NUTRITIONAL STATUS OF UNDERGRADUATE STUDENTS IN THE FACULTY OF HEALTH SCIENCES AT THE UNIVERSITY OF THE FREE STATE

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DECLARATION

I declare that the dissertation hereby submitted by me for the Magister degree at the University of the Free State is my own independent work and has not previously been submitted by me to another university/faculty. I further cede copyright of this research report in favour of the University of the Free State.

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SUMMARY

The aim of this study was to describe the nutritional status and related lifestyle factors of undergraduate students in the Faculty of Health Sciences at the University of the Free State. A representative sample of 161 (24% male and 76% female) full time students were randomly selected. The median ages of students were 21.8 years for males and 21.4 years for females. Dietary intake, lifestyle and anthropometric variables and associations between the above were determined.

Dietary intake was determined by means of a 24-hour recall and short food frequency questionnaire. Weight and height, waist and hip circumference measurement were obtained to calculate body mass index (BMI) and fat distribution. Lifestyle factors included smoking, alcohol consumption, physical activity and socio-demographic status and these were determined by means of a questionnaire. Adequacy of diet was evaluated by comparing the intake of each student to the intake recommended by the Food Guide Pyramid.

Almost 44% of students' daily intake of bread, cereals, rice and pasta was lower than the recommended six servings. Similarly, 98% ate less than three servings of vegetables and 58.4% ate less than two servings of fruits. More than 80% of students ate less than two servings of milk, yoghurt and cheese, while 16.1% ate less than two servings of meat, poultry, fish, dry beans, eggs and nuts. Only 57.1% of students reported consuming small quantities of fats, oils and sweets. Meal patterns showed that a small percentage of students skipped breakfast (7%). Median energy intake of female students (5195kJ) was significantly lower than that of male students (8943kJ). Median energy and fat intake was relatively low, while carbohydrate and protein intakes were slightly higher than recommendations.

Anthropometric information included BMI, waist circumference and waist hip ratio (WHR). 22.1% of female and 12.9% of male students were overweight or obese and 10.7% of female and 0% of male students were underweight. Four students had values above cut off points for waist circumference (for females > 88 cm for males > 102 cm)

and six students had values above cut off point for waist-hip ratio (for females > 0.8 and for males > 0.9), indicating risk for cardiovascular disease.

The physical activity level of the students broadly classified them as very active (59%) and active (39%). However, 68% of the students did not attend gym or participate in any sporting activities. Of the total students, 10.6% were smokers; smoking a median of 3.5 cigarettes per day. The majority of the students (62%) consumed alcohol. The median frequency of alcohol consumption was 4.0 days per month, and on those days (mostly weekend days), the median intake was 3 drinks. A positive association between smoking and alcohol consumption was found. Alcohol consumption was also significantly higher in students residing off-campus.

No significant difference in the energy intake of students living on-campus and off-campus was found. Median energy intake of students in the three different BMI categories indicated that overweight/obese students had the highest median energy intake. However, the differences in median energy intake between the three groups were not statistically significant. Students that smoked also tended to be more underweight.

A physically active lifestyle with abstention from smoking, moderate alcohol consumption, and consumption of healthy foods maximizes the chance of having a normal weight. Although relatively low, prevalence of obesity in this population needs attention. High BMI values at a young age are independent predictors of being overweight in later years. Being overweight at a young age indicates an increased risk for developing diseases of lifestyle, such as cardiovascular disease. Therefore physical activity and healthy eating habits should be encouraged to prevent obesity and its comorbidities.

OPSOMMING

Die doel van hierdie studie was om die voedingstatus en leefstylfaktore wat daarmee verband hou van studente in die Fakulteit Gesondheidswetenskappe, Universiteit van die Vrystaat te bepaal. ‘n Verteenwoordige steekproef van 161 (24% manlik en 76% vroulik) voltydse studente is lukraak geselekteer. Die mediaan ouderdom van studente was 21.8 jaar vir mans en 21.4 jaar vir dames. Dieetinname, leefstyl en antropometriese veranderlikes en verbande tussen bogenoemde is bepaal.

Dieetinname is deur middel van ‘n 24-uur herroep en kort voedselfrekwensievraelys bepaal. Massa en lengte sowel as middel- en heupomtrek is bepaal om liggaamsmassaindeks (LMI) en vetverspreiding te bereken. Leefstylfaktore het rook, alkoholinname, fisiese aktiwiteit en sosio-demografiese inligting ingesluit wat deur middel van ‘n vraelys ingesamel is. Toereikendhied van die dieet is geëvalueer deur die innames van elke student met die aanbevole innames wat deur die Voedselpiramiede aanbeveel word te vergelyk.

Amper 44% van studente se inname van brood, grane, rys en pasta was laer as die aanbevole ses porsies. Amper alle studente (98%) het minder as drie porsies groente geëet en 58.4% het minder as twee porsies vrugte geëet. Meer as 80% van studente het minder as twee porsies melk, jogurt en kaas geëet, terwyl 16.1% minder as twee porsies vleis, pluimvee, vis, droë bone, eiers en neute geëet het. Ongeveer 57% van studente het klein hoeveelhede vette, olies en soetigheid ingeneem. Maaltydpatrone het getoon dat ‘n klein persentasie studente wel ontbyt oorslaan (7%). Mediaan energieinname van vroulike studente (5195kJ) was betekenisvol laer as die van mans (8943kJ). Mediaan energie- en vetinname was relatief laag terwyl koolhidraat- en proteïeninname effens hoër as die aanbevelings was.

Antropometriese inligting het LMI, middelomtrek en middel-heup-verhouding ingesluit. 22.1% van vroulike studente en 12.9% van manlike studente was oormassa of vetsugtig terwyl 10.7% van vroulike en 0% van manlike studente ondermassa was. Vier studente het waardes bo die afsnypunte vir middelomtrek (vir vrouens > 88 cm en vir mans > 102

cm) en ses studente het waardes bo die afsnypunte vir middel-heup-verhouding (vir vrouens > 0.8 en vir mans > 0.9) gehad, wat ‘n risiko vir hartsiektes aandui.

Die fisiese aktiwiteitvlakke van die studente is as baie aktief (59%) en aktief (39%) geklassifiseer. Ten spyte daarvan, het 68% van die studente nooit gimnasium toe gegaan nie of aan sportaktiwiteite deelgeneem nie. Van die totaal, het 10.6% gerook en ‘n mediaan van 3.5 sigarette per dag gerook. Die meerderheid (62%) het alkohol gebruik. Mediaan alkoholinname was 4.0 dae per maand en op hierdie dae (hoofsaaklik naweke) is ‘n mediaan van 3 drankies gedrink. ‘n Positiewe verband is tussen rook en alkoholinname gevind. Alkoholinname was ook betekenisvol hoër in studente wat nie op die kampus gewoon het nie.

Geen betekenisvolle verskil is gevind tussen enrgieinname van studente wat op die kampus en nie op die kampus gewoon het nie. Mediaan energieinname van studente in die drie LMI kategorieë het getoon dat oormassa/ vetsugtige studente die hoogste mediaan energieinname gehad het. Die verskil tussen energieinname van die groepe was egter nie betekenisvol nie. Studente wat gerook het was ook meer geneig om ondermassa te wees.

‘n Fisies aktiewe lewenstyl en matige alkoholinname sowel as inname van ‘n gesonde dieet sal ‘n persoon se kans om ‘n normale gewig te handhaaf bevorder. Alhoewel relatief laag, moet die voorkoms van oormassa in hierdie steekproef aangespreek word. Hoë LMI op ‘n jong ouderdom is ‘n onafhanklike voorspeller van oormassa in later jare. Oormassa op ‘n jong ouderdom hou ook verband met ‘n verhoogde risiko om siektes van leefstyl, soos hartsiektes, te ontwikkel. Om hierdie redes moet fisiese aktiwiteit en gesonde eetgewoontes aangemoedig word in die stryd teen vetsug en geassosieerde siektes.

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LIST OF ABBREVIATIONS

AI	Adequate Intake
BMI	Body Mass Index
BMR	Basal Metabolic Rate
CDC	Center for Disease Control
CHD	coronary heart disease
cm	centimetre
DHHS	Department of Health and Human Services
DRI	Dietary Reference Intakes
EAR	Estimated Average Requirement
EEPA	Energy Expended in Physical Activity
FAO	Food and Agriculture Organisation
FBDG	Food-Based Dietary Guidelines
FFQ	Food Frequency Questionnaire
g	gram
g/day	grams per day
g/kg	gram per kilogram
IASO	International Association for the Study of Obesity
kg	kilogram
kg/m^2	kilogram/meter square
kJ	kilojoules
MET	metabolic equivalent
Mg/day	milligrams per day
PAL	physical activity level
RDA	Recommended Dietary Allowance
RMR	Resting Metabolic Rate

REE	Resting Energy Expenditure
SADHS	South African Demographic and Health Survey
SASSO	South African Society for the Study of Obesity
TEE	Total Energy Expenditure
TEF	Thermic Effect of Food USDA/DHHS
UFS	University of the Free State
ULs	Upper Intake Levels
USDA	United States Department of Agriculture
WHO	World Health Organisation
WHR	Waist-to-Hip circumference Ratio
<	less than
>	greater than
≥	equal to or greater than
≤	equal to or less than

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Chapter 1: Introduction and motivation for the study

1. Introduction

Until about the middle of the twentieth century, infectious disease was the leading cause of death in developed countries and nutritional deficiencies were common. In contrast, nowadays, in Western populations, the improved sanitation, vaccine development, and improved health care have virtually eliminated infectious disease as a major killer and nutrient deficiency is much less common (Walker *et al*., 2003; Kale, 1995).

Increasing life expectancy, a higher standard of living, and an abundance of food have, however, resulted in an epidemic of chronic diseases, many of which are related to excessive consumption of high-fat food and alcoholic beverages and inadequate consumption of food high in unrefined carbohydrates and fiber (Bourne *et al.*, 2002).

A well-nourished population consumes a diet that prevents deficiencies and at the same time does not promote conditions related to excess intake of energy or nutrients. In developed nations today, there are pockets of undernutrition, but the majority of nutritional problems are related to overconsumption and overnutrition. Overnutrition, defined as a pattern of intake that is high in energy, saturated fat, cholesterol, added sugar and sodium, and low in fiber, contributes to nutrition-related diseases, such as cardiovascular disease, obesity, hypertension, cancer, Type 2 diabetes and osteoporosis (Steyn *et al.*, 2006; Grosvenor and Smolin, 2002, p.630).

About 60% of all deaths across the world and 47% of the burden of disease can be attributed to these nutritional related diseases. About two-thirds of deaths linked to these diseases occur in the developing world. The major risk factors are poor diet, low levels of physical activity, high consumption of alcohol and smoking as well as the associated obesity (International Association for the Study of Obesity (IASO), 2004).

South Africa suffers from a quadruple burden of disease. These include a combination of poverty related infectious diseases, lifestyle-related diseases associated with inactivity

and obesity and violence-related trauma. In addition, the HIV/AIDS epidemic is increasing rapidly (Bourne *et al.*, 2002).

Generally, the predominant pattern of malnutrition in South African adults, particularly in African women, is one of overweight and remarkably high rates of abdominal obesity, which occur together with micronutrient deficiencies (Puoane *et al.*, 2002). Intake of high fat food items, alcohol, smoking and physical inactivity are major causes of overweight or obesity in the South African black adult population (Senekal *et al.*, 2003; Le Roux *et al.*,2003). In South Africa there is a diversity of ethnic and cultural groups with different traditional eating patterns. The white population generally consumes a typically Western diet, which has a high fat (>30% of total energy intake), lower carbohydrate (< 55% of total energy intake), low fibre and high free sugar intake (>10% of total energy intake). The Indian and Colored populations have a very similar pattern to the white population. The black African population has two distinct types of eating patterns. Most rural populations still follow a traditional diet; which is high in carbohydrates (> 65% of total energy intake); low in fat (< 25% of total energy intake); low in sugar (< 10% of total energy intake); and moderately high in fibre. On the other hand, the black African urban population demonstrates an adoption of the Western diet of the other groups (Steyn, *et al.*, 2006).

The South African Demographic and Health Survey (SADHS), undertaken in 1998, found high rates of overweight and obesity, with 29 percent of men and 56 percent of women being overweight or obese. More recent survey data showed the prevalence of overweight (including obesity) among young people aged 13-19 years to be 17%, affecting more girls (25%) than boys (7%). Prevalence was highest (over 20% for boys and girls combined) in white and Indian population groups (IASO, 2004). According to Steyn *et al.* (2006), obesity increases with age until about 35 years in both men and women. In South Africa, prevalence of obesity is the highest in black women and white men.

2 Nutritional status of university students

Dietary intake, anthropometry and lifestyle of university students will be discussed in the following section.

2.1 Dietary intake

Inappropriate eating behavior, as well as underestimation of food intake, is often observed among obese first-year medical and nursing students compared to senior students (Rasheed, 1999). In spite of their generally healthy dietary patterns and a high prevalence of vitamin-mineral supplement use, many first year college female students in America had inadequate intakes of iron, calcium and folate (Hendricks *et al.*, 2004). Female university students in Japan had insufficient intake of energy, protein and minerals such as calcium and iron (Shimbo *et al.*, 2004). Similarly, female adolescent college students in Turkey often miss meals but regularly have breakfast and dinner which do not meet the Recommended Dietary Allowance (RDA) for essential micronutrients such as thiamin, riboflavin, niacin, calcium and iron (Mazicioglu and Ozturk, 2003).

A study done by Baric *et al*. (2003) showed that breakfast was the meal most often skipped by university students in Croatia. More often, male students consumed red meat, cereals and fast food, while female students consumed low-fat dairy products, whole grain products and breakfast cereals. This study showed that a total of 80.4% of students were well nourished. However, a study done by Zyto *et al*. (2004) in Poland showed that unhealthy nutrition behaviors were common and characterized by irregular consumption of vegetables and fruits (about 50%) and sporadic chips and fast-food consumption (about 80%). Less than half of Hong Kong University students ate fruits and vegetables everyday (Lee and Loke, 2005). In contrast, exemplary habits involving regular eating patterns and vegetable intake were reported in Chinese university students (Sakamaki *et al*., 2005b).

According to Anding *et al.* (2001) and Horacek and Betts (1998) female college students in America had sufficient micronutrient intakes, but higher energy, fat, and sodium-rich

food intake than recommended. They met the minimum number of servings for meat, but failed to consume the minimum number of servings for breads and grains, fruits and vegetables, and dairy products. Dietary intakes of female, nursing students in Canada showed that although energy intake was low, dietary intake of fat, protein, and carbohydrates were within acceptable limits (Best *et al.*, 1996). In Boston, college female students practiced significantly better nutrition than males (Larouche, 1998). In Spain, university students' energy intake for macronutrients was unbalanced: high in lipids, and very low in carbohydrates (Roldan *et al*., 2005; Segovia and Monzo, 2002; Gonzalez *et al*., 1999).

According to Stefanikova *et al*. (2001) energy, fat, cholesterol, animal protein and salt intakes of Slovak medical students were low, whereas intakes of carbohydrates, sucrose, fiber, magnesium, vitamins C and E were relatively high over a period of 15 years. In contrast, another study done by Szarazova *et al*. (2002) showed that Slovak medical students (30% of the women and 58% of the men) had a daily fat intake exceeding 150% of the recommended allowance; even more than 200% for men. In women the vitamin E and fiber intake was inadequate. Another study showed that more than half of students consumed less than 1 piece of citrus fruit per day (Baska *et al*., 2001). In Greece, the regular diet of medical students contained excessive quantities of saturated fat, cholesterol and sodium; while quantities of dietary fiber, calcium, vitamin C and fruits were inadequate (Mammas *et al*., 2004).

According to Steyn *et al.* (2000), South African black female university students' intake of calcium, zinc, iron and legumes were low but they consumed large amounts of sugar and confectionery. In addition Peltzer (2002) has reported that South Africa students' knowledge of nutrition was below average and food choices were mostly influenced by sensory appeal and mood. Generally, students are most influenced by what tastes good, is convenient and fits in with their lifestyle, which puts them at increased risk for chronic disease (Georgiou *et al.*, 1997).

2.2 Antropometric indicators

Body mass index (BMI) is a validated measurement of nutritional status that requires weight and height measurements. BMI is an indicator of body fitness and defines the level of adiposity according to the relationship of weight to height (Hammond 2004, p. 424). According to Lowry *et al*. (2000) 25% of university students in the USA had a BMI $\geq 25 kg/m^2$ (overweight or obese). In Slovakia, the mean BMI values of university students were normal (BMI $18.5 kg/m^2$- $24.9 kg/m^2$) but mild obesity was recorded in 8.7% of females and 22.2% of males (Janusova *et al.,* 2002). In China 97.1% of students were classified as underweight or normal weight and only 2.9% were overweight or obese (Sakamaki *et al.,* 2005b). Higher BMI is associated with higher intakes of saturated fat as well as lower fiber intake (Hendricks *et al.,* 2004).

Waist circumference measurement alone has been shown to correlate well with body fatness and may be used as a quick indicator of health risk from overweight (Barasi 2003, p. 12; Janssen *et al.,* 2004). Chan *et al.* (2003), indicated that waist circumference is probably the most convenient and reliable clinical measure of abdominal fat compartments.

The presence of excess body fat around the abdomen, out of proportion to total body fat, is considered a risk factor for obesity and the metabolic syndrome. Although, waist-hip ratio (WHR) is used to determine fat distribution (Hammond, 2004, p. 425-426), waist and hip circumferences measure different aspects of body composition and fat distribution and have independent and often opposite effects on cardiovascular disease risk factors. A narrow waist and large hips may both protect against cardiovascular disease (Seidell *et al.,* 2001). Large hip circumference seems to have an independent and positive effect on cardiovascular disease morbidity and mortality in women (Heitmann *et al.,* 2004).

A study done by Janusova *et al.* (2002) in Slovakia university students showed that the mean value of WHR were normal in both sexes and only 4.8% of men and 5.4% of females had the android type of obesity.

2.3 Lifestyle

In adults, smoking, alcohol consumption, physical inactivity, and obesity are well-known risk factors associated with cardiovascular disease and relative risk of death (Paffenbarger *et al.*, 1986). Leisure sports activities, together with BMI, were reported to be the most powerful predictors of adult biological risk factors, but attitudes to sports and educational level were also significant determinants (Bergkvist *et al*., 2001*).*

Physical activity is important in preventing and treating overweight and obesity and is extremely helpful in maintaining weight loss, especially when combined with healthy eating (Wildman and Miller, 2004, p 22). In addition, higher levels of physical activity are associated with increased intake of key micronutrients (Hendricks *et al.*, 2004). In a study by Brevard and Ricketts (1996), investigating physical activity of American students, the researchers found that 29% of students living on-campus and 28% of those living off-campus reported being sedentary or only lightly active. In this study, alcohol intake was higher for men living off-campus and women living on-campus.

Many adolescents smoke cigarettes and some adolescents use smoking as a weight control measure. Alcohol continues to be a problem on university campuses where heavy drinking is associated with careless and risky behavior (Peter *et al.*, 2000). Peltzer and Phaswana (1999) indicated that alcohol has negative effects on physiological (general deterioration of health), behavioral (aggressive behavior) and social factors (loss of status, family and friends). Physiologically alcohol damages the brain, liver and kidneys, destroys the immune system, and depresses brain activity.

Diet and lifestyle should be jointly targeted for promotion of healthy behavior or individually targeted for behavior change (Hendricks *et al.*, 2004). Reinforcing cognitive patterns and promoting active attitudes toward food consumption might be effective measures in the fight against overweight and obesity (Adame and Cordera, 2003).

3 Aim and Objectives

The time spent at university represents an important transition period in the lives of many young people; this is an important time for interventions to reduce the risk for chronic disease. This study describes the usual diet and lifestyle of undergraduate students in the Faculty of Health Sciences at the University of the Free State.

3.1 Aim

The main aim of this study was to describe the nutritional status and related lifestyle factors of undergraduate students in the Faculty of Health Sciences at the University of the Free State.

3.2 Objectives

In order to achieve the main aim, the following objectives were set

Determination of:

- Nutritional status:
    - Usual diet (food, energy and macronutrient intake)
    - Weight and height status (BMI)
    - Waist-hip-ratio and waist circumference
- Lifestyle behaviors
- Associations between the above.

4 Outline of the dissertation

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

Chapter 2: Literature review

Chapter 3: Methodology

Chapter 4: Results

Chapter 5: Discussion of results

Chapter 6: Conclusions and recommendations

Chapter 2: Literature review

2.1 Introduction

Nutrition is an important factor in the etiology and management of several major causes of death and disability in contemporary society. Nutritional deficiency or excess occurs when the nutrient intake is not balanced with specific requirements for optimal health. When nutritional reserves are depleted or nutrient intake is inadequate to meet the body's daily metabolic needs, a state of undernutrition develops. Nutrient deficiency may stem from inadequate ingestion, impaired digestion or absorption, dysfunctional metabolic processing, or increased excretion of essential nutrients. Overnutrition also presents major nutritional problems, manifesting as obesity and related disease states such as diabetes, atherosclerotic heart disease, hypertension, and the metabolic syndrome (Hammond, 2004, p. 408 and 409).

Nutritional health is maintained by a state of equilibrium in which nutrient intake is balanced by nutritional requirements (Rutishauser and Black, 2002, p. 226). Food choices can affect risk of chronic disease. For example, high-fat diets have been linked to heart disease and cancer. Other nutrients, such as the minerals sodium, chloride, calcium, and magnesium, affect blood pressure (Insel, *et al.*, 2001, p. 17).

2.2 Dietary intake

Adequacy of the diet implies that the diet provides sufficient energy and enough of all the nutrients to meet the needs of healthy people. A balanced diet involves eating enough but not too much of each type of food (Whitney and Rolfes, 2002, pp.32).

In the human body, carbohydrate, fat, and protein release energy, measured in kilojoules (kJ). The amount of energy a food provides thus depends on how much carbohydrate, fat, and protein it contains. When completely broken down in the body, a gram of carbohydrate and protein yields about 17 kJ of energy; and a gram of fat yields 38 kJ. Another substance that contributes energy is alcohol. Alcohol is not a nutrient because it interferes with growth, maintenance, and repair of the body, but it does yield energy of 29

kJ when metabolised in the body. Most food contains all three energy-yielding nutrients, as well as water, vitamins, minerals, and other substances. The body uses the energy-yielding nutrients to fuel all its activities. When the body uses carbohydrate, fat, or protein for energy, the bonds between the nutrient's atoms break. As the bonds break, they release energy. Some of this energy is released as heat, but some is used to send electrical impulses through the brain and nerves, to synthesize body compounds, and to move muscles. If the body does not use these nutrients to fuel its current activities, it rearranges them into storage compounds (such as body fat); to be used between meals and overnight when fresh energy supplies run low. When consumed in excess of energy need, alcohol, too, can be converted to body fat and stored. When alcohol contributes a substantial portion of energy in a person's diet, the harm it does extends far beyond the problems of excess body fat (Whitney and Rolfes, 2002, p. 6 and 7).

2.2.1 Dietary recommendations

The intake level of key nutrients that will meet specified criteria of nutritional adequacy, and thereby prevent the risk of deficit or excess, is called the individual requirement. In most cases, observed balance based on input-output measurement is greatly influenced by level of intake (Dagach and Hertranpf, 2001, p. 640). Nutrient recommendations are used as standards for measuring healthy people's energy and nutrient intakes (Sizer and Whitney 2000, p. 28)

Dietary References Intakes (DRIs) are a set of four reference values for the intakes of nutrients and food components that can be used for planning and assessing the diets of healthy people (Grosvenor and Smolin, 2002). The DRI model expands the previous RDA, which focused on establishing Adequate intake (AI) of nutrients for healthy populations to prevent deficiency diseases. DRIs include RDA's as well as AI, Tolerable Upper Intake Levels (ULs), and Estimated Average Requirements (EARs). The RDA is the amount of a nutrient needed to meet the requirements of almost all (97 to 98%) of the healthy population of individuals. They are based on EARs. An EAR is the amount of a nutrient with which about one half of individuals would have their needs met and one half would not. The EAR should be used for assessing the nutrient adequacy of populations,

not individuals. The AI is a nutrient recommendation based on observed or experimentally determined approximation of nutrient intake by a group (or groups) of healthy people when sufficient scientific evidence is not available to calculate an RDA or EAR. ULs have been established (for nutrients for which adequate data are available) to reduce the risk of adverse or toxic effects from increased consumption of nutrients in concentrated form either alone or combined with others (not in food) or from enrichment and fortification. A UL is the highest level of daily nutrient intake that is unlikely to have any adverse health effects on almost all individuals in the general population (Earl, 2004, p.364 and 365; Groff and Gropper, 2000, p.246).

2.2.1.1 Nutrient recommendations

Nutrients are chemical substances obtained from food and used in the body to provide energy, structural materials, and as regulating agents to support growth, maintenance, and repair of the body's tissues. In the body three of the organic nutrients can be used to provide energy such as carbohydrate, fat, and protein. In contrast, vitamins, minerals and water do not yield energy in the human bodies (Rolfes *et al*., 2006, p.7). Nutrients are classified as macro- and micronutrients.

a) Macronutrients

Table 2.1: Recommended intakes for Water, Energy and Macronutrients of males and females (19-30 years) (Rolfes *et al.,* 2006, p A)**.**

Nutrients	Male (19-30)	Female (19-30)
Water (L/day) (AL)	3.7	2.7
Energy (kJ/ day) (EER)	12881	10093
Carbohydrate (g/day) (RDA)	130	130
Total fiber (g/day) (AI)	25	38
Protein (g/day) (RDA)	56	46
Total fat (g/day) (RDA)	102	80

Water is a macronutrient that doesn't provide energy. Water makes up about 60% of the weight of the human body and is required in large amounts in the daily diet. It serves many functions in the body, including acting as a lubricant, a transport fluid, and a regulator of body temperature (Grosvenor and Smolin, 2002, p. 7 and 9).

Energy is provided by the macronutrients in food, which are broken down into their constituent parts by digestion, and metabolised in the tissues. Energy requirements are expressed as estimated energy requirements (EER).

According to the Food and Agriculture Organisation and the World Health Organisation (FAO/WHO, 1998), carbohydrates are the single most important source of food energy in the world. They comprise some 40 to 80 percent of total food energy intake, depending on local and cultural considerations or economic status. Diets high in carbohydrate as compared to those high in fat, reduce the likelihood of developing obesity and its co-morbid conditions. Carbohydrate containing foods are also important vehicles for protein, vitamins, minerals and phytochemicals, as well as antioxidants. An optimum diet should consist of at least 45-65% total energy from carbohydrate obtained from a variety of food sources such as cereals (rice, wheat, maize, barley, rye, oats, millet and sorghum) (Mann, 2001, p.59).

Fibers are the structural part of plants and thus are found in all vegetables, fruits, grains and legumes. Most fibers are polysaccharides in that the bonds between their monosaccharides cannot be broken down by digestive enzymes in the body. Consequently fibers contribute no monosaccharides, and therefore little or no energy, to the body. The recommended intake of fiber (30g/day) is important for prevention of cancer and constipation (Rolfes *et al.,* 2006, p. 108).

Protein is needed for growth, repairing or replacing tissue and fighting infections in the body and as a component of the diet to replace the amino acids that are broken down for energy or metabolised in an irreversible fashion. For a typical adult, protein losses for energy purposes are approximately 20-30 g daily. The RDA for protein for adults is 0.8 g/kg of body weight. The DRIs also list the acceptable range of protein intake as 10-35% of total energy (Wildman and Miller, 2004, p. 139).

Dietary fat is an essential component of the diet. It contributes a concentrated source of energy and essential fatty acids. Dietary fat is needed to insulate the body, preserve body

heat and maintain body temperature. It is also essential for digestion, absorption, and transport of fat-soluble vitamins and fat-soluble phytochemicals. The recommended range for fat intake is 20-35% of total energy in the diet (Wildman and Miller 2004, p. 166; Ettinger, 2004, p. 51; Lichtenstein and Peter, 2001, p. 9).

b) Micronutrients

Micronutrients are nutrients needed by the body in small amounts. These include vitamins, minerals and phytochemicals. Vitamins are organic molecules that do not provide energy but are needed to regulate body processes. There are 13 essential vitamins. Some are soluble in water (the B vitamins and vitamin C) and others are soluble in lipid (vitamins A, D, E, and K). Each has a unique structure and function. Many are involved in the production of energy from carbohydrates, lipids, and proteins; others function in processes such as bone growth, blood clotting, vision, and tissue growth and development (Grosvenor and Smolin, 2002, p. 9). Table 2.2 lists the recommended intakes of water soluble vitamins, while table 2.3 lists those for fat soluble vitamins.

Table 2.2: Recommendations for water-soluble vitamin intakes (19-50 years) (Whitney and Rolfes, 2005, p. 319-358).

Name of water soluble vitamin	Male	Females	Adults
Thiamine (vitamin B1) (mg/day) (RDA)	1.2	1.1	
Riboflavin (vitamin B2) (mg/day) (RDA)	1.3	1.1	
Niacin (mg NE/day) (RDA)	16	14	
Biotin (μg/day) (AI)			30
Panatothenic acid (mg/day) (AI)			5
Vitamin B6 (pyridoxine) (mg/day) (RDA)			1.3
Folate (μg/day) (RDA)			400
Vitamin B12 (μg/day) (RDA)			2.4
Vitamin C (Ascorbic acid) (mg/day) RDA)	90	75	

Table 2.3: **Recommendations for fat–soluble vitamin intakes (19-50 years)** (Whitney and Rolfes, 2005, p. 366-388).

Fat-soluble vitamin	Male	Female	Adults
Vitamin A (μg/day) (RDA)	900	700	
Vitamin D (μg/day) (AI)	5	10	
Vitamin E (mg/day) (RDA)			15
Vitamin K (μg/day) (AI)	120	30	

Minerals are inorganic elements. Like vitamins, they do not provide energy. Many have regulatory roles and some are important structurally. They are needed for bone strength, the transport of oxygen, the transmission of nerve impulses, and many other functions. (Grosvenor and Smolin, 2002, p. 9). The minerals are a large class of micronutrients, most of which are considered essential. They are traditionally divided into macrominerals (bulk elements) and microminerals (trace elements) (Anderson, 2004, p. 121). The distinction between the major and trace minerals does not mean that one group is more important then the other; all minerals are vital. The major minerals are so named because they are present, and needed, in larger amounts in the body (Whitney and Rolfes, 2005, p. 405). Table 2.4 lists the recommended intakes of macrominerals (major mineral), while table 2.5 lists those for trace minerals.

Table 2.4: **Recommendation for intakes of major minerals (19-50 years)** (Rolfes, *et al*, 2006, p. 405-423)**.**

Major mineral	Males	Females	Adults
Sodium (mg/day) (AI)			1500
Chloride (mg/day) (AI)			2300
Potassium (mg/day) (AI)			4700
Calcium (mg/day) (AI)			1000
Phosphorus (mg/day) (RDA)			700
Magnesium (mg/day) (RDA)	400	310	

Table 2.5: Recommendations for intakes of trace minerals (19-50 years) (Rolfes, *et al*., 2006, p. 445-456).

Trace mineral	Males	Females	Adults
Iron (mg/day) (RDA)	8	18	
Zinc (mg) (RDA)	11	8	40
Iodine (μg/day) (RDA)			150
Selenium(μg/day) (RDA)			55
Copper (mg/day) (RDA)			900
Manganese (mg/day) (AI)	2.3	1.8	
Fluoride (mg/day) (AI)	3.8	3.1	
Chromium (μg/day) (AI)	35	25	
Molybdenum (μg/day) (RDA)			45

2.2.1.2 Food based dietary recommendations

Amongst others, food based dietary recommendations include the South African Food-Based Dietary Guidelines (FBDG) and the United States Department of agriculture{USDA}/ United States Department of Health and Human Services {DHHS} food guide pyramid.

a) South African Food-Based Dietary Guidelines (FBDG)

The South African FBDG were formulated to address existing under and overnutrition in different communities in South Africa. The guidelines are based on existing eating patterns appropriate to the various South African dietary cultures. Clearly the guidelines demonstrate the striving towards equity in diet and health. The aim of the South African FBDG is to optimise nutritional status in both disadvantaged and affluent communities. These guidelines can be used as a basis in planning, implementation and evaluation of public health nutrition strategies. The aims of developing guidelines for South Africans were to help individuals and groups choose an adequate and prudent diet; to improve dietary intake, nutritional status and health; as well as in the prevention of diet-related diseases (Gibney and Voster, 2001). The following South African (FBDG) have been formulated

- Enjoy a variety of food
- Be active
- Make starchy food the basis of the most meals
- Eat plenty of vegetables and fruits every day
- Eat dry beans, peas, lentils and soy often
- Meat, fish, chicken, milk and eggs can be eaten every day
- Eat fats sparingly
- Eat salt sparingly
- Eat and drink food and drinks containing sugar sparingly and not between meals
- Drink lots of clean, safe water
- If you drink alcohol, drink sensibly (Vorster *et al.*, 2001; Steyn *et al*., 2003).

b) USDA/DHHS food guide pyramid

The food guide pyramid was developed based on the nutrition problems, food supplies, eating habits and cultural beliefs of populations. The aims of these guidelines are to promote good health and reduce the risk of chronic diseases such as heart disease, certain types of cancer, diabetes, strokes and osteoporosis. The USDA food guide encourages greater consumption of fruit, vegetables, milk and milk products and whole grains. The following USDA food guide pyramid assigns food to five major food groups with recommended daily amounts of those food groups (Mathai, 2004, p.304).

Figure 2.1: USDA/DHHS food guide pyramid

Portion sizes (a serving) include the following:

Bread, Cereal, Rice and pasta: ½ cups cooked/ 1 slice of bread/ 30g dry cereal

Vegetable: ½ cup cooked/ 1 cup raw leafy vegetables

Fruit: 1 medium fruit/ ½ cup chopped fruit/ ¾ cup fruit juice

Milk, yoghurt and cheese: 1 cup milk/ 45g cheese

Meat, Poultry, Fish, Dry beans, Eggs and Nuts: 30g Meat fish or poultry/ 1egg/ 1cup beans and 10 nuts

Fats, Oils and Sweet: Use sparingly (Mathai, 2004, p.304).

2.2.2 Measurement of dietary intake

The ability to accurately assess nutritional status and lifestyle has become critically important in recent decades. Nowadays as knowledge and interest in the relationships between diet and health have increased, nutrition researchers must be able to measure food and nutrient intake as well as lifestyle with accuracy and precision before drawing conclusions about how health and risk for disease are influenced by what a person eats and lifestyle (Lee and Nieman, 2003, p. xv).

The most important reason for measuring dietary intake is to prevent disease and improve human health. Nutritional problems which include undernutrition and overnutrition, are at the root of the leading causes of death, in both developing and developed nations. Food and nutrient intake data are critical for identifying groups at risk and for disease reduction and their health promotion (Lee and Nieman, 2003, p. 73 and 74).

The purpose of dietary assessment is to estimate food consumption or nutrient intake in individuals or groups of people (Nelson, 2000, p. 311). One may collect dietary intakes to screen, assess, evaluate, and plan interventions or monitor dietary intake or nutritional status of individuals, groups, or nations (Dwyer, 1999, p. 937). Assessments vary from very precise estimates of nutrient intake in metabolic studies to broad estimates of the amounts of food available to entire populations. The reasons for carrying out dietary assessment vary widely, but they usually relate to the need to understand the effects of diet on health (Nelson, 2000, p. 311).

Measurement of nutrient intake is probably the most widely used indirect indicator of nutritional status. However, estimating an individual's usual dietary and nutrient intake is difficult. The task is complicated by weaknesses of data-gathering techniques, human behavior, the natural tendency of individual's nutrient intake to vary considerably from day to day, and the limitations of nutrient composition tables and data bases. Despite these weaknesses, nutrient intake data are valuable in assessing nutritional status when used in conjunction with anthropometric, biochemical, and clinical data (Lee and Nieman, 2003, p.73 and 74). The best method depends on the purpose of the investigation (Dwyer, 1999, p. 937). Before undertaking dietary assessments, it is necessary to consider the exact purpose of the assessment, what is to be measured, in whom, over what time period, and how the measurements are to be collected. This will determine which technique is most appropriate for a given purpose, and avoid wasting resources using a technique that does not provide an appropriate measure (Nelson, 2000, p. 311).

There are two main approaches to individual dietary assessments, namely prospective and retrospective. Prospective methods involve collecting or recording current diet, while retrospective methods require subjects to recall either recent or past diet. The main advantage of prospective methods is that they provide a direct measure of current diet. Also, they can be carried out for varying lengths of time according to the level of accuracy of the estimate of food consumption or nutrient intake needed at the individual level. Retrospective methods include the 24-hour recall, food frequency recalls, and dietary histories (Dwyer, 1999, p 942). These methods require subjects to recall aspects of their diet. This may involve remembering the type and amount of all individual items consumed over a specified time as well as recollecting both the frequency of consumption of specific food or food groups. The retrospective methods are quick to administer compared with prospective methods. Retrospective methods are also less expensive in terms of equipment and the time taken for interviewers to see subjects, there is a lower respondent burden than required for prospective methods and the chances of obtaining a more representative sample of all consumers are increased (Nelson, 2000, p. 318 and 319).

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

2.2.2.1 Food frequency questionnaires (FFQs)

a) Characteristics

FFQs are preprinted lists of food on which subjects are asked to indicate the typical food frequency of consumption and to state in household measures the average amount consumed (Nelson, 2000, p.320). The FFQ is a retrospective review of intake frequency, that is, food consumed per day, per week, or per month (Hammond, 2004, p.418) or per year (Lee and Nieman, 2003, p.81). FFQs assess energy and/or nutrient intake by determining how frequently a person consumes a limited number of food types that are major sources of nutrients or of a particular dietary component in question. Questionnaires can be semi-quantitative when subjects are asked to quantify usual portion sizes of food items, with or without the use of food models. Record is obtained by interview or self-administered questionnaire (Lee and Nieman, 2003, p. 80 and 81).

b) Uses

FFQ's are mainly used in studies that are designed to look for associations between food intake and disease, particularly when specific foods rather than the level of consumption of a nutrient are thought to be the important factor. They are also used for geographical, seasonal and demographic subgroups and individuals (Rutishauser and Black, 2002, p. 226). The respondent records or describes usual intakes of a list of different foods and the frequency of consumption per day, week, or month, over a period of several months or a year. The number and the type of food items vary, depending on the purpose of the assessment (Dwyer, 1999, p. 942).

c) Advantages

FFQ's are suitable for large-scale surveys (Nelson, 2000, p. 317) and useful where the purpose is to study associations of a specific food or a small number of food groups and disease such as heart disease and diabetes (Dwyer, 1999, p. 943). It is relatively inexpensive for large sample sizes (Barasi, 2003, p. 10; Lee and Nieman, 2003, p. 86;

Dwyer, 1999, p. 943), and provides an overall picture of intake and is easily standardized (Hammond, 2004, p.422). FFQs are quick to administer (Barasi, 2003, p. 10; Dwyer, 1999, p.943) and can also be self-administered (Lee and Nieman, 2003, p. 86; Barasi, 2003, p. 10; Ruishauser and Black, 2002, p. 235; Nelson, 2000, p.328) or interviewer administered (Dwyer, 1999 p. 943). Some FFQs also attempt to quantify the frequency of information by obtaining data on a portion size, called quantitative FFQ (Rutishauser and Black, 2002, p. 235).

d) Disadvantages

FFQ's are not suitable for small-scale studies as the random errors are large and precision at the individual level is limited (Rutishauser and Black, 2002, p. 235). Most food frequency questionnaires obtain information only on the frequency of consumption of a food over a given period and not on the context in which the food groups were eaten, that is, on meal patterns (Rutishauser and Black, 2002, p. 235). FFQs do not provide meal pattern data, require knowledge of portion sizes, and require literacy skills if self-administered (Hammond, 2004, p. 422; Nelson, 2000, p 317). The results are culture-specific and different groups may require a new questionnaire. Additionally, individuals with unusual diets within the study group may not fit the predetermined criteria for coding (Barasi, 2003, p. 10).

2.2.2.2 24-hour recall

a) Characteristics

With the 24-hour recall, the interviewer asks the respondent to remember all the food and drinks consumed during the previous 24 hours. The interviewer helps the respondent to recall the types of foods and drinks consumed in each meal and also assists the respondent to estimate portion sizes. After the interview, the recall is checked for omissions and/or mistakes (Lee and Nieman, 2003, p.77). The interviewer then records this information for later coding and analysis (Hammond, 2004, p. 419; Lee and Nieman, 2003, p. 77).

b) Uses

The 24-hour recall is probably the most widely used method of obtaining information on food intake from individuals. It is often used in national surveys because it has a relatively high response rate and can provide the detailed information required by regulatory authorities for representative samples of different population subgroups (Rutishauser and Black, 2002, p. 233).

c) Advantages

The 24-hour recall is quick method to assesses usual diet. It can provide detailed information on types of food consumed with low respondent burden and only requires short-term memory. The 24 hour recall can be used to estimate nutrient intake of groups and multiple recalls can be used to estimate nutrient intake of individuals (Lee and Nieman 2003, p .77-78; Nelson, 2000, p.317).

d) Disadvantages

Respondents may withhold or alter information about what they have eaten because of poor memory or embarrassment or to please or impress the interviewer. Respondents tend to underreport binge eating, consumption of alcoholic beverages, and consumption of foods perceived as unhealthy (Lee and Nieman, 2003, p. 76). Another disadvantage of 24-hour recall is an inability to recall accurately the kinds and the amounts of food eaten, and the tendency for persons to overreport low intakes and underreport high intakes of foods (Hammond, 2004, p. 419; Lee and Nieman 2003, p. 76).

2.2.2.3 Other methods

Dietary intakes can also be determined by the daily food record diary, diet history, photographic or video records (visual records), weighed food intake, telephonic interviews, observation of food intake, food balance sheets, duplicate food collection intake and computerized techniques (Lee and Nieman, 2003, p. 84-91).

2.3 Anthropometric status

Anthropometry is the measurement of body size, weight, and proportion. It involves obtaining physical measurements of an individual and relating them to standards that reflect the health, growth and development of the individual. These physical measurements are another component of the nutritional assessment and useful for evaluating overnutrition or undernutrition (Hammond, 2004, p. 421; Lee and Nieman 2003, p. 164; Barasi, 2003, p. 11). The measurements should be made carefully, in a room without the presence of unnecessary people (Lohman, *et al.*, 1991, p.1).

Various methods can be used to determine anthropometric measurements. For the purpose of this dissertation, height and weight (BMI), waist circumference, and waist and hip circumference ratio will be discussed.

2.3.1 Height and weight (Body Mass Index)

A weight/height index aims to correct body weight for height. A weight/height index should have a high correlation with body fat, but also a low correlation with body height, otherwise in short people body fat would be systematically overestimated or underestimated. In the literature, a number of weight/height indices have been proposed. The Quetelet index or BMI is the most widely used index today. The World Health Organization (WHO) promotes BMI as a crude indicator for weight judgment. In Table 2.6 the cut-off points for underweight, normal weight, overweight and obesity are given. These cut-off values are based on the relation of BMI with mortality and with risk factors for disease as found in Caucasian populations. The WHO is presently considering adaptation of these cut-off points for other populations. BMI is determined by dividing the weight (in kilograms) by the square of the height (in meters) (Whitney and Rolfes, 2002, p. 251). Although it does not directly assess percent body fat, BMI values correlate well with body fat in most people (Grosvenor and Smolin, 2002, p. 235).

Table 2.6: Classification of weight in adults according to BMI (Laquatra, 2004, p. 565, Table 24-1).

Classification	BMI (kg/m^2)	Risk of chronic, non-communicable diseases
Underweight	< 18.5	Low (but risk of other clinical problems may be greater)
Normal range	18.5-24.9	Average
Overweight	25.0-29.9	Increased
Obese class I	30.0-34.9	Moderate
Obese class II	35.0-39.9	Severe
Obese class III	>40	Very severe

2.3.2 Waist and hip ratio (WHR)

WHR is increasingly used as an indicator of body fat distribution. The circumference of the waist at the umbilicus and the hips around the fattest part of the buttocks are used to calculate this ratio. Values above 0.8 in women and 0.9 in men are indicative of a tendency for central fat deposition (Barasi 2003, p. 12), and a possible increased health risk for conditions such as hypertension, type 2 diabetes, and hyperlipidemia associated with increased abdominal fat.

Lower risks are associated with fat placement in the hips and thighs (Lee and Nieman, 2003, p. 182). The "pear-shape" or gynoid obesity, more common in women, has fat distributed predominantly around the hips and thighs (Insel, *et al*., 2001, p. 302), and is not as strongly associated with chronic diseases (Whitney and Rolfes, 2005 p. 265). The apple shape, "android obesity" typical of men, has extra fat distributed higher up, around the abdomen (Insel, *et al*., 2001, p. 302). This kind of fat distribution is closely associated with heart disease, stroke, diabetes, hypertension, and some types of cancer (Whitney and Rolfes, 2005 p. 265).

2.3.3 Waist circumference (WC)

WC is an anthropometric measurement used to assess a person's abdominal fat. WC measurement alone has been shown to correlate well with body fatness and can be used as a quick indicator of health risk from overweight (Barasi, 2003, p. 12; Janssen *et al.*,

2004). When WC is used as an independent predictor of risk, a WC of >102cm in men and > 88cm in women is considered a risk (Lee and Nieman, 2003, p.183).

2.4 Lifestyle

Lifestyle factors that will be discussed un this dissertation are include physical activity, smoking and alcohol consumption.

2.4.1 Physical activity

In the past, activity came in the form of daily work such as hunting, food gathering, and shelter building. Palaeolithic research has noted that it was common for our ancestors to walk as much as 20 miles (32 km) to trade their goods and visit family and friends in neighbouring villages. However, today, this long walk may seem an unpleasant task due to the availability of transport (Wildman and Miller, 2004, p. 73-75).

Physical activity, by definition, results in an increase in energy expenditure due to the cost of the activity itself, and is also hypothesized to increase resting metabolic rate (RMR). Increases in energy expenditure are likely to decrease the likelihood of positive energy balance (Goran and Astrup, 2002, p. 44 and 45). Energy balance can be defined as the difference between food energy intake (metabolizable energy) and energy expenditure (Van Raaij, 2000, p.87). Physical activity represents the metabolic cost of external work, which includes the energy needed for exercise as well as for the functions of daily life, such as sitting, standing, and walking. For most people, physical activity accounts for 15 to 30% of energy requirements, but this varies greatly. The energy required to perform an activity, such as walking, increases with increasing body weight, because it takes more energy to move a heavier body. Energy requirements also depend on how strenuous the activity is and the length of time in which it is performed (Grosvenor and Smolin, 2002, p. 228 and 229).

Physical activity leads to fitness. Fitness refers to the characteristics that enable the body to perform physical activity. A broader definition of fitness is the ability to meet routine

physical demands with enough reserve energy to rise to sudden challenges. This definition shows how fitness relates to everyday life (Whitney and Rolfes, 2002, p. 464).

2.4.1.1 Energy Expended in Physical Activity (EEPA)

EEPA encompasses all types of activity, including sports and leisure, work related activities, general activities of daily living and fidgeting. The cumulative total daily energy cost of physical activity is highly variable both within and between individuals, depending on the size of the subject, the speed, nature and duration of the activity, the time resting between movements, the skill with which the movements are made and the efficiency of the muscles (Goran and Astrup, 2002, p.37; Van Raaij, 2000, p. 84).

In affluent countries, physical activity accounts for twenty to forty percent of total energy expenditure in most individuals (Van Raaij, 2000, p. 90). EEPA is the most variable component of Total Energy Expenditure (TEE). It may range from as little as ten percent in a person who is bedridden to as much as fifty percent of TEE in athletes. EEPA includes energy expended in voluntary exercise and during involuntary activity such as shivering, fidgeting, and maintaining postural control. The level of fitness also affects the energy expenditure of voluntary activity, probably because of variation in muscle mass. EEPA decreases with age, a trend that is associated with a decline in fat free mass and an increase in fat mass. Men generally have a higher EEPA than women, primarily because of their larger body size and greater fat free mass (Frary and Johnson, 2004, p.25).

2.4.1.2 Physical activity level

Physical activity level (PAL) values for various activities performed throughout the day can be determined by adding the PAL for each activity. PAL can be determined by the method shown in Table 2.7 and categorised using Table 2.8.

Table 2.7: Method of determining intensity and impact of various activities on physical activity levels (Frary and Johnson, 2004, pp.33, Table 2-4).

Physical activity	PAL/10 min	PAL/hr
Daily activities		
Lying quietly	0	0
Riding in a car	0	0
Light activity while sitting	0.005	0.03
Watering plants	0.014	0.09
Walking the dog	0.019	0.11
Vacuuming	0.024	0.14
Doing household tasks (moderate effort)	0.024	0.14
Gardening (no lifting)	0.032	0.19
Mowing lawn (Power mower)	0.033	0.20
Leisure activities: Mild	0.014	0.09
Walking (2 mph)	0.014	0.09
Canoeing (leisurely)	0.014	0.09
Golfing (with cart)	0.018	0.11
Dancing (ballroom)		
Leisure activities: Moderate		
Walking (3 mph)	0.022	0.13
Cycling (leisurely)	0.024	0.14
Performing callisthenics (no weight)	0.029	0.17
Walking (4 mph)	0.0.33	0.20
Leisure activities: Vigorous		
Chopping wood	0.037	0.22
Playing tennis (doubles)	0.038	0.23
Ice skating	0.043	0.26
Cycling (moderate)	0.045	0.27
Skiing (downhill or water)	0.055	0.33
Swimming	0.057	0.34
Climbing hills (5 mph)	0.061	0.37
Walking (5 mph)	0.067	0.40
Jogging (10-minute mile)	0.088	0.53
Skipping rope	0.105	0.63

Table 2.8 Physical activity level categories (Frary and Johnson, 2004, pp. 32, Tables 2.3)**.**

PAL category	PAL values
Sedentary	1-1.39
Low active	1.4-1.59
Active	1.6-1.89
Very active	1.9-2.5

2.4.1.3 Benefits of physical activity

Throughout much of recorded history, physical activity has been promoted for improved health, function, and longevity. Physical activity combined with healthy diet and rest are

important contributors to overall well-being (Wildman and Miller, 2004, p. 73-75). Therefore, physical activity provides the greatest source of flexibility of the joints, strength and endurance of the muscles, including the heart muscle (Goran and Astrup, 2002, p.37; Van Raaij, 2000, p. 84).

Physical activity has beneficial effects on substrate metabolism, with an increased reliance on fat relative to carbohydrate for fuel utilization, and it has been hypothesized that highly active individuals can maintain energy balance on a high-fat diet (Goran and Astrup, 2002, p. 44 and 45).

Various epidemiological studies have shown that activity increases energy expenditure and is, therefore, crucial for the maintenance of energy balance and normal weight. Regular physical exercise may be important in lowering diastolic blood pressure, protects against the development of heart disease, reduces cardiovascular mortality, prevents colon cancer, regulates blood glucose levels, lowers blood lipid levels and modifies associated risk factors (such as hypertension, insulin resistance, lower risk of suicidal behavour and obesity). It improves exercise tolerance and improves the body's ability to withstand stress, meaning both physical and psychological stress as well as to eliminate anxiety (Irazusta *et al.*, 2006; Wildman and Miller, 2004, p. 73-75; Lucas, 2004, p. 280; Adami et al., 2003; Brown and Blanton, 2002; Whitney and Rolfes, 2002, p. 464; Akandere and Tekin 2002; Anderson, 1999, p.1386; Paffenbarger *et al.*, 1986). Activity offers still more psychological advantages. The fit person looks and feels healthy and, as a result, gains self-esteem. High self-esteem motivates a person to persist in seeking good health and fitness (Whitney and Rolfes, 2002, p. 284-255). Therefore physical activity can preserve and improve health, help individuals to avoid illness, and play a role in rehabilitating patients (American College of Sports Medicine, 1998).

Activity helps to maintain muscle mass and sense of balance, which is important with increasing age to preserve independence and prevent falls (Barasi, 2003, p. 382 and 383). Activity, combined with an optimal calcium intake, is associated with increased bone mineral density in children and adolescents (Lucas, 2004, p. 280). Physical activity

lessens coronary heart disease (CHD) risk by retarding atherogenesis, increasing the vascularity of the myocardium, increasing fibrinolysis, and modifying other risk factors, such as improving glucose tolerance and insulin sensitivity (Krummel, 2004, p. 874). A physically active life with abstention from smoking, moderate alcohol consumption and consumption of healthy foods maximizes the chances of having a normal weight (Koski *et al.*, 2002).

A routine exercise program is important for all people. The most beneficial exercise program differs for each person, but walking is best for obese individuals. Other exercises such as bicycling, stair climbing, swimming, and aerobic dancing are good alternatives to walking (Anderson, 1999, p.1386). A person can choose to undertake a range of different activities during the course of a typical day, walking to work or school, taking part in sports, or having hobbies that involve movement. On the other hand, a person can drive or take the bus to work, sit during breaks and lunch and, on returning home, spend the evening in front of the television. Clearly such contrasting lifestyles will be associated with different levels of energy output (Barasi, 2003, p. 133).

The opposite of a physically active life is a sedentary life. Today's world fosters inactivity by providing people with escalators, cars and other labour-saving devices. As people go through life exerting minimal physical effort, they become weak and unfit and begin to feel unwell. In fact, a sedentary lifestyle fosters the development of several chronic diseases (Whitney and Rolfes, 2002, p. 464).

Strenuous leisure time physical activity is associated with a reduced risk of breast cancer in both pre-and postmenopausal women (Dorna *et al*., 2003). Short bouts of regular low to moderate intensity exercise are importance to reduce fatigue in women with breast cancer (Schwartz *et al*., 2001). A single bout of aerobic walking exercise can improve fibrinolysis profiles in chronic stroke patients (Ivey *et al.*, 2003).

2.4.1.4 Recommendations for physical activity

Exercise programs for both prevention and rehabilitation are most effective when they are individualized. Exercise programs must be based on the person's current fitness and health status with emphasis on intensity, frequency, duration and type of exercise (William *et al.*, 1996). Prior to engaging in a regular exercise program it is suggested that participants receive a physical examination by a physician. The basic exercise routine or regimen should consist of the following exercise prescription (Wildman and Miller 2004. p. 71)

Warm-up: A 5-10 minute light aerobic warm-up should be performed prior to any other exercise to increase body temperature and prepare the body for work.

Stretch: should follow a warm-up in order to increase muscle and soft connective tissue temperature and decrease viscosity.

Strength training: should be performed 2-3 days/week using all the major muscle groups.

Cardiorespiratory: Perform 30-60 minutes of continuous rhythmic movement 3-5 days/week.

Warm-down: Gradually decreasing the intensity level allows the pumping of the skeletal muscles to maintain adequate venous return to the heart and hence keep blood from pooling in the extremities..

Stretch: Performing static stretches after a training session helps bring the muscle tissue bake to normal resting lengths.

According to Corbin and Pangrazi, (1998, as referred to by Lucas 2004), children should be active for at least a total of 60 minutes a day, with activity including moderate to vigorous activity. To prevent weight gain and support weight loss, 60 minutes of moderate intensity physical activity a day in addition to activities of daily life are recommended. Adults should engage in moderate intensity physical activities for at least 30 minutes on 5 or more days of the week and vigorous intensity physical activity 3 or more days per week for 20 or more minutes per occasion (Centre for Disease Control (CDC), 1996).

2.4.2 Smoking

Throughout history, man has smoked or ingested any number of plant-derived substances such as opium from the poppy, marijuana from the cannabis plant, peyote from a cactus, and nicotine from tobacco (Handelsman, 1995, p. 365).

2.4.2.1 Smoking and health complications

Smoking is linked to many health problems, from minor mouth sores, to tumours in the nasal cavities, cheeks, gums, and throat. The risk of mouth and throat cancers is even greater for chewing tobacco. Tobacco chewing also damages the gums, tooth surfaces and jawbones, making it likely that users will lose their teeth in later life (Whitney and Rolfes, 2002, p. 564).

Tobacco alone or in combination with alcohol, remains the most important cause of cancer, accounting for about one of every three cancer cases. Cigarettes are the most important cause of tobacco related cancer, but other forms of tobacco (chewing tobacco and snuff) are also established carcinogens (Williams, 1993, p. 737).

Smokers have an almost threefold increase in heart attacks compared to non-smokers. Cigarette smoking is also considered the major risk factor for sudden cardiac death. A heart attack in a smoker is more likely to be fatal than in a non smoker (Brown and Smith, 1995, p. 439). Cigarette smokers often possess characteristics associated with low bone density independent of their exposure to tobacco (Huges and Krall, 1999, p. 1361). Lung cancer is the second most common cancer worldwide and the established cause is cigarette smoking (Bingham, 2000, p. 773).

Smoking may increase the risk of having gastric intestinal metaplasia in *H. pylori*-positive subject (Russo *et al.*, 2001). Relative risks of death for individuals were highest among cigarette smokers and men with hypertension, and attributable risks in the community were highest among smokers (Paffenbarger *et al*., 1986).

2.4.2.2 Effects on nutritional status

Smoking suppresses the appetite and produces a marked increase in motor activity and mood elevation; as a result, an individual may be unaware of the need for food for long periods of time. In smokers, eating is often focused on energy dense foods with a low nutrient density, such as jelly doughnuts, cream-filled cakes, chips, pretzels, and soft drinks (Handelsman. 1995, p. 366). Smokers generally have the lowest dietary antioxidant intake and status (vitamin A, beta-carotene, folate, zinc and vitamin C) as well as a lower intake of dietary fiber, milk, fruits, vegetable and water (Rolfe *et al.*,. 2006, p.541; Faruque *et al.,* 1995). Generally, smokers have a higher intake of alcohol than non-smokers (Hendricks, *et al.,* 2004; Mammas et al., 2004; Sizer and Whitney, 2000 p. 467; Mascarnhas *et al.,* 2001, p.435; Ma *et al*., 2000).

2.4.2.3 Benefits of quitting

The health benefits of quitting are substantial. Ten to fifteen years after quitting, an ex-smoker's risk of shorter life expectancy, and of cancer of the lungs, mouth and larynx, is close to that of someone who has never smoked. The risk of coronary heart disease drops one year after quitting and after 10 years is the same as in non-smokers. The ability to breath improves immediately (Handelsman, 1995, p. 371). Quitting smoking, even late in life after heavy long-term abuse, greatly reduces cancer risk when compared with the risk had smoking been continued (Williams, 1993, p. 737).

2.4.3 Alcohol consumption

Alcohol (its chemical name ethanol) is the result of the breakdown of sugars and starches by fungus (yeast) in a process called fermentation. Modern beer is made by fermenting barley and hops. Wine comes from the fermentation of grapes or others fruits or plants, and hard liquors from the fermentation of starches derived from various grains or from potatoes. After fermentation, the resulting product is distilled to concentrate the alcohol. Alcohol has been used as a mind altering substance, disinfectant, tonic and diuretic (Liber, 1995, p. 348).

Alcoholic beverages are consumed as part of many social activities, but consumption can also become excessive and result in physical, psychological and social harm to the individual as well as those around them. Economic estimates suggest that health and other problems related to alcohol consumption, including time away from work, represent a heavy financial burden (Barasi, 2003, p. 52).

Alcoholism is a major problem in adolescence and can occur as early as the 12th grade (Mascarnhas *et al*., 2001, p. 43). Alcohol is also the most commonly used substance at university (Sliva *et al.,* 2006). In the UK, men drink twice as much as women and the young more than the old; married adults drink less than single men and women. Usually poor people drink less than the affluent sector of society and permitted drinking hours influence the pattern of drinking and its consequences (James and Ralph, 2000, p. 122). The effects of alcohol, physically, psychologically and economically, depend on the amount and the type of drink a person consumes (Williams, 1993, p. 588).

2.4.3.1 Alcohol and health complications

In the brain, alcohol acts as a depressant. First, it affects reasoning and if drinking continues, the vision and speech centres of the brain are affected. Next, large muscle control becomes impaired, causing lack of coordination. Finally, the individual loses consciousness. This can occur with binge drinking. Binge drinking is a problem on college campuses that causes about 50 percent of deaths and hundreds of cases of alcohol poisoning annually (Grosvenor and Smolin, 2002, p.591).

Alcohol represents a risk factor for overweight and obesity as a result of specific effects on energy metabolism and substrate metabolism (Suter, 2004). Consumption of more than two alcoholic drinks per day is associated with a significant elevation in the risk of iron overload (Ioannou *et al.,* 2004) and ischemic stroke (Mukamal *et al.,* 2005). In addition, heavy drinking is associated with hypertension, heart disease, and other health problems (Grosvenor and Smolin, 2002, p. 591).

Excessive alcohol intake can cause dehydration (Barasi, 2003, p. 222). Long-term excessive alcohol consumption has serious health implications. Alcohol either directly or

indirectly affects every organ in the body or increases the risk of malnutrition and many chronic diseases (Grosvenor and Smolin, 2002, p.591). Alcohol also increases risks of upper gastrointestinal tract cancer, and even moderate intake appears to increase risk of cancers of the breast and large bowel (Willett, 1999, P. 1250). Excess consumption alters liver metabolism (James and Ralpha, 2000, p. 132).

Excessive alcohol use has been linked to increased risk of cancer, high blood pressure, heart disease, dementia, and other disorders. Years of excessive drinking can cause liver cirrhosis (Liber, 1995, p. 349). Alcohol use has also been consistently linked to colorectal cancer and female breast cancer. Liquor, wine and beer seem to be equal in their effect on cancer risk (Williams, 1993, p. 737).

Excess alcohol intake contributes to other diseases, such as hypertension, ulcers and mental illness, as well as accidents and violence. Drinking among women has possible implications for the health of the fetus, if it is continued throughout pregnancy. High levels of alcohol ingestion may result in fetal alcohol syndrome; characterized by developmental abnormalities of the face, brain, heart and kidneys of the baby (Barasi, 2003, p.358; Mascarnhas *et al*., 2001, p. 43).

Moderate alcohol consumption has also been linked to beneficial effects, particularly in protection against coronary heart disease. There is a J-shaped relationship between overall mortality and alcohol consumption, with abstainers and heavier drinkers having higher mortality rates than those seen as moderate drinkers. Maximum health advantage for coronary heart disease lies at levels of intake between 1-2 units per day. The reasons for the shape of this curve are still not agreed. In addition, the J-shaped relationship is now known to apply predominantly to men over the age of 35 years and women after the menopause, with benefits increasing in older age groups. The level at which no harm is caused by alcohol also increases with age, so that the young drinker is most at risk. Mortality risk is increased in young drinkers at levels of alcohol consumption normally considered to be ‘safe’; this may be associated with accidents and injury rather than the long-term physical damage caused by alcohol itself (Barasi, 2003, p. 52).

2.4.3.2 Effect of alcohol on nutritional status

The interactions between nutrition and alcoholism occur at many levels and are complex. Alcoholic beverages contain energy but almost no other useful constituents. Ethanol containing beverages alter appetite and affect food intake and use. They displace required nutrients from the diet. Ethanol and nutrients have multiple interactions at almost every level of the gastrointestinal tract. Ethanol alters the storage, mobilization, activation and metabolism of nutrients (Feinman and Lieber, 1999, p. 1523). Alcohol provides some energy but no protein and practically no vitamins and minerals, which contributes to both primary and secondary malnutrition (Nicolas *et al.,* 2003; Williams, 1993, p.588).

Alcohol also directly interferes with the body's absorption, storage, and use of nutrients, even if they are present in adequate amounts in the diet (Liber, 1995 p. 349). Alcohol damages the lining of the small intestine, decreasing the absorption of several B vitamins and vitamin C (Grosvenor and Smolin, 2002, p. 591). Alcohol impairs thiamin absorption and enhances thiamin excretion in the urine (Rolfes et al., 2006; Grosvenor and Smolin, 2002, p. 589).

Nutritional intake is likely to be affected and chronic over-consumption of alcohol is associated with a number of specific nutritional deficiencies. Even at moderate intakes, it is likely that alcohol contributes to total energy supply and this may result in weight gain. Social consumption of alcohol accompanying meals has been shown to be associated with a larger food intake (Barasi, 2003, p. 52), and consumers of alcohol had a lower intake of fruit, dairy products, and cereal products as well as higher consumption of fat (Ruf *et al*., 2005).

Chapter 3: Materials and Methods

3.1 Introduction

A descriptive study was conducted, as the main aim was to describe the nutritional status and related lifestyle factors of undergraduate students in the Faculty of Health Sciences at the University of the Free State.

In order to achieve the main aim, the following information was collected: usual diet (food, energy and macronutrient intake), weight and height status of students (BMI), waist-hip-ratio, waist circumference and lifestyle behaviors (physical activity, smoking and alcohol consumption). Associations between parameters of nutritional status and lifestyle factors were also determined.

3.2 Ethical considerations

Ethical approval was obtained from the Ethics Committee of the University of the Free State. Approval was obtained from the Vice Rector: Academic Planning, Deputy Dean: Student Affairs and the Heads of the Schools of Medicine, Nursing, and Allied Health Professions (Appendix A) prior to the study. The consent form included information explaining the purpose of the study as well as procedures to be followed during the study (Appendix B).

3.3 Sample selection

A list of all students in the Faculty of Health Sciences at the University of Free State was obtained from the administration office. A systematic sampling method was used. By selecting a starting point at random, every k^{th} individual on the list was selected by the Department of Biostatistics at the University of the Free State, using population size divided by desired sample size, giving k, the size of the gap between elements. Sample size was 232. The total population number was 1408, divided by 232, so that every 6^{th} person on the list was included. The next person on the list was considered if the chosen student could not be contacted or did not consent to participate. The response rate was 69%.

Inclusion criteria:

Health Science undergraduate students of all ages

Full-time students at UFS

Exclusion criteria:

Part-time students

Physically handicapped and pregnant students

3.4 Operational definitions

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

3.4.1 Usual Diet

Usual diet refers to usual daily intake of foods, energy and macronutrients. A food intake less than the recommendations of the food guide pyramid for each food group were considered inadequate. An intake equal to the recommendations of the food guide pyramid was considered adequate, and an intake higher than the recommendations of the food guide pyramid was considered high. Meal patterns and individual habitual intake of food and drinks expressed as frequency of usual intake were also evaluated.

3.4.2 Body mass index (BMI)

BMI refers to current weight in kg divided by height in m^2. According to international recommendations (Laquatra, 2004, p 565), underweight is defined as a BMI of less than 18.5 kg/m^2; normal weight is 18.5 to 24.9 kg/m^2; overweight is defined as BMI of 25.0-29.9 $kg/m^{2,}$ and obesity is defined as BMI $\geq$ 30 kg/m^2.

3.4.3 Waist-hip-ratio (WHR) and waist circumference (WC)

WHR refers to waist circumference (cm) divided by hip circumference (cm). For the purpose of this study a WHR above 0.8 in women and 0.9 in men are indicative of a tendency for central fat deposition, and a possible increased health risk **(**Barasi 2003, p. 12). The area where fat is deposited is defined as android distribution (fat around the waist and upper abdomen, or "apple shape") and gynoid distribution (fat in the buttocks and thighs or "pear shape") (Hammond, 2000, p.372).

WC measurement alone has been shown to correlate well with body fatness and can be used as a quick indicator of health risk from overweight (Barasi, 2003, p. 12; Janssen *et al*., 2004). When WC is used as an independent predictor of risk, a WC of >102cm in men and > 88cm in women is considered a risk (Lee and Nieman, 2003, p.183).

3.4.4 Physical activity levels

Physical activity levels were determined using the Previous Day Physical Activity Recall (excluding Saturday). Four physical activity level (PAL) values (Frary and Jonson, 2004, p.32) were categorized as follows:

- Sedentary: 1-1.39 PAL;
- Low active: 1.4-1.59 PAL;
- Active: 1.6-1.89 PAL; and
- Very active: 1.9-2.5 PAL.

3.4.5 Smoking: for the purpose of this study, smoking refers to the number of cigarettes smoked per day. According to Russo *et al*. (2001) and Hill *et al.* (1998), smoking can be categorized as follows:

- Non-smokers: defined as students who had never at any stage smoked;
- Former smokers: defined as students who had formerly smoked but who had stopped smoking for at least one year before entering the study; and
- Current smokers: defined as students who had smoked at least one cigarette or pipe, per day for at least 1 year prior to entering the survey.

3.4.6 Alcohol consumption

According to Mukamal *et al*. (2005) alcohol consumption can be categorized as follows:

- Teetotalers: defined as never having at any stage consumed alcoholic beverages;
- Former consumers: defined as formerly having consumed alcoholic beverages, but not at the time of the survey; and
- Consumers: defined as using alcohol at the time of the survey.

3.5 Pilot study

A pilot study was undertaken on five students that were similar to the target group and met the inclusion criteria. For the pilot study students were randomly selected and excluded from the main study. The pilot study indicated how long it takes to complete the questionnaires and to perform anthropometric measurements as well as the need for interpreters when administering the questionnaires.

3.6 Data collection process

The researcher compiled questionnaires, took all the anthropometric measurements and conducted all interviews from7:30am-6:00pm Monday to Friday. The data collection process took 30 minutes per student and a 24-hours recall, short food frequency questionnaire, physical activity questionnaire, socio-demographic questionnaire and anthropometric measurements were completed.

Steps in the data collection process:

Step1

- Approval was obtained from the Ethics Committee of the Faculty of Health Sciences, Vice Dean: Student Affairs and the Head of each School (Medicine, Nursing, and Allied Health Professions) (Appendix A).
- Students were contacted telephonically
- Information regarding the study was given to students by the researcher
- Pilot study was undertaken

Step 2

- Participants completed the consent form (Appendix B).
- Interview was completed at the Department of Human Nutrition
- A structured interview was used to determine the usual diet intake, using a standardized 24-hours recall and short food frequency questionnaire (Appendix C), lifestyle, socio-demographic questionnaire and anthropometric measurements (Appendix D).

Step 3

- The reliability interviews (16 participants) were conducted one month after the initial interview.

3.7 Materials and methods

3.7.1 Usual diet questionnaire

Dietary intake was determined using a questionnaire (Appendix C). A face-to-face interview was conducted with each student. During the interview food modules were demonstrated to the students.

A 24-hour recall was used to determine intake of milk; meat; fruit and vegetables (Vit A); fruit and vegetables (Vit C); fruit and vegetables (other); bread and grains; fats and oils; and sugar and alcohol. Intake of these was categorized as adequate or inadequate by comparing with USDA/DHHS food guide pyramid.

The frequency of intake of relevant foods was determined using the short food frequency questionnaire.

3.7.2 Anthropometric measurements (Appendix D)

Anthropometric measurements, namely weight (kg), height (m), and waist and hip circumferences (cm) were recorded.

3.7.2.1 Weight

Weight was determined with an electronic scale. Subjects wore minimal clothing (removed jacket, shoes and jewelry) stood still in the middle of the scale's platform without touching anything and with the body weight equally distributed on both feet. The weight was recorded to the nearest 100 g as recommended by Lee and Nieman (2003, p.167).

3.7.2.2 Height

Height was determined by means of a standardized stadiometer to the nearest 0.5 centimeters. Subjects stood without shoes and wore minimal clothing. The subjects stood with heels together, arms to the side, legs straight, shoulders relaxed, and head in the Frankfort horizontal plane (looking straight ahead). Heals, buttocks, scapulae (shoulder blades), and back of the head were against the vertical surface of the standiometer. Just before the measurement was taken, the subject inhaled deeply, held the breath, and maintained an erect posture (stand up tall) while the head board was lowered to the highest point of the head with enough pressure to compress the hair (Lee and Nieman, 2003, p.65).

3.7.2.3 Waist and hip circumference

Waist and hip circumference were determined in upright position using a tape measure to the nearest 0.5 cm maintaining close contact with the skin, without compressing outer tissue. To measure the waist, the subject wore minimal clothing, stood erect with the abdomen relaxed, the arms at the sides and the feet together. The measurer faced the subject, and placed an inelastic tape around the subject, in a horizontal plane, at the level of the natural waist, which is the narrowest part of the torso. The measurement was taken at the end of a normal expiration, without the tape compressing the skin (Callaway *et al.*, 1991, p. 44-45).

To measure the hip, the subjects stood erect with arms at the sides and feet together. The measurer squatted at the side of the subject and an inelastic tape was placed around the buttocks in horizontal plane at this level without compressing the skin. The tape was in contact with the skin and the measurement was recorded to the nearest 0.5 cm (Callaway, *et al*, 1991, p.46).

3.7.3 Lifestyle

Socio-demographic information as well as lifestyle factors such as physical activity, smoking and alcohol consumption were determined by means of a questionnaire (Appendix C) completed by the researcher in an interview with each student.

3.8 Statistical analysis

Adequacy of diets was evaluated by comparing the intake of each student to the intake recommended by the Food Guide Pyramid. Food, energy and macronutrient intake, anthropometric status and lifestyle were described by means of descriptive statistics. Descriptive statistics, namely frequencies and percentages for categorical data and medians and percentiles for continuous data, were calculated. Associations between variables were calculated and described by means of 95% confidence intervals.

The Department of Biostatistics at the University of the Free State analyzed the data.

3.9 Reliability and validity

Reliability refers to the degree of similarity of the information obtained when measuring the group. The question is asked whether the same value is arrived at every time the measurement is taken, or whether the values vary a lot on repeated administration (Katzenellenbogen *et al.,* 1997, p. 90).

Validity refers to the extent to which a measure actually measures what it is meant to measure (Katzenellenbogen *et al*., 1997, p. 90).

3.9.1 Usual diet

Validity was ensured as follows:

All issues addressed by the questionnaires were directly related to the aim and objectives of the study. To ensure that the questions were valid, intakes were compared to the recommendations of the Food Guide Pyramid as discussed in the literature. A number of dietitians (experts in the field) were also consulted to comment on the validity of the questionnaire.

Reliability was ensured as follows:

Reliability was ensured by interviewing 10% of randomly selected participants for a second time. The same respondents were contacted one month after the main study and the questionnaire was re-administered. Where the answer to questions differed with more than 20% the question was considered unreliable, and the results were not reported.

3.9.2 Anthropometry

Validity was ensured as follows:

In order to ensure validity of the results, the scales were moved to the zero point before each measurement. The scale was calibrated after every 20th students measured by the researcher using a known weight (Katzenellenbogen 1997, p. 126 and 275).

Reliability was ensured as follows:

In order to ensure reliability of the results, weight and height were measured by the researcher according to standard procedures, as recommended by Lee and Nieman, (2003.p. 65).

3.9.3 Lifestyle

Validity was ensured as follows:

All issues addressed by the questionnaire were directly related to the aim and objectives of the study. The content of the lifestyle questionnaire was chosen in accordance with recommended measures of lifestyle as discussed in the literature.

Reliability was ensured as follows:

The physical activity, alcohol, smoking and demographic questionnaire was tested for reliability by repeating the same questionnaire in 10% of the sample. The same respondents were interviewed one month after the main study and the questionnaires were re-administered to determine reliability.

Chapter 4: Results

4.1 Introduction

In this chapter results pertaining to socio-demographic information, dietary intake, anthropometric and lifestyle factors information of students are included. Associations between the above are also included.

4.2 Socio-demographic information

Table 4.1: Socio-demographic information

Variable	Category	Number	Percent	Median (years)
Age (n=159)	Male	39	24.2	21.8
	Female	122	75.8	21.4
Gender (n= 161)	Male	39	24.2	
	Female	122	75.8	
Place of residence (n= 161)	On campus	52	32.3	
	Off campus	109	67.7	
Academic level (n= 161)	First year	19	11.8	
	Second year	22	13.7	
	Third year	58	36.0	
	Fourth year	52	32.3	
	Fifth year	10	6.2	
Department (n= 161)	Medicine	70	43.4	
	Nursing	25	15.5	
	Physiotherapy	17	10.6	
	Optometry	17	10.6	
	Occupational Therapy	14	8.7	
	Human Biology	1	0.6	
	Radiation	5	3.1	
	Human Nutrition	12	7.5	
Marital status (n= 161)	Single	154	95.7	
	Engaged	2	1.2	
	Married	5	3.1	
	Divorced	0	0.0	
	Widowed	0	0.0	
	Other	0	0.0	
Language (n= 161)	Afrikaans	102	63.4	
	Sotho	23	14.3	
	English	24	14.9	
	Tswana	5	3.1	
	Other	7	4.3	

Of the 161 students included in this study, 24.2% were male and 75.8% were female (Table 4.1). As is shown in the table, the median ages of the students were 21.8 years for males and 21.4 years for females. The majority of students (67%) were living off-

campus. Of the total number of students participating in this study, 36.0% were third year and 32.3% were fourth year students. The students were from different disciplines, namely Medicine, Nursing and Allied Health. Their marital status indicated that 95.7% of the students were single. The students' home languages were Afrikaans (63.4%), Sotho (14.3%) and English (14.9%).

4.3 Dietary intake

Dietary intake was determined using both a 24-hour recall and FFQ.

4.3.1 24-hour recall

Table 4.2: Evaluation of dietary intake

Variable	Category	Number	Percent
Bread, Cereal, Rice and Pasta (n=160)	< 6 Serving per day	70	43.7
	6-11 Serving per day	67	41.9
	> 11 Serving per day	23	14.4
Vegetables (n=161)	< 3 servings per day	158	98.1
	3-5 Servings per day	2	1.3
	> 5 serving per day	1	0.6
Fruits (n=161)	< 2 servings per day	94	58.4
	2-4 servings per day	47	29.2
	> 5 servings per day	20	12.4
B- Carotene rich fruit / vegetable included (n= 161)	Yes	64	39.8
	No	97	60.2
Vitamin C-rich fruit / vegetable included (n= 160)	Yes	111	69.4
	No	49	30.6
Milk, Yoghurt and Cheese (n=161)	< 2 servings per day	133	82.6
	2-3 servings per day	24	14.9
	> 3 servings per day	4	2.5
Meat, Poultry, Fish, Dry Beans, Eggs and Nuts (n= 161)	< 2 servings per day	26	16.1
	2-3 servings per day	51	31.7
	> 3 servings per day	84	52.2
Fats, Oils and Sweets (n= 161)	Small quantities	92	57.1
	High quantities	69	42.9

Table 4.2 shows that 43.7% of student's intake of bread, cereals, rice and pasta was less than the recommended 6 servings. Similarly, 98% of the students ate less than three servings of vegetables and 58.4% of students ate less than two servings of fruits. The majority (60.2%) of students did not include B-carotene rich fruits or vegetables in their diet and 30.6% of the students did not include vitamin C-rich fruits or vegetables on a daily basis. More than 80% of students ate less than two servings of milk, yoghurt and cheese, while 16.1% of students ate less than two servings of meat, poultry, fish, dry

beans, eggs and nuts. It was also reported that 57.1% of the students' intakes of fat, oils and sweets were small in quantity.

4.3.2 Meal patterns

Meal patterns were determined by the 24-hour recall and are shown in Table 4.3. Almost 7% of students regularly skipped breakfast, 0.6% skipped lunch and 3.7% skipped supper.

Table 4.3: Meal patterns of students (n= 161)

Variables	Category	Number	Percent
Breakfast	Yes	150	93.2
	No	11	6.8
Lunch	Yes	160	99.4
	No	1	0.6
Supper	Yes	155	96.3
	No	6	3.7

4.3.3 Energy and macronutrient intake

Median intakes of carbohydrates, protein, and fat were 192g, 59g, and 49 g/day, respectively. For the group as a whole, the median for total energy intake was 6137 kJ/day (Table 4.4). Median intake of energy for males was 8943 kJ and for females were 5195 kJ.

Table 4.4: Total daily energy and macronutrient intakes

Variable	High quartiles	Median	Low quartiles
Carbohydrate (g)	266	192	132
Protein (g)	89	59	40
Fat (g)	85	49	32
Total energy(kJ)	8186	6137	4077
Total energy (kJ) male		8943	
Total energy (kJ) female		5195	

4.3.4 Food frequency questionnaire

The results of the food frequency survey are shown in Table 4.5. The largest proportion of students consumed food types such as sugar, coffee, bread and tea on a daily basis. On the other hand, a very small proportion of students ever ate soy mince/legumes, cereals, and samp. Table 4.4 also shows that 92%, 87.6%, 77.0% and 65.2% of the students ate sweets/chocolates, cakes/biscuits, cooldrinks and alcohol respectively on a weekly basis.

Fifteen percent used cremora, 43% had coffee, and 47.8% had tea weekly. Further, 26.1% had sugar, 83.2% had eggs, and 40.4% had peanut butter weekly (Table 4.5). Among these students, 79.0%, 62.1%, and 57.1% never consumed non-dairy coffee creamers (Cremora), soy mince/legumes and peanut butter, respectively. The food frequency results pertaining to full-cream milk, low fat/skim milk, salt/stock, soup powders and mixed food flavourings (Royco) and water intake frequency results are not included because of poor reliability.

Table 4.5: Food types and frequency of consumption (n=161)

Food type	Frequency	Students	
		Number	Percent
Sweets/chocolates	Never	5	3.1
	Every day	7	4.4
	Weekly	149	92.5
Chips (crisp)	Never	19	11.8
	Every day	0	0
	Weekly	142	88.2
Cake/ biscuits	Never	16	9.9
	Every day	4	2.5
	Weekly	141	87.6
Cool drinks	Never	20	12.4
	Every day	17	10.6
	Weekly	124	77.0
Cremora	Never	128	79.0
	Every day	9	6.0
	Weekly	24	15.0
Coffee	Never	36	22.3
	Every day	56	34.8
	Weekly	69	42.9
Tea	Never	35	21.8
	Every day	49	30.4
	Weekly	77	47.8
Sugar	Never	27	16.8
	Every day	92	57.1
	Weekly	42	26.1
Eggs	Never	23	14.3
	Every day	4	2.5
	Weekly	134	83.2
Peanut butter	Never	92	57.1
	Every day	4	2.5
	Per week	65	40.4
Soy mince/ legumes	Never	100	62.1
	Every day	2	1.2
	Weekly	59	36.7
Chicken/meat/fish	Never	1	0.6
	Every day	27	16.8
	Per week	133	82.6
Bread	Never	2	1.2
	Every day	50	31.1
	Weekly	109	67.7

Table 4.5: Cont.

Food type	Frequency	Student Number	Percent
Porridge cooked	Never	66	41.0
	Every day	4	2.5
	Weekly	91	56.5
Cereal (e.g. Pronutro)	Never	32	19.9
	Every day	2	1.2
	Weekly	127	78.9
Samp/mielie rice	Never	74	46.0
	Every day	3	1.9
	Weekly	84	52.1
Margarine/oil/fat	Never	17	10.5
	Every day	51	31.7
	Weekly	93	57.8
Fruit juice	Never	15	9.3
	Every day	25	15.5
	Weekly	121	75.2
Fruit	Never	2	1.2
	Every day	48	29.8
	Weekly	111	68.9
Vegetables	Never	3	1.9
	Every day	30	18.6
	Weekly	128	79.5
Alcohol	Never	56	34.8
	Every day	0	0.0
	Weekly	105	65.2

4.4 Anthropometric information

Anthropometric information included body mass index (BMI), waist circumference and waist-hip- ratio.

4.4.1 Body mass index

The BMI of the students included in the study is shown in Table 4.6. Out of 161 students interviewed 87.1% of male and 67.2% of female students had a normal BMI. However, 22.1% of female and 12.9% of male students was overweight or obese and 10.7% of female and 0% of male students were underweight.

Table 4.6: Body mass index of male and female students (n=161)

BMI (kg/m^2)	Category	Male (%)	Female (%)
< 18.5	Underweight	0	10.7
18.5 to 24.9	Normal weight	87.2	67.2
≥ 25.0	Overweight and obese	12.8	22.1

4.4.2 Waist circumference and waist-hip-ratio

Of the 161 students included in the study four students had values above cut-off points (for females > 88 cm for males > 102 cm) for waist circumference and six students had values above cut-off point (for females> 0.8 and for male > 0.9) for waist-hip ratio and thus had an increased risk for heart disease (Table 4.7).

Table 4.7: Waist circumference and waist-hip ratio (n=161)

Variable	Category	Students	
		Number	Percent
Waist circumference	Risk	4	2.5
Waist-hip ratio	Risk	6	3.7

4.5 Lifestyle factors

Table 4.8 shows the lifestyle factors of the students which included physical activity, smoking and alcohol consumption. Of the total students, 10.6% were smokers, smoking a median of 3.5 cigarettes per day.

The majority of the students (62%) consumed alcohol. White wine and cider, red wine, spirits and beer were the most preferred alcohols (Table 4.8). The median frequency of alcohol consumption was 4.0 days per month. The median intake of alcohol was 3 glasses per day. The median number of drinks per day were 1.5 glasses for red wine, 2.0 glasses for white wine, 3.0 glasses for beer, 3.0 shots for sprits, and 2.0 bottles for cider. Alcohol was mostly consumed during weekends.

The physical activity level of the students broadly classifies the students into very active (59%) and active (39%). However, 68% of the students did not attend gym or participate in any sporting activities.

Table 4.8: Lifestyle (Smoking, alcohol consumption and physical activity)

Variable	Category	Number	Percent	Median
Smoke (n= 161)	Yes	17	10.6	
	No	138	85.7	
	Previously	6	3.7	
Number of cigarettes per day (n = 17)				3.5
Alcohol consumption (n= 160)	Yes	100	62.5	
	No	53	33.1	
	Previously	7	4.4	
Days alcohol consumed (per month) (n= 100)				4.0
Kind of alcohol (n= 100)	Red wine	44	44	
	White wine	46	46	
	Beer	19	19	
	Sprite	28	28	
	Cider	46	46	
Total consumption of all kind of alcohol per day (n= 100)				3.0
Number of drinks per day (n= 100)	Red wine (glass)	44		1.5
	White wine (glass)	47		2.0
	Beer (glass)	19		3.0
	Sprite (shot)	27		3.0
	Cider	47		2.0
Days alcohol consumed (n= 100)	Weekday	0	0.0	
	Weekend	95	95	
	Both	5	5	
Physical activity level (PAL) (n=161)	Sedentary	0	0.0	
	Low active	3	1.9	
	Active	63	39.1	
	Very active	95	59.0	
Gym (n= 161)	Yes	51	31.7	
	No	110	68.3	

4.6 Associations between variables

Table 4.9 shows that median energy intake of females (5195 kJ) was significantly lower than that of men (8943 kJ); the 95% CI for the median difference was [2773; 4891].

Table 4.9: Energy intake of male and female students

Student by gender	Lower quartile	Median	Upper quartile
Male (n=39)	7020.0	8943*	11983.0
Female (n=122)	3712.0	5194.5*	7243.0

A positive association between smoking and alcohol consumption was found. Table 4.10 reveals that higher percentages of smokers consumed alcohol compared to non-smokers. The 95% confidential interval [4.5%; 40.3%] for the percentage difference was statistically significant.

Table 4.10: Association between smoking and alcohol consumption (n= 160)

Variable	Students	
	Number	Percent
Smoke, Alcohol	15	88.2*
No smoke, Alcohol	82	59.9*

The comparison made between students residing on-campus and off-campus for alcohol consumption shows that alcohol consumption was significantly higher for students residing off-campus (Table 4.11), with a 95% confidence interval of [-40%; -9.2%] for the percentage difference.

Table 4.11: Alcohol consumption of students living on campus and off-campus

Residential area	Students consumed alcohol	
	Number	Percent
On campus (n=51)	23	45.1*
Off campus (n=109)	77	70.6*

No significant difference in the energy intake of students living on-campus and off-campus was found (Table 4.12), with a 95% confidence interval for the percentage difference of [-945; 1121].

Table 4.12: Energy intake of students living on campus and off campus

Category	Energy intake		
	Lower quartile	median	Upper quartile
On campus (n=52)	3894.5	6625.5	8499.0
Off campus (n= 109)	4190.0	5665.0	8046.0

Median energy intake of students in the three different BMI categories indicated that overweight/obese students had the highest median energy intake (7220 kJ); the students with a normal BMI reported a median intake of 5952 kJ and the underweight students had a median intake of 6285 kJ (Table 4.13). These differences in median energy intake were not statistically significant between underweight and normal weight students (95% CI [-1833; 1442]); between underweight and overweight/obese students (95% CI for percentage difference [-3015; 954]); or between normal weight and overweight/obese students (95% CI for percentage difference [-2000; 389]).

Table 4.13: Association between BMI and energy intake

Categories BMI (kg/m^2)	Energy intake (kJ/day)		
	Lower quartile	Median	Upper quartile
< 18.5(n=13)	3720.0	6285.0	7689.0
18.5 - 24.9 (n=116)	4034	5951.5	8028.0
> 25 (n= 32)	5024	7220	8853

When comparing BMI of students with a low level of physical activity, only one student in each of the BMI categories had a low level of physical activity and thus the significance of differences could not be determined (Table 4.14).

Table 4.14 Association between BMI and low physical activity

Categories BMI (kg/m^2)	Students	
	Number	Percent
< 18.5 (n=13)	1	7.7
18.5-24.9 (n=116)	1	0.9
> 25 (n= 32)	1	3.1

Among the smokers, 23.1% were underweight, 15.6% were overweight/obese and 7.8% were normal weight (Table 4.15). The 95% CI for the percentage difference between underweight and normal weight was very close to significant at [-0.9%; 42.75]; for normal weight and overweight it was [-24.4%; 2.9%], and for underweight and overweight it was [-14.5%; 36.0%].

Table 4.15: Association between BMI and smoking

Categories BMI (kg/me^2)	Smoker students	
	Number	Percent
< 18.5 (n=13)	3	23.1
18.5 - 24.9 (n = 116)	9	7.8
> 25 (n= 32)	5	15.6

The largest percentage (65%) of students that reported consuming alcohol had a normal BMI (Table 4.16). Almost 60% of overweight/obese students drank alcohol and 46.2% of underweight students consumed alcohol. The difference in the percentage of underweight and normal weight students that consumed alcohol was close to statistically significant [-43.7%; 6.9%] while the difference between underweight and overweight/obese [-39.6%; 18.2%] and normal weight and overweight/obese [-24.4%; 2.9%] were not statistically significant.

Table 4.16: Association between BMI and alcohol consumption

Categories BMI (kg/m^2)	Alcohol consumption students	
	Number	Percent
≤ 18.5 (n=13)	6	46.2
18.5-24.9 (n=116)	76	65.5
> 25 (n=32)	18	58.1

Almost 100% of normal weight students, 96.9% of overweight/obese students and 92.3% of underweight students consumed < 3 servings of vegetables per day (Table 4.17). The difference in the percentage of underweight and normal weight [-32.5%; 0.6%]), and normal weight and overweight/obese [-2.4%; 14.9%] students for < 3 servings of vegetables intake per day were statistically close to significant, while the difference between underweight and overweight/obese students [- 30.3%; 9.5%] was not statistically significant.

Table 4.17: Association between BMI and vegetable intakes (< 3 servings per day)

Categories BMI (kg/m^2)	Students	
	Number	Percent
< 18.5 (n=13)	12	92.3
18.5-24.9 (n=116)	115	99.1
> 25 (n= 32)	31	96.9

Almost 70% of underweight, 57.8% of normal weight, and 56.3% of overweight/obese students ate < 2 servings of fruits per day (Table 4.18). When comparing < 2 servings of fruit consumption per day between the underweight and normal weight groups there was no significant difference [-16.7%; 31.7%]. The same was true for the underweight and overweight/obese [-18.1%; 37.8%] and normal weight and overweight/obese groups [-16.5%; 20.5%].

Table 4.18: Association between BMI and fruit intake (< 2 servings per day)

Categories BMI (kg/m^2)	Students	
	Number	Percent
< 18.5 (n=13)	9	69.2
18.5-24.9 (n=116)	67	57.8
BMI > 25 (n= 32)kg/m^2 (n= 32)	18	56.3

Twenty five percent of overweight/obese, 16% normal weight and almost 8% underweight students reported never eating sugar (Table 4.19). There were no

statistically significant differences between underweight and normal weight [-17.8%; 18.4%], underweight and overweight/obese [-35.5%; 10.9%], and between normal weight and overweight/obese [-27.4%; 4.6%] students who never ate sugar.

Table 4.19: Association between BMI and no sugar consumption

Categories BMI (kg/m^2)	Students	
	Number	Percent
< 18.5 (n=13)	1	7.7
18.5-24.9 (n=116)	18	15.5
> 25 (n= 32)	8	25

Almost 70% of underweight students, 57.8% of normal weight and 50% of overweight students reported eating small quantities of fat of in their diet (Table 4.20). No significant differences between fat intake were found between underweight and normal weight [-16.7%; 31.7%]; underweight and overweight/obese [-12.2%; 43.6%] and between normal weight and overweight/obese [-11.0%; 26.2%] groups.

Table 4.20: Association between BMI and low fat intake

Categories BMI (kg/m^2)	Students	
	Number	Percent
<18.5 (n=13)	9	69.2
18.5-24.9 (n=116)	67	57.8
> 25 (n= 32)	16	50.0

Chapter 5: Discussion of results

5.1 Introduction

The main objective of this study was to describe the nutritional status and related lifestyle factors of undergraduate students in the Faculty of Health Sciences at the University of the Free State. The results will be discussed according to lifestyle factors, dietary intake, anthropometric information and associations between the above.

5.2 Dietary intake

Dietary intake included the 24-recall, FFQ and energy and macronutrient intake.

5.2.1 24-hour recall and food frequency questionnaire

Guidelines for healthy eating encourage greater consumption of fruits, vegetables, milk and milk products and whole grains (Wildman and Miller, 2004, p.5). A healthy diet can reduce major risk factors for chronic disease such as obesity, high blood pressure, and high blood cholesterol. Furthermore, diet or specific nutrients, can improve physical and mental performance, enhance immunity and prevent cancer (Dagach and Hertranpf, 2001, p. 637). Nutrition in the adult years emphasizes the importance of diet in maintaining wellness, promoting health and preventing disease (Mathai, 2004, p. 303).

In this study, a high proportion of students' intakes of bread, cereals, rice and pasta were lower than the recommended 6-11 daily servings. Students' intakes of vegetables and fruits were also lower than the recommended number of 3-5 daily servings. In general, this study shows that the majority of students ate less than the recommended daily servings of most of the food groups and thus the students have unhealthy patterns of usual food intake.

In accordance with the results of this study, Lopez *et al*. (2006) reported that protein intake of Spanish students was slightly higher than the recommended intake which was positively associated with meat intake. In the same study, deficiencies in fruit and vegetable intakes were also reported. Unusan (2004) also reported that Turkish students

did not eat enough fruit and vegetables. In America, students met the minimum number of serving for meat, but they failed to consume the minimum number of servings for breads and grains, fruits and vegetable and dairy products (Anding *et al*. 2001). A study done by Georgiou *et al* (1997) showed that American college students and graduates ate more whole grains, high in dietary fiber, fruits, and dark green vegetables and less full cream milk and meat than non students. Despite this, they still consumed less than the recommended servings. The intakes of milk and milk products among Asian college students were also inadequate (Yen *et al.*, 1998).

The results of these studies have implications for chronic diseases, since inadequate consumption of grains, vegetables and fruits may result in lower intake of antioxidants and phytochemicals, which are thought to play important roles in preventing cancer and heart disease (Mathai, 2004, p. 305). In China, almost 80% of University students eat vegetables and fruits twice a day (Sakamaki *et al*., 2005a). In our study it was found that only 28.8% and 18.6% consumed fruits and vegetables, respectively, everyday, but that their intakes were still below the recommended level. In Japan, 22% of university students had at least three servings of fruits and vegetables per day (Johnson, 2004). In Bialystok, medical female university students reported eating cottage cheese and whole-grain bread more often than male students, while males consumed meat products and potatoes more often. It was also observed that overweight males ate fewer meals, and more seldom ate vegetables and fruits compared to those with normal body mass. In other studies, the diet of female overweight students was characterized by fewer meals per day and lower consumption of milk products, vegetables and fruits (Stefanska *et al*., 2003).

Skipping breakfast is related to cardiovascular risk factors. In a study by Sakata, *et al.* (2001) it was observed that a small percentage of students skip breakfast and lunch due to early classes or practical sessions. This study is in agreement with that of Baric *et al.* (2003) which reported that breakfast was the most frequently skipped meal by Croatian University students. In Korea, it was reported that 59% of university students eat two meals per day whereas in Japan 81% of university students eat three meals per day

(Johnson, 2004). In Slovakia, irregularity of meals and the absence of breakfast were also reported among students (Szarazova *et al*., 2002).

The present study shows that the largest proportion of students consumed sugar, coffee and tea on a daily basis. On the other hand a very small proportion of students ever ate soy mince/legumes, cereals, and samp. It was also observed that large proportions of students consumed sweets/chocolates, cake/biscuits, and cool drinks on a weekly basis. Similarly, 15.0% had cremora, and 47.8% had tea weekly. Despite being health science students the results indicate that the students do not have sufficient information regarding healthy food habits or otherwise have the necessary knowledge, but do not apply it practically. A study done by Kolarzyk *et al*. (2003) shows that in Australia 32% of students consumed animal proteins below the recommended serving per day, 32% of students did not eat milk products or cheese every day, and 36% ate fruit and vegetables once a day or even less. Only 26% of students ate whole grain bread, cereals or pulses every day.

5.2.2 Energy and macronutrient intake

The ideal ratio of total daily energy should consist of 45-65% energy from carbohydrate, 10-35% from protein and 20-35% from fat (Wildman and Miller, 2004, p. 139; Ettinger, 2004, p. 51; Lichtenstein and peter, 2001, p. 9; Mann, 2001, p. 59). In the present study, median values for total energy intake of 8943 kJ for males and 5195 kJ for females were reported. The total energy obtained from carbohydrate and protein intakes was slightly higher than the RDA but lower for fat intake. Dietary intake of female nursing students in Canada also showed that energy intake was relatively low, but intakes of fat, protein and carbohydrates were within the recommended ratios. A study done by Horacek and Betts (1998) indicated that American students had adequate nutrient intakes, but consumed more energy than recommended.

The present study shows that medians for the intakes of carbohydrates, protein, and fat were 192 g, 59 g, and 49 g/day, respectively. Carbohydrate containing foods are important vehicles for protein, vitamins, minerals and phytochemicals as well as

antioxidants. Carbohydrates should be obtained from a variety of food sources such as cereals, rice, wheat, maize, barley, rye, oats, millet and sorghum (Mann, 2001, p.59). In addition to carbohydrates, adolescents should consume enough high quality protein from meat and milk products to provide for adequate growth and maturation (Oner *et al*., 2005). In this study protein intake was slightly higher than the recommended intake. This result is in agreement with studies done at the University of Granada (Lopez *et al*., 2006) and at the University of Basque (Irazusta *et al.*, 2006) in Spain.

Fat is essential for digestion, absorption and transport of fat-soluble vitamins and fat-soluble phytochemicals (Wildman and Miller, 2004, p. 139). When people consume either too much or too little fat, or large amounts of certain kinds of fat, health is affected (Rolfes *et al*., 2006). High dietary fat intake may be associated with overweight and obesity (Zaliah *et al*., 2006). Although Hendricks (2004) showed that total fat intake was not correlated with BMI, higher BMI was associated with higher intake of saturated fat. According to Mammas *et al*. (2004) higher consumers of fat had significantly higher energy, cholesterol and sodium intake than lower consumers of fat. In addition, lower fat eaters had higher intakes of fruits and lower intakes of red meat and milk than those with higher fat intake. In our study, intake of fat was lower than the recommended amount. Similarly, Stefanikova *et al*. (2001) reported that Slovak medical students' energy, fat and animal protein intakes were low.

5.3 Anthropometric information

In the following section body mass index, waist circumference and waist-hip ratio will be discussed.

5.3.1 Body mass index (BMI)

BMI is an indicator of size (amount of fat and fat free mass) as well as fatness. Its relation to fatness and interpretation as a measure of energy stores may vary in different groups (Norgan, 1990). BMI alone has been found to be a significant predictor of co-morbidity (Janssen *et al.*, 2004). Both BMI and eating plan analyses are useful in nutritional assessment and should be used in combination (Iwanicka and Borzecki, 2004).

The present study shows that the majority of students had a normal body weight. The percentage of male students with a normal BMI was higher than that of female students. However, 22% of female and 13% of male students were overweight or obese. According to WHO's BMI classification (Chapter 2, Table 2.6), the observed prevalence of overweight/obesity is considered to be relatively high.

Cilliers *et al.* (2006) also reported that 10.8% of South African black first year female university students were overweight/obese. Another study also showed that at the University of the North in South Africa, 25% of first year female students were overweight/obese and 26.8% were underweight (Steyn *et al.,* 2000).

In other countries, similar findings have been reported. In Iran, 9.3% of students were overweight (Faghih and Eghtesadi, 2005). A study done by Wong and Huang (1999) amongst Taiwanese, female university students reported that 13.6% of students were overweight and 2.6% were obese. These students were classified according to severely underweight (BMI < 16.9), underweight (16.9 ≤ BMI < 18.5), acceptable (18.5 ≤ BMI < 21.7), overweight (21.7 < BMI ≤ 25.1) and obese (BMI > 25.1). In Kuwait a very large percentage (49.6%) of male university students were overweight/obese (BMI > 25kg/m^2) (AI-Isa, 1999). This prevalence was lower in our study and in Poland where13.9% of medical students were overweight/obese (Jonczyk *et al*., 2002).

5.3.2 Waist circumference and waist-hip ratio

Among male and female health science students included in this study, only 2.5% of male and 3.7% of female students had above cut-off point waist circumference and waist-hip ratio, indicating an increased risk for heart disease. In contrast, Faghih and Eghtesadi (2005) reported that 40.5% of female students in Iran had central obesity (WHR > 0.8).

5.4 Lifestyle factors

Lifestyle is one of the most important factors influencing health throughout life (Kawasaki *et al.,* 2003). Lifestyle factors such as smoking, alcohol consumption and physical inactivity are associated with coronary heart disease, high blood pressure,

diabetes mellitus and certain cancers (Zyto *et al.,* 2004; Kawasaki *et al*., 2003; Rolfes *et al.,* 2006, p. 541). Alcohol drinkers and smokers are characterized by less healthy dietary patterns which could also have an impact on cancer risk (Ruf *et al.,* 2005). Good eating habits and physical activity are essential parts of a healthy lifestyle, by helping to prevent diseases of lifestyle (Iwanicka and Borzecki, 2004).

5.4.1 Physical activity

In the present study, most students were classified as very active and active but the majority of the students did not participate in any sport or go to gym. Very active and active physical activity levels observed in this study might be attributed to the nature of the students' lifestyle itself. In general, students did not have a sedentary lifestyle. Walking to and from classrooms, walking to and from the library, and walking in the hospitals or communities, make up a significant percentage of students' activities. All of the students included in this study had busy schedules for classes and practical sessions (working at a hospital). The age of the students (all young, the median age for male students = 21.8 years and for female students = 21.4 years) could also be another important factor which contributed to high levels of physical activity. The younger people are, the more active lifestyles they have.

It is difficult to compare results of this study with other studies, since different methods were used to determine levels of physical activity. Contrary to the present findings, Irazusta *et al*. (2006) reported 50% of female first year nursing students in Spain were sedentary and classified students into three categories: physically inactive or sedentary (less than one exercise session per week), irregularly or moderately active (between one and two exercise sessions per week) and active (three or more exercise sessions per week). In Spain, Segovia and Monzo (2002) classified students' physical activity levels as average. Variable results were also reported by other investigators. Anding *et al.* (2002), using the Self Reported Physical Activity scale method, has reported that 33% of female students in America were physically active. In their study, participants selected a number on a scale from 0 (avoiding physical activity entirely) to 7 (exercising more than 10 hours per week). According to Brown and Blanton (2002), sport participation was

categorized into groups of students who indicated that they participated in one or more college sports teams and those students reporting no sports involvement. According to Faghih and Eghtesadi (2005), in Iran, 37% of students did not exercise at all. Similarly, 38% of students in the University of Costa Rica did not exercise (Ramirez and Montero, 1998).

Studies indicate that physical activity is important in preventing and treating overweight and obesity and is extremely helpful in maintaining weight loss, especially when combined with healthy eating (Wildman and Miller, 2004, p 22). In addition, higher levels of physical activity are associated with increased intake of key micronutrients (Hendricks *et al.*, 2004).

Various epidemiological studies have shown that activity increases energy expenditure and is, therefore, crucial for the maintenance of energy balance and normal weight. Regular physical exercise may be important in lowering diastolic blood pressure, protects against the development of heart disease, reduces cardiovascular mortality, prevents colon cancer, regulates blood glucose levels, lowers blood lipid levels and modifies associated risk factors (such as hypertension, insulin resistance, lower risk of suicidal behavior and obesity). In addition, physical activity improves exercise tolerance and improves the body's ability to withstand stress, including both physical and psychological stress as well as anxiety (Irazusta *et al.*, 2006; Wildman and Miller, 2004, p. 73-75; Lucas, 2004, p. 280; Adami *et al*., 2003; Brown and Blanton, 2002; Whitney and Rolfes, 2002, p. 464; Akandere and Tekin 2002; Anderson, 1999, p.1386; Paffenbarger *et al.*, 1986).

5.4.2 Smoking

In the present study it was observed that 10.6% of the students in health science related courses were current smokers and 3.7% were previous smokers. Other studies also indicate that cigarettes are widely smoked in South Africa. Steyn *et al.* (2006) has reported that 31.5% of South Africans (18 years and older) smoke cigarettes. The prevalence of smoking (daily and occasionally) is higher in 14-year old adolescent males

than in females (21.5% vs. 15.7%). Similar findings have also been reported by Hendricks *et al.* (2004) in America where 10% of university students smoke daily; and in Costa Rica it was reported that nearly 10% of students smoke (Ramirez and Montero, 1998).

Studies done in several countries also show the prevalence of smoking is high among university students. These studies reveal the percentages of university students that smoke as 38.7% in Turkey (Tot *et al.,* 2004), 37.7% in China (Xiang *et al.*, 1999); 20.7% in Brazil (Silva *et al*., 2006); 22.5% in Slovakia (Baska *et al*., 2001); and 16% in South Africa at the University of the North (Peltzer, 2001). The major reasons for smoking were reported to be stress, curiosity and loneliness. Compared to these figurers the prevalence of smoking in the sample included in this study was relatively low (10.6%).

In 2004, an estimated 20.9% of US adults were current smokers, of which 81.3% smoked every day, and 18.7% smoked some days (CDC, 2004). In other studies, including in South Africa it has been reported that smoking is much more common among men than women (SADHS, 1998). SADHS (1998) found that more than 39% of African, white, colored and Indian adult males (15 years and older) smoke daily or occasionally, with the lowest prevalence among rural black males (37%). In rural areas, only 4% of black females smoke daily compared with 6% of urban females. According to the SADHS, the overall prevalence of daily smoking for females was the lowest in black females (5%) and the highest among white females (27%).

Smoking suppresses the appetite which means an individual may be unaware of the need for food for long periods of time (Handelsman, 1995, p. 366). Smokers generally have the lowest dietary antioxidant intake and status (Vitamin A, Beta-carotene, folate, zinc and vitamin C) and a lower intake of dietary fiber, fruits and vegetable which prevent cancer (Rolfes *et al.,* 2006, p. 541; Faruque *et al.,* 1995). Smoking is a risk factor for increasing heart disease and minor mouth sores to tumors in the nasal cavities, cheeks, gums, throat and lung (Steyn *et al.*, 2006; Whitney and Rolfes, 2002, p. 564). Many adolescents smoke and some adolescents use smoking as a weight control measure (Peter *et al.,* 2000).

5.4.3 Alcohol consumption

Alcoholism is a major problem in adolescence and can occur as early as the 12th grade (Mascarnhas *et al.,* 2001). In adults, nearly 30% of South African males and 10% of females reported using alcohol excessively (Steyn *et al.,* 2006). Alcohol continues to be a problem on university campuses where heavy drinking is associated with careless and risky behavior (Peter *et al.,* 2000, Hendricks *et al*., 2004).

The present study reveals the majority of Health Science students (62%) consumed alcohol. The median for the amount of alcohol consumed per day was relatively high. According to SADHS (1998) 45% of men and 17% of women age 15 years or older currently consume alcohol. Rate of current drinking differs substantially by population group and sex, with the highest level reported by white men (71%), followed by white women (51%) and colored men (45%); the lowest rates were reported by African and Asian women (12% and 9% respectively). In other countries such as Brazil, alcohol is also consumed in large quantities by under graduate Health Science students (Lucas *et al*., 2006; Silva *et al*., 2006).

According to Mukamal *et al* (2005), alcohol consumption appeared to be associated with a higher risk for ishcemic stroke among men who consumed more than 2 drinks per day. A trend toward lower risk for stroke associated with light drinking was most evident for thrombotic stroke and for consumption of 1 to 2 drinks 3 or 4 days per week. Red wine consumption had an inverse association with ishcemic stroke, but other beverages did not. Furthermore, high alcohol consumption is a risk factor for depression, hypertension, heart disease, malnutrition and chronic diseases (Grosvener and Smolin, 2002, p.591); overweight and obesity (Suter, 2004); diabetes, cancer of the esophagus, liver, breast gastrointestinal tract, and large bowel (Steyn *et al.,* 2006; Willett, 1999, p. 1250), dementia (Liber, 1995, p. 339); ulcers, accidents and violence as well as fetal alcohol syndrome (Mascarnhas *et al.,* 2001, p. 43). Furthermore, mortality risk is increased in young drinkers at levels of alcohol consumption normally considered to be safe; this may be associated with accidents and injury (Barasi, 2003, p 52).

5.5 Associations

Associations between nutritional status and lifestyle factors will be discussed in the following section.

5.5.1 Energy intake and gender

Median energy intake of males was higher than that of females, probably because of higher daily energy expenditure and requirements in males. Similar findings were also reported in Greek medical students where the estimated mean daily energy intake was 10437 kJ for males and 7012 kJ for females (Mammas *et al.,* 2004). Herrera *et al.* (2003) reported that, in Belgium, energy intake of males was also higher than that of females. In contrast, Muzaffar *et al.* (2002) reported that energy intake in females was higher than that of male students in Pakistan.

5.5.2 Energy intake and residence

In the present study, energy intake of student living on-campus was slightly higher than that of students living off-campus. This could be due to the availability of energy dense foods available in the campus cafeterias and dining halls. In contrast, a study done by Brevard and Ricketts, (1996), showed that the percentage of energy from protein, which is usually also higher in fat, was significantly higher for students living off-campus.

5.5.3 Smoking and alcohol consumption

In the present study, significantly higher alcohol consumption was found in smokers compared to non-smokers. Similarly, Peltzer (2002), Kitamura *et al.* (2003), Hendricks *et al*. (2004) and Ruf *et al.* (2005) reported correlations between smoking and alcohol use. Alcohol consumption in particular and smoking of Health Science students included in this study indicate a potential healthy risk. Alcohol drinkers and smokers are characterized by less health dietary patterns which could also have an impact on risk for chronic disease, especially cancer (Ruf *et al.,* 2005).

5.5.4 Alcohol consumption and residence (on-campus or off-campus)

Students residing off-campus consumed more alcohol compared to those residing on-campus, probably due to the accessibility to bars or bottle stores. The restriction of consuming alcohol on campus might also contribute to lower alcohol consumption by students residing on-campus. In accordance with these results, Brevard and Ricketts (1996) also reported higher alcohol consumption in American university students living off-campus.

5.5.5 BMI and dietary intake

As expected, there was a positive association between overweight/obesity and high energy intake. In this study higher energy intake was observed in overweight subjects when compared to normal weight and underweight subjects; which was close to statistically significant. Herrera *et al*. (2003) reported that BMI is found to be highly influenced by energy intake independent of gender.

In the present study, BMI was not significantly affected by vegetable, fruit, sugar, and fat intakes. As discussed above, median intakes of vegetables and fruits were below the recommended servings.

5.5.6 BMI and lifestyle

Association between physical activity, smoking and alcohol consumption with BMI will be discussed in the following section.

5.5.6.1 BMI and physical activity

In this study physical activity did not show a significant association with BMI. In contrast Cilliers *et al*. (2006) reported that normal weight students are more physically active than both underweight and overweight students.

5.5.6.2 BMI and smoking

In this study more underweight students smoked compared to normal and overweight students. This confirms that smoking can suppress appetite and affect energy intake.

However, smoking did not significantly influence BMI. Smokers generally have the lowest dietary antioxidant intake status, as well as the lowest intake of dietary fiber, milk, fruits, vegetable and water (Rolfes *et al.,*. 2006, p.541, Faruque *et al.,* 1995).

5.5.6.3 BMI and alcohol consumption

The largest percentage (65%) of students that reported consuming alcohol had a normal BMI. Almost 60% of overweight/obese students drink alcohol. Although not statistically significant, the results indicate that there is a trend between lower BMI and alcohol consumption. This could be due to the energy provided by alcohol in addition to the usual dietary energy intake.

5.6 Limitation of the study

Limitations that were experienced in the execution of the study will be discussed in the following section.

5.6.1 Sample size

Initially a total sample of 232 was planned, but only 161 students agreed to participate, thus resulting in the response rate of 69%. Lack of time (the period of data collection was around examination and holiday times) and also lack of interest due to the absence of compensation for students, could have contributed to this. Despite this, a response rate of 69% is considered to be good.

5.6.2 Recall of dietary intake : FFQ and 24-hour recall

Respondents may withhold or alter information about what they have eaten because of poor memory or embarrassment or to please or impress the interviewer. Respondents often tend to underreport binge eating, consumption of alcoholic beverages and consumption of foods perceived as unhealthy. The inability to recall accurately the kinds and the amounts of food eaten, as well as the tendency for persons to overreport low intakes and underreport high intakes of foods are all limitations of dietary intake methods (Hammond, 2004, p. 419; Lee and Nieman 2003, p. 76). In this study students were

assured that all results would be confidential and they were encouraged to be honest about what they ate.

5.6.3 Portion sizes

Accurate estimation of portion sizes is reported to be a common limitation of dietary intake methods (Hammond, 2004, p. 422; Nelson, 2000, p 317). In this study food models were used to obtain accurate information about portion sizes.

Most food frequency questionnaires obtain information only on the frequency of consumption of a food over a given period and not on the context, in which the food groups were eaten, that is, on meal patterns (Rutishauser and Black, 2002, p. 235). To ensure that this factor was not a limitation in this study, the FFQ was combined with a 24-hour recall.

In order to obtain complete assessment of nutritional status it could have been helpful to include biochemical measures of nutritional status as well. Due to financial constraints this was not possible.

Chapter 6: Conclusions and Recommendations

6.1 Introduction

In this study relatively high rates of obesity, smoking and alcohol consumption were found. Low intakes of the recommended servings of food groups such as bread, cereals, pasta, vegetables, fruits, and milk and milk products were also identified which put the students at risks for developing several chronic diseases.

6.2 Conclusions

The following conclusions can be made from this study:

6.2.1 Dietary intake

- Almost 45% of students ate less than 6 servings of bread, cereals, rice and pasta per day
- Almost 100% of students ate less than 3 servings of vegetables per day
- Almost 60% of students ate less than 2 servings of fruit per day
- 82.6% of students ate less than 2 servings of milk, yoghurt, and cheese per day
- 57.1% of students ate small quantities of fats, oils and sweets per day
- A small percentage of student skipped lunch and supper every day
- Median energy intake of students were lower than the recommended amount in both females and males
- Median energy intake of male students was significantly higher than that of female students
- Median energy intake of students living on-campus was higher than that of students living off-campus, but not significantly so
- The median energy intake of overweight/obese students was higher than that of normal weight and underweight students but not significantly so
- Median carbohydrate intake of students was slightly higher than the recommended amount
- Median protein intake was slightly higher than the recommended amount
- Median total fat intake of students was lower than the recommended amount

- The largest number of students consumed food such as sugar, coffee, alcohol, margarine/oil/fat, bread and tea on a daily basis, while a very small proportion of students ate soy mince/legumes, peanut butter, eggs, cooked porridge, cereals and samp on a daily basis
- More than 80% of students ate sweet/chocolates, cake/biscuits and cooldrinks on a weekly basis
- More than 60% of students never consumed cremora, soy mince/legumes and peanut butter

- **6.2.2 Anthropometric status**
- 22.1% of female and 12.9% of male students were overweight/obese (BMI>25 kg/m^2)
- 10.7% of female and 0% of male students were underweight
- A higher percentage of smokers were underweight compared to normal weight and overweight students, but not significantly so
- BMI was not significantly associated with physical activity, vegetable intake, fruit intake, sugar intake, and fat intake.
- Four students had waist circumference measurements above high risk cut-off points (for female >88 cm and male >102 cm)
- Six students had a waist-hip-ratio above high risk cut-off points (for female > 0.8 and male > 0.9)

6.2.3 Physical activity

- Almost all students were physically active or very active

  Physical activity consisted mostly of busy daily schedules (e.g. practical work at hospital). Very few students were involved in sport.

6.2.4 Smoking

- The prevalence of smoking was relatively high at 10%
- A median of 3.5 cigarettes was smoked per day
- Smokers consumed significantly more alcohol than non-smokers

6.2.5 Alcohol consumption

- The prevalence of alcohol consumption was very high
- Alcohol was consumed for a median of 4.0 days per month
- When consumed, a median of 3.5 glasses per day was consumed, classified as heavy drinking
- Students living off-campus consumed significantly more alcohol than students living on-campus
- Alcohol was consumed mostly over weekends

6.3 Recommendations

Recommendations regarding dietary intake, anthropometry and lifestyle are discussed in the following section.

6.3.1 Dietary intake

Diet and lifestyle should be jointly targeted for promotion of healthy behavior or individually targeted for behavior change (Hendricks *et al.*, 2004). Reinforcing cognitive patterns and promoting active attitudes toward food consumption might be effective measures in the fight against overweight and obesity (Adami and Cordera, 2003).

Guidelines for healthy eating encourage greater consumption of fruits, vegetables, milk and milk products and whole grains (Wildman and Miller, 2004, p.5). A healthy diet can reduce major risk factors for chronic disease such as obesity, high blood pressure, and high blood cholesterol. Nutrition in the adult years emphasizes the importance of diet in maintaining wellness, promoting health and preventing disease (Mathai, 2004, p. 303).

University represents the final opportunity for nutrition education of a large number of students. Over all, the results confirm that the higher proportion of our subjects did not consume the recommended food groups and energy intakes. Therefore, major changes in nutritional habits of this sample are required. Nutrition education should be targeted at students, and should motivate them to make more healthy food choices. In addition, the students included in the present study were all studying health science related courses.

These students will be responsible for teaching healthy living practices to their patients and clients as part of their work and thus they should practise what they preach.

6.3.2 Anthropometry

BMI is a validated measurement of nutritional status that requires weight and height measurements. BMI is an indicator of body fitness and defines the level of adiposity according to the relationship of weight to height (Hammond 2004, p. 424).

Waist circumference measurement alone has been shown to correlate well with body fatness and may be used as a quick indicator of health risk from overweight (Barasi *et al*., 2003, p. 12; Janssen *et al.,* 2004). Chan *et al.* (2003), indicated that waist circumference is probably the most convenient and reliable clinical measure of abdominal fat compartments.

Although, WHR is used to determine fat distribution (Hammond 2004, p. 425-426), waist and hip circumferences measure different aspects of body composition and fat distribution and have independent and often opposite effects on cardiovascular disease risk factors. A narrower waist and larger hips may both protect against cardiovascular disease (Seidell *et al,* 2001). Large hip circumference seems to have an independent and positive effect on cardiovascular disease morbidity and mortality in women (Heitmann *et al.,* 2004).

6.3.3 Lifestyle

6.3.3.1 Physical activity

A routine exercise program is important for all people. The most beneficial exercise program differs for each person, but walking is considered best for obese individuals. Other exercises such as bicycling, stair climbing, swimming, and aerobic dancing are good alternatives to walking (Anderson, 1999, p.1386).

Leisure sports activities, together with BMI, were reported to be the most powerful predictors of adult biological risk factors, but attitudes to sports and educational level were also significant determinants (Bergkvist *et al.*, 2001*)*.

Physical activity is important in preventing and treating overweight and obesity and is extremely helpful in maintaining weight loss, especially when combined with healthy eating (Wildman and Miller, 2004, p 22). In addition, higher levels of physical activity are associated with increased intake of key micronutrients (Hendricks *et al.*, 2004).

6.3.3.2 Smoking and alcohol consumption

Alcohol consumption and smoking among health sciences students are a concern because of the potential health risks associated with excessive intake. Students should be encouraged to improve their lifestyles.

Quitting smoking, even late in life after heavy long-term abuse, greatly reduces cancer risk when compared with the risk had smoking been continued (Williams, 1993, p. 737).

Further studies investigating the eating habits, physical activity and lifestyle of health science students are recommended.

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Appendix A

24/04/06

Prof Magda Fourie
Vice-Rector: Academic planning

Re: Permission to perform a research study on the campus of The University of the Free State

I am currently a student registered for the M Nutrition degree in the Department of Human Nutrition at the University of the Free State. I hereby apply for permission to undertake a study on the campus titled "The nutritional status of undergraduate students in the Faculty of Health Sciences at the University of the Free State".
The evaluation will involve the following:

1 An interview with selected students, during which two questionnaires regarding the student's usual diet and lifestyle will be completed.
2 Body weight and height will be measured
3 Waist and hip circumference will be measured

The study will be submitted for approval to an Evaluation Committee in the School of Allied Health Professions as well as the Ethics Committee of the Faculty of Health Sciences. All information will be kept strictly confidential, and no information will be used for purposes other than the research project. The respondent's decision to participate is voluntary and they are allowed to withdraw from the study at any time.

Sincerely

Banchewesen Melaku Abera (2001045380)
M Nutrition student

Appendix B

Informed Consent **Respondent Number_____**

Nutritional status of students at the University of the Free State

The purpose of the study is to describe the nutritional status of undergraduate students in the Faculty of Health Sciences at the University of the Free State. The present and future students of the University of the Free State will benefit from the information generated from this study, since it will be used to plan relevant intervention programs.

The Ethics Committee of the Faculty of Health Sciences has approved the study and its procedures. The study procedures involve no foreseeable risks or harm to you.

The procedures include:

1 Two questionnaires regarding your usual diet and lifestyle will be completed

2 Your body weight and height will be measured and

3 Your waist and hip circumference will be measured

For the above mention measurement, you will be asked to empty your bladder, and wear light clothes. Participation in this study will take approximately 1 hour. You are free to ask any questions about the study and may call Mrs. Abera at 0722793190 at any time.

Your participation in this study is voluntary and you have the right to withdraw at any time. There is no compensation for participation in this study.

Your identity will not be revealed while the study is being conducted or when the study is reported or published. All study data will be collected by Mrs. Abera, stored in a secure place, and not shared with any other person without your permission.

I have read this consent form and voluntarily consent to participate in this study.

Subject's Signature_____ Date_____

Appendix C

Department of Human Nutrition
Dietary intake questionnaire

Subject number: | | | | 1-3

24 Hour recall

Food/Drinks and amounts	Milk	Meat	Fruit and veg β-Carotene	Fruit and veg Vit C	Fruit and veg Other	Bread and grains	Fat and oils	Sugar/ alcohol
Breakfast and mid-morning _____ _____ _____ _____ _____ _____ _____ _____ _____ _____								
Lunch and mid afternoon _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____								
Supper and late night _____ _____ _____ _____ _____ _____ _____ _____ _____ _____								
Total:								

Evaluation of dietary intake:

Calculated estimated total values for:

Carbohydrate (g): ☐☐☐ 4-6

Protein (g): ☐☐☐ 7-9

Fat (g): ☐☐☐ 10-12

Energy (kJ): ☐☐☐☐☐ 13-17

Bread, Cereal, Rice and Pasta group: ☐ 18

1. < 6 servings per day
2. 6 -11 servings per day
3. > 11 servings per day

Vegetables: ☐ 19

1. < 3 servings per day
2. 3 -5 servings per day
3. > 5 servings per day

Fruits: ☐ 20

1. < 2 servings per day
2. 2 - 4 servings per day
3. > 4 servings per day

Is a β-carotene rich fruit/ vegetable included: ☐ 21

1. Yes
2. No

Is a Vitamin C-rich fruit/ vegetable included: ☐ 22

1. Yes
2. No

Milk, yoghurt and cheese: ☐ 23

1. < 2 servings per day
2. 2 – 3 servings per day
3. > 3 servings per day

Meat, Poultry, Fish, Dry Beans, Eggs and Nuts: ☐ 24

1. < 2 servings per day
2. 2 - 3 servings per day
3. > 3 servings per day

Fats, Oils and Sweets: ☐ 25

1. Small quantities
2. Large quantities

Portion sizes:

Bread, Cereal, Rice & Pasta:	½ cup cooked/ 1 slice of bread/ 30 dry cereal
Vegetables:	½ cup cooked/ 1 cup raw leafy vegetables/
Fruit:	1 medium fruit/ ½ cup chopped fruit/ ¾ cup fruit juice
Milk, yogurt & cheese:	1 cup milk / yogurt/ 45 g cheese/
Meat, Poultry, Fish, Dry beans, Eggs & Nuts:	30 g meat fish or poultry/ 1 egg/ 10 peanuts or ½ cup beans/ legumes
Fats, oils and sweets:	Use sparingly.

How often are the following items consumed?

number of times per day, per week or per month (only use one option)

Food	**/day**		**/week**		**/month**		
Sweets/ chocolates							26-31
Chips (crisp)							32-37
Cake/ biscuits							38-43
Cool drinks							44-49
Cremora							50-55
Coffee							56-61
Tea							62-67
Sugar							68-73
Full-cream milk							74-79
Low fat/ skim milk							1-6
Eggs							7-12
Peanut butter							13-18
Soya mince/ legumes							19-24
Chicken/ meat/ fish							25-30
Bread							31-36
Porridge cooked							37-42
Cereal (eg. Pronutro)							43-48
Samp/ mielie rice							49-54
Margarine/ oil/ fat							55-60
Fruit juice							61-68
Fruit							67-72
Vegetables							67-72
Salt/ stock/ Royco							1-6
Alcohol _____							7-12
Water							13-18

Remarks:_____
_____
_____
_____
_____

Appendix D

Nutritional status of undergraduate students in the Faculty of Health Sciences at the University of the Free State
Socio-demographic, lifestyle and anthropometric questionnaire
All information in this questionnaire is confidential

1 Subject number: | | | | 1- 3

2 Date: _____ | | | | | | | | | 4 - 11

3 Birth date: | | | | | | | | | 12- 19

4 What is your gender? | | 20

1	Male
2	Female

5 Where do you stay ? | | 21

1	On campus
2	Off campus

10 What is your current academic level of study? | | 22

1	First year
2	Second year
3	Third year
4	Fourth year
5	Other, please specify _____

11 Which department? | | 23

1	Medicine
2	Nursing
3	Physiotherapy
4	Optometry
5	Occupational therapy
6	Human Biology
7	Radation
8	Nutrition

12 What is your marital status ? | | 24

1	Single
2	Engaged
3	Married
4	Divorced
5	Widowed
6	Other, please specify _____

13 What language do you speak? | | 25

1	Afrikaans
2	Sotho
3	English
4	Tswana
5	Other, please specify _____

94

14 Do you smoke at all? ☐ 26

1	Yes
2	No
3	Previously

If yes, how many cigarettes per day? _____ ☐☐ 27- 28

15 Do you drink alcohol? ☐ 29

1	Yes
2	No
3	Previously

If yes, number of days per week that you consume alcohol? ☐ 30

_____

If yes, what kind of alcohol do you drink?

1	Red wine	1. Yes	2. No	☐ 31
2	White wine	1. Yes	2. No	☐ 32
3	Beer	1. Yes	2. No	☐ 33
5	Liquor	1. Yes	2. No	☐ 34
6	Other, please specify _____			☐ 35

_____

If yes, the number of drinks per day?

1	Red wine (glass) _____	☐☐	36- 37
2	White wine (glass) _____	☐☐	38- 39
3	Beer (glass) _____	☐☐	40- 41
4	Liquor (shot) _____	☐☐	42- 43
5	Other, please specify _____	☐☐	44- 45

_____

If yes, which day of the week are you taking more alcohol?

1	Week day	☐ 46
2	Week end	
3	Both	

1 Day of the week for which the form was filled in ☐ 47

1. Monday 2. Tuesday 3. Wednesday 4. Thursday 5. Friday 6 Saturday

Think back to yesterday. For each of the following 30 minutes periods, select a primary activity from the attached list of activities that you performed.

Time	_	PAL/HR			
0:00			.		
0:30			.		
1:00			.		
1:30			.		
2:00			.		
2:30			.		
3:00			.		
3:30			.		
4:00			.		
4:30			.		
5:00			.		
5:30			.		
6:00			.		
6:30			.		
7:00			.		
7:30			.		
8:00			.		
8:30			.		
9:00			.		
9:30			.		
10:00			.		
10:30			.		
11:00			.		
11:30			.		
12:00			.		
12:30			.		
13:00			.		
13:30			.		
14:00			.		
14:30			.		
15:00			.		
15:30			.		
16:00			.		
16:30			.		
17:00			.		
17:30			.		
18:00			.		96

18:30			.		
19:00			.		
19:30			.		
20:00			.		
20:30			.		
21:00			.		
21:30			.		
22:00			.		
22:30			.		
23:00			.		
23:30			.		
24:00			.		

1	Sedentary
2	Low active
3	Active
4	Very active

[ ] 48

Anthropometry

1	Weight (kg)	[ ][ ][ ].[ ]	49- 53
2	Height (cm)	[ ][ ][ ].[ ]	54- 58
3	Waist circumference (cm)	[ ][ ][ ].[ ]	59- 63
4	Hip circumference (cm)	[ ][ ][ ].[ ]	64- 68

List of physical activity

A Daily Activities

1. Lying quietly
2. Riding in a car
3. Light activity while sitting
4. Watering plants
5. Walking the dog
6. Vacuuming
7. Doing house hold tasks (moderate effort)
8. Gardening (on lifting)
9. Moving lawn (power mower)

B Leisure Activities: Mild

1. Walking (3.2 km/hour)
2. Canoeing (leisurely)
3. Golfing (with cart)
4. Dancing (ballroom)

C Leisure Activities: Moderate

1. Waking (4.8 km/hour)
2. Cycling (leisurely)
3. Performing calisthenics (no weight)
4. Walking (6.4km/hour)

D Leisure Activities: Vigorous

1. Chopping wood
2. Playing tennis (doubles)
3. Ice skating
4. Cycling (moderate)
5. Skiing (downhill or water)
6. Swimming
7. Climbing hills(5-kg load)
8. walking (8km/hour)
9. Jogging (10km/hour)
10. Skipping rope