table border="1"> <tr> <td>Yes(1)</td> <td>No(2)</td> </tr> </table>	Yes(1)	No(2)	☐	75
Yes(1)	No(2)				
39. IF YES which type of sport do you play?	_____	☐	76-78		
40. How long do you practice per week?(min)	_____	☐	79-81		
41. How many months per year?	_____	☐	82-83		
42. Do you have leisure time? IF NO STOP HERE!	<table border="1"> <tr> <td>Yes (1)</td> <td>No(2)</td> </tr> </table>	Yes (1)	No(2)	☐	84
Yes (1)	No(2)				
43. IF YES, do you watch television during leisure time?	<table border="1"> <tr> <td>Yes (1)</td> <td>No(2)</td> </tr> </table>	Yes (1)	No(2)	☐	85
Yes (1)	No(2)				
44. Do you do other sitting activities?*	<table border="1"> <tr> <td>Yes(1)</td> <td>No(2)</td> </tr> </table>	Yes(1)	No(2)	☐	86
Yes(1)	No(2)				
45. IF YES, which type of activity?*	_____	☐	87-88		
46. During leisure time, do you walk or do standing activities?*	<table border="1"> <tr> <td>Yes(1)</td> <td>No(2)</td> </tr> </table>	Yes(1)	No(2)	☐	89
Yes(1)	No(2)				
47. IF YES, how long per day? (min)	_____	☐	90-92		
48. Do you have any other leisure time activities?*	<table border="1"> <tr> <td>Yes(1)</td> <td>No(2)</td> </tr> </table>	Yes(1)	No(2)	☐	93
Yes(1)	No(2)				
49. IF YES, which type? _____		☐	94-95		
50. IF YES, how long per day ? (min)	_____	☐	96-98		

*

NOTES TO THE INTERVIEWER

ITEM 43:

Sitting activities: watch tv, listen radio, reading, writing, knitting, needlework, playing cards, visiting friends

ITEM 45:

Standing activities: gardening, walking with friends, after work at your own home

LEISURE TIME:

Time after work when housework is finished.

APPENDIX F

Nutritional Health of Women (25-44yrs) in Mangaung, 2000

Medical examination

Name: _____

Respondent number: _____

1-3

Blood pressure: _____

4-9

Chronic medication:

Yes (1)

No (2)

10

(including birth control)

If yes, specify 1. _____

2. _____

3. _____

4. _____

11-
12
 13-
14
 15-
16
 17-
18

1. Are any of the following visible/tangible?

Jaundice	Yes (1)	No (2)
Anaemia (Pale)	Yes (1)	No (2)
Clubbing	Yes (1)	No (2)
Cyanosis	Yes (1)	No (2)
Glands	Yes (1)	No (2)
Oedema	Yes (1)	No (2)

19
 20
 21
 22
 23
 24

2. Are there any cardiovascular abnormalities?

Yes (1)

No (2)

If yes, specify

1. _____

25
 26-
27

2. _____

28-
29

3. Are there any respiratory abnormalities?

Yes (1)

No (2)

If yes, specify

1. _____

30
 31-
32

2. _____

33-
34

4. Is there any abdominal pathology?

Yes (1)	No (2)
---------	--------

If yes, specify

1. _____

2. _____

		35
		36-
		37

		38-
		39

Do you want to be informed of the results of your HIV/AIDS result?

Yes (1)	No (2)
---------	--------

	35
--	----

Comments:
