THE RELATIONSHIP BETWEEN ANTHROPOMETRY, DIETARY INTAKE AND PHYSICAL ACTIVITY IN WOMEN (25–44 YEARS) IN MANGAUNG

MARIANNE LE ROUX

Dissertation submitted in fulfillment of the requirements for the degree

MAGISTER TECHNOLOGIAE:
FOOD AND CONSUMER SCIENCES

in the
Faculty of Management
School for Tourism, Hospitality and Sport

at

Technikon Free State

Supervisor: Dr CM Walsh, Ph D
Co-supervisor: Dr FF Coetzee, Ph D
Dr FJ Veldman, PhD

BLOEMFONTEIN

February 2003

Declaration of independent work:

DECLARATION WITH REGARD TO INDEPENDENT WORK

I, **MARIANNE LE ROUX, 660425 0208 082,** and **20134045** , do hereby declare that this research project submitted to the Technikon Free State for the Degree **MAGISTER TECHNOLOGIAE: FOOD AND CONSUMER SCIENCES**, is my own independent work; and complies with the Code of Academic Integrity, as well as other relevant policies, procedures, rules and regulations of the Technikon Free State; and has not been submitted before to any institution by myself or any other person in fulfilment of the requirements for the attainment of any qualification.

SIGNATURE OF STUDENT

14 Februarie 2003
DATE

ACKNOWLEDGEMENTS

This study would not have been possible without the assistance of the following persons:

- My Heavenly Father, for giving me the ability and strength to undertake this study.
- My supervisor, Dr CM Walsh, for her advice, assistance, and encouragement;
- Dr FF Coetzee, my co-supervisor, for his valuable input and guidance;
- The Department of Biostatistics, University of the Free State, for the valuable input regarding the statistical analysis of the data;
- The National Research Foundation (NRF) for the financial support in the execution of the study;
- The respondents for taking part in the study;
- My family and friends especially Iessie, Sandra, Nelia and Zorada for their interest and moral support;

SUMMARY

South Africa, like many other countries, is a country in transition, leading to political, demographic, social, economical, and nutritional changes, affecting particularly the African population. This new era is characterised by changes from the traditional lifestyle, to a more western sedentary lifestyle and eating habits, associated with chronic diseases of lifestyle, including obesity. In addition, the HIV/AIDS epidemic in South Africa cannot be ignored, since nutrition, physical activity and HIV are strongly related.

The effect of the nutrition transition, including the increase in chronic diseases of lifestyle, has prompted the need to determine the association between anthropometry, dietary intake and physical activity.

A representative sample of 500 African women, (age groups 25-34, and 35-44 years), from the Mangaung area of Bloemfontein, was selected for the study. Levels of physical activity, anthropometric status and dietary intake were determined.

Physical activity was determined using an adapted questionnaire that classified respondents into one of three physical activity categories (low, normal and high). Weight, height, circumference (waist and hip), and bio-impedance measurements were obtained, and used to calculate body mass index, fat distribution and fat percentage of respondents. Dietary intake was determined by means of a standardized food frequency questionnaire, and analyzed to determine the habitual food intake of respondents.

A very small percentage of both HIV negative and HIV positive younger and older women had physical activity levels that fell within the normal to high category. Women that were unemployed generally had lower levels of physical activity than those that were employed. Employed women perspired more, climbed more stairs and participated more in sporting activities than unemployed women. As expected, women that fell in the normal to physically active category also cycled more, although watching television was a leisure time activity practiced by both physically inactive and physically active women.

Anthropometric results included body mass index, fat distribution and fat percentage. More than fifty percent of respondents of HIV negative women had a body mass index above 25 kg/m². Fat distribution showed a gynoid fat distribution, with 83.5 percent of the women from the younger group, and 62.7 percent of women from the older group having a waist-hip-ratio smaller than 0.8. The fat percentages of both HIV negative and HIV positive women from both age groups were high. The BMI and fat percentage of HIV positive women was significantly lower than that of HIV negative women.

Median dietary intakes indicated high energy and macronutrient intakes for both HIV positive and HIV negative women. Median intakes of the macronutrients calculated as percentage of the total daily energy intake showed that median percentage of protein fell within recommendations, while median percentage of carbohydrate and fat intake exceeded recommendations.

Reverting to a more traditional lifestyle, including diet and physical activity, could assist in alleviating the conditions of over-and under nutrition, and unfavourable anthropometric parameters associated with the health status of these African women.

OPSOMMING

Suid-Afrika, soos baie ander lande, beleef tans 'n oorgangsperiode, wat tot politieke-, demografiese-, sosiale-, ekonomiese- en voedingsveranderinge lei. Hierdie veranderinge raak veral die swart bevolking. Dié nuwe era word gekenmerk deur veranderinge in die tradisionele leefstyl, na 'n meer westerse leefstyl en eetgewoontes, wat met sommige chroniese siektes, insluitende, vetsug verband hou. Die invloed van die HIV/VIGS epidemie in Suid Afrika kan nie geignoreer word nie, aangesien diëet, fisieke aktiwiteit en HIV nou verband hou.

Die invloed van die voedingsoorgangsperiode, insluitende die toename in chroniese leefstylsiektes, het die behoefte om die verband tussen antropometrie, diëet-inname, en fisieke aktiwiteit te bepaal, genoodsaak.

'n Verteenwoordigende steekproef van 500 swart vrouens (ouderdomsgroepe 25-34, en 35-44 jaar), van die Mangaung-gebied van Bloemfontein, is vir die studie gekies. Die vlak van fisieke aktiwitiet, antropometrie en dieet-inname, is bepaal.

Die vlak van fisieke aktiwiteit is bepaal deur gebruik te maak van 'n aangepaste aktiwiteits vraelys wat respondente in een van drie kategorie (laag, normal en aktief) klassifiseer. Gewig, lengte, middel en heup omtrekke asook bio-impedansmates is verkry, en gebruik om die liggaamsmassa-index, vetpersentasie en vetverspreiding van die respondente te bepaal. Die dieetinname is bepaal deur gebruik te maak van 'n gestandardiseerde voedsel frekwensievraelys, en ontleed om die gebruiklike voedselinname van repondente te bepaal.

'n Baie klein persentasie van beide HIV negatiewe en HIV positiewe jonger en ouer vroue beskik oor fisieke aktiwiteitsvlakke wat in die normaal tot hoë kategorie val. Werklose vroue het oor die

algemeen laer aktiwiteitsvlakke as die vroue wat werk. Werkende vroue het meer geperspireer, meer trappe geklim asook aan meer sportsaktiwiteite deelgeneem, as die werklose vroue. Soos verwag, het vroue wat in die normaal tot aktiewe kategorie val, meer fiets gery, hoewel televisie deur beide fisiek aktiewe en onaktiewe vroue as vryetydsbesteding aangedui is.

Antropometriese resultate het ligaamsmassa-index, vetverspreiding en vetpersentasie ingesluit. Meer as vyftig persent van die HIV negatiewe vroue het 'n ligaamsmassa-indeks van bo 25 kg/m^2 getoon. Vetverspreiding het 'n genoïde verspreiding getoon, met 83.5 persent van die jonger vrouens, en 62.7 persent van die ouer vrouens wat 'n middel-heup-omtrek verhouding van kleiner as 0.8 gehad het. Die vetpersentasie van beide HIV positiewe en HIV negastiewe vroue in beide ouderdomsgroepe was hoog. Die ligaamsmassa-indeks en vetpersentasie van HIV positiewe vroue was egter betekenisvol laer as die van die HIV negatiewe vroue.

Mediaan dieetinnames het hoë innames vir energie en makro-voedingstowwe vir beide HIV positiewe en HIV negatiewe vroue aangetoon. Mediaan innames van die makro-voedingstowwe, bereken as persentasie van die totale daaglikse energie-inname, het getoon dat innames van proteïen binne die aanbevelings val, terwyl die mediaan persentasie inname van vette en koolhidrate aanbevelings oorskrei het.

Die terugkeer na 'n meer tradisionele lewensstyl, insluitend dieetinname en fisieke aktiwiteit, kan verligting bring in die ongunstige voedingsomstandighede asook die antropometriese parameters wat geassosieer word met die gesondheidsvlakke van die swart vroue.

TABLE OF CONTENTS PAGES

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AI	adequate intake
BIA	bioelectrical impedance
BMI	body mass index
BMR	basal metabolic rate
BRISK	Coronary Heart Disease Risk Factor Study in the African Population of the Cape Peninsula
CARDIA	Coronary Artery Risk Development in Young Adults
CAD	coronary artery disease
CI	confidence interval
cm	centimeter
CARDIA	Coronary Risk Factor Study among the coloured population of the Cape Peninsula
CORIS	Coronary Risk Factors Resurvey
COMA	Committee on Medical aspects of food and nutrition policy
CRISIC	Coronary Risk Factor Study among the Coloured Population of the Cape Peninsula
DRI	dietary reference intakes
DXA	Dual-energy X-ray absorptiometry
EE	Energy expenditure
EEPA	energy expended in physical activity
FFM	fat free mass
FFQ	food frequency questionnaire
g	gram
g/day	grams per day

g/l	grams per liter
Kcal / day	kilocalories per day
kg	kilogram
kJ	kilojoules
LBM	lean body mass
MET	metabolic equivalent
mg	milligram
mg/day	milligrams per day
ml	milliliter
mm	millimeter
NCHS	National Center for Health Statistics
NHANES I & II	National Health and nutrition survey I and II
NIDDM	non-insulin-dependent diabetes mellitus
PAI	physical activity index
RDA	recommended dietary allowance
REE	Resting energy expenditure
RMR	resting metabolic rate
RQ	respiratory quotient
SAT	Sub-cutaneous adipose tissue
US	United states of America
TEE	Total energy expenditure
TEF	Thermic effect of food
THUSA	Transition and Health during Urbanisation of South Africans
Trp64Arg	substitution of tryptophan for arginine at codon 64
VAT	visceral adipose tissue
$\dot{V}O^{2}$max	maximum oxygen consumption per minute

W/H^2	W is weight in kilograms and H is height in square meters
WHR	waist-to-hip circumference ratio
>	bigger than
<	smaller than
≥	equal to, and bigger than
≤	equal to, and smaller than

LIST OF APPENDICES

CHAPTER 1

LIFESTYLE TRANSITION

1.1 Introduction

Statues, wall paintings, tomb and temple relics of ancient Rome, Greece and Egypt depict men and women with thin bodies and limbs. The earliest double chin was on a painting (1537) of Henry VIII in England in the National Portrait Gallery of kings, queens and statesmen (Trowel, 1995).

The profound changes in diet and activity patterns encouraged by the technological revolution of the late 20th century, have had a profound effect on body weight regulatory mechanisms. A decline in infectious diseases and a movement towards an increase in the prevalence of chronic diseases of lifestyle, such as obesity, have now become a worldwide epidemic (Musaiger, 1992; Trowel, 1995).

Rapid urbanization, which is occurring at lower income levels, is one critical underlying cause of increased rates of obesity (Walker, 1995; Popkin & Doak, 1998). Instead of being a sign of economic progress, rapid urbanization has become part of the process of underdevelopment leading to considerable urban poverty in developing countries. Changing environmental and socio-economic conditions commonly occur with urbanization of rural dwellers. Urban poverty has a profound effect on the population's health status as rural dwellers adopt new lifestyles (Walker, 1995; Hoffman et al., 1997). For this reason, rural women moving to cities have been identified as the most vulnerable group in terms of developing obesity. Traditionally, women are usually responsible for planting, rearing and harvesting crops while the men attend to the cattle

(Walker, 1995). Thus, a move from rural areas to urban areas is often accompanied by a decrease in physical activity.

1.2 Lifestyle transition

Obesity affects wealthy, middle and low-income countries, and even more so the poorer communities, where efforts to combat these disorders are hindered by poverty (Walker, 1995; Popkin & Doak 1998). For this reason, it is important to understand the factors contributing to this worldwide trend. The major factors implicated in the West have been the modern food supply and ready availability of high fat foods for at home consumption, along with a marked decrease in physical activity patterns at work and during recreation (Walker, 1995).

Untill recently, African populations that followed traditional diet and activity patterns gained little or no weight with increasing age. This phenomenon has been reported in South Africa (Walker, 1964), in Kenya (Kennedy, 1994) and among the San hunters gatherers in Botswana (Hansen et al., 1993). Urbanization is one of the major factors contributing to changes in lifestyle (Levitt et al., 1993). It usually includes major changes in diet and lower levels of physical activity which lead to increased obesity compared with those of people in their traditional surroundings. In their natural habitat, Mycoba Pima Indian men and women are very active and eat a diet low in fat. Their counterparts that live in Phoenix, who have adopted a more Westernized lifestyle (diet higher in fat and lower level of physical activity), were fifty pounds heavier and fifty percent had diabetes compared to ten percent of those in Mycoba (Franz, 2000, p. 742).

1.2.1 The global nutrition transition

Popkin (1994) broadly defined the nutrition transition as " a sequence of characteristics dietary and nutritional patterns resulting in major changes in dietary structure related to changes in economic, social, demographic and health factors." Over the last three centuries the pace of dietary change has accelerated at various degrees in different regions. Additionally, dietary and body composition changes are parallel to major health outcomes and socioeconomic and demographic changes. Changes in structure of diet, physical activity and obesity in low-income countries are greater than before. Problems of over- and undernutrition often co-exist and reflect a trend in which an increasing proportion of people consume diets associated with various chronic diseases. This is increasing more rapidly than in high-income countries. The so called " Western diet " can be defined as a diet high in saturated fat, sugar and refined food and low in fiber (Popkin, 1994).

The nutrition transition is intertwined with the demographic and epidemiological transition. The demographic transition refers to a pattern of high fertility and high mortality compared to low fertility and low mortality which are more common today. The epidemiological transition (first described in 1971 by Omran) refers to a pattern where pestilence, famine and poor sanitation (leading to a high prevalence of infectious diseases and malnutrition) have been replaced by a pattern of chronic and degenerative diseases (Olshansky & Ault, 1986; Popkin, 1994).

The nutrition transition can be described in five broad patterns namely: (1) Collecting food, (2) famine, (3) receding famine, (4) degenerative disease, and (5) behavioral change. In table 1.1 a summary of the characteristics of the nutrition transition and broad changes in dietary patterns are shown (Popkin, 1994).

Diets in excess or deficit have significant impacts on health and survival. It is important for low-income countries to direct the nutrition transition in more healthy directions. The patterns of change in structure of diet, physical activity and obesity are greater in developing countries (Popkin, 1994).

In the United States of America (USA) and most European Countries, the first half of the century saw a rise in sugar intake, as well as in meat and dairy product intake while grain consumption decreased (Slattery & Randall, 1988). As a result of this change in diet structure, an increase in body size and obesity emerged (Stephen & Wald, 1990). Among better-educated groups, however, the increased consumption of low fat and higher fiber foods are becoming prevalent again, indicating a desire to prevent degenerative diseases and prolong health.

Among lower income Americans, no positive dietary shift has been observed (Popkin et al., 1989). A combination of reduced physical activity and minimal dietary change may be part of the reason why people in lower income groups, particularly Hispanics and African Americans, have a higher prevalence of obesity than people in higher income groups (Popkin et al ., 1989; Sobal & Stunkard, 1989; Kuczmarski, 1992).

Social and economic factors	Pattern 1: Collecting food	Pattern 2: Famine	Pattern 3: Receding Famine	Pattern 4: Degenerative Diseases	Pattern 5: Behavioral Change
Nutrition					
Diet	Plants, wild animals; varied diet	Cereals predominant; diet less varied	Fewer starchy staples; more fruits, vegetables, animal protein; low variety continues	More fat (especially from animal products), sugar, and processed foods; less fiber	Less fat and processing; increased carbohydrates, fruits, and vegetables
Nutritional status	Robust, lean, few nutritional deficiencies	Children, women suffer most from low fat intake; nutritional deficiency diseases emerge; stature declines	Continued maternal/child nutrition problems; many deficiencies disappear; weaning diseases emerge; stature grows	Obesity; problems for elderly; many disabling conditions	Reduced body fat levels and obesity; improved bone health
Economy	Hunter-gatherers	Agriculture, animal husbandry, home-making begin; shift to monocultures	Second agricultural revolution (crop rotation, fertilizer); Industrial Revolution; women join labor force	Fewer jobs with heavy physical activity; service sector and mechanization; household technology revolution	Service sector mechanization, industrial robotization dominate; leisure exercise grows to offset sedentary jobs
Household production	Primitive; onset of fire	Labor-intensive primitive technology begins (clay cooking vessels)	Primitive water systems; clay stoves; cooking technology advances	Household technology mechanized and becomes more varied	Food preparation technology changes rapidly
Income and assets	Subsistence; primitive stone tools	Subsistence, few tools	Increasing income disparity, agricultural tools, industrialization rises	Growth in income and income disparities	Income growth slows; home and leisure technologies increase
Demography					
Mortality/fertility	Low fertility, high mortality; low life expectancy	High natural fertility, low life expectancy, high infant and maternal mortality	Mortality decline; fertility static, then declines; cumulative population growth	Life expectancy reaches high levels (60s-70s); fertility low and fluctuating	Life expectancy extends to 70s, 80s; disability-free life expectancy increases
Morbidity	Much infectious disease; no epidemics	Epidemics; endemic disease (plague, small-pox, polio, TB); deficiency disease begins; starving common	TB, smallpox, infection, parasitic disease, polio, weaning disease (diarrhea, retarded growth) expand, later decline	Chronic disease related to diet pollution (heart disease, cancer); infectious disease declines	Increased health promotion (preventive and therapeutic); decline in coronary heart disease, improvement in age-specific cancer profile
Age structure	Young population	Young; very few elderly	Chiefly young; shift to older population begins	Fertility decline; elderly proportion increases	Increasing proportion of elderly > 75 years

Figure 1. Broad changes in Dietary Patterns and their relationship to social and economic factors (Adapted from Popkin, 1994).

The increased prevalence of obesity in countries like Canada and the United Kingdom are significant (Helmett et al., 1990; Hulshoff et al., 1991). The only countries that attempted to change this trend at national level are Norway and Finland. Norway has markedly reduced the percentage of energy obtained from animal fats from 29 percent in 1961 to 23 percent in 1988. A reduction in total fat intake from about 41 percent to 35 percent of total energy was noted between 1975 and 1989 (Oshaung, 1991).

Body mass Index (BMI) in South Africa and USA is much higher than in France and the Netherlands, particularly among African women (Gracey et al., 1996). High BMI values have been reported for Pima Indians in USA (Price et al., 1992) and for Samoan women in Hawaii (Barker, 1982). In contrast, Tuffrey et al. (1995) reported that obesity is almost absent in rural Nepal and rural India.

After World War II the energy intake in Japan increased, peaking in 1975, while the intake of animal products and fat has increased continuously from 1946 – 1987. Younger Japanese consume a Western style diet while older people cling to the more traditional pattern. Obesity is also increasing among the Japanese and is associated with greater visceral fat mass that leads to a much higher risk of coronary heart disease at a low BMI (Matsuzawa, 1995).

In Japan, a marked decrease in consumption of grain per capita and an increase in fish, milk and meat intake has been observed. A diet high in fat, together with a low level of physical activity in Japan, has lead to obesity and a number of resulting chronic diseases (Popkin, 1994; Kim et al., 2000).

Larger countries in Asia are also experiencing economic and demographic transformation that is reflected in their food consumption patterns (Popkin, 1994). Although changes in energy intake have been small, the consumption of animal products, sugar and fat has increased. Today very few Chinese still consume a traditional diet that is low in fat and a large proportion of people consume more than thirty percent of their energy intake from fat. This is more prevalent in urban high-income populations than in rural populations. In addition, the Chinese population has also adopted a more sedentary lifestyle. This phenomenon has not been noted in rural areas where high activity pattern are still common (Popkin, 1994).

Thailand has been undergoing an economic transition at a slower rate. Despite this, an increase in obesity has been reported in Bangkok and other urban areas. The result has been a significant change in adult body composition. A decline in the prevalence of underweight in middle and high income groups has become apparent, with an increase in underweight in low income groups (Tamphaichitr et al., 1991).

Westernization has been associated with an even higher prevalence of obesity in the South Pacific Islands, particularly among urban residents. High rates of obesity, similar to those in Native Americans in the USA, are seen in Fiji, Kiribati and Vanatu. Changes in diet and low physical activity have been associated with urban residence. These changes give rise to the evolutionary adaptation to increased energy intake, which causes rapid increases in fat tissue during times of dietary excess – the thrifty gene hypothesis (Neel, 1962; Popkin, 1994).

According to Lunes & Monteiro (1993), and Sichieri et al. (1994), a remarkable decline in the proportion of malnourished children and adults is taking place in Brazil in all income groups. In this region, where the dietary change has been much slower, the problem of obesity and other dietary excess problems among the rich and poor is, however, also emerging (Popkin, 1993). In Brazil, the poor suffer more from problems related to dietary excess (cardiovascular disease and diabetes mellitus), than do the rich (Popkin, 1994).

A survey in New Delhi showed that higher income individuals consume a diet averaging more than 32 percent of energy from fat while lower income individuals only consume 17 percent energy from fat. A random sample of adults in New Delhi showed that thirty to fourty percent in various socio-economic categories were obese (Chadha et al., 1990; Goplan, 1992).

A continuous high energy intake and low energy expenditure will lead to obesity. Dietary analysis in the USA has shown that even though energy intake is slightly lower, the energy intake from fat has escalated from 32 – 43 percent, while energy from carbohydrates has declined from 57 – 46 percent and protein intake increased from 11-13 percent (Walker et al., 1999).

The BRISK survey (Coronary Heart disease risk factor study in the African Population of the Cape Peninsula) revealed that fat intake increased from 24 – 30 percent, animal protein from six to nine percent and energy from carbohydrates decreased from 61-51 percent from 1979-1991(Steyn et al., 1992). The typical African diet consists of 23 percent energy from protein (of which seventy percent is from plant sources), 23 percent energy from fat, and 53 percent complex carbohydrates (Gresse et al., 1993). People who grew up under adverse and disadvantaged circumstances have now adopted typical western lifestyles and eating patterns (Vorster et al., 1999). Urban African populations are experiencing rapid urbanization and about thirty percent of their energy intake is from fat (Bourne et al., 1993; MacIntyre, 1998) while the diet of rural people is still low in fat (Vorster et al., 1999). The THUSA study showed that fruit and vegetable intake is higher (and therefore dietary fiber and micronutrients intake as well) among urbanized Africans compared with their rural counterparts (Levitt et al., 1993; MacIntyre, 1998). Data from deaths reported to the Central Statistical Services in 1998, indicate that chronic diseases of lifestyle were responsible for 24,5 percent of all deaths in South Africa. These data highlight the urgent need to address diseases of lifestyle in South Africa (Steyn et al., 1992).

After the Korean War, rapid lifestyle changes took place, and Western lifestyle elements were adopted. Fast food restaurants became popular among the younger generations, with less time for food preparation at home. Several movements have tried to keep traditional Korean elements in the diet. This phenomenon has resulted in a unique form of the nutrition transition in Korea. Rapid economic growth enhances purchasing power and food availability, which has accelerated the nutrition transition. A shift from energy intensive occupations in the rural agriculture forestry and fisheries to service and manufacturing jobs took place. This shift in occupation lead to a major reduction in energy expenditure at work. Changes in food supply as a result of industrial and policy changes also brought about a shift in food intake. Despite these changes in lifestyle, rice consumption did not change. Legume intake increased in the mid 1980 but decreased again. Overall consumption of vegetables did not change much. To understand the unique nutrition transition in South Korea the nutrient intake can be reviewed. In contrast to most other developing countries, total energy intake decreased dramatically after 1969 and continues to decrease as a result of industrialization. Most noticeable in South

Korea, is that the dietary shifts were not linked to increases in fat intake, and can be part of the reason why the prevalence of obesity is lower in this country (Kim et al., 2000) compared to other countries.

The major dilemma facing the health and nutrition profession in any country is how to promote economic growth, reduce infectious diseases and delay or prevent the onset of diseases of lifestyle (Drewnowski & Popkin, 2000).

1.2.2 The physical activity transition

Fussell and Fussell (1981) are of the opinion that western women are almost sedentary compared with their active forbearers, even as recent as the Victorian times. Changes in activity levels vary with age. Among adults there is a vast shift in the structure of employment, with a movement towards more capital-intensive and knowledge-based employment that relies far less on physical activity. The rapid decline in physical activity at work is significantly associated with increased adult BMI and obesity. The shift in activity is also due to the increased use of transport to get to work or school, more technology in the home and more passive leisure time activities such as watching television (Hays & Clark, 1999; Whitney & Rolfes, 1999, p. 260). A decrease in energy expenditure of two hundred Kcal / day can lead to a nine kilogram weight gain per year (Hays & Clark, 1999).

Prentice (2000) states that prevention and management of obesity should always be considered hand in hand with physical activity as two sides of the energy balance equation. According to Saris (1998), physical activity facilitates weight maintenance through direct energy expenditure and improved physical fitness. Indirectly exercise may act through physiological mechanisms such as lean body mass, lipid mobilization and oxidation (Walker, 1995; Whitney et al., 2001, p. 141).

It is estimated that sixty to eighty percent of the adult population of the USA do not meet the daily recommended levels of physical activity. Hays & Clark (1999) have reported that 54,6 percent of respondents reported 0 minutes of weekly exercise. Studies further suggest that socio-demografic and health characteristics, such as low socio-economic status, older age, race and presence of chronic disease, tend to be associated with lower levels of activity.

Personal barriers have consistently been associated with low participation in physical activity. Perceived health is associated with physical activity. Younger persons reported more minutes of weekly physical activity, perceived their health as good or excellent and reported fewer motivational barriers and performance expectations (judgement of one's capability to accomplish a certain level of performance) (Hays & Clark, 1999). Incorrect perceptions of older persons, such as the belief that one should exercise less as people get older, and persons with high blood pressure should not exercise, further complicate the situation.

It has been theorized that performance expectations predict whether an individual will choose to engage in a behavior and how much effort the individual will expend on the behavior, as well as how persistent the individual will be in spite of barriers or obstacles. Persons from low socio-economic status have limited performance expectations for basic exercise, and it is quite unlikely that this most vulnerable group will initiate a program of physical activity (Hays & Clark, 1999).

1.3 Obesity and related conditions

Obesity, hypertension, Type 2 diabetes mellitus and certain types of cancer are associated with a sedentary lifestyle and a high level of energy intake. Obesity is defined as a BMI above thirty kg/m^2 (Kumanyika et al., 1993; Seidell, 1999; Whitney et al., 2001, p.139). Conditions related to overweight, with higher morbidity and mortality rates, are more prevalent among black than white women in South Africa (Walker, 1995).

African city dwellers have shown an increase in the prevalence of hypertension and diabetes formally unknown in these populations. Other non dietary factors such as smoking, alcohol consumption, lower physical activity, poverty and stress associated with urbanization, also influence health and disease patterns (Levitt et al., 1993; Walker, 1995).

Obesity is defined as a disease in which excessive fat has accumulated to the extent that health may be adversely affected, and is a complex and incompletely understood chronic disease (Kalk, 2001). In past centuries obesity was largely unknown due to the fact that people ate prudent diets and were physically active.

The current epidemic of obesity is the result of an imbalance between man's ancient genes and his modern environment (Bray & Popkin, 1998). Kuczmarski et al. (1994) reported that between 1976 and 1980, and 1988 and 1991 the BMI of American adults rose from 24.3 to 26.3; an average gain of seven kilograms. In the USA the percentage of obese (BMI >30 kg/m^2) adults rose from seven to 12 percent for men, and 13 to 16 percent for women (Seidell, 1995). As a result of the adoption of a western lifestyle, developing communities have also shown an increase in the prevalence of obesity. In

South Africa factors that determine obesity were found to be no education, female gender, and residence in urban areas, especially in more wealthy parts like Gauteng and the Western Cape (Kalk, 2001).

1.3.1 Health risks associated with obesity

Obesity is present in persons with a BMI of thirty kg/m^2 or above. Obesity is a major risk factor for many serious chronic diseases such as insulin resistance, Type 2 diabetes mellitus, hypertension and blood lipid abnormalities. Additionally, obesity is an independent risk factor for coronary heart disease, hormonal abnormalities that are associated with infertility, gallbladder disease, sleep apnea, osteo-arthritis, and several forms of cancer (Walker, 1995; Foreyt & Walker, 1998; Kruger et al., 1999). Anxiety and depression are also more common among obese individuals (Woodman, 1996). Severe obesity is associated with reduced life expectancy (Flynn & Gibney, 1991).

1.3.2 Aetiology of obesity

Obesity results from an imbalance between energy intake and energy expenditure. (Flynn & Gibney, 1991; Bray, 1992; Pi-Sunyer, 1993; Van Itallie & Simopoulos, 1993; Barnes-Josiah et al., 1995; Giovannucci et al., 1996).

Diets high in fat are usually energy dense and lead to an increase in energy intake. Fat intake is less well regulated than carbohydrate intake, and thus high-fat diets are more likely to lead to weight gain and obesity than iso-energenic low fat diets (Seidell, 1998; Kruger et al., 1999). Various sources of energy have been blamed for obesity. Contrary to what was commonly believed, a diet high in carbohydrates or "starch" is not consistent with weight gain (Walker, 1964). The COMA Report (1990) and Gibson (1996), showed that high sugar intake has a weak negative influence on BMI. High consumption of sugar did not increase the total energy intake because these people ate less other food (Nelson, 2000). According to Whitney et al. (2001), the satiety level of a diet high in fat is reached later than one high in sugar which leads to a higher level of overeating. Drewnowski and Garn (1993) stated that the most important component in the aetiology of obesity is the energy derived from fat. Studies showed that in general, obese subjects consume a more fat rich diet than normal subjects (Marin et al., 1992; Astrup et al., 1994). According to Tucker and Kano (1992) fat intake is related to adiposity more than protein or carbohydrate intake. Snacking, especially in front of the television, has also often been pointed out as a culprit which is positively related to the development of obesity (Locard et al., 1992).

Excess fat cell development during childhood may cause obesity. The number of fat cells increase most rapidly during the growing years and puberty. Fat cells increase more rapidly in obese children than in lean children (Whitney et al., 2001, p. 143). Preventing obesity during childhood will reduce the rate of cardiovascular disease in adulthood. Children are heavier today than twenty years ago. Since 1970 overweight in children has doubled. Diet and inactivity are largely responsible for this phenomenon (Whitney et al., 2001, p. 86).

Evidence for genetic factors in human obesity has increased. Inherited metabolic characteristics in conjunction with unfavorable environmental circumstances, such as access to energy dense food and low physical activity, cause the development of obesity. In westernized environments favorable to weight gain, some people will not gain weight, probably as a result of their genetic background (Walker, 1995; Ravussin, 2000).

Two genes involved in obesity have received attention recently, namely the ß3-adrenoreceptor gene and the ob gene (Laquatra, 2000, p. 494). Mitchell et al. (1998) conducted a study on the effect of the variant Trp64Arg on obesity in Mexican Americans. On chromosome eight the ß3 adregenic receptor is located and is an important regulator of energy expenditure and lypolysis. A variant of this gene that results in a substitution of tryptophan for arginine at codon 64(Trp64Arg), associated with obesity and insulin resistance, has been identified. Individuals with this Trp64Arg variant were found to be more obese than those without the variant. This was true for nearly all of the obesity phenotypes, indicating the association between the Trp64Arg variant and obesity in this Mexican Americans (Mitchell et al., 1998).

The ob gene produces leptin (Mc Ardle et al., 1996, p. 605; Laquatra, 2000, p. 493; Whitney et al., 2001, p. 143), a hormone secreted by the adipose tissue, that seems to inform the brain about the amount of adipose tissue in the body (Laquatra, 2000, p. 493). The leptin receptor and agouti signaling protein seem to be possible candidate genes in the development of obesity (Ravussin, 2000). Obese humans produce significant quantities of leptin. It's concentration is correlated with the percentage of body fat, and is elevated in obese individuals. Weight loss is therefore associated with a reduction in leptin concentrations (Laquatra, 2000. p. 493). The discovery of leptin has been described as a great step forward, but it is doubted weather it is of that much importance in terms of everyday problems of obesity (Walker et al., 1999). It has been estimated that genes account only for five percent of BMI and subcutaneous fat, implying that the primary causes of obesity are not genetic (Laquatra, 2000, p. 495), but environmental.

Recent findings suggest that genes contribute to the perceptibility for obesity, but are not the actual cause. Other determinants must be present for obesity to occur, of which the environment is a major one (Laquatra, 2000, p. 495; Whitney et al., 2001, p. 145). Eaton et al. (1988) proposed the "discordance hypotheses", suggesting that obesity results from a mismatch between modern lifestyle and the lifestyle from which humans, and our genes, evolved.

1.3.3 Fat distribution

Central obesity, also called apple-shaped figures, upper body fat or android obesity, consists of visceral adipose tissue (VAT) and truncal (abdominal) sub-cutaneous adipose tissue (SAT) (Pi-Sunyer & Albu, 1999; Whitney et al., 2001, p. 140).

Central obesity is defined as a waist circumference of 102 cm or more in men and 88 cm or more in women (Bray & Popkin, 1998). A waist to hip ratio of higher than 0,8 is also an indicator of android fat distribution in women (Whitney et al., 2001, p. 140).

Abdominal obesity, or the apple shape, is more common in men, while gynoid obesity or the pear shape, is more common in women (Whitney et al., 2001, p. 140). The pattern of fat distribution plays an important role in the development of chronic diseases such as diabetes mellitus (Björntorp, 1984). The risk factors associated with central obesity have been termed the "metabolic syndrome" and are associated with increased VAT rather than SAT (Blackard et al., 1993).

Conditions such as gender, aging and ethnicity influence fat distribution. Women in general have less central fat than men for a given amount of fatness, and men have almost twice as much visceral fat than pre-menopausal women. Aging in men and pre-menopausal women show a greater accumulation of central fat, especially VAT (Whitney et al., 2001, p. 140).

1.3.4 Obesity related disorders

According to Walker (1995) diabetes among rural traditionally living people is uncommon compared to urban dwellers. Certain environmental or lifestyle factors increase the prevalence of type 2 diabetes in susceptible populations eg, in the Mexican Americans the higher prevalence can be attributed to higher incidence of obesity and genetic factors.

Risk factors for type 2 diabetes include older age, obesity, a family history of diabetes, history of gestational diabetes, impaired glucose homeostasis, physical inactivity, and ethnicity (Bloch and Mueller, 2000, p. 478). Control over blood glucose levels can be improved with exercise, because of the decrease in insulin resistance and insulin sensitivity. Regular exercise at regular intervals reduces insulin intolerance (Bloch and Mueller, 2000, p. 478).

Physical inactivity is also thought to be a risk factor for the development of glucose intolerance. Overall body mass, the distribution of fat and the level of physical activity are potential modifiable risk factors for glucose intolerance and may influence the bio-chemical risk profile. The benefits of regular physical activity of moderate intensity include improved insulin sensitivity as well as benefits for cardiovascular health, functional status and longevity. Increased insulin sensitivity occurs within weeks of adoption of a program of regular physical activity (Dowse et al., 1991).

Recent projections predict that developed countries will show a 42 percent rise in the prevalence of type 2 diabetes between 1995 and 2025 with developing countries showing an increase of 170 percent (King et. al., 1998). Australian Aboriginal subjects who reverted from living a modern to a traditional lifestyle, which involved changes in both diet and physical activity, showed significant improvements in glucose tolerance (Dowse et. al., 1991).

According to Steyn et al. (1992) coronary artery disease (CAD) contributes largely to the burden on mortality and morbidity from chronic diseases in industrialized countries, including South Africa. Increasing urbanization and the adoption of Western lifestyles and dietary habits seem to play the mayor role in the development of these diseases (Seedat et al., 1982). According to a study by Mollentze et al. (1995) to determine and compare the prevalence of ischaemic heart disease risk factors in a rural and urban black population, all the elements for a potential epidemic of atherosclerotic cardiovascular disease in decades to come, are present in these populations.

1.4 Problem statement

Mangaung is an urban area situated in Bloemfontein where changes in diet and activity patterns have most likely occurred due to urbanization and Westernisation. This makes Mangaung an ideal area to study the impact of the nutrition transition on levels of activity, anthropometry and energy intake. Information of this nature is essential to understanding the association between lifestyle and health status and can make an indispensable contribution to the science of nutrition in developing countries.

1.5 Main objective:

To determine the relationship between level of physical activity, anthropometry and energy intake.

1.5.1 Sub Aims Necessary To Achieve The Main Objective:

1.5.1.1 To determine the level of physical activity of women 25-44 years.

1.5.1.2 To determine the energy intake of the women.

1.5.1.3 To determine the anthropometric status of the women.

1.5.1.4 To determine the associations between 1, 2 and 3.

1.6 Outline Of Dissertation

Chapter 1: Introduction and motivation for the study (Problem statement)

Chapter 2: Literature review: Physical activity

Chapter 3: Methodology

Chapter 4: Results

Chapter 5: Discussion of results

Chapter 6: Conclusion and recommendations

CHAPTER 2

LITERATURE REVIEW: PHYSICAL ACTIVITY

2.1 Introduction

Energy is defined as the capacity to do work. This, in nutritional terms, refers to the manner in which the body makes use of the energy in the chemical bondings within food (Johnson, 2000, pp. 19 - 20). Energy balance can be defined as the difference between food energy intake (metabolizable energy) and energy expenditure (EE). If a person is in a positive energy balance (ie. energy intake exceeds energy expenditure) body weight will increase. In a state of negative energy balance, body tissues will be mobilized and weight will decrease (Van Raaij, 2000, p. 87).

2.2. Energy Expenditure

Energy is expended by the human body, in the form of resting energy expenditure (REE) the thermic effect of food (TEF) and energy expended in physical activity (EEPA) (McArdle et al., 1996, p. 605; Sizer & Whitney, 1998, p. 315; Whitney et al., 2001, p. 128; Johnson, 2001, p. 20). These three components make up a person's total daily energy expenditure (TEE). Except in extremely active subjects, the REE constitutes the largest portion (sixty - seventy percent) of the TEE (Jequier & Shultz, 1983; Mifflin et al., 1990; Johnson, 2000, p. 20). The TEF represents approximately ten percent of the total daily energy expenditure. Physical activity is the most variable component of TEE which may be as low as 100 kcal per day for sedentary people or as high as 3 000 kcal per day in very active people (Johnson, 2000, p. 20). REE, the thermic effect of food and energy expended in physical activity will be briefly reviewed.

2.2.1 Basal Metabolic Rate (BMR) and Resting Metabolic Rate (RMR)

REE is the amount of energy required to maintain BMR or RMR. Basal metabolism can be defined as the energy needed to sustain the basic essential metabolic processes involved in keeping the body alive, without conscious awareness (Whitney et al., 2001, p. 128). The energy required to sustain a basal metabolism is also known as the Basal Metabolic Rate (BMR). In most individuals the BMR is the largest single component of 24 hour energy expenditure. BMR is most frequently measured using the Douglas bag or ventilated hood technique or using portable respirometers. BMR is measured in kJ/min but often extrapolated to 24 hours and then expressed as mJ/day (Whitney & Rolfes, 1999, p. 236; Johnson, 2000, p. 20).

RMR is the largest portion of total energy expenditure and represents the amount of energy needed for life sustaining processes and homeostasis in a neutral thermal environment (Mahan & Arlin, 1992, p. 18; McArdle et al., 1996, p. 151; Johnson, 2000, p. 20). These activities include respiration and circulation, the synthesis of organic compounds, pumping ions across membranes, the energy consumed by the central nervous system, and the maintenance of body temperature. Of the total, 29 percent of REE is expended by the liver, much of which is involved in synthesizing glucose and ketone bodies as fuels for the brain (McArdle et al., 1996, p. 151). BMR and RMR measurements differ only in the time of day when tested and the length of time since the last meal. BMR and RMR differ less than ten percent and therefore the terms are usually used interchangeably (FNB, 1989, p. 25; Mahan & Arlin, 1992, p. 18). BMR has a significant correlation with fat-free mass. BMR may be increased by resistance training which increases lean body mass (Poehlman, 1989; Sizer & Whitney, 1994, p. 315). Lower BMR have been reported in black women than in white women which may be attributed to hormonal responsiveness. This may contribute to the higher level of obesity in black than in white women (Albu et al., 1999).

Body size, body composition, age, sex, nutrition and physiological state are major determinants of the BMR. BMR is usually expressed per kg of body weight or per kg of fat free mass (Van Raaij, 2000, p. 89). BMR measurements are made early in the morning before the person has engaged in any physical activity, and with no ingestion of tea or coffee or inhalation of nicotine for at least 12 hours before the measurement. If any of the conditions for BMR are not met, the energy expenditure should be termed the RMR. RMR are thus usually higher than BMR (McArdle et al., 1996, p. 152; Johnson, 2000, p. 20).

REE can be simply defined as the minimal amount of energy expended that is compatible with life. REE is the amount of energy used in 24 hours by a person who is lying at physical and mental rest, at least 12 hours after the last meal, in a thermo-neutral environment that prevents the activation of heat-generating processes, such as shivering (Johnson, 2000, p. 20).

Factors that affect energy expenditure, or BMR, include physical activity, pregnancy, body size, body composition, age, sex and hormonal status.

During pregnancy, RMR seems to decrease in the early stages, whereas later in pregnancy the metabolic rate is increased by the process of uterine, placental and fetal growth and by the mother's increased cardiac work (Johnson, 2000, p. 21). As pregnancy progresses, the increased body weight adds significantly to exercise effort in weight bearing exercise such as walking, jogging and stair climbing. Pregnancy also increases pulmonary ventilation. This maternal "hyperventilation" has been attributed to the direct stimulating effect of progesterone and increased sensitivity to carbon dioxide (McArdle et al., 1996, p. 157).

Energy requirements for lean people are less than for overweight persons. Sleeping, sedentary activities and bicycling showed a higher total energy expenditure (EE) in overweight persons compared to normal weight persons. Energy requirements for lean and overweight people are the same per kg fat free mass (De Boer et al., 1987). Larger people have higher metabolic rates compared to people of smaller size. A difference in weight of ten kilograms would lead to a difference in RMR of about twelve kcal per day in adult men or women, or a difference in total daily energy expenditure of approximately 200 kcal per day in people with a little physical activity (Sizer & Whitney, 1994, p. 315; McArdle et al., 1996, p.155).

The major single determinant of REE is fat-free mass (FFM) or lean body mass (LBM). FFM is the metabolically active tissue in the body which leads to a higher BMR (James et al., 1978; De Boer et al., 1987; Sizer & Whitney, 1994, p. 315; Whitney et al., 2001, p. 129) and so most of the variation in REE between people can be accounted for by the variation in their FFM. FFM can be measured accurately by using reference body composition methods. These include underwater weighing, measuring total body water using stable isotopes of deuterium or 18-oxygen, total body potassium counting and dual-energy x-ray absorptiometry (DXA). DXA is a novel scanning technique that accurately estimates bone mineral, fat and fat-free soft tissue. Owing to the expense and impractical nature of these reference methods, other sometimes less accurate methods are often used to estimate body composition. These include skinfold anthropometry, bio-electrical impedance and near infrared interactance (Johnson, 2000, p. 20).

Because of the significant positive correlations between fat free mass and BMR it has been suggested that resistance exercise training could increase BMR by increasing lean body mass. On the other hand, endurance training may increase the effect of thyroid hormones and the sympathetic nervous system and increase substrate metabolism in this way (Poehlman, 1989; Whitney et al., 2001, p. 128).

The loss of FFM with aging is associated with a decline in RMR, amounting for about a two to three percent decline per decade, after early adulthood (Sizer & Whitney, 1994, p. 315; Johnson, 2000, p. 21). Exercise can however, help maintain a higher lean body mass and thus a higher RMR (Johnson, 2000, p. 21).

The decline in metabolic rate after early childhood is largely explained by the changes in body composition, usually a decline in fat-free mass and an increase in adipose tissue (Van Raaij, 2000, p. 89). Because it is determined by the FFM, the REE is highest during periods of rapid growth, chiefly during the first and second years of life, and reaches a lesser peak through the ages of puberty and adolescence in both sexes (Johnson, 2000, p. 21; Whitney et al., 2001, p. 128). Athletes with greater muscular development show approximately a five percent increase in basal metabolism compared to non-athletic individuals owing to their greater FFM (Johnson, 2000, p. 21).

Sex differences in metabolic rates are primarily attributed to differences in body size and composition. Women who generally have more fat proportion to muscle than men, have metabolic rates that are around, five to ten percent lower than men of the same weight and height (Johnson, 2000, p. 21; Van Raaij, 2000, p. 89).

Hormonal status can impact metabolic rates, particularly in endocrine disorders such as hyperthyroidism and hypothyroidism, when energy expenditure is increased or decreased, respectively. Stimulation of the sympathetic nervous system, such as occurs during emotional excitement or stress, increases cellular activity by the release of epinephrine, which acts directly to promote glycogenolysis. Other hormones such as cortisol, growth hormone, and insulin, also influence metabolic rates (Johnson, 2000, p. 21).

The metabolic rate of adult females fluctuates with the menstrual cycle. An average of 359 kcal/day differences in the BMR has been measured between its low point, about 1 week before ovulation, at day 14, and its high point just before the onset of menstruation. The mean increase in energy expenditure is about 150 kcal/day during the second half of the menstrual cycle (Johnson, 2000, p. 21).

Fever increases metabolic rate by about 13 percent for each degree in body temperature above 37° C (Sizer & Whitney, 1994, p. 315; Johnson, 2000, p. 21; Whitney et al., 2001, p.128). RMR is also affected by extremes in environmental temperature. People living in tropical climates usually have RMR that are five to twenty percent higher than those living in a temperate area. Exercise in temperatures greater than 86° F also imposes a small additional metabolic load of five percent owing to the increased sweat gland activity (Sizer & Whitney, 1994, p. 315; Johnson, 2000, p. 21). Extreme climates can affect energy expenditure. EE will be increased if heat production is needed to maintain body temperature in a cold climate (Van Raaij, 2000, p. 90).

2.2.2 Thermic Effect of Food (TEF)

The thermic effect of food (TEF) of dietary induced thermogenesis is the stimulation of metabolism that occurs up to three to six hours after a meal as a result of the processing of the food in the stomach and intestine and of nutrients in the blood and body cells. The energy corresponding to the thermic effect of food includes the energy costs of the absorption, metabolism and storage of nutrients within the body (Van Raaij, 2000, p. 90; Johnson, 2000, p. 22).

The TEF was originally called the specific dynamic effect of food because the stimulation of EE depends upon the composition of the diet. The TEF is also called post prandial thermogenesis (PPT) or diet induced thermogenesis (DIT) (Van Raaij, 2000, p.90).

The thermic effect of food has been subdivided into two components, namely the obligatory thermogenesis and facultative thermogenesis.

The obligatory component is the unavoidable energy cost associated with absorption and transport of nutrients and the synthesis of protein, fat and carbohydrates required for the renewal of body tissue and the storage of energy. Adoptive or facultative thermogenesis is the excess energy expended above obligatory thermogenesis (Johnson, 2000, p. 20), thought to be attributable to the metabolic inefficiency of the system stimulated by the sympathetic nervous activity (McArdle, 1996, p. 155; Johnson, 2000, p. 22).

The TEF is greater in response to protein ingestion than to the same energy intake in the form of carbohydrate or fat. There is some evidence that the magnitude of the thermic effect of food as a whole is genetically determined. TEF varies with the composition of the diet, being greater after carbohydrate and protein ingestion than after fat. This is attributable to the metabolic inefficiency of metabolizing carbohydrate and protein in comparison with fat. Fat is stored very efficiently with only four percent wastage, compared with 25 percent wastage, when carbohydrate is converted to fat for storage. These factors are thought to contribute to the obesity promoting characteristics of fat.

TEF usually accounts for approximately ten percent of TEE (Johnson, 2000, p. 22). A meal of pure protein, however, elicits a thermic effect that is nearly 25 percent of the meals total calories. This large thermic effect is due to the digestive process and extra energy required by the liver to assimilate and synthesize protein or deaminate certain amino acids and convert them to glucose (McArdle, 1996, p. 155).

Spicy foods both enhance and prolong the effect of TEF. Cold, caffeine and nicotine also stimulate the TEF. The amounts of caffeine in one cup of coffee (100 mg) if ingested every two hours for 12 hours, increase TEF by eight to 11 percent. Nicotine has a similar effect (Johnson, 2000, p. 22).

The magnitude of the facultative thermic effect of food seems to depend on several factors including the energy content of the meal itself, how well-nourished a person is, and the composition of the diet they have been following (Van Raaij, 2000, p. 90; Johnson, 2000, p. 22).

2.2.3 Energy expended in physical activity (EEPA)

EE for physical activity is the increase in metabolic rates above basal metabolic rate and the thermic effect of food. In affluent countries, physical activity accounts for twenty to fourty percent of total energy expenditure in most individuals. The EE in physical activity depends on the nature and duration of the various activities carried out throughout the day. The energy expenditure of standardized activities, such as treadmill walking and cycling on a bicycle-ergometer, is usually measured using the Douglas bag or the ventilated hood technique. Everyday life or field activities are usually measured using portable respirometers. The energy cost of activities are usually expressed in kJ/min or as multiples of BMR (PAR - Physical Activity Ratio). If energy costs are expressed in kJ/min they are usually inclusive of basal metabolism and the thermic effect of food. If they are expressed as multiples of BMR they are usually also inclusive of the thermic effect of food (Van Raaij, 2000, p. 90).

EEPA is the most variable component of TEE. It may range from as little as ten percent in bedridden persons to as much as fifty percent of TEE. EEPA includes energy expended in voluntary exercise, as well as energy expended involuntarily in activities like shivering, fidgeting and postural control (Johnson, 2000, p. 22).

EEPA varies considerably depending on body size and the efficiency of individual habits of motion. The level of fitness also affects the energy expenditure of voluntary activity, probably owing to increased muscle mass. EEPA decreases with age, a trend that is associated with a decline in FFM and an increase in fat mass. Men generally have a higher EEPA than women, primarily because of their larger body size and greater FFM. (Johnson, 2000, p. 24). The energy cost of any particular activity varies between individuals, depending on the size of the subject, the speed of the activity, the time resting between movements, the skill with which the movements are made and the efficiency of the muscles (Van Raaij, 2000, p. 84).

2.3 Measurement of energy expenditure

The standard unit for measuring energy is the calorie, which is the amount of energy required to raise the temperature of 1 ml of water at 15° C by 1° C. The joule, which measures energy in terms of mechanical work, is the amount of energy required to accelerate 1 Newton over 1 meter. One kilocalorie is equivalent to 4,184 kJ.

The term " metabolizable energy" refers to food and indicates how much energy from the food may become available to the body if the food were to be oxidized. The amount of metabolized energy is also referred to as expended energy. Measurement of energy expenditure is based on direct and indirect calorimetry (Van Raaij, 2000, p. 92).

2.3.1 Direct Calorimetry

All metabolic processes result in production of heat. Human calorimeter is very accurate and of great importance, but has limited use. It is very expensive to build and maintain and not applicable in sport, recreation and occupation. This method is impractical on a large scale. The Atwater-Rosa human calorimeter was the first calorimeter to infer energy expenditure indirectly from metabolic gas exchange in respiration chambers. Measurement of metabolic and thermal balance using water and air flow calorimeters is also possible (McArdle et al., 1996, p. 139).

Direct calorimetry monitors the amount of heat produced by a subject placed inside a structure large enough to permit moderate amounts of activity. These rooms are referred to as whole room calorimeters. Direct calorimetry provides a measure of energy expended in the form of heat, but provides no information of the kind of fuel being oxidized (Johnson, 2000, p. 23).

A direct calorimeter measures the heat production of a human subject over 24 hours. Direct calorimetry is based on the fact that all the energy liberated in the substrate oxidation will eventually be released as heat and as mechanical work performed in the outside environment. Limitation of this method is the confined nature of the testing conditions. This method is not representative of a free-living environment because PA in the chamber is limited. Further limitations are the high cost, complex engineering and a scarcity of appropriate facilities (Johnson, 2000, p. 23; Basset, 2000). In addition, direct calorimetry is time consuming with each measurement taking several hours (Van Raaij, 2000, p. 86).

2.3.2 Indirect Calorimetry

All energy releasing reactions in the body depend on the utilization of oxygen. Measurement of a person's oxygen uptake at rest and under steady rate exercise is possible to obtain using indirect estimates of energy metabolism. The anaerobic energy yield is small under these conditions. Indirect calorimetry through oxygen measurement is a means to evaluate caloric stress in most physical activities. Indirect calorimetry (IC) is relatively cheap in relation to direct calorimetry, but also gives comparable results. There are two methods of measuring IC: Closed Circuit Spirometry and Open Circuit Spirometry (McArdle et al., 1996, p. 139).

Closed Circuit Spirometry is routinely used in hospitals and laboratories to estimate REE. The subject breathes from a prefilled conteurer spirometer with 100% oxygen. It is called closed circuit because the subject rebreathe only the gas in the spirometer. Carbon dioxide in the exhaled air is absorbed by a sodalime canister in the circuit. The changes in the volume of the system are recorded on a drum attached to the spirometer – indicating the oxygen consumed. This method is difficult to use during exercise because of its bulk and the fact that the person has to be close to the equipment. When open circuit spirometry is used, the subject does not breath from a container but breaths ambient air with constant composition of 20.93% oxygen, 0,03% carbon dioxide and 79,04% nitrogen (including inert gasses).

Oxygen is used during activity or exercise and carbon dioxide is produced. The exhaled air contains less oxygen than the inhaled air. The difference in composition of inhaled and exhaled air reflects the body's constant release of energy through metabolic reactions. There are three methods to measure oxygen uptake, namely portable spirometry, the bag technique and a computerized technique (McArdle et al., 1996 p.139).

Indirect calorimetry is easier to carry out than direct calorimetry and provides information about the metabolic fuel that the body is using (Van Raaij, 2000, p. 86; Johnson, 2000, p. 23). Gas exchange is converted to REE because oxygen consumption is proportional to the intensity of work and EE. The equipment varies, but in the most commonly method used the person breathes into a mouthpiece or ventilated hood through which their expired gases are collected. Indirect calorimetry has the advantage of mobility and low equipment cost. The most widely used form of indirect calorimetry is the measurement of RMR through a respirator gas exchange canopy. These ventilated hoods are useful for both short and long term measurements, but have fewer advantages in measuring EEPA. Data are obtained from indirect calorimetry in a form that permits calculation of the respiratory quotient (RQ). RQ = moles CO_2 expired / moles O_2 consumed (Johnson, 2000, p. 23).

This result is converted into kilocalories of heat produced per square meter of body surface per hour and is extrapolated to energy expenditure in 24 hours. RQ depends on the fuel mixture being metabolized. The RQ for carbohydrates is 1,00 because the number of CO_2 molecules produced is equal to the number of O_2 molecules consumed. The energy value of 4,825 kcal/l of oxygen consumed is used as the factor for estimating the energy expenditure based on oxygen consumption. This unit is called a metabolic equivalent (MET) (Johnson, 2000, p. 23).

Heart Rate Monitoring is based on the positive correlation between heart rate and oxygen consumption. Continuous monitoring of heart rates is easy to perform under free-living conditions with electronic equipment. The relationship between an individual heart rate and level of oxygen consumption must be calibrated in laboratory trials in which heart rate and oxygen consumption are directly monitored, while the subject undertakes a series of increasingly strenuous activities. A mathematical equation describing the relationship between heart rate and oxygen consumption can be derived for each individual. The correlation between heart rate and oxygen consumption is strong from a certain level of activity onwards. At lower rates of activity, other factors may confound the relationship, so for daily activity patterns classified as very light or light, this method is less appropriate. This method is inexpensive and non-restrictive to the subject and can be used in large populations (Van Raaij, 2000, p. 86).

Various mechanical and electrical motion sensors have been developed for the recording of body movement in humans. With current technology, heart rate data are sent from a transmitter worn around the chest to a wristwatch or a similar small device. Data can be stored for several days (Basset, 2000). Ankle or waist pedometers are used to count the steps during walking or running. The number of steps in time is used as a measure of physical activity. The Actometer makes it possible to measure and quantify body movement. Major drawbacks of mechanical sensors are the low reliability and the complicated calibration of the instrument (Basset, 2000).

Various electronic accelerometers have been introduced. These sensors measure both frequency and amplitude of accelerations produced during body movement. Current knowledge in miniature computer technology makes it possible to build very small and light instruments that can be worn for several days. The use of body-fixed accelerometers is an attractive and frequently applied method for the assessment of daily physical activity (Van Raaij, 2000, p. 86; Basset, 2000).

The doubly labeled water technique is also used to measure TEE. Since it was developed in 1982, the usage of this method has increased. The method is based on the principle that carbon dioxide production can be estimated from the difference in the elimination rates of body hydrogen and oxygen. The principle of the method is that, after administering a loading dose of water labeled with deuterium oxide (^2H_2O) and oxygen - 18 ($H_2{}^{18}O$) the deuterium is eliminated from the body as water and oxygen - 18 is eliminated as water and carbon dioxide. The elimination rates of the two isotopes are measured over a period of ten to fourteen days by periodic sampling of body water through urine, saliva or plasma. The difference between the two elimination rates is a measure of carbon dioxide production. Carbon dioxide production can then be equated to total energy expenditure using standard indirect calorimetric techniques for the calculation of energy expenditure (Van Raaij, 2000, p. 86).

The doubly labeled water method has a number of advantages, which make it ideal for use in various populations. The first advantage is that it provides a measure of energy expenditure that incorporates all the components of TEE (REE; TEF and EEPA). The technique is easily administered and the subject is able to engage in free-living activities throughout the measurement period, measuring the person's usual and typical daily TEE. The doubly labeled water technique also provides a method by which more subjective estimates of energy intakes (diet recalls and records) and energy expenditure (physical activity logs) can be validated. The method is accurate and has a precision of two to eight percent. Drawbacks of this method include the expense of the stable isotopes and the expertise required to operate the highly sophisticated and costly mass spectrometer for analysis of the isotope enrichments (Johnson, 2000, p. 24; Van Raaij, 2000, p. 86).

2.4 Physical activity

McArdle et al. (1996, p. 3) and Caspersen et al. (1985) define physical activity as any body movement produced by muscles that results in increased energy expenditure. Exercise is a physical activity that is planned, structured, repetitive and purposeful. Physical activity is thus a generic term of which exercise is a major component.

People of all ages can improve their quality of life though a lifelong practice of moderate physical activity (Astrup et al., 1994). It is evident that regular physical activity, which is still a complex and developing science, will provide clear and substantial health gains.

A natural linkage exists between nutrition and exercise. Adequate nutrition is the basis for physical performance because it provides fuel and chemicals to extract energy from this fuel for physical activity (McArdle et al., 1996, p. 3). Changes in technology bring about changes in physical activity in the workplace and during leisure time. During intense mental activity and small movement activities, in a variety of jobs eg. business, trading , education, administration and service industry, the energy expenditure is about 8.4 kJ / minute, while during more manual work the energy expenditure (EE) is 33 kJ

/min. EE from cycling, playing tennis, and gardening may range from 12 to 60 kJ / min (McArdle et al., 1996, p. 167).

PA has by far the biggest influence on human energy expenditure. Under normal circumstances physical activity accounts for between 15 - thirty percent of a persons total daily energy expenditure.

2.4.1 Advantages of physical activity

Physical activity is associated with numerous health benefits and need not be strenuous to achieve benefits (Pate et al., 1995; Brown et al., 2000). Moderate amounts of physical activity make it possible to vary the activities to meet individual needs, lifestyles and preferences. The total amount, rather than the intensity, make it possible to incorporate exercise in everyday living (Berlin & Colditz, 1990; Phaffenbarger et al., 1993; Shephard, 1995).

Physical activity is influenced by age, sex, physical fitness, occupation, leisure time (amount and use), accessibility of facilities (Sallis & Owen, 1997) and personality (McDonald & Hodgdon, 1991; Johnson, 2000, p. 21). An increase in regular physical activity can be benefitial for healthy, physically handicapped (Johnson, 2000, p. 21), psychotic (Van Heerden & Joubert, 2002), and mental patients, by reducing anxiety and depression (; Martinsen & Stephens, 1994; Murtrie & Biddle, 1995; Foreyt, 1997; Saris, 1998; Johnson, 2000, p. 21; Strawbridge et al., 2002).

Various epidemiological studies showed that a decrease in coronary heart disease, hypertension, obesity, stroke, colorectal cancer and osteoporosis is associated with increased physical activity (Kohl & McKenzie, 1994; Phaffenbager et al., 1993; Sizer & Whitney, 1998, p. 4) and a healthy lifestyle (NAIM, 2002).

Systolic and diastolic blood pressure can be lowered by approximately 6 to 10 mm Hg with regular aerobic exercise for many previously sedentary men and women regardless of age. These results have been observed with normotensive and hypertensive subjects both at rest and during exercise (Shephard, 1995; McArdle et al., 1996, p. 278;). Regular aerobic exercise contributes to controlling the tendency for blood pressure to increase over time in individuals at risk for hypertension. The effects of exercise training on blood pressure are the most impressive in most patients with moderate or borderline hypertension. The precise mechanism for the exercise training effect on lowering blood pressure is not known. Significant contributing factors may include a reduced activity of the sympathetic nervous system with training. This would contribute to a decrease in peripheral resistance to blood flow and a subsequent reduction in blood pressure. An altered renal function to facilitate the elimination of sodium by the kidneys to subsequently reduce fluid volume and blood pressure is also evident (McArdle et al., 1996, p. 275).

Regular physical activity greatly reduces the chances of developing type 2 diabetes mellitus. People at greater risk (obese, hypertension, family history, sedentary lifestyle) will benefit most from physical activity in the prevention of type 2 diabetes mellitus. Regardless of sex, individuals with diabetes consistently reported less physical activity over their life-time than those who were disease free (McArdle et al., 1996, p. 376).

Insulin resistance and the metabolic syndrome are associated with low physical activity and poor physical fitness, which predispose to type 2 diabetes mellitus. Maximal oxygen uptake is necessary and is determined by habitual physical activity and exercise. Oxygen uptake are closely related to insulin action by the non-oxidative pathway of glucose disposal in skeletal muscles. In fit muscles there is a faster switch to use fatty acids as substrate than in unfit muscles. Diabetic patients with the metabolic syndrome, have a poor oxygen uptake. This is accompanied by lower lung vital capacity, higher resting heart rate and obesity (Eriksson, 1999).

Acute exercise causes an abrupt decrease in plasma glucose levels. This improvement in glucose regulation with high-intensity and low-intensity exercise may persist for up to several days and is possibly due to the active muscles increased insulin sensitivity. The long-term improvement in glycemic control with regular exercise is due to the acute effects of each exercise session, rather than to chronic changes in tissue function. Hyperinsulemic patients are most likely to benefit from regular exercise which is consistent with the theory that exercise acts by reversing insulin resistance (McArdle et al., 1996, p. 375).

The excess morbidity and mortality in type 2 diabetes mellitus is attributed to coronary heart disease, stroke and peripheral vascular disease resulting from atherosclerosis (Solomon, 1996). Risk factors for diseases that may improve as a result of regular exercise participation include favourable modification in hyperinsulinemia, hyper-glycemia, plasma lipoproteins, some blood coagulation parameters and blood pressure (Gudat et al., 1994; Solomon & Rainer, 1997).

Weight loss and the accompanying reduction in body fat and its distribution enhance glucose tolerance and insulin sensitivity. The beneficial effects of exercise on weight loss are often underestimated because the changes in body weight with exercise do not always reflect the even more favourable changes in body composition. Data indicate that the combination of diet and regular exercise is more effective in reducing body fat than either treatment alone. A shift in focus from dietary treatment to combined dietary and physical activity management in the treatment of obesity is necessary (; McArdle et al., 1996, p. 603; Saris, 1998; Whitney et al., 2001, p. 151). People who combine diet with physical activity are likely to loose more fat, retain more muscle and gain less weight than those who diet alone (Whitney & Rolfes, 1999, p. 220; Whitney et al., 2001, p. 151;). Physical activity contributes to weight loss by directly increasing energy output by the muscles and cardiovascular system and indirectly through speeding up BMI over short and long term periods.

Increase in exercise is associated with decreased anxiety, improved mood and self-esteem, increased sense of well-being and psychological control, and an enhanced quality of life (Shephard, 1995; Biddle, 1995; McArdle et al., 1996, p. 376).

Various epidemiological studies have demonstrated a protective association between regular physical activity and risk of cancer of the breast, colon, lung and prostate (Lee, 1996) and renal disease. Thune et al. (1997) reported that the risk for breast cancer decreased with increased physical activity. Prevalence of breast cancer was the lowest in lean women who exercise at least four times per week. This can be attributed to increased physical activity that helps to reduced the fat stores that serve as a substrate for the metabolism of androgens to estrogen (Peters et al., 1994; McArdle et al., 1996, p. 38) Other potential effects of regular exercise on aspects of cancer development include beneficial changes in the body's antioxidant functions, endocrine profiles, prostaglandin metabolism, body composition and in the case of colon cancer, a beneficial increase in intestinal transit time with exercise. Regular exercise has a desirable effect on natural immune function. This may protect not only from upper respiratory tract infections, but a variety of cancers (Lee, 1996; McArdle et al., 1996, p. 38).

With regard to upper respiratory track infections moderate exercise appears to decrease risk although high endurance exercise may increase risk (Lee, 1996).

Physiologic and performance capability generally decline after approximately thirty years of age. The rates of decline in various functions differ and are significantly influenced by many factors, including the level of physical activity. Regular physical training enables an older person to retain higher levels of functional capacity, especially cardiovascular function. Cardiac patients can often improve their functional capacity with exercise training to the same extent as healthy people of the same age (McArdle et al., 1996, p. 664; Sizer & Whitney, 1998, p. 4).

Sound beneficial sleep (Pate et al., 1995), more youthful appearance, healthy skin, faster wound healing and improvement or elimination of menstrual cramping have been associated with physical activity (Sizer and Whitney, 1998, p. 4) and less heavy periods as well as lower premenstrual syndrome symptoms (Pate et al., 1995).

Physical activity lowers the incidence of heart attack by fifty percent. It increases the size of the coronary arteries, reduces clogging and increases the efficiency of the blood's oxygen carrying capacity. Higher levels of high density lipoprotein cholesterol and lower levels of low density lipoprotein are associated with exercise (Szmedra et al., 1998; Edlin et al., 1999, p. 127).

Physical activity also has a positive effect on bone mineral density (Chilibeck et al., 1995; McArdle et al., 1996, p. 800; Vorster & Nell, 2001) especially in patients with anorexia nervosa (Van Marken Lichtenbelt et al., 1997). There is also evidence that exercise can increase the effect of estrogen on BMI (Sizer & Whitney, 1998, p. 4).

Physical activity positively influences most structural components of the musculoskeletal system that are related to functional capabilities and the risk of degenerative diseases. It can also delay or reduce mechanical lower back pain, neck and shoulder pain, and osteoporosis and related fractures (Vuori, 2001). In a study by Pate et al. (1995) among Australian women, thirty percent of the women reported less tiredness and 44 – 58 percent less of the above mentioned symptoms.

2.4.2 Recommendations for physical activity and energy intake

Physical activity and exercise promote health and vigor. As identified previously by other groups (DHHS, 1996), some benefits can be achieved with a minimum of 30 minutes of moderate intensity physical activity most days of the week. However 30 minutes per day of regular activity is insufficient to maintain bogy weight in adults in the recommended body mass index range from 18.5 up to 25 achieve all the identified health benefits fully. Hence, to prevent weight gain as well as to accrue additional weight-dependent health benefits of physical activity, 60 minutes of daily moderate intensity physical activity (e.g., walking/jogging at 4 to 5 mph) is recommended, in addition to the activities required by a sedentary lifestyle. This amount of physical activity leads to an 'active' lifestyle (NAIM, 2002).

The recommendations for healthy eating from the National Academies' Institute of Medicine (NAIM, 2002) stresses the importance of balancing diet with exercise, recommending total calories to be consumed by individuals of given heights, weights, and genders for each of four different levels of physical activity. For example, a 30-year-old woman who is 162 centimeters tall and weighs 50,45 to 68.18 kilogram should consume between 7 560 and 8 400 kilojoules daily if she lives a sedentary lifestyle. However, if she is a very active person, her recommended total caloric intake increases to 10 500 to 11 760 kilojoules per day. If her lifestyle fits the moderately active category, which is the minimum level of activity to decrease risk of chronic disease, she should eat between 9 2400 and 10 500 kilojoules daily.

The new one-hour-a-day-total exercise goal stems from studies of how much energy is expended on average each day by individuals who maintain a healthy weight. Energy expenditure is cumulative, including both low-intensity activities of daily life, such as stair climbing and housecleaning, and more vigorous exercise like swimming and cycling. Someone in a largely sedentary occupation can achieve the new exercise goal by engaging in a moderate-intensity activity, such as walking at 4 miles per hour, for a total of 60 minutes every day, or engaging in a high-intensity activity, such as jogging for 20 to 30 minutes four to seven days per week.

To maintain cardiovascular health at a maximal level, regardless of weight, adults and children also should spend a total of at least one hour each day in moderately intense physical activity, which is double the daily goal set by the 1996 Surgeon General's report.

2.4.3 Measurement of physical activity

Variations among individuals and populations make measuring physical activity a challenging task. There are several health related dimensions such as caloric expenditure, weight bearing, aerobic intensity, flexibility and strength that complicate measurement of physical activity (Ainsworth, 2000). Differences in these aspects of physical activity may have implications for the prevention of specific diseases. The quality of measure of physical activity is important because poor quality measures can obscure important associations between physical activity and disease outcomes (Ainsworth, 2000).

Numerous field methods have been developed for assessing physical activity. These range from direct observation to written instruments e.g. diaries, logs, questionnaires and interviews to more direct assessment of movement through pedometers, electronic motion sensors an accelerometers as well as physiological response methods e.g. heart rate monitors (Wood, 2000).

Various dimensions and attributes of physical activity are measured by different assessment tools. Most assessment tools have focused on the amount of energy expended. The advantages and disadvantages of different approaches depend on the population and research objectives. Freedson et al. (1998) as well as Basset (2000) recommended multiple measurement devices to achieve an accurate profile of physical activity.

Epidemiological studies use subjective measures like questionnaires. Objective measures can be used to validate subjective activity measures. Popular objective activity assessments include measure of TEE with doubly labeled water and the respiratory chamber. Generally questionnaires are non-reactive, practical, applicable and accurate (DiPietro, 1995; Masse, 2000). Although objective measures of EE provide more precise estimates, they but are not practical for epidemiological studies (Kriska et al., 1992; Booth, 2000). Results from questionnaires are valuable to at least categorize individuals from least to most active. These rankings can then be examined with the aid of physiological parameters and disease outcomes (Kriska & Caspersen, 1997).

Physical activity surveys differ in complexity. These vary from self-administered, single item questions to interviewer-administered surveys of lifetime physical activity. Single item questionnaires may ask the individual if he/she is more active than others of their age and sex, or whether the exercise is long enough to break a sweat. More complex questionnaires attempt to survey a wide range of popular activities over a selected period of time (Kriska & Caspersen, 1997).

Questionnaires may ask about the physical activity done within the last week, month, year or even lifetime. Diaries or logs can also be used to record activities over one to three days or longer (week). Questionnaires focusing over a longer time frame, e.g. one year, will reflect usual activity patterns and are widely used in epidemiological surveys. Short term surveys have the advantage that estimates are less vulnerable to recall bias. Short-term assessment may reflect usual behavior because activities vary with seasons and illness and time constraints. The best assessment seems to be the questionnaire that includes a long and short time period (Baecke et al., 1982; Falkner et al., 2001). Lifetime physical activity patterns can also be assessed because chronic disease develops over a longer period of time. These may evaluate leisure, occupational or both performed during specific age periods. Recall and validation problems limit these assessment methods and they are more often used in case control studies (Kriska & Caspersen, 1997; Falkner et al., 2001).

Only a few questionnaires include both leisure and occupational activities. Focus on leisure and occupational physical activity may be valid for younger and healthier populations. Different activities of daily living and low level leisure activities may represent EE of PA in older and diseased populations. Various questionnaires for these types of activities for the low-end activity spectrum have been developed (Voorrips et al., 1993 & Washburn et al., 1992; DiPietro, 1995).

Because there is no single standard for measuring physical activity (Wood, 2000), time considerations often require a brief survey that measures most physical activities of the population. Further critical issues are the characteristics of the population such as culture, gender, age and outcome of interest (Booth, 2000). In the evaluation of the relationship between physical activity and any disease outcome, accurate information must be obtained on the components of EE (leisure, sporting and occupational activity) (Kriska & Caspersen, 1997).

Retrospective questionnaires are often used in epidemiological studies, for example the Framingham Study. Specially designed questionnaires for specific populations have also been developed (DiPietro, 1995). Questionnaires range form one to twenty pages. If the questionnaire is too long, the accuracy of the information tends to decrease. Many of the participants overestimate the duration and/ or intensity of previous physical activity (DiPietro, 1995).

The dimensions of physical activity and indices are determined in the construction of the questionnaire. Habitual physical activity is measured in time spent on the activity and then multiplied by the energy expenditure per unit time of the activity (DiPietro, 1995; Kriska & Caspersen, 1997). It may also be expressed as physical activity units (Slattery & Randall, 1988). Various types of activity are coded in intensity values. REE and average body weight of the subjects can be taken into account in the calculation of intensity codes (DiPietro, 1995). Energy expenditure can however, be estimated without consideration of the individual body weight, as in epidemiological studies (Kriska & Caspersen, 1997).

Energy expenditure of individuals for the same amount of time for a particular activity may vary according to the skill level, pace, environmental conditions, clothing, equipment and walking surface (Kriska & Caspersen, 1997; Booth, 2000). According to Baecke et al. (1982) it is difficult to test the reliability and validity of these questionnaires because a valid reference method that measures habitual physical activity is not readily available (Seale & Rumpler, 1997). The correlation coefficient between measured activity and laboratory results (oxygen consumption, resting diastolic blood pressure, heart rate and doubly labeled water) may be used as validation standards (Slattery& Randall, 1988).

The repeatability and reliability of questionnaires can be determined by the calculation to test – retest correlation coefficients (DiPietro, 1995). Retest data may vary from baseline data, especially for lower intensity activities, because it is more difficult to remember accurately (Falkner, 2001; DiPietro, 1995). After the first administration subjects may pay closer attention to their activities and therefore report different results (DiPietro, 1995).

Baecke et al. (1982) developed a short questionnaire for the measurement of habitual physical activity in epidemiological studies. Occupational physical activity where defined as low level (clerical work, driving, shop keeping, teaching, studying, housework, medical education), middle level (factory work, plumbing, carpentry, farming) and high level (dock work, construction work, sport). Sport were categorized into three levels: low level (billiards, sailing, golf), middle level (badminton, cycling, dancing, tennis) and high level (boxing, rugby, football and rowing). The sport score is calculated from intensity factor, amount of time per week, and proportion of the year played. Physical activity during the leisure time excluding sport, occupational physical activity and sport during leisure time can also be determined. The Baecke questionnaire can be used for various socio-economic classes. The questionnaire can be used to assess physical activity in subjects between the ages of twenty and seventy years and reliability of 0.76 and 0.93 have been found (Jacobs et al., 1993). Disadvantages of Baeke's questionnaire include the fact that data cannot be compared across populations and the five point Likert scale lacks precision. Defining the terms precisely (e.g. always is equal to five to seven days per week) can eliminate these problems. Pereira et al. (1997) suggest that categorizing subjects into quantity of activity levels will be more accurate since the Baecke questionnaire has no measure unit (eg KJ/hour).

Other questionnaire that have frequently been used include the Bouchard Three Day Physical Activity Record, The Seven-Day Physical Activity Recall, the Coronary Risk Factor Study among the Coloured population of the Cape Peninsula (CARDIA) Physical Activity History, the Framingham Physical Activity Index, Tesumseh Community Health Study (Baecke et al., 1982), the Health Insurance Plan of New York Activity Questionnaire (HIP), the Lipid Research Clinics Questionnaire and Minnesota Leisure-Time Physical Activity (LTA) Questionnaire (Pereira et al., 1997). The first two records measure daily energy expenditure in kJ, while the others measure a relative energy score that may be calculated to categorize subjects according to their level of physical activity.

Jacobs et al. (1993) evaluated ten commonly used physical activity questionnaires for reliability and validity in 78 men and women between twenty and 59 years, over a sixty week period. The scores of the questionnaires were compared with treadmill exercise performance vital capacity, percentage body fat, accelerometer readings and four-week physical activity diaries. No significant correlations between questionnaire measures and accelerometer readings of vital capacity were found. Vital capacity is, however, not an appropriate validation standard because only extreme values of vital capacity influence physical activity performance. Cardio respiratory fitness (VO^2 max) and body fat percentage were use to relate to performance scores of physical activity in most questionnaires. Many participants never take part in heavy physical activity but perform moderate physical activity more regularly, and in these cases VO^2 max may not reflect their EE.

The capacity of questionnaire scores to correlate well with validation measures where not related to questionnaire length or attention to detail, but rather to the logic construction of questions. Pereira et al. (1997), who reviewed 31 questionnaires, recommended that questionnaire results should be compared against 24 hour physical activity records in order to identify high prevalence activities which are typically omitted from questionnaires.

There is a fragmentation of data on the physical activity of South Africans. Many of the questionnaires that have been used were not validated or based on categorical classification or dichotomous variables (inactive versus active). The questionnaire used in the BRISK study also indicated that some results were paradoxical e.g. men with a low to moderate level of occupational physical activity had the lowest overall coronary risk (Sparling et al., 1994).

Thirty percent of women and forty percent of men of mixed racial ancestry and Black South Africans living in the Western Cape reported no physical activity in their occupation or leisure time (Steyn et al., 1991; Levitt et al., 1993). Only one in seven adult South Africans owns a passenger vehicle which means that walking to and from public transport is not considered when reporting activity. This highlights the problems of cultural perception regarding the nature of physical activity (Lambert, 1998).

Other problems associated with physical activity questionnaires in South Africa include a lack of culturally specific, language specific, validated questionnaires. Low levels of literacy in specifically older adults from previously disadvantaged rural areas or under unemployed individuals, and different cultural perceptions of exercise or physical activity, are other barriers that are often encountered. Additionally there is a total lack of South African – specific MET's for activities in our own population, which lead to large assumptions on occupational activities like domestic service and manual labour. (Ainsworth et al., 1993; Lambert, 1998).

2.4.4 Classification of physical activity

Different types of classifications of physical activities are possible. Macera & Pratt (2000) classify physical activity according to intensity, frequency and duration. Moderate-intensity activities are those that cause some increase in breathing or heart rate, such as brisk walking. Vigorous intensity activities are those that cause large increases in breathing or heart rate, such as aerobic dancing or running. Those in the insufficient-activity category report doing some activity (vigorous or moderate) but not for the recommended duration or frequency. Different questionnaires give multiples non overlapping dimensions of physical activities. One classification would include sleep, light intensity leisure activities, moderate intensity leisure activities, heavy intensity leisure activities, household chores and occupational activity. Other categorizations only include light versus moderate versus heavy intensity occupational activities (Jacobs et al., 1993).

Baecke et al. (1982) classify habitual physical activity into three categories; work activity, sport activity, and non-sport activity. In the questionnaire, each category or section consists of several questions scored on a five point Likert scale, ranging from never to always or very often. Scoring the questions gives an indication of the work index, sport index and non sport leisure index. Total score is the sum total of all three indexes. Score categories are as follows: 1 = low level; 2 = middle level; 3 = high level. Since the questionnaire scores have no inherent unit of measure (e.g., kcal/unit time), they were designed to be categorized into quantiles for general classification of activity levels.

2.5 Dietary Intake

Dietary recommendations for macronutrients and measurement of dietary intake will be discussed.

2.5.1 Dietary recommendations for macronutrients

Recommendations for nutrient intakes are generally set to provide an ample supply of the various nutrients needed (i.e., enough to meet or exceed the requirements of almost all healthy individuals in a given gender/life-stage group) and enough to allow reasonable fast recovery of losses that may have been incurred. For most nutrients, requirements are thus set to correspond to the average amounts sufficient to meet a specific criterion plus two standard deviations to meet the needs of nearly all healthy individuals. However, this is not the case with energy because excess energy cannot be eliminated and is eventually deposited in the form of body fat. This reserve provides a means to maintain metabolism during periods of limited food intake, but it can also result in obesity.

The first alternate criterion that may be considered is that energy intake should be commensurate with energy expenditure, so as to achieve energy balance. Although frequently applied in the past, this is not appropriate as a sole criterion, as easily understood by considering the rationale used in the 1985 Technical Report published by the FAOIWHO/UNU Expert Consultation on Energy and Protein Requirement (FAO/WHO/UNU, 1985) states that:

> "The energy requirement of an individual is a level of energy intake from food that will balance energy expenditure when the individual has a body size and composition, and level of physical activity, consistent with long-term good health;

and that would allow for the maintenance of economically necessary and socially desirable physical activity." (FAO/WHO/UNU, 1985, p. 121).

The definition indicates that desirable energy intakes for obese individuals are less than their current energy expenditure, as weight loss and establishment of a steady state at a lower body weight is desirable for them (NAIM, 2002).

According to the recommendations for healthy eating from the National Academies' Institute of Medicine (NAIM, 2002) to meet the body's daily energy and nutritional needs while minimizing risk for chronic disease, adults should get 45 to 65 percent of their calories from carbohydrates, twenty percent to 35 percent from protein fat .

Because carbohydrates, fat, and protein all serve as energy sources and can substitute for one another to some extent to meet caloric needs, the recommended ranges for consuming these nutrients should be useful and flexible for dietary planning (Sizer &; Brownsell et al., 1992; McArdle et al., 1996, p. 598; Whitney, 2001, p. 359). Earlier guidelines called for diets with 50 percent or more of carbohydrate and 30 percent or less of fat, while; protein intake recommendations remained the same.

In the past, recommended dietary allowances, or RDAs, have served as the benchmarks of nutritional adequacy. The new Dietary Reference Intakes (DRI), or DRIs, have been established using an expanded concept that includes indicators of good health and the prevention of chronic disease, as well as possible adverse effects of over consumption. Thousands of scientific studies linking excessive or inadequate consumption of fats, carbohydrates, and protein with increased risk for dietary deficiency diseases, obesity, heart disease, diabetes, and other chronic illnesses were consulted in the development of the DRI's. The DRI's include not only recommended intakes, intended to help individuals meet their daily nutritional requirements, but also tolerable upper intake levels (ULs) that help them avoid harm from consuming too much of a nutrient (NAIM, 2002).

The DRIs are designed to meet the needs of individuals who are healthy and free of specific diseases or conditions that may alter their daily nutritional requirements. It is expected that people known to have specific conditions or chronic diseases will get nutritional advice from their health professionals that are tailored to their special needs.

Energy is provided by the macro-nutrients in food, which are broken down into their constituent parts by digestion, and metabolised in the tissues. The macro-nutrient classification serves to classify energy sources as sugars and starches (carbohydrates), fats and oils (lipids) and proteins which have not been used for building and repairing the body. Energy intake is the first part of the energy balance system and includes factors of both the quantities of food eaten by an individual as well as the energy content of the diet/foods ingested (Van Rensburg & Gordon-Davis, 2001, p. 113).

Fat is a major source of fuel energy for the body and aids in the absorption of fat-soluble vitamins and other food components such as carotenoids. Fat is a major source of energy for the body and aids in the absorption of essential vitamins. Some foods that are major contributors of fat in the diet include butter, margarine, vegetable oils, visible fat on meat and poultry, whole milk, egg yolks, and nuts. High-fat diets usually mean increased intakes of saturated fat, which can raise the amount of low-density lipoprotein and the level of "bad" cholesterol in the bloodstream of some individuals and heightens their risk for heart disease. Meats, baked goods, and full-fat dairy products are the main sources of saturated fat in most diets. Because saturated fat and cholesterol provide no known beneficial role in preventing chronic diseases, they are not required at any level in the diet. Recognizing that completely eliminating saturated fat and cholesterol from the typical diet would make it very difficult to meet other nutritional guidelines, keeping consumption as low as possible while maintaining a nutritionally adequate diet has been recommended (Van Rensburg & Gordon-Davis, 2001, p. 113).

Mono-unsaturated and polyunsaturated fatty acids, also present in fat, reduce blood cholesterol levels and thus lower the risk of heart disease when they replace saturated fats in the diet. Partially hydrogenated vegetable oils, such as those used in many margarines and shortenings, contain a particular form of unsaturated fat known as trans fatty acids. Trans fatty acids have physical properties generally resembling saturated fatty acids, and their presence tends to harden oils. Often found in cookies, crackers, dairy products, meats, and fast food, trans fatty acids increase the risk of heart disease by boosting levels of bad cholesterol. Because they are not essential and provide no known health benefit, there is no safe level of trans fatty acids and people should eat as little of them as possible while consuming a nutritionally adequate diet (Sizer & Whitney, 1998, p. 35; Insel et al., 2001; NAIM, 2002;).

Established recommended levels of protein intake, are 0.8 grams per kilogram of body weight for adults. Because data on the potential for high-protein diets to produce chronic or other diseases are often conflicting or inadequate, tolerable upper intake levels for consumption have not been determined for protein or for the individual amino acids.

Carbohydrates (sugars and starches) provide energy to cells in the body, particularly the brain, which is a carbohydrate-dependent organ. An RDA for carbohydrate is established based on the average amount of glucose utilized by the brain. The RDA for carbohydrate is set at 130 g/day for adults and children (Insel et al., 2001, p. 498; NAIM, 2002).

2.5.2 Measurement of dietary intake

Dietary assessment is used to estimate food consumption or nutrient intakes in individuals or groups of people (Nelson, 2000, p. 315).

Measurement of nutrient intakes is probably the most widely used indirect indicator of nutritional status. Estimation of an individual is usual dietary and nutrient intake is difficult. The task is complicated by weaknesses of data gathering techniques, human behaviour, a nutrient intake varies from day to day, limitations of nutrient composition tables and databases. Despite these weaknesses (Dwyer, 1998, p. 937), nutrient intake data are valuable in assessing nutritional status when used with anthropometric, biochemical and clinical data (Lee & Nieman, 1996, p. 91).

The most appropriate method must be chosen after thorough consideration of the exact purposes of the assessment, what is to be measured, in whom, and over what period of time. This will determine the most appropriate technique for the given purpose and avoid wasting resources using a technique that does not provide an appropriate measure (Nelson, 2000, p. 314).

There are two main approaches in dietary assessment, namely prospective and retrospective. Prospective methods involve collecting or recording information about current diet, while retrospective methods requires subjects to recall either recent or past diet (Nelson, 2000, p. 316).

Reliability and validity of methods of dietary recall are important. Validity may be influenced by people knowing or unknowingly altering the contents of the diet. To be reliable, dietary intake should reflect typical food patterns. Memory lapses, inaccurate knowledge of portion sizes and over- or underestimation of the amounts consumed may jeopardise the reliability (Hammond, 2000, p. 367). Validating involves comparing estimates of intake obtained by the instrument with the usual intake of respondents. Because it is difficult, if not impossible, to know a persons true usual intake, investigators must turn to relative or criteria validity. This can be defined as the comparison of a new instrument with another instrument that has a great degree of demonstrated or face validity (Lee & Nieman, 1996, p. 116).

Reliability or reproducibility can be defined as the ability of a method to produce the same estimate on two or more different occasions, assuming nothing has changed in the interim. Reproducibility is concerned with the capability of a method to provide the same or similar answers two or more times and does not necessarily indicate if an answer is correct. Reproducibility can partially answer the validity question, - a method cannot give a correct answer every time unless it gives approximately the same answer each time (Lee & Nieman, 1996, p. 123).

Various methods can be used to determine dietary intake. For the purpose of this dissertation, the food frequency questionnaire (FFQ), 24 hour recall, food records and the diet history will be discussed.

2.5.2.1 Food Frequency Questionnaire (FFQ)

FFQ's are preprinted lists of food on which subjects are asked to indicate the typical frequency of consumption and to state in household measures the average amount consumed (Nelson, 2000, p. 320). The FFQ is thus a checklist assessing energy and/or nutrient intake by determining how frequent a person consumes a limited number of foods that are major sources of nutrients or of a particular dietary component in question (Lee & Nieman, 1996, p. 100). The FFQ is a retrospective review of intake frequency per day, per week or per month (Hammond, 2000, p. 366). The questionnaire usually consists of a list of approximately 100 or fewer individual foods or food groups that are important contributors to the populations intake of energy and nutrients.

If no portion size is given, it is referred to as simple or non-qualitative FFQ format. The semi-quantitative FFQ gives an idea of portion size. The portion size and numbers are entered into a computer database, which multiplies these by nutrients contained in each food or food group and arrives at an estimated nutrient intake. Some questionnaires have been designed to assess intake of individual nutrients or food components such as vitamin A, fat and calcium for investigating the relationship between diet and conditions such as cancer and cardiovascular diseases. The results can quickly be analysed into food groups by computer and the foods can be ranked in relation to intakes of certain food items. The disadvantages of the FFQ are that incomplete responses may be given and response rates may be lowered if self administered underestimation occurs and total consumption is difficult to obtain because not all foods can be included in lists.

Respondent burden rises as the number of food items queried increases. Analysis of the FFQ is difficult without the use of computers and special programs. Reliability is lower for individual foods than for food groups. Specific culture groups require a culture specific FFQ (Dwyer, 1998, p. 943; Nelson, 2000, p. 321).

2.5.2.2 24 Hour Recall

When a 24 hour recall is used, a trained interviewer asked the respondent to recall or remember in detail all the food and drink consumed during a period of time in the recent past. This information is later coded and analysed using computerized diet analysis programs. In most instances the period is 24 hours.

The 24 hour recall is easy to administer in a short period of time (Nelson, 2000, p. 321; Dwyer, 1998, p. 943; Lee & Nieman, 1996, p. 100). It is inexpensive and respondent burden is low. This method is more objective than the diet history and data can be repeated with reasonable accuracy over a short period of time. Disadvantages of the 24-hour recall are that it does not provide adequate quantitative data on nutrient intakes. Individual diets vary and thus a single day's intake may not be representative. An experienced interviewer is required to administer the interview. Over and underreporting is possible and subjects often report what the interviewer wants to hear. This method also does not reflect differences in intake over weekdays versus weekends, season to season or shift to shift (Dwyer, 1998, p. 943; Hammond, 2000, p. 368).

2.5.2.3 Daily Food Records / Diary

In this method, the respondent records, at the time of consumption, the identity, and amount of all foods and beverages consumed over a period of time ranging from 1 to 8 days.

Food and beverage consumption can be quantified by estimating portion sizes using household measures, or weighing the food or beverage on scales. This method is also referred to as estimated food records or weighed food records. The degree of accuracy from household measures appears acceptable for most research purposes, especially when considering whether respondents will adhere to the program if they must weigh everything that they eat (Lee & Nieman, 1996, p. 99).

Strengths of this method is that it provides daily records of food consumption, quantity of food, how it is prepared as well as timing of meals and snacks (Hammond, 2000, p. 369).

The report does not depend on memory because the respondent ideally records food and beverages at the time of eating. It can provide detailed food intake data and important information about eating habits. Data from a multiple day food record would also be more representative of usual intakes than single day data from 24 hours of 1 day food record. Multiple records from non-consecutive, random, days (including weekends) covering different seasons are necessary to arrive at useful estimates of usual intakes (Lee & Nieman, 1996, p. 100). Recording error can be minimized if subjects are given proper directions (Dwyer, 1998, p. 944).

Limitation of this method is that it requires a literate and co-operative respondent who is able and willing to expend time and effort to record dietary intakes. People may alter their diet to streamline the recording process (Lee & Nieman, 1996, p. 100; Dwyer, 1998, p. 44). Women are more competent than men in recording and underreporting is common (Dwyer, 1998, p. 944). Other limitations are high costs of coding and analysis (Dwyer, 1998, p. 944), and questionable reliability (Hammond, 2000, p. 369).

2.5.2.4 Dietary History

The diet history is used to assess an individual's usual dietary intake over an extended period of time such as a month or a year (Lee & Nieman, 1996, p. 107). This method produces a more complete and detailed description of both qualitative and quantitative aspects of food intake than food records, 24 hour recalls or FFQ. A trained nutritionist asks questions on the number of meals eaten per day, appetite, food dislikes, the presence or absence of nausea and vomiting, use of nutritional supplements, cigarette smoking, habits related to sleep, rest, work, exercise and so on. This is followed by a 24-hour recall in which the interviewer also inquires about the respondents usual pattern of eating during and between meals, beginning with the first food intake, including types of food eaten, serving sizes, frequency and timing and significant seasonal variations. The data is crosschecked by asking specific questions about the respondent's dietary preferences and habits. An additional three day food records must also be completed to serve as another method of crosschecking the usual intake (Lee & Nieman, 1996, p. 107).

The principal advantage of the diet history is the quantity of information about eating habits which can be obtained from a single interview (Dwyer, 1998, p. 942). Limitations of this method is that a highly trained nutritionist is required to administer dietary histories (Lee & Nieman, 1996, p. 208; Dwyer, 1998, p. 943; Nelson, 2000, p. 32). A standardized version is difficult to obtain because of a considerable variability among and within interviews (Dwyer, 1998, p. 943). This is a very time consuming method taking one to two hours to administer (Lee & Nieman, 1996, p. 108; Dwyer, 1998, p. 943). Diet histories may overestimate intakes compared with food records collected over the same period of time because of bigger portion sized and greater frequencies reported (Dwyer, 1998, pp. 943 - 944).

2.5.2.5 Other Methods

Dietary intakes can also be determined by duplicate food collections, food accounts, food balance sheets, telephone interviews, visual records, computerized techniques, surrogate sources, direct observation by video recording or trained observers and food checklists (Lee & Nieman, 1996, pp. 108 – 116; Dwyer, 1998, p. 945).

2.6 Anthropometery

Anthropometry involves physical measurement (body size, weight and proportions) of an individual and relating them to standards to reflect growth and development of the individual (Hammond, 2000, p. 368). Anthropometry can be used as a sensitive indicator of health (Lee & Nieman, 1996, p. 224). Valuable measurements are height, head circumference, weight, skinfold thicknesses and other girth measurements. These parameters may be influenced by ethnic, familial, birth weight and environmental factors (Hammond, 2000, p. 368).

The advantages of anthropometrical status measurements are that they are non-invasive, safe, simple and practical for large population groups. The equipment is inexpensive, portable and durable. Relatively unskilled personnel can perform the procedures. The methods are accurate and precise if standardized techniques are used. Anthropometrical assessment can assist in identification of mild to moderate malnutrition or severe malnutrition (Gibson, 1996, p. 427).

2.6.1. Height and weight status (Body Mass Index)

Body Mass Index (BMI) accounts for differences in body composition by defining the level of adiposity according to the relationship of weight to height, eliminating dependence on frame size. This index has the least correlation with body height and the highest correlation with independent measures of body fatness for adults (Hammond, 2000, p. 370).

Body Mass Index is measured as W/H^2 in which W is weight in kilograms and H is height in square meters (Pressman & Adams, 1990, p. 46; Hammond, 2000, p. 370). A BMI of 20 to 25 is associated with the least risk of early death. The classification of BMI is represented in Table 2.1 Classification of BMI.

TABLE 2.1 CLASSIFICATION OF BMI

CLASSIFICATION OF BMI (LAQUATRA, 2000, P 493)	
Underweight	< 18,5
Normal	18,5 - 24,9
Overweight	25,0 - 29,9
Obesity, Class I	30,0 - 34,9
Obesity, Class II	35,0 - 39,9
Extreme obesity, Class III	$\geq$ 40

Weight is an important variable in equations predicting calorie expenditure and in indices of body composition. Body weight indicates the sum of protein, fat and bone mineral mass of an individual (Gibson,1996, p. 428). It may be interpreted in several ways, including ideal weight for height, usual and actual weight. Reference standards such as Metropolitan Life Insurance Tables and NHANES I and II percentiles (Hammond, 2000, p. 369) or the National Centre for Health Statistics (NCHS) medians can be used to calculate ideal weight for height (Lee & Nieman, 1996, p. 233).

In order to obtain reliable results, scales must be placed on a flat hard surface and the zero weight on the scale must be checked regularly after moving the scale. Minimum clothing or an examination gown should be worn. Weight is recorded to the nearest 0,1 kg (Lee & Nieman, 1996, p. 228).

Various methods can be used to measure height. The simplest method is to use a con-stretchable tape or measuring stick fastened to a flat vertical surface, for e.g. a wall without a skirting and without a carpet. A right-angled headboard is used for reading measurements (Lee & Nieman, 1996, p. 225). The stadiometer can also be used to measure height. Measurement of length, stature (or height) must take place with the head in the Frankfort horizontal plane, legs straight, heels together, arms to the side and shoulders relaxed (Lee & Nieman, 1996, p. 225). The subject should inhale deeply and hold her breath before the measurements are taken. Maintaining the erect position, the headboard is lowered to the highest point of the head compressing the hair. Measurements are taken to the nearest 0,1 cm. Parallax errors should be avoided by taking measurements at eye level with the headboard.

2.6.2 Body Composition

Body composition is defined as the ratio of fat to fat free mass (FFM) and frequently expressed as the percentage of body fat (Lee & Nieman, 1996, p. 247; Gibson, 1996, p. 431; Laquatra, 2000, p. 488).

Body fat is the most variable composition of the body, differing among individuals of the same sex, height and weight. Average fat content of women is higher than that of men (Gibson, 1996, p. 431).

Body composition can be determined by means of skinfold thicknesses, bio-electrical impedance and other methods.

2.6.2.1 Skinfold Thickness (Sub-Cutaneous Fat)

The most widely used method of indirectly assessing the amount of body fat of an individual is skinfold measurement - the thickness of a double fold of skin and compressed sub-cutaneous adipose tissue (Lee & Nieman, 1996, p. 249; Gibson, 1996, p. 432). This method is performed using a skinfold caliper, which measures the thickness of sub-cutaneous fat tissue in millimetres, giving a rough measurement of adiposity. This measurement basis total body fat estimates on the assumption that fifty percent of body fat is sub-cutaneous. Accuracy decreases with an increase in adiposity (Hammond, 2000, p. 371).

This method has the advantages that that the equipment needed is inexpensive, it requires little space and measurements are obtained quick and easy. If correctly done, skinfold measurement provides estimates of body composition that correlates well with those derived from hydrostatic weighing, the most widely used laboratory method for determining body composition (Lee & Nieman, 1996, p. 249).

Different skinfold sites give different thicknesses of sub-cutaneous adipose tissue among individuals and for the same skinfold site between individuals. Overall sub-cutaneous adipose tissue is best assessed by measuring multiple skinfold sites. At least three different sites are recommended (Lee & Nieman, 1996, pp. 137 - 138). Skinfold sites identified as most reflective of body fatness are over the triceps, biceps, below the scapula, above the iliac crest and the upper thigh (Hammond, 2000, p 371). Other sites are medial calf, abdomen, suprailiac, mid-auxiliary chest (Lee & Nieman, 1996, pp 253 - 254) The most accessible site is the triceps.

A major drawback of skinfold measurements is to obtain consistent values. The person taking the measurements must have considerable experience (Whitney et al., 2001, p.352; Insell et al., 2001, p. 301). In extremely obese people the fatfold may exceeds the jaws of the calliper. (McArdle et al., 1996, p.557).

2.6.2.2 Bio-Electrical Impedance

Bio-electrical impedance analysis (BIA) is also used for body fat analysis. This technique is based on the principle that compared to fatty tissue, lean tissue has a higher electrical conductivity and lower impedance relative to water based on electrolyte content. BIA usually involves attaching four electrodes to the extremities of a patient and (hand and foot) passing a small electrical current through the electrodes to obtain electrical and resistance measurements. The current is harmless and cannot be felt by the subject (Pressman & Adams, 1990, p. 52; Lee & Nieman, 1996, p. 272; Hammond, 2000, p. 373).

Reliability of these measurements can be influenced by fever, electrolyte imbalance and hydration status of the patient (Pressman & Adams, 1990, p. 61; Hammond, 2000, p. 373).

A weakness of BIA is that the technique assumes that subjects are normally hydrated. Dehydration due to insufficient water intakes, excessive perspiration, heavy exercise or caffeine or alcohol use, will result in over estimation of fat mass. Subjects are therefore advised to drink plenty of water, avoid alcohol and caffeine a day before testing and heavy exercise 12 hours before testing.

BIA has been show to be as good, if not slightly better, than skinfold measurements in predicting percentage body fat. The method is safe and comfortable, the instrument convenient to use, portable, quick and non-invasive. The instrument is, however, expensive and accuracy is affected by the physical conditions described (Pressman & Adams, 1990, p. 63; Lee & Nieman, 1996, p. 273).

2.6.2.3 Other Methods

Other methods that can also be used to determine body composition include densitometry, total body water, total body potassium, neutron activation analysis, creatine excretion, 3 methylhistione, total body electrical conductivity, infrared interactance, ultrasound computed tomography and magnetic resonance imaging.

2.6.3 Waist To Hip Circumference Ratio (WHR)

Determining the ratio of the waist or abdominal circumference to the hip or gluteal circumference is an easy way to assess body fat distribution. The waist to hip ratio (WHR) provides an index of regional body fat distribution and is a valuable guide in assessing health risk (Lee & Nieman, 1996, p. 245)

WHR differentiates between android and gynoid obesity. A WHR of 1,0 or greater in men or 0,8 or greater in women is indicative of android obesity and increased risk for obesity related disorders. The hip circumference is defined as the largest circumference between the waist and knees (Hammond, 2000, p. 372). The waist circumference is measured at the most narrow area below the rig cage and above the umbilicus as viewed from the front. The subject stands erect, abdominal muscles relaxed, arms at the side, and feet together. The measurement is taken at area of least circumference or at the umbilicus level.

The tape is put in a horizontal plane around the hips at the point of the greatest circumference, in close contact with the skin without indenting soft tissues. The measurement should be recorded to the nearest 0,1 cm. The WHR is calculated by dividing the waist circumference by the hip circumference (Lee & Nieman, 1996, p. 245).

2.7 Human immunodeficiency virus (HIV) and physical activity

Although the South African AIDS epidemic has been the last to develop in Africa (NICDAM, 2000), South Africa is now experiencing the fastest growing HIV rates in the world (MRC, 2000; TAC, 2001), with 4,7 million people living with AIDS (UNAIDS/WHO, 2001), and over 1 500 people becoming infected every day (NICDAM, 2000). Until a cure for this chronic, progressive disease has been developed, our aim should be to increase the quality of life and years of "wellness" of the HIV/AIDS sufferer (Steyn & Walker, 2000).

Before the HAART (Highly active anti-retroviral therapy) era, several studied investigated the resting energy expenditure (REE) or basal metabolic rate in HIV-infected patients (Garcia-Lorda et al., 2000), supporting the opinion that HIV infection is a hypermetabolic disorder (Selberag et al., 1995; Grinspoon et al., 1998). Although it has been documented that REE is increased in HIV positive patients even with normal CD4+ cell counts and in the absence of opportunistic infection (Melchior et al., 1991; Pollard, 1995), this hypermetabolic response seems to become more severe particularly in the presence of secondary infections (Melchior et al., 1993; Garcia-Lorda et al., 2000). An 11 percent increase in REE among HIV-positive patients, a 25 percent increase among AIDS patients, and a 29 percent increase in AIDS patients with secondary infections were observed by Grunfeld et al. (1992). A correlation between weight and energy intake, but not between weight and REE was further reported (Grunfeld et al., 1992), while an increase in REE, and a correlation between weight loss and decreased energy intake in HIV positive patients were observed by Macallan et al. (1995). As metabolic rate increases, energy needs also increase. An increase in dietary intake is thus recommended to maintain weight in physically active HIV positive patients (Grunfeld et al., 1992; Macallan et al., 1995). According to Macallan et al. (1995) TEE is reduced during episodes of weight loss but not as a result of elevated energy expenditure. Reduction in physical activity in HIV individuals are likely to contribute to the wasting process.

Because people living with HIV/AIDS eat less due to appetite loss and difficulty in eating, they fail to meet their dietary requirements (Dept. of Health, 2001; USAID, 2001). Appetite loss or anorexia does not only lead to malnutrition, but also plays a major role in weight loss and loss in lean muscle tissue in HIV patients (Shephard & Shek, 1994; Birk, 1996; Cimoch, 1997; Piwoz & Preble, 2000; Fenton & Silverman, 2000, p. 899; USAID, 2001).

Activity can also affect energy requirements. Although activity can be beneficial in HIV/AIDS, chronic exercise and high-fat diets have been associated with immune suppression. Weight loss, together with depletion of body cell mass, decreased skinfold thickness and midarm circumference, and changes in fat free mass, are common indicators of HIV/AIDS infection (Fenton & Silverman, 2000, p. 899; Piwoz & Preble, 2000). According to Babameto & Kotler (1997), "weight loss is often the event that begins a vicious circle of increased fatigue and a decrease in physical activity, including the inability to prepare and consume food" for the person living with HIV/AIDS.

Poor nutrient absorption may give rise to inefficient food digestion, making it unable for the body to use nutrients properly, particularly fats, carbohydrates and proteins. Metabolic disturbances and muscle and tissue catabolism also take place (Piwoz & Preble, 2000). These factors result in weight loss, loss in lean muscle tissue and increased damage to the immune system (USAID, 2001).

Infection with HIV has been associated with several alterations in body composition and metabolism (Yarasheski & Raubenoff, 2001). HIV infection leads to impairment in a number of important elements of immune function, mostly in a progressive decline in the number of CD4+ T lymphocytes (Shephard, 1998). Physical activity improves exercise tolerance, body composition and blood lipid profiles (Jones et al., 2001).

HIV positive individuals are encouraged to maintain their levels of physical activity (Piwoz & Preble, 2000). Exercise and training, especially aerobic exercise, will result in slowing of the disease symptom progression (Werner, 1997; Mustafa et al., 1999). The individual's physical condition, as well as psychological state improve. This improvement greatly enhances the quality of the individual's life (Werner, 1997; Kanouse et al., 2001) through improving their aerobic capacity (Stringer et al., 1998; Terry et al., 1999; Stringer, 2001; Yazrasheski & Raubenoff, 2001), with small but significant beneficial effects on the immune system (Stringer, 2001). Very intensive bouts of competitive exercise must however be avoided because of the adverse effect on the immune system (Key et al., 1999). Studies on the influence of moderate exercise training on host protection and immune function have shown that daily brisk walking compared with inactivity, reduced the number of sickness days without change in resting immune function. Positive effects on immune surveillance and host protection that come from moderate exercise training are probably related to a summation effect from acute positive changes that occur during each exercise bout (Nieman & Pedersen, 1999).

Loss of muscle mass early in life and early in the progression of HIV infection may result from decreased levels of physical activity . Resistance exercise training can attenuate or slow down loss of muscle mass (Evans et al., 1998; Roubenoff et al., 1999). Physical activity has been positively advocated as part of the non-pharmacologic treatment of HIV individuals (Key et al., 1999; Jones et al., 2001). In addition, exercise interventions enhance physical self efficacy, positive mood and satisfaction with life (Lox et al., 1995). Physical activity should thus be recommended during HIV/AIDS infection.

The resulting gain of aerobic power and muscle strength for people with early to moderate advanced HIV are similar to those observed in healthy individuals with comparable initial fitness (Shephard, 1998). In fully developed AIDS the ability to exercise may be compromised by deterioration in cardiorespiratory and neuromuscular function (Shephard, 1996).

Acute and chronic responses to exercise in HIV negative individuals suggest that lymphocyte counts increase as fitness is enhanced. However, exercising with HIV could bring varying results relevant to the amount of immune system compromise. Severely immune compromised individuals can expect to increase in CD4+ count with exercise (Lox et al., 1995). According to Stringer (1999), current recommendations for aerobic exercise training for HIV positive individuals are three times per week for an hour, which will significantly improve their aerobic capacity, without detrimental effects on the immune system.

CHAPTER 3

EXPERIMENTAL PROCEDURES

3.1 Introduction

A framework was compiled to describe the experimental procedures for determining the relationship between physical activity, anthropometry and energy intake of women (25 – 44) in Mangaung (fig. 1).

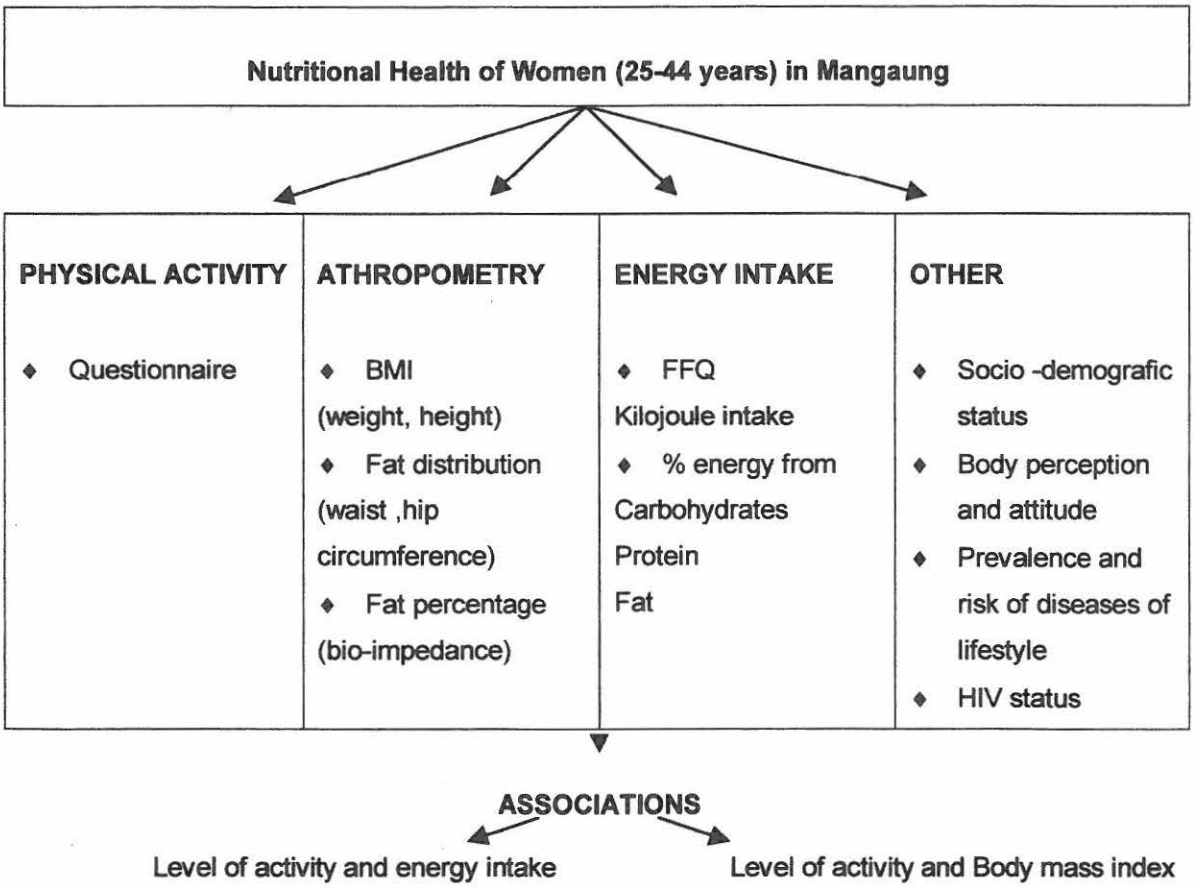

FIGURE 2: Framework of experimental procedures

This study formed part of a larger study, investigating the nutritional health of women in Mangaung. The study investigated the prevalence and risk of diseases of lifestyle namely obesity, hypertension, type 2 diabetes, cancer, fibrinogen status, iron status and HIV status.

The following information was collected as part of the large study:

- Socio-demographic status
- Anthropometric status: weight, height, waist-to-hip-ratio, fat percentage
- Dietary intake
- Level of activity
- Body image(perception and attitude)
- Biochemical parameters indicative of :
  - prevalence and risk of cardiovascular disease
  - prevalence and risk of type 2 diabetes
  - prevalence and risk for obesity
  - Iron status
  - Cancer risk
  - HIV risk

For the purpose of this sub-study, the relationship between physical activity, anthropometry and energy intake was determined.

The data was collected by a research team under the leadership of a project manager.

The researcher was involved in the following:

Adaptation and administering of level of physical activity questionnaire

Collection of blood samples (assisting nursing sister)

Measurement of anthropometric variables.

3.2 Pilot Study

Ten black women (25 – 44 years) took part in the pilot study. The subjects consisted of Technikon Free State personnel (Class C workers) as well as domestic workers. During the pilot study the following mearsuring instruments were standardised:

- A socio demographic questionnaire;
- Physical activity questionnaire
- Other questionnaires not applicable to this study

The following adjustments were made to the physical activity questionnaire after the pilot study:

The same questions were used but the original questionnaire (Kruger, 1999) was altered by changing the categories of the questions (never, seldom, sometimes, often and always) to time spent in minutes on each activity.

The respondents were asked if this particular action was applicable, to which the respondent should answer yes or no. If the question was applicable, the time spent on the activity was given in minutes.

The pilot study indicated the number of subjects that could be handled during one data collection session and the need for interpreters when administering the questionnaires.

3.3 Population and Sampling

A random sample of 500 Black pre-menopausal women (25-44 years) was selected by the Department of Bio-statistics at the University of the Free State, using a township map of Mangaung, the African residential area, obtained from the greater Bloemfontein municipality.

The residential plots in four selected areas were counted and numbered, and the respondents were then selected randomly and proportionally. The sample included respondents from two built-up areas , namely Pahameng (1359) and Botschabela (2308) and two informal settlements, namely Joe Slovo (1359) and Namibia (2995).

- Inclusion and exclusion criteria:
  - Voluntarily participation
  - African female
  - Age group 25 – 44
  - Non pregnant
  - fasting from 22;00 the night prior to data collection
  - Available for the full duration of the investigation.

3.4 Operational definitions

For the purpose of this study the following definitions were compiled:

3.4.1 Level of activity

Level of activity was determined by means of a physical activity questionnaire in which the daily activities of the women at home and at work were recorded. The activities were then classified into three categories, namely low level of activity, moderate level of activity and high level of activity.

3.4.2 Anthropometry

Anthropometry involves the physical measurements (size, weight and proportions) of the individual and the relationship of these to standards that would reflect their growth and nutritional status (Lee & Nieman, 1996, p. 224; Hammond, 2000, p. 353).

For the purpose of this study BMI, waist to hip circumference and fat percentage were determined:

Body mass index refers to weight (kg) / height (m^2) and is an indicator of degree of adiposity

Underweight BMI:	<18.5 kg / m^2
Normal BMI:	18.5 < 25 kg / m^2
Overweight BMI:	25<30 kg / m^2
Obese BMI:	≥30 kg / m^2 (Laquatra, 2000, p. 493).

Waist-to-hip circumference indicates fat distribution. The area where fat is deposited differentiates between android distribution ≥0.8 (fat around the waist and upper abdomen; "apple shape") and gynoid distribution <0.8 (fat in the buttocks and thighs "pear shape")(Hammond, 2000, p. 372).

Fat percentage was categorized as follows:

<20: Low;

20≤25: Normal

>25: High (Laquatra, 2000, p. 488).

3.4.3 Energy intake

Energy intake can be defined as the total number of kilojoules consumed daily as determined by a Quantitative Food Frequency Questionnaire measuring the habitual types and quantities of foods and drinks consumed by the respondent.

3.5 Materials and methods

The following materials and methods were used for this study:

3.5.1 Physical Activity Questionnaire (Appendix A)

A questionnaire based on the one developed by Baecke et al., (1982) and adapted by Kruger (1999), was used to develop a questionnaire measuring physical activity for occupation and leisure time specifically in our sample. This questionnaire was completed in an interview situation. According to the questionnaire respondents were categorized into three activity levels, namely low, moderate and high.

The questionnaire included the following information:

- Identifiable details of the respondent

- Main occupation
- Standing activities at work
- Standing activities at home
- Sitting activities at home
- Sitting activities at work
- Duration of sitting activities at home / work
- Duration of standing activities at home / work
- Type and duration of transport
- Leisure time activities and the duration of the activities

3.5.2 Anthropometry (Appendix B)

Anthropometrical status of the respondents included the following measurements:

- Weight;
- Height;
- Circumferences (waist ,hip);
- Bio-impedance.

All measurement was taken after the bladder was emptied, wearing a light examination gown and bare foot.

Weight was determined with a Seca digital electronic scale, to the nearest 0,1 kilogram.

Height was determined by means of a stadiometer to the nearest 0, 5 centimeters. Subjects were without shoes, standing upright against a flat surface, with the Frankfort plane for height measurements. The headboard was then lowered upon the highest point of the head and the measurement was then read on eye level (Norton & Olds, 1996, p. 37).

Waist and hip circumference were determined in the upright position using a tape measure to the nearest 0,5 centimeters maintaining a close contact with the skin, without compressing outer tissue. The hip was defined as the widest circumference over the great trochanters. Waist was defined as the minimal abdominal circumference located midway between the lower rib margin and the iliac crest. Measurements were taken with a 7 mm wide flexible steel tape. Circumferences were measured using the cross-hand technique with the tape at right angles to the body (Norton & Olds, 1996, p. 53).

Bio-electrical impedance analysis (BIA) was used for body fat analysis. This technique is based on the principle that compared to fatty tissue, lean tissue has a higher electrical conductivity and lower impedance relative to water based on electrolyte content. BIA involves attaching four electrodes to the extremities of a patient and (hand and foot) passing a small electrical current through the electrodes to obtain electrical and resistance measurements. The current is harmless and cannot be felt by the subject (Hammond, 2000, p. 373; Lee & Nieman, 1996, p. 272; Pressman & Adams, 1990, p. 52). To determine bio-impedance elbow width was also necessary. Elbow width was determined using a slide rule to the nearest 0.1 mm. The respondent stretched out the right arm, palm up and brought up the lower arm to a vertical position. The width between the protruding condiles of the elbow was measured with the slide ruler and the reading was recorded.

Subjects lay relaxed and flat on an examination bed, with the arms and legs slightly spread, but with no parts of the body touching one another. The self-adhesive disposable electrodes were attached to the right hand and the right foot. One red lead was placed behind the knuckle of the middle finger of the right hand. One black lead was placed on the wrist next to the ulna head of the right hand. The other red lead was placed behind the second toe next to the big of the right foot. The machine was switched on, and when the reading was stabilized, the impedance reading was recorded (Bodystat R1500 Bodystat, Isle of Man, Limited).

3.5.3 Dietary intake (Appendix C)

The energy intake of the respondents was recorded by using the information obtained by administering a Food Frequency Questionnaire (FFQ) adopted from the THUSA study (Kruger, 1999). Both traditional and Western food items were included. Provision was also made for the addition of unlisted food items.

A special section for reporting foods hunted and or collected such as wild birds, animals, insects fruit and berries was included in the questionnaire.

The FFQ were administered by three interviewers after attending a training session by a dietitian that participated in the National Food Consumption Survey. Three interpreters (one Xhosa and two Sotho) assisted the interviews. Participants were requested to report food items selected from the different categories listed on the FFQ as consumed daily, monthly or seldom.

The following materials and equipment were used to determine food choices and proportion sizes:

- A set of household measuring cups (250 ml, 125 ml, 62 ml and 31 ml)
- A set of household measuring spoons (15 ml, 7,5 ml, 2,5 ml, 1,2 ml and 0,6 ml)
- A large household spoon used for dishing up (heaped spoon, 125 ml)
- Empty labeled food containers
- Real food (snack foods), weighted on a analytical scale to determine the weight for commonly used portion sizes
- Food models

Food items were coded by means of the Food Composition Tables of the Medical Research Council (1998). The quantities of the food items were converted into grams using the Food Quantities Manual (Langenhoven et al., 1991). The weight of the food items not selected on a daily basis were calculated as follows:

- Food in grams consumed on a monthly basis divided by thirty days
- Food consumed on a weekly basis divided by seven days

Complex dishes not appearing in the Food Composition tables were broken into individual ingredients and weights and coded as such.

3.5.4 HIV status

HIV tests were performed on a abbott AxSYM ® System, using the Human Immunodeficiency Viruses (HIV 1/ HIV-2): (recombinant antigens and Synthetic Peptides) reagent pack (Abbott, Germany, cat. no. 3D41-20). The HIV1/2 gO reagent pack is for the *in vitro* qualitative detection of antibodies to human immunodeficiency virus Type 1 and/or Type 2 in serum or plasma, by Micro-particle Enzyme Immunoassay.

3.6 Study procedures

Approval for the study was obtained from the Ethics Committee of the University of the Free State. Prior to the study the approval of the Community leaders of the four selected areas (Pahameng, Botshabela, Joe Slovo and Namibia) was obtained. The Community leaders also received a letter informing them about the purpose of the study (Appendix D). In addition the study leader spoke on Radio Lesedi as a means to inform the community of the project.

Two community health workers assisted in the study. They were informed about the procedures to follow when recruiting subjects. Twenty subjects were visited at their homes the week before the session at the Technikon Free State to explain the purpose and procedures and obtain written consent for inclusion in the study (Appendix E). Employed respondents were given a letter for employers in order to be able to participate in the study (Appendix F). Respondents were instructed to fast overnight, abstain from exercise for 24 hours and avoid alcohol and caffeine 24 hours prior to the session.

If a subject meeting inclusion the criteria was not available, the residence to the right was selected. If not successful, the residence to the left was chosen. If this also failed a new plot was selected by the Department of Biostatistics, University of the Free State.

The subjects were collected at a central point and transported to the research unit at Technikon Free State where all investigations were undertaken. All investigations were undertaken over a period of 25 weeks, during March – November 2000. On arrival each respondent received a nametag with a number and a list of the seven stations which they had to visit before receiving their remuneration of R 40.00.

A research assistant supervised the procedures to ensure that each respondent visited each station for interviews and examinations. Tea and sandwiches were served after the medical examination and blood sampling.

The stations were as follows:

- A medical practitioner performed the general medical examination
- Blood samples were taken
- Anthropometric measurements were taken
- Food Frequency Questionnaire was administered
- Physical activity Questionnaire was administered
- Other questionnaires not relevant to the study were administered

Three interpreters (Sotho and Xhosa) were available to help with the administering of the Questionnaires.

The Physical Activity Questionnaire was tested for reliability by repeating the same questionnaire with fifty respondents. The same respondents were contacted one month after the main study and the questionnaire was re-administered.

3.7 Statistical analysis

The data for all data sets were categorized into two age groups: 25-34 years, and 35-44 years. For each group, continuous variables were described by means and standard deviations, or medians and percentiles as applicable. Categorical variables were described by frequencies and percentages.

3.7.1 Energy expenditure requirement (EER)

The energy expenditure is 2403 for females older than 18 years. 7 kcal per day for each year above 19 years was subtracted.

For each age group and physical activity group:

> The energy expenditure requirement was calculated and compared by means of chi-square test.

3.7.2 Physical activity questions

For each age group:

> The medians of physical activity index were compared by 95% non-parametric confidence intervals for the median difference. The confidence intervals were clinically interpreted for significance.

The categorized questions were compared by means of chi-square test and Fisher's exact test.

For each age group and physical activity group:

The medians of physical activity questions were compared by 95% non-parametric confidence intervals for the median difference. The confidence intervals were clinically interpreted for significance.

The categorized questions were compared by means of chi-square test and Fisher's exact test.

For each combination of age group, physical activity group and HIV-group:

The physical activity questions were compared by means of chi-square test and Fisher's exact test and 95% confidence intervals for the percentage difference.

Medians were compared by 95% non-parametric confidence intervals and the Kruskal-Wallis test.

3.7.3 Physical activity index

Physical activity was calculated in the same manner as in the THUSA study (Kruger, 1999). The physical activity index was calculated as follows:

Physical activity Index = 0.47 (work index) + 0.059 (commuting index) + 0.001(stair index) + 0.47(sport index + leisure index)

The questionnaire of this study differed from the THUSA study's in the classification of time of the activity. In this study respondents were asked to specify the amount of time spent on an activity in minutes, while the THUSA study had a classification of time as "never, seldom, sometimes and always". The amount of time for each activity was defined as never when a person spent 0% of their time at work or at home with inactivity. Seldom was defined as less than 10% of the time and 10% to 50% was defined as sometimes. Fifty percent to less than 85% was defined as often and more than 85% as always. Classification of activities at home and at work were included. As the physical activity index for the THUSA study was calculated for the work place, activity at home were calculated as work activity when a person did not work. If a person was working then work was calculated as work activities at work plus work activities at home.

The physical activity index was calculated and categorized as follows:

< 4: Low

$4 < 6$: Normal;

> 6: High (Kruger, 1999)

For each combination of age group, physical activity group and HIV-group, the physical activity questions were compared by means of chi-square test and Fisher's exact test and 95% confidence intervals were calculated for the percentage difference. Medians were compared by 95% non-parametric confidence intervals and the Kruskal-Wallis test.

3.7.4 Validity and reliability of the Physical Activity Questionnaire

For each question, the answers obtained in the main survey and the reliability study were compared by k*k tables and where the percentages who gave conflicting answers were more than 20%, the variables were considered as unreliable and ignored in further computations.

For continuous variables, the difference between the two surveys was calculated and the number of non-zero differences reported.

The Physical Activity Questionnaire was retested for reliability by repeating the same questionnaire in fifty respondents. The same respondents were contacted one month afterwards and the questionnaire was re-administered.

3.7.5 Anthropometry

Body mass index (weight / meter^2), waist-hip ratio (waist / hip), waist circumference and fat percentage were calculated and categorized according to cut off points discussed under Operational definitions. For each age group and physical activity group the BMI was compared by means of an analysis of variance. The categorized BMI was compared by means of chi-square test and Fisher's exact test for both HIV negative and HIV positive women in the two age categories.

For each age group:

The medians of physical activity index were compared by 95% non-parametric confidence intervals for the median difference. The confidence intervals were clinically interpreted for significance.

For each age group and physical activity group:

The body mass index was compared by means of an analysis of variance.

The categorized body mass index was compared by means of chi-square test and Fisher's exact test.

For each age group and physical activity group and HIV-group:

The body mass index was compared by means of an analysis of variance.

The categorized body mass index was compared by means of chi-square test and Fisher's exact test.

3.7.6 Energy intake

The energy intake of each respondent was calculated using the Food composition database of the MRC (2001), and described for each group by medians and percentiles because the data were skewly distributed. All nutrients were categorized as<67 percent or >67 percent of the recommended dietary intake (RDA) or adequate intake (AI) and described by frequencies and percentages.

For each age group:

the medians were compared by 95% non-parametric confidence intervals for the median difference. The confidence intervals were clinically interpreted for significance.

For each age group and physical activity group:

The kilojoules was compared by means of an analysis of variance.

The medians were compared by 95% non-parametric confidence intervals for the median difference. The confidence intervals were clinically interpreted for significance.

For each age group and physical activity group and HIV-group:

The kilojoules was compared by means of an analysis of variance.

The medians were compared by 95% non-parametric confidence intervals for the median difference. The confidence intervals were clinically interpreted for significance.

CHAPTER 4

RESULTS

4.1 Introduction

A short overview of the socio-demographic profile of the respondents is given as a introduction to the results (Appendix G).

The mean age of the women from the younger group who participated in this study, was 29.2 years, and from the older group 39.5 years. From the women of the younger group, 52,3% were Sotho speaking and 25,1% Tswana speaking. Of the older women, 51,1% were Sotho speaking, and 26,7% Tswana speaking. In the younger group, the mean number of years living in an urban area was fifteen years, while in the older group it was nineteen years. In this population, the prevalence of HIV infection was higher in younger (25-34 years) than in older women (35-44 years). 61 percent of younger women and 38% of older women were HIV infected. Room density was high in both groups (mean 3.2 persons/room and 3.1 persons /room for the young and the older age groups respectively). Results from the question on level of education showed that the highest level of education appeared in women from the younger group on secondary school level (standard 6-8: 37,6% and standard 9-10: 47,3%). In the older group, the highest level of education appeared in the standard 6-8 category (42.4%), while 15,7% had standard 9-10.

The results of the study are presented under the following headings: physical activity, anthropometry and energy intake.

Central University of Technology, Free State

4.2 PHYSICAL ACTIVITY QUESTIONNAIRE

The main objective of the physical activity questionnaire was to be able to categorize the respondents into one of three categories of physical activity – low, normal and high. Due to the small numbers of respondents with normal and high levels of physical activity, these two categories were combined to make statistical analysis of data possible. If the PAI were between 4 < 6, women were considered to have a normal level of physical activity. Women were considered to have a high level of physical activity if the PAI were > 6.

Women were divided into eight groups, according to age, level of physical activity and HIV status. Group 1 – 4 included women with low levels of physical activity, while groups 5 – 8 included women that had normal to high levels of physical activity. In the groups with low levels of physical activity and normal to high levels of physical activity , women were categorized according to age (25 – 34 years, and 35 – 44 years) as well as HIV status.

Table 4.1 represents the occupational status of the respondents. Groups 1-4 represent women with low levels of physical activity, while groups 5-8 represent women with normal to high levels of physical activity. In the inactive group there were 88 women that were between 25 and 34 years old and HIV negative, while 152 younger women were HIV positive. In the older inactive group (35 –44 years old) there were 128 HIV negative women and 76 HIV positive women. In the normal to active groups (group 5-8) there were 18 women that were between 25 and 34 years old and HIV negative, while 15 younger women were HIV positive. In the older normal to active group (35 –44 years old) there were 5 HIV negative women and 6 HIV positive women.

Table 4.1 Occupational status

	LOW PHYSICAL ACTIVITY				NORMAL TO HIGH PHYSICAL ACTIVITY			
PARAMETER	1	2	3	4	5	6	7	8
	< 35 HIV -	< 35 HIV +	≥35 HIV -	≥35 HIV+	< 35 HIV -	< 35 HIV +	≥5 HIV -	≥5 HIV+
	n = 88	N=152	n=128	n=76	n =18	n=15	n=5	n=6
1. Main occupation								
Volunteer	0	0.7	0.8	0	0	6.7	20.0	0
Student	2.3	0.7	0	0	0	6.7	0	0
Teacher	0	0	0	0	5.6	0	0	0
Part time	1.1	2.8	1.6	0	5.6	13.4	0	16.7
Lund Industries	1.1	0	0	0	0	0	0	0
Domestic worker								
Prestige cleaner	1.1	2.0	6.3	5.3	0	0	0	16.7
Till packer, Packer								
Wool-worths Foods	1.1	0.7	0.8	0	0	6.7	0	0
Nurse	0	0	0	0	0	0	20.0	0
Unemployed	93.2	93.4	90.6	94.7	88.9	66.7	60.0	66.7
2. Work away from home	n=88	N=152	n=128	n=76	n=18	n=15	n=5	n=6
Yes	5.7	7.2 *	10.2	5.3	11.1	33.3 *	40.0	33.3
No	94,3	92,8	89,8	94,7	88,9	66.7	60.0	66.7
3. Days per week work	n=5	N=11	n=13	n=4	n=2	n=5	n=2	n=2
1-2	40.0 *	18.2*	46.2	25.0	50.0	40.0	0	0
3-4	60.0	45.5*	15.4	50.0	0	20.0	50.0	100.0
5	0	27.3	30.8	25.0	50.0	20.0	50.0	0
6-7	0	9.1	7.7	0	0	20.0	0	0
Median	3	3	3	3.5		3		

A very high rate of unemployment, ranging between sixty percent in group seven to 94,7 percent in group four, were found among the women in Mangaung. The lowest levels of physical activity were among the unemployed groups 1-4, (90, 6 – 94,7 percent). Groups 5-8,with the higher level of activity, included higher percentages of women that worked away from home. There was a statistically significant difference between group 2 (HIV + < 35) and group 6 (HIV + <35) with a confidence interval of [-5,2; -7,2] indicating that more younger HIV positive in the PA active group worked away from home than in the physically inactive group. Of those women that worked, the median days per week worked was 3-3,5 days.

Table 4.2 Work activities at work

	LOW PHYSICAL ACTIVITY				NORMAL TO HIGH PHYSICAL ACTIVITY			
PARAMETER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	< 35 HIV -	**< 35 HIV +**	**≥35 HIV -**	**≥35 HIV+**	**< 35 HIV -**	**< 35 HIV +**	**≥35 HIV -**	**≥35 HIV+**
5. Sit at work	n=5	n=11	n=13	n=4	n=2	n=5	n=2	=2
Yes	60.0	45.5	61.5	50.0	50.0	60.0	100.0	50.0
7. Walk at work	n=5	n=11	n=13	n=4	N=2	n=5	n=2	n=2
Yes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
9.Lift heavy loads at work	n=5	n=11	n=13	n=4	n=2	n=5	n=2	n=2
Yes	60.0	54.6	69.3	75.0	0	20.0	50.0	50.0
10. Duration of lifting loads (min)	n=3	n=6	n=9	n=3	n=1	n=0	n=1	n=1
10 – 35	33.3*	50.0	100.0	100.0	0	0	0	100
36 –180	33.3	50.0	0	0	0	0	100.0	0
181-480	33.3	0	0	0	0	100.0	0	0
Median	180	47.5	10					
11. Tired at work	n=5	n=11	n=13	n=4	n=2	n=5	n=2	n=2
	60.0	72.7	69.2	100.0	50.0	40.0	50.0	50.0
14. How do you get to work	n=5	N=11	n=13	n=4	n=2	n=5	n=2	n=2
Walk	0	18.2	53.90	25.0	0	40.0	50.00	50.0
Cycle	100.0	54.6	38.5	75.0	50.0	60.0	50.0	50.0
Bus	0	27.3	0	0	0	0	0	0
Taxi	0	0	7.7	0	0	0	0	0
Car	0	0	0	0	50.0	0	0	0
16. Pace of walking to work	n=0	N=2	n=5	n=1	n=0	n-=2	n=1	n=1
Casual strolling	0	0	40.0	0	0	50.0	0	0
Fairly brisk / brisk	0	0	20.0	0	0	0	0	0
Fast	0	100.0	40.0	100.0	0	50.0	100.0	100.0
17.Duration of walk to work (min)	n=0	N=2	n=7	n=1	n=0	n=2	n=1	n=1
0-30	0	100.0	71.5	0	0	50.0	0	0
31-50	0	0	0	0	0	0	100.0	0
51-70	0	0	14.3	100.0	0	0	0	100.0
71-90	0	0	0	0	0	50.0	0	0
90-180	0	0	14.3	0	0	0	0	0
Median			30					

In table 4.2 the work activities at work of the women in Mangaung are indicated. A very low number of the total sample worked. As expected of those that worked, groups 1-4 (inactive groups) reported lower levels of PA than groups 5-8 (normal to high active group). Only 1 respondent in group 5 (<35 HIV +) traveled by car to work. More women (27,3%) make use of bus transport to work, while only (7,7%) use a taxi to get to work.

Table 4.3 Work activities at home

	LOW PHYSICAL ACTIVITY				NORMAL TO HIGH PHYSICAL ACTIVITY			
PARAMETER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	< 35 HIV -	**< 35 HIV +**	**≥35 HIV -**	**≥35 HIV+**	**< 35 HIV -**	**< 35 HIV +**	**≥35 HIV -**	**≥35 HIV+**
23. Walk at home	n=88	n=152	n=128	n=76	n=18	n=15	n=5	n=6
Yes	96.6	98.0	99.2	100.0	94.4	93.3	100.0	100.0
24. Duration of walk at home(min)	n=85	n=149	n=127	n=76	n=17	n=14	n=5	n=6
2-15	3.6	2.0	0.8	1.3	0	7.1	0	0
16-90	25.9	23.5	22.1	23.7	5.9	14.3	20.0	16.7
91-180	36.6	33.6	40.9	30.3	64.7	21.4	40.0	50.0
181-300	23.6	24.1.	21.3	29	11.8	35.7	20.0	16.7
301-420	4.8	8.8	5.6	11.8	17.7	0	20.0	16.7
421-600	6.0	8.1	9.4	3.9	0	21.4	0	0
Median	180	180	180	180	180	240	120	150
25. Lift heavy loads at home	n=88	n=152	n=128	n=76	n=18	n=15	n=5	n=6
Yes	56.8	60.5	53.9	63.2	61.1	60.0	80.0	100.0
26. Duration of lifting heavy loads(min)	n=50	n=92	n=69	n=48	n=11	n=9	n=4	n=6
2 – 10	64.0	53.3	60.8	47.9	54.6	77.7	50.0	50.0
11 – 30	24.0	33.7	31.9	35.5	27.3	11.1	50.0	50.0
31 – 90	10.0	7.6	4.4	6.3	9.1	0	0	0
91 – 180	0	2.2	3.0	10.5	9.1	11.1	0	0
181 – 480	2.0	3.3	0	0	0	0	0	0
Median	10	10	10	15	10	10	12.5	12.5
27. Tired at home	n=88	n=152	n=128	n=76	n=18	n=15	n=5	n=6
Yes	72.7	79.0	78.9	84.2	72.2	80.0	100.0	83.3
28. Duration – tired at home (min)	n=64	n=120	n=101	n=64	n=13	n=12	n=5	n=5
2 – 10	7.9	4.1	10.9	11.0	0	33.3	40.0	0
11 – 30	17.3	15.0	9.9	15.7	23.1	8.33	0	40.0
31 – 90	32.8	30.8	29.7	32.8	38.5	25.0	20.0	0
91 – 180	34.4	42.5	43.6	34.5	38.5	25.0	20.0	60.0
181 – 480	7.9	7.4	6.0	6.4	0	8.3	20.0	0
Median	60	105	90	60	60	60	60	180
29. Sweat as result of work at home	n=88	n=152	n=127	n=76	n=18	n=15	n=5	n=6
Always	20.5	18.4	32.3*	31.6	16.7	20.0	40.0*	50.0
35. Climbing stairs	n=87	n=150	n=128	n=76	n=18	n=15	n=5	n=6
Yes	8.1	9.3	7.0	9.2	27.8	26.7	20.0	33.3

In table 4.3 the work activities at home of the women in Mangaung are indicated. A median of 120 - 180 minutes of walking at home was reported. Lifting or moving of heavy objects took a median time of 10 minutes per day. The groups with higher physical activity (group 5-8) are more tired at home than the lower physical activity women in group1-4. Respondents were tired/sleeping for about 60 – 180 minutes during the day at home. Most women sweat a lot at home. There was a statistically significant difference between group 3 (≥ 35 HIV -) and 7 (≥ 35 HIV-) with the confidence interval of [145,4%; 21,8%] indicating that women that are more physically active tent to perspire more. The women in groups 5-8 with the higher levels of physical activity, climb more stairs than those in groups 1-4 with the lower levels of physical activity.

Table 4.4 presents the sport activities of the women of Mangaung. As expected the physically active women (groups 5-8) take part in more sport activities (66,7-100 %). Various types of sport were reported. Netball was the most popular sport with 81,3 % in group 5 (< 35 HIV-) playing netbal. Tennis, dancing and jogging were also popular among the women. Of those that take part in sport, the duration of sport practice was a median of 120 minutes per day. There was a statistically significant difference in the median duration of sport practice between group 1 (<35 HIV -) and 5 (<35 HIV -)
[-300,0; -120] as well in the number of months spent practicing in sport [-6; 0]. Thus younger HIV- women that were physically inactive spent significantly less time participating in sport compared to the physically active group.

Table 4.4 Sport activities

	LOW PHYSICAL ACTIVITY				NORMAL TO HIGH PHYSICAL ACTIVITY			
PARAMETER	1	2	3	4	5	6	7	8
	< 35 HIV -	< 35 HIV +	>35 HIV -	>35 HIV+	< 35 HIV -	< 35 HIV +	>35 HIV -	>35 HIV+
38. Playing sport	n=88	n=152	n=128	n=76	n=18	n=15	n=5	n=6
Yes	9.1	12.5	4.7	5.3	88.9	93.3	100.0	66.7
39. Type of sport	n=8	n=19	n=6	n=4	n=16	n=14	n=5	n=4
Karate	0	5.3	0	0	0	0	0	0
Jogging	0	10.5	16.7	0	6.3	7.1	0	25.0
Aerobics	0	0	16.7	0	6.3	0	0	0
Netball	62.5	52.6	50.0	25.0	81.3	71.4	40.0	25.0
Tennis	25.0	5.3	0	50.0	0	0	0	0
Basket ball	12.5	10.5	0	0	0	7.1	0	50.0
Dancing	0	10.5	0	25.0	0	7.1	20.0	0
Foot ball	0	0	0	0	0	7.1	20.0	0
Gym	0	0	16.7	0	0	0	0	0
Tennis, volley ball, Athletics	0	0	0	0	0	0	20.0	0
Soccer, tennis	0	0	0	0	6.3	0	0	0
Darts	0	5.3	0	0	0	0	0	0
Volley ball	0	0	0	0	0	0	0	0
Median	63	63	63	64	63	63	67	64
40. Duration of sport practice (min)	n=8	n=19	n=6	n=4	n=16	n=14	n=5	n=4
0 – 60	25.0	21.1	33.4	0	0	14.3	0	0
61 – 120	50.0	42.1	50.0	50.0	0	28.6	40.0	0
121 – 180	25.0	15.8	16.7	25.0	25.1	0	20.0	25.0
181 – 240	0	10.5	0	25.0	12.5	14.2	0	0
241 – 360	0	10.6	0	0	37.6	21.4	20.0	50.0
361 – 510	0	0	0	0	6.3	7.1	0	25.0
511 – 600	0	0	0	0	18.9	7.1	20.0	0
601 – 940	0	0	0	0	0	7.1	0	0
Median	120*	120	120	150	360*	225	210	330
41. Months per year practicing sport	n=8	n=19	n=6	n=4	n=16	n=14	n=5	n=4
1	0	5.3	16.7	25.0	0	0	0	0
2	0	5.3	0	0	0	0	0	0
3	0	5.3	0	0	0	0	0	0
4	0	5.3	0	0	6.3	0	0	0
6	62.5	36.8	66.7	50.0	18.8	14.3	20.0	50.0
8	12.5	0	0	0	0	0	0	0
10	12.5	0	0	0	12.5	21.4	0	25.0
12	12.5	21.1	16.7	25.0	62.6	64.3	80.0	25.0
Median	6*	6	6	6	12*	12	12	8

Table 4.5 Leisure time activities

	LOW PHYSICAL ACTIVITY				NORMAL TO HIGH PHYSICAL ACTIVITY			
PARAMETER	1	2	3	4	5	6	7	8
	< 35 HIV -	< 35 HIV +	≥35 HIV -	≥35 HIV+	< 35 HIV -	< 35 HIV +	≥35 HIV -	≥35 HIV+
21. Sit at home	n=88	n=152	n=128	n=76	n=18	n=15	n=5	n=6
Yes	98.9	98.7	100.0	100.0	100.0	93.3	100.0	100.0
31. Walk outside home (min)	n=88	n=152	n=128	n=76	n=18	n=15	n=5	n=6
2 – 10	26.1	36.2	41.4	31.6	38.9	53.4	20.0-	33.3
11 – 30	33.0	25.6	28.9	31.5	27.8	26.7	60.0	50.0
31 – 90	23.9	17.2	19.6	14.4	11.2	13.4	20.0	0
91 – 180	13.6	16.5	7.0	17.1	16.7	0	0	16.7
181 – 300	3.4	4.6	2.4	2.6	5.6	6.7	0	0
301 – 540	0	0	0.8	2.6	0	0	0	0
Median	30	30	15	30	20	10	30	22.5
32. Cycle at home	n=88	n=152	n=128	n=75	n=18	n=15	N=5	n=6
Yes	8.1	11.9	5.5*	8.0	22.2	26.7	40.0*	16.7
33. Cycling pace	n=7	n=18	n=7	n=6	n=4	n=4	N=2	n=1
Casual cycling	28.6	33.3	28.6	16.7	50.0	25.0	50.0	0
Fairly brisk	0	11.1	14.3	0	0	25.0	0	0
Brisk	0	0.	14.30	0	0	0	0	0
Fast	71.4	55.6	42.9	83.3	50.0	50.0	50.0	100.0
43. Watching television during leisure time	n=85	n=143	n=126	n=72	n=16	n=15	n=5	n=5
Yes	82.4	83.2	70.6	80.6	100.0	100.0	100.0	100.0
44. Other sitting activities	n=85	n=143	n=126	n=72	n=16	n=15	n=5	n=5
Yes	97.6	97.2	92.9	93.1	100.0	100.0	100.0	100.0
47. Duration walk or standing in leisure time (min)	n=53	n=66	n=94	n=40	n=12	n=8	N=4	n=4
3 – 5	13.3	0	5.4	2.5	8.3	0	0	0
6 – 15	3.8	15.3	1.1	5.0	0	0	0	0
16 – 30	11.4	12.1	9.6	12.5	8.3	25.0	0	0
31 – 60	15.1	15.2	29.8	24.5	41.6	25.0	50.0	0
61 – 150	37.5	31.8	30.9	32.5	0	37.5	50.0	50.0
151 – 240	18.9	21.2	18.1	15.0	33.3	12.5	0	50.0
241- 320	3.8	3.0	4.3	2.5	0	0	0	0
321 – 480	1.9	1.5	1.1	2.5	0	0	0	0
481 – 500	0	0	0	0	8.3	0	0	0
Median	120	120	120	90	60	90	90	
48. Other leisure time activities	n=84	n=140	n=125	n=70	n=16	n=15	N=5	n=5
Yes	2.4	5.7	2.4*	2.9	12.5	6.7	60.0*	20.0

Table 4.5 presents the leisure time activities of the women of Mangaung. As expected due to the high level of unemployment, most respondents sit at home (93,3-100%). The women only walk for short periods of time (median of 30 minutes) outside their homes, mostly to the shop or to a friend's house.

The more physical activite groups 5-8 cycle more at home. A statistically significant difference was found between the older HIV- women in terms of the percentage that cycled at home in the inactive compared to the normal to active groups. The women in the normal to active group (group 7) cycle more than the inactive group (group 3) [-71,6%; -5,8%]. Most of the women cycle fast, ranging from 42,9% in group 3 ($\geq$ 35 HIV -) to 100,0% in group 8 ($\geq$35 HIV+). A total of 70,6 – 100% of the women watch television during leisure time. Other leisure time sitting activities (playing cards and listening to the radio) were also reported. The duration of other walking or standing leisure activities, which were mostly church activities, was a median of 60- 120 minutes per day. The groups with lower physical activity have less other leisure time activities than group 5-8 who are more physically active.

4.3 Anthropometry

BMI, waist-hip-ratio and fat percentage were determined.

4.3.1 Body mass index

The median body mass index of HIV negative and HIV positive physically inactive and physically active women is indicated in table 4.6.

Table 4.6: Median BMI of HIV negative and HIV positive physically inactive and physically active women

	Median BMI (kg/m²)
Group 1: 25-34 years, HIV - Low physical activity (PA) (n=88)	27.18*
Group 2: 25-34 years, HIV + Low PA (n=152)	24.87*
Group 3: 35-44 years, HIV - Low PA (n=128)	24.98
Group 4: 35-44 years, HIV + Low PA (n=76)	25.58
Group 5: 25-34 years, HIV - Normal to high PA (n=18)	27.81
Group 6: 25-34 years, HIV + Normal to high PA (n=15)	22.12
Group 7: 35-44 years, HIV - Normal to high PA (n=5)	27.02
Group 8: 35-44 years, HIV + Normal to high PA (n=6)	22.41

The median BMI of the younger HIV negative women in group 1 (low physical activity) was 27.18 kg/m², thus falling within the overweight BMI category. In contrast, the BMI of the same group with HIV (group 2) was 24.87 27.18 kg/m², thus falling within the normal weight BMI category. This difference was significant (95% CI for the median difference: [0.91; 3.78]), indicating that the presence of HIV infection has a significant effect on BMI. Although no significant associations could be found between the BMI of the other groups (possibly due to the small number of respondents in the physically active groups 4-8), close to significant differences were found between groups 2 and 6 (CI [-0.55; 3.86]), and groups 5 and 6 (CI [-0.14; 7.19]).

In tables 4.7 and 4.8 BMI of HIV negative and HIV positive is described categorically.

Table 4.7: Body mass index of HIV negative physically inactive and physically active women

	Body mass index categories					
	<18.5 Underweight		18.5<25 Normal weight		≥25 Overweight and obese	
	N	%	N	%	N	%
25-34 yrs; Low physical activity (PA) (n = 88)	2	2.27	31	35.23	55	62.50
35-44 yrs; Low PA (n = 128)	4	3.13	60	46.88	64	50.0
25-34 yrs; Normal to High PA (n = 18)	0	0.00	7	38.89	11	61.11
35-44 yrs; Normal to High PA (n = 5)	0	0.00	2	40.00	3	60.00

Two hundred and thirty nine women were HIV negative. Of these, 106 (88 +18) were between 25 and 34 years old and 133 (128 + 5) were between 35 and 44 years old. The majority of women were physically inactive with only 23 women falling in the normal to high physical activity category. Of the younger, physically inactive women (n=88) 62.5% had a BMI ≥ 25 kg/m² indicating that they were overweight or obese. Of the younger physically active women (n=18), 60% also had a BMI ≥ 25 kg/m².

The percentage of older women with a BMI $\geq$ 25 kg/m² was high in both the physically active and normal to physically active groups. Once again, the small number of women in the normal to physically active group made comparisons difficult. Of the older physically inactive women (n=128), 50% had a BMI $\geq$ 25 kg/m². Of the older physically active women (n=5), 3 (60%) had a BMI $\geq$ 25 kg/m².

Two hundred and fourty eight women were HIV positive. Of these, 166 (151 + 15) were between 25 and 34 years old and 82 (76 + 6) were between 35 and 44 years old. As in the HIV negative group, the majority of HIV positive women were physically inactive with only 21 women falling in the normal to high physical activity category. Of the younger, physically inactive women (n=151) 49.0% had a BMI $\geq$ 25 kg/m² indicating that they were overweight or obese. Of the younger physically active women (n=15) fewer were overweight with only 26.7% having a BMI $\geq$ 25 kg/m².

Of the older physically inactive women (n=76), 56.6% had a BMI $\geq$ 25 kg/m². Of the older physically active women (n=6), only 1 (16.7%) had a BMI $\geq$ 25 kg/m².

Table 4.8: Body mass index of HIV positive physically inactive and physically active women

	Body mass index categories					
	<18.5 Underweight		18.5<25 Normal weight		≥25 Overweight and obese	
	N	%	N	%	N	%
25-34 yrs; Low physical activity (PA) (n = 151)	5	3.31	72	47.68	74	49.01
35-44 yrs; Low PA (n = 76)	5	6.58	28	36.84	43	56.58
25-34 yrs; Normal to High PA (n = 15)	0	0.00	11	73.33	4	26.67
35-44 yrs; Normal to High PA (n = 6)	0	0.00	5	83.33	1	16.67

Table 4.9: Waist-hip-ratio of women 25-34 years and 35-44 years.

	Waist-hip-ratio			
	<0.8		≥0.8	
Age group	N	%	N	%
25-34 years (n = 279)	233	83.5	46	16.5
35-44 years (n = 217)	136	62.7	81	37.3

4.3.2 Waist-hip-ratio (fat distribution)

Since waist-hip-ratio is not associated with BMI or HIV status, the waist-hip-ratio of the two age groups are given without taking these two variables into account (table 4.9).

The majority of younger women had a waist-hip-ratio below 0.8, indicating a gynoid fat distribution. Although fewer than the younger group, most women in the older group also had a gynoid fat distribution.

4.3.3 Fat percentage (body composition)

The fat percentage of HIV negative and HIV + women is given in table 4.10.

Table 4.10: Fat percentage of HIV negative and HIV positive women

	Mean fat %	Low <20%		Normal 20≤25%		High >25%	
Age group		N	%	N	%	N	%
25-34 years, HIV – (n = 106)	38.32*	1	1.0	4	3.8	101	95.3
25-34 years, HIV + (n = 167)	35.34*	2	1.2	12	7.2	153	91.6
35-44 years, HIV – (n = 133)	38.37		0.8		4.5		94.7
35-44 years, HIV + (n = 82)	38.86		0.0		1.2		98.8

The mean fat percentage of the HIV negative younger women was 38.32% compared to the 35.34% of the HIV positive women, thus a mean percentage difference of 2.98% which was found to be statistically significant (CI for mean difference [1.11; 4.85], $p<0.01$). In contrast to the younger group, the mean fat percentage of HIV negative and HIV positive older women did not differ significantly (CI for mean difference [-2.70; 1.72], $p = 0.66$).

In both the HIV negative and HIV positive younger and older women, more than 90% had a fat percentage above 25%.

Table 4.11: Median energy intake of HIV negative and HIV positive physically inactive and physically active women

	Median Energy intake (kJ)
Group 1: 25-34 years, HIV - Low physical activity (PA) (n=88)	10 349
Group 2: 25-34 years, HIV + Low PA (n=152)	12 072
Group 3: 35-44 years, HIV - Low PA (n=128)	10 847
Group 4: 35-44 years, HIV + Low PA (n=76)	10 090*
Group 5: 25-34 years, HIV - Normal to high PA (n=18)	10 927
Group 6: 25-34 years, HIV + Normal to high PA (n=15)	11 074
Group 7: 35-44 years, HIV - Normal to high PA (n=5)	11 771
Group 8: 35-44 years, HIV + Normal to high PA (n=6)	14 519*

4.4 Energy intake

The median energy intake of HIV negative and HIV positive physically inactive and physically active women is indicated in table 4.11.

In all 8 groups, the median intake was higher than the RDA for this age group of 9196kJ, ranging from 10 090kJ in group 4 to 14 519kJ in group 8. The energy intake of the women in group 4 (35-44 years, HIV + Low physical activity) was significantly lower than that of the women in group 8 (35-44 years, HIV + Normal to high physical activity) (CI for the median difference [-7857; -457]). Since the women in these groups were both older and HIV positive, the only difference was their level of physical activity. Thus the more physically active women had a higher energy intake than the physically inactive women. No significant associations could be found between the energy intake of the other groups (possibly due to the small number of respondents in the physically active groups 4-8).

In order to determine the percentage energy from the macronutrients, the median kilojoule intake of HIV negative and HIV positive women are given in table 4.12 for younger and table 4.13 for older women without taking physical activity into account.

Table 4.12: Energy and macronutrient intake of HIV+ (N = 167) and HIV- (N = 106) women 25-34 years of age

Nutrient		Median	% Energy from macronutrients	RDA	<67% of RDA
Energy (kJ)	HIV+	12024		9196 kJ	10.18
	HIV-	10447			14.15
Total protein (g)	HIV+	84.03	12	50g	1.80
	HIV-	75.49	12		8.49
Total CHO (g)	HIV+	350.17	50	130g	
	HIV-	315.39	51		
Total fat (g)	HIV+	101.33	32	<73g	
	HIV-	94.27	34		

Table 4.13: Energy and macronutrient intake of HIV+ (N = 82) and HIV- (N = 133) women 35-44 years of age

Nutrient		Median		RDA	<67% of RDA
Energy (kJ)	HIV+	10454		9196 kJ	12.20
	HIV-	11110			12.03
Total protein (g)	HIV+	70.64	11	50 g	6.10
	HIV-	80.28	12		6.02
Total CHO (g)	HIV+	311.57	51	130 g	
	HIV-	322.24	49		
Total fat (g)	HIV+	84.73	31	<73 g	
	HIV-	90.39	31		

When the macronutrients are viewed as a percentage of total energy intake, protein contributed between 11 and 12 %, carbohydrate between 49 and 51% and fat between 31 and 34 % of total energy. According to the new DRI's, this represents a prudent diet composition that is within the recommendations. However, when the total amount of macronutrients in gram is compared to the recommendations (RDA), it is clear that the median intake of all macronutrients exceeds recommendations (due to the higher total energy intake).

CHAPTER 5

DISCUSSION OF RESULTS

5.1 Introduction

Throughout history, balancing dietary energy intake and total energy expenditure (TEE) was accomplished unconsciously by most individuals because of the large component of occupation-related energy expenditure. Today, despite common knowledge that regular exercise is healthful, more than sixty percent of Americans are not regularly physically active, and 25 percent are not active at all (DHHS, 1996). The same trend has been reported in South Africa by Kruger (1999) and Lambert (1998). It seems reasonable to anticipate continuation of the current trend for reductions in occupational activity and other activities of daily life. Furthermore, in patients with HIV/AIDS, nutrition and physical activity can have a significant impact on quality of life and prognosis.

In the general population, low energy expenditure is a risk factor for weight gain. As previously mentioned, obesity is a multifactorial problem. Obesity results from an imbalance between energy intake and energy expenditure. The health risks associated with obesity include increased mortality, hypertension, cardiovascular disease, diabetes mellitus, gallbladder disease, some cancers, and changes in endocrine function and metabolism (NHLBI/NIDDK, 1998). The risk factors for becoming obese are not entirely understood but are thought to include genetics, food intake, physical inactivity, and some rare metabolic disorders (NHLBI/NIDDK, 1998).

In this chapter, possible reasons for research findings will be given, and where possible, results will be compared to similar studies.

5.2 Limitations of the study

Limitations experienced in the execution of the study will be discussed in the following sections.

5.2.1 Sample

Initially it was planned that an equal number of women (250) would be included in each group. This objective was not met. The community health worker who was involved in contacting the respondents asked the subject's age, while in the actual study identification documents were used to obtain the correct age of respondents. The younger sample thus consisted of 279 women, and the older sample consisted of 217 women. Four subjects were pregnant, and could not be included in the study. Since the number of respondents in the two age groups remained high, this limitation did not affect the results of the study.

5.2.2 Questionnaire

The original questionnaire was adjusted by changing the categories of the questions (never, seldom, sometimes, often and always) to time spent in minutes on each activity. The respondents could however not accurately recall the time spent on the activities they performed. This influenced the reliability of the questions answered in minutes and for this reason some of the questions related to time were excluded in the results on the grounds of reliability.

With the adjustment of the questionnaire the question on standing at work and at home were omitted. The question on sweating was not understood by the respondents who found it difficult to put into a time frame and thus these results were considered unreliable and omitted.

The results will be discussed according to physical activity, antropometry and dietary intake.

5.3. Physical activity

Energy expenditure by physical activity varies considerably between individuals, affecting the energy balance and the body composition by which energy balance and weight maintenance are achieved (Ballor and Keesey, 1991; Williamson et al., 1993). Indeed, physical inactivity is a major risk factor for development of obesity in children and adults (Astrup, 1999; Goran, 2001).

The energy expended for physical activity varies greatly among individuals as well as from day to day. In sedentary individuals, it dissipates less than half as much as is spent to sustain the BMR over 24 hours (BEE). In very active individuals, 24-hour energy expenditure can rise to twice as much as resting energy expenditure (Grund et al., 2001), while even higher expenditures occur among heavy laborers and some athletes.

Traditionally, the types of activities recommended for cardiovascular fitness are those of a prolonged endurance nature, such as bicycling, hiking, jogging and swimming. Sometimes the word "aerobic" is used as an alternative to describe such activities because integrated functions of lungs, heart, cardiovascular system and associated muscles are involved (NAIM, 2002). Energy expenditure for physical activity (EEPA) is the most variable component of TEE (Schoeller, 2001). The increase in energy expenditure elicited while physical activities take place accounts for the largest part of the effect of physical activity on overall energy expenditure, which is the product of the cost of particular activities and their duration.

In cross-sectional studies, there is a substantial difference in PAL between long-term exercising women and sedentary women. For example, Willet (1998) observed a mean PAL value of 2.48 in long-term active women reporting a mean 8.6 hours/week of aerobic exercise compared with a mean PAL value of 1.87 in non-exercisers. Intensive exercise programs such as those undertaken by subjects training to run a half-marathon and requiring 8 to 10 hours/week of strenuous exercise can also effect a substantial 15 to 50 percent increase in TEE in both adults and children (Eliakim et al., 1996; Goran et al., 1994; Westerterp et al., 1992). However, more moderate exercise programs are reported to have a much smaller effect (Goran and Poehlman, 1992; Treuth et al., 1998).

Spontaneous non-exercise activity has been reported to be quantitatively important, accounting for 100 to 700 kcal/day even in subjects residing in a whole body calorimeter chamber (Ravussin et al., 1986). Sitting without or with fidgeting raises energy expenditure by 4 to 54 percent respectively, compared to lying down (Levine et al., 2000), whereas standing motionless or while fidgeting raised energy expenditure by 13 or 94 percent, respectively. The impact of fidgeting was positively correlated with body weight while standing, but not while sitting. (For comparison, walking at speeds of 2 to 3 miles/hour increases energy expenditure by 150 to 230 percent, respectively). It is not known to which extent spontaneous non-exercise activity is affected by intentional physical activity and by its intensity. Shah et al. (1988) reported a five percent mean increase in 24-hour TEE with a program of moderate exercise (walking) compared with a three percent increase with an equivalent amount of strenuous aerobic training. This suggests that the subjects had lower levels of spontaneous movement after strenuous exercise because they were more tired. In contrast, Schulz et al. (1991) reported no difference in sedentary 24-hour TEE between aerobically fit and sedentary individuals (NAIM, 2002).

The effects of planned physical activity on activity at other times are highly variable (ranging from overall positive to negative effects on overall energy expenditure). This probably depends on a number of factors including the nature of the exercise (strenuous versus moderate), the initial fitness of the subjects, body composition, and gender (NAIM, 2002).

Cross-sectional studies consistently show that overweight and obese individuals have higher absolute values for TEE than non obese adults, as the effect of high RMR values associated with increased body size generally outweighs the influence of low energy expenditure for physical activity (EEPA)(Platte et al., 1995; Prentice et al., 1996; Schoeller and Field, 1991).

The efficiency with which energy from food is converted into physical work is remarkably constant, when measured under conditions where body weight and athletic skill are not a factor, for instance on bicycle ergometers (Pahud et al., 1980). For weight bearing physical activities, the cost is roughly proportional to body weight. In the life of most persons, walking represents the most significant form of physical activity, and many studies have been performed to determine the energy expenditures induced by walking or running at various speeds (NAIM, 2002).

The level of physical activity is commonly described by the ratio of total to basal daily energy expenditure (TEE/BEE). This ratio is known as the Physical Activity Level (PAL), or the Physical Activity Index (PAI). Describing physical activity habits in terms of PAL is not entirely satisfactory because the increments in energy expenditure brought about by most physical activities where body weight is supported against gravity (eg., walking, but not cycling on a stationery cycle ergometer) are directly proportional to body weight, whereas BEE is more nearly proportional to body weight. However, PAL is a convenient notion and it was used in this research to describe and account for physical activity habits.

5.3.1 Occupational status

As expected there was a very high rate of unemployment (60 –94,7%) among the women in Mangaung. The study population in Mangaung is considered to be an example of a typical developing community in transition from a traditional to an urban lifestyle. It is estimated that by 2010 more than 75% of South Africa's population will be urbanized which will mainly affect the black population. The rapid urbanization will inevitably lead to more unemployment (Mollentze et al., 1995; Bourne et al., 1993; Lambert et al., 2001a). South Africa has an unemployment figure of fourty percent and in an urbanized community the physical activity levels decrease daily (Lambert et al., 2001b). This phenomenon was also found among the women in Mangaung who have a very high rate of unemployment and low levels of physical activity.

5.3.2 Work activities at work

Most of the women were employed in light occupations and most of them live near public transport pick up areas, which take them to work. These results are the same as reported Sobngwi et al. (2002). This study characterizes urbanized individuals with low physical activity, light occupation and reduced walking and cycling time.

Increasing sedentary lifestyle is caused by an increased reliance on technology and labour saving devices, which reduce the need for physical exertion for everyday activities. Examples of these devices that have resulted in secular decline in PA include increased use of automated transport rather than walking or cycling (Goran & Treuth, 2001). According to King et al. (2001), when considering disease free adults above twenty years of age employed in high and low activity occupations, a high level of occupational activity is associated with a decreased likelihood of being obese. Avoiding sedentariness and lower levels of PA therefore is associated with normal weight (Llahti-Koski et al., 2001), and not contributing to the obesity epidemic (Steinbeck, 2001). Physical inactivity is recognized as a major risk factor for the so-called, non-communicable diseases such as hypertension, cardiovascular disease, diabetes and cancer (Pate et al., 1995). Wilber et al. (1999) showed that women in sedentary occupations have higher total cholesterol and lower HDL than those in active occupations despite similar leisure time and household chores.

5.3.3 Work activities at home

PA time and motion studies indicate that women spend a lot of their time in occupational, household and family care activities rather than recreational and conditioning activities (Ainsworth et al., 1999; Shaw, 1991). In contrast with our study, Ainsworth (2000) found that women spend about 3,9 hours per day on household and family care activities. These activities included indoor household chores, caring for children, and obtaining goods and services (Ainsworth, 2000). Ainsworth et al., (1999) reported that women could meet the recommended levels of physical by just being active at home. A study using the Minnesota Leisure Time Physical Activity to identify the impact of excluding household activities and energy expenditure of non-occupational activities among women found that the EE was 183 MET/min/day. McCarthy et al., (2002) also found that women are more active in household chores than in sport. However Schor (1992) reported that over the last thirty years household and family care activities have declined with 15% from 4,6 hours per day to 3,9 hours per day, while time in paid work increased with 27%. This leads to a decrease in time available for recreation and other leisure time activities. Barriers against participation in physical activity are lack of time, energy and family concerns (Jaffe et al., 1999). Young et al., (1998) reported that walking and occupational walking is important when determining activity status.

5.3.4 Sport activities

Traditionally, the types of activities recommended for cardiovascular fitness are those of a prolonged endurance nature, such as bicycling, hiking, jogging and swimming. Sometimes the word "aerobic" is used as an alternative to describe such activities because integrated functions of lungs, heart, cardiovascular system and associated muscles are involved (NAIM, 2002).

As expected, this study showed that physically normal to high activity groups participated in sport more than the low activity groups. A lack of facilities or interest may influence the participation in sport activities. Ainsworth (2000) reported that when asking about participation in exercise and sport 16% were defined as participating in regular activities. When the concept of physical activity participation was broadened including walking 38% women were active.

Ball et al. (2000) found that a lot of women feel too fat to exercise. This can also lead to lower levels of activity, especially among the older women.

5.3.5 Leisure time activities

Most of the women (70,6%-100%) sit during leisure time, watching television, listening to the radio or playing cards. Watching television is one of the biggest reasons for sedetariness (McCarthy, 2002; Goran & Treuth, 2001), and is associated with several biochemical makers for obesity and cardiovascular risk (Fung et al., 2000). Sable et al. (2002) found that sport is markedly negatively correlated with sport participation and positively to television viewing in children, suggesting that a decrease in PAL in free-living conditions seem to follow and not necessarily precede the development of obesity.

Increased concern for crime also reduced the level of outdoor activities (Lambert et al., 2001a; Goran & Treuth, 2001).

5.4 Anthropometry

The anthropometric results of BMI, WHR, and fat percentage assessments will be discussed in the following sections.

5.4.1 Body Mass Index

The prevalence of overweight and obesity in the studied group of women was an outstanding anthropometrical feature. Overweight and obesity occurred in 62,5 percent of the younger (25-34 years) HIV negative group with low levels of physical activity and in 61,1 percent of the same group with normal to high levels of physical activity. In the older (35-44 years) HIV negative groups with low physical activity, 50,0 percent were overweight or obese, while 60.0 percent of women with normal to high physical activity were overweight or obese.

Although still high, the prevalence of overweight and obesity in the HIV positive groups were lower than in the HIV negative groups (significantly in the younger women). In the younger HIV positive women in the low physical activity class, 49,0 percent were overweight and obese, while in the normal to high physical active group, 26.67 percent were overweight or obese. Immune impairment due to HIV/AIDS leads to malnutrition (which is starting to develop in this sample when compared to the HIV negative women), and malnutrition in turn leads to immune impairment, worsens the effect of HIV and contributes to a more rapid progression to AIDS.

Obesity figures *per se* ranged between 23.3 and 24 percent for these age groups, which was in contrast to findings from the QwaQwa-Mangaung study by Mollentze et al.

(1995), in which prevalences ranged from 31.1 percent to 54.3 percent in Mangaung women. Although our figures for women falling in the obese class were slightly lower than the figures reported by Mollentze et al. (1995), the percentage of women falling in the overweight category should also be a matter of concern, as overweight may eventually lead to obesity.

Statistics reported from the BRISK study performed on African women in the Cape Peninsula (Steyn et al., 1991) revealed that the mean percentage of African women with a BMI above thirty was found to be 30.6 percent, and 47.7 percent respectively for women of the same age groups used in our study. Data obtained from three other large South African studies on Coloured women in the CRISIC study (Steyn et al., 1990), Indian women (Seedat et al., 1982) and White women in the CORIS study (Jooste et al., 1988), were all lower than figures reported for African women.

Weight loss can in the short term reduce many of the health hazards associated with obesity, including insulin resistance, type 2 diabetes, cardiovascular disease, and hypertension, while in the long term, it might be associated with changes in longevity. The importance of a healthy lifestyle, including an increase in physical activity and a reduction in the total energy consumption, should therefore be propagated amongst these African women. Habitual physical activity plays more of a role in attenuating age related weight gain, rather than in promoting weight loss. Data suggested that increasing amounts of physical activity may be necessary to effectively maintain a constant body weight with increasing age (Dipietro, 1995).

5.4.2 Waist-Hip-Ratio

Visceral fat in women is defined as a WHR higher than 0.80 centimeters (Hammond, 2000, p. 372). In this study, most women in the various age groups had a waist-hip-ratio smaller than 0.80 centimeters, indicating a gynoid fat distribution. Mollentze et al. (1995), who studied the indigenous African populations of QwaQwa and Mangaung, found that a subgroup of obese persons with central or android obesity are at greater risk of developing cardiovascular disease. The mean waist-hip-ratio of women in both these populations, and for all age groups, exceeded 0.8 (Mollentze et al., 1995). A study performed in urban Africans in Cape Town however showed a mean WHR of 0.80 for women above the age of thirty years (Levitt et al., 1993). Similar results were obtained in a study on amongst others, obese black and white women by van der Merwe et al. (1999). Fat distribution is affected by a number of conditions, such as gender and ethnicity. Women in general have less central fat than men. This difference in genders might be an important contributor to the greater prevalence of diseases associated with central obesity in men compared with pre-menopausal women (Pi-Sunyer & Albu, 1999). A peripheral fat distribution shows relationships with less serious problems, such as joint disease and varicose veins due to mechanical problems associated with increased weight (Björntorp, 2001). Different ethnic groups might also accumulate abdominal fat differently as they gain weight (Pi-Sunyer & Albu, 1999). Conway et al. (1995) however reported WHR of 0.86 and 0.84 for black and white women respectively, indicating that there were no significant differences between races. Treatment of particularly women in the older age group, where 37.3 percent of respondents had WHR equal to, or exceeding 0.8 should receive high priority to decrease the risk of cardiovascular disease, type 2 diabetes, stroke, certain cancers, and premature mortality (Björntorp, 2001). An increase in physical activity will have a favorable effect on body fat distribution, resulting in a reduction in the WHR (Walker, 1995) and abdominal obesity (Björntorp, 2001; Ross & Janssen, 2001).

5.4.3 Fat Percentage

A matter that needs to be addressed urgently, is the total number of women who demonstrated extremely high fat percentages. Almost all the subjects had a fat percentage higher than the recommended twenty to 25 percent ranging from 91,6 percent in the younger HIV positive group to 98,8 percent in the older HIV positive group. The fat mass percentage of white and African obese women studied by van der Merwe et al. (1999), was reported as 42.1 and 45 percent respectively. Although it is difficult to compare the results, the figures reported by van der Merwe et al. (1999) also indicated fat percentages much higher than the normal percentage of twenty to 25 percent.

Although exercise in itself may not produce major weight losses, it helps to alter the body composition favorably by reducing fat, and increasing muscle. Increased physical activity is therefore a basic, necessary intervention (Caterson, 1998, pp. 267-268) to be taken on a national scale.

Malnutrition is a serious problem in HIV/AIDS, since timing of death is directly related to the degree of body mass depletion and loss of lean body mass and body fat mass. Although the younger HIV positive respondents in the study also had a mean fat percentage of 35.34%, which is much higher than the recommendation, this was significantly lower than the mean fat percentage (38.32%) of the HIV negative younger women. This indicates that loss of body fat mass had occurred as a result of the HIV infection.

5.5 Dietary intake

The mean energy intake of women in all age groups was markedly higher than the results obtained from other studies utilizing the food frequency questionnaire, in South Africa and overseas (Bingham et al., 1994; Bonifacj et al., 1997; Larkin et al., 1989; Stuff et al., 1983; Romieu et al., 1997; Vorster et al., 1999). A significant difference between the energy intake of rural and urban black women has been reported by Vorster et al. (1997), with urban women taking in more kilojoules than their rural counterparts. Although it is difficult to compare mean intake of nutrients obtained by means of other dietary assessment methods, the results of the total mean energy intake of this study also showed to be higher than a similar study performed on black women in South Africa, where the 24-hour recall method was used (Bourne et al., 1993). The tendency for persons to over-report low intakes, and to under-report high intakes of foods may be encountered with the latter method (Dwyer, 1998, p. 943; Hammond, 2000, p. 369; Lee & Nieman, 1996, p. 99; Pressman & Adams, 1990, p. 36).

5.5.1 Energy intake

The available data on whether diets high in total fat increase the risk for obesity is conflicting and is complicated by underreporting of food intake, notably fat intake (Bray and Popkin, 1998; Lissner and Heitmann, 1995; Lissner et al., 2000; Willett, 1998). Intervention studies have shown that high-fat diets, as compared to low-fat diets with equivalent energy intake, are not intrinsically fattening (Davy et al., 2001), whereas cross-cultural, animal, and some human studies have provided support for the theory that diets with a high percentage of fat increase the risk of obesity (Astrup et al., 1997; Lissner and Heitmann, 1995;). Other studies have shown that as the proportion of fat in the diet increases, so does energy intake (Kendall et al., 1991; Lissner et al., 1987; Stubbs et al., 1995).

Further studies have shown that fat content does not affect energy intake (Saltzman et al., 1997; Stubbs et al., 1996; van Stratum et al., 1978), and that energy density has an effect on energy intake independent of the fat content of the diet (Bell et al., 1998).

Over the last forty years, a growing body of evidence has accumulated regarding the relationships among consumption of dietary fat, carbohydrate, protein, and energy and risk of chronic disease. The data available to date regarding the relationships among major chronic diseases have been linked with consumption of dietary energy and macronutrients (fats, carbohydrates, fiber, and protein), as well as physical inactivity.

5.5.2 Macronutrient intake

The intake of the macronutrients protein, carbohydrate and fat will be discussed.

The mean figures for total protein intake for all age groups, indicate an intake that exceeded the RDA of fifty grams per day (Earl, 2000; p. 334). These high intakes of total protein has been observed to be the international tendency (Bingham et al., 1994; Bonifaci et al., 1997; Larkin et al., 1989; Stuff et al., 1983; Romieu et al., 1997). Vorster et al. (1997) reported from South African studies that the intakes of total protein of

Whites, Africans, Coloureds, and Indians were found to either meet, or exceed recommended intakes (Vorster et al., 1997). In this study, the mean intake of total protein for both age groups exceeded the mean intake of 71.2 grams per day total protein for urban African women (Vorster et al., 1997). This trend of high total protein intake may be ascribed to the fact that urbanisation is accompanied by the increased intake of animal protein typical of a more Western diet (Vorster et al., 1997). Diets become more diverse with urbanisation, with more people including meat and fish, milk, eggs and cheese into their habitual diet (Drewnowski & Popkin, 1997). The free availability of cheaper cuts of red meat, offal, sausage, chicken and chicken offal, could contribute to the high intake of total protein in this study.

The mean total carbohydrate intake of women of both age groups in this study not only exceed the RDA, but also mean intakes of this macronutrient in international studies (Bingham et al., 1994; Bonifaci et al., 1997; Larkin et al., 1989; Stuff et al., 1983; Romieu et al., 1997). In South Africa, Bourne et al. (1993) reported a considerably lower intake of carbohydrates in a similar study, where the 24-hour recall method of dietary assessment was used. Mean carbohydrate intakes were however reported to be higher for Africans and Coloureds by Vorster et al. (1997). Notwithstanding the high mean total carbohydrate intake, a staple diet of cereals and grains, typical of this study group, may have beneficial health effects (Venter & Silvis, 1990). Although the mean total arbohydrate intake of women of both age groups fell within the recommended fifty to sixty percent of the total energy intake per day, the total mean energy intake of women of both groups were too high, placing them at risk for developing chronic diseases, including obesity.

The mean total fat intake of women in both age groups was considerably higher than the recommended intake of less than 73 grams per day, and higher than results of fat intakes obtained from several overseas studies (Bingham et al., 1994; Bonifacj et al., 1997; Larkin et al., 1989; Stuff et al., 1983; Romieu et al., 1997). In South Africa, rural blacks follow a diet much lower in fat than urban blacks (Vorster et al., 1997). The typical African diet consists of 23 percent fat (Gresse et al., 1993), while in this study, fat made out 32 and 31 percent respectively for the young and older age group, of the total energy intake. These results compare favourably with reported results of approximately thirty percent fat intake by Vorster et al., (1997), MacIntyre, (1998), and Bourne et al., (1993). Saturated fat intakes of 30.8 grams and 26.7 grams per day for women in the younger and older age groups respectively, were higher than the recommended intake of less than 24 grams per day. These figures were higher than figures reported by Romieu et al. (1997), and Bourne et al. (1993), using the 24-hour recall method, but lower than figures reported by Bonifaci et al. (1997).

Central University of Technology, Free State

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

In this study of a community undergoing rapid epidemiological and demographic transition, high rates of physical inactivity and obesity were identified. The effect of the nutrition transition is also reflected in their diet with a very high energy intake.

As both lack of physical activity and obesity are now recognized as risk factors for several chronic diseases, logic requires that activity recommendations accompany dietary recommendations (DHHS, 1996). In terms of making a realistic exercise recommendation for busy individuals to maintain their weight, it is important to recognize that exercise and activity recommendations consider "accumulated" physical activity. Efforts should be directed at developing practical, yet reliable methods to assess habitual levels of physical activity.

6.2 Conclusions

The following conclusions evolved from this study:

6.2.1 Physical activity

- There is a very high rate of unemployment among the women
- The women have a very high prevalence of physical inactivity
- The women are more involved in household chores than sport

- Most of the women spend their time watching television during leisure time although some are engaged in gardening activities

6.2.2 Anthropometry

- The prevalence of overweight and obesity was an outstanding feature.
- Women in both age groups had a waist to hip ratio smaller than 0.80 centimeters, indicating a gynoid fat disribution.
- A matter that needs serious attention, is the total number of women who demonstrated extremely high fat percentages. Regardless of weight, almost all the subjects had a fat percentage higher than 25 percent.
- BMI and fat percentage of HIV positive younger women was significantly lower than that of HIV negative women with low levels of physical activity.

6.2.3 Dietary intake

- The mean energy intake of women in all age groups was high.
- The mean figures for total protein intake of all age groups, exceeded the DRI of fifty grams per day.
- The mean total carbohydrate intake of women in all age groups in the study exceeded the DRI.
- The mean total fat intake of women in all age groups was considerably higher than the recommended intake of less than 73 grams per day.

6.2.4 HIV infection

- Prevalence of HIV infection in this sample was very high, especially in the younger age group (25-34 years).

6.3 Recommendations

The rapid increase of the prevalence of obesity is the consequence of environmental factors (mainly overeating and physical inactivity) while genetic factors also play a role. Lifestyle modification on a population level requires a comprehensive, community based, integrated, multidisciplinary and multi-sectorial strategy. Dietary modification aimed at consumption of a more prudent diet together with higher levels of physical activity may be the optimum way of reducing obesity and its related diseases.

Increased mortality and morbidity associated with physical inactivity suggests that public health action is warranted. High medical costs attributed to physical inactivity justify increased attention to encouraging a more physically active lifestyle at a national and community level. The high direct and indirect costs are preventable (Macera & Pratt, 2000; Colditz et al., 1998). The success of a community-based lifestyle intervention programme is dependent on its acceptability, individualization, sensitivity, and sustainability and the degree to which the community adopts it (Levitt et al., 1999; Mc Carthy, 2002; Lambert, 2001).

Obesity should now be accorded the seriousness it deserves (Ravussin, 2000). Obesity is no longer an individual disorder, but a population based disorder. Education to increase the awareness of the consequences of obesity is necessary (Kalk, 2001).

Preventative education starts at childhood level, because behavior learned then is continued throughout life (Goran & Treuth, 2001). Development of reliable methods to measure dietary energy intakes in populations are needed.

Availability of energy dense, low fiber foods and the absence of physical active friendly structures may be blamed as the unfavourable external environment that is responsible for obesity. The focus should thus fall on changes in the food supply in the local area and a supportive environmental physical activity programme (Egger and Swinburn, 1997).

The dual role of exercise and diet must be emphasized for a healthy lifestyle. Physical inactivity is recognized as a major risk factor for chronic diseases of lifestyle, and increasing quality of life in HIV individuals. Thus physical activity is an ideal target for a public health intervention in this population group especially with the increasing numbers of HIV infections (Lambert et al., 2001; Ravussin, 1999; Saris, 1999). Leisure time activities should be encouraged, and sedentariness discouraged (Kalk, 2001). A recommended one hour of moderate intensity physical activity should be promoted (NAIM, 2002). Accessible, affordable physical activity facilities should be provided by local authorities. A good example of such intervention programmes include Community Health Intervention Programme (CHIPS) which is a privately funded physical activity programme initiated by a non profitable academic institution and a national insurance company in South Africa, and PATHWAYS, a church-based physical activity programme for weight loss in the USA (Lambert, 2001). A health promotion programme, with billboards providing health messages and pamphlets distributed by health workers and doctors (since they are perceived to be the most trusted source of information) at the clinics, with informative messages on physical activity, could provide educational messages to the community.

As there is a lack of data on physical activity in South Africa futher research is necessary to:

- Identify biological markers of risk of excess weight gain in children and young adults.
- Develop methods suitable for free-living population based studies or applications to measure physical activity levels in order to classify children and adults into sedentary, low active, active, and very active levels of physical activity.
- To determine whether and which dietary composition patterns facilitate permanent weight loss in adults and children.
- Develop recommendations for aerobic exercise training for HIV positive individuals, which will improve their aerobic capacity and muscle strength.

It is very important that these urban dwellers should be educated about the importance of the correct diet and sufficient physical activity to improve their general health. The development of a community-based, holistic, multidisciplinary programme aimed at changing lifestyles associated with disease, needs to be encouraged in Mangaung.

LIST OF REFERENCES

Atkinson, R.L. 1992. Treatment of obesity. Nutritional Reviews, 50(11):338–339.

Ainsworth, B.E., Jacobs, D.R., & Leon, A.S. 1993. Validity and reliability of self reported physical activity status: The Lipid Research Clinics Questionnaire. Medicine and Science in Sports and Exercise, 25(1):92-94.

Ainsworth, B.E. 2000. Issues in the Assessment of physical activity in women. Research Quarterly for Exercise and Sport, 71(2):37-42.

Albu, J.B., Curi, M., Shur, M., Murphy, L., Matthews, D.E., & Pi-Sunyer, F.X. 1999. Systemic resistance to the antilipolytic effect of insulin in black and white women with visceral obesity. American Journal of Physiology, 277(3)(part 1):551–560.

Astrup, A., Toubro, S., Raben, A., & Skov, A.R. 1997. The role of low-fat diets and fat substitutes in body weight management: What have we learned from clinical studies? Journal of American Dietetic Association, 97(Suppl 7):S82-S87.

Astrup, A. 1999. Macronutrient balances and obesity: The role of diet and physical activity. Public Health and Nutrition, 2(3A):341-347.

Astrup, A., Buemann, B., Western, D., Toubio, S., Raben, A. & Christensen, N.J. 1994. Obesity as an adaptation to a high fat diet: evidence from a cross-sectional study. American Journal of Clinical Nutrition, 59(2):350 – 355.

Babameto, G., & Kotler, D.P. 1997. Malnutrition in HIV infection. Gastroenterology, 26(2):393-415.

Baecke, J.A., Burema, J. & Frijiters, E.R. 1982. A short questionaire for the measurement of habitual physical activity in epidemiological studies. The American Journal of Clinical Nutrition, 36(5):936-942.

Ball, K., Crawford, D., & Owen, N. 2000. Too fat to exercise? Obesity as a barrier to physical activity. Australian and New Zealand Journal of Public Health, 24(3):331-333.

Ballor, D.L., & Keesey, R.E. 1991. A meta-analysis of the factors affecting exercise-induced changes in body mass, fat mass and fat-free mass in males and females. International Journal for Obesity, 15(1):717-726.

Barker, P.T. 1982. Why do Samoans grow so fat? New Scientist, 96:592-594.

Barnes-Josiah, D., Potter, J.D., Sellers, T.A., & Himes, J.H. 1995. Early body size and subsequent weight gain as predictors of breast cancer incidence. Cancer causes and control, 6(2):112–118.

Basset, D.R. 2000. Validity and reliability Issues in objective monitoring of physical activity. Research Quarterly for Exercise and Sport, 71(2):30-36.

Bell, E.A., Castellanos, V.H., Pelkman, C.L., Thorwart, M.L., & Rolls, B.J. 1998. Energy density of foods affects energy intake in normal-weight women. American Journal of Clinical Nutrition, 67(3):412-420.

Berlin, J.A., & Colditz, G.A. 1990. A meta-analysis of physical activity in the prevention of coronary heart disease. American Journal of Epidemiology, 132(4):612–628.

Biddle, S. 1995. Exercise and psychosocial health. Research Quarterly for Exercise and Sport, 66(4):292–297.

Bingham, S.A., Gill, C., Welch, A., Day, K., Cassidy, A., Khaw, K.T., Sneyd, M.J., Key, T.J., Roe, L., & Day, N.E. 1994. Comparison of dietary assessment methods in nutritional epidemiology: weighed records versus 24-hour recalls, food frequency questionnaires and estimated –diet records. British Journal of Nutrition, 72(4):619-643.

Birk, T.J. 1996. HIV and exercise. Exercise Immunology Review, 2 (March):84–95.

Björntorp, P. 1984. Hazards in subgroups of human obesity. European Journal of Clinical Investigation, 14(4)239–241.

Björntorp, P. 2001. Obesity – an overview of obesity as a disease with many risks for comorbidities. Continuing Medical Education, 19(8):552-556.

Blackard, W.G., Clore, J.N., Glickman, P.S., Nestler, J.E., & Kellum, J.M. 1993. Insulin sensitivity of splanchnic and peripheral adipose tissue *in vivo* in morbidly obese man. Metabolism, 42(9):1195–1200.

Bodystat R1 500 – Bodystat, Iste of man, Limited.

Bonifaci, C., Gerber, M., Scali, J., & Daures, JP. 1997. Comparison of dietary assessment methods in a Southern French population: use of weighed records, estimated-diet records and a food frequency questionnaire. European Journal of Clinical Nutrition, 51(4):217-231.

Booth, M. 2000. Assessment of physical activity: An International Perspective. Research Quarterly for Exercise and Sport, 71(2):114-120.

Bourne, L.T., Langenhoven, M.L., Steyn, K., Jooste, P.L., Laubscher, J.A., & Van der Vyver, E. 1993. Nutrient intake in the urban African population of the Cape Peninsula, South Africa. The BRISK study. The Central African Journal of Medicine, 3(4):238–246.

Bray, G.A. 1992. Obesity increases risk of diabetes. International Journal of Obesity, 16 (suppl):513–517.

Bray, G.A., & Popkin, B.M. 1998. Dietary fat intake does affect obesity! American Journal for Clinical Nutrition, 68(6):1157-1173.

Brown, W.T., Mishra, G., Lee, C., & Bauman, A. 2000. Research Quarterly for Exercise and Sport, 71(3):206–216.

Brownsell, V.L., Griffith, C.J., & Jones, E. 1992. Second Edition. Applied Science for Food Studies, England : Longman Group UK Limited

Caspersen, C.J., Powell,K.E., & Christenson, G.M. 1985. Physical activity exercise and physical fitness: definitions and distinctions for health related research. Public Health Report, 100:126-131.

Caterson, I. 1998. Overweight and Obesity. In: Mann, J. & Truswell, A.S. (ed.). Essentials of Human Nutrition. First Edition. Oxford University Press.

Chadha, S.L., Radhakrishan, S. Ramachandran, K., Kaul, U., & Gopinath, N. 1990. Epidemiological study of coronary hweart disease in urban population of Dehli. Indian Journal of Medical Research, 92:424-430.

Chilibeck, P.D., Sale, D.G., & Webber, C.E. 1995. Exercise and bone mineral density Sports Medicine,. 19(2):103–122.

Cimoch, P.J. 1997. Nutritional health: Prevention and treatement of HIV-associated malnutrition: A case Managers's Guide. Journal of International Physicians in AIDS Care(IAPAC), 3(5):28-40.

Colditz, G.A., Willett, W.C., Rotnitzki, A., & Manson, J.E. 1998. Weight gain as a risk factor for clinical diabetes in women. Annals of Internal Medicine, 122(7):481-486.

Committee on Medical aspects of food and nutrition policy (COMA Report). 1990. Dietary sugars and human disease : Conclusions. Department of Health and Social Subject. No 37. London : Her majesty's stationery office.

Conway, J.M., Yanovski, S.Z., Avila, N.A., & Hubbard, V.S. 1995. Visceral adipose tissue differences in black and white women. American Journal of Clinical Nutrition, 61(4):765-771.

Davy, K.P., Horton, T., Davy, B.M., Bessessen, D., & Hill, J.O. 2001. Regulation of macronutrient balance in healthy young and older men. International Journal for Obesity and Related Metabolic Disorders, 25(10):1497-1502.

De Boer, J.O., Van Es, A.J.H., Van Raaij, J.M.A., & Hautvast, J.G.A.J. 1987. Energy requirements and energy expenditure of lean and overweight women, measured by indirect calorimetry. American Journal of Clinical Nutrition, 46(1):13–21.

Department of Health, 2001. South African National Guidelines on Nutrition for People living with TB, HIV/AIDS and other Chronic Debilitating Conditions.

DHHS. 1996. Physical Activity and Health: A Report of The Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

DiPietro, L. 1995. Physical activity, body weight and adiposity: an epidemiologic perspective. Exercise and Sport Science Reviews, 23:275–303.

DiPietro, L. 1999. Physical activity in the prevention of obesity: current evidenceand research issues. Medicine and Science in Sports and Exercise, 31(11suppl):S542-546.

Dowse, G.K., Zimmet, P.Z., Gareeboo, H., Alberti, K.G.M.M., Tuomilehto, J., Finch, C.F., Chitson, P., & Tulsidas, H. 1991. Abdominal obesity and physical inactivity as risk for NIDDM and impaired glucose tolerance in Indian, Creole, and Chinese Mauritians. Diabetes Care, 14(4):271-282.

Drewnowski, A., & Popkin, B.M. 1997. The nutrition transition : New trends in the global diet. Nutrition Reviews, 55(2):31–43.

Drewnowski, A., & Garn, S.M. 1993. Pathophysiology of obesity. Lancet, 341(8836):55-56.

Dwyer, J.T. 1998. Dietary assessment. In : Modern nutrition in health and disease. Shils, M.E. Olsen, J.A. Shike, M., & Ross, A.C., (ed.). Ninth Edition. Philadelphia : Lea and Febiger.

Eaton, S.B., Konner, M., & Shostak, M. 1988. Stone agers in the fast lane : Chronic degenerative diseases in evolutionary perspective. American Journal of Medicine, 84(4):739–749.

Earl, R. 2000. Guidelines for Dietary Planning. In: Mahan, L.K. & Escott-Stump, S. (ed.). Krause's Food, Nutrition & Diet Therapy. Tenth Edition. Philadelphia: W.B. Saunders Company.

Edlin, G., Golanty, E., & Brown, K.M. 1999. Health and Wellness. Sixth Edition. Boston:Jones and Bartlett Publishers.

Egger, G., & Swinburn, B. 1997. An "ecological" approach to the obesity pandemic. British Medical Journal, 315(7106):477-480.

Eliakim, A., Barstow, T.J., Brasel, J.A., Ajie, H., Lee, W.N., Renslo, R., Berman, N., & Cooper, D.M. 1996. Effect of exercise training on energy expenditure, muscle volume, and maximal oxygen uptake in female adolescents. Journal for Pediatrics, 129(4):537-543.

Erikson, K. 1999. Physical exercise in the prevention of the metabolic syndrome. Diet and metabolic syndrome, August 26-28, 1999. Swedish Nutrition foundation and the Swedish Society of Medicine.

Evans, W.J., Roubenoff, R., & Shevitz, A. 1998. Seminar in Oncology, 2(6suppl):S112–S122.

Falkner, K.L., McCann, S.E., & Trevisan, M. 2001. Participant characteristics and quality of recall of physical activity in the distant past. American Journal of Epidemiology, 154(9):865-872.

FAO/WHO/UNU (Food and Agriculture Organization / World Health Organization / United Nations University). 1985. Energy and Protein Requirements. Report of a Joint FAO/WHO/UNU Expert consultation. Technical Report Series No. 724. Geneva, Switzerland: World Health Organization.

Fenton, M., & Silverman, E. 2000. Medical Nutrition therapy for Human Immunodeficiency Virus (HIV) infection and acquired Immunodeficiency Syndrome. AIDS. In : Mahan, L.K., & Escott-Stump, S. (ED) Krause's Food, Nutrition & Diet Therapy. Tenth Edition. Philadelphia : WB Saunders Company.

Flynn, M.A.T., & Gibney M.J. 1991. Obesity and health: why slim? Procedures Nutritional Society, 50(2):413–432.

FNB(Food and nutrition board). 1989. Recommended dietary allowances. Washington : National Academy Press. pp. 283-287.

Foreyt, J.P. 1997. An etiologic approach to obesity. Hospital Practice, 52(Aug):123–146.

Foreyt, J.P., & Walker, S.C.P. 1998. Obesity: A Never ending Cycle? International Journal of Fertility, 43(2):111-116.

Franz, M.J. 2000. Medical Nutrition Therapy for Diabetes Mellitus and Hypoglycemia of Nondiabetic origin. In: Mahan, L.K. & Escott-Stump, S. (Ed). Krause's Food, Nutrition & Diet Therapy. Tenth Edition. Philadelphia : W.B. Saunders Company.

Freedson, P.S., Melanson, E.R., & Sirard, J. 1998. Calibration of Computer Science and Applications Inc. accelerometer. Medicine and Science in Sports and Exercise, 30(5): 777–781.

Fung, T.T., Hu, F.B., Yu, J., Chu, N.F., Spiegelman, D., Tofler, G.H., Willet, W.C., & Rimm, E.B. 2000. Leisure-time physical activity, television watching, and plasma biomarkers of obesity and cardiovascular disease risk. American Journal of Epidemiology, 152(12):1171-1178.

Fussel, G.E., & Fussel, K.R. 1981. The English Country Women. London: Orbis Publishing.

Garcia-Lorda, P., Serrano, P., Jiménez-Exposito, M. J., Fraile, J., Bullò, M., Alonso, C., Boada, A.Q., Viciana, P., Gracia Luna, P.P., & Salas- Salvadò, J. 2000. Cytokine-driven inflammatory response is associated with the hypermetabolismof AIDS patients with opportunistic infections. Journal of Parental Enteral Nutrition, 24(6):317-322.

Gibson, S.A. 1996. Are high fat, high sugar foods and diets conductive to obesity? International Journal Food Science and Nutrition, 47(5):405–415.

Giovannucci, E., Colditz, G.A., Stampfer, M.J., & Willet, W.C. 1996. Physical activity obesity and risk of colorectal adenoma in women (United States). Cancer causes and control, 7(2):253–263.

Goplan, C. 1992. Nutrition in developmental transition of South-East Asia. SEARO Regional Health Paper 21. New Delhi : World Health Organisation.

Goran, M.I., Calles-Escandon, J., Poehlman, E.T., O'Connell, M., & Danforth, E. 1994. Effects of increased energy intake and/or physical activity on energy expenditure in young healthy men. Journal for Applied Physiology, 77(1):366-372.

Goran, M.I., & Poehlman, E.T. 1992. Endurance training does not enhance total energy expenditure in healthy elderly persons. American Journal of Physiology, 263(5):E950-E957.

Goran, M.I. 2001. Metabolic precursors and effects of obesity in children: A decade of progress. 1990 – 1999. American Journal for Clinical Nutrition, 73:158-171.

Goran, M.I., & Treuth, M.S. 2001. Energy expenditure, physical activity and obesity in children. Pediatrician Clinics of North America, 48(4):931-953.

Gracey, M., Spargo, R.M., Smith, P., Smith, R.M., Burke, V., Beilin, L.J., Beilby, J., & Chin, C. 1996. Risk factors for ill-health in a remote desert – dwelling. Aboriginal community in Western Australia. Australian and New Zealand Journal of Medicine, 26 : 171 – 179.

Gresse, A., Vorster, H.H., Dauth, J., Welgemoed, D.J. & Crowther, G. 1993. Effects of a typical African diet on metabolic control of black non-insulin dependent diabetes mellitus patients. The South African Journal of Food Science & Nutrition, 5(2):43–48.

Grinspoon, S., Corcoran, C., & Miller, K. 1998. Determinants of increased energy expenditure in HIV-infected women. American Journal of Clinical Nutrition, 68(5):720-725.

Grund, A., Krause, H., Kraus, M., Siewers, M., Rieckert, H., & Müller, M.J. 2001. Association between different attributes of physical activity and fat mass in untrained, endurance- and resistance-trained men. European Journal of Applied Physiology, 84(4):310-320.

Grunfeld, C., Pang, M. Shimizu, L., Shigenaga, J.K., Jensen, P., & Feingold, K.R. 1992. Resting energy expenditure, caloric intake, and short-term weight change in human immunodeficiency virus infection and the acquired immunodeficiency syndrome. American Journal of Clinical Nutrition, 55:455-460.

Gudat, U., Berger, M., & Lefebre, P. 1994. Physical activity fitness and non-insulin dependent (Type II) diabetes mellitus. In: Bouchard, C., Shephard R.J., & Stephens, R. (Eds) Physical activity fitness and health, pp 669 – 683. Champaign, I.L.: Human Kinetics.

Hammond, K.A. 2000. Dietary and Clinical Assessment. In: Mahan, L.K., & Escott-Stump, S. (ed). Krause's Food, Nutrition & Diet Therapy. Tenth Edition. Philadelphia: W.B. Saunders Company.

Hansen, J.D.L., Dunn, D.S., Lee, R.B., Becker, P.J., & Jenkins, T. 1993. Hunter gatherer to pastoral way of life: effects of the transition on health, growth and nutritional status. South African Journal of Science, 89(11):559–564.

Hays, L.M., & Clark, D.O. 1999. Correlates of Physical activity in a Sample of older adults with type 2 diabetes. Diabetes Care, 22(5):707-712.

Helmett, U., Shea, S., Herman, B., & Greiser, E. 1990. Relationship of social class characteristics and risk factors for coronary heart disease in West Germany. Public Health, 104(6):399–416.

Hoffman, M., Pick, W.M., Cooper., & Myers, E. 1997. Women's health status and use of health services in a rapid growing area of South Africa. Social Science and Medicine, 45(1):149-157.

Hulshoff, K.F., Lowik, M.R., Kok, F.J., Wedel, I., Brants, H.A., Ermus, R.J., & Hoor, F. 1991. Diet and other life-style factors in high and low socio-economic groups (Dutch Nutrition Surveillance System). European Journal for Clinical Nutrition, 45:441–450.

Insel, P., Turner, R.E., & Ross, D. 2001. Nutrition, Boston : Jones & Bartlett.

Jacobs, D.R., Ainsworth, A.E., Hartman, T.J., & Leon, A.S. 1993. A simultaneous evaluation of 10 commonly used physical activity questionnaires, Medicine and Science in Sports and Exercise, 25(1):81–91.

Jaffe, L., Lutter, J.M., Rex, J.,Hawkes, C., & Buccacio, P. 1999. Incentives and barriers to physical activity for working women. American Journal of Health Promotion, 13:215-218.

James, W.P.T., Bailes, J., Davies, H.L., & Dauncey, M.J. 1978. Elevated metabolic rates in obesity. Lancet, 1(8074):1122–1125.

Jequier, E., & Schutz, Y. 1983. Long-term measurements of energy expenditure in humans using a respiration chamber. American Journal of Clinical Nutrition, 38(6):989–998.

Johnson, R.K. 2000. Energy. In : Mahan, L.K. & Escott-Stump, S. (ed). Krause's Food, Nutrition & Diet Therapy. Tenth Edition. Philadelphia : W.B. Saunders Company.

Jones, S.P., Doran, D.A., Leat, P.B., Maher, B., & Piromohame, M. 2001. Short-term exercise training improves body composition and hyper lipidaemia in HIV positive individuals with lipodystrophy. AIDS, 15,October:2049–2051.

Jooste, P.L. Steenkamp, H.J., Benadè, A.J., & Rossouw, J.E. 1988. Prevalence of overweight and obesity and its relationto coronaryheart diseasein the CORIS study. South African Medical Journal, 74(3):101-104.

Kalk, W.J. 2001. Epidemiology of obesity: Where do we stand in terms of obesity in South Africa? Continuing Medical Education, 19(8):576 – 578.

Kanouse, D.E., Collins, R.L., Gifford, A.C. Senterfitt, J.W., Schuster, M.A., McCaffrey, D.F. Shapiro, M.F., & Winger, N.S. 2001. Changes in Health-promoting behaviour following diagnosis with HIV:Prevalence and correlates in a National Probability sample. Health Psychology, 20(5):351–360.

Kendall, A., Levitsky, D.A., Strupp, B.J., & Lissner, L. 1991. Weight loss on a low-fat diet: Consequence of the imprecision of the control of food intake in humans. American Journal of Clinical nutrition, 53(5):1124-1129.

Kennedy, E. 1994. Discussion – Maternal body mass index and pregnancy outcome in the Nutrition Collaborative Research Support Program. European Journal of Clinical Nutrition, 48 (suppl):S16-S18.

Central University of Technology, Free State

Key, S.W., Denoan, D.J., & Boyles, S. 1999. Combining exercise with male hormone therapy benefits men with HIV disease. AIDS Weekly Plus, April:6–7.

Kim, S., Moon, S., & Popkin, B.M. 2000. The nutrition transition in South Korea. American Journal of Clinical Nutrition, 71(1):44–53.

King, H., Aubert, R.E., & Herman, W.H. 1998. Global burden of diabetes, 1995 – 2025. Prevalence, numerical estimates, and projections. Diabetes Care, 21(9):1414–1431.

King, G.A., Fitzhugh, E.C., Basset,D.R., Mclaughlin, J.E., Strath, S.J., Swartz, A.M., & Thompson, D.L. 2001. Relationship of leisure-time physical activityand occupational activity to the prevalence of obesity. International Journal of Obesity and Related Metaboblic Disorders, 25(5):606-612.

Kohl, H.W., & McKenzie, J.D. 1994. Physical activity, fitness and stroke. In: Bouchard, C., Shephard, R.J., & Stephens, T. (Eds). Physical activity, fitness and health. Champaign, I.L.: Human Kinetics.

Kriska, A.M., & Caspersen, C.J. 1997. Introduction to a collection of physical activity questionnaires. In: Kriska, A.M. & Caspersen, C.J., eds. A collection of physical activity questionnaires for health-related research. Medicine and Science in Sports and Exercise, 29,(suppl):S5–S9.

Kruger, H.S. 1999. The puzzle of Obesity in African women: contributing factors and associated risk factors (Thesis) Potchefstroom PU for CHE, 1-210.

Kruger, H.S., Venter, C.S., Vorster, H.H., Greer, C.A., MacIntyre, U.E., & Matshego, L.R. 1999. Physical inactivity is an important contributing factor to obesity in Black women in the North West. South African Medical Journal, 89(4):463-465.

Kuczmarski, R.J. 1992. Prevalence of overweight and weight gain in the United States. American Journal of Clinical Nutrition, 55(suppl):4955–5025.

Kuczmarski, R.J., Flegal, K.M., Campbell, S.M., & Johnson, C.L. 1994. Increasing prevalence of overweight among US adults : the National Health and Nutrition Examination Surveys, 1960 – 1991. Journal of the American Medical Association, 272(3):205–211.

Kumanyika, S., Wilson, J.F., & Guildford-Davenport, M. 1993. Weight-related attitudes and behaviours of black women. Journal of the American Dietetic Association, 93(4):416–422.

Lambert, E.V. 1998. Weight reduction and management – research into practice. Continuing Medical Education Journal, 16(7):611–619.

Lambert, E.V., Bohlmann, I., & Hudson, K. 2001a. Physical activity for health: understanding the epidemiological evidence for rest benefits. International Sport Medical Journal, 2:1-5.

Lambert, E.V., Bolmann, I., & Kolbe – Alexander, T. 2001b. "Be Active" – Physical activity for health in South Africa. South African Journal of Clinical Nutrition. 14(3) Sept:35-39.

Langenhoven, M.L., Conradie, P.J., Wolmarans, P., & Faber, M. 1991. MRC food quantities manual, Second Edition. Parowvallei, South Africa: Medical Research Council.

Laquatra, I. 2000. Nutrition for Weight Management. In: Mahan, L.K. & Escott-Stump, S. (ED). Krause's Food, Nutrition & Diet Therapy. Tenth Edition. Philadelphia: W.B. Saunders Company.

Larkin, F.A., Metzner, H.L., Thompson, F.E., Flegal, K.M., & Guire, K.E. 1989. Comparison of estimated nutrient intakes by food frequency and dietary records in adults. Journal of the American Dietetic Association, 89(2):215-223.

Lathi-Koski, M.M., Pietinen, P .,Heliövaara, M., & Vartiainen, E. 2002. Associations of body mass index and obesity with physical activity, food choices, alcohol intake, and smoking in the 1982-1997 FINRISK studies. American Journal of Clinical Nutrition, 75(5):809-817.

Lee,I.M. 1995. Exercise and physical health: cancer and immune function. Research Quarterly for Exercise and Sport, 66:286-291.

Lee, R.D. & Nieman, D.C. 1996. Nutritional Assessment. Second Edition. McGraw Hill Companies.

Levine, J.A., Schleusner, S.J., & Jensen, M.D. 2000. Energy expenditure of nonexercise activity. American Journal for Clinical Nutrition, 72(6):1451-1454.

Levitt, N.S., Katzenellenbogen, J.M., Bradshaw, D., Hoffman, M.N., & Bonnici, F. 1993. The prevalence and identification of risk factors for NIDDM in urban Africans in Cape Town, South Africa. Diabetes Care, 16(4):601–607.

Levitt, N.S., Steyn, K., De Wet, T., Morrel, C., Edwards, R., & Ellison, G.T.H. 1999. An inverse relation between blood pressure and birth weight among 5 year old children form Soweto. South Africa Journal of Epidemiology and Community Health, 53(5):264-268.

Lissner, L., & Heitmann, B.L. 1995. Dietary fat and obesity: Evidence from epidemiology. European Journal of Clinical Nutrition, 49(2):79-90.

Lissner, L., Heitmann, B.L., & Bengtsson, C. 2000. Population studies of diet and obesity. British Journal of Nutrition, 83(suppl1):S21-S24.

Lissner, L., Levitsky, D.A., Strupp, B.J., Kalkwarf, H.J., & Roe, D.A. 1987. Dietary fat and the regulation of energy intake in human subjects. American Journal of Clinical Nutrition, 46(6):886-892.

Locard, E., Mamelle, N., Billete, A., Miginiac, M., Munoz, F., & Rey, S. 1992. Risk factors of obesity in a five year old polpulation. Parental versus environmental factors. International Journal of Obesity, 16:721-729.

Lox, C.L., McAuley, E., & Tucker, R.S. 1995. Exercise as an intervention for enhancing subjective well being in a HIV-1 population. Journal of Sport and Exercise Psychology, 17(4):345-362.

Lunes, R.F. & Monteiro, C.A. 1993. The improvement in child nutritional status in brazil: How did it occur? Geneva: United Nations Administrative Committee on Coordination, Subcommittee on Nutrition.

Macallan, D.C., Noble, C., Baldwin, C., Jebb, S.A., Prentice, A.M., Coward, W.A., Sawyer, M.B., Mcmanus, T.J., & Griffin, G.E. 1995. New England Journal of Medicine, 333(2):83–88.

Macera, C.A., & Pratt, M. 2000. Public Health Surveillance of Physical Activity. Research Quarterly for Exercise and Sport, 71(2):97-103.

Mahan, L.K., & Arlin, M.T. 1992. Krause's food, nutrition and diet therapy. Philadelphia : W B Saunders Company.

MacIntyre, U.E. 1998. Dietary intakes of Africans in transition in the North-West Province(Dissertation) Potchefstroom PU for CHE, 1-542.

Marin, P., Andersson, B., Ottosson, M., Olbe, L., Chowdhury, B., Kvist, H., Holm, G., Sjöström, L., & Björntorp, P. 1999. The morphology and metabolism of intra-abdominal adipose tissue in men. Metabolism, 41(11):1242-1248.

Martinsen, E., & Stephens, T. 1994. Exercise and mental health in clinical and free-living populations. In: Dishman, R.K. (Ed) Advances in exercise adherence. Champaign, I.L.: Human Kinetics.

Masse, L.C. 2000. Reliability, validity, and methodological issues in assessing physical activity in a cross-cultural setting. Research Quarterly for Exercise and Sport, 71(2):54-58.

Matsuzawa, Y. 1995. Pathogenesis of visceral obesity. Obesity Research, 3(2):1875-1945.

McArdle, W.D., Katch, F.I., & Katch, V.L. 1996. Exercise Psychology. Fourth edition. London: Williams & Wilkins.

McCarthy, S.N., Gibney, M.J. & Flynn, A. 2002. Overweight, obesity and physical activity levels in Irish adults: evidence from the North/South Ireland food consumption survey. Proceedings of the Nutrition Society, 61(1):3-7.

McDonald, D.G., & Hodgdon, J.A. 1991. Psychological effects of aerobic fitness training. New York : Springer-Verlag.

Melchior, J.C., Salmon, D., Rigaud, D., Leport, C., Bouvet, E., Detruchis, P., Vilde, J.L., Vachon, F., Coulaud, J.P., & Apfelbaum, M. 1991. Resting energy expenditure is increased in stable, malnourished HIV-infected patients. American Journal of Clinical Nutrition, 53(2):437-441.

Melchior, J.C., Raguin, G., & Boulier, A. 1993. Resting energy expenditure in human immunodeficiency virus-infected patients: comparison between patients with and without secondary infections. American Journal of Clinical Nutrition, 57(4):614-619.

Mifflin, M.D., St Jeor, S.T., Hill, L.A., Scott, B.J., Gaugherty, S.A.,& Koh, Y.O. 1990. A new predictive equation for resting energy expenditure in healthy individuals. American Journal of Clinical Nutrition, 51(2):241–247.

Mitchell, B.D., Blangero, J., Comuzzie, A.G., Almasy, L.A., Shuldiner, A.R., Silver, K., Stern, M.P., Maccluer, J.W., & Hixson, J.E. 1998. Paired sibling analysis of the Beta-3 adrenergic receptor and obesity in Mexican Americans. Journal of Clinical Investigation, 101(3):584–587.

Mollentze, W.F., Moore, A.J., Moore, A.J., Steyn, A.F., Joubert, G., Steyn, K., Oosthuizen, G.M., & Weich, D.J.V. 1995. Coronary heart disease risk factors in a rural and urban Orange Free State black population, South African Medical Journal, 3(4):90–96.

MRC, (2001). HIV: The greatest threat to the African Renaissance [Internet] 32 (4). Medical Research Council of South Africa, Tygerberg, South Africa. Available from: <http://www.mrc.ac.za/mrcnews/sep2001/hiv.htm> [Accessed 7 March 2002].

Musaiger, A.O. 1992. Diabetes mellititus in Bahrian: An overview. Diabetes Medicine, 9(6):574-578.

Mustafa, T., SY, F.S., Macera, C.D., Thompson, S.J., Jackson, K.L., Selassie, A., Dean, L.L. 1999. Annals of Epidemiology, 9(2):127–131.

Mutrie, N. & Biddle, S.J.H. 1995. The effect of exercise on mental health in non-clinical populations. In: Biddle, S.J.H. (Ed). European perspectives on exercise and sport psychology. Champaign, I.L.: Human Kinetics.

NAIM(National Academies Institute of Medicine). 2002. Dietary reference intake for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids. Washington: The national academics press.

Neel, J.V. 1962. Diabetes Mellitus: A "thrifty" genotype rendered detrimental by "progress"? American Journal of Human Genetics, 14;353–362.

Nelson, M. 2000. Methods and validity of dietary assessment. In : Human Nutrition and Dietetics. Garrow, J.S., James, W.P.T., & Ralph, A. (Ed). Tenth Edition. Edinburgh: Churchill Livingstone.

NICDAM(National Institute Community Development and Management). 2000. HIV/ AIDS in the working environment. First edition.

NHLBI/NIDDK (National Heart, Lung, and Blood Institute/National Institute of Diabetes and Digestive and Kidney Diseases). 1998. Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. The Evidence Report. NIH Publication No. 98-4083. Bethesda, MD: National Institutes of Health.

Nieman, D.C., & Pedersen, B.K. 1999. Exercise and immune function : recent developments. Sports Medicine, 7(2):73–80.

Norton, K., & Olds, T. 1996. Anthropometrica. A textbook ofbody measurements for sports and health courses. Sydney: University of New South Wales Press.

Olshansky, S.J., & Ault, A.B. 1986. The fourth stage of the epidemiology transition : the age delayed degenerative diseases. Milbank Memorial Fund Quarterly, 64(5):355–391.

Omran, A.R. 1971, The epidemiologic transition : a theory of the epidemiology of population change. Milbank Members Fund Questionnaire 49(4):509–538.

Oshaung, A. 1991.Towards nutrition security. Presented at the International Conference on Nutrition, Oslo, Norway.

Pahud, P., Ravussin, E., & Jequier, E. 1980. Energy expended during oxygen deficit period of submaximal exercise in man. Journal of Applied Physiology, 48(5):770-775.

Pate, R.R., Pratt, M., & Blair, S.N. 1995. Physical activity and public health : a recommendation from the Centres of Disease Control and Prevention and the American College of Sports Medicine. Journal of the American Medical Association, 273(5):402–407.

Pate, R.R., Pratt,. M.M., & Blair, S.N. 1995. Physical activity level and other lifestyle characteristics with mortality among men. New England Journal of Medicine, 328 (8):538-545.

Phaffenbarger, R.S., Hyde, R.T., Wing, A.L., Lee, I.M., Jung, D.L., & Kampert, J.B. 1993. The Association of changes in physical activity level and other lifestyle characteristics with mortality among men. New England Journal of Medicine, 328:538–545.

Pereira, M.A., Fitzgeral, S.J., Gregg, E.W., Joswiak, M.L., Ryan, W.J., Suminski, R.R., Utter, A.C.,& Zmuda, J.M. 1997. Baecke questionnaire of habitual physical activity. In: Kriska, A.M., & Caspersen, C.J., eds. A collection of physical activity questionnaires for health-related research. Medicine and Science in Sports and Exercise, 29(6suppl):S5–S9.

Peters, C., Lötzerich, H., Niemeier, B., Schüte, K., & Uhlenbruck, G. 1994. Influence of moderate exercise training on natural killer cytotoxicity and personality traits in cancer patients. Anti-cancer Research, 14(3A):1033–1036.

Pi-Sunyer, F.X., & Albu, J. 1999. Fat distribution and health risks in differing racial/ethnic groups. Paper presented at the 21st International Symposium of the Swedish Nutrition Foundation. August 26 – 28 1999, Ystad, Sweden.

Pi-Sunyer, F.X. 1993. Medical hazards of obesity. Annals of Internal Medicine, 119(7 Part 2):655–660.

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. Academy for Educational Development. Washington DC:

Platte, P., Pirke, K.M., Wade S.E., Trimborn, P., & Fichter, M.M. 1995. Physical activity, total energy expenditure, and food intake in grossly obese and normal weight women. International Journal for Eating Disorders, 17(1):51-57.

Poehlman, E.T.1989. A review: exercise and its influence on resting energy metabolism in man. Medicine and Science in Sports and Exercise, 21:515-525.

Pollard, L. 1995. Nutrition in Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS). Australian Journal of Nutrition and Dietetics, 52(2):104-105.

Pols, M.A., Peeters, P.J.M., & Bueno-De Mesquita, H.B. 1995. Validity and repeatability of a modified Baecke questionnaire and physical activity. International Journal of Epidemiology, 24(2):381–388.

Popkin, B.M. 1993. Nutritional patterns and transitions. Population Development Review, 19(1):138–157.

Popkin, B.M. 1994. The nutrition transition in low-income countries : an merging crisis. Nutrition Reviews, 52(9):285–298.

Popkin, B.M., & Doak, M. 1998. The obesity epidemic is a worldwide phenomenon. Nutrition Reviews, 56(4):106-114.

Popkin, B.M., Haines, P.S., & Reidy, K.C. 1989. Food consumption trends of US women: patterns and determinants between 1977 and 1989, Obesity Research, 49:1307–1319.

Prentice, A.M. 2000. Epidemic Obesity and Diabetes in Developing Countries. Paper presented at The Congress of the South African Sugar Association, February 24 2000, Pretoria .

Prentice, A.M., Black, A.E., Coward, W.A., & Cole, T.J. 1996. Energy expenditure in overweight and obese adults in affluent societies: an analysis of 319 doubly-labelled water measurements. European Journal of Clinical Nutrition, 50(2):93-97.

Pressman, A.H., & Adams, A.H. 1990. Clinical Assessment of Nutritional Satus – A Working Manual. Second Edition. Baltimore : Williams & Wilkins.

Price, R.A., Lunella, K., Ness, R., Charles, A., Saad, M.F., Ravussin, E., Bennet, P.H., Pettitt, D.J., & Knowler, W.C. 1992. Obesity in Pima Indians. Distribution characteristics and possible thresholds for genetic studies. International Journal of Obesity, 16(11):851–857.

Ravussin, E., Lillioja, S., Anderson, T.E., Christin, L., & Bogardus, C. 1986. Determinant of 24-hour energy expenditure in man. Methods and results using a respiratory chamber. Journal of Clinical Investment, 78(6):1568-1578.

Ravussin, E. 2000. Metabolic predictors of weight gain. Paper presented at the symposium "Obesity in Poverty and Affluence", hosted by the South African Sugar Association, CSIR, Pretoria, February 2000.

Romieu, I., Hernandez-Avila, M., Rivera, J.A., Ruel, M.T., & Parra, S. 1997. Dietary studies in countries experiencing a health transition: Mexico and Central America. American Journal of Clinical Nutrition, 65(4suppl):S1159-S1165.

Ross, R.,& Janssen,I. 2001. Physical activity, total and regional obesity: dose response considerations. Medicine and Science in Sports and Exercise, 33(6):S521-S529.

Roubenoff, R., McDermot, A., Weiss, L., Suri, J., Wood, M., Bloch, R., & Gorbach, S. 1999. Short-term progressive resistance training increases strength and lean body mass in adults infected with human immunodeficiency virus. AIDS, 13(2):231–239.

Salbe, A.D., Weyer, C., Harper, I., Lindsay, R.S., & Ravussin, E. 2002. Assessing risk factors for obesity between childhood and adolescence. Pediatrics, 110(2P1): 307-314.

Sallis, J.F. & Owen, N. 1997. Ecological models. In: Glanz, K., Lewis, F.M. & Rimer, B.K. (Eds). Health behavior and health education: Theory research and practice. Second edition. San Fransica: Jassey – Bass.

Saltzman, E., Dallal, G.E., & Roberts, S.B. 1997. Effect of high-fat and low-fat diets on voluntary energy intake and substrate oxidation: Studies in identical twins consuming diets matched for energy density, fiber, and palatability. American Journal of Clinical Nutrition, 66(6):1332-1339.

Saris, W.H.M. 1998. Fit, Fat and Fat Free: The metabolic aspects of weight control. International Journal of Obesity and Related Disorders, 2 (suppl2):S15-S21.

Saris, W.H.M. 2000. Physical activity in the management of obesity. Paper presented at the symposium "Obesity in Poverty and Affluence", hosted by the South African Sugar Association, CSIR, Pretoria, February 2000.

Schoeller, D.A., & Field, C.R. 1991. Human energy metabolism: What we have learned from the doubly labelled water method? Annual Nutrition Review, 11:355-373.

Schoeller, D.A. 2001. The importance of clinical research: The role of thermogenesis in human obesity. American Journal of Clinical Nutrition, 73(3):511-516.

Schor, J.B. 1992. The overworked American. New York.Harper Collins.

Schulz, L.O., Nyomba, B.L., Alger, S., Anderson, T.E., & Ravussin, E. 1991. Effect of endurance training on sedentary energy expenditure measured in a respiratory chamber. American Journal of Physiology, 260(2 part 1):E257-E261.

Seale, J.L., & Rumpler, W.V. 1997. Comparison of energy expenditure measurements by diet records, energy intake balance, doubly labelled water and room calorimetry. European Journal of Clinical Nutrition, 51(12):856–863.

Seedat, Y.K., Seedat, M.A., & Hackland, D.B.T. 1982. Biosocial factors and hypertension in urban and rural Zulus. South African Medical Journal, 61(26):999–1002.

Seidell, J.C. 1995. Obesity in Europe. Obesity Research, 3(suppl 2):S89–S93.

Seidell, J.C. 1998. Dietary fat and obesity: An epiodemiologic perspective. American Journal of Clinical Nutrition, 67(suppl 3):S546-S550.

Seidell, J.C. 1999. Obesity, insulin resistance and diabetes – a worldwide epidemic? Paper presented at the 21st International Symposium of the Swedish Nutrition Foundation, August 26 – 28, 1999, Ystad, Sweden.

Selberag, O., Süttmann, U., Melzer, A., Deicher, H., Müller, M.J., Henkel, E. & McMillan D.C. 1995. Effect of increased protein intake and nutritional status on whole-body protein metabolism of AIDS patients with weight loss. Metabolism, 44:1159-1165.

Shah, M., Geissler, C.A., & Miller, D.S. 1988. Metabolic rate during and after aerobic exercise in post-obese and lean women. European Journal for Clinical Nutrition, 42(6):455-464.

Shaw, S. M. 1991. Women's leisure-time – Using time budget data to examine current trends and future predictions. Leisure Studies, 10:71-181.

Shephard, R.J. 1995. Physical activity health and well-being at different life stages. International Journal of Sports medicine, 66(4):298–302.

Shephard, RJ. 1996. Exercise and cancer: Linkages with obesity? Critical Reviews on Food Science and Nutrition, 36(4):321-339.

Shephard, R.J. 1998. Exercise, immune function and HIV infection. Journal of Sports Medicine and Physical Fitness, 38(2):101–110.

Shephard, R.J., & Shek, P.N. 1994. Potential impact of physical activity and sport on the immune system a brief review. British Journal of Sports Medicine, 28(4):255–257.

Sichieri, R., Coitinho, D.C., Leao, M.M., Recine, E., & Everhart, J.E. 1994. High temporal, georgraphic, and income variation in body mass index among adults in Brazil. American Journal for Public Health, 84(5):793 – 798.

Sizer, F., & Whitney, E. 1998. Nutrition concepts and controversies. Eighth edition. Belmont: Wadsworth/Thomas Learning.

Slattery, M.L., & Randall, D.E. 1988. Trends in coronary heart disease mortality and food consumption in the United States between 1909 and 1980. American Journal of Clinical Nutrition, 47(6):1060–1067.

Sobal, J., & Stunkard, A.J. 1989. Socio-economic status and obesity : a review of the literature, Psychology Bulletin, 105:260–275.

Sobngwi, E., Mbanya, J.C., Unwin, N.C., Kengne, A.P., Fezeu, L. Minkoulou, E.M., Aspray, T.J. & Alberti,K.G. 2002. Physical activity and its relationship with obesity, hypertension and diabetes in urban and rural Cameroon. International Journal of Obesity and Metabolic Disorders, 26(7):1009-1016.

Solomon, N.W., & Rainer, G. 1995. Urban nutrition in developing countries. Nutrition Reviews, 35:90-95

Sparling, P.B., Noakes, T.D., Steyn, K, Jordaan, E., Jooste, P.L., Bourn, L.T, & Badenhorst, C. 1994. Medical Journal and Exercise, 26(7):896 – 902.

Stephen, A.M., & Wald, M.J. 1990. Trends in individual consumption of dietary fat in the United States, 1920 – 1984. American Journal of Clinical Nutrition, 52(3):457–469.

Steinbeck, K.S. 2001. The importance of physical activity in the prevention of overweight and obesity in childhood: a review and a opinion. Obesity Review, 2(2):117-130.

Steyn, K., Fourie, J., & Bradshaw, D. 1992. The impact of chronic disease of lifestyle and their major risk factors on mortality in South Africa. South African Medical Journal, 82(4): 227-231.

Steyn, K., Jooste P.L., & Bourne, L. 1991. Risk factors for coronary heart disease in Black population of the Cape Peninsula: The BRISK Study. South African Medical Journal, 79(8):480–485.

Steyn, K., Steyn, M., Langenhoven, M.L., Rossouw, J.F., & Fourie, J. 1990. South African Medical Journal, 78(2):45-50

Steyn, N.P. & Walker, A.R.P. 2000. Nutritional status and food security in Sub-Saharan Africa: Predictions for 2020. Asia Pacific Journal of Clinical Nutrition, 9(1):1-6.

Strawbridge, W.J., Deleger, S., Roberts, R.E., & Kaplan, G.A. 2002. American Journal of Epidemiology, 156(4):328-330.

Stringer, W.W. 1999. HIV and aerobic exercise : current recommendations. Sports Medicine, 28(6):389–395.

Stringer, W.W. 2001. The role of aerobic exercise for HIV positive / AIDS patients. International Sports Medical Journal Campaign, 1(5):20-21.

Stringer, W.W., Berezoskaya, M. O'brien, W.A., Beck, C.K., Casaburi, R. 1998. Medicine and Science in Sports and Exercise, 30(2):11–16.

Stubbs, R.J., Harbron, C.G., & Prentice, A.M. 1996. Covert manipulation of the dietary fat to carbohydrate ratio of isoenergetically dense diets: Effect on food intake in feeding men ad libitum. International Journal for Obesity and Related Metabolic Disorders, 20:651-660.

Stubbs, R.J., Ritz, P., Coward, W.A., & Prentice, A.M. 1995. Covert manipulation of the ratio of dietary fat to carbohydrate and energy density: Effect on food intake and energy balance in free-living men eating ad libitum. American Journal of Clinical Nutrition, 62(2):330-337.

Stuff, J.E., Garza, C., Smith, E.O., Nichols, B.L., Montandon, C.M. 1983. A comparison of dietary methods in nutritional studies. American Journal of Clinical Nutrition, 37(2):300-306.

Szmedra, L., Lemura, L.M., & Shearn, W.M. 1998. Exercise tolerance, body consumption and blood lipids in obese African-American women following short-term training. Journal of Sports Medicine and Physical Fitness, 38(1):59–65.

TAC Statement, (June 2001). Meeting with Minister of Health reveals serious divisions [Internet] [s.l. : s.n.] Available from: <http://www.tac.org.za/newsletter/ns010612.txt> [Accessed 22 February 2002].

Tamphaichitr, V., Kulapogse, S., Pakpeankitvatana, R., Leelahagul, P., Tamwiwat, C., Lochaya, S. 1991. Prevalance of obesity and its associated risks in urban Thais. Progress in obesity research. London: Libbey.

Terry, L., Sprinz, E., & Ribeiro, J.P. 1999. Moderate and high intensity exercise training in HIV-1 Seropositive individuals: a randomized trial. International Journal of Sports Medicine, 20 (2):142–146.

Thune, I., Brenn, T., Lund, E., & Goard, M. 1997. Physical activity and the risk of breast cancer. New England Journal of Medicine, 336(18):1269–1275.

Treuth, M.S., Hunter, G.R., Pichon, C., Gigueroa-Colon, R., & Goran, M.I. 1998. Fitness and energy expenditure after strength training in obese prepubertal girls. Medicine and Science in Sports and Exercise, 30:1130-1136.

Trowel, H. 1995. Obesity in the Western World. Plant Foods for Man, 1:157–168.

Tuffrey, V.R., Strickland, S.S., Ulijeszek, S.J. & Guring, G.M. 1995. Body mass Index, body composition and age in rural Nepali men and women. Proceedings of Nutritional Society. 54:84A

USAID, 2001. HIV/AIDS: A Guide For Nutrition, Care and Support. Food and Nutrition Technical Assistance Project, Academy for Educational Development. Washington DC.

UNAIDS/WHO (2001). AIDS Epidemic update December 2001 [Internet] UNAIDS,New York. Available from: <http://www.unaids.org/epidemic_update/report_dec01/index.html> [Accessed 14 May, 2002].

Van der Merwe, M-T., Panz, V.R., Crowter, N.J., Schlaphoff, G.P., Gray, I.P., Froguel, P., Joffe, B.I., & Lönnroth, P.N. 1999. Free fatty acids and insulin levels – relationship to leptin levels and body composition in various patient groups from South Africa. International Journal of Obesity, 23(9):909-917.

Van Heerden, M., & Joubert, G. 2002.The effect of physical activity on the activity participation of psychotic patients. South African Journal of Occupational Therapy, 32 (1):2–5.

Van Itallie, T.B., & Simopoulos, A.P. 1993. Summary of the National Obesity and weight control Symposium. Nutrition Today. July/August : 33 - 35

Van Marken Lichtenbelt, W.D., Heidendal, G.A.K., & Westerterp, K.R. 1997. Energy expenditure and physical activity in relation to bone mineral density in women with anorexia nervosa. European Journal of Clinical Nutrition, 51(12):826–830.

Van Raaij, J. 2000 In : Mann, J. & Truswell, A.S. Essentials of human nutrition. Second Edition. New York : Oxford University Press.

Van Rensburg, L., & Gordon-Davis, L. 2002. The hospitality industry handbook on Nutrition and menu planning for South African students and practitioners. Landsdown: Juta & Co.

Van Stratum, P., Lussenburg, R.N., van Wezel, L.A., Vergroesen, A.J., & Cremer, H.D. 1978. The effect of dietary carbohydrate: fat ratio on energy intake by adult women. American Journal for Clinical Nutrition, 31(2):206-212.

Venter, C.S. & Silvis, N. 1990. Comparison of the effects of maize porridge consumed at different temperatures on blood glucose, insulin and acetate levels in healthy volunteers. The South African Journal of Food Science & Nutrition, 2(1):2-5.

Voorrips, L.E., Ravelli, P.C., Dongelmans, P.C., Deurenberg, P. & Van Staveren, A. & Janney. 1993. The physical activity scale for the elderly (PASE): Development and Evaluation. Journal for Clinical Epidemiology 46:153–162.

Vorster, H.H., Oosthuizen, W., Jerling, J.C., Veldman, F.J., & Burger, H.M. 1997. The nutritional status of South Africans. A review of the literature from 1975-1996. Durban: Health Systems Trust, 1:1-48; 2:1-122.

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 Review, 57(11):341–349.

Vorster, H.H.Jr 2000. The effect of urbanization on bone turnover in black postmenopausal South African women. MSc thesis. Potchefstroom, PU for CHE, 1 – 65

Vorster, H.H. & Nell, T.A. 2001. Make starchy foods the basis of most meals. South African Journal of Clinical Nutrition, 14(3)(suppl):S17-S24.

Vuori, I. 2001. Exercise and physical health. Musculoskeletal health and functional capabilities. Research Quarterly for Exercise and Sport, 66 (4):276–285.

Walker, A.P.R. and Segal, I. 1997. Effects of transition on bowel disease in sub-Saharan Africans. European Journal of Gastroenterology & Hepatology, 9(2):207-210.

Walker, A.R.P. 1964. Overweight and hypertension in emerging populations. American Heart Journal. 68:581–585.

Walker, A.R.P. 1995. Changing views on the treatment of obesity. Tydskrif vir Dieetkunde en Huishoudkunde, 23(3):157-163.

Walker, S., Poston I.I., C., & Foreyt, J.P. 1999. Obesity is an environmental issue. Atherosclerosis, 146(2):201-209.

Washburn, R.A., Cline, G., Lackland, P.T.,& Wheeler, F.C. 1992. Leisure time and physical activity: Are there black/white differences? Preventive Medicine, 21(1):127–135.

Werner, T. 1997. Effects of exercise on a HIV positive patient: a case study. Clinical Kinesiology, 51(4):86–87.

West, D.B., & York, B. 1998. Dietary fat, genetic predisposition, and obesity: Lessons from animal models. American Journal of Clinical Nutrition, 67(3):S505-S512.

Westerterp, K.R., Meijer, G.A., Janssen, E.M., Saris, W.H., & Ten Hoor, F. 1992. Long-term effect of physical activity on energy balance and body composition. British Journal of Nutrition, 68(1):21-30.

Whitney, E.N., & Rolfes, S.R. 1999. Understanding nutrition (Eighth Edition) Belmont : Wadsworth, Thomson Learning.

Whitney, E.N., Cataldo, C.B., De Bruyn, L.K., & Rolfes, S.R. 2001. Nutrition for health and health care (Second Edition) Belmont : Wadsworth/Thomson Learning.

WHO, 1990. Interhealth division of non-communicate able diseases and health technology. Guidelines for protocols for local projects Geneva: Interhealth

Wilber, J. Naftzger - Kang, L., Miller, A.M., Chandler, P., & Montgomery, A. 1999. Women's occupations, energy expenditure and cardiovascular risk factors. Journal of Women's Health, 8:377-387.

Willett, WC. 1998. Is dietary fat a major determinant of body fat? American Journal of Clinical Nutrition, 67(3):S556-S562.

Williamson, D.F., Madans, J., Anda, R.F., Kleinman, J.C., Kahn, H.S., & Byers, T. 1993. Recreational physical activity and ten-year weight change in a US national cohort. International Journal for Obesity Related Metabolic Disorders, 17(5):279-286.

Wood, P.D. 2000. Physical activity diet and health – independent and interactive effects. Medical Journal for Science Sports and Exercise, 26:838-43.

Woodman, R. 1996. Who launches initiative against obesity. Lancet, 347 : 751.

Yarasheski, K.E., & Raubenoff, R. 2001. Exercise treatment for HIV associated metabolic and anthropomorphic complications. Exercise and Sport Sciences Reviews, 29(4):170–174.

Young, D.R., Miller, K.W., Wilder, I.B., Yanek, I. R., & Becker, D.M. 1998. Physical activity patterns of urban African Americans. Journal of Community Health, 23:99-112.

APPENDICES

APPENDIX A

PHYSICAL ACTIVITY OF WOMEN (25 – 45 YRS) IN MANGAUNG

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

Name:________________________________

Respondent number:_______________ 1-3

Interviewer number: _______________ 4-5

1. What is your main occupation ?

________________________________ 6-7

2. Is your workplace away from home? IF NO,OR UNEMPLOYED GO TO QUESTION 20 | Yes (1) | No(2) | 8

3. How many days per week do you work? ______ 9-10

4. How long per day do you work?(min) ______ 11-13

5.At work I sit . | Yes(1) | No(2) | 14

6. IF YES, how long?(min) ______ 15-17

7. At work I walk. | Yes(1) | No(2) | 18

8. IF YES, how long?(min) ______ 19-21

9. At work I lift heavy loads. | Yes (1) | No(2) | 22

10. IF YES, how long?(min) ______ 23-25

11.At work I am tired. | Yes(1) | No(2) | 26

12. IF YES, how long?(min) ______ 27-29

13. At work I sweat as a result of the work I do. | 1. never | 2. seldom | 3.some times | 4. often | 5.alw ays | 30

14. How do you get to work? | 1. walk | 2. cycle | 3. bus | 4. taxi | 5. car | 31

15.If by bus or taxi how long does it take you to walk to the bus or taxi rank(mins) ______ 32-34

16. If you walk to work, what is your usual pace? | 1. casual strolling | 2. fairly brisk | 3. brisk | 4. fast | 35

17.How long do you take to get to walk to work?(min) ______ 36-38

18 If you cycle, what is your usual pace? | 1. casual cycling | 2. fairly brisk | 3. brisk | 4. fast | 39

II

Question	Response					Code
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.alw ays	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	Yes(1)	No(2)				75

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! | Yes (1) | No(2) | 84

43. IF YES, do you watch television during leisure time? | Yes (1) | No(2) | 85

44. Do you do other sitting activities?* | Yes(1) | No(2) | 86

45. IF YES, which type of activity?* ________ | 87-88

46. During leisure time, do you walk or do standing activities?* | Yes(1) | No(2) | 89

47. IF YES, how long per day? (min) ________ | 90-92

48. Do you have any other leisure time activities?* | Yes(1) | No(2) | 93

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 B

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:____________________ [ ][ ][.][ ] 15-18
Waist: ____________________ [ ][ ][ ][.][ ] 19-23
Hip: ____________________ [ ][ ][ ][.][ ] 24-28

Bio-impedance:
Age (yrs):____________________ [ ][ ] 29-30
Elbow width (cm): ______________ [ ][.][ ] 31-33
Bodystat count: ________________ [ ][ ][ ] 34-36

Frame size [ ] 37
1. Small
2. Medium
3. Large

% Fat: ______________ [ ][ ][.][ ] 38-41
*% Lean mass:*________________ [ ][ ][.][ ] 42-45

APPENDIX C

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

Name:____________________________ 1-3
Respondent number:

Interviewer:____________________________ 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

If yes, please specify (encircle appropriate answer) 7

1. Diabetic diet
2. Slimming diet
3. Allergies
4. Other

(Specify)____________________________

APPENDICES

APPENDIX A

PHYSICAL ACTIVITY OF WOMEN (25 – 45 YRS) IN MANGAUNG

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

Name:______________________________
Respondent number:________________ 1-3
Interviewer number: ________________ 4-5

1. What is your main occupation ?

______________________________ 6-7

2. Is your workplace away from home? IF NO,OR UNEMPLOYED GO TO QUESTION 20 | Yes (1) | No(2) | 8

3. How many days per week do you work? ______ 9-10

4. How long per day do you work?(min) ______ 11-13

5.At work I sit . | Yes(1) | No(2) | 14

6. IF YES, how long?(min) ______ 15-17

7. At work I walk. | Yes(1) | No(2) | 18

8. IF YES, how long?(min) ______ 19-21

9. At work I lift heavy loads. | Yes (1) | No(2) | 22

10. IF YES, how long?(min) ______ 23-25

11.At work I am tired. | Yes(1) | No(2) | 26

12. IF YES, how long?(min) ______ 27-29

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

1. never	2. seldom	3.some times	4. often	5.alw ays

30

14. How do you get to work?

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

31

15.If by bus or taxi how long does it take you to walk to the bus or taxi rank(mins) ______ 32-34

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

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

35

17.How long do you take to get to walk to work?(min) ______ 36-38

18 If you cycle, what is your usual pace?

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

39

- **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)** 9

Please specify________________________________

- **Do you use beef/ chicken stock in your food?** **YES (1) NO (2) DON'T KNOW (3)** 10
- **Do you use any dietary supplements?** **YES (1) NO (2) DON'T KNOW (3)** 11

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

Vitamins:____________________________ 12-14

Minerals:____________________________ 15-17

Protein:____________________________ 18-20

Energy:____________________________ 21-23

Other:____________________________ 24-26

EATING PATTERNS: (FREQUENCY OF EATING)

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

27

- 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): ____

DO YOU EAT BREAKFAST: 28

- 1.Regularly ($\geq$4 times a week)
- 2.Sometimes (1 – 3 times a week)
- 3.Never

Central University of Technology, Free State

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

X

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	45
Lunch	1. Yes	2. No	46
Supper	1. Yes	2. No	47
Snacks	1. Yes	2. No	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 ☐ White ☐ Brown ☐ Syrup ☐ Honey ☐ Sweetener: type___________						 3989 4005 3988 3984	
Is fat added to porridge or cereal? (Tick box)	None ☐ Animal fat (butter) ☐ Hard margarine ☐ Soft margarine ☐ Oil ☐ Peanut Butter ☐						 3479 3484 3496 3507 3485	
Samp/Maize rice Samp and beans Samp and peanuts	Bought Self ground Specify ratio (1:1) Specify ratio						3250 3725 3402	
Rice: specify brands names:	White Brown Sorghum rice						3247 3315 3437	
Stamped wheat							3249	

Pastas	Macaroni Spaghetti Spaghetti in tomato sauce Other:						3262 3262 3258	

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/ DAY
			Per day	Per week	Per month	Seldom/ Never		
Bread/Bread rolls	White						3210	
Bread slices: thin	Brown						3211	
Medium, thick	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 tipes)	____________ ____________ ____________							
Dumpling							3210	

Vetkoek							**3257**	
Provita **Crackers (refined)** **Crackers (whole wheat)**							**3235** **3331** **3391**	
Rusks	Bran						**3330**	
	Buttermilk						**3329**	
	White						**3364**	
	Boerebeskuit, white						**3364**	
Home-made:	All-bran						**3380**	
	Raisins						**3380**	
	Buttermilk, white						**3215**	
	Buttermilk, whole wheat						**3255**	
	Other							
Scones							**3237**	
Muffins	Plain Bran						**3408** **3407**	

HOW MANY TIMES A DAY DO YOU EAT BREAD? ________

	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom / Never		
Chicken	Boiled: with skin without skin						**2926** **2963**	
Do you eat the chicken with the skin?	Fried: in batter/crumbs Fried, but not coated						**3018** **2925**	
Yes ☐ No ☐	Roasted/grilled with skin without skin						**2925** **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 Home-made						**2954** **2954**	
Red meat: Beef	Fried/grilled: with fat without fat						**2908** **2959**	
	Stewed/boiled: with fat without fat						**3006** **2909**	
	Mince with tomato and onion						**2987**	
Red meat: Mutton	Fried/grilled: with fat without fat						**2927** **2934**	
	Stewed/boiled: with fat without fat						**3040** **2916**	
Red meat: Pork	Fried/grilled: with fat without fat						**2930** **2977**	
	Stewed/boiled: with fat without fat						**3046** **3045**	

Red meat: Goat	Fried/grilled: with fat without fat						**4281**	
	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**	
	Frankfutter						**2937**	
	Other (specify)							
Canned meat	Bully beef						**2940**	
	Other (specify)							
Meat pie	Bought						**2939**	

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom / Never		
Legumes: specify dried beans/peas/ Lentils	Stews & curries (specify) Soups Salad						 **3157** **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 Without batter/crumbs						**3072** **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 In tomato sauce						**3087** **3087**	
Tuna	In oil In brine						**3093** **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 Scrambled in: oil butter margarine Fried in: oil butter margarine bacon fat Curried						**2867** **2889** **2886** **2887** **2869** **2868** **2877** **2870** **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						**3912**	

	(nothing added)							
	Boiled, then fried with potato, onion						A006	
	Other:							
Spinach/morogo/imfino/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	Cooked in fat & sugar						A010	
Specify type:	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 Off cob whole kernel						3726 3942	
Beetroot	Cooked Salad (bought or home-made)						3698 3699	

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		
Potatoes	Boiled with skin						4155	
	- without skin						3737	
	Baked in skin(flesh and skin) - in skin (flesh only)						3736 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 Green, frozen with sugar With sugar and butter Tinned peas						4146 3720 3859 4149	
Green peppers	Raw Cooked (stew with oil)						3733 3865	
Brinjal/egg plant	Cooked Fried in oil Stew (oil, onions, tomato)						3700 3802 3798	
Mushrooms	Raw Sautéed in brick margarine Sautéed in oil						3842 3839 3841	
Onions	Sauteed in sun oil Sauteed in margarine						3730 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						3716	
Other vegetables; specify								
If you fry veg or add fat specify type of fat usually used	Butter ☐ Butro ☐ Animal fat (beef tallow) ☐ Lard ☐ Hard margarine (brick) ☐ Soft margarine (tub) ☐ Soft margarine (light) ☐ Sunflower oil ☐						3479 3523 3494 3495 3484 3496 3524 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 home-made Cooked salad dressing Salad dressing low-oil Salad dressing French Oil: Olive Sunflower Canola						3488 3506 3503 3505 3487 3509 3507 4280	
Apples	Fresh Canned, unsweetened						3532 4216	
Pears	Fresh Canned, in syrup						3582 3583	
Bananas							3540	
Oranges **Naartjie**							3560 3558	
Grapes							3550	
Peaches	Fresh Canned, in syrup						3565 3567	
Apricots	Fresh Canned, in syrup						3534 3535	
Mangoes	Fresh						3556	
Pawpaw	Raw						3563	
Pineapple	Raw Canned (syrup)						3581 3648	
Guavas	Fresh Canned (syrup)						3551 3553	
Watermelon							3576	
Spanspek	Orange flesh Green flesh						3541 3575	
Wild fruit/berries (Specify types)	____________ ____________ ____________ ____________ ____________							
Dried fruit (also as snacks)	Raisins Prunes (raw) Prunes (cooked with sugar) Peaches (raw) Peach (cooked with sugar) Apples (raw) Dried fruit sweets Other ________ ____________ ____________ ____________						3552 3596 3564 3568 3569 3600 3995	
Other fruit	____________ ____________	______ ______	__ __	____ ____	____ ____	____ ____		______ ______

OW MANY TIMES A WEEK DO YOU EAT FRUITS? ______________

E 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		
ater							**4042**	
ea	Ceylon Rooibos						**4038** **4054**	
offee							**4037**	
ugar per cup f tea or coffee	White Brown						**3989** **4005**	
ilk per cup of ea or coffee	Fresh/long life whole						**2718**	
hat type of milk o you put in tea nd/or coffee?	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							

							CODE	AMOUNT/DAY
Milk as such: What type of milk do you drink as such?	Fresh/long life/whole Fresh/long life/2% Fresh/longlife/fat free (skimmed) Goat						2718 2772 2775 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________ Milo________ Flavoured milk________ Other						4287 2735 2774	
Yoghurt	Drinking yoghurt Thick yoghurt, plain, fruit						2756 2732	
Squash	SixO Oros Lecol with sugar -artificial sweetener Kool Aid Other________ ________						3990 3982 3982 3990 3982	
Fruit juice	Fresh/Liquifruit/Ceres/						2866	
	"Tropica"/ mixtures with milk						2791	
Fruit syrups	Average Guava syrup						2865 2864	
Fizzy drinks Coke, Fanta	Sweetened Diet						3981 3990	
Mageu/Motogo							4056	
Alcoholic beverages such as Sorghum beer	Sorghum beer Specify:						4039	
Other , specify:	Beer average Wine Cider ________ ________ ________ ________ ________ ________						4031 4033 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 Roasted, salted						3452 3458	
Cheese curls: Niknaks etc.	Average Savoury						3267 3418	
Popcorn	Plain (no salt and butter) Plain (salt and butter added) Sugar coated						3332 3359	
Raisins (seeds)							4231	
Chocolates	Milk Kit Kat Peppermint crisp Specify types and names						3987 4024 3997	
Candies	Sugus, gums, hard sweets (specify) Peppermint						3986 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 **Worcester sauce**							**3139** **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

Technikon
Vrystaat • Free State • Foreistata

APPENDIX D

THE COMMUNITY OF NAMIBIA

This letter serves to inform the community of a research project titled " The nutritional health of women (25-44 years) in Mangaung" that will be undertaken by the Technikon Free State, University of the Orange Free State and the National Research Foundation during 2000. The project is aimed at investigating the change from the traditional healthy diet to a more Western unhealthy diet. The influence of this change of diet on health will be determined.

A random selection of 500 households in Bochabela, Phahameng, Joe Slovo and Namibia will be made to be included in the study. The women living in these households will be contacted by the community health workers and they will be asked whether they are interested in participating in the study. If they agree they will be fetched from Mangaung and taken to the Technikon for one day. No one will be forced to participate in the study.

On the day that they participate in the study a free medical examination will be done, blood will be drawn (including a HIV test), and they will be asked a number of questions about general background, what they eat, how active they are, and attitude towards health. None of the questions are difficult and anyone will be able to answer these questions.

The information will help to determine nutritional problems in women and to develop solutions for these problems. The project will benefit the community since we will be able to determine what interventions are required to improve the health of women in South Africa. The project will not cause any harm to the participants in any way. By participating in the research survey you will help other women in the country. The individual information will be kept strictly confidential. Women that participate will be paid an amount of R40.00 for their time. Please feel free to contact the community health workers at any time if you have any questions about the project.

DR CORINNA WALSH
PROJECT COORDINATOR

APPENDIX E

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.

.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.

:.5 I have been told that it will not take more than one day to collect the information.

} I have been told that the measurements will not cause any harm to me in any way.

I 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 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

Technikon
Vrystaat • Free State • Foreistata

PPENDIX F

HE EMPLOYER

his letter serves to certify that ____ has been andomly selected to participate in a research project, undertaken by the Technikon Free State, Jniversity of the Orange Free State and the National Research Foundation on the _______________ date).

he project will investigate the nutritional health of women (25-45 years) living in Mangaung. The urpose of the project is to collect information on usual food intake, activity level, attitude toward health, is well as risk for developing diseases related to eating habits and life-style. The information collected vill be used to determine nutritional problems and to develop solutions to these problems. The articipant will be required to be available for the full duration of the day.

'our kind consideration is appreciated.

ie werkgewer

liermee word bevestig dat ____ gekies is om leel te neem aan 'n navorsingsprojek wat onderneem word deur Technikon Vrystaat, die Universiteit van lie Oranje Vrystaat en die Nasionale Navorsings Stigting op die ________________ (datum).

ie projek ondersoek die voedinggesondheid van vroue (25-45 jaar) wat in Mangaung woonagtig is. Die loel van die projek is om inligting te versamel oor gewoontelike voedselinname, aktiwiteitsvlak, houding eenoor gesondheid, sowel as risiko om siektes te ontwikkel wat verband hou met eetgewoontes en ewenstyl. Die inligting sal gebruik word om voedingsprobleme te identifiseer en om oplossings vir laardie probleme te ontwikkel. Die deelnemer sal die hele dag beskikbaar moet wees.

J goedgunstige oorweging word waardeer.

R CORINNA WALSH
ROJECT COORDINATOR/ PROJEK KOöRDINEERDER

APPENDIX G

WOMENS NUTRITIONAL HEALTH SURVEY: WOMEN 25-44 YEARS OLD

SOCIO-DEMOGRAPHIC QUESTIONNAIRE

(All information in this questionnaire is confidential).

Name:________________

Respondent number: [ ][ ][ ] 1-3

Interviewer: [ ][ ] 4-5

	D	D	M	M	Y	Y	Y	Y	
Birth Date:									6-13
Interview Date:									14-21

Age (years) if Birth Date unknown:________________ [ ][ ] 22-23

Address: ____________________________________

Tel No (H):________________ **(W):**________________

How many years have you been living in an urban area (like Mangaung)? [ ][ ] 24-25
Encircle the appropriate answer:

Language: [ ] 26
1. Sotho
2. Tswana
3. English
4. Afrikaans
5. Other,

specify________________

Number of children: (born):______________ [ ][ ] 27-28

Number of children: (alive):______________ [ ][ ] 29-30

Do you smoke at all? [ ] 31
1. Yes
2. No

If yes, how many cigarettes per day? [ ][ ] 32-33

Household composition:

How many persons live in the house permanently (5-7 days per week)?__________ [ ][ ] 34-35

Number of children (< 18 yrs):______________ [ ][ ] 36-37

Number of adults (≥ 18 yrs): ______________ [ ][ ] 38-39

XXX

Marital status of respondent: 40

1. Unmarried
2. Married
3. Divorced
4. Separated
5. Widowed
6. Living Together
7. Traditional Marriage
8. Other, specify________________

What is your highest level of education? 41

1. None
2. Primary School
3. Std 6-8
4. Std 9-10
5. Tertiary Education
6. Don't Know

Employment status of respondent 42

1. Housewife by choice
2. Unemployed
3. Self Employed
4. Full time wage earner (receive a salary)
5. Other, specify (part-time, peace job etc.)__________________
6. Don't Know

Husband/ partner's employment status 43

1. Retired by choice
2. Unemployed
3. Self Employed
4. Full time wage earner (receive a salary)
5. Other, specify (part-time, peace job etc.)__________________
6. Not Applicable e.g. dead

Who is the head of this household? 44

1. Self
2. Husband
3. Child/ren
4. Parent
5. Grandparent
6. Friend
7. Other, specify ___________________

ype of dwelling: 45

Brick, Concrete
Traditional mud
Tin
Plank, wood
Other, specify________________

umber of rooms in house (excluding bathroom, toilet and kitchen, if ›parate) 46-47

/here do you get drinking water most of the time? 48

. Own tap
. Communal tap
. River, dam
. Borehole, well
. Other, specify ________________

/hat type of toilet does this household have? 49

. Flush
. Pit
. Bucket, pot
. VIP
. Other, specify ________________

/hat fuel is used for cooking most of the time? 50

. Electric
. Gas
. Paraffin
. Wood, Coal
. Sun
. Open fire

)o you use a cast iron pot for cooking? 51

. Never
. ≤ Once a week
. > Once a week
. Every day

)oes the home have a working:

tefrigerator and/or freezer 52

. Yes
:. No

Stove (Gas, Coal or electric) or Hot Plate 53

. Yes
:. No

rimus or Paraffin Stove 54

. Yes
. No

licrowave 55

. Yes
. No

ladio and/or Television 56

. Yes
. No

low many people contribute to the total income? ____________ 57-58

lousehold income per month (including wages, rent, sales of vegs, etc. ;tate grants). 59

1. None
2. R100-R500
3. R501- R1000
4. R1001-R3000
5. R3001-R5000
6. Over R5000
7. Don't know

Is this more or less the income that you had over the past six months? 60

1. Yes
2. No

If no, is it more or less? 61

1. More
2. Less

How much money is spent on food weekly? 62-63

1. R0-R50
2. R51-R100
3. R101-R150
4. R151-R200
5. R201-R250
6. R251-R300
7. R301-R350
8. R351-R400
9. Over R 400