RELATIONSHIP BETWEEN DIET QUALITY, NUTRITION STATUS AND ACADEMIC PERFORMANCE OF FIRST AND NON-FIRST GENERATION UNIVERSITY STUDENTS IN DURBAN

By

Ntombenhle Pretty Ndlovu

20609593

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Supervisor: Prof C. E. Napier

Co-Supervisor: Miss N. X. Mkhize

DECLARATION

This work has not been previously accepted in substance for any degree and is not being concurrently submitted in candidature of any degree.

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ABSTRACT

Introduction: Many studies have attempted to establish the association between the academic performance of university students and various factors that impact on academic performance. Students' socio-economic backgrounds have been cited as a significant predictor of academic success among university students, with first generation students (FG) reporting a lower retention and graduation rate compared to non-first generation (NFG) students. First generation students are those that are the first in a family to enroll in institutions of higher learning, whether college or university, while NFG students, are students whose parents or siblings have attended an institution of higher learning. The low academic success rate among FG students is mainly attributed to unpreparedness for college/university, financial challenges and lack of support from family.

Aim: The aim of the study was to determine the relationship between diet quality, nutrition status and academic performance of first generation and non-first generation university students in Durban.

Methodology: A total of 270 randomly selected students (135 FG and 135 NFG) between the ages of 18 and 30 years participated voluntarily in the study. The study was descriptive in nature with a cross-sectional design. Trained fieldworkers administered the questionnaires in an interview setting. A socio-demographic questionnaire measured the socio-economic characteristics of the students; anthropometric measurements were used to determine the nutritional status against the WHO cut-off points; three 24 hour recall questionnaires and a food frequency questionnaire determined their diet quality and nutrition adequacy, and the students' matric and first year results were used to measure academic performance. The socio-demographic questionnaire, anthropometric measurements and the academic results were captured on Microsoft Excel® and analyzed using the Statistical Package for Social Sciences® (SPSS) version 21.0. A trained nutrition professional captured and analyzed the 24 hour data using the Food Finder® version 3 computer programme.

Results: The sample was fairly representative of both groups of students and genders with 20% (n=52) FG men, (17%; n=44) NFG men, (30%; n=78) FG women, and 33% (n=86) NFG women. The majority of FG (63.1%; n=82) and NFG (59.2%; n=77) students came from townships, and the highest number of students (FG 60.7%; n=79 and NFG 49.3%; n=64) depended on student loans to pay for university fees. Furthermore, most of the FG (76.8%; n=100) and NFG (81.5%; n=106) students lived in university residences. Although the highest number of FG students (38.5%; n=50) had a household income of between R0–R500 compared to the highest number of NFG students having a household income of R501–R1000 per month, the highest number of both groups of students (FG=25.4%; n=33 and NFG=26.2%; n=34) spent R401–R500 per month on food, and almost 50% of both groups of students indicated that they sometimes lacked money to buy food. Non-first generation students were affected by obesity more so than FG students, with one (2.27%) NFG man and 13.92% (n=12) affected by obesity class I (BMI 30-34.99), and 4.65% (n=4) NFG women falling within the obesity class II range (BMI of 35-

39.99), compared to none of the FG men affected by obesity, and only 3.85% (n=3). Furthermore, a higher number of NFG students exceeded the WC cut-off points for men (102cm) and women (88cm) compared to FG students, with none of the FG men exceeding the cut-off points for men, compared to 1.82% of NFG men, and only 20.51% of FG women exceeding the cut-off points for women compared to 32.61%. The waist-to-height ratio also indicated that a higher percentage (63.74%) of NFG women exceeded the cut-off point (>0.5) compared to 60.25% of FG women.

Refined carbohydrate based foods made up the majority of the students' diet, with the top 3 foods among FG and NFG men being carbohydrate based (maize meal pap, bread/rolls, and rice), and the top two foods being rice and bread/rolls among FG and NFG women. All the students (FG and NFG), failed to meet the WHO's recommendation of consuming ≥400g of fruits and vegetables. Furthermore, between 80-100% of men and women (FG and NFG) failed to meet the RDI's for calcium, magnesium, and vitamins C, D, E and K. Although both FG and NFG students reported few protein rich sources on the top 20 foods lists, all the students exceeded the DRI for protein with mean (SD) intakes of (62.62g±21.984) by FG men, 70.98g±25.534 (NFG men), 57.97g±23.248 (FG women), and 55.94g±18.397 (NFG women). Carbonated drinks were ranked 6th for both FG and NFG men, and 8th among FG and NFG women, with NFG men reporting a higher per capita intake per day (142.52g) compared to FG men (115.67g) and among women, a per capita intake of 106.07g (FG) 96.95g (NFG). Both FG and NFG students reported low food variety scores (<30 individual foods), with FG men reporting a slightly higher mean (SD) FVS (28.56±10.079) compared to 27.41±10.342 of NFG men, and NFG women reported a higher mean (SD) FVS (29.92±8.549) compared to 28.67±10.775 (FG women). The majority of the students (FG and NFG) reported high food group diversity scores (FGDS), with the majority of men (FG=98.08%; n=51 and NFG=93.18%; n=41) and women (FG=94.9%; n= 74 and NFG=100%; n=86) reporting a high FGDS (6-9 food groups).

The matric results of the participants indicated that 100% (n=260) of all the students (FG and NFG) passed matric with a pass rating of 3-6, and the first year academic results indicated that the highest number of FG and NFG students passed the first year of university with a percentage range of 51-74% [FG men=92.31(n=48); NFG men=86.36 (n=38); FG women=93.59% (n=73); and NFG women=84.88 (n=73)]. The first year results also showed that a higher number of NFG (11.36%; n=5) men and women (10.47%; n=9) failed the first year of university compared to the FG men (5.77%; n=3) and women (5.13%; n=4).

Conclusion: Although there are some statistically significant correlations between some of the variables, it does not prove conclusively that diet and nutrition status had an impact on the academic performance of this group of students. Due to the lack of diversity with regard to socio-demographic factors, including socio-economic profile and race, no notable differences were observed except in the case of nutrition status, where a higher incident of obesity was observed among NFG students compared to FG students. Inter-gender differences were more apparent compared to inter-generation differences.

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LIST OF ABBREVIATIONS

AACC	American Association of Cereal Chemists
AHA	American Health Association
AI	Adequate Intake
AIDS	Acquired Immune Deficiency Syndrome
AMDR	Acceptable Macronutrient Distribution Range
AN	Anorexia Nervosa
ARV	Anti-Retroviral
ART	Antiretroviral Therapy
BED	Binge Eating Disorder
BMI	Body Mass Index
BMR	Basal Metabolic Rate
BN	Bulimia Nervosa
CAO	Central Application Office
CFB	Campus Food Bank
CGIAR	Consultative Group on International Agriculture Research
CHD	Coronary Heart Disease
Cm	Centimetres
CVD	Cardio-Vascular Disease
DASH	Dietary Approaches to Stop Hypertension
DDS	Dietary Diversity Score
DG	Tentative Dietary Goals
DNA	Deoxyribonucleic Acid
DUT	Durban University of Technology
DV	Dietary Values
DHET	Department of Higher education and Training
DoE	Department of Education
DoH	Department of Health

DRI	Dietary Reference Intake
EAR	Estimated Average Requirement
EER	Estimated Energy Requirement
EFA	Essential Fatty Acids
FAO	Food and Agriculture Organization
FB	Facebook
FBDGs	Food Based Dietary Guidelines
FFQ	Food Frequency Questionnaire
FG	First Generation
FGDS	Food Group Diversity Score
FNB	Food and Nutrition Board
FNS	Faculty of Natural Sciences
FRC	Faculty Research Committee
FVS	Food Variety Score
g	Gram
GDP	Gross Domestic Product
GI	Glycemic Index
GL	Glycemic Load
GMF	Genetically Modified Foods
GMFHB	Genetically Modified Foods with Health Benefits
HC	Head Circumference
HIV	Human Immunodeficiency Virus
HSRC	Human Sciences Research Council
IDA	Iron Deficiency Anemia
INP	Integrated Nutrition Programme
IoM	Institute of Medicine
IREC	Institutional Research Ethics Committee
J	Joules

Kg	Kilogram
KZN	Kwa-Zulu Natal
LDL	Low Density Lipoprotein
m^2	Square Metre
MARCOMS	Marketing and Communications
MDG	Millennium Development Goal
mg	Milligram
ml	Millilitre
MUAC	Mid-upper Arm Circumference
MUFA	Monounsaturated Fatty Acids
MUT	Mangosuthu University of Technology
NAR	Nutrient Adequacy Ratio
NCD	Non-Communicable Disease
NFG	Non-First Generation
NICUS	Nutrition Information Centre of the University of Stellenbosch
NSFAS	National Students Financial Aid Scheme
OSFED	Other Specified Feeding Eating Disorder
PAL	Physical Activity Level
PUFA	Poly Unsaturated Fatty Acids
QFFQ	Quantitative Food Frequency Questionnaire
RDA	Recommended Daily Allowance
RDI	Recommended Dietary Intake
SA	South Africa
SAFBDG	South African Food Based Dietary Guidelines
SANHANES	South African National Health and Nutrition Examination Survey
SCOFF	Sick, Control One stone Fat and Food
SD	Standard Deviation
SDG	Sustainable Development Goals

SFA	Saturated Fatty Acids
SRC	Student Representative Council
THMDP	Traditional Healthy Eating Mediterranean Diet Pyramid
TB	Tuberculosis
UK	United Kingdom
UKZN	University of KwaZulu-Natal
UL	Upper Tolerable Limit
UN	United Nations
UNDP	United Nations Development Programme
UNFPA SA	United Nations Fight for Poverty Statistics South Africa
USA	United States of America
WC	Waist Circumference
WHO	World Health Organization
WHR	Waist to Hip Ratio
WHtR	Waist to Height Ratio

CHAPTER ONE – THE PROBLEM AND ITS SETTING

1.1 INTRODUCTION

The World Health Organization (WHO), defines an adolescent as an individual aged between 10 and 19 years, and classifies youth as persons aged between 10 and 24 years (Wenhold, Kruger and Muehlhoff 2008: 443). However, there are various definitions that attempt to define the term 'adult', and explain the age categories that exist within the definition of adulthood. According to Dietz, Sly, Lee, Arheart and McClure (2013: 115), the youth age category is from the age of 12 to17 years, young adults are between the ages of 18 to 24 years, and an adult is categorized as an individual aged 25 years and above. Senekal, Mchiza and Bonley (2008: 483) indicate that early adulthood occurs between the ages of 19 and 30 years, and adults are between the ages of 31-50. This then implies that universities' student intakes include adolescents, young adults and adults. According to Tavolacci, Grigioni, Richard, Meyrignac, Dechelotte, and Ladner (2015: 412), most university students fall within the emerging adulthood population (18-25 years).

The majority of the South African population is made up of young adults. According to the United Nations Fight for Poverty statistics (UNFP SA, 2014), 66% of the South African population is made up of youth (between the ages of 15-35 years). Youth aged between 15-24 years make up 24% of that population, which is the estimated normal university-going age in South Africa. Two million South African youth between the ages of 15 and 24 are either unemployed or not enrolled in a tertiary institution due to various social and economic factors. Living conditions and quality of life among South African youth have improved in recent years and statistics show that 88.1% of the youth have access to a cellphone and internet service (UNFP SA, 2014), which indicates that the youth is more technologically inclined than was previously thought. Despite the positive advances, unemployment and HIV infection among South African youth is still on the rise, with 52.9% of youth between 15-24 years being unemployed (Mthembu and Govender 2015: 2), and 300 000 adolescents (aged 10-19) are Human Immunodeficiency Virus (HIV) positive (Vale and Thabeng 2015: 797). These statistics indicated pose a threat to the health and socio-economic status of South African youth. Labadarios, Dhansay and Hendricks (2008: 131) reported that HIV is the dominant cause of death in both adults and adolescents in South Africa; furthermore, the second leading cause of death in adults is cardiovascular disease.

Good nutrition is essential in addressing specifically the issue of HIV and non-communicable diseases. Good nutrition is essential in maintaining all body functions and overall health. According to Khuzwayo (2008: 162), malnutrition is a global phenomenon that affects all age groups and it results from poor nutrition and promotes disease and, if severe, can lead to death. Food insecurity is the driving force behind malnutrition in many countries, and developing countries are the most affected (Braun and Tadesse 2012: 299). Adolescents and young adults are also affected by malnutrition, but little or no research exists to support or challenge this statement. However, children, the elderly and individuals with

eating disorders (which mostly affect adolescents) can become malnourished, increasing the risk for disease (Safer, Safer and Doruk 2014: 242). Hunger is also associated with malnutrition and affects an individual's ability to be productive; however minimal research has been conducted to correlate malnutrition among young adults and academic performance.

Young adults are faced with many diverse challenges that may directly or indirectly affect their malnutrition status negatively. According to Steyn (2006: 33), transitional is the key word to describe this age group, and whether they are experiencing personal, education, or career problems, this is the most important stage for young adults as habits and lifestyle choices made during this stage may be maintained right throughout adulthood. It is therefore very important to monitor and track various trends within this particular age group because they are the constituent of any nation's economic growth. Youth also will contribute towards leadership and societal roles in the country's future.

1.2 BACKGROUND TO THE PROBLEM

The Mangosuthu University of Technology is located in Umlazi township's ward 88, which accounts for 0.3% of KwaZulu-Natal's total population, and which is the second highest provincial population in the country (Statistics South Africa 2012: 1-4). The population of Umlazi is evenly distributed between males and females which is inconsistent with the provincial statistics. A large number of the population is illiterate; and almost 40% of Umlazi's ward 88 residents are unemployed, which is a great concern since unemployment has a contributing factor to poverty (STATS SA 2012: 4), and a significant number of residents depend on social grants. This is because of the low average annual household income, which indicates that 43% of the population is surviving on less than $1.25 a month, sourced mainly from grants. The statistics indicate that households have a significant level of household food insecurity and are living on less than $1.25 per day which is one of the Millennium Development Goals (MDGs). South Africa is included in the list of countries in the world whose citizens are grant dependent. Welfare grants were introduced after the post-apartheid area in the country, and this has brought both pros and cons within the socio economic landscape.

The improved state of education quality and accessibility in South Africa has resulted in increased matric pass rates. This has resulted in an increased number of South African youth meeting the Higher Education admissions requirements, and furthermore, an increase in the number of African youth obtaining higher education qualifications. Education is the key to success and opens up many opportunities, and it is also a measurable indicator of progress for young students. In South Africa, higher education is even more valuable in a country plagued by HIV and AIDS (Acquired Immune Deficiency Syndrome), an inadequate health and education system, a staggering rate of unemployment, and a history of oppression and discrimination. For countless South African youth, obtaining a diploma, degree or any other form of higher education qualification is perceived as means to ending a life of poverty and an assurance of job opportunities. The importance of education has been of great concern as the demand

for skilled labour continues to increase. Globally, the increasing demand for skilled, educated graduates has forced governments to re-evaluate their contribution towards funding youth from disadvantaged communities. It is projected that this stance will continue to be supported by many governments due to the substantial impact that a labour shortage has on a country's economy. Many countries, including Australia and New Zealand, still continue to source skilled employees from other countries due to the lack of local skilled labour. Apart from government support through the National Student Aid Financial Scheme (NSFAS), student mentorship and scholarships are also successful interventions that have been implemented by institutions of higher learning to promote higher throughputs, which increase the availability of skilled labour (Labadarios, Dhansay and Hendricks 2008: 115; Wobbekind 2012: 95).

Academic success of students is a culmination of various factors and according to Talib and Sansgiry (2012: 265), academic success of students enrolled in higher education institutions is dependent on different factors. These factors include tendency to test or exam anxiety, strategic studying, academic competence, time management, and test competence. Several research studies have made a correlation between an unhealthy lifestyle and disease. Nutrition in particular has been an area of interest, especially in the contribution it makes to producing healthy individuals. The majority of research has focused mainly on adults in general and not specifically on young adults (Strawson, Bell, Downs, Farmer, Olstad, and Willows 2013: 138).

The African population is the majority race in South Africa, and the one most impacted by poverty and according to Senekal, Mchiza and Bonley (2008: 483), 19.7% of females between the ages of 15 and 24 years are overweight, and 11% are obese. In the age group 25 to 34 years, 20.9% of men and 29.4% of women are overweight, and 26% of women in this age group are obese. The high prevalence of inactivity, overweight and obesity among the South African population significantly contributes to the growing prevalence of non-communicable diseases. In many regions within South Africa this can be attributed to the deviation from the traditional diet (Bourne, Lambert and Steyn 2012: 157). South African studies indicate that a lack of dietary diversity is more prevalent in low income groups and among black South Africans (Labadarios, Steyn and Nel 2011: 8-11). The majority of University students that reside in university residences face financial challenges which may lead to food insecurity (Shah, Memom, Laghari and Kazi 2013: 356). These are students who usually come from afar. It is very important to monitor the adolescent and young adult group of the population, as it was predicted that this particular group will increase by 600% between the years of 1970 to 2025 (Wenhold, Kruger and Muehlhoff 2008: 443).

Previous studies have concluded that there is no significant impact of an improved socio-economic status on improved nutrition status (Bourne, Lambert and Steyn 2012: 157). According to Labadarios, Steyn and Nel (2011: 11), environmental factors are very important determinants of household food security, but poverty and the lack of nutrition knowledge puts healthy eating at the bottom of people's minds. Eating snacks away from home results in eating refined foods which are higher in fat (Shah *et al* 2013:356). Many diseases result from nutrition deficiencies, the most prevalent being overweight and obesity (Safer,

Safer and Dorukjk 2014: 243). The majority of all obesity and overweight cases indicate a trend that is predicted to start at a young age. Studies have shown that men are less prone to obesity and overweight than women (Bourne, Lambert and Steyn 2012: 157).

Young university students are going through a transitional phase from living at home to living independently. The consequences of the transition may be the risk of adopting unhealthy food choices as well as eating patterns. Factors that influence a student's food intake include the availability of food, affordability, social influences and level of convenience. These factors can prevent university students from meeting the recommended dietary allowance, and the problem is intensified during the first year of study. Dietary diversity and the consumption of adequate food are important factors in reaching nutrient adequacy, which is a goal in achieving and maintaining optimal health. Unfortunately, in South Africa, there is a scarcity of studies focused directly on dietary diversity, and this has been attributed to the lack of national data on adolescents and adults (Labadarios, Steyn and Nel 2011: 11; Shah *et al* 2013: 356; Strawson *et al* 2013: 139).

1.3 BACKGROUND TO SOUTH AFRICAN UNIVERSITIES AND UNIVERSITY STUDENTS

An increase in university enrolment in South Africa has been attributed to the increasing financial support from government to ensure that the throughput rate of graduates is high, and which has yielded economic and social benefits for middle and low income communities in particular. Between 1993 and 2004, student enrolment in South African universities increased by 193 000, and the majority of the new enrolments were students from disadvantaged backgrounds. Research has also documented that although unemployment rates continue to rise among the South African youth, tertiary education is still associated with better employment opportunities. The increase in university student populations has put considerable strain on the Higher Education sector, which has seen many universities struggle to maintain high throughput rates. Dropping graduation rates of 17% to 15% between the periods of 1993–1998 and 2000–2005 have also been a strong indicator of the extent of the problem (Peterson, Louw and Dumont 2009: 100; Bowman and Payne 2011: 143).

Studies that report on the factors that contribute to the low academic performance of underprivileged students in universities are limited. The available data on South African university students indicate that unpreparedness for university is the key contributor to low throughput rates. The quality of secondary education has also been questioned, especially the role it has on university students' academic performance, particularly during the first year. A trend of poor performance has been identified among students from disadvantaged backgrounds, and this has been attributed to inequalities in the education system that existed during the apartheid era and still persist. Over a decade after the new democracy students from disadvantaged backgrounds still carry that burden. The age range of university students in South Africa is 18–30 years. This particular age group has the highest instance of HIV and AIDS

infection. Although there has not been any research targeted specifically at the rate of infection in tertiary institutions, numerous studies have documented the high death rate as a result of HIV and AIDS related diseases and illnesses (Peterson, Louw and Dumont 2009: 100; Mulwo, Tomaselli and Dalrymple 2009: 311; Strydom 2010: 313;).

Interventions such as bridging courses, foundation programmes, university entrance tests, and academic support have been some of the strategies that have been implemented by many South African institutions of higher learning, aimed at remedying the problem of low throughput rates and student retention; however the graduation rate has continued to be poor (Strydom 2010: 313). The first year of study is generally associated with a high drop-out rate, and the problem is especially higher among students that come from low socio-economic environments (Peterson, Louw and Dumont 2009: 101).

1.4 FIRST GENERATION AND NON-FIRST GENERATION STUDENTS

The increase in first generation university student admissions has become a global trend, as more, younger people realize the importance of obtaining a post-secondary school education with the dream of being financially independent. First generation university students are defined as students whose parents or guardians have not attained a post-secondary school education, and these students are the first members in their respective families to attend a university or college. The social and economic profile of this group of students is defined as follows: fall within minority groups or previously disadvantaged groups, live in poor communities, and fall within a low income class. First generation students face considerable challenges compared to non-first generation or continuing generation students, which include a lack of knowledge relating to university culture, and this makes the transition from secondary school to university difficult. The impact of these challenges is directly linked to poor academic performance and is evident in the university students enrolled in the United States of America (USA). The challenges facing these students include lower family income, being unprepared for university or college, and having dependents, and as a result, first generation students are 45% less likely to return for the second year of study. To date there is no research that has attempted to establish the challenges facing this particular group of students in South Africa (Mehta, Newbold and O'Rorke 2011: 20-24; Sorina and Stapleton 2012: 678).

Changes in American demographics have seen an increase of first generation students enrolling in post-secondary institutions, while minority groups such as Hispanics account for a large percentage of these students. Tutoring and remedial work is required in subjects such as English and mathematics in order to increase the chances of academic success. Between 1975 and 2006, there has been a 58% increase in the number of first generation student enrolments, the majority opting for two year qualifications rather than four year degrees and the University of California has one of the highest retention rates of first generation students. This success is attributed to the varied support programmes that are offered to students, which focus on equipping students with tools that will promote better adaptation to changes,

managing stress, and financial support. However, pass rates among first generation university students continue to be lower compared to non-first generation students and this is attributed to the lack of engagement in academic activities, class room discussions and faculty activities. Demographics and social and academic pressures have also been cited as major problems as well as limiting factors in engaging fully with the learning environment, while in many developing countries poverty plays a major role in the retention of first generation students. Students are unable to meet financial commitments and keep up with increasing academic pressures (Horwedel 2008: 11-12; Sorina and Stapleton 2012: 680).

In South Africa, previously disadvantaged groups account for the majority of South African university students. This is substantiated by enrolment at Nelson Mandela Metropolitan University, where black students make up 60% of the total student population. Although black students make up the majority of the student population, this group of students continues to face many challenges including student engagement, financial support and academic success (Wawrzynski, Heck and Remely 2012: 107-108). There has been a growing concern and focus on first generation students compared to non-first generation students. Further research reports indicate that of 52% of first generation students attending university, only 24% will complete a degree, and compared to their counterparts, first generation students work longer hours in part-time employment jobs and spend less time attending extra tutorial classes. Family responsibilities and financial instability have been cited for long hours spent working while enrolled at a tertiary institution.

Language and university culture are potential motivators for the low retention of first generation students. Students often struggle to grasp academic information, as English is often their second language. International students face a similar challenge especially since language and communication becomes a barrier, therefore more emphasis should be placed on creating an environment where cultural diversity is embraced and language diversity encouraged. Class and cultural differences also play a role on low retention and academic completion on the part of university students. In South Africa, the majority of students from disadvantaged ethnic groups are on the National Student Financial Aid Scheme (NSFAS), and reside in students' residential facilities, but there have been few studies that have made the association between university residence and positive academic performance. However, in one study conducted at the Nelson Mandela Metropolitan University, no significant link was made between student engagement and living on campus, and although students living on campus participated in many institutional activities, this had no significant impact on academic performance (Snel 2008: 29; Tas 2013: 1).

1.5 DIETARY BEHAVIOUR AND NUTRITION STATUS OF UNIVERSITY STUDENTS

The first year of university is associated with many changes both internally (psychologically) and externally (physically). Stress is highly prevalent among many first year university students, and with the multitude of changes occurring in the first year, many changes regarding habits are expected. This is supported by a study conducted among Australian university students that reported that the percentage of students who experienced a degree of stress of some sort was 52.9% (Papier, Ahmed, Lee and Wiseman 2015: 324-326). They were also exposed to dietary behaviour shifts towards unhealthy food consumption choices; which had a negative impact on their overall health. Stress has a significant impact on food choices, and the degree of impact varies according to gender. Men consumed more meat and fat during stressful periods, while women consumed more sugar and starch. Numerous studies have reported an increased intake of sweet foods, convenience foods, carbohydrate rich foods and snacks during periods of increased stress, namely during tests and examinations. However, these results have been inconclusive in establishing a link between the amount of food consumed and the stress among university students during tests and examinations.

The results from the South African National Health and Nutrition Examination Survey (SANHANES), reported that 25.3% of women between the age group 18 to 24 years were overweight, and 36.3% of women between the ages of 25 and 34 were obese, while only 19.2% of men between the ages of 25 and 34 were overweight, and 8.1% of men between the ages of 25 and 34 were obese (Labadarios, Shisana, Rehle and Simbayi 2014: 1). These results are consistent with global overweight and obesity trends, and further illustrate the impact of urbanization on the nutrition status of the young adult and adult population in South Africa. There are only limited studies that look at the nutrition status of university students specifically. Globally, there has been a growing prevalence of overweight among university students; however, research studies have been inconsistent in establishing the magnitude of the problem and how it impacts on gender. In a study conducted among Brazilian students, 19.2% of the students were classified as overweight and 1.3% obese. The findings indicated the prevalence of overweight was greater among men, and the prevalence of underweight was greater among women (Sanlier, Biyikli and Biyikli 2015: 177-178). These results highlight the need to conduct more studies in order to establish a reliable database for this particular population. Another study conducted among university students in Turkey, indicated that 17.3% of the students were overweight; however, no attempt to differentiate the prevalence of overweight between genders was made (Barbosa, Lanzillotti, Galvao, Barbosa and Hendriques 2015: 70-72).

Increasing Body Mass Index (BMI) among students has had a negative impact on the number of non-communicable disease (NCD) cases reported. High blood pressure, high blood sugar, stroke and heart

disease are the most prevalent NCDs among both the youth and adult populations in South Africa (Labadarios *et al* 2014: 1). The rise of NCDs is further exacerbated by the lack of nutrition knowledge among university students, as well as poor body perception. In South Africa, a study conducted among university students indicated that 47.1% of men and 78.6% of women who were underweight believed that their weight was normal, and the majority of women that were overweight believed their weight was normal (Peltzer and Pengpid 2012: 4510). An international study conducted among students enrolled at a Kuwait university also illustrated a lack of health knowledge (Son, Ro, Hyun, Lee and Song 2014: 205-207). Thirty nine percent of students believed that having a body weight that was lower than that which is considered normal was healthy, while 32% of the students involved in the study did not believe that obesity was related to cardio-vascular disease. The abovementioned studies have disputed the positive link previously reported between education level and increased knowledge of nutrition status. Furthermore, there is a definite need to introduce nutrition education during the first year of university or college as part of enhancing student knowledge on what could pose threats to their own health.

The rise of non-communicable diseases and obesity in South Africa has been attributed to changing food consumption patterns. Food consumption patterns now tend to deviate from the traditional low fat and low sugar diet towards a more western diet. Price mostly determines the type of foods bought in South African households as a healthier diet costs 69% more than the typical South African diet (Ronquest-Ross, Vink and Siggie 2015: 64-72). The SANHANES 2012 reported a low consumption of fruits and vegetables by 25.6% of South Africans, while in another South African study it was reported that South Africans were consuming more fruits and vegetables compared to 1994 (Deshpand and Basil 2009: 145). Furthermore, the current South African diet has shifted towards an increase in the consumption of sugar, sweetened beverages, processed and packaged foods, animal sourced foods, added caloric sweeteners, and decreased vegetable consumption. A significant decrease in fruit and vegetable consumption has also been reported among university students. In an American university, only 7.3% of students consumed five or more servings of fruit daily (De Piero, Bassett and Samman 2015: 1824). These results are concerning since low fruit and vegetable consumption is associated with weight problems, especially during the first year of university. Comparatively, a study conducted among university students in Spain found that the majority of the students involved in the study did meet the recommended daily intake of iron, calcium and vitamin A, and noted a gradual increase in the consumption of snacks, processed foods and sugary products and a decrease in the consumption of fish, fruits and vegetables. The results from these two groups of university students are consistent with dietary changes occurring in South Africa, and further emphasize the need to monitor these changes.

Furthermore, within this particular life stage, significant developmental decisions that relate to exploring and establishing eating and weight related issues, health habits and beliefs are made. These facts substantiate the prevalence of eating disorders among the youth, particularly among university and college students. At a French university, 20.5% of the students had positive responses on the Sick,

Control, one Stone, and Fat, Food (SCOFF) test, which is used to screen and diagnose eating disorders (Tavolacci *et al* 2015: 415-416). The study also reported that 26.3% of the students had been on a diet at least once, and 25% of the students admitted to being worried about losing control over the amount of food consumed. Positive SCOFF results were more prevalent among women than men since women were three times more likely to have a positive score than men. This indicates that women are at higher risk of being diagnosed with eating disorders than men. Additionally, students who were diagnosed with eating disorders or identified as being at risk of developing eating disorders were more likely to suffer from anxiety, stress and depression. Poor body image and dissatisfaction with weight is experienced by a greater proportion of youth in developing countries, and this is substantiated by a study conducted among university students in 22 countries, of which South Africa was one (Peltzer and Pengpid 2015: 177). The results reported that 27.1% of students of normal weight were trying to lose weight, the majority of the students being women. More concerning was that 19% of students that fell within the underweight to normal weight range perceived themselves to be overweight, 11.3% were dieting, and 53.5% regarded losing weight was a great priority. A greater number of female students of normal weight than male students were trying to lose weight, further emphasizing the magnitude of the problem among women. The results from this study were consistent with those from a study conducted among students in a developed country (France), highlighting that eating disorders are prevalent in students from both developed and developing countries.

Diet and stress are the two factors that have considerable impact on growth and learning ability. Good dietary knowledge is associated with better food choices. However, numerous studies that seek to understand student dietary behaviour report that students have a poor knowledge of good food consumption patterns and nutrition. In a study conducted among Kuwait university students, 73% were first generation students and 27% were non-first generation. Non-first generation students had more nutrition knowledge compared to first generation students, and factors that impacted on the level of nutrition knowledge included demographic characteristics and level of parents' education. The study supported previous research, which reported that university students display poor dietary habits and knowledge (Son *et al* 2014: 205-207; Farouk and Badr 2011: 191).

Dietary changes are associated with the abandonment of traditional diets which are associated with fat content and high fibre (Takomana and Kalimbira 2012: 135). University students in particular tend to deviate towards convenience, and this is attributed to the significant increase in fast food consumption. Farouk and Badr (2011: 185) emphasised this problem and reported that in a study conducted among Kuwaiti students, the majority of the students indicated that a fast food diet was the dominant diet among university students. Many studies have attributed the rise in fast food consumption to the fact that it is readily available and also has good sensory appeal, but in a study conducted among male and female university students in Kuwait, price, taste and ease of preparation were found not to be important factors in choosing which foods to eat (Deshpande and Basil 2009: 160). This is contrary to the popular belief

that convenience is the sole contributor when unhealthy food is chosen over healthy food. The study further concluded that gender, dietary status and perceptions about healthy food influence the choice of food students consume, rather than the ease of preparation and availability of the food. It is vital that students learn good eating behaviours early, because habits and lifestyle choices adopted during university years are likely to be continued into adulthood (Takomana and Kalimbira 2012: 132). The consumption of soft drinks and in particular energy drinks has also increased among university students. Adepoju and Ojo (2014: 2209) emphasize the dangers, especially among students, due to the high quantities of sugar and caffeine found in energy drinks. The increased consumption of energy drinks among university students was supported by a study conducted among Ibadan university students. Fifty two comma one percent of the students consumed at least one can of energy drink per day, while 42.4% of the students that participated in the study admitted to consuming at least one can of energy drink per week. The students reported that the energy drinks were consumed for mental alertness and athletic performance. The study further established a positive correlation between increased energy drink consumption and weight gain and dental erosion.

Achieving academic excellence comes with various pressures, which include adapting to new environments and maintaining a healthy diet, and the increasing evidence of overweight and obesity trends in the world, particularly among young adults, can be attributed to a student's diet that remains unhealthy together with minimal physical activity (Ren, Chen, He, Jin, Tian, Lu, Lu, Ding, Guo, Wang, Nie and Yao 2015: 1089). According to Trapp, Allen, O'Sullivan, Robertson, Jacoby and Oddy (2014: 32), alcohol consumption is common among students, and Nemer, Fuasto, Silva-Fonseca, Ciomei and Quintaes (2013: 65) further explains that students usually consume copious amounts of alcohol, which could affect academic performance and overall health. Smoking and the use of recreational drugs are also common, while fruit and vegetable intake is low, and this is further verified by a study conducted among Malawian university students where only 3% of university students consumed five fruits and vegetables a day and the majority of the students consumed junk food, and reported little or no exercise (Takomana and Kalimbira 2012: 135). The majority of university students relocated in order to be closer to university, and the transition of moving from a rural area to an urban area can result in several lifestyle alterations (Steyn 2006: 33), which included a decrease in physical activity, a modification in diet and eating patterns, consumption of tobacco and alcohol abuse.

Access to healthy and nutritious food is a basic human right that is violated globally daily (Khush, Lee and Cho 2012: 195) and poor consumption of nutritious foods is linked to health problems including weight gain and susceptibility to chronic diseases, which may impact on students' academic performance. However, there is restricted research on the effectiveness of healthy eating interventions among college and university students specifically (Kelly, Mazzeo and Bean 2013: 304). One study conducted among school students in Canada observed an inverse relationship between diet quality and academic performance (Florence, Asbridge and Veugelers 2008: 209). Students with low quality diets performed

poorly compared to students who consumed adequate quality diets. The paucity of studies that attempt to establish the association between diet and academic performance of university students, even more so FG and NFG students, further motivates the importance of conducting this study. Additionally, to our knowledge, no study has been conducted to discern the diet quality and nutrition status between first generation students and non-first generation students.

1.6 FOOD SECURITY AND MALNUTRITION: A GLOBAL PERSPECTIVE

Malnutrition is a result of hunger which stems from food insecurity. Food security is related to food unavailability, poor utilization of food, the vulnerability of the individual, and the micro-nutrient content of the food. In order for the prevalence of malnutrition to be reduced, critical issues including food production, food distribution and pricing, as well as climate change need to be addressed. Little progress has been made globally towards solving the current problem of malnutrition, and attempts to remedy this problem have only focused on increasing agricultural outputs, while forgetting the significance of human nutrition. Globally, an increase in young adult populations has resulted in a 'bulging' population trend, where a growing population among the age group of 15-24 year-olds has increased significantly compared to other age groups. This poses a global problem indicative of high levels of unemployment which has the potential to translate into hunger and malnutrition particularly in this age group. Increasing populations are also putting a burden on food insecurity interventions, with estimations that the world population will reach 8 billion by 2030 (Stein 2010: 134; Lancet 2012: 622; UNICEF, 2012; Khush, Lee and Cho 2012: 196).

Increasing university fees have had a negative impact on the food security of university students. Food insecurity during university years can impact a student's cognitive, psychosocial and thus academic development. Research focused on establishing the degree of food insecurity among university and college students indicates that there is a higher prevalence of food insecurity among university students compared to the general population. A study conducted in Hawaii revealed that 45% of the university students were food insecure (Patton-Lopez, Lopez-Cevallos, Cancel-Tirado and Vazquez 2014: 209). A similar study conducted among Australian university students reported that 72% of the students were food insecure, which is double the average number of food insecure individuals, within the Australian general population. Another subsequent American study found that in the United States of America (USA), 59% of the students were food insecure. Food insecurity can also determine dietary quality, which may impact on overweight, obesity and under-nutrition. University students in developed countries are also likely to experience the challenges of food insecurity, and this can be attributed to financial stress. An inadequate student loan system and an increase in compulsory tuition fees have contributed to the student food security status, and this has been reported in Canada (Hughes, Donaldson, Serebryanikova and Leverette 2011: 27-31). Strategies such as campus food banks have been implemented to minimize this growing problem. The most common coping strategies administered by food insecure university

students include living with parents, and borrowing food from various sources such as friends, neighbours etc. Other coping strategies include seeking food from food banks, asking for support from universities and financial institutions, and in extreme cases, pawning items and stealing to buy food. Although it has been proven that working over 12 hours a week may impact on academic performance in university, many university students may also increase working hours to cope with the increasing financial stress and food insecurity. Students that receive government student loans may also be at risk of becoming food insecure because of financial restrictions associated with these loans and the fact that such benefits often range between 20–-39% below the poverty line. There have been limited studies that look at the impact of food insecurity on academic performance specifically among university students. In addition, only a few studies have attempted to establish the degree of food insecurity among students, the determinants of food insecurity among students, as well as the consequences of food insecurity among university students globally (Chaparro, Zaghloul, Holck and Dobbs 2009: 2097).

The most immediate side effect of malnutrition currently is overweight and obesity (Atinmo, Mirmiran, Oyewole, Belahsen and Serra-Majem 2009: 44) prevalence among this population group. This trend is seen in both developing and developed countries, which have seen escalating cases of cardiovascular diseases (CVDs), type 2 diabetes, hypertension, and types of cancer. The cases of heart disease and diabetes have increased significantly, and the poor are not excluded from this problem (Atinmo *et al* 2009: 41-44). The negative impact of obesity has not only been limited to disease, but has other consequences including increased medical bills. Other negative impacts include decreased chances of fulfilling education and employment aspirations, and potential disability (Cort, Gwebu, Tull, Cox and Modise 2013: 557). Research is indicating that there is a definite increase in overweight and obesity among adults, with a growing prevalence of obesity among university and college students. Studies conducted among American university students revealed that as many as 19.2% of university students were overweight (Sanlier, Biyikli and Biyikli 2015: 177-178), and female students are more likely to be overweight then male students. Many studies have indicated a definite increase in body weight of students during university years and confirm that university years are a critical period for weight gain. However, a study conducted among Spanish students indicated that male students are at greater risk for weight gain then female students (Ruiz, Ontoso, Armayor, Grima, Mendoza, Monzo and Feranadez 2015: 240). This is in contrast to prevailing trends showing that female students are predominantly overweight. The mean body weight increased by 0.6 kg for all students involved in the study and a mean weight gain of 1.8kg for male students, while no significant mean weight gain was observed for female students. These disparities highlight the importance of conducting more studies which may further explain the factors that contribute to weight gain among university students.

In countries such as India, there has been a gradual decrease in kilojoule consumption and this trend is evident in both poor and affluent sections of the population. The decrease in overall kilojoule intake is inclusive of proteins, but excludes the consumption of fats which has been on an increase. Contrary to

the global trend of increased obesity prevalence, India has seen a growing trend of under-nutrition (Kaicker and Gaiha 2013: 271). In rural parts of the country, the number of undernourished people rose from 71% in 1993 to 80% in 2004. There has been some economic growth in India, and economic growth has been linked to a decreased prevalence of malnutrition. However, research results in another Indian study contradict this relationship, and reveal that, in fact, economic growth has shown to have no impact on the prevalence of malnutrition in this particular country. Ren *et al* (2015: 1089) highlights an increasing problem of underweight, specifically among university students globally, where studies indicate that in some countries, as many as 12.5% of students (China) were underweight. A gradual trend among underweight university students was also confirmed in a study conducted at 22 universities in low income countries (Peltzer and Pengpid 2015: 178). The study revealed that underweight was found in 17.6% of female students. There is a compelling need to conduct more research focused on this particular gender, since underweight can have a negative impact on reproductive ability, which is critical during childbearing years. Furthermore, a study in Malaysia, found that 14.8% of medical students were underweight, where 12.2% were male students, and 17.0% were female students (Khattak, Draman, Khan and Khuttak 2012: 335). Ellis, Costa and Amirabdollahian (2012: 163), also reported that energy intake among United Kingdom (UK) university students was lower compared to energy expenditure, and this result was found to be consistent in both male and female students.

Hidden hunger, which results from micronutrient deficiency, has been severe among the world's poorest regions and the WHO and the Consultative Group on International Agriculture Research (CGIAR, 2010) have highlighted micronutrients such as vitamin A, zinc, and iron as most prevalent in terms of deficiency. Furthermore, within the adult population, Iron Deficiency Anaemia (IDA) affects 2 billion people (which is a little over 30% of the world's population). Women of childbearing age are most vulnerable to poverty and are prone to becoming anaemic. Productivity among people affected by anaemia is reduced due to potential lifelong tiredness, and as a result the WHO encourages and supports interventions including food fortification, supplementation and food enrichment. Biofortification is a rural based intervention that aims to produce high density nutrient based foods. It is also the most cost effective strategy that tries to reduce global malnutrition which is acerbated (Bouis and Welch 2010: 21).

The most commonly researched nutrition deficiencies among university students in various studies around the world are iron and vitamin D deficiencies. The incidence of iron deficiency, especially among women in their reproductive years, is significant, which explains the importance and need for continued studies in this area. This significant incidence could also be attributed to the fact that university students are typically made up a large portion of women during their reproductive years. A significant difference in vitamin D deficiency was observed between female university students and male university employees in a Jordan university (Khush, Lee and Cho 2012: 195-196). The prevalence of vitamin D deficiency was 31.2% among female students, and 20.5% among female university employees. Low sunlight exposure is associated with vitamin D deficiency, and more studies should be conducted among university students to

determine other factors that cause vitamin D deficiency in areas where these is significant exposure to sunlight.

Although there has been a gradual decrease in the number people dying as a result of coronary heart disease (CHD) in the United States, the decline has been slower for young women (Chomistek, Chiuve, Eliaseen, Mukamal, Willet and Rimm 2015: 43). Better lifestyle choices reduce the chances of CHD, hypertension, and diabetes. In Australia, however, the number of young women between the ages of 18 and 30 years affected by CHD has increased drastically with as many as 31 young women dying every day (Share, Kemp, Naughton, Obert and Aumand 2012: 233). This increase has been attributed to increased waist circumference also known as central obesity due to inactivity and increased consumption of energy dense foods. This research result is consistent with current data linking affluent global regions to over-nutrition and poorer regions to under-nutrition. University students are usually perceived to be healthy. However, according to Fernandez, Art, Dimond, Hirshberg and Lofgren (2013: 648), there is a definite presence of risk factors for coronary heart disease among university students, with 33% of university and college students being overweight, 53% having low-density lipoprotein cholesterol, 47% suffering with hypertension, 18% with elevated triacylglycerol (TAG), and 20% having high-density lipoprotein cholesterol. Magnesium deficiency has been linked to an increased risk of non-communicable diseases such as cardiovascular disease, osteoporosis, hypertension, and type II diabetes (Sales, Nascimento, Medeiros, Lima, Pedrosa and Colli 2014: 200-201). A study conducted among healthy college students at a public university in Brazil found that 42% of students had plasma or erythrocyte magnesium below the limit of 0.75 and 1.65 mmol/l, and these results indicate a low dietary magnesium intake. These results build on the assumption of non-communicable disease prevalence among university students.

An increasing number of HIV infections continues to place an added burden on food security interventions especially as, globally; more than 33 million people are infected by this epidemic. Poverty results in decreased consumption of nutritious food which may hinder immune function and increase mortality among HIV infected people. A combination of HIV infection and the prevalence of malnutrition is accountable for the high mortality and morbidity rates in many developing countries (Ivers, Cullen and Freedberg, Block, Coates and Webb 2009: 1096). Billions of dollars are spent on antiretroviral therapy every year globally, but this effort will be in vain if the issue of malnutrition and food insecurity is not effectively addressed. Ounjit (2014: 526), states that young people between the ages of 18 and 25 years who are still at university or college are at high risk of HIV and AIDS infection due to irregular condom use and incorrect information relating to prevention. According to Bcheraoui, Sutton, Harnett and Jones (2013: 186), 61% of United States (US) diagnoses of HIV infections are in 20–24 year old African-Americans. This is attributed to the high level of sexual activity among the age group, and among American college students where 86% of the students were found to be sexually active, while only 35%

reported consistent condom use. This increases the risk of HIV and AIDS infections which could impact on malnutrition risk for this particular student population.

Malnutrition can cost countries billions of dollars every year. In 2005, it was found that the United Kingdom's National Health Service spent $14.3 billion on treating malnourished individuals, and 29.7% of the malnourished in-patients died within the first year of being diagnosed (Lamb, Parr, Lamb and Warren 2009: 571). In America, the overall cost of treating NCDs was just over $245 Billion dollars in 2012, and in Europe it cost EUR 196 billion. This means that as the number of people with NCD increases globally, a large percentage of countries' healthcare funds will go towards treating patients with NCDs (Kengne, Mchiza, Amoah and Mbanya 2013: 302). Under-reporting of malnutrition statistics is a barrier to establishing and implementing nutrition policies and programmes (Elia, Russell and Stratton 2010: 471). The Food and Agriculture Organization (FAO) stated that 925 million people are affected by malnutrition in both developed and developing countries (Safer, Safer and Doruk 2014: 240), while 800 million people are chronically malnourished (Ivers, Cullen and Freedberg 2009: 1096). Malnutrition also leads to decreased productivity and impacts an individual's total earning ability which also impacts the country's Gross Domestic Product (GDP). This can impact an individual's ability to afford nutrient rich food, which may fuel the cycle of malnutrition (Tirado, Cohan, Aberman, Meerman and Thompson 2010: 1731). As the world population is predicted to increase by 37% to 9.2 billion by 2050 (Tirado *et al* 2010: 1738), global concern about the impact this has on current interventions to promote food security grows. However, with an increasing world population, it is therefore difficult to maintain sustainable food security (Van Dijk 2014:378).

1.7 FOOD SECURITY AND MALNUTRITION: AN AFRICAN PERSPECTIVE

Malnutrition is a serious problem in many African countries, which mainly stems from the enormous burden of food insecurity (Sambo 2012: 1), and this is mainly due to lack of resources to plan and implement interventions. Chronic hunger affects one in five people in developing countries and rural areas are most affected, and barriers to intervention programmes include the threat to peace, lack of job opportunities, HIV and AIDS, and unsustainable natural resources (Atinmo *et al* 2009: 41). HIV and AIDS infection is a growing problem in Africa, and a call for more nutrition based rather than medicine based approaches to alleviate this issue has been proposed by the global community (Ivers, Cullen and Freedberg, Block, Coates, and Web 2014: 1096). Under reporting of poverty and malnutrition cases continues to be a problem in many African countries (Pauw and Thurlow 2011: 803), but there is a general consensus that considerable agricultural growth, research and investment, especially in crops such as maize, which is the staple food in many African countries, is required. Intervention programmes are not very effective in many African countries. This is the case more so than ever when it comes to nutrition education programmes. According to the WHO, only 35% of infants are breastfed, despite the message of exclusive breastfeeding for six months being communicated to people (Sambo 2012: 1). An

added concern stems from the fact that 35% of under-five child mortality cases is as a result of under nutrition. The most crucial stage of life occurs during pregnancy and during the first 2 years of life (Atinmo *et al* 2009: 40). Any form of malnutrition experienced during this stage will negatively affect an individual during the various life stages including adulthood, and the consequences are irreversible and will most probably be perpetuated from one generation to the next.

Many east African countries are exposed to limited diets which include mainly maize meal, sugar and vegetables, and limited access to protein food sources (Dunbar, Bosire and Deckelbaum 2014: 74). Increased availability of fast foods and the use of processed oils including sunflower oil and corn oil are also part of the diet shift. The nutrition transition currently taking place in developing countries is attributed to the double burden of the nutrition situation currently engulfing African countries. Sub-Saharan countries are further faced with added micronutrient deficiency issues, with iron and vitamin A deficiency more prevalent in women (Zeba, Delisle, Renier, Boubacar and Banza 2012: 2210). With the adoption of westernized diets and inactive lifestyles in Africa, the rise of non-communicable diseases, cardio-vascular disease and diabetes is not surprising, while the prevalence of obesity in Africa has risen by a staggering 114% between 2005 and 2010, and this trend is more prevalent among women than men (Zeba *et al* 2012: 2211). Many studies have made a strong association between childhood obesity and adult obesity (Mogre and Aleyira 2014: 69); however little has been reported about the prevalence of obesity among young adults, and in particular university students, in Africa. However, in a study conducted among university students in Ghana, 60.9% of the students were overweight and central obesity was found in 9.8% of the students. Central overweight and obesity was more prevalent in female students (69.7% and 27.3%, respectively). The majority of the students took part in either light or moderate physical activity (67%). The prevalence of weight gain is even more prevalent in the first year of university, and it is estimated that students will gain ±6.8kg during the duration of their academic period (Takomana and Kalimbira 2012: 133). The Malawian Demographic and Health Survey reported that 11.2% of women between the ages of 15 and 49 years were overweight, and 2.4% were obese. A study conducted among Malawian university students indicated that, within a seven month period in the first year of study, students gained a mean 8.5kg±3.6 more with male students gaining (9.6kg±3.5) and female students (7.1kg±3.2).

A positive growth trend in people affected by cardiovascular disease (CVD) and diabetes has been observed in Africa (Kengne *et al* 2013: 302), and the most affected group is young adults living in urban areas. Obesity, diabetes, CVDs and cancer have been on the increase especially in Sub-Saharan African countries and this is attributed to urbanization and industrialization which tend to change lifestyle habits. With an increase in both communicable and non-communicable diseases (NCDs) in African families, health sectors and economies are not fully equipped to respond to the problem efficiently and adequately (Kengne *et al* 2013: 303). It is estimated that the implication of diabetes will be so great in the future, that it will surpass even the devastation caused by HIV and AIDS. There has been a significant change in

diets in developed countries associated with diseases of lifestyle (Dunbar, Bosire and Deckelbaum 2014: 74), but this has not extended to developing countries. There is a definite correlation between economic growth and health, and the emphasis should be on establishing improved healthcare facilities in order to counteract this economic development. The increase of non-communicable diseases, which is mostly as a result of lifestyle choices, places a huge financial burden on growing economies, especially in developing countries in Africa. According to Kengne *et al* (2013: 310) urbanization and globalization are believed to be responsible for the increase in NCD cases in Africa. Diseases such as diabetes were almost unheard of in Africa, but there has been a surge in both type I and type II diabetes cases with an estimated increase of 110% expected between 2013 to 2035 (Peer, Kengne, Motala and Mbanya 2014: 197). Type II diabetes, which is commonly associated with lifestyle, affects mostly men and women between the ages of 20 and 79 years of age, and in 2008, the WHO estimated that Africa had the highest diabetes related mortality rates in the world of individuals between the ages of 30 and 70 years, and it is expected that diabetes will overtake infectious diseases as the leading cause of death in Sub-Saharan Africa (Peer *et al* 2014:198). The greatest concern is the high number of undiagnosed cases, which contributes to the high diabetes mortality rate. Lack of efficient health facilities has also been linked to the high diabetes related mortality rate in this continent.

1.8 FOOD SECURITY AND MALNUTRITION: A SOUTH AFRICAN PERSPECTIVE

According to the Food Agriculture Organization (FAO), 50–60% of countries in Sub-Saharan Africa have a hunger prevalence of more than 35% (Sambo 2012: 2). The rejection of indigenous foods in South Africa has been cited as one of the major reasons for many households being food insecure (Cloete and Idsardi 2013: 902). This rejection can be attributed to peoples' perception that indigenous food is a 'poor people's food'. As a result, foods that include sorghum, sweet potatoes and cowpea leaves are being shunned, reducing the diet diversity of the majority of South African people which has led to compromised dietary diversity resulting in poor nutrition status, and in most cases leading to malnutrition. Poverty is the foremost cause of hunger and malnutrition (Atinmo *et al* 2009: 41), and this is more apparent in South Africa which is a country still grappling with political and economic transition. This has resulted in significant gaps between the rich and the poor. These gaps then translate into the nutrition status of rich and poor communities (Vorster, Badham and Venter 2013: 5). Furthermore, South Africa is going through a nutrition transition phase, with a double burden of nutrition clearly evident and with the prevalence of both under- and over nutrition. Obesity seems to have infiltrated rural areas as well now, and this is attributed to the increased consumption of processed foods as opposed to indigenous foods (Cloete and Idsardi 2013: 902).

Malnutrition increases the vulnerability of HIV patients to the virus as well as increasing the susceptibility to opportunistic infections. There is a therefore a negative relationship between HIV and AIDS and malnutrition, and HIV infection can also lead to malnutrition due to decreased food intake caused by poor

appetite, and malabsorption of nutrients. South Africa has one of the highest HIV and AIDS infections in the world, and this increases the country's vulnerability to malnutrition, further fuelling HIV and AIDS related deaths. Billions of rands are being spent on the rollout of ARVs, but more emphasis has now been focused on diet quality and nutrition as a coping strategy to reduce the high HIV and AIDS mortality rate, and to improve the quality of life of those affected by the virus. A study conducted by the Higher Education HIV and AIDS Programme showed that prevention of risky sexual behaviour of university students should be a priority to reduce HIV and AIDS infection as one in four university students in South Africa is likely to be infected with the virus. There has been a noticeable decline in the number of HIV cases among 15–24 year olds, however, with a decline of 8.7% in 2008, and 7.1% in 2012 but research still indicates that 3.4% of students in South Africa were HIV-infected (Tirado *et al* 2010: 1731; Buldeo and Gilbert 2015: 209-210).

In Africa, South Africa has one of the largest and fastest growing economies as a result of the increase in urbanization and industrialization; however, this economic growth has had a negative impact on the nutrition status of South Africans. Among women between the ages of 18–24, 25.3% are overweight and 21.7% are obese, while among men in the same age group, only 5.8% are overweight and 4.2% obese. KwaZulu-Natal has the second highest prevalence of overweight among men in the country (23.7%), and the third highest among women (25.2%). Obesity is becoming a growing problem, not only in developed countries, but in developing countries as well. In developing countries especially, the problem is significant since the prevalence of obesity now far exceeds the prevalence of underweight. In South Africa, the percentage of obese individuals has increased significantly, and this increase has been attributed to increased income, and easy access to fast food, which tends to be higher in fat and salt, and lower in essential micro-nutrients. Although there has been an increased dietary diversity in South African diets, the issue now is the diet quality (Kengne *et al* 2013: 302; Labadarios *et al* 2014: 1; and Averett, Stacey and Wang 2014: 23-24).

Eating habits learnt at childhood are carried onto adulthood (Feeley, Musenge, Pettifor and Morris 2012: 1), and eating habits are established by the age of thirteen years. In South Africa, there is an increasing trend of consuming energy dense and nutrient poor foods, and this trend is more evident among adolescents and young adults. The ease of accessibility of fast foods from both formal and informal fast food outlets has fuelled this growing pattern, which has health implications for people in these age groups (Feeley *et al* 2012: 2). Poorer populations have also taken to the fast food consumption trend. Availability of convenience foods to low income populations has increased the obesity statistics in South Africa and the added burden of high food costs has resulted in people consuming foods with poor nutrient density (Temple, Styne, Fourie and De Villiers 2011: 55). Refined foods with added sugar cost less than nutrient dense lean meat, fish, fruit and vegetables, and there is a limited availability of nutrient rich foods in the most rural parts of South Africa. Food prices and the availability of fast food have contributed to the increased incidence of overweight and obesity of South Africans. In Cape Town, a study found that the

cheapest fast food sources were cookies, sugar, oil and margarine. Further research has shown that to improve the traditional South African diet and change it into a healthy diet would result in increased household food costs, which many low income household cannot afford. According to Temple *et al* (2011: 57), healthy foods were found to be 10% to 60% more expensive than unhealthy foods in South Africa, and in response, the concept of home gardens was introduced by the Department of Agriculture to promote more vegetable and fruit intake among low income communities. However, this intervention has not been very successful in many communities due to the lack of training, education and monitoring.

The fact that the majority of the South African population is made up of youth or young adults highlights the need to conduct more group specific research focused in this particular population. Poverty, lack of quality education and the significant increase of new HIV and AIDS cases has made South African youth vulnerable to the vicious cycle of malnutrition and food insecurity and has increased the percentage of overweight and obese youth. The side effects of overweight and obesity on overall health and overall quality of life increase the urgency to make more data available so as to understand these conditions in order to establish and implement effective nutrition intervention programmes and tools. Additional government support and a general increase in household income among previously disadvantaged communities has resulted in university education being more accessible to these population groups. There is no doubt that education is one of the keys to a healthier life but, unfamiliar environments can lead to numerous challenges which have been experienced by First generation students. This may impact on overall academic performance, which is not the case for non-first generation students. No student study in South Africa has sought to establish the impact of family background on academic performance and relate this to the academic performance among university students. Various studies have tried to establish the relationship between academic performance and nutrition status; however, the results have been inconclusive, highlighting the need for more studies to be conducted.

Table 1.1 depects the various studies that assesses the diet and/or nutritional status of university students for the past 10 year (2005-2015).

Table 1.1: South African studies conducted among university students (2005-2015)

TITLE OF STUDY	AUTHOR	MEASURING TOOLS	SUMMARY OF RESULTS
Nutrient intake and consumption of indigenous foods among college students in Limpopo Province (n=37 students).	Mbhenyane, Venter, Vorster and Steyne 2005.	Quantitative Food Frequency questionnaire	Mean dietary intakes were 10 042 kJ,16.3% protein energy, 28.9% fat energy and 54.8% carbohydrate energy for women; and 12 050kJ 16.7% protein energy, 26.4% fat energy and 56.9% carbohydrate energy for males. The macronutrient contribution to total energy intake was similar for both genders.

			Frequency of foods Consumed varied among students, with the consumption of indigenous foods low and this was consistent for both genders.
An investigation of socio-demographics, nutrition knowledge and dietary intakes of Black Students attending the Steve Biko Campus of Durban Institute of Technology (n=192).	Ntuli 2005.	Socio-demographic questionnaire Nutrition Knowledge questionnaire Anthropometric measurements	The results of the study indicated that the nutrient intake of the students did not comply with the dietary guidelines. The consumption of fruits, vegetables, and meat and dairy groups was low, which resulted in micronutrient deficiencies. The nutrition knowledge score indicated that the students had a limited knowledge of nutrition concepts.
Dietary supplement use and associated factors among university students (n=400).	Steele and Senekal 2005.	Interview schedule consisting of questions relating to demographics, health and lifestyle and supplement use.	Thirty eight point five % of the students did not use supplements, and the reasons cited were that the students did not see the need to use them. Nineteen point five % of the students used supplements during times of increased stress and fatigue, while 42% of students used supplements containing a combination of both vitamins and minerals. Students that used supplements had no specific demographic profile, but the majority attributed the use of supplements to family, friends' and doctors' recommendations to maintain good nutrition health.
Hunger for knowledge: Food insecurity among students at the University of KwaZulu-Natal (n=1083).	Munro, Michaels, Heather and Shelley 2013.	Developed Food Security questionnaire.	The results indicated that 20.8% of the sample experienced some level of vulnerability to food insecurity, with 16.1% reporting serious levels of vulnerability, and 4.7% experiencing severe to critical levels of vulnerability to food insecurity. Students on financial aid were found to be significantly more

			vulnerable to food insecurity when compared to those who were not on financial aid.
Exploring food insecurity and socio-economic factors affecting academic performance: a case study of first year students on probation and at risk of academic exclusion (n=511).	Gwacela 2013.	Food Security questionnaire Focus group discussions Key informant interviews	Fifty-three per cent of students came from disadvantaged socio-economic backgrounds characterized by unemployed parents and a high dependency on government grants. Twenty per cent of students regularly send remittances home, diverted from their scholarships/ bursaries and study loans thus leaving little for students to survive on. HFIAS results showed the majority of students were food insecure as 80% experienced anxiety about food availability and accessibility and 54% had periods of complete inaccessibility to food. The majority of students proved to have a lack skills in grocery listing and financial management skills. Affordability and storage facility challenges led to students consuming nutritionally poor foods which compromised their health status. The IDDS showed 92% of students consumed bread, rice and maize, 70% ate foods with high levels of sugar, 71% ate foods made with oil, fat or butter, 66% ate meat, 58% ate vegetables and 50% ate fruits.
The assessment of dietary diversity and nutrition knowledge of student nurses at the KwaZulu-Natal College of Nursing (n=398).	Wirth 2014.	General Knowledge Nutrition questionnaire Food Frequency questionnaire Anthropometric measurements Socio-demographic questionnaire	The majority of the respondents (70.3%) were between the ages of 20 and 28. The number of students that reported an increase in body weight after enrolling at the college was 51%, while 55% of the students had a waist to height ratio of more than 0.5. A significant number of

			students had knowledge on the importance of the consumption of fruits and vegetables (93%). The FFQ results showed high Food Group Diversity scores and a medium food variety score.
Eating behaviour, eating attitude and body mass index of dietetic students versus non-dietetic students majors: A South African Perspective. (n=83 non-dietetic students and n=62 dietetic students).	Kassier and Veldman 2014.	Three-factor Eating Questionnaire (TFEQ) Eating Attitudes Test (EAT) BMI	The TFEQ indicated that there was a high prevalence of eating restraint followed by inhibition of eating and hunger scores in first year dietetic students and the results were similar for non-first year non-dietetic students. The mean scores for the EAT were significant and were indicative of eating disorders. First year dietetic students were more likely to experience distorted eating then non-dietetic students. The BMI of all the participants fell Into the normal range.
Eating, drinking and physical activity in Faculty of Health Science students compared to other students at a South African University (n=619).	Gresse, Steenkamp and Pieterson 2015.	Electronic self-administered survey	Statistical difference was found between eating patterns, alcohol consumption and physical activity for Health Science (HSS) students and Non-Health Science (NHSS) students. Furthermore, 65% of HSS and 67% of NHSS consumed less than one piece of fruit a day. Ninety one % of HSS and 93% of NHSS consumed less than two glasses of milk per day. The percentage of HSS students that consumed alcohol more than twice a week was 4% and 9% for the NHSS students, while binge drinking was more common among the HSS students. Forty eight % of HSS students indicated that they were not physically active, compared to 49% of NHSS students.

Food Insecurity among students at the University of the Free State, South Africa (n=1416).	Van den Berg and Raubenheimer 2015.	Self-administered web-based questionnaire.	The prevalence of food insecurity was 65% using the one item measure, while using the 10-item measure, the prevalence was 60% of the students experiencing food insecurity with hunger and 26% without hunger. Blacks and coloureds were the most food insecure
Students' Food Acquisition Struggles in the Context of South Africa. The fundamentals of Student Development (n=66).	Dominuguez-Whitehead 2015.	Focus group interviews	The study found that the three factors that impacted food acquisition among university students were the depletion of food funds, acquiring food on campus, and awareness of other food struggles. Results also highlighted that serious food acquisition problems exist among university students in South Africa, and inaccessibility to food on campus may have a negative impact on students' involvement.

1.9 STUDY AIM AND OBJECTIVES

1.9.1 STUDY AIM

The aim of this study is to determine the relationship between diet quality, nutritional status and academic performance of First and Non-first generation university students in Durban in order to bring awareness about transitional challenges facing university students, and inform the development of a nutrition education programme.

1.9.2 STUDY OBJECTIVES

The specific objectives of this study were to:

- Determine the students' dietary intake by completing 3 x 24 - hour recall questionnaires.
- Determine the food variety and dietary diversity of the students by completing a food frequency questionnaire.
- Establish the anthropometric status of the students by determining body mass index (BMI), and waist circumference using anthropometric measurements.
- Establish the level of students' academic performance using matric results and first year academic records supplied by students.

- Establish the socio-demographic profile of the students by means of a socio-demographic questionnaire.
- Compare the above variables between the First and Non-first generation student groups.

1.10 CONCEPTUAL FRAMEWORK FOR THE STUDY

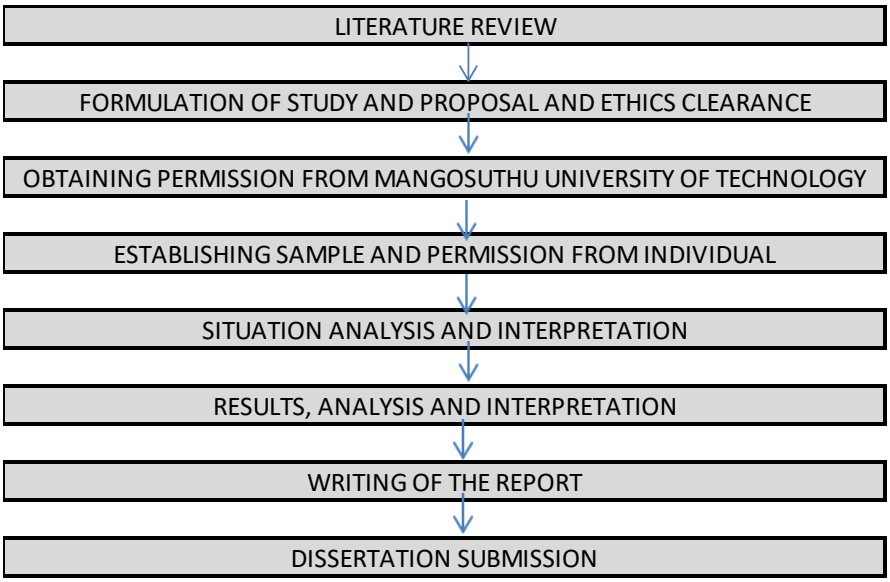

Figure 1.1: Framework of the research

1.11 STRUCTURE OF THE DISSERTATION CHAPTERS

Chapter 1: Introduction and Motivation for the Study

Chapter 2: Literature Review

Chapter 3: Methodology

Chapter 4: Results

Chapter 5: Conclusions and Recommendations

1.12 CONCLUSION

Malnutrition continues to be a global concern, and as stances towards alleviating this problem continue to be ineffective a lot more will have to be understood about what causes malnutrition, and greater efforts will have to be made to reduce this problem. Young adults will also need to be part of efforts to solve this problem, but efforts have to be made to focus on the problems related to nutrition and diet experienced by

this group, and the potential effects these issues may have on their overall wellbeing. It is important to conduct youth specific research due to the lack of data focused on this group in relation to the critical role and responsibility this group has to play in the future development of the country. The more we know about the current health status of young adults, the more health facilities will be equipped to handle hunger and food insecurity related incidences facing the future adult population. Part of fighting the problem of malnutrition involves gathering more reliable data on the actual problem. Research should be representative of all age groups and races, and both genders. Accurate and representative data will enable better and more effective programmes and policy developments, which will lead to the implementation of problem specific programmes and activities.

Globalization, urbanization and industrialization have shown positive economic growth in both developed and developing countries. But this has had serious implications for the health and nutrition status of people residing in these countries. With the prevalence of both under-nutrition and over-nutrition increasing, diseases of lifestyle will still continue to be the leading cause of death after HIV and AIDS globally.

CHAPTER TWO – LITERATURE REVIEW

2.1 INTRODUCTION: DEFINITION OF MALNUTRITION

Malnutrition is hard to define because it is not a single condition (Nazarko 2009: 133); however the World Health Organization (WHO) defines malnourished individuals as those whose diet does not provide enough macro- and micronutrients for growth, maintenance and health (Lamb *et al* 2009: 571). This also includes the inability to utilize nutrients because of illness. Malnutrition can be further classified into acute malnutrition which results from abrupt periods of food shortage resulting in loss of body fat and wasting. Another classification is of chronic malnutrition which results from long periods of hunger, and hard long-term adverse effects on the body, especially the brain (Safer, Safer and Doruk 2014: 240). According to Khuzwayo (2008: 161) malnutrition is a condition that takes place when an individual's diet fails to provide adequate macronutrients and micronutrients to promote the growth, maintenance and health of that individual. This condition could, however, relate to under-nutrition, where an individual's diet consists of inadequate nutrients, and over-nutrition (obesity), where an individual's diet consists of more than the required nutrients.

2.2 OVER-NUTRITION

2.2.1 OBESITY

Globally, approximately 1.3 billion people are overweight or obese (Obgbuji 2010: 143). Excess weight gain and obesity are responsible for almost three million deaths every year (Stephens, MacNaughton, Crawford, MacFarlene and Bell 2011:1219) and there is a growing trend worldwide of obesity among young adults (Han and Powell 2011: 131). The natural developmental shift from childhood to adulthood has been affiliated to this spike in adult obesity, and the frequency of youths affected by this pandemic seems to increase especially among young females in African countries including Nigeria (Ejike and Ljeh 2012: 2). Globally, there is a definite trend of an increasing prevalence of obesity, some studies even estimating an accelerated growth and this comes with vast health challenges in many nations (Steven *et al* 2012: 1).

Obesity affects the majority of the adult population and is a serious health issue due to the fact that it leads to adverse health consequences which include hypertension, stroke and coronary heart disease (Baalwa, Byarugabe, Kabagaambe and Otim 2010: 367-368). Research has attributed the increase of global obesity on changing diets and the adaption of a sedentary lifestyle, especially in developing countries. Obesity and food insecurity are related because when people are food insecure, unhealthy, high energy foods that cost less become the only option. That is the reason obesity and food insecurity are more prevalent in low income populations (Liping, Bettylou, Rashid and Blanck 2012: 1403). There is

a definite awareness of the risks involved with overweight and obesity. Diseases of lifestyle, including hypertension and cardiovascular disease, have been identified as high risk among minority communities, but the association between obesity and cancer is minimal. It is very important to increase nutrition education, especially in disadvantaged communities, where traditional and cultural beliefs play an important role in high obesity prevalence (Winston, Phillips, Peterson, Wells, Martinez, Chen, Foster and Charlson 2014: 123-126).

Additional adopted habits including smoking, alcohol abuse, and the consumption of sweetened drinks have been cited as contributing factors impacting on the astonishing obesity statistics among young adults According to Bermudez and Gao (2010: 211), dietary changes in America have seen a drastic increase in the consumption of sweetened drinks as a replacement for healthier beverages such as milk and fruit juices. Fructose sweetened soft drinks are currently the major source of energy in the United States, and a direct relationship between the consumption of sweetened drinks and obesity has been established. Proposed interventions to reduce the prevalence of obesity among young adults have included possible tax hikes for fast foods and sweetened beverages, and subsidies for healthy food options, for example, fruits and vegetables (Han and Powell 2011: 130-131).

Dietary intake, especially increased sugar consumption, has contributed to the adult obesity statistics The role that sugar consumption has in the increase of obese adults in developing countries has been documented in many studies, and has been cited as the major energy source in adolescents and young adults, especially in the form of sugary drinks. There has been an increase in the consumption of total and added sugars and carbohydrates in the last 30 years. The availability of refined carbohydrates, which include flours, sweet drinks and grains has also contributed to the high reported incidences of obesity among the young adult and adult populations Watching television and videos, and playing computer games were the main reasons for the inactive lifestyles among young adults (Song, Wang, Chung, Song, Lee, and Chun 2012: 1137-1140).

According to table 2.1, an individual is classified as overweight if the body mass index (BMI) is ≥25kg/m², and is classified as being obese when the BMI is ≥30kg/m². Kim, Seo, Swearingin and So (2013: 114) argue that obesity is not a result of dietary factors independently, but is also affected by lifestyle factors, which include frequency of drinking alcohol and smoking, stress, sleep deprivation, financial stability and education. Strong correlations exist between financial stability and education to the prevalence of obesity. When combined, obesity and smoking have the potential to cost any country millions in lost revenue (Song *et al* 2012: 1138-1140), and this may be as a result of lost productivity and medical expenditure. In a study conducted among US adults that were 18 years and above, 26.8% of the sample were obese and 45.4% were smokers. Health care costs associated with obesity and smoking was tracked over 13 years, and there was a positive growth trend observed with regard to healthcare expenditure as a result of both obesity and smoking.

Table 2.1: BMI classification in determining overweight and obesity (WHO, 2014)

Classification	BMI(kg/m^2)	
	Principal cut-off points	Additional cut-off points
Overweight	≥25.00	≥25.00
Pre-obese	25.00 - 29.99	25.00 - 27.49
		27.50 - 29.99
Obese	≥30.00	≥30.00
Obese class I	30.00 - 34.99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

South Africa is a country plagued by both under-nutrition and obesity, and the prevalence of obesity has been acknowledged and accepted as a result of cultural and traditional norms (Averett, Stacey and Wang 2014: 23). According to Lobstein (2011: 11), developing countries such as South Africa and Brazil have reported increasing levels of obesity, which is attributed to urbanization, increasing education levels, and increasing household incomes, and which affects African females more so than females from other races and males. This is concerning especially since obesity has been linked to infertility among women of childbearing age (Ogbuji 2010: 143). Health complications associated with obesity can place strain on healthcare systems which are already over-utilized, and also negatively impact unstable growing economies in developing countries (Lobstein 2011: 11).

There is definite evidence that shows the relationship between obesity and mortality as well as the link between obesity and cardiovascular disease resulting in mortality (Wang 2015: 1). But research studies now suggest that age is a big factor in determining whether obesity will result in mortality. Obesity may play a greater role in mortality among younger people than older people. Obesity is a serious health problem due to its link to mortality rates but obesity affects populations differently. In developing countries where education levels are low, obesity is highly prevalent (Leon-Munoz, Gutierrez-Fiasco, Guallar-Castillion, Regidor, Lopez-Garcia, Martinez-Gomez, Graciani, Banegas and Rodriguez-Artalejo 2014: 836), and in a study conducted among Spanish adults, those with only primary school education were more than twice as obese as adults who had attended university, and this was attributed to the increased time available to watch television and increased energy drink intake. In America studies indicate that obesity is greatest among adults aged between 18 and 49 in low income communities, and this may be due to low education levels, low income levels and food insecurity (Liping *et al* 2012: 1408). There is, however, a notable awareness of the consequences related to an individual being overweight or obese (Winston *et al* 2014: 123).

Recommendations to tackle youth obesity have included portion control, promoting an adequate intake of fruits and vegetables, and promoting a healthy lifestyle. There is a higher incidence of overweight and obesity among youth from rural areas, and geographic isolation, low socio-economic status, lack of health resources and lifestyle changes have been cited as the major contributing factors for this statistic (Reed, Patterson and Wasserman 2011: 401).

2.2.2 DISEASES OF LIFESTYLE/ NON COMMUNICABLE DISEASES

Lifestyle diseases are usually reported as a result of poor nutrition and energy expenditure choices (Kozica, Deeks, Gibson-Helem, Teede and Moran 2012: 70), and are responsible for thirty percent of all deaths worldwide (Pappachan 2011: 143). Contrary to previous studies, recent studies have ascribed both internal and external factors in the development of lifestyle diseases (Sasamura and Itoh 2012: 272), while lack of exercise and poor dietary habits have also been attributed to the increase in lifestyle diseases.

Cardiovascular disease (CVD) is one of the leading causes of mortality worldwide and is more prevalent than other lifestyle diseases (Zang and Hu 2012: 65). The diagnostic remedies include maintaining a healthy BMI, consuming a healthy diet, participating in moderate exercise, regulating alcohol consumption and quitting smoking. In women, polycystic ovary syndrome, gestational diabetes mellitus, and type II diabetes are associated with poor lifestyle choices (Kozica *et al* 2012: 70). Furthermore, reported incidences of stroke have been on a sharp increase, in developing countries in particular, with 15% of ischemic strokes affecting adolescents and young adults. Lack of knowledge and awareness of the risk factors associated with stroke have been cited as the major cause of the high prevalence of stroke among the youth, but little research has been conducted to link this lack of knowledge and prevalence of stroke among the youth (Kamolafe, Olaogun, Adebiyi, Obembe, Fawale and Debowale 2015: 687)

The leading cause of death globally is stroke, and it accounts for three –13% of deaths among young adults (under 45 years of age), and in a study conducted among Taiwanese adults, smoking and hypertension were the leading risk factors for stroke. Although there are ample studies that attempt to identify the cause of stroke among young adults, many depend on less expensive measuring tools, which could impact the validity and accuracy of the results (Dhaarmasaroja, Muengtaweepongsa, Lechawanich and Pattaraarchachai 2011: 247).

Young adults have the highest rate of smoking of any age group, with males being the most affected. Lifestyle behaviour has been cited as one of the contributing factors as to whether or not the individual adult smokes or not. This is because the adult is socially and economically emancipated and this may impact on the affordability of the smoking lifestyle as compared to the younger adult, who is still at school and in many instances lacks the finances to maintain this lifestyle (Dietz *et al* 2013: 115-120).

Coronary heart disease has also been common among the young population in countries such as India. This disease affects young adults during their youth years and can have severe consequences. In a study conducted in India among university students, non-smoking students were found to have a lower incidence of low density lipoproteins (LDL) and BMI compared to smoking students, which increased the risk of cardiovascular disease (CVD) (Ismail and Anil 2014: 592). In young adults in Nigeria, hypertension was the leading risk factor for stroke, followed by excessive alcohol intake, heart disease, diabetes, smoking and HIV. Only 53.7% of the Nigerian youth diagnosed with stroke survive, which is concerning, and more emphasis should be placed on identifying preventable and modifiable risk factors for this age group, so that stroke-related mortality is reduced among the young population (Onwuchekwa, Onwuchekwa and Asekomaeh 2009: 98).

The prevalence of stroke in Asian countries has also risen, and the youth is just as affected as other age groups. This was apparent in a study conducted among Korean males, where 40% of the males were reported to have cardiovascular stroke during youth years (Hyun, Chung, Hyun, Kim and Park 2012: 467-468). This is in line with global statistics that indicate that stroke has become a leading cause of death and disability among the youth and adolescents. Adolescents and the youth have a tendency to adopt lifestyles that have the potential to affect their adult lives. In a study conducted among Ghanaian youth, 89.2% had no knowledge of cardiovascular disease, and this was also related to their diet, where meals such as breakfast and lunch were the most commonly skipped meals (Nti, Brown and Danquah 2012: 1527-1529). The study also identified a growing trend of increased food diversity with increased knowledge of diseases. This study is important in acknowledging the importance of education and knowledge in attempting to decrease cardiovascular diseases in the youth.

Diet is an important aspect of controlling lifestyle diseases, and nutrition interventions that focus on diet alteration have been developed and implemented in some countries in an attempt to slow down the increasing trend of hypertensive adults. The effectiveness of such programmes has been questioned by some studies, including a study among hypertensive and diabetic adults compared to non-hypertensive and diabetic adults. The study found that compared to non-hypertensive adults, those adults who were hypertensive and diabetic and who were on the DASH diet, were found to consume more fibre, fat and total sodium. These studies are imperative in validating the effectiveness of current interventions, as well as assisting in the development of further strategies to combat the growing scourge of lifestyle diseases. The importance of healthy eating has proven to have significant benefits particularly for diabetic individuals but changing a lifelong lifestyle has in most cases proven to be very challenging to many diabetics. Emotional eating and adapting to mindful eating have led to failure for many diabetics who have attempted to change in order to live healthier lives. Interventions that promote healthy eating tend to promote drastic changes to the diet, and do not consider the individual's lifestyle, socio-economic status, and the availability of healthy food. This can result in successful lifestyle changes but can negatively

affect achievement of a healthy nutritional status (Morton, Saydah and Cleary 2012: 1798-1801; Tak, Hendrieck, Nefs, Nyklicek, Speight and Pouwer 2015: 288).

Accessibility of supermarkets and fast food outlets is another important hindering aspect in attempts to decrease the prevalence of diseases of lifestyle among the youth. In a study among youth in America, accessibility of supermarkets and fast food outlets was associated with an increased consumption of high sugar and high fats in foods. As much as accessibility to fast food outlets is a contributing factor to an increased consumption of 'unhealthy' foods among the youth in this study, it also showed an increase in the validity of the results. This was due to the family dynamics and economic status of the youth which were also considered, as the relationship between accessibility to fast food outlets is not justifiable if the means to purchase in the outlets is not considered (Lamichhane, Mayer-Davis, Puett, Bottai, Porter and Liese 2012: 217-221).

Alcohol consumption is evident among adults, but alcohol abuse is fast becoming popular among the youth, and this has been associated with poor health consequences. In a study among Korean men and women, increased alcohol and salty food consumption was associated with a higher possibility of developing hypertension, and these results emphasis the importance on changing unhealthy lifestyle habits in order to reduce the incidences of lifestyle diseases in both the youth and adults. Changing dietary patterns from traditional diets to western diets should also be monitored and has been associated with the rapid increase on lifestyle diseases in Asian countries (Eun Park, Jung and Eun Lee 2012: 597-602).

In South Africa, the prevalence of hypertension among adults is 1.4 times higher in women than it is in men (Malaza, Mossong, Barnighausen and Newell 2012: 1-3), and in a country plagued by the devastation of high HIV infection rates, the high prevalence of hypertension can have a negative impact on the lives of those infected. Overweight and obese individuals are at a higher risk of developing hypertension; however the results of a South African study indicate HIV-infected men and women had lower BMI values compared to HIV negative men and women. The results indicate that HIV-positive individuals are less likely to develop hypertension than HIV-negative individuals. More research needs to be conducted where HIV-positive individuals are grouped into those that use anti-retroviral treatment and those who do not. This would further validate the results obtained in the study. Proposed coping strategies to reduce the probability of the development of lifestyle diseases include long-term activity monitoring (Yongkoo, Manhyung, Sungyoung, Sarkar and Young-Koo 2012: 5363), which involves monitoring an individual's activity profile in the long term, to detect early negative lifestyle factors in order to prevent and possibly manage the prevalence of lifestyle related disease.

2.3 UNDER-NUTRITION

Globally, the number of obese individuals with resultant complications has surpassed the number of underweight individuals, and South Africa has not been exempt from this statistic. Limited data on the total South African population makes identifying the possible risk factors associated with under nutrition for the various adult groups difficult. Diet, exercise, smoking, education, employment and gender are some of the factors that could impact on an individual being overweight or underweight. Although South Africa's leading current health problem is overweight and obesity, underweight as a result of malnutrition and poverty continues to be a challenge. Men generally tend to be underweight and more women than men tend to be obese, and this is especially apparent in the coloured community in South Africa (Averett, Stacey and Wang 2014: 24-39). Underweight is far less a prevalent problem globally, with less than two percent of the population of the United States (US) affected. Individuals that are underweight as a result of illness or malnourishment may benefit from weight gain. The causes of underweight may be diverse and different from those that cause overweight and include genetic tendencies, hunger, appetite, satiety irregularities, psychological traits and metabolic factors. Weight gain is encouraged in underweight adults, as underweight individuals are unable to preserve lean tissue when fighting diseases that result in body wasting, which include cancer, HIV and AIDS and digestive disorders. Without adequate nutrient and energy reserves, an underweight individual will have a challenge against these medical stresses. Underweight women may develop menstrual irregularities and may become infertile. Furthermore, underweight and significant weight loss may be associated with osteoporosis and bone fractures (Rolfes, Pinna and Whitney 2015: 257).

2.3.1 EATING DISORDERS

Eating disorders result from a relationship between external factors as well as the biological and developmental features of the person, and affect both the physiological and mental functioning of the body. Most eating disorders result from body image dysfunction and body dissatisfaction, and the majority of women in the world with or without eating disorders experience this state. In a study conducted among women (18-55 years), all the women had an internal or external desire to lose weight, and to reach a BMI of between five to 19. It is therefore important to understand body weight dissatisfaction in order to attempt to detect, treat and prevent eating disorders (Treasure, Claudino and Zucker 2010: 590; Coker and Abraham 2014: 455).

The majority of eating disorder sufferers are women (90%) and this illness develops during adolescent years (Snyder 2014: 51). In America, one percent of young adults suffer from anorexia nervosa (AN) and two percent suffer from bulimia (BN). According to Martin and Golden (2014: 12), girls between the ages of 15 and 19 years of age are at highest risk of developing eating disorders, and family based therapy has proven to be the most effective psychological treatment for patients. In the United Kingdom, 310 young people between the ages of 10 and 24 years reportedly suffered from an eating disorder in 2010, and this

has social as well as economic consequences in a country (Harris 2012: 14). According to Zerwas, Larsen, Peterson, Thornton, Mortonsen and Bulik (2015: 16), the peak age for developing eating disorders is between 16 and 21 years of age, and most eating disorder related data is based on females, and little data exists to establish the extent of the problem among the male population. Smink and Van Hoeken (2012: 412) state that anorexia nervosa is the leading category of eating disorders, and there has been an increase in incidence among the age group of between 15 and 19 years. The most commonly known eating disorders are anorexia nervosa (AN), bulimia nervosa (BN), and more recently, binge eating disorder (BED) (Snyder 2014: 51). However, there are three categories of eating disorders which include, anorexia nervosa, bulimia nervosa and binge eating disorder not otherwise specified (Treasure, Claudino and Zucker 2010: 583). Anorexia nervosa is the desire to achieve a very low body weight and an extreme fear of gaining weight; bulimia nervosa is related to continuous binge eating followed by measures to neutralize the consequences of the eating; and binge eating disorder not otherwise specified, consists of modifications of both anorexia and bulimia nervosa. According to Gianini, White and Masheb (2013: 309), binge eating disorder (BED) is associated with recurrent episodes of binge eating as a result of emotional distress, and affects between one to three percent of people in the world, and the occurrence increases among overweight individuals. However, Smink and van Hoeken (2012: 406) categorise eating disorders as specified eating disorders which include anorexia and bulimia nervosa, and non-specified eating disorders which include purging disorder and binge eating. According to Zerwas *et al* (2015: 16), 'eating disorders otherwise specified' have been renamed to 'other specified feeding eating disorders' (OSFED).

Early detection of an eating disorder is essential for the full recovery (Harris 2012: 14) of a patient. The use of hormone replacement therapy, however, is not endorsed for the treatment of amenorrhea in young women and adolescents as it has not been shown to increase bone mass and ensure the return of normal menstrual cycles (Martin and Golden 2014: 17). Eating disorders can affect the reproductive organs, the functioning of the heart, the gastro-intestinal system and the brain, and are also known to have been associated with death and disability cases as well.

The criteria used to diagnose eating disorders have been criticized especially in non-western countries; this is especially relevant among the black female population. This is due to the different perceptions of female attractiveness in western communities, where being thin is generally accepted as being attractive, and in non-western communities where being fat which is accepted as being attractive. A study among South African black females indicated that thinness was an indication of sickness or distress rather than a refusal to eat (Morris and Szabo 2013: 338). Various studies have been conducted in universities to compare the eating behaviour of students with nutrition related majors and those without. In a study conducted among South African university students, results showed a higher rate of eating disorders among first year dietetic students compared to non-dietetic students (Kassier and Veldman 2014: 112), which disregards nutrition knowledge as a factor in whether or not an individual develops an eating disorder.

Several factors, both internal and external, can predict whether an individual has a tendency to develop an eating disorder. According to Quick (2011: 39) eating disorders among adolescents and young adults are as a result of some demographic and psychographic characteristics. These characteristics include body image distortion, depression, obsessive compulsive disorders, self-esteem and pressures from the media. Monitoring these factors may be important in identifying youth that may be at risk of developing eating disorders. There is a definite relationship between depression and eating disorders. This was substantiated by a study conducted among Pakistani university students, which indicated that both depression and eating disorders were interdependent on each other (Saleem, Sattar, Zafer and Ismail 2014: 925). The study also found that female students were more vulnerable to eating disorders and depression than male students.

2.4 CAUSES OF MALNUTRITION

2.4.1 INADEQAUTE DIETARY INTAKE

Acquiring good nutrition is vital for achieving optimal development and growth and this is especially important among adolescents and young adults where increased nutrient requirements for rapid growth, physiological changes and mental development are required. Eating behaviours learnt during this time can impact long-term eating habits; however the majority of the youth fail to meet the daily recommended intake of micro and macro nutrients (Stephens *et al* 2011: 1219-1220).

According to Mis, Kobe and Stemec (2012: 305), adolescents' and young adults' eating habits are influenced by society, family eating habits, eating away from home and physiological requirements, while bad eating habits such as skipping meals and poor snacking habits can result in this population group acquiring an inadequate dietary intake. Adolescents from low socio-economic backgrounds are susceptible to inadequate dietary intake due to reduced exposure to food variety and food availability. Inadequate dietary intake can result from numerous factors which can include a lack of knowledge on the importance of consuming healthy and sufficient food, peer pressure associated with maintaining a certain weight or size, access to food, and cultural norms. Diets high in saturated fatty acids, sugar and salt result in inadequate dietary intake and increase the risk of cardiovascular disease and these lifestyle choices are especially prevalent among the youth. Micronutrients that are vitally important during this time of tremendous growth are calcium, iron, zinc and vitamins A and B (Dapi, Hornell, Janlert, Stenlund and Larsson 2010: 905); however many youths from low socio-economic environments are deficient in these micronutrients, and in African countries such as Cameroon, this trend is mainly as a result of the abandoning of traditional diets and the adoption of more westernized diets characterized by refined carbohydrates, fats and high sugar content.

Dietary changes in South Africa have been attributed to the high levels of inadequate dietary intake among the adult populations (Oldewage-Theron, Kruger and Egal 2014: 523), with urbanization being

cited as the major cause of dietary changes that have led to inadequate micronutrient intake. Urbanization results in a better quality of life; however this has not translated positively to food consumption patterns and dietary habits. Lack of education and poverty was also observed to be associated with poor dietary intake among low socio-economic households, with low intake of fruits and vegetables contributing to a low vitamin intake. The direct consequence of inadequate dietary intake has seen many urban black females suffering from low bone mass and osteoporosis (Kruger, Kolar, Fisher, Plascak, Stumbo, Wess and Paskett 2012: 57), and this trend is more apparent in urban areas compared to rural areas. This is indicative of the inadequate dietary intake of micronutrients such as calcium.

2.4.2 ILLNESS AND DISEASE

In South Africa, infectious diseases such as TB and diarrhoea (Wenhold, Kruger and Muehlhoff 2008: 449) affect children and the youth, and are mainly the result of poverty and under nutrition. Diarrhoea is characterized as three or more watery stools in a day, and can result in malnutrition as a result of dehydration and the body's inability to use the nutrients consumed by the affected individual. Furthermore, diarrhoea can lead to mortality if not treated and accompanying symptoms such as vomiting and nausea may lead to many nutrition deficiencies. Chronic diarrhoea is the most common gastrointestinal condition, which can result in nutrition deficiencies and malnutrition and is caused mainly by the malabsorption of nutrients. Food intolerance and a poor diet in the presence of malabsorption can result in chronic diarrhoea (Talbert, Thuo, Karisa, Chesaro, Ohuma, Ignas, Berkley, Toromo, Atkinson and Maitland 2012: 2; Gorospe and Oxententko 2012: 663-664).

A food allergy is associated with an immune reaction that is abnormal after consuming food, and there has been an increase in the number of food allergy patients worldwide, which is inclusive of all age groups. This phenomenon has resulted in many patients being malnourished due to the elimination diet which is normally used to determine the actual food causing the allergy in admitted patients. The results of an elimination diet can be over elimination of certain foods, which could result in an unbalanced diet (Takamasu, Miyagawa, Wada, Harada, Hiroki and Kurihara 2014: 344).

HIV and malnutrition are closely related due to the fact that HIV attacks the body's immune system which results in an immune deficient individual. A malnourished HIV individual will develop AIDS at a faster rate, as good nutrition has been proven to promote a good immune system, therefore reducing the chance of illness and disease infection. HIV also negatively affects the appetite, which results in weight loss and malnutrition. Micronutrient deficiency is common and a lack of access to treatment of both HIV and subsequent malnutrition increases the risk of mortality. In Sub-Saharan Africa, many countries are not able to meet the demand for ART treatment, as the number of HIV infections increase by the day; however, the majority of patients that start HIV treatment are already malnourished as a result of inadequate diet intake as well as HIV-related wasting. This poses an obstacle as low BMI has been loosely related to higher risks of mortality and morbidity in HIV positive patients due to the impact it has

on lowering immunity. HIV can result in morbidity, and disables heads of households, which leads to household poverty and food insecurity as well as under nutrition in dependents, who are in most cases adolescents and youths (Wenhold, Kruger and Muehlhoff 2008: 449; Duggal, Chugh and Duggal 2012: 1-3; Tshingania, Schirvela, Mukumbib, Ngambweb and Wilmet-Dramaixa 2014: 18-19;).

Tuberculosis (TB) is an infectious disease that is the number one killer among HIV-positive individuals, and is most prevalent in developing countries, where adequate health facilities are lacking. There is a higher mortality rate among both HIV-positive and negative women, making women more vulnerable to the disease than men. Pulmonary TB has been in particular associated with more cases of malnourished individuals with all forms of TB being associated with nutrition deficiencies. Studies in England and Spain reported a definite reduction of BMI, triceps skin hold and muscle circumference, which are also side effects of malnutrition, after patients were diagnosed with TB (Miyata, Tanaka and Ihaku 2013: 1-5).

2.4.3 INSUFFICIENT HOUSEHOLD FOOD SECURITY

Food insecurity exists when all people, at all times, , have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for active and healthy life (FAO, 2006), and studies indicate that a higher household food insecurity is prevalent in low income households with children (Mello, Gans, Risica, Kitania, Stroller and Fournier 2010: 1906-1911). Food security can be classified as mild, moderate and severe, with the latter having more serious consequences on overall diet quality and health (Kac, Velasqueez-Melendez, Schlussel, Segall-Correa, Silva and Perez-Escamilla 2011: 1854).

Although South Africa is regarded as a food secure country, according to the WHO, South Africa is listed 36th in high burden countries, and this is due to the increasing rate of malnutrition in children and adults (Faber, Witten and Drimie 2011: 21-22). The implementation of the Integrated Nutrition Programme (INP) in 1995 by the Department of Health was aimed at increasing the nutrition status of all citizens, and as a member of the United Nations, also achieving the Millennium Goals. However, this has not been the case, with an increase in food insecurity, poor diet quality and basic services, together with the added burden of HIV and AIDS, exacerbating the situation. Food crises and financial instability can worsen food insecurity both at the national level and the household level (Ramsey, Giskes, Turrell and Gallegos 2010: 235). Studies conducted in Africa over the past 15 years indicate that adolescents in the Sub-Saharan region are undernourished (Corderio, Wilde, Semu and Levinson 2012: 1741), and this is a huge concern since projections indicate that one third of Africa's population will be made up of individuals between 10 and 24 years of age.

The household income in South Africa is among the most unequal in the world, with 10% of the population earning 50% of the household income and 40% percent earning only seven percent of the household income (Faber, Witten and Drimie 2011: 22). At a household level, South Africans consume half of the recommended fruits and vegetables, according to the WHO, thus resulting in micronutrient

deficiencies that cause vulnerability to cardiovascular diseases and cancers, and depression, which puts pressure on already overburdened health facilities. This is in line with the general trend of food insecure households consuming fewer fruits and vegetables and lean meats (Ramsey *et al* 2010: 227-228). As the level of household food insecurity increases, it has also been shown that the consumption of fruits and vegetables decreases, but specific food choices and preparation methods may also be affected. In a study conducted among food insecure households in America, results indicated that even though there was a low consumption of fruits and vegetables, there was, however, a higher consumption of fruit juices, further emphasizing the importance of nutrition education when implementing strategies to reduce household food insecurity. Fat intake is also high among food insecure households, and it is difficult to encourage the consumption of low fat choices due to the relationship between income and fat consumption, food preparation methods including using additional fat as a flavouring, and not removing excess fat from meat cuts. This trend was observed in food insecure households (Mello *et al* 2010: 1906-1911).

At a household level, food insecurity is a result of low income and poverty and other factors, including lack of education, family type (single parent household) and age (younger age), are important in establishing household food insecurity. Poor households spend the majority of their income on purchasing food, and spend 15% less per household member compared to urban dwellers. In countries such as Australia, household insecurity can affect as many as 25% of households and these households are characterized by a low income. Household food insecurity has a negative impact on food availability and diet quality, therefore creating a direct relationship between household insecurity and malnutrition (Ramsey *et al* 2010: 222-235; Faber, Witten and Drimie 2011: 22; Corderio *et al* 2012: 1742).

The prevalence of food insecurity among adolescents and young adults has been linked to morbidity and poor dietary habits, which increases the chances of stunting, in particular among adolescents, and this impacts overall height during adult years. In Ethiopia, food insecure adolescents were found to be shorter than food secure adolescents, while girls were mostly affected as indicated by low diversity scores, morbidity and absenteeism. Coping strategies implemented by adolescents who were involved in the study included consuming cheaper foods, consuming food less frequently, and consuming reduced portions of food (Belachew, Lidstrom, Hadley, Gebremariam, Kasahun and Kolsteren 2013: 2-7). Under nutrition is detrimental during adolescence years and early adulthood, especially among young women, since research indicates undernourished young women are most at risk of giving birth to babies with a low birth-weight (Corderio *et al* 2012: 1742). Food insecure households are more likely to have overweight individuals due to a high intake of high fat and energy foods which are regarded as more affordable (Mello *et al* 2010: 1906-1911).

Household food insecurity has been linked to overweight and obesity especially among women (Gaines, Knol and Robb 2010: 110-114) and research suggests that increased beverage intake is also prevalent among food insecure households. Adult men in food insecure households tend to consume more sugar

sweetened beverages then females and less milk, fruit juices and water. Other studies established that many food insecure households were linked to lower breakfast consumption, and fewer fruits and vegetables, and a higher consumption of sugar sweetened drinks (Bruening, Neumark-Sztainer, Loth and MacLehose 2011: 100). Household food insecurity is associated with obesity, in particular among adult women more so than men in developing countries, and adolescents in food insecure countries are more likely to be twice the weight of adolescents in food secure households (Kac *et al* 2011: 1859).

2.4.4 URBANISATION

Urbanization is defined as 'the increasing share of a nation's population living in urban areas, and thus a declining share living in rural areas'. The consequences of urbanization include high levels of urban poverty, food insecurity, high infant and child mortality and a high rate of HIV and AIDS infection and the implications are more immediate in the agricultural sector and affect food production. Urban food security is dependent on households being able to afford food over other needs that have to be purchased, and in many developing countries, food subsidies and social grants have attempted to solve the growing burden of urban food insecurity (Satterthwaite, McGranahan and Tacoli 2010: 2809-2812).

More than half of the global population are urban dwellers, and it is expected that the total population of urban dwellers will reach 1.6 billion by the year 2030, and this then concludes that the rural population will decrease. The greatest urbanization will take place in developing continents, namely Africa and Asia. This change will bring forth different trends in health and diet, which will influence the number of non-communicable diseases (NCD) negatively. There is no doubt that obesity and an inactive lifestyle are risk factors for NCDs which are responsible for 60% of deaths worldwide. Nutrition transition, with a high intake of sugar, fat and salt foods, is also associated with increasing urbanized areas. Although South Africa is a developing country, the rate of overweight and obesity is increasing at an alarming rate, even surpassing that of developed countries (Allender, Wickramasinghe, Goldacre, Mattews and Katulanda 2011: 906-909).

The migration of rural dwellers to urban areas also places huge pressure on food producers (Satterthwaite, McGranahan and Tacoli 2010: 2809). This can be attributed to the reduced number of primary farmers, who contribute immensely to global food production. Rural to urban migration is also characterized by the abandonment of an agricultural lifestyle and the adoption of an industrialized lifestyle, but it is important to understand that urbanization does not always translate into a higher income. The eating habits of lower income urban dwellers are not the same as those of higher income urban dwellers, which concludes that household food insecurity may still be present in many urbanized households. Urbanization, industrialization, globalization and rural to urban migration are responsible for changing diet habits due to the availability and affordability of fast foods, which usually have a diminished nutritional value, and this convenience lifestyle is passed on from parent to child and from generation to generation. This explains the spike in the number of obese children, adolescents and young adults,

especially women and girls. Food price crises affect urban dwellers more so than rural dwellers, as rural dwellers still maintain some level of agricultural activity, while urban dwellers rely on markets. Developing countries will continue to experience both chronic and acute hunger as food prices continue to increase (Wurwarg 2014: 75-86).

The rise of urbanization has seen a rise in the rate of overweight and obese individuals in both developing and developed countries with the increase in technological advances also promoting a sedentary lifestyle that further fuels this growing health issue. There is a definite relationship between obesity and urbanization, and this has been proved extensively by numerous studies worldwide. The main reason attributed to urban dwellers being more overweight than rural dwellers is the low level of physical activity, due to more people having office jobs, spending more time watching television and participating in indoor activities that do not require energy expenditure. Also, the frequent use of technological assets such as cars, elevators and escalators makes it harder for individuals to use up energy. The general trend of obesity in urbanized regions poses a serious health threat to developing countries currently going through rapid urbanization (Goryakin and Suhecke 2014: 109-124).

2.4.5 POVERTY

It is important to view poverty not only as an economic problem but also as a social problem, as it prevents people from living an acceptable life. Food and nutrition security plays an essential role in eradicating poverty. The MDG 1, to eradicate poverty and hunger, further acknowledges that poverty and hunger should not be addressed independently. The major reason for the failure of attempts to reduce poverty is attributed to the exclusion of malnutrition alleviation in the strategies developed. In 2013, the United Nations Development Programmers published a report, which indicated that South Africa had achieved MDG 1, reducing by half the number of people living on less than $1.25/day (UNDP, 2013). In 2015, the 17 Sustainable Development Goals were adopted to continue to make progress, especially in areas where MDG 1 failed to be effective (UN, 2015). The Food and Agriculture Organization (FAO) reported that the world is currently producing enough food to feed everyone, and that is taking into account that the world's population has increased by 70%. The demand for food is expected to increase by nine billion by 2020. Agriculture has a critical role to play in producing enough food to ensure that people are fed; and the biggest challenge in future years will be the quality of the produced food in terms of nutritional content. Escalating food prices will have detrimental consequences on the availability and affordability of food, but more so on that of nutritious food (Vorster, Badham and Venter 2013: 1-2; Cuesta 2013: 1-3).

The impact of not adopting and implementing effective strategies to reduce hunger and poverty for developing countries is substantial, even though most programmes in Africa are focused on breaking the cycle of poverty. In developing countries, one in five people are affected by hunger. Malnutrition, as a result of hunger and poverty, is difficult to eradicate, and is passed on from one generation to the next.

Hunger is a result of poverty, and the ineffectiveness of attempts to eradicate malnutrition increases the incidence of poverty. In Africa, problems which include the threat to peace, a lack of job opportunities, poor health and the spread of HIV and AIDS, unsustainable management of natural resources and gender discrimination continue to be obstacles to attempts to decrease hunger and poverty. Sub-Saharan Africa has the highest number of people living in poverty, and a substantial number living on less than US$1.25 a day (Atinmo *et al* 2009: 40-41).

According to Davison, Share, Hennessy, Bunting, Markovina and Stewart-Knox (2015: 40), young people are also vulnerable to malnutrition, and the biggest contributor to poverty in this particular age group is unemployment. In Europe alone, almost 10% of educated youth between the ages of 15 and 24 years are unemployed. Research aimed at unemployed young people and the factors involved in determining food choices and coping strategies to alleviate hunger are scarce. Additionally, the youth is associated with a trend of junk food consumption and food with generally low nutritional content. Studies in Australia and the United Kingdom suggest that this is a result of food insecurity as well as a result of a lack of access to healthy food (Davison *et al* 2015: 41).

Increasing food prices as a result of instability in global finances adds a further burden to poverty stricken populations as this increases the proportion of household income that goes towards purchasing food. In Latin American countries, during the 2008 and 2011 food price crises, energy intake decreased by as much as eight percent. The food price crises are associated with the abandoning of luxury foods, which are in most cases rich in micronutrients, and this may result in households that are food insecure with malnourished occupants (Lannotti, Robles, Pachon and Chiarella 2012: 1568-1569).

Results to research attempts to establish the association between poverty, food insecurity and obesity have been inconsistent, and this demonstrates the complexity of the relationship (Rutten, Yaroch, Colon-Ramos, Johnson-Askew and Story 2010: 403-407). In America, the US Census Bureau uses various household threshold factors, such as family size and composition, to determine the level and degree of household poverty. During 2008, 13.8% of US citizens lived below the poverty line. This is concerning as the United States of America is a developed country, and this result highlights the magnitude of the poverty facing developing countries. Poverty has a definite impact on food insecurity, obesity and ill health. There are various factors that contribute towards high levels of poverty in Africa. According to Were (2012: 1-2), the decrease in small-scale farming, economic crises and increasing food prices are the major reasons for the high prevalence of poverty in Africa. Climate change has also had a significant impact, and floods and drought continue to plague African countries, and the consequences are poverty and hunger.

2.5 FACTORS AFFECTING STUDENT FOOD INTAKE

2.5.1 NUTRITION KNOWLEDGE

The exposure to nutrition knowledge can have a positive impact on the food intake of university students (Strawson *et al* 2013: 74). The knowledge of a healthy diet is one of the most important determinants of food choices among university students. However, a study conducted among a sample of female university students in Canada indicated that students who had completed at least one nutrition course did not meet any of the recommended dietary intakes. That observation indicates that nutrition knowledge alone was not enough to ensure good dietary patterns among university students. A systematic review using 1 193 articles aimed at identifying the relationship between nutrition knowledge and dietary intake found that there was a positive but weak association between better nutrition knowledge and dietary intake, mostly affected by the consumption of fruits and vegetables (Spronk, Kullen, Burdon and O'Connor 2014: 1713). Furthermore, low health literacy was associated with poor health status.

Emrich and Mazier (2009: 187), however, suggest that when it comes to differentiating between good and healthy fats, students with nutrition knowledge are more likely to make better choices. A study in Nova Scotia university indicated that fourth year students consumed fewer grams of total and saturated fat compared to first year students, which emphasizes the significant role nutrition knowledge plays in enabling university students to make better and healthier food choices. Similar results were noted in a study among Sam Houston State University students in Texas, where significant relationships were found between dietary intake and nutrition knowledge scores (p=0.001) (Sealey-Potts, Hougen, Ferriola and Linehan 2009: 24). Kresic, Jovanovic, Zezelj, Cvijanovic and Ivezic (2009: 1047) reported that Croatian university students with a higher level of nutrition knowledge were more likely to have a diet which was in line with the nutrition recommendations in comparison to students with a lower level of nutrition knowledge.

2.5.2 FOOD PRICES

Food prices are the main driver of food choice and intake in the majority of households, and it is no different among university students. Although many studies have concluded that it is possible to choose more nutritious foods without spending more money, healthier versions of staple foods like bread still cost more than less nutritious breads (Katz, Doughty, Njike, Treu, Reynolds, Walker, Smith and Katz 2011: 1693). A study conducted among Ghanaian university students found that there was a strong correlation between price and fruit intake among the students ($p<0.05$), which indicates that food cost is a major factor in food choices made by university students (Mintah, Eliason, Nsiah, Baah, Hagan and Ofosu 2012: 5979). Higher energy and sugar foods are widely consumed by university students, mainly due to convenience and lower costs (Heidal, Colby, Mirabella, Al-Numair, Bertrand and Gross 2012: 942). A study in America found that a high number of university students spent the majority of money allocated to

food on fast foods, which had an adverse effect on overweight and obesity incidence. However, the number of fast food outlets around the university could also have had a significant contribution towards the high fast food intake among the university students.

There is a strong perception of higher costs associated with healthy eating observed among the adult community. A study conducted among a low income adult population in America found that over 75% of the respondents perceived healthy foods to cost more, and 97% indicated that they would be willing to buy healthy foods if they cost less (Peterson, Dodd, Kim and Roth 2010: 41). An Australian population study also reported that an increase in food costs resulted in an increase in the consumption of higher energy dense foods, which cost less compared to nutrient dense food (Lee, Ralston and Truby 2011: 248-249). Furthermore, increased food costs caused a considerable reduction in weight, waist circumference, BMI and obesity, which is not a similar trend observed among university students globally.

2.5.3 ENVIRONMENT

During the first year of university, many students find themselves away from home, and in some instances in a new country (Perez-Cueto, Verbeke, Lachat and Winter 2009: 84). This forces students to face cultural adjustment pressure, and in most instances, this exposes students to a new responsibility of having to budget for food, decide on the food purchased and determine preparation methods. This could be a burden on students, and in most instances, students often prefer to buy food which tends to be nutrition deficient, rather than prepare nutritious food. In a study conducted among Belgian immigrant students, 85% of the students admitted that they had made dietary changes on arrival at university, and 65% of the students reported that no information regarding healthy eating had been provided for them. Students' ability to maintain eating habits maintained during childhood also change, and this is supported by a study conducted among Belgian university students, that found that students were more likely to change dietary habits, and divert from traditional home meals to more convenient fast food (De Bekker 2013: 65). The study also found that students who grow up with mothers who cooked, were more likely to cook when they left home to live in university residences.

Lee, Gao and Kim (2015: 304) report that changing geographic location can have a negative impact on food intake. Chinese international students reduced their fruit and vegetable intake upon leaving their families, and inversely, increased the consumption of instant noodles and convenience foods and developed negative dietary habits such as skipping breakfast. A similar study conducted among Korean students found that negative food intake and dietary habits were also adopted when students moved from home. These unhealthy habits included meal time irregularity, increased tendency of students to skip meals, and an increase in students' eating speed. A study conducted in Greece among university students, however, indicated that students who resided away from home adopted healthy eating patterns adopted when they were living at home and rather chose to consume lower fat dairy products, and reduced their margarine and white bread intake (Ansari, Stock and Mikolajczyk 2012: 28). In another

study conducted among university students in the same region, unfavourable eating habits were observed among more females than males, with increased consumption of sweets, cakes, snacks and fast foods.

Moving away from home can also be a barrier to healthy eating. This was supported by a study conducted among university students in London, where it was reported that moving away from home made cooking a healthy meal impractical and as a result most cooking utensils remained in their boxes, and added to that, living with a roommate made cooking even more undesirable as this increased the level of uncleanliness, which was not acceptable (Garcia, Sykes, Matthews, Martin and Liepert 2010: 32).

2.5.4 MEDIA

Adolescents and youth are exposed to extreme amounts of media, which include television, computers and computer games and smartphones. The impact of media on dietary choices has been greatly researched, with one study conducted among American adolescents indicating that 23% of the participants used some sort of electronic media device for up to three hours a day, and 41% of the participants admitted to eating dinner while watching television at home. The study also reported that participants with high media exposure were likely to consume two or more sugar sweetened beverages three times a day. However they were less likely to drink a glass of water three or more times a day, or to drink two or more glasses of milk a day. Similarly, a study conducted among undergraduate students in the United States found that increased television viewing increased the amount of energy dense food consumption, with students in the first group (pizza consuming group) increasing their caloric intake by 36%, and the second group (macaroni and cheese consuming group) increasing their caloric intake by 71%. These results indicate the role of the media such as television in the mounting obesity problem facing both developing and undeveloped countries (Blass, Anderson, kirkorian, Pempek, Price and Koleini 2006: 602; Demissie, Lowry, Eaton, Park and Kann 2013: 757-758).

Research based on the impact of the media on diet has placed great emphasis on the duration of media viewing and how it is prioritized (Kobayashi 2010: 205), and the results of studies conducted among university students in different countries seem to vary as well. This is supported by a study conducted among American and Japanese university students in order to determine the impact of television viewing on fast food consumption. Among 222 Japanese students, no significant difference was observed between students who watched television for less than an hour, and those who watched television for more than an hour, while the results among American students were different. An increased television viewing time (60 minutes or more) increased the fast food intake of the American students. Chapman, Nilsson, Thune, Cedernaes, Greves, Hogenkamp, Benedict and Schioth (2014: 212) also reported that the level of interest that the students have in programmes on the media had an impact on the food consumed by university students. This study also reported that the results were similar to those of a study conducted among Swedish university students that found that students who viewed television that was

perceived as boring consumed more unhealthy food in high amounts, while students who viewed engaging television consumed more healthy food in moderate amounts.

2.55 LEVEL OF STRESS

Level of academic stress may have a negative impact on food choices amongst students (Kim, Yang, Kim and Lim 2013: 213), with students experiencing high levels of stress consuming larger meals, and having a higher frequency of sugar intake and higher total sugar intake. Lazarevich, Irogoyen-Camacho, Velazquez-Alva and Salinas-Avila(2015: 2439), further highlights the impact of stress, especially on emotional eating which leads to poor dietary habits, and in a sample of Mexican university students, emotional eating as a result of stress was significantly linked to obesity (p=0.026). A large number of university students experience stress, especially during examinations, which impacts the type of foods consumed during that period. A study conducted among university students in Australia found that 52.9% of the students reported that they experienced some degree of stress, with female students (57.4%) suffering more than male students (47.4%). Male students who experienced mild to moderate levels of stress were also more likely to eat more meat alternatives (p=0.05) and highly processed foods (p=0.05) and consumed more alcohol (p=0.05), and were less likely to consume fruits and vegetables (p=0.05), compared to male students who did not experience stress, while female students who experienced mild to moderate stress were 2.22 times more likely to eat processed foods than their less stressed counterparts (Papier *et al* 2015: 326). A study conducted among Indian postgraduate university students, however, found that there was no significant relationship between micro- and macronutrient consumption between students with low, middle and high levels of stress (Puri 2012: 1590), indicating that stress is not a factor in food choice among university students.

Conflicting research results on the impact of stress on food intake of university students highlights the need for more research to be conducted with differentiation between the levels of stress, the reason for the stress and the impact of this stress on the consumption of particular foods, especially those linked to obesity.

2.6 FACTORS AFFECTING ACADEMIC PERFORMANCE

2.6.1. LACK OF STUDY SKILLS AND ATTITUDE

Students enrolled in institutions of higher learning faced with academic stress and the inability to engage in challenging activities due to time limitations is a major factor contributing to the achievement of poor results. The importance of establishing effective study strategies becomes all the more important, and many students lack this skill. Lack of time management and the inability to adhere to scheduled academic tasks (academic procrastination) have been acknowledged to be responsible for poor results in the majority of university students. Academic procrastination has been associated with poor academic results, low self-esteem, guilt and stress. Furthermore, concentration and memory, study aids and note

taking, test strategies and test anxiety, organizing and processing information, motivation and attitude are also important factors that contribute towards the academic performance of a university student (Hassanbeigi, Askari, Nakhjavani, Shirkhoda, Barzgar, Mozayyan and Fallahzdeh 2011: 1416-1417).

Bakar, Tarmizi, Mahyuddin, Elias, Luan and Ayub (2010: 4906), emphasizes the importance of motivation as a major determinant towards academic performance and students' attitude towards learning. Afzal, Ali, Khan and Hamid (2010: 80-84) supports the importance of motivation in academic success and adds that many students who obtain poor results may drop out of university due to a lack of eagerness to learn. Additionally, student motivation is further categorized into two groups around intrinsic and extrinsic motivation where intrinsic motivation comes from within, and no incentive or reward is required for motivation, while extrinsic motivation coming from external factors and motivation is driven by reward or fear of punishment. In a study conducted among Iranian university students, intrinsically motivated students performed better than extrinsically motivated students. Students who are motivated and have a positive attitude towards learning obtain positive academic results. Cognitive and learning factors are also important factors that may impact academic performance (Talib and Sansgiry 2012: 265), and these factors include academic competence, strategic studying and test anxiety. The transition from secondary school and the engagement during the first year of university also has an impact on the students' academic performance, especially during the first year of study. According to Topham and Moller (2011: 196), a large proportion of first year students have issues adapting to university life. Motivation is the driving force behind an individual's actions and academic motivation and attitude are the best predictors of academic performance among university students. Furthermore, a positive and significant correlation was established between students' attitude and academic performance. Other predictors of academic performance included peer influence and gender differences.

Academic stress as a result of psychosocial, academic and financial challenges can also affect the academic performance of university students and affect a large number of students. Symptoms associated with academic stress include fatigue, difficulty to concentrate, headaches, mood swings and anxiety. Female students experience more academic stress which is attributed to the seriousness placed on academic success. The mental health of university students needs to be given attention, as many studies have concluded that mental health does have an impact of academic performance. Other factors that impact on academic performance of university students include psychological, physical, socio-economic and educational factors, and these are especially evident during examinations. Other factors including a change in the pattern of examination questions, lack of proper guidance prior to examinations, overconfidence and phobia during examinations, and the internal environment in the examination venue contributed to the examination pass rate (Rasul and Buksh 2011: 2042; Banu, Deb, Vardhan, and Rao 2015: 231).

2.6.2 SUBSTANCE ABUSE AND HEALTH

Alcohol abuse among university students is highly prevalent and can often result in blackouts and injuries; however, substance abuse can also affect academic performance (Osain and Alekseevic 2010: 215). In a study conducted among alcohol and non-alcohol using university students in Belarus, non-alcohol using students reported a higher academic performance of between 10.9–11.4% than alcohol-using students. This study demonstrated that alcohol, even if taken in moderation, has an undesirable impact on academic performance among university students. Other substances that may impact academic performance negatively include tobacco and dagga, which are commonly used by university students. (Lemma, Berhane, Worku, Gelaye and Williams 2014: 257-258). According to Ansari and Stock (2010: 509-510), students that use alcohol, tobacco, or any other form of drugs obtained poor academic results, displayed a negative attitude towards university, and also had a higher prevalence of absenteeism. Health is an important aspect of university, and the relationship between health parameters and academic performance may vary but has shown some correlation, especially with regard to physical activity. Poor nutrition and physical inactivity may impact academic performance at university, and physical health, health awareness and health behaviour have a direct impact on the academic performance of university students.

2.6.3 SOCIAL AND ECONOMIC FACTORS

Financial stability impacts on a student's ability to perform well (Talib and Sansgiry 2012: 265), and this can be attributed to job responsibilities and family responsibilities. Social class also has an impact on students' academic performance, and first generation students have experienced the impact of culture mismatch, and this results in poor academic performance (Jury, Smeding, Court and Darnon 2015: 25). The academic success of non-first generation students is associated with generational status, which is associated with academic fit and which translates into better results. Topham and Moller (2011: 196-197) further indicate that personal concerns, self-esteem and social anxiety also contribute to academic performance. In a study conducted by the American Health Association, 10% of the students cited depression as an obstacle to academic performance whereas emotional competency is associated with higher academic performance. Challenges within universities can also impact academic performance of students (Christiana 2014: 171); this is due to many financial constraints, and constant structural changes which may impact students negatively. Challenges within the institution may also affect the students' academic performance, and these factors may include poor funding, lack of frequent curriculum review, student over-population, student unrest, staff strikes, poor infrastructure and inadequate research facilities.

Global trends in colleges and universities have seen increasing tuition fees and an increase in financial aid in the form of scholarships. The rising costs as a result of decreased subsidies from universities affect students the most, since the majority of their student base is made up of students with a poor socio-

demographic profile. Interventions such as financial aid have not been ineffective and contrary to many studies indicating that poor students do not perform well in university, literature suggests that the differences between rich and poor students in relation to academic performance are subtle; however, poor students face several challenges of which many are financially driven. This indicates that social standing and family economic background may impact academic performance among university students (Douglass and Thompson 2012: 66). Residency while studying also has a significant impact on results, with students who stay in university residences generally not performing as well as students who stay at home, and this is attributed to low parental control (Deliens, Clarys, Van Hecke, De Bourdeaudhuij and Deforche 2013: 162).

According to Garkaz, Banimaha and Esmaeili (2011: 122-126), the most prominent factors that affect university academic performance are gender, type of diploma, interests and employment status. Gender is an important factor, as women generally tend to perform better academically than male students. Deliens *et al (*2013: 162) further supports this notion, highlighting that female students have more success during the academic years than males, while parental education and ethnicity have a positive impact on academic performance as well. Employment status can also have an impact on students' academic performance, depending on the type of employment. Previous studies have reported that there is no significant relationship between employment and academic performance; however more recent studies indicate that there is a significant impact, and students who are employed in a job related to their studies perform better than students who are unemployed. Marital status could also play a role in the academic performance of a student, but since it is regarded as an external factor, it is difficult to measure the full impact that being married has on academic performance.

Gebka (2014: 813) describes academic success as a culmination of vehicle variables which include resources, staff and students' quality; process variables which include class size, contact hours, feedback quality, and the ability to engage students; and product variables which include retention and employability, which are overlooked in many institutions of higher learning.

2.6.4 INADEQUATE SLEEP

Sleep is important especially for students as it facilitates learning and memory retention and lack of sleep results in reduced alertness, attention and concentration. Sleep habits are measured using sleep quality, sleep duration, regular waking cycle and daytime sleepiness. Many university students change sleeping patterns as a coping mechanism to offset the increased workload and academic pressure; however good sleep quality has been associated with better academic performance. Research related to the influence of sleep on the academic performance of university students has not been consistent, with some studies indicating that sleep duration has more impact on academic performance than sleep quality. Some substances, which include coffee, tobacco and alcohol may be used for recreational purposes, but may also affect sleeping patterns among students (Lemma *et al* 2014: 257-258).

Sleep is necessary for memory consolidation, learning, decision making and critical thinking, and is therefore an important factor as to whether or a not a student is successful in higher education. Sleep deprivation is endemic globally and sleep quality and students' sleeping patterns usually change for the worse on arrival at university. Depression is usually screened by university psychologists for its role in the poor academic performance of students at university; however, there is a scarcity of research that has studied the result of sleep deprivation, and the effect of poor sleep quality on academic performance may be more prevalent than depression in universities. In a study among first year university students, the majority of the students had sleep duration of eight hours, and 70% of those students had poor sleep quality compared to the control group used in the sample. There is therefore an established relationship between sleep quality and academic performance among university students (Gilbert and Weaver 2010: 296-302).

2.6.5 INTERNET AND SOCIAL MEDIA

Internet addiction is defined as an individual's inability to control his or her use of the internet, which eventually results in psychological, social, and academic or work related difficulties (Ratanpara and Dave 2015: 1261). Many university students can be classified into this group. Internet addiction is as prevalent among adolescents and young adults as drug and alcohol addiction, and has a negative impact on academic performance. Poor academic performance is also the result of insufficient sleep, not eating for long periods, and low physical activity which may result in low self-esteem, anxiety and depression. Social network sites such as Twitter and Facebook are the most popular and it is estimated that an average social networker spends at least 19% of their time online. Eighty two percent of the global population is also spending one minute out of every five minutes online (Karpinski, Kirschner, Ozer, Mellott and Ochwo 2013: 1182). College students are very active social networkers, and are in most cases involved in social network activity while studying. Recent studies have shown that multitasking with technology (internet and social media) can impact academic performance negatively, and academic performance is also impacted by the length of time spent on social networks. However, in a study conducted among undergraduate students at a university in India, the results indicated that increased internet usage actually had a positive impact on the academic results of students, contrary to numerous studies indicating otherwise.

The increasing availability of and access to devices such as smartphones and laptops has intensified the addiction of students to social networks and this has a negative impact on the students' academic performance. Spending too much time on social networks which include Facebook, Twitter, Instagram, and MySpace is associated with less time spent focusing on academic work, which can result in low grades. The impact of social media on academic results has been thoroughly researched; however, contradicting results have been reported. In a study conducted among university students that used Facebook and those that did not use Facebook, students using Facebook obtained lower academic results compared to students who did not use Facebook, while other studies have shown that social

media have no impact on academic performance. The amount of time spent on social media, the number of times the site is visited and the total number of online friends are some of the variables that have been used to determine the impact of social media use on academic performance, and moderate use of these platforms have been associated with better academic performance (Iorliam and Ode 2014: 275-279).

2.6.6 DIET AND NUTRITION

Physical activity and healthy diets (low in saturated fats and refined sugars) have been shown to have a positive impact on cognitive capability, which would suggest that health related behavior may affect academic performance (Deliens, Clarys, De Bourdeaudhuij, and Deforche 2013: 2). A study conducted amoung Belgian university students reported that an increase in weight, body mass index, waiste circumference, eating at the students restaurant more frequenctly, higher soda and French fries consumption, and higher frequency of alcohol use, predicted lower GPAs amoung the students (Deliens, Clays, De Bourdeaudhuij, and Deforche 2013: 3-7), which would indicate that health behaviours of university students may impact academic performance.

Numerous studies have sought to establish the role of diet and nutrition on academic performance. Unfortunatly, many studies have focused on young children and adolescents, and not young adults. A study conducted amoung Spanish adolscents reported that a relationship existed between adherenece to the meditarranean diet and academic performance ($p<0.001$), and adolecents that indicated a good adherence to the mediterranean diet reporting a significantly higher academic scores than those who with poor adherence to the diet ($p\leq 0.001$) (Esteban-Cornejo, Izquierdo-Gomez, Gomez-Martinez, Padilla-Moledo, Castro-Pinero, Marcos, and Veiga 2016: 1135). While in another study also conducted among adolescents, positive associations between academic performance and the consumption of fruit, vegetables and whole grains, while negative associations between consumption of foods with refined sugars and saturated fats (Nyaradi, Li, Hickling, Foster, Jacques, Ambrosini, and Oddy 2015: 2974-2977). Correa-Burrows, Burrows, Blanco, Reyes, and Gahagan (2016: 187) support these results, further re-interating that a healthy diet is associated with good academic performance, and this was further evident in a study amoung Chilean adolescents where those who followed a healthy diet reported an academic performance that was at least two times better than those that followed an unhealthy diet (high in fat, sugar, salt, and calories).

The above mentioned studies have alluded to a relationship extisting between diet, and nutritional status on academic performance; however, none of the studies have been able to establish the extent of the relationship, and whether the results were independent of other factors.

2.7 NATIONAL AND INTERNATIONAL STRATEGIES TO ADDRESSMALNUTRITION

2.7.1 FOOD FORTIFICATION

Food fortification is a nutrition intervention to improve the nutrition status of the population with the addition of micronutrients during the processing of staple foods, and the most frequently reported micronutrient deficiencies in the world are of vitamin A, iron (Fe), iodine and zinc (Papathakis and Pearson 2012: 1810). In 2003, legislation for the mandatory fortification of flour and maize meal was passed in South Africa with the aim of reducing nutrient deficiencies. There has been a positive outcome in the incidences of neural tube defects as a result of increased folic acid intake attributed to fortification; however, deficiencies still exist. This is due to insufficient levels of micronutrients added to maize and flour, and this is greatly impacted by the inadequate addition of micronutrient premix at the mills. Lack of compliance, monitoring and enforcement of fortification legislation has also impact on the success of this strategy. The current South African staple food fortification regulation (R7634) was amended and published in 2008, and requires that all maize meal and bread flour be fortified with the micronutrients Vitamin A, thiamine (B1), riboflavin (B2), nicotinamide (B3), pyridoxine (B6), folic acid, iron and zinc (Yusufali, Sunley, De Hoop and Panagides 2012: 321-327).

Half of all pregnancies in developed countries are unplanned, which increases the chances of neural tube defects as a result of low folic acid levels during pregnancy. Results also indicate that only 50% of women who plan their pregnancy keep to the pregnancy supplementation guidelines (Mallard and Houghton 2012: 440). Furthermore, this motivated the decision of countries such as Australia to increase folate intake. Folic acid fortification is one of the strategies implemented to address folic acid deficiency. Severe anemia during pregnancy can contribute to as much as 20% of maternal mortality. In South Africa (SA), 3500 maternal deaths were reported in the year 2000, and were related to iron and vitamin A deficiency (Papathakis and Pearson 2012: 1810). Diet diversity in SA is low, and increases the risk for micronutrient deficiency. In a study among lactating women in SA consuming fortified foods, most of the women did not meet the EAR for zinc, vitamin A, Riboflavin and B_6.

Fortification of staple foods with micronutrients is a public health approach that is both cost effective and effective in reducing the levels of micronutrient deficiencies, while bio-fortification is considered to be more a long-term, sustainable food-based answer to the increasing global population. Many efforts have been made towards improving fortification programmes; however, despite these efforts, fortification programmes have still failed to reduce anemia worldwide. In order for fortification programmes to be successful, constant evaluation is necessary and decisions to adjust, maintain, expand or dismantle implemented fortification programmes must be made (Garcia-Casal 2014: 880-886).

Biofortification is defined as the process of increasing the micronutrient density of stable crops through conventional plant breeding and modern bio-technology which results in a measurable and positive

impact on human health (Cakmak, Pfeiffer and McClafferty 2010: 10), and it is important that the following aspects be considered in biofortified crops:

1. Bioconversion or bioavailability of the ingested nutrients.

2. Retention of nutrients after storage, processing, and cooking.

3. Micronutrient requirements of a population.

4. Potential levels of consumption by a population.

The most commonly consumed grains worldwide are wheat and rice (Da Silva, Galli, Da Silva, Schirmer and Rombaldi 2015: 123); and it is no co-incidence that these grains have been selected for biofortification.

2.7.2 FOOD SUPPLEMENTATION

Food supplementation, commonly in the form of pills and beverages, is the addition of micro- and macronutrients to the diet that are not found in food form (Steyn, Blaauw, Lombard and Wolmarans 2008: 236). However, it is very important to remember that dietary supplementation should not replace whole foods. In America, it is estimated that there are approximately 75 000 supplements on the market, and more than 50% of adults in the United States take a dietary supplement on a regular basis. According to Rolfes, Pinna and Whitney (2015: 331) people take supplements to:

- Correct nutrition deficiencies
- Support increased nutrition needs
- Improve nutrition status
- Improve the body's defences, and
- Reduce disease risk.

Supplementation can also be used to aid weight loss, especially in the current climate of drastic increase in overweight and obese individuals. A study conducted among university students in Shanghai China, found that students with low calcium levels prior to the study, benefited from a calcium and vitamin D supplementation over a period of 12 weeks independent of energy restriction (Zhu, Cai, Wang, Lin, Hu, Qi, Ma and Amarasekara 2013: 2-4). The mean (SD) BMI of the students was 26.0±1.8 prior to participating in the study, and after 12 weeks the mean (SD) BMI of the group was reduced to 24.2±1.8. On the other hand, supplementation can also be used to decrease body wasting which is characterized in Human Immune Virus (HIV) patients. In a study conducted in Kimberly, Upington, Kuruman, Prieska, and Springbok in South Africa, it was discovered that 49.4% of HIV patients that were given supplemented micronutrient porridge gained weight, of which 42% gained a significant amount of weight (Lategan, Steenkamp, Joubert and Le Roux 2010: 198-201).

Supplementation can cause problems if the dosage of the supplemented nutrient is not given in correct dosages. Such was the case in South Africa, where pregnant women were given 5mg of folic acid daily, which was ten times the recommended daily allowance (RDA), and five times higher than the upper tolerable limit (UL) (Melse-Boonstra 2006: 1). The consequences of this high intake could result in possible late vitamin B12 deficiency detection, which could lead to compromised immune function and permanent neurological damage. It is therefore very important to monitor the dosage given to supplement an individual's nutrients.

Furthermore, in South Africa, prophylactic micronutrient supplementation of vitamin A to women and children 6-60 months has been implemented in clinics and hospitals, as is done with iron, where ferrous sulphate is made available and taken daily by pregnant women with a hemoglobin level of ≤10 g/Dl. Furthermore, all South African women who have access to a health facility receive 5mg of folic acid tablets daily for the first trimester of pregnancy (Moeng and De Hoop 2008: 307-310).

2.7.3 GENETICALLY MODIFIED FOOD (GMF)

Genetically modified foods are foods where specific genes are transferred from one organism to the host organism, and there has been great global debate on the health consequences of consuming these genetically modified foods. This has resulted in greater interest in consumer perception and acceptability of these products, and the factors that affect the acceptability of these foods. Genetically modified foods with health benefits (GMFHB), are consumed by numerous consumers around the world; however their acceptability has been shown to be more favourable among males than females. In a study conducted among German university students, it was found that the majority of the students had a negative attitude towards GMFs, even those marketed as having health benefits. Similarly, in a separate study conducted among adults in Turkey, the majority of the participants had a negative attitude towards GMFs due to their carcinogenic properties, and a greater percentage of participants reported that they were aware of the term GMFs, but did not have enough knowledge on genetic modification technology. Farmers and food manufacturers have benefited greatly with GMF technology due to increased production yields, and decreased labour and production costs (Rojas-Mendez, Ahmed, Claro-Riethmuller and Spiler 2012: 201-212; Tas, Balci, Yuksel and Yesilcubuk 2015: 1427).

According to Divyadharsini (2014: 392), GMFs are important in meeting the population's food requirements; however, in the same regard, these foods have been associated with kidney and reproductive problems. A large proportion of the global population that consumes GMFs is unaware that they are actually consuming GMFs. Furthermore, Dona and Arvanitoyannis (2009: 164) indicated that the consumption of GMFs is not limited to the negative impact they can have on the kidneys and reproduction systems, but may affect the hepatic and pancreatic systems as well. However, the impact of GMF on reducing food insecurity and addressing world hunger are immense and undeniable, which calls for more research towards ensuring the safety of these foods.

The labeling of GMFs is very important and in South Africa, the Department of Health is responsible for food labelling regulations, which are important in empowering the consumer to be able to decide whether they purchase GMFs or non-GMFs (Oldewage-Theron and Fuller 2008: 653).

2.7.4 FOOD BASED DIETARY GUIDELINES

According to Vorster, Badham and Venter (2013: 5), Food Based Dietary Guidelines (FBDGs) are 'short, positive, science-based messages that aim to change the eating behavior of the general population towards more optimal diets that meet energy and nutrient requirements, while simultaneously helping to protect against the development of non-communicable diseases'. FBDGs are an important part of national food and nutrition policies, and in a study conducted in four countries, which included South Africa, it was reported that FBDGs were mainly implemented in a written and/ or electronic format by the health and education departments (Keller and Lang 2007: 867). The study also highlighted an important limitation on studies conducted around FBDGs, which has limited the knowledge on the effect of FBDGs on consumer's food choices and dietary habits.

The relevance of the SAFBDGs has been in the spotlight, especially with the rising food prices that leave the poor more vulnerable to nutrition related deficiencies (Schonfeldt, Hall and Bester 2013: 226). Furthermore, with the average household income of South Africans only being able to afford low cost staple foods like maize meal, it is hard to acknowledge the effectiveness of these dietary guidelines in food insecure households in South Africa.

The first set of South African Food Based Dietary Guidelines (SAFBDGs) was released in 2003, and were:

- Enjoy a variety of foods.
- Be active.
- Make starchy foods the basis of most meals.
- Eat dry beans, peas, lentils and soy regularly.
- Chicken, fish, meat or eggs can be eaten daily.
- Drink lots of clean, safe water.
- Eat plenty of vegetables and fruit every day.
- Eat fats sparingly.
- Use salt sparingly.
- If you drink alcohol, drink sensibly.
- Use foods and drinks containing sugar sparingly and not between meals.

Changes in population dynamics, economic development and urbanization have led to change in South African diets, and the new SAFBDGs were developed in line with those changes in mind (Vorster, Badham and Venter 2013: 6).The revised guidelines are targeted at adults and children over the age of five years, while separate guidelines exist for children younger than five years, but have not been accepted by the Department of Health (DoH). The changes in the revised food guidelines include the inclusion of the milk group, emphasise the quality of fats, as well as incorporate changes in the wording.

Revised general food-based dietary guidelines for South Africans, 2012:

- Enjoy a variety of foods.
- Be active!
- Make starchy foods part of most meals.
- Eat plenty of vegetables and fruit every day.
- Eat dry beans, peas, lentils and soy regularly.
- Have milk, maas or yoghurt every day.
- Fish, chicken, lean meat or eggs can be eaten daily.
- Drink lots of clean, safe water.
- Use fats sparingly. Choose vegetable oils rather than hard fats.
- Use sugar and foods and drinks high in sugar sparingly.
- Use salt and food high in salt sparingly.

2.7.5 MILLENNIUM DEVELOPMENT GOALS (MDGs) AND SUSTAINABLE DEVELOPMENT GOALS (SDGs)

The Millennium Development Goals (MDGs) are a set of goals that were drawn up by the United Nations (UN) members in 2000, and were established as a way to help deal with global problems, which include poverty, hunger, gender inequality, maternal health, disease and environmental issues (Shrivastava, Shrivastava and Ramasamy 2016: 87). The eight MDGs were:

1. To eradicate extreme poverty and hunger.
2. To promote universal primary education.
3. To promote gender equality and empower women.
4. To reduce child mortality.
5. To improve maternal health.
6. To combat HIV and AIDS, malaria and other diseases.
7. To ensure environmental sustainability.
8. To develop a global partnership for development.

A total of 189 member states pledged to reach the eight goals by 2015, and although many countries have achieved most of the goals, some countries have not achieved good results (Haileamlak 2015: 109). Furthermore, African countries covered considerable ground in achieving the goals despite unfavourable conditions at the start of the implementation of this global commitment. Ethiopia in particular, is one of the African countries that made excellent strides in achieving the goals by reducing the mortality rate of children under the age of five years by two thirds, three years before 2015. They have also met the MDG 4 of reducing the maternal mortality rate by 2014 (Haileamlak 2015: 110). In South Africa, tremendous strides were made, especially towards achieving health related goals (Pillay and Barron 2014: 223). Reducing the mortality of children under five years was a goal of particular importance, especially with regard to mother to child transmission of HIV, while malaria related mortality; with a 90% decrease in the number of cases since 1999, demonstrated the priority placed on achieving the MDG in South Africa. However, there was considerable criticism of the formulation of the MDGs, with literature suggesting that developing countries were not well represented in the drawing up of the goals, and many stakeholders suggesting that several previously agreed upon objectives were not included in the final goals (Fehling,

Nelson and Ventatapuram 2013: 1109). Furthermore, literature reviews indicated that many health professionals felt that the MDGs were too simplistic and unachievable, in relation to the magnitude of problems they were intended to solve. In 2013, the United Nations Development Programmers released a report, which indicated that South Africa had achieved MDG 1. Furthermore; the report indicated that the youth and women continued to be disproportionally exposed to forms of poverty explained under MDG 1 (UNDP, 2013).

On the 25th September 2015, world leaders gathered at the United Nations (UN) in New York to adopt the 2030 agenda for sustainable development. The 2030 agenda comprised of 17 new Sustainable Development Goals (SDGs)/Global Goals (GGs). The SDGs build on the MDGs; however, unlike the MDGs, the SDGs aim to address the root causes of poverty (UN, 2015).

Table 2.2: The new Sustainable Development Goals to be achieved by the year 2030 (UN, 2015).

Sustainable Development Goals
Goal 1. End poverty in all its forms everywhere.
Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
Goal 3. Ensure healthy lives and promote well-being for all at all ages.
Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
Goal 5. Achieve gender equality and empower all women and girls.
Goal 6. Ensure availability and sustainable management of water and sanitation for all.
Goal 7 Ensure access to affordable, reliable, sustainable and modern energy for all.
Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
Goal 10. Reduce inequality within and among countries.
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable.
Goal 12. Ensure sustainable consumption and production patterns.
Goal 13. Take urgent action to combat climate change and its impacts.*
Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

2.7.6 NUTRITION EDUCATION

Nutrition education among university students is highly recommended; however the effectiveness of traditional nutrition education programmes amongst this population group has been largely ineffective, mostly due to the use of inappropriate tools. Multimodal nutrition education programmes have been shown to be more effective among university students. This was supported by a study at four Malaysian public universities, where the intervention group exposed to a combination of conventional lectures, brochures and text messages conveying nutrition information showed significantly improved dietary habits as evidenced by improved micronutrient intake, mainly attributed to the higher intake of fruits and vegetables and a substantial reduction in the consumption of processed foods compared to the control group. This research supports the need to use more technology based approaches to disseminate nutrition education among this population group, due mainly to the popularity of social media among this group (Shahril, Dali and Lua 2013: 2-9).

Numerous studies have linked increased nutrition knowledge to improved eating habits. However, few studies have attempted to attribute the improved dietary habits after exposure to nutrition education to nutrition education alone (Emrich and Mazier 2009: 187). A study conducted among university students enrolled in a nutrition course reported that exposure to nutrition education over a prolonged period significantly decreased the students' dietary fat intake, in particular saturated fat. Fourth year students demonstrated better results compared to first year students. Strawson *et al* (2013:138), however, argues that nutrition education alone may not be enough to encourage healthy eating behaviour among university students. This is attributed to the fact that good nutrition choices are made as a result of multidimensional factors and are not reliant on nutrition knowledge alone. Additionally, a study conducted among university students in Canada supported this statement, where the majority of the students did not meet the RDIs for most nutrients and did not adhere to the two most recommended eating plans in the country, which are the Eating Well With Canada's Food Guide (EWCFG), and Traditional Healthy Eating Mediterranean Diet Pyramid (THMDP).

In South Arica, the integrated nutrition programme (INP), focuses on vulnerable groups which include children, women of reproductive age and the elderly. Even though it's an effective programme in its own right, it is not inclusive of all population groups (DoH, 2010). The SAFBDGs are the recommended nutrition education tool in South Africa, which are focused on increasing nutrition awareness among all citizens in the country (DoH, 2010).

2.7.7 FOOD BANKS

The Tennessee State University in Nashville is among the many public universities that have established food banks to aid students who are temporarily unable to fund meals (Tennessee State University, 2012). Food supplies are sourced mainly through donations by fellow students, staff and local businesses and community members. Hunger among university students becomes severe especially in times when the economy is not doing well, and the number of students seeking assistance at university food banks increases (Timothy 2012: 2), with the university of West Virginia assisting up to 30 000 students a year. The shame and stigma attached to seeking help from a university food bank have been counteracted by using packaging that is not associated with the food bank, and using online methods to fill in forms to apply for a food package from a food bank.

A study conducted among students receiving assistance form the campus food bank (CFB) at the university of Alberta reported that over 90% of the students involved in the study, and who were made up of 50% graduate students and 46.6% international students, were food insecure (Farahbakhsh, Ball, Farmer, Maximova, Hanbazaza and Willows 2015: 201-202). The majority of the students (82.9%) reported that they enjoyed the food offered at the food bank. Food sourced from food banks alone is not enough to ensure food security among students, as, in most cases, food bank parcels are collected at most twice a month, and although most parcels met the recommended minimum servings for each food group, most were low in proteins and fat from animal sources (Willows and Au 2006: 104-105).

In South Africa, to our knowledge none of the South African universities have on campus food banks and research needs to be conducted to ascertain the feasibility of food banks in SA institutions of higher learning.

2.7.7 STUDENT BURSARIES AND FOOD ALLOWANCES (NSFAS)

The National Students Financial Aid Scheme (NSFAS) is a South African government initiative, which aims to provide study loans and bursaries to underprivileged students. The loan or bursary includes financial assistance towards tuition, accommodation and a food allowance. A report issued by the Department of Higher Education reported that NSFAS loans and bursaries were insufficient to cover tuition, accommodation and food. A study conducted among students at the University of KwaZulu-Natal (UKZN), reported that students on financial aid were significantly more vulnerable to food insecurity in comparison to those not receiving financial aid. Furthermore, the UKZN student funding department in 2011 stated that students that were on NASFAS received an annual meal allowance of R5 026 per year. This amount was paid out in instalments of R628.24 over eight months, which is equivalent to R20.85 per day or R7.00 per meal (Kassier and Veldman 2013: 250-259).

2.7.8 HEALTH TAX

The health tax is a tax paid by consumers and is linked to specific foods that have triggered unhealthy habits associated with negative health outcomes. The health tax has been referred to by various names, including fat tax, sin tax, junk food tax, or the soda tax. In 2010, Denmark introduced health taxes on food that were high in saturated fats, sugar products, and soft drinks (Smed 2012: 142). In 2011, Scotland also implemented a tax on chocolate in an attempt to combat the high obesity rate. However, the effectiveness of this fiscal measure to regulate unhealthy diets has been met with great sceptism, with many countries including the United States reporting only a modest impact of the fiscal measures in attempts to reduce consumption of these foods. However, this intervention has been successful in generating revenue, which could be used to increase more awareness of the health implications of consuming saturated fat and sugar, through nutrition education campaigns (Tiffin and Arnoult 2011: 427). In South Africa, the effectiveness of the health tax has been debated at length and the effectiveness of taxes on tobacco and alcohol in reducing overall intake has encouraged the government to implement a sugar tax on all carbonated drinks in response to the resoundingly high statistics on overweight and obesity cases in South Africa. In the 2016 financial budget, the minister of finance announced the introduction of a sugar tax, which will be effective from the 1st April 2017, in an attempt to reduce excessive sugar intake (South African Treasury, 2016).

2.8 DIETARY REQUIREMENTS FOR MEN AND WOMEN BETWEEN 19 and 30 YEARS OF AGE

2.8.1 THE ROLE OF DIETARY REFERENCE INTAKES (DRIs) AND OTHER DIETARY REQUIREMENTS

According to the Academy of Nutrition and Dietetics (previously called the ADA)) (2011: 762-770), dietary reference intakes are a set of nutrient reference standards developed by the Institute of Medicine (IOM) for the United States and Canada. Recommended Daily Allowances (RDAs) were previously only used by nutritionists and dietitians as dietary assessment tools for both groups and individuals and meal planning. Dietary Reference Intakes (DRIs) were created to magnify the application of RDAs (Nakade, Imai, Tsobuta-Ustugi, Tsuboyama-Kasaoke and Takimoto 2013: 474). The DRIs were established for vitamins, minerals, macronutrients, electrolytes and water (Trumbo, Barr, Murphy and Yates 2013: 657); however in 2012, an updated report on DRI's for calcium and vitamin D were published. These recommendations apply to healthy people and may not be appropriate for people with diseases that increase or decrease nutrient needs.

The DRIs include the Estimated Average Requirement (EAR), Recommended Daily Allowance (RDA), the Adequate Intake (AI), the Tolerable Upper Intake Level (UL), as well as the Estimated Energy Requirement (EER), and in some countries, may also include the Acceptable Macronutrient Distribution Range (AMDR) (American Dietetic Association 2011: 762). However, according to Wallace (2012: 234),

the Food and Nutrition Board FNB) of the Institute of Medicines developed four DRIs for Americans and Canadians namely, EAR, RDA, AI, and UL (also used in South Africa).

According to Trumbo *et al* (2013: 658), reports were also published on how to use DRIs (planning report) and how to assess dietary inadequacy (assessment report) and it is very important to note the following considerations:

1. DRIs are intended for use by generally healthy people.
2. DRIs apply to all sources of food, beverages and dietary supplements.
3. DRIs apply to usual intake rather than total intake on any given day.

The United .States. Food and Drug Administration (USFDA) and the Institute of Medicine's Food and Nutrition Board have proposed that DRIs be included on food labels in addition to Dietary Values (DVS), as well as EARs, (Wallace 2012: 233). Different regions use different DRIs; for example Japan uses Estimated Energy Requirement (EER), EARs, AI, RDA, UL, and Tentative Dietary Goal for Preventing Lifestyle-related Diseases (DG) (Nakade *et al* 2013: 474).

According to Aranceta and Perez-Rodrigo (2012: 8), DRIs serve the following purposes:

1. Prevention of nutrient deficiencies.
2. Help individuals optimize their health.
3. Prevent disease.
4. Prevent the over consumption of nutrients.

- **EAR**

Estimated Average Requirement refers to the average daily nutrient intake that is estimated to meet the requirements of 50% of healthy people in a particular life stage and group and is used to calculate the RDA (American Dietetic Association, 2011: 762). The EAR plays a significant role in determining the prevalence of nutrient deficiency in a group, however, the RDA cannot be calculated without the EAR, and in that instance, the AI can be used (Wallace 2012: 234).

- **RDA**

The American Dietetic Association (2011: 762-770) describes Recommended Dietary Allowance as 'the average daily dietary nutrient intake that is adequate to meet the nutrient requirements of nearly all (97%-98%) of healthy people in a particular life stage and group'. The RDA cannot be used in nutrition assessments and in planning dietary intakes.

- **AI**

Average Intake is defined as 'the recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups). The AI helps guide healthy people, and are used when the RDA cannot be determined' (American Dietetic Association, 2011: 763). AI serves as a goal of dietary intake for groups and individuals. Wallace (2012: 234) states that lack of data prevents the specification of the actual percentage covered by this intake.

- **UL**

The tolerable Upper Intake Level is defined as 'the highest average daily nutrient intake level that is likely to pose no risk or adverse health effects to almost all individuals in the general population. As intake increases above the UL, the risk of adverse effects may increase' (American Dietetic Association, 2011: 763), but UL excludes individuals that are already being treated for nutrient deficiencies.

- **DG**

Dietary Goal (DG) is the value for primary prevention of lifestyle-related diseases and nutrients and includes fats, saturated fatty acids, n-6 fatty acids, n-3 fatty acids, cholesterol, dietary fibre, sodium and potassium (Nakade *et al* 2013: 488) and forms part of Japanese DRIs.

2.8.2 MACRONUTRIENTS

Carbohydrates, proteins and fats are sometimes referred to as energy yielding nutrients, and are used by the body to provide energy. These macronutrients are required in large amounts in contrast to micronutrients. The energy released from carbohydrates, proteins and fats is measured in joules (J). The amount of energy a food provides is dependent on how much carbohydrate, protein and fat the food contains. Fats have a higher energy density compared to carbohydrates and proteins, as fats provide more energy per gram (Rolfes, Pinna and Whitney 2015: 8). Table 2.3 illustrates the macronutrient requirements for girls and boys aged between 14 and 18, and men and women between the ages of 19 and 30.

Table 2.3: Macronutrient requirements for women and men between the ages of 19 to 30 years.

MACRONUTRIENTS	REQUIREMENTS PER DAY WOMEN 19-30	REQUIREMENTS PER DAY MEN 19-30
Energy (EER kJ/day)	10 093kJ	12 881kJ
Carbohydrates (EAR)	100g	100g
Fibre (AI)	25g	38g
Protein (RDA)	46g	56g

2.8.2.1 ENERGY

Carbohydrates, proteins and fats are the key energy nutrient sources, and are the basis of life, and make life activity possible (Pang, Xie, Qing and Hu 2014: 89). However, overconsumption and accumulation of these nutrients may lead to overweight, which is linked to diseases such as cardiovascular disease, diabetes, hypertension and cancer. The absorption, storage and accumulation of energy substances are regulated by the law of energy conservation and surplus energy is stored in the body as fat. In humans, energy intake is expressed in terms of estimated energy requirement (EER) which is defined as 'the average dietary energy intake that is predicted to maintain energy balance in healthy adults of defined age, sex, weight, height and level of physical activity consistent with good health', and it provides estimates of an individual's energy needs. Balance is crucial to the energy recommendation. Sufficient food energy is required to sustain a healthy and active life; however, excess energy can result in weight gain. No upper level (UL) for energy has been determined because any amount of energy in excess will result in weight gain (American Dietetic Association, 2011: 763).

Normal energy requirements and intake depend on age, sex, and physical activity level (PAL) (Tazhibi and Bahraini 2012: 686). Basal metabolic rate (BMR), on the other hand, is the minimal rate of energy consumption necessary to support all cellular functions and accounts for 50–70% of total energy expenditure and is used in EER estimation. University students are susceptible to a positive energy imbalance due to the high consumption of snacks and convenience foods, and a lack of physical activity. This statement is supported by a study conducted at two universities in the United Kingdom (UK) that reported that the results for the mean energy intake were consistent between both men and women, which was significantly lower than the mean energy expenditure (Ellis, Costa and Amirabdollahian 2012: 163). Furthermore, among men, the average contribution to energy intake was 16.6% protein, 51.2% carbohydrate, and 31% fat, while amongst women it was 15% protein, 54.6% carbohydrates and 29% fat.

Energy contribution from snacks represented a large percentage of total caloric intake in students. In a study conducted among Nigerian university students, soft drinks were the favourite snack (69%), followed by biscuits (35.1%), meat pies (27.36%) and cakes (17.3%) (Ukegbu, Uwaegbute, Anyika-Elekeh, Echendu, Asumugha, Oti and Nwofia 2014: 82). Male students had a higher energy intake (11 796.79 kJ) compared to female students (8 581.38 kJ) (p<0.05). Snacks contributed to 87.7% of energy intake in male students, and 85.5% in female students. Similarly, in a study conducted among Croatian university students, the average energy intake was found to be 130% of DRI, which was also accompanied by a high prevalence of overweight (Satalic, Baric and Keser 2007: 398). Furthermore, this study found that 83% of males and 65% of females reported ≥0.5 hours of high intensity exercise per week, which was higher than the level of physical activity reported by a study conducted among university students from 13 European countries (76% of men and 65% of men had exercised at least once in the past two weeks).

The use of energy drinks can also contribute to increased energy intake among university students, and high energy drink consumption among university students is quite common. In a study conducted among Turkish university students, the mean energy intake (SD) was 9 275.93±262.50kJ for men, and 7 171±189.62kJ for women, which is below the DRIs for energy required by active individuals between the ages of 19 and 30 years (3067kJ for men and 2403kJ for women). Skipping breakfast was common among university students; however in a study conducted among Turkish students, dinner was the main source of energy intake. Snacks were the least contributor of energy for male and female students, which was inconsistent with studies previously published on the energy consumption patterns of university students (Neslisah and Emine 2011: 117-119)

2.8.2.2 DIETARY FIBRE

According to Dhingra, Micheal, Rajput and Patil (2012: 255), the American Association of Cereal Chemists (AACC) defines dietary fibre as the edible parts of a plant that are resistant to digestion and absorption in the human intestine. Food sources of dietary fibre include cereals, legumes, nuts, fruits and vegetables. Additionally, dietary fibre can be found in functional foods such as baked goods, beverages and meat products. A study conducted among American college students found that the top five food sources of dietary fibre consumed were Mexican mixtures, whole grain bread/rolls, fried potatoes and ready to eat cereal (Byrd-Williams, Strother, Kelly, and Huang 2009: 896).

Cardiovascular disease is the leading cause of death and disability in developed countries, and diet, especially one rich in dietary fibre, has been linked to reduced risk of cardiovascular disease in both developing and developed countries (Sanchez-Muniz 2012: 31). Byrd-Williams *et al* (2009: 896), further emphases the role of dietary fibre in the prevention of obesity, and type 2 diabetes. Anderson, Baird, Davis, Ferreri, Knudtson, Koraym, Waters and Williams (2009: 188) emphasized the role that dietary fibre plays in reducing the risk for disease, and the benefits of a fibre rich diet. The benefits of this diet include the lowering of blood pressure, regularity, weight loss and immune function. In a study conducted among first year and fourth year dietetics students at a Dutch university, >80% of first year students met the RDA's for macronutrients; however, of these students, only 37% of the students met the RDA for dietary fibre (van der Kruk, Jager-Wittenaar, Nieweg and van der Schans 2013: 1237). More fourth year students met the RDA for fruits (55%) and vegetables (74%), which may conclude that nutrition adequacy may possibly increase with more nutrition education.

2.8.2.3 CARBOHYDRATES

Carbohydrates have been researched extensively, especially the impact of high glycemic index (GI), and glycemic load (GL), as well the low consumption of whole grains, and the role it plays in the increased risk of obesity (Song *et al* 2014: 54). Furthermore, research suggests that high GI and GL diets are associated with increased risk of coronary heart disease, type II diabetes and stroke, while less refined whole grain consumption may help prevent diabetes and cardiovascular disease. Carbohydrates are the

second biggest group of nutrients that are a source of energy to the body. They play a vital role in the prevention of nutrition related diseases (Hauner, Bechthold, Boeingm, Bronstrup, Buyken, Leschik-Bonnet, Linseisen, Schulze, Strohm and Wolfram 2012: 2). The quality of the carbohydrate consumed has a significant role in preventing nutrition disease, rather than the quantity of carbohydrates consumed. The changing dietary patterns in African countries have been of great interest, in particular to carbohydrate intake, due to its association with obesity (Akarolo-Anthony, Odubore, Yilme, Aragbada, Odonye, Hu, Willett, Spiegelman and Adebamowo 2013: 293).

Different regions consume varying amounts and food sources of carbohydrates based on their cultural inclinations. Asians consume large amounts of rice, and dietary carbohydrates have been associated with metabolic syndrome, especially in Asian regions (Song *et al* 2014: 54). In Sub-Saharan Africa, however, carbohydrates are synonymous with staple foods for different countries. In Tanzania and Kenya, ugali, a stiff maize-based porridge is the most common carbohydrate consumed with meat dishes. In South Africa, the most common carbohydrate based foods are maize and bread, while in Nigeria, the most commonly consumed carbohydrates are roots and tubers (Akarolo-Anthony *et al* 2013: 292). Refined carbohydrate consumption has been related to higher blood pressure, type II diabetes, and small intestine, prostate and pancreatic cancers (Delibasi and Cakir 2014: 401). In addition, the consumption of refined carbohydrates has also been associated with the development of allergic diseases which include skin disease, which is unfortunate since the majority of all diets globally contain more refined carbohydrates then complex carbohydrates.

2.8.2.4 PROTEIN

According to Bain, Myint, Jennings, Lentjies, Mulligan, Lunben, Khaw and Welch (2015: 179), protein is an important nutrient in human health, and it has many functions which include its role as a component within the skeletal muscles and in the prevention of nutrition related diseases. Protein has also been linked to the reduced prevalence of type II diabetes and chronic non-communicable diseases, but there is limited research on the actual role that protein plays.

Protein can be sourced from both animal (meat, fish, milk, eggs and cheese) and plant sources (mostly legumes and pulses), but the majority of the adult population obtain their protein from animal sources (Bain *et al* 2015: 180). Animal sources of protein are considered to have a higher quality of protein, but unfortunately, animal sources of protein can be expensive, which is why in many developing countries, people use cereals are the major source of protein in the diet (Schonfeldt and Hall 2012: 69).

Dietary protein and certain amino acids may also play a role in body weight loss, maintenance of body weight and satiety, and reduce the rate of muscle loss, which leads to ageing (Moughan 2012: 2). Furthermore, protein plays a role in immune function, which may impact infection. Diets high in protein as an aid to weight loss have at least 25-30% of the energy supplied by protein; however, total energy intake

is reduced (Westerterp-Plantenga, Lemmens and Westerterp 2012: 105-110), and the success of the popular low carbohydrate diet is mainly based on the diet being high in protein.

2.8.2.5 FATS

Fats are an important source of energy and play a crucial part in the facilitation of the absorption of fat soluble vitamins; fats and oils are important sources of essential fatty acids (EFA's). Fats also play a vital role in improving the taste and acceptability of foods in terms of texture, flavour and aroma (Aranceta and Perez-Rodrigo 2012: 8). The Acceptable Macronutrient Distribution Range (AMDR) is a range of intakes for a particular energy source that is associated with reduced risk of chronic disease while providing adequate intake of essential nutrients (American Dietetic Association 2011: 763). This can be expressed as the total energy intake for macronutrients and n-3 and n-6 polyunsaturated fatty acids. AMDR was introduced by the IoM in the 2002 report on energy and macronutrients, and it is expressed as a percentage of total essential nutrients (Aranceta and Perez-Rodrigo 2012: 9).

A study conducted among university students in England aged between 18 and 24 years indicated that although male students had a higher overall micronutrient intake, female students had a significantly higher intake of fat, saturated fatty acids(SFA), polyunsaturated fatty acids (PUFA), and monounsaturated fatty acids (MUFA) (Foster, Alaunyte and Amirabdollahian 2015: 320). A Spanish study among university students also yielded similar results where a sharp increase in lipid intake, especially saturated fat was reported (Navarro-Prado, GGonzalez-Jimenez, Montero-Alonso, Lopez-Bueno and Schimdt-Rio Valle 2015: 2651). Contrasting results were, however, presented in a study among Oregon State University students, where male students consumed a higher energy intake from fat than female students (Li, Conception, Lee, Cardinal, Ebbeck, Woekel and Reddy 2012: 246).

Pi, Vidal, Brassesco, Viola and Aballay (2015: 1748) states that the high prevalence of overweight among university students is a result of increased carbohydrate and fat intake. This is validated by a student study in the University of Technology in Cordoba, which found that 40% of the student sample had high body fat. The same study was able to establish a positive relationship between fat storage and age. The role of dietary fat and its effect on cardiovascular disease has been greatly documented in several papers, with a significant relationship identified between fat, saturated fat intake and heart disease as well as mortality (Aranceta and Perez-Rodrigo 2012: 8).

2.8.3 MICRONUTRIENTS

Table 2.4: Dietary Requirement Intakes (DRIs) for micronutrients for men and women between the ages of 18 to 30 years.

REQUIREMENTS PER DAY FOR MEN AND WOMEN BETWEEN THE AGES OF 19-30			
NUTRIENT (g) per day	RDI	MEN	WOMEN
Calcium (mg)	AI	1000	1000
Zinc (mg)	EAR	9.4	6.8
Iron (mg)	EAR	6	8.1
Iodine (µg)	EAR	95	95
Phosphorus (mg)	EAR	580	580
Magnesium (mg)	EAR	330	255
Fluoride (mg)	AI	3.8	3.1
Selenium (µg)	EAR	45	45
Chromium (µg)	AI	35	25
Vitamin A (µg)	EAR	625	500
Vitamin C (mg)	EAR	75	60
Thiamin (mg)	EAR	1	0.9
Riboflavin (mg)	EAR	1.1	0.9
Vitamin D (mg)	AI	5	5
Vitamin B6 (mg)	EAR	1.1	1.1
Vitamin B12 (µg)	EAR	2	2
Vitamin E (mg)	EAR	12	12
Vitamin K (µg)	AI	120	90
Folic Acid (µg)	EAR	320	320
Biotin (µg)	AI	30	30

2.8.3.1 FAT SOLUABLE VITAMINS

- **Vitamin A**

Vitamin A is a fat soluble vitamin which is necessary in embryo development, growth, vision, reproduction and immune function. Vitamin A is found in either the form of preformed vitamin A or provitamin A carotenoids foods. Furthermore, vitamin A is vital in gene expression, and the most important function of provitamin A carotenoids is their capacity to transform to retinols in the body (Kraemer, Semba, Eggersdorfer and Schaumberg 2012: 185). Carotenoids play an important role as antioxidants which reduce DNA damage, maintain immune function and have been associated with the inhibition of cancer

(Sungah, Young-Nam and Youn-Ok 2012: 45). According to Ahmad, Haskell, Raqib and Stephenson (2009: 797), vitamin A is stored in the liver, and although it plays a very important role in immunity and maintaining normal vision, higher levels of vitamin A stored in the liver are required for immunity compared to maintaining normal vision, as normal vision is maintained at vitamin A liver stores of ±0.070µmol/g.

Food sources of preformed vitamin A include liver, eggs, butter, milk and milk products, while, carotenoids are found in foods which include dark green leafy vegetables and orange and yellow fruits (Kraemer *et al* 2012: 185). The WHO defines the recommended safe intake of vitamin A according to age, pregnancy and lactating categories (Laleye, Kerkadi, Wesasa, Rao and Aboubacar 2011: 370). According to Ribeiro, Araujo, de Souza, Soares, Pereira and Dimstein (2010: 154) serum retinol concentrations are mostly used to detect people that are at risk of vitamin A deficiency, and a serum retinol concentration below 0.70µmol L^{-1} is a strong indicator of hypovitamosis risk, and numerous epidemiology studies indicate that there is a greater incidence of low serum levels in pregnant and lactating women in Africa (86.6%). It is hard to meet the vitamin A requirements in developing countries, because adequate preformed vitamin A is not consumed at adequate levels, which is necessary since provitamin A has a low bioavailability due to several factors, but is the major source of vitamin A in many poor families. Sungah, Young-Nam, and Youn-Ok (2012: 45) argue that an increased consumption of fruits and vegetables is associated with a low prevalence of chronic diseases, which include cardiovascular disease.

Vitamin A deficiency is a major cause of death and disability in children and women of reproductive age in developing countries, and there are limited studies that focus on the influence of vitamin A deficiency among pregnant and lactating women compared to preschool-going children (Ribeiro *et al* 2010: 154). Wenhold, Kruger and Muehlhoff (2008: 454) state that vitamin A deficiency can result in infection, eye disease, blindness and even death, and in children vitamin A deficiency is the most serious with the occurrence of exophthalmia, which is associated with stunting and wasting, which when not addressed can have lifelong consequences, which may potentially affect quality of life during adult years. According to Kraemer *et al* (2012: 185), vitamin A deficiency affects 20 million women around the world and vitamin A supplementation has been the most adopted strategy to combat this deficiency, which has been implemented in over 80 developing countries. The importance of eradicating vitamin A deficiency stems from the seriousness of its consequences and the multiple effects it has on health, and developing countries are most affected. The major contributing factor to the low consumption of vitamin A is poor dietary intake, inadequate consumption of vitamin A rich foods, and depending on plant sources of vitamin A, which has impaired bioavailability. Studies report that there is a strong presence of vitamin A deficiency among women of child-bearing age, and in a study conducted among university students in the United Arab Emirates, 30% of women that participated in the study consumed insufficient amounts of vitamin A as indicated in self-reported food records (Laleye *et al* 2011: 370-375), and according to the WHO this is categorized as a serious problem.

- **Vitamin D (Calciferol)**

Vitamin D is made up of two closely related compounds namely vitamin D2 (ergocalciferol) and vitamin D3 (cholecalciferol) (Kaemer *et al* 2012; 186). Cholecalciferol is manufactured by the body with sufficient exposure to sunlight, but in many regions sunlight exposure is not adequate to enable the body to produce vitamin D. This is due to cultural factors and inadequate diet, and fortification of foods such as milk, oil and margarine has been proven to be effective (Laleye *et al* 2011:371). Food sources of vitamin D are limited and include fish liver oils, fatty fish and eggs from vitamin D-fed chickens. Under normal conditions, and adequate exposure to the sun, the body is able to supply the body with 80-100% of vitamin D (Qatatsheh, Tayyem, Al-Shami, Al-Holy and Al-Tetaia 2015: 68). This has led to the unacceptability of vitamin D as a true vitamin; it is considered to be a steroid hormone. Vitamin D is important in regulating the absorption of calcium and phosphorus in the intestine, maintaining bone health and immunity. Vitamin D has also been known to prevent rickets and in adults, D-hypovitaminosis is associated with oesteomalacia, which causes demineralization and structural changes in bones. According to Papandreou *et al* (2014: 2048), vitamin D deficiency is associated with related diseases such as osteoporosis and type II diabetes, and a validated food frequency questionnaire is an adequate tool to assess the vitamin D intake of healthy college students.

It is reported that there is a prevalence of vitamin D deficiency in countries such as the Middle East, and this is due to limited sun exposure (Golbahar, Al-Saffer, Diab, Al-Othman, Darwish and Al-Kafaji 2012: 732), and the prevalence of deficiency is precipitated during the winter months. Arab women and Egyptian women are reported to be more susceptible to vitamin D deficiency as a result of limited sun exposure caused by lifestyle factors (wearing a long cultural dress that covers all parts of the body, and decreased outdoor activity). Other factors include dark skin due to the skin pigment melanin, and breastfeeding without vitamin D supplementation and reduced calcium intake (Qatatsheh *et al* 2015: 69). Laleye *et al* (2011:375) reported that during a study conducted over a period of nine months among female university students in the United Arab Emirates, 37% of the students were found to be deficient in vitamin D, which is above a third of the female university population. However, sun exposure is not the only determinant of a vitamin D deficiency. This is supported by a study conducted among Jordan's female university students and employees, whose results indicated that the younger students experienced greater prevalence of vitamin D deficiency compared to the older employees, even though Jordan is a sunny country. The participants were healthy and educated although the younger students preferred to stay indoors in fear of skin cancer, and when outdoors, sunscreen was used. Furthermore, an association between a history of chronic disease and vitamin D deficiency was proven, and the prevalence of vitamin D deficiency was not affected by income level, education, region, dress style, sunscreen use, physical activity and smoking status.

Boland, Irwin and Johnson (2015: 99) reports that there is a worldwide epidemic of vitamin D deficiency, and the general public is not aware of the problem. Furthermore, vitamin D is associated with

musculoskeletal health, immune functioning, preventing and managing of cardiovascular disease and several cancers. In Canada, the most vulnerable age group for vitamin D deficiency is adults between the ages of 20 and 39 years.

It is important to remember that sufficient vitamin D intake during early years of life has been shown to prevent osteoporosis, multiple sclerosis, cardiovascular disease, rheumatoid arthritis and some types of cancer in later life (Boland, Irwin and Johnson 2015: 99). A study conducted among Canadian university students found that, generally, there was a low knowledge among students related to vitamin D and vitamin D deficiency, which was consistent with a similar study conducted among American university students. Zhu *et al* (2013: 1) reported that greater vitamin D intake has been associated with fat loss and metabolic health. In a study conducted among overweight and obese college students, results showed that supplementation of calcium and vitamin D3 for three months promoted body fat and visceral fat loss during energy restriction.

In South Africa, to our knowledge there has not been a study that attempts to determine the prevalence of vitamin D deficiency among the general population or among university students. This could be attributed to the assumption that South Africans are exposed to adequate sunlight, which makes the probability of a vitamin D deficiency minimal.

- **Vitamin E (α-Tocopherol)**

Vitamin E is a fat soluble vitamin (Major, Yu, Weinstein, Berndt, Hyland, Yeager, Chanock and Albanes 2014: 729) that is composed of four tocopherols and four tocotrienols, and when present in a particular food, vitamin E is emulsified in the stomach and small intestine. In the liver, vitamin E in the form of α-tocopherol is secreted in very low density lipoproteins (Kaemer *et al* 2012; 187). Food sources of vitamin E include vegetable oils, eggs, margarine, wheat germ, nuts, whole grains and green leafy vegetables (Dror and Allen 2011: 126), and all eight isoforms of vitamin E occur naturally in foods but in different amounts.

The main function of Vitamin E in the human body is its role as an antioxidant, but vitamin E also plays a vital role in immune function. Vitamin E deficiencies are rare, but have been associated with neurological problems when present (Kaemer *et al* 2012; 190). Symptoms of a vitamin E deficiency include peripheral neuropathy, ataxia and anemia. Wong and Lodge (2012: 1-3) indicate that α-tocopherol can impact several biological functions and metabolism, as well as play a role in glucose control. Vitamin E supplementation has been shown to influence platelet and mononuclear cell functions and decreases oxidative stress and inflammation in humans. However, when taken in high doses (>400mg/day), vitamin E supplementation can interfere with drug metabolism and increases mortality. Major *et al* (2014:729) further indicate that vitamin E also plays an important role in the regulation of cell growth and differentiation. According to Dror and Allen (2011: 124) developing countries are at higher risk of a vitamin E deficiency in relation to developed countries. Poor nutrition status and HIV infections increase the

possibility of a vitamin E deficiency, because of inadequate consumption of vitamin E rich foods, and the ability of HIV infection to increase the depletion of vitamin E in the body.

Vitamin E is a widely researched vitamin due to its anti-oxidant and non-antioxidant functions, but particularly because of the possibility of its being a cardio-protective agent (Wong and Lodge 2012: 2). Furthermore, many studies have been conducted to determine the relationship that exists between vitamin E supplementation and the impact on heart disease risk and recovery. However, McKreag, McKinley, Woodside, Harbinson and McKeown (2012: 871-873) reports that insignificant results have been observed in all studies attempting to identify the impact of vitamin E supplementation on heart disease. The researcher highlights the need for continued research. Studies that investigate the relationship between α-tocopherol and percent body fat have been conflicting; other studies, however, show a positive correlation and others no significant correlation (Mullee, Mulhern, Wallace and Strain 2012: 129). In a study conducted among normal weight and overweight/obese females between the ages of 18 and 40years, vitamin E status was shown not to be affected by increased adiposity in females with a BMI of 25-39kg/m² compared to normal female weight. Vitamin E has also been researched extensively as a chemo-preventative agent for prostate cancer in particular (Major *et al* 2014: 729-730). Research results have also been inconclusive on the impact of vitamin E supplementation of various cancers; however many studies have shown a positive impact of supplementation on prostate cancer risk, with one study conducted among smokers reporting a 32% reduction in cancer risk.

It is important to note that studies have demonstrated that men have a higher prevalence of vitamin E deficiency then women (Dror and Allen 2011: 134). In adults, insufficient vitamin E intake might be connected to the risk of heart disease, type II diabetes and certain types of cancers, therefore highlighting the important role vitamin E may play in preventing disease (Kim and Cho 2015: 192). In a study conducted among adults between the ages of 20 and 59 years in South Korea, 23% of the participants were vitamin E deficient based on α-tocopherol concentrations.

- **Vitamin K**

Vitamin K is found in in two forms; Phylloquinone (vitamin K1), the main form of vitamin K in the diet, which is found primarily in green leafy vegetables (Kaemer *et al* 2012; 187) and plant oils (Centi, Brown-Ramos, Hayowitz and Booth 2015: 42), and menaquinone (vitamin K2) is found primarily in meat, eggs, cheese (Beulens, Bots, Atsma, Bartelink, Prokop, Geleijnse, Witteman, Gobbee and van der Schouw 2008: 664), as well as fish, and fermented foods

Vitamin K deficiency is uncommon among adults (Kaemer *et al* 2012; 187); however, vitamin K plays an key role in blood clotting and current studies have associated vitamin K with brain functioning. Anta, d Gonzalez-Rodriquez, Lomban and Lopez-Sobaler (2014: 187), also highlights the benefits of vitamin K on age-dependent bone loss, on metabolism of glucose, insulin sensitivity and type II diabetes. Vitamin K also plays an important role in bone formation, according to Kim, Kim and Sohn (2010: 507). It is vital that

women in their 20's are educated on the importance of bone mineral density, and its importance in preventing osteoporosis in later years. Other studies have indicated that vitamin K has preventative effects against type II diabetes and obesity (Eun-Soo, Mi-Sung, Woo-Ri and Cheong-Min 2013: 503). Food processing can reduce vitamin K levels in food (Centi, 2015: 42). This occurs when vitamin K1 rich plant oils are hydrogenated, the vitamin K content is reduced, and the remaining vitamin K1 is transformed into dihydrophylloquinone, which is found in commercially fried and baked foods.

In a study conducted among Spanish adults between the ages of 17 to 60 years, 30.2% of the participants had a vitamin K intake that was lower than the established adequate, and vitamin K intake increased with age. The study also found that the major vitamin K food sources for the group were vegetables (45.35%), followed by fats and oils (13.28%), pulses (11.69%), meat (10.62%), cereals (5.33%) and fruits (4.6%) (Anta *et al* 2014: 188). Studies have shown a positive correlation between vitamin K intake levels and bone mineral density and a negative correlation with the prevalence of pelvic bone fractures in women (Kim, Kim and Sohn 2014: 508). In a study conducted among young Korean women in their 20's, vitamin K was appropriately consumed at an amount of 78.82µg compared to the mean AI of 65µg (Korean Dietary Reference Intakes). The study concluded that vitamin K affects inflammatory status and bone formation, and that a sufficient intake of vitamin K is required to ensure that peak bones mass is achieved in young adult women. Beulens *et al* (2008: 664) also documented the significance of vitamin K in the prevention of disease, in particular the prevention of cardiovascular disease. A study conducted among Dutch women concluded that adequate intake levels of menaquinone (K2) in particular may be useful in preventing heart disease.

2.8.3.2 WATER SOLUBLE VITAMINS

- **Thiamin (Vitamin B1)**

Thiamin is a water soluble vitamin that plays a significant part in the metabolism of carbohydrates and lipids (Kaemer *et al* 2012; 188). Thiamin is also known as vitamin B1 aneurin (Poel, Backermann and Ternes 2009: 506). In plant based foods, thiamin occurs in a free form, whereas in animal based foods, it occurs in phosphorylated forms as thiamin monophosphate, thiamin triphosphate, and thiamin triphosphate (Tiaong, Chandre-Hioe and Arcot 2015: 27). Thiamin found in food is very sensitive to pH, high temperatures and light. Dietary sources of thiamin include rice bran, baker's yeast, pork and legumes. According to Poel, Backermann and Ternes (2009: 506), in pork the most thiamin is found in the skeletal muscles, and pork has ten times more thiamin in its skeletal muscles then beef and chicken. Thiamin is absorbed in the intestine, and its highest concentrations are found in the liver, kidney, heart and brain. The main functions of vitamin B1 are to promote normal appetite, promote digestion, maintain a healthy nervous system and also prevent irritability (Elfalleh, Nasri, Hannachi, Tllili, Ying and Ferchichi 2011:374).

A thiamin deficiency stops the thiamin-dependent enzyme activity, changes the mitochondrial function and causes selective neuronal death (Bravata, Minafra, Callari, Gelfi and Grimaldi 2014: 486). Thiamin deficiency is characterized by beriberi which affects the cardiovascular system and Wernicke-Korsakoff syndrome which affects the peripheral and central nervous systems (Kaemer *et al* 2012: 188). According to Tiaong, Chandre-Hioe and Arcot (2015: 27), Australia has had the highest incidences of Wernicke-Korsakoff syndrome, which resulted in a mandatory thiamin fortification programme being introduced. Thiamin deficiency is common among alcoholics, and is often the result of inadequate dietary intake, impaired thiamin absorption in the gastrointestinal tract, and reduced liver storage. Although studies have shown inconsistent associations with heart failure and thiamin deficiency, some studies have found that heart failure does result in thiamin deficiency, and that thiamin supplementation did improve the thiamin levels of the thirty heart failure patients that participated in the study, which was the only randomized controlled placebo trial that had been published (McKreag *et al* 2012: 873).

- **Riboflavin (Vitamin B2)**

Riboflavin, also known as vitamin B2, is an orange-yellow organic compound, and unlike plants that can synthesize riboflavin, animals and humans must obtain this vitamin through the diet (Northrop-Clewes and Thurnham 2012: 224). Riboflavin is a heat-stable vitamin; however heating for long periods of time can change or destroy this vitamin. Light and oxygen can also degrade riboflavin, which is why milk packaged in glass material has been linked to riboflavin loss (Sunaric, Denic and Kocic 2012: 352). Vitamin B2 helps in the absorption of nutrients, maintains healthy skin, tongue and lips, and aids various metabolic activities (Elfalleh *at al* 2011: 374). Riboflavin also plays a vital role in energy metabolism, especially in fats, carbohydrates and proteins. According to Ashore and Saedismeolia (2014: 1985), riboflavin is also essential in antioxidant protection.

Food sources of riboflavin are milk and milk products, meat, liver, leafy vegetables, egg whites, whole grains, fortified cereals and bread (Kaemer *et al* 2012: 188). According to Sunaric, Denic and Kocic (2012: 352), dairy products are the most significant dietary sources of riboflavin, and in cow's milk, about 90% of the riboflavin is in free form. Deficiency in riboflavin is known as ariboflavinosis, and is characterized with the cracking of the skin at the corners of the mouth, a swollen red tongue, sensitivity of the eyes to light, and itching and scaling of facial skin (Northrop-Clewes and Thurnham 2012: 224). Furthermore, Vitamin B2 deficiency is common in developing countries, and its deficiency is characterized by glossititis, angular stomatitis, and dermatitis. Ashore and Saedismeolia (2014: 1985) report that incidences of riboflavin deficiency have been reported in developing countries, which include the United States of America, and the United Kingdom. A deficit in riboflavin intake or increased demand for this vitamin is seen in malnourished people, anorexics, alcoholics, vegetarians (vegans especially), the elderly and sportsmen and women (Szczuko, Seidler, Mierzwa, Stachowska and Chlubek 2011: 432).

Two studies conducted in Russia and America among students between the ages of 22 and 25 found that men had a better provision of riboflavin then women, and the provision of riboflavin was lower in black students compared to white students (Szczuko *et al* 2011: 431). This was attributed to the low intake of milk and milk products consumption among this particular race group.

- **Niacin (Vitamin B3 or Nicotinic acid)**

Niacin is a water soluble vitamin and plays a vital role in oxidation and reduction reactions of catabolic pathways (carbohydrates, proteins and lipids) and anabolic pathways (fatty acids and cholesterol synthesis) (Kaemer *et al* 2012: 188-189), and is absorbed in the stomach and intestine. Food sources of niacin are red meat, liver, fish, poultry, legumes, eggs, oil seeds, cereal grains and yeast. Niacin deficiency results in pellagra, which is characterized by dermatitis, diarrhoea and dementia, and this prompted countries such as Canada to fortify white wheat flour (Colbourne, Baker, Wang, Liu, Tucker and Rebothan 2013: 63) in order to reduce pellagra incidences. In a study conducted among the Newfoundland and Labrador adult population, results indicated that 21.9% of the participants were consuming niacin in excessive amounts, 73.6% were within the recommended range, and 4.5% were below the adequate consumption intake. The study found that more than 20% of the population was consuming a dietary intake of niacin that was more than 20% above the recommended maximum dose.

- **Vitamin B_6 (Pyridoxine)**

Vitamin B6 is important as it is involved in immune function and the formation of niacin, and plays an important role in hormone modulation (Kaemer *et al* 2012: 189). Vitamin B6 is also involved in the breakdown of proteins, lipids, and carbohydrates, as well as playing a role in immune and endocrine systems (Ahmad *et al* 2013: 1057). Vitamin B6 is available in both animal and plant sources (Kim and Cho 2014: 688). Animal sources include meats and eggs, and plant sources include beans, cereals and brown rice. Other dietary sources of vitamin B6 include soybeans, walnuts, chicken, lentils and bananas.

According to Kreamer *et al* (2012: 189), vitamin B6 deficiency is not common. Ahmad *et al* (2010:1057) further reports that symptoms associated with vitamin B6 deficiency are related to the nervous system and include hyper-irritability, impaired alertness, abnormal health movements and convulsions. Additionally, Kim and Cho (2014: 688) stated that vitamin B6 deficiency is also associated with weakness, sleeplessness and depression, and a low vitamin B6 level has also been associated with increased risk of immune deficiency, cancer, cardiovascular disease and diabetes. In a study conducted among Korean adults between the ages of 20 and 64, the dietary intake of vitamin B6 was found to be higher in this particular sample (men=2.17mg/day and women=1.84mg/day) compared to a study conducted among young Koreans where the levels were 0-987mg/day (Kim and Cho 2014:691). This study indicates that young adults would be more likely to have lower levels of vitamin B6 then older adults.

Another study conducted among pregnant women in Tokyo showed that women who had an iron deficiency and were unresponsive to iron supplementation also had a vitamin B6 deficiency (Hisano, Suzuki, Sago, Murashima and Yamaguchi 2010: 221). Researchers in the study were not able to show conclusive evidence that the vitamin B6 deficiency was as a result of iron shortages in the body, or whether this was a natural way a pregnant women responds to pregnancy. Hence this study was unable to establish a relationship between vitamin B6 deficiency and anemia. But in an older separate study, researchers were also not able to establish a relationship between vitamin B6 deficiency and postpartum anaemia (Allen and Chad 1997: 834).

- **Folic Acid (Folate, Folacin)**

Folate is a term used to refer to a family of compounds with the activity of folic acid (Kaemer *et al* 2012: 189). Folic acid is a water soluble B vitamin involved in red blood cell formation, protein synthesis and cell growth and division (Garcia-Casal *et al* 2005: 1064). Rich dietary sources of folate include liver, yeast, dark green leafy vegetable, certain fruits and legumes. Folate deficiency is characterized by megaloblastic anaemia. However, not meeting the RDAs for folate has been associated with neural tube defects in infants, which is the reason why women are encouraged to consume at least 400µg of folic acid per day (Colbourne *et al* 2013: 64). In Canada, the mandatory fortification and enrichment of white flour, pasta and cornmeal has lowered the prevalence of neural tube defects cases. Studies have determined that folic acid administration before pregnancy reduces the prevalence of neural tube defects. Folic acid deficiency may also escalate the development of cardiovascular disease and cancer. Dary (2009:235) reported that folate deficiency can also lead to high blood homocysteine levels.

In a South African study conducted among women who reside in Gauteng, 32% of the women were folate deficient during pregnancy and lactation, and among pregnant women in Limpopo province, 48% of pregnant women were folate deficient in their last trimester of pregnancy (Nsele 2014: 80). There have also been varying results on the prevalence of folic acid deficiency among adolescents and young women, with Costa Rica reporting 11.4% and 24.7% respectively, and Mexico reporting 2.3% and 5% respectively. Other similar cases have been reported in Chile, Spain, Cuba and Poland (Garcia-Casal *et al* 2005: 1068-1069). In the same regard, when folic acid levels are low, this can cause a deficiency; and likewise, a high intake of folic acid may have a negative impact on the physiological capacity to process it into biologically active folate (Dary 2009: 235).

- **Vitamin B12 (Cobalamin)**

According to Mearns, Kaziol-McLain, Obolonkin and Rush (2014: 871), maintaining a healthy supply of vitamin B_{12} in the human body is essential for normal growth, development and function. Although a deficiency is rare in most countries, in India between 40-75% of women of childbearing age have low vitamin B_{12} concentrations. Other Indian studies indicate that 75% of men and women in urban areas in India are vitamin B_{12} deficient (Samual, Duggan, Thomas, Bosch, Rajendran, Vietanen, Srinivasen and

Kurpad 2013: 114). El-Khateeb, Kahder, Batieha, Jaddou, Hyassat Belbisi and Ajlouni (2014: 102) argues that B12 deficiency is highly prevalent worldwide, especially in developing countries. There are limited studies on the prevalence of deficiency in developing countries.

Vitamin B_{12} is a vitamin associated most commonly with animal sources (meat, dairy products and eggs), hence it is more acceptable for a vegetarian population to be susceptible to a vitamin B_{12} deficiency more than omnivores and young adults (Kwak, Lee, Lee, Whang and Park 2010: 230). However, plant sources of vitamin B_{12} include soybean-fermented foods, seaweed and tea leaves, foods of animal origin and fortified cereals. A poor vitamin B_{12} level is associated with neurological conditions, depression, Alzheimer's disease and poor bone health. Maternal vitamin B_{12} deficiency is associated with metabolic and functional abnormalities which include neural tube defects in babies born to affected women (Mearns *et al* 2014: 871). Furthermore, Samual *et al* (2013: 114) report that small for gestational age, miscarriage, neural tube defects and preeclampsia may also occur as a result of low vitamin B12 intake during pregnancy.

- **Biotin**

Biotin is a water soluble vitamin that is made up of enzymes that play a key role in the metabolism of fatty acids, glucose and amino acids. Biotin deficiency is rare and it is important for adults to maintain a normal, healthy diet to avoid a deficiency. Deficiency symptoms of biotin include depression, lethargy, hallucinations, numb or tingling sensations in the arms and legs, and a scaly rash around the eyes, nose and mouth. Food sources of biotin include animal and plant sources; animal sources include chicken, eggs and milk products and plant sources include tomatoes, carrots, lettuce walnuts and berries. Biotin is also produced by the GI (gastrointestinal) bacteria (Eng, Giraud, Schlegel, Wang, Lee, and Zempleni 2013: 322-325).

- **Vitamin C**

According to Cardoso, Tomazini, Stringheta, Ribeiro and Pinheiro-Saint'Ana (2011: 411), vitamin C is one of the most important antioxidants found in fruit and vegetables. Furthermore, this particular vitamin is important in human nutrition, and in the food industry, vitamin C is used as an additive in processed foods. Scurvy is a more severe form of vitamin C deficiency, and in developed countries, scurvy is said to be endemic, and studies suggest that it might affect up to 30.5% of the population (Doll and Ricou 2013: 881). Factors that may increase the risk of scurvy include low socio-economic status, alcoholism and critical illness. Studies have shown an inverse relationship between vitamin C and breast cancer risk (Hutchinson, Rollo, Callister and Collins 2012: 561); however, there has been no conclusive evidence, with only four studies conducted, and one study showing an increase in breast cancer risk with increased intake of supplementary and dietary intake of vitamin C. Other studies have sought to establish the role vitamin C plays in reducing fatigue (Suh, Bae, Ahn, Choi, Jung and Yeom 2012: 3). In one of the studies conducted among participants with initially low levels of vitamin C, and those with higher levels, vitamin C

injections were effective in reducing fatigue more so among those with lower levels of vitamin prior to participating in the study.

Furthermore, the study found that the results were more apparent after a day, while in those participants that had lower levels of vitamin C, improvement in fatigue was observed from as little as two hours after receiving the vitamin C injections. In a Korean study, vitamin C injections improved fatigue levels among terminal cancer patients (Suh *et al* 2012: 4). Lykkesfeldt and Poulsen (2010: 1251), indicate that vitamin C supplementation can remedy diseases from colds to cancers, and literature from epidemiological studies has shown a positive relationship between vitamin C supplementation and health. However, an inverse relationship was evident between high vitamin C concentrations and CVD risk and mortality.

2.8.3.3 MICRO-MINERALS

- **Calcium**

Dietary calcium is a non-energy supplying nutrient and plays a vital role in the regulation of lipid and energy metabolism (Zhu *et al* 2013: 1). The major sources of calcium are milk and milk products and when taken in conjunction with vitamin D-rich food sources, this can positively affect calcium metabolism and bone health (Hong, Kim and Lee 2013: 409). Adolescents, young adult women and older adult women are the most susceptible to consume an inadequate calcium intake (Kim and Kim 2015: 530). In America, African American women consume the least amount of calcium, with women between the ages of 19 and 30 years consuming the least amount with the median calcium intake being approximately 675mg/day against the 1000mg/day recommended by Institute of Medicine (Douglas, Rumbak, Baric, Kovacina, Piasek and Lick 2010: 599). In Croatia, a similar trend of inadequate calcium consumption among women has been reported. Conversely, a study conducted among Croatian women found that the average calcium intake of adolescents and adult women was 1444mg/day, while the average intake of older women in the country was 900mg/day (Douglas *et al* 2010: 600), which is significantly above the recommended daily intake.

Calcium is one of the most important micronutrients in relation to bone health, and plays a very important role in minimizing age related bone loss and osteoporosis. The knowledge relating to the importance of adequate calcium intake is often low in many developing countries, and in a study conducted among Bangladesh university students enrolled in a pharmacy course, the majority of the students were aware of the importance of calcium in the human body and the dangers of osteoporosis. However, 10.7% of the students failed to mention at least one food source of calcium (Uddin, Huda, Jhanker, Jesmeen, Imam and Akter 2013: 4).

Kia, Amani and Cheraghian (2015: 225-227) indicate that calcium supplementation has been associated with decreasing symptoms of premenstrual syndrome (PMS), which include headaches, joint pain, appetite changes, and depression and sleep disorders. In a study conducted among female university

students in the University of Abadan, the risk of PMS increased by 19% with a decrease in serum calcium levels, showing the positive relationship between calcium and PMS symptomatic relief.

In Korea, 67.1% of its population fails to achieve the recommended intake level of calcium, and the consequence of this is the sharp increase of osteoporosis cases. In 2001, the medical bill associated with this deficiency was worth 72.2 billion, emphasizing the severity of the problem. Studies have shown a definite increase in bone mineral density with an increase in calcium intake, and in a study conducted among Korean adults, results showed that bone mineral density increased as the calcium intake was increased, and accordingly the risk of osteoporosis decreased (Hong, Kim and Lee 2013: 409).

The role of calcium in body weight has not been conclusive with various randomized controlled trials yielding different results. A study conducted among university students in China, however, found that students who were given a combination of calcium and vitamin D displayed a significant decrease in fat mass compared to the control group that was put on an energy restricted diet for twelve weeks. The calcium and vitamin D group also exhibited a greater reduction of visceral fat mass and visceral fat area then the control group (Zhu *et al* 2013: 2).

2.8.3.4 TRACE ELEMENTS

- **Magnesium**

Food sources of magnesium, which plays an important role in energy utilization and various nerve functions, include fruits, vegetables, cereals, nuts and dairy products (Sales 2014: 200) Epidemiological studies suggest that a magnesium deficiency is associated with atherosclerosis, hypertension, osteoporosis, diabetes and some cancers. This has led to the conclusion that magnesium deficiency is a greater nutrition problem than previously thought (Nielsen 2010: 333). In a study conducted among Spanish university students, the results showed that women were more likely to have a higher magnesium intake than men, and their activity levels increased as their magnesium intake increased (Derom, Martinez-Gonzalez, Sayon-Orea, Bes-Rastrollo, Beunza and Sanchez-Villegas 2012: 1055). Despite previous studies that have made a link between magnesium intake and depression, this study found that a higher magnesium intake was not associated with a lower depression risk. A separate study conducted among Brazilian university students found that magnesium levels were low for both men and women, and that 42% of all participants had low magnesium levels, increasing the probability of magnesium deficiency.

- **Iron**

Food sources of iron include meat, fish, poultry, eggs, peanut butter and beans. Iron deficiency anaemia results from an insufficient intake of iron, and is more common among rural women and young children. Furthermore, university students are also susceptible to micronutrient deficiencies such as iron deficiency

anaemia due to the fact that food consumed is mostly purchased on campus and is often not balanced and healthy. In a study conducted among university students in Bangladesh, 55.3% of the students were found to be anaemic, of whom 36.7% were men and 63.3% were women. The same study also found that underweight students had a higher prevalence of anaemia then those that were overweight and obese (Shill, Karmakar, Kibria, Das, Ratman, Hossain and Satter 2014: 103-105).

Beck, Conlon, Kruger, Heath, Matthys, Coad and Stonehouse (2012: 45) reported that there was a possible link between iron status and fatigue, especially among young women and, in particular, university students. This was attributed to menstrual cycles that can deplete iron stores; dietary factors such as a low intake of iron rich food sources, and balancing the pressures of studying, working part time and limited finances. However, in a study conducted among New Zealand university students with regard to fatigue levels, those with iron depletion did not vary significantly from women who were iron sufficient.

- **Iodine**

Iodine is an important mineral especially for women of childbearing age, as it plays an important role in foetal brain development. Food sources of iodine include fish, eggs, milk and dairy products. However, in research in the United Kingdom, a prevalence of iodine deficiency among school girls was observed. Additionally, iodine education is very low among pregnant women. This is supported by a study conducted among midwives in the United Kingdom that reported that 67% of the midwives interviewed indicated that iodine awareness was not emphasized during ante-natal classes compared to iron, vitamin A and folic acid (Williamson, Lean and Combet 2012: 142). A study conducted among refugees in East, North, and southern Africa also indicated that most surveyed populations consumed excessive amounts of iodine (Seal, Creeke, Gnat, Abdalla and Mirghani 2005: 37).

Iodine is important in the production of the thyroid hormones, which are important in foetal development, and a deficiency during pregnancy may lead to cretinism, which is associated with mental retardation and deafness in children. Furthermore, research suggests that women who have had adequate levels of iodine stores throughout life have a better thyroid profile during pregnancy, compared to women who began supplementation during pregnancy. This is very concerning, especially with the high rate of unplanned pregnancies, especially among young adults (Bath, Sleeth, McKenna, Walter, Taylor and Rayman 2014: 1715).

Iodine deficiency may also result in; goitre, an epidemic that was effectively eradicated in South Africa in 1995, after the iodization of salt was increased from 10-20ppm in 1954, to 40-60ppm in 1995, and resulted in a decrease in reproductive failure, and perinatal and infant mortality (Jooste and Zimmerman 2008: 8). Iodization of salt is the most effective universal strategy to eliminate iodine deficiency (Seal *et al* 2005: 36).

Iodine is a trace element that has been associated with overconsumption in countries such as Japan, but iodine deficiency is a worldwide problem. Traditional Japanese diets generally contain higher iodine due to the consumption of seaweed, with the UL for iodine set at 3000µg/day. The Japanese DRIs, are significantly higher than the 1100µg/day UL set for South Africans. However, the iodine median for Japanese youth was below the recommended values. This is attributed to the adoption of a Westernized diet, which does not include traditional ingredients like seaweed. It should therefore be expected that the future habitual intake of iodine would change in the future in most high iodine consuming countries due to a shift towards more Westernized diets (Katagiri, Asakura, Uechi, Mayayasu and Sasaki 2015: 2).

- **Zinc**

Zinc is a trace element that plays a role in human metabolism and immune function. Zinc is available in both animal (meat, poultry and seafood) and plant (grains, nuts, legumes and vegetables) sources; however, the bioavailability of zinc is higher in plant sources compared to animal sources. Vulnerable zinc deficiency groups include pregnant and lactating women, malnourished individuals, children and infants, as well as individuals suffering from eating disorders (Lokuruka 2012: 6647; Bilandzic, Sedak, Dokic, Varenina, Kolanovic, Bozic, Brstilo and Simic 2014: 62).

Zinc deficiency may result in disorders that include diarrhoea, growth retardation, weaker immunity against infection, problems affecting both the eyes and skin, and slower wound healing (Bilandzic *et al* 2014: 62). Similarly, significantly high levels of zinc may result in toxicity, which may result in changed iron function, and decreased immune function. Kim (2013: 380) reported that zinc may be important in the regulation of blood pressure. This was investigated using a sample of young obese Korean women between the ages of 19 and 28 years. The results indicated that zinc deficiency was an independent factor for elevated blood pressure in the study's sample population.

In a study conducted in Latin America and the Caribbean, only four countries (Mexico, Columbia, Ecuador and Guatemala), had national data relating to zinc adequacy (Cedial, Olivares, Brito, Cori and Romana 2015: 129). The research also reported that 56.3% of women between the ages of 12 and 49 years were deficient in zinc.

2.9 METHODS TO DETERMINE DIETARY INTAKE AND NUTRITION STATUS

2.9.1 DIETARY INTAKE

It is very difficult to obtain accurate dietary data, as much of the data is dependent on the interviewer's skill and training, and the interviewee's memory and honesty. Each type of food intake method has its own strengths and weaknesses, and it is best to use a combination of methods to ensure accuracy. After food intake data is collected, nutrient intake can be estimated using dietary analysis software (Rolfes, Pinna and Whitney 2015: 559).

- **Food frequency questionnaire (FFQ)**

The food frequency questionnaire (FFQ) is a dietary assessment tool and is used in many epidemiology studies to evaluate diet and health (Jayawardena, Swaminathan, Byrne, Soares, Katulanda and Hills 2012: 1). Cade, Thompson, Burley and Warm (2001: 567) indicates that FFQs are mostly used to obtain estimates of an individual's food intake which can help estimate the potential of the development of disease. It is important to develop a FFQ specific to the population studied as different populations consume varied diets due to cultural and regional factors. The FFQ also answers questions relating to chronic disease; however limitations to the availability of practical tools to measure dietary intake have also left questions on the effectiveness and accuracy of the FFQ (Hite 2013: 925). FFQs are popularly used in large epidemiology studies due to their low cost and because they are user-friendly, but under- and over-reporting is also common (Hite 2013: 926). FFQs are very useful in group comparison studies because they capture the habitual intake over a given period of time, and provide reasonable estimates of average energy and nutrient intake (Thedford, Archer, Sayka, Gernhofer, Peters, Gowan, Johnson and van Horn 1999: 92). According to Carter (2015: 4017), measurement error is inevitable with the use of a FFQ. This is due to the lack of accuracy in relation to portion size, limited foods list, and lack of detail when it comes to the way the food is prepared. The shortfalls of paper FFQs, which include skipped questions and multiple answers, have resulted in the increased popularity of web-based FFQs (Kristal, Kolar, Fisher, Plaskcak, Stumbo, Weiss and Paskett 2014: 614) or computer administered food frequency questionnaires, which offer solutions to problems experienced with paper based FFQs.

Many limitations have been cited with the accuracy and validity of the FFQ, nevertheless, Kristal *et al* (2014: 613) acknowledges and emphasizes the role of FFQs in:

- Measuring intake of nutrients concentrated in relatively few foods.
- In measuring aspects of food use, such as consumption of fruits and vegetables that are related to chronic disease risk, and
- They can also be used to formulate personalized feedback in clinical interventions to promote healthy eating.

- **Quantitative food frequency questionnaire (QFFQ)**

A quantitative food frequency questionnaire is a nutrition tool used to describe and assess unique diets which are population or region specific (Koladooz, Simeon, Fergusen and Sharma 2014: 1). Furthermore, QFFQs are used to identify tools and nutrients to be implemented in culturally acceptable nutrition interventions, to evaluate the effectiveness of diet interventions, and to monitor the nutrition transitions taking place in that particular population as a result of urbanization and globalization. Sheehy, Kolahdooz, Mtshali, Karmis and Sharma (2013: 448) states that a validated QFFQ can also be used to monitor diet related disease.

- **24 hour recall**

The 24 hour recall is a traditional method of dietary assessment, which can be impractical for large cohort studies, as it can be costly and requires time consuming manual nutrition coding (Carter 2015: 4017). Furthermore, multiple 24-hour recalls represent habitual dietary intake effectively and have shown less bias in the reporting of energy and protein intakes compared to FFQs. The 24 hour recall provides information on the respondent's food intake during the previous 24 hours (Thakwalakwa, Kuusipalo, Maleta, Phuka, Ashorn and Cheung 2012: 380). The questionnaire is filled in by a trained field worker, who interviews the respondent, and the respondent has to recall all foods and drinks consumed and identify the portion sizes. Like any dietary assessment tool, the 24-hour recall has several disadvantages which include the fact that this dietary assessment tool relies on the respondent's memory of consumption, estimation of portion sizes, decomposition of mixed dishes, which result in unknown recipes, and supplement use which may not be reliable and accurate (Bornhorst, Huybrechts, Ahrens, Eiben, Micheals, Pala, Molnar, Russo, Barba, Bel-Serrat, Mureno, Papoustou, Veidebaum, Loit, Lissner and Pigeot 2013: 1257).

- **Food record**

A food record is a self-report method, where a participant records all food and beverages consumed over a period of between one to seven days, and is one of the most accurate forms of self-reported nutrition analysis forms (Liberato, Bressan and Hills 2009: 621). However, a distinct disadvantage of a food record is that the responsibility for the accuracy of the recorded intake rests on the participant, which may lead to decreased accuracy. Another disadvantage is that the amount of food consumed can be estimated visually or weighed, the latter being the most accurate, but the most time consuming. Food records are used for self-monitoring and to assess dietary intake, and traditionally, this has been done in paper-based format, but according to Hutchesson, Truby, Callister, Morgan, Davis and Collens (2013: 140), when used to measure total energy expenditure, paper-based food records indicated that energy intake is under estimated by four to 37%. As a result, web-based food records are preferred as they lower participant burden, simplify the recording process, and reduce completion time. Furthermore, in the age of information technology, computers and smartphones have made self-monitoring of dietary intake more accurate, and the rate of participant adherence is also higher. A result obtained in a study conducted among young women in the University of Newcastle, Australia, to determine the most preferred self-monitoring recording form, found that 50% of the women that participated in the study preferred computer recording, 44.4% preferred the smartphone, and 5.6% preferred paper-based records. Advantages of food diaries include decreased reliance on memory for respondents, and accuracy is also improved as food recording occurs as food is consumed, and the process is very useful for controlling intake because keeping records increases awareness of food choices (Rolfes, Pinna and Whitney 2015: 559).

- **Direct observation**

This involves observing meal trays before and after eating and is normally done in residential facilities. The advantage of this method is that it does not rely on memory, it does not influence food intake, and it can be used to evaluate the acceptability of a prescribed diet. The disadvantage is that this particular method can only be used in residential situations and it is very labour intensive (Rolfes, Pinna and Whitney 2015: 559).

2.9.2 NUTRITION ASSESSMENTS

2.9.2.1 ANTHROPOMETRIC INDICATORS

According to Utkualp and Ercan (2015: 2), anthropometric measurements are important in monitoring changes occurring in human beings and enable medical professionals to establish the relationship between the human body and disease. Kiisk, Kaarma and Ots-Rosenberg (2012: 1325) further highlight the important role anthropometric measurements have in determining nutrition status, which is a very important determinant of the clinical outcome in many admitted patients, especially those suffering from diseases of lifestyle. Anthropometry is used in epidemiological studies, and clinical and population studies. The study of body composition is most important to health, and anthropometric measurements are commonly used because they are the most practical, simple, inexpensive and non-invasive. The accuracy of the measurements taken are also important, and can be considered 'precise' depending on how many times the measurements were taken by the same person on the same subject (Arroyo, Freire, Ansotegui and Rocandio 2010: 1053).

- **Body Mass Index (BMI)**

The body mass index is an index using height and weight, which is commonly used worldwide to determine the susceptibility of overweight and obesity and is considered to be the best available tool currently to monitor the development and progress in the plight of the obesity epidemic. BMI is categorized as underweight (<18.5), normal weight (18.5-24.99), overweight (25-29.99), and obese (≥30) (Hall and Cole 2006: 285).

- **$BMI = Weight(kg) \div Height(m)^2$**

According to the WHO (1995) the following guidelines are to be followed to ensure that accurate readings of weight and height are taken:

Weight

- Valid weight measurements require scales that have been carefully maintained, calibrated and checked for accuracy at regular intervals. Beam balance and electronic medical scales are the most accurate.
- Subjects must wear light clothing and shoes must be removed before weighing.
- The scale must be placed in a level, uncarpeted area.
- The scale must be switched on and the operator must wait until a zero indication (0.0) appears.
- The subject is required to step on the scale, standing upright, facing straight ahead, with arms at the sides. The feet have to be flat on the scale, with legs slightly parted. The subject has to stand still until the measurements are taken.
- It is advisable to take the average of two readings.

Height

- A stadiometer is used to measure height.
- The respondent must remove shoes, and must stand upright facing the field worker.
- The shoulders must be relaxed, with shoulders, buttocks, and heels touching each other against the wall.
- The arms must be relaxed at the sides, legs must be straight, with knees together, feet flat and heels touching.
- The respondent must look straight ahead before the headpiece is placed on the head.
- It is advisable to take the average of two readings.

Despite its worldwide use, BMI is considered a poor indicator of body fat and can result in the misclassification of individuals. This is due to the fact that BMI does not take into account individual factors that contribute to body fat, which include the individual's age, sex, bone structure, fat distribution, or muscle mass (Rothman 2008: 56). Additionally, self-reported BMI may contain errors. An increase in consumer surveys conducted over the telephone and online have resulted in the popularity of self-reported BMI measurements, which can be inaccurate (Gosse 2014: 105). Furthermore, a literature review in the area of BMI, reported an underestimation of BMI category in self-reported BMI, and more underestimation was prevalent among overweight and obese categories.

With mounting questions as to the reliability of BMI measurements continuing to be asked, Peregan (2009: 20), emphasizes the accuracy of BMI measurements taken by doctors, and in a study among primary care workers in Switzerland, the accuracy of the measurements taken (weight and height), were found to be reliable and accurate, whereas waist circumference (WC), hip circumference (HC), and weight to height ratio (WHtR) was regarded as being unsatisfactory. Only one percentage of the volunteers was misclassified with regards to BMI, whereas 6% of WC and 23% of WHtR of the volunteers were misclassified. The accuracy, however, improved with training. Gosse (2014: 106) states that accuracy of the BMI value is determined by whether or not the individual taking the measurements is trained or not, as well as whether the equipment used is calibrated.

High BMI and low BMI have been strongly associated with coronary heart disease (CHD), and data from a study conducted among adult patients in a Swedish hospital observed gender and BMI differences in the prevalence of CHD (Sandberg, Rinnstrom, Dellborg, Thilen, Sorensson, Nielson, Chrsitersson, Wadell and Johansson 2015: 220-222). The majority of the men with CHD were classified as underweight, whereas no significant correlations were determined between BMI and CHO among women. Wandell, Carlsson and Theobald (2009: 579-581) similarly found that underweight was associated with higher mortality in men, while among women, on the other hand, underweight was associated with lower mortality, with the exception of women who smoked in a cohort of Swedish adults aged 18-64 years. Peter, Mayer, Concin and Nagel (2015: 531), suggests that gender is not the only factor affecting BMI and mortality, but age also has a significant role. Data from a study conducted with an Austrian sample indicated that BMI increased with age among women, with women between the ages of 20-54 years falling within the normal weight (18.5-24.99) category and women over the age of 55 years falling within the overweight category. Among men, however, BMI increased slightly from 23.7kg/m² to 25.4kg/m² between the ages of 20-59 years, and decreased afterwards to 22.7kg/m² at the age of 80 years.

- **Waist circumference (WC)**

Waist circumference is used to assess abdominal obesity, and along with waist to height ratio (WHtR), is now thought to be more effective in predicting all-cause mortality and cardiovascular disease (CVD) risk (Lear, James, Ko and Kumanyika 2010: 42), as it establishes visceral adiposity fat. Furthermore, the central obesity cut-off points set according to the WHO, of >88cm for women and >102cm for men, are said to possibly not be appropriate for other non-European individuals, and calls to establish ethnic group specific cut-off points have been raised. When measuring, it is important to note that WC is at a level between the lower rib and iliac crest, and a non-stretchable tape is used in a horizontal position. The measuring tape needs to be held firmly, ensuring a horizontal position. The tape must be loose enough to allow the observer to place one finger between the tape and the subject's body (Rolfes, Pinna and Whitney 2015: 562).

Waist circumference, along with BMI, is used to plan appropriate interventions for patients, and is most effective due to the short time it takes to measure and little or no cost is attached to it (Verweij, Terwee, Proper, Hulshof and Mechelen 2012: 282). However, there have been studies that established that measurement error can occur, but which is reduced when measurements are taken by trained researchers and primary care workers who are trained in anthropometry. Furthermore, there are limited studies that have established the appropriate WC decrease value that makes a difference in reducing the risk of all-cause mortality and CVD risk.

The effectiveness of WC in establishing obesity is related to ectopic body fat, which is stored in the abdomen, and is associated with metabolic abnormalities (Huxley 2010: 17), and there has been a significant increase in central obesity, where BMI can be normal, while central obesity may exist. This has

become a growing trend in particular among the Asian populations, with WC central obesity cut-off points for this particular population being set at >90cm for men and >80cm for women. Stevens, Katz, and Huxley (2010: 6), also highlight that WC increases with age, and this may occur even when there is no increase in body weight; furthermore, this also concludes that ageing people may in turn be at increased risk of chronic disease if WC is not managed. In addition, this highlights the appropriateness of WC in determining mortality and morbidity as a result of obesity compared to BMI. A study conducted among Canadian adults concluded that physical inactivity increased mortality risk more compared to active adults and those with a low WC (Staiano, Reeder, Elliot, Joffres, Pahwa, Kirkland, Paradis and Katzmarzyk 2012: 1009), which emphasizes the role of exercise in reducing WC and chronic disease.

- **Waist-to-Height ratio (WHtR)**

Waist-to-height ratio is an anthropometric measurement commonly used to determine visceral fat, which is believed to be associated with cardiovascular disease and metabolic syndrome risk, and according to the World Health Organization (WHO), the WHtR cut-off point is ≥05. Visceral fat is strongly believed to be responsible for causing obesity related diseases, more so than BMI, which is commonly used by researchers and health care practitioners. In a study conducted among a section of the Japanese population, low birth weight was associated with low adult height among men and women; furthermore, low birth weight was also associated with a high adult waist-to-height ratio among non-obese women (Harada, Torii, Saruwatari, Tanaka, Kitaoka, Takaki, Aoi, Wada, Ohkubo, Miura, Watanabe and Higashi 2012: 205).

Bohr, Boardman, Dominigue and McQueen (2015: 1-4) found an inverse relationship between breastfed babies and WHtR during adulthood. This research suggests that the manner in which visceral adiposity is distributed could be affected by whether or not an individual was breastfed during infancy. Waist circumference and WHtR have been championed in establishing cardiovascular disease, more so than BMI. A study conducted among a Qatar population concluded that WC was the best predictor of metabolic syndrome in particular, followed by WHtR, with BMI being the least effective anthropometric measurement (Bener, Yousafzai, Darwish, Hamaq, Nasralla and Abdul-Ghani 2013: 6). However, the finding in the study recommended ethnic group specific cut-off points for WC, which also impacted WHtR measurements which could result in underestimation and overestimation. A conflicting report from a systemic review, however, highlighted WHtR as the most effective screening tool for cardio metabolic risk more so than WC (Ashwell, Gunn and Gibson 2012: 275). The superiority of the latter research was the inclusion of both sexes. In the prediction of type II diabetes, Xu, Qi, Darl and Xu (2013: 201) reports that all three screening tools, which include WC, WHtR, and WHR, could possibly be the best predictors compared to BMI.

- **Waist/Hip ratio (WHR)**

A waist-to-hip ratio of more than 0.9 for men and 0.8 for women is associated with increased risk of NCDs, and in particular type II diabetes (Ramadevi, Padmini and Vadlamani 2015: 10364). The use of WHR as an anthropometric screening tool for type II diabetes is beneficial due to its simplicity and cost effectiveness, and it requires personnel with less expertise. Similarly, Qiao and Nyamdorj (2010: 31) also reported the effectiveness of WHR in predicting the risk of type II diabetes; however, limitations to this particular review included the paucity of studies on the topic, and the lack of variety of ethnic groups involved in the research.

Obesity is an established risk factor for atherosclerosis and CVD (Lee, Hwang, Hong, Ryu, Seo, Kim, Kim, Choi, Baik, Choi and Yoo 2015: 323); furthermore, the WHR was found to be a superior predictor of atherosclerosis, in particular among postmenopausal women. Various anthropometric measurements were also taken into account, which included WC and BMI. A separate study, which sought to identify the most effective screening tool for chronic kidney disease, also found WHR to be the most effective, more so than systolic blood pressure, diastolic blood pressure, BMI, and WC (Tian, Zhou, Wu and Chen 2015: 111-112).

- **Mid-upper arm circumference (MUAC)**

MUAC is a cheap and a simple way to assess nutrition status, and in children, it has been found be very effective in determining mortality (Rasmussen, Anderson, Fisker, Ravn, Sodemann, Rodrigues, Benn and Aaby 2012: 998). Among women of reproductive age however, Nguyen, Ramakrishnan, Katz, Gonzalez-Caanova, Lowe, Ngyan, Pham, Truong, Nguyen and Martorell (2014: 301) states that MUAC can also be useful in predicting underweight. This was supported by a study conducted among Vietnamese women, where the overall prevalence of underweight was found to be 32% using MUAC, which was adequate based on a low misclassification rate of 16%. Mid-upper arm circumference is also an important indicator of pregnancy outcomes, for both the mother and child, and is commonly used in developing countries. This is used as an indication of the weight gained during pregnancy, since the weight before pregnancy is commonly not known in these populations. This was exemplified in a study conducted among pregnant women in Argentina, whose MUAC increased by 1.7 cm between 16 and 36 gestational weeks. It was further observed that overweight and obese women experienced a smaller MUAC compared to women of normal weight. Additionally, the study reported an apparent lower birth weight of babies in women who had lower average MUAC measurements (Lopez, Calvo, Poy, Balmaceda and Camera 2011: 253-255).

- **Head circumference (HC)**

Head circumference (HC) is one of the anthropometric measurements that is taken to monitor the cranial growth of infants and toddlers, and serves as an indication of brain development and growth. HC is used

in clinical and research settings for children and adults, and abnormal HC growth has been reported in children and adults suffering from mental conditions which include autism, schizophrenia and dementia, and from malnutrition (Sullivan, Tavassoli, Armstrong, Baron-Cohan and Humphrey 2014: 2).

2.9.2.2 BIOCHEMICAL INDICES

Biochemical indices are the most objective nutrition assessment tool; however, they are expensive, and require trained professionals to interpret the results accurately (Sanlier and Koksal 2011: 333). Laboratory analysis is used to assess vitamin and mineral profiles, metabolic complications and body composition. Commonly biochemical indices measured in nutrition therapy may include albumin, haemoglobin, serum iron, cholesterol, and triglyceride levels. Biomedical indices have been proven to be more accurate in determining conditions including obesity. Rodriguez, Fierro and Legleu (2015: 2547) reported that in a study conducted among women in Mexico to establish the relationship between anthropometric and biochemical indices, it was found that BMI alone was able to be a predictive factor in blood glucose and triglyceride concentration, which attests to the effectiveness of BMI as a tool to assess obesity.

2.9.2.3 SKINFOLD THICKNESS

Skinfold thickness (SFT) can be used to determine the prevalence of overweight and obesity, and the most commonly used instrument to measure SFT is the Harpenden skinfold caliper (Nassau, Singh, Mechelen, Brug and Chinapaw 2014: 137). Al-Bachir and Ahhmad (2016: 37) also highlighted the effectiveness of SKT in determining body fat, and areas where measurements are commonly taken are the biceps, triceps, sub-scapular and suprailiac. However, some studies are now using the Lange skinfold caliper, which is factory calibrated. Currently, SFT is commonly used in clinical and research settings, and in most cases is used in conjunction with other anthropometric measurements (Rostami, Yekta, Noormohammadpour, Farahbakhsh, Kordi and Kordi 2013: 102).

2.10 CONCLUSION

The literature reviewed in this chapter sought to establish the role of nutrition status, diet quality and factors that impact on the academic performance of university students globally. Literature established the significant impact of ‘transition’ in the lives of university students. Major changes including residential, cultural and social changes, together with dietary changes play a crucial role in the overall nutrition status of university students. A smooth transition may be associated with positive nutrition status, while an inability to adapt to new environments may be linked to the growing prevalence of obesity and associated diseases among students. Under nutrition as a result of eating disorders was also noted, with the media playing a crucial role, especially on the perception of the perfect body, and the impact this message has on the body perception of students. The increasing prevalence of non-communicable diseases among university students is also a great concern, with cardiovascular disease, type II diabetes, and certain cancers affecting more students now than before.

Poor diet quality was cited, with diets high in processed foods and sugary beverages estimated to make up the major part of student diets. As expected, the consumption of fruits and vegetables did not meet the recommended dietary intakes, while sugar, salt and saturated fats exceeded the recommended intakes. This, in conjunction with a sedentary lifestyle, amplified the obesity epidemic, which has been shown to impact academic performance.

Literature also established the high prevalence of food insecurity among university students, especially students originating from poor socio-economic backgrounds. Coping strategies reported by students, which included working more hours and making use of study loans, impacted on students' academic performance, which is associated with high dropout and throughput rates. Although limited studies reported on the impact of nutrition status and diet on academic performance, many studies made an association between diet quality and the cognitive ability of students, and more studies have found a relationship between high sugar and fat diets and poor cognitive function.

A paucity of student studies in South Africa, with particular reference to university students, is a concern, since university students fall under the majority population group in South Africa. Studies of this nature can assist the country in building intervention strategies that can address this challenge for the future of South Africa. Studies focused on establishing the factors that hinder the development and growth of this particular population and implementing corrective measures are important, as they are a good predictor of a country's future. A nation has to invest in its youth if it is to develop.

CHAPTER 3: METHODOLOGY

3.1 INTRODUCTION

The purpose of this chapter is to describe the methods involved in obtaining the socio-demographic profile, nutrition status and diet quality in relation to the academic performance of two groups of students at Mangosuthu University of Technology (MUT) i.e. First Generation (FG) students and Non-First generation (NFG) students. When choosing measuring tools it is very important to make sure that they are practical, valid and reliable. Proper planning and the selection of good research tools were critical in ensuring that good quality data was collected, and that the study objectives were met. It was also vital to consider the targeted sample population and the length of time available to complete the study when the research tools were selected. This chapter will give an overview of the necessary variables (study plan, design and data) as well as instruments used to collect the data for each specific objective. Habits learned during youth years may be carried to adulthood (Steyn 2006: 33).Therefore it is important to study the nutrition and dietary habits of young adults during this stage of their development and to determine the impact these habits have on academic performance.

Student studies play an important role, as they give insight into the future adult population and enable potential future problems to be addressed before they even present themselves. In order to meet the research objectives set out in the study the following factors had to be taken into consideration:

- Population characteristics (age, sex, motivation, type of student)
- Time frame to complete the study
- Available resources including food models and scales
- Availability of supporting data (Academic records and matric results)
- Willingness of students to participate in the study.

According to United Nations Fund Population Activities (UNFPA SA, 2014), South African youth make up the majority of the population, but there is an increasing prevalence of overweight and obesity among this group. This makes it very important to examine the magnitude of the problem by determining the nutrition status, diet quality and socio-demographics, and the possible consequences which may include the effect on academic performance.

The instruments chosen for the study included a socio-demographic questionnaire, three 24-hour recall questionnaires, a food frequency questionnaire, anthropometric measurements, matric and first year academic results.

3.2 PERMISSION AND CONSENT

Before the commencement of the study, the research proposal was submitted and approved by the Faculty of Applied Sciences Faculty Research Committee (FRC) and the Institutional Research Ethics Committee (IREC) at the Durban University of Technology in September 2014 (IREC-066/14-Annexure A). The study was also approved by the Mangosuthu University of Technology (MUT) ethics committee, as well as the Faculty of Natural Science Research Advisory Board (Annexure B) at MUT. Participation was voluntary and all participants were required to sign a consent form (Annexure C). Participants were assigned a participation number to ensure confidentiality and anonymity.

Students that participated in the study were given an information letter (Annexure D) stating the purpose of conducting the study as well as the expectations of participating in the study. The respondents were assured that they could withdraw from the study at any stage without penalties, and that personal information would be kept confidential and only the researcher and the supervisor would have access to this information. The researcher followed the Human Sciences Research Council (HSRC) ethical guidelines for research on human beings throughout the study.

Personal information of the participants will be stored at the Department of Food and Nutrition: Consumer Science in a locked cupboard for a period of 5 years. After this period, it will be disposed of by shredding. Electronic information and data will be password protected and deleted after five years.

3.3. STUDY DESIGN

An empirical study design was used to obtain the data, and consists of five stages, namely:

STAGE 1 - LITERATURE REVIEW

This stage involves collecting all the appropriate studies and data relevant to the study.

- Scientific journals and websites, and MUT student admissions department policy were used to obtain the information.
- Central Application Office (CAO) matriculation grading system for effective assessment of matriculation status (CAO handbook 2015). This was done to ensure that conducting the study would be justifiable.

STAGE 2 - PLANNING AND STUDY DESIGN

During the planning stage, the following activities took place:

- Writing and submission of the Research Proposal for approval by the DUT Faculty Research Committee (FRC)

- Submission of the Research Proposal at the Institutional Research Ethics Committee (IREC)
- Presentation of the Research Proposal to the MUT Ethics Committee
- Submission of the Research Proposal at the Natural Sciences Faculty Research Advisory Board (MUT)

STAGE 3 - STAKEHOLDER CONSULTATION AND PLAN IMPLEMENTATION

- Meeting with the MUT Student Representatives Council (SRC), to explain the intent of conducting the study involving students at MUT, and the impact the study would have on the students
- Meeting with MUT Department of Marketing and Communications (MARCOMS) to explain the intent of conducting the study within MUT premises, and requesting support in building awareness so that a large pool of students could be selected.
- Meeting with the MUT Registrar with the intention of obtaining the academic records of students involved in the study.

MUT is made up of three Faculties: Faculty of Engineering, Faculty of Management Sciences and Faculty of Natural Sciences. The Faculty of Natural Sciences (FNS) is located across the road from the University's main campus, and many scientific activities are conducted there, including agricultural, nature conservation and biomedical technology. It was very important to ensure that all students enrolled at MUT had an opportunity to participate in the study and in order to achieve this, the students from the Faculty of Natural Sciences had to be involved. This was essential because students within the field of mathematics and science, which are scarce skills, are needed by the country and needed to be included in this scientific study. Data collecting took place on the main campus as well as on the Faculty of Natural Sciences campus.

STAGE 4 - ROLL OUT OF STUDY

The study was conducted during two weeks in October 2014.

STAGE 5 - REPORTING ON RESULTS

The results and discussions will be reported in detail in Chapter 4.

3.4 STUDY TYPE

The study was descriptive in nature with a cross-sectional design. Cross sectional approach is appropriate for this particular study as the elected sample group's university students will be studied once, and an attempt to establish a relationship between the diet, nutritional status and academic performance will be defined without taking into account changes that may occur over time(Levin 2006: 24), This study design is used when the aim of the study is descriptive (i.e survey), which was the case in

this particular study. Furthermore, cross sectional studies are very effective in studies which sought to establish associations between multiple risk factors and multiple outcome variables in a population, which is very relevant for this particular study(Joubert and Ehrlich 2007: 87).

A quantitative research approach was implemented using questionnaires during interviews.The quantitative research approached was selected as the most appropriate for this particular study, as the structure of the study was focused on establishing measurable and obtaining statistical data, which would not be effective with a qualitative research approach. Furthermore, since structured methods of collecting data are used to collect data, the results can be documented in the form of graphs and tables, which is an effective way to prove or dispel a proposed assumption that diet and nutritional status may impact students' academic performance (Creswell 2014: 4-13).

The anthropometric measurements and interviews were conducted in hallways near lecture halls to ensure that students were easily approached. Anthropometric measurements were first taken in a screened-off area, followed by interviews. To express gratitude for the students' participation in the study, energy bars were handed out and were intended to be consumed as a snack during the interviews. Interviews were 30–40 minutes per participant. Data recorded was checked daily to ensure that full databases were obtained for every participant, and if any incomplete questionnaires were identified the researcher could approach the students again the following day. Data was collected from 270 students who met the inclusion and exclusion criteria.

3.5 STUDY VARIABLES

Numerous questionnaires were used to measure a range of variables. Variables that were measured in the study included: gender, age, living conditions, anthropometric measurements, dietary intake and food diversity. Academic records and matric results were also analyzed.

3.6 SAMPLING STRATEGY

The study focused solely on second year students registered at the Mangosuthu University of Technology. The sample included an equal number of first generation (FG) and non-first generation (NFG) students, in order to get accurate information differentiating the two groups. The students were approached individually and in groups, and briefly informed about the study. Once students showed interest in participating in the study, they were asked if they were second year students (this was proved by the student's number, which indicates the year of first enrolment into the university), and were further requested to declare whether they were first generation or non-first generation students. The interested students were then given the relevant files with the appropriate file numbers and group code upon registration with the researcher (01-FG, for first generation students, and 01-NFG for non-first generation students). The researcher explained the purpose and objectives of the study to students individually, and once understood the student signed the consent form and was given a copy of the information letter (Annexure C). The student participant number was updated on an Excel spreadsheet, which was developed to track the progress of the field work. The spreadsheet also assisted the researcher in identifying which group (either first generation or non-first generation) was not reaching the projected sample size. Although each file had a participant number and group name (EG. 01-FG), additionally, each

questionnaire in the file was also marked with the same code. This was done to avoid questionnaires being mixed up with questionnaires from other files. The consent form was updated and signed with a black pen, while the questionnaires were completed in pencil. This was done to enable the fieldworkers to erase any information if the participants made errors, and to ensure that the writing was clear and easily interpreted during the data capturing stage.

Anthropometric measurements were taken first by the researcher to ensure accuracy, and the interviews which were conducted by the fieldworkers followed. Data was collected during a period of four days; however, the fourth day was used to reach the desirable sample size for non-first generation students, as it was difficult recruiting this particular group of students. Although the sample size for this study was 260 participants (130 FG and 130 NFG students), 270 students were recruited to account for the possibility of incomplete questionnaires. Many students declined to participate in the study when approached. The main reasons students cited for not wanting to participate in the study was the length of time required to complete all the questionnaires. This was attributed to the fact that students had to participate in the study between class periods and during forum periods (held every Tuesday) and the gaps were not very long, especially for students moving from the Faculty of Natural Sciences to main campus. The students were not able to wait while the field workers completed interviewing the other participants, and as a result many questionnaires were left incomplete. Other restrictions included that students did not have proper sitting space within the campus where they are able to socialize sitting down. They usually stand in open spaces, which hinders their ability to effectively engage for long periods. The researcher checked the questionnaires for completeness daily, and mistakes made by field workers were addressed the following day in a meeting held before the field work commenced. Some students were uncomfortable taking off some of their heavy clothing items, especially takkies and closed shoes for anthropometric measurements. The importance of this was explained to the students and no student was allowed to participate if they were not willing to take off their shoes and heavy clothes. This was done to ensure uniformity and accuracy of the results. Students were approached continuously to ensure the recruitment process was met to achieve the full sample size

The sample size was calculated using the power calculation indicating that 260 participants would present a reliable sample (Cole 1997: 80-84), 95% confidence level. The sample was rounded off to 270 to account for possible dropouts. This is based on the total population of registered Mangosuthu University of Technology students which is 10 000 students according to the university's registrar.

Sample size

$$Ss = \frac{Z^2 * (p) * (1-p)}{c^2}$$

Where

Z=Z value (e.g. 1.96 for 95%confidence level)

p=percentage picking a choice, expressed as decimal

(5 used for sample size needed)

c=confidence level, expressed as a decimal =.06 (three units on both sides of the normal).

The sample was defined as adults aged 18-30 years. The respondents had to be second year MUT students enrolled on a full time basis.

The community was selected using a geographic location as it is a university in a township, where first generation students are most likely to attend. Men and women students were included in the study in order to give more students the opportunity to participate in the research, increasing the validity of the study.

The following were used as the exclusion and inclusion criteria:

Exclusion criteria:

- Students not registered at the university.
- Students under the age of 18 years, and those over 30 years old.
- Students studying nutrition as a course subject.
- Members of the academic staff of the university.
- First year students, third year students and part time students.

Inclusion criteria:

- First and non-first generation students.
- Students registered on a full time basis at MUT.
- Students that are between the ages of 18-30 years.
- Students that are not registered for a course with nutrition and dietetics as a subject.
- Second year students.

Purposive-quota sampling was conducted in the study, which is a mixed sampling method. Purposive or convienece sampling is a widely used samplying method, and participants are usually chosen as they happen to be at the right place at the right time, provided the inclusion criteria is met. In this particular study, While quota sampling is an example of non-probablity sampling, where the probability of a participant to be chosen is unknown, and this form of sampling is usually conducted to ensure that certain charaterictics of a population sample will be represented axactly as the researcher desires, in which case, for this particular study, to ensure that an equal number FG and NFG students participate in the study. The advanatages of this type of mixed method sampling is that it ensures that the study aims, which is to compare FG and NFG students are met. Furthermore, both purposive and quota sampling are commonly used and less expensive (Creswell and Tashakkori 2007: 177-178; Teddlie and Yu 2007: 80-81; Acharya, Prakash, Saxena, and Nigam 2013:332).

Firstly, the students were grouped into two categories, first generation, and non-first generation. Secondly, the required sample size was determined at 260 (although 270 students were approached to account for incomplete questionnaires). Proportional quota was established to differentiate between the students group categories (FG and NFG); however, non-proportional quotas were established for gender (unequal proportions of men and female were accepted, e.g. 55% men and 45% women). Purposive sampling method was implemented. On the third day of the field work session, the required number of non-first generation students was reached. On the fourth day, a quota sampling strategy was implemented to ensure that the required sample of first generation students was also reached. The students were approached and asked whether they were FG or NFG students. Only FG students were allowed to participate in the study to ensure that the required sample size for this group was reached. The process was repeated until the required sample size was achieved.

This strategy ensured that all MUT students were given an equal chance to participate in the study, except for the fourth day when only FG students were allowed to participate.

3.7 RESPONSIBILITY OF THE FIELD WORKERS

Thirteen field workers were recruited from 3rd year students enrolled at the Department of Community Extension at Mangosuthu University of Technology. All the field workers attended a field worker training workshop which was one day long. The field workers were all given a training manual (Annexure E), which they were able to refer back to if the need arose during the field work. The workshop was conducted in English and the training manual was written in English. Although the questionnaires were written in English, all the fieldworkers spoke isiZulu, and were further trained to communicate in isiZulu effectively, so that if the need arose, they could interview the students in isiZulu. This was done to eliminate any language barriers. Field worker training included training on using food models to estimate food portion sizes to complete the 24 hour recall questionnaires, food frequency questionnaires and socio-demographic questionnaires. The field workers were also advised to start with questionnaires that

required concentration and memory (24 hour recall questionnaire), as well as questionnaires that required a lot of time to complete (socio-demographic questionnaire). Role-play technique was used to train and assess the competency of the field workers. Role-play was used to estimate the time each questionnaire would require to be completed by each participant. The estimated time was then used to determine how much time the student would need to participate in the study. Key qualities such as patience, friendliness and accuracy were emphasized during training, as field workers would be dealing with their peers, and so they had to demonstrate good interpersonal skills and professionalism. The field workers were also required to encourage the respondents to be as accurate as possible when answering the questions. The importance and significance of conducting such a study was explained to the field workers, as well as the objectives. This was aimed at showing the fieldworkers the importance in collecting accurate and valid data, and to emphasize the key role that field workers have in the study.

The researcher organized daily meetings before the field work resumed to correct any mistakes picked up in the previous day's questionnaires, and to discuss possible ideas and strategies to ensure the effectiveness of the field work. The field workers were also encouraged to identify possible challenges that they were facing daily, and the researcher and fellow field workers proposed relevant solutions. The best solution was chosen and used as a basis for all field workers who faced that particular challenge. The field work was conducted over a period of four days, and punctuality was highlighted and tracked with the aid of an attendance register. Each field worker signed in and out daily and this was done to ensure that the fieldwork was completed within the set time frame.

3.8 ADMINISTRATION OF MEASURING INSTRUMENTS

Various questionnaires were used as measuring instruments to measure variables in the study. Socio-demographic status, dietary intake, anthropometric data and academic results were collected during the field work stage. All the questionnaires were checked for accuracy and completeness daily.

3.8.1 SOCIO-DEMOGRAPHIC QUESTIONNAIRE

A valid English socio-demographic questionnaire developed by Napier (2013) was adapted for the university students and used to measure each participant's socio-economic profile. The questionnaire was divided into categories which included accommodation and family composition, work status, education and language, and assets (Annexure F). The questionnaire took about 10-15 minutes to complete, and 270 questionnaires were completed in an interview situation by trained field workers. The socio-demographic questionnaire took the most time to complete due to the length and the complexity of the questions.

3.8.2 ANTHROPOMETRIC MEASUREMENTS

Anthropometric measurements included weight, height, BMI and waist circumference. All the measurements were recorded on one form (Annexure G).

- Weight

All participants were weighed using a calibrated electronic medical scale (MDW-250L Digital Physicians Scale). The scale was placed on a level, uncarpeted surface. The scale was switched on and the field workers waited until the zero indication (0.00) appeared on the display panel. Two measurements were taken and rounded off to one decimal place in kilograms (kg). Each participant was asked to step on the scale standing upright on the middle of the scale, facing straight ahead with feet flat and slightly apart. The participant was required to stand still until the measurements were recorded. The participant then stepped off the scale and the process was repeated for the second recording. The average of the two measurements was taken as the actual weight measurement. The researcher was responsible for weighing all the participants to ensure accuracy and validity of the measurements. All the participants were required to take off shoes, socks and any heavy clothing items which included heavy jackets and jewellery. Heavy objects such as wallets and keys were removed from the pockets to ensure the accuracy of the measurements. Students were also requested to leave their bags and laptop bags on the researcher's table while the measurements were being taken. This was done to minimize theft. Participants that refused to adhere to these instructions were not allowed to participate in the study.

- Height

The participant's height was measured using the built-in stadiometer on the medical scale (MDW-250L Digital Physicians Scale), which has a built-in stadiometer. After their weight was measured, the participant remained in the same position on the medical scale. The participant was then asked to face the researcher who was responsible for measuring all the participants. The participant's shoulders were relaxed, the arms were relaxed and held at their sides, legs were straight with knees together, and feet were flat with the heels touching each other. The participant had to maintain in that position before the headpiece was placed on their head. The headpiece was placed on the centre of the crown of the head. Two measurements were taken and recorded on a form (Annexure G) in Meters (m).

- Waist Circumference

A non-stretchable measuring tape was used to measure the participant's waist circumference. The measurement was taken in the area between the lower rib and the iliac crest. The tape was held firm, and allowed one finger to be placed between the tape and the participant's body. The measurements were taken twice in a horizontal position. The measurements were in centimetres (cm), and recorded to one decimal place (Annexure G) on the form.

The participants were asked to stand with their feet close together to ensure that their weight was evenly distributed, and were asked to breathe normally to ensure accurate measurements were taken. Heavy clothing including jackets and large waist belts were removed. Waist circumference is an important indicator in identifying risk for cardiovascular disease (Abreu, Santos, Moreira, Santos and Mota 2015:1834).

3.8.3 DIETARY INTAKE

Each respondent was required to complete three 24 hour recall questionnaires and one food frequency questionnaire.

- 24 hour recall questionnaire

A structured and valid 24 hour recall questionnaire was used to establish the normal daily eating patterns of the respondents (Annexure H). The 24 hour recall questionnaire is a commonly used dietary assessment tool that can be used as an assessment tool for intervention studies and can also be used to validate other diet assessment tools (e.g FFQ). Yunsheng, Olendzki, Pagoto, Hurley, Magner, Ockene, Schneider, Merriam, and Hebert 2009: 554-558) suggest the use of three 24 hour recalls to minimize over and under reporting of nutrient values.

A total of three 24 hour recall questionnaires were used for each respondent (two consecutive week days, and one weekend day (Sunday).The questionnaires were conducted by the field workers in an interview situation. Food models were used by field workers to assist the participants in estimating the portion size and helped the field worker to identify and describe food items to the participants. The food models also helped in reducing the amount of time spent completing the questionnaires and increased the reliability of the answers given by the participants. The 24 hour recall questionnaires took a total of 15-20 minutes to complete. Even though this questionnaire is relatively short, it took the longest time to complete due to the participants' inability to timeously recall what they had eaten 2 days before. Field workers were also discouraged from suggesting the possible foods eaten by the participants to jog their memory. This was done to ensure that the information given by the participants was as accurate as possible.

- Food Frequency questionnaire (FFQ)

The FFQ questionnaire was used to determine the dietary diversity by establishing the food variety consumed by the respondents. This particular questionnaire was used because it is relatively quick to administer, inexpensive and relatively accurate (Walsh and Joubert 2007: 294). Streppel, De Vries, Meijboom, Beekman, De Craen, Slagboom, and Feskens (2013: 7) indicated that a FFQ is an acceptable tool to measure and rank food intake, and Carithers, Talegawkar, Rowser, Henry, Dubbert, Bogle, Taylor and Tucker (2009: 118) further support this by reporting that the FFQ is a valid instrument especially

when establishing a relationship between diet and another variable (e.g cardio vascular health), and was also deemed as a culturally sensitive instrument.

The foods were grouped into nine groups according to FAO (2011) nine nutritious food groups. The questionnaire was used to determine the foods consumed by the respondent during a period of a week. The FFQ was adapted for this particular target group by having a focus group discussion with a group of ten randomly selected students not involved in the study, in order to identify the different foods commonly consumed by students. The adapted questionnaire was then used (Annexure I). A total of 270 questionnaires were completed by trained field workers in an interview situation, and it took approximately five minutes to complete each questionnaire.

3.8.4 ACADEMIC RESULTS

The participants' matric results and first year academic records were obtained with permission from the MUT Registrar, and the students' admissions and examinations departments.

- Matric results

Matric results were obtained from the MUT Admissions department. Once all the students consented to participate in the study, the institution's Business Analyst created a specialized report which included six subjects, namely, two languages and four compulsory subjects. Additional subjects were excluded. Life Orientation was also excluded from the report because this subject was common to all the participants. The report was obtained in Microsoft Excel format, with subject results and an overall academic average rating for each participant. The Department of Education's (DoE) current rating system of using numbers 1–7 as a tool to measure the academic performance of matriculants was used (Table 3.1), where 7 indicates outstanding performance and 1 indicates no achievement.

Table 3.1: The DoE's Matric Results Rating Codes (DoE, 2015)

RATING CODE	% LIMITS	COMPETENCE
7	80-100	Outstanding Achievement
6	70-79	Meritorious Achievement
5	60-69	Substantial Achievement
4	50-59	Adequate Achievement
3	40-49	Moderate Achievement
2	30-39	Elementary Achievement
1	0-29	No Achievement

However, some students completed matric prior to the current coding system, which changed in 2008 (DoE, 2015). These students' matric results were represented alphabetically (A–G). In order for the results to be associated accurately, the same coding system had to be used. Therefore the older results represented alphabetically were converted to the current number coding system as in the table below

(Table 3.2). An overall average matric result was used as an indicator of academic performance for each student.

Table 3.2: Representation of the old rating codes and equivalent current rating codes (DoE, 2015)

RATING CODE	% LIMITS	COMPETENCE	RATING SCORE
A	80-100	Outstanding Achievement	7
B	70-79	Meritorious Achievement	6
C	60-69	Substantial Achievement	5
D	50-59	Adequate Achievement	4
E	40-49	Moderate Achievement	3
F	33.39	Elementary Achievement	2
FF	30-33	No Achievement	2
G	25-29	No Achievement	1
GG	20-24	No Achievement	1
H	0-19	No Achievement	1

- First year Academic Results

The first year academic records were obtained from the examinations department at MUT after consent was received from the students. The results were obtained in printed format, and all the students' personal details including student number, identity number and address had to be removed for ethical reasons. Each student was assigned a participation number for identification.

The academic records gave the students' results as a percentage, therefore this had to be changed to the number rating code (matric results). This was done to enable the researcher to compare the matric results and the first year academic results. The results included all subjects registered for the year for annual and semester students. In the case of semester students, both the first and second semester results were included.

The results were converted as follows:

• Results were converted per subject; if a participant obtained a percentage for a particular subject, that subject was assigned a number ranging from 1–7 according to the result (e.g. 75% = 6), using the rating codes in table 3.1.

• Once all the subjects were assigned a number ranging from 1–7 as per the result, an average figure was calculated. The maximum result being 7 (80%–100%) for outstanding performance, and the minimum being 1 (0%–29%) for no achievement, using the rating codes indicated in table 3.1.

3.9 STATISTICAL ANAYSIS OF DATA

Although 270 participants were interviewed, 10 participants' files were deemed not to be complete data bases and were therefore excluded.

3.9.1 SOCIO-DEMOGRAPHIC QUESTIONNAIRE

The questionnaires were checked daily after fieldwork for completeness and accuracy by the researcher and (n=260) were used. The data from the completed questionnaires was captured onto an Excel®2010 spreadsheet by the researcher and analyzed using Statistical Package for Social Sciences® (SPSS) software for Windows Version 21.0. Descriptive statistics were determined with the assistance of a statistician to indicate frequencies for the different variables. The data was presented in the form of tables, graphs, frequencies and percentages.

3.9.2 ANTHROPOMETRIC MEASUREMENTS

The average weight and height measurements of the respondents (n=260) were captured onto a Microsoft Excel spreadsheet, and used to classify and determine the body mass index (BMI), and waist to height ratio (WHtR). Two measurements were used to calculate the BMI using the formula: BMI=Weight /height². The BMI cut-off points were as follows: [normal weight (BMI=18.5-24.9, overweight (BMI=25-29.9), obese 1(BMI=>30), obese 2 (BMI=>35), and obese 3 (BMI=>40)] (WHO, 2000).The average waist circumference cut-off point for men (≥102cm) and women (≥88cm) (WHO, 2000) for each participant was also captured on a Microsoft Excel spreadsheet. The WHtR was determined using the average height and average waist circumference calculations for each participant, and 0.5 as cut-off points (Abreu *et al* 2015:1834).

3.9.3 DIETARY INTAKE

The food consumption data from the 24 hour recall questionnaires were analyzed using the Food Finder® version 3 computer programme and the results were compared to the Daily Recommended Intakes (DRIs) (IOM, 2006) for the relevant age groups. The data obtained from the FFQ was captured onto a Microsoft Excel® spreadsheet, and analyzed using an SPSS version 21.0 software programme to determine the food group diversity (FGDS), food variety scores (FVS) and mean scores for the food groups. The scores were calculated over a reference period of seven days for this particular study. Cut-off points were categorized as follows:

- Low = 0-3 food groups or < 30 individual foods
- Medium = 4-5 food groups or 30-60 individual foods
- High = 6-9 food groups or > 60 individual foods (Matla 2008: 523)

The FFQ also served a crucial role in terms of validating the results obtained from the 24 hour recall. Descriptive statistics which include the means, standard deviations, frequencies and confidence levels were established and presented in the form of tables and graphs.

3.9.4 ACADEMIC RESULTS

The matric results and first year academic results were captured on Excel® and analyzed using the SPSS® software version 21.0 to obtain descriptive statistics, and presented in tables and graphs.

3.10 CORRELATIONS

Sample *t*-tests and Pearson correlations were conducted using SPSS version 21.0 software programmes to determine whether a statistical significance existed between the two groups of students using various variables described in the results chapter (Table 3.3). A $p<0.05$ was used as an indication of statistical significance, and $p<0.001$ indicated a strong significance.

Table 3.3: Various correlations conducted between FG and NFG student groups.

Variables	Group
BMI	FG - NFG men
BMI	FG - NFG women
BMI	FG men and women
BMI	NFG men and women
WHtR	FG men and women
WHtR	NFG men and women
Food variety score (FVS)	FG men and women
Food variety score (FVS)	NFG men and women
BMI and energy	FG men
BMI and energy	NFG men
BMI and energy	FG women
BMI and energy	NFG women
BMI Carbohydrates	FG men
BMI Carbohydrates	NFG men
BMI Carbohydrates	FG women
BMI Carbohydrates	NFG women
FVS and BMI	FG women
FVS and BMI	NFG women
FVS and BMI	FG men
FVS and BMI	NFG men
Calcium intake	FG - NFG men
Calcium intake	FG - NFG women
Iron intake	FG - NFG men

Iron intake	FG - NFG women
Zinc intake	FG - NFG men
Zinc intake	FG - NFG women
Academic and matric results	FG men and women
Academic and matric results	NFG men and women
Matric results and money spent on food	FG men and women
Matric results and money spent on food	NFG men and women
First year results and money spent on food	FG men and women
First year results and money spent on food	NFG men and women
No money to spend on food and first year results	FG men and women
No money to spend on food and first year results	NFG men and women
Total monthly income and first year results	FG men and women
Total monthly income and first year results	NFG men and women
BMI and first year results	FG men
BMI and first year results	FG women
BMI and first year results	NFG men
BMI and first year results	NFG women
BMI and matric results	FG men
BMI and matric results	FG women
BMI and matric results	NFG men
BMI and matric results	NFG women
WHtR and first year results	FG men
WHtR and matric results	FG men
WHtR and first year results	NFG men
WHtR and matric results	NFG men
WHtR and first year results	FG women
WHtR and matric results	FG women
WHtR and first year results	NFG women
WHtR and matric results	NFG women
Energy and WHtR	NFG men
Energy and WHtR	NFG men
Energy and WHtR	FG women
Energy and WHtR	NFG women

3.11 CONCLUSION

This chapter included all the instruments and tools used to determine the socio-economic profile, the diet quality, nutrition status and the academic performance of the two groups of university students included in the study. The instruments selected are appropriate in order to achieve the objectives set out for the study. The results of the data collected in this chapter will be interpreted and discussed in chapter four.

CHAPTER FOUR - RESULTS AND DISCUSSION

4. INTRODUCTION

The purpose of this study was to investigate the socio-demographic profile and nutrition status relating to the academic performance of first generation and non-first generation students within a university in Durban, Kwa-Zulu Natal.

This chapter will focus on presenting, discussing and correlating the results obtained in the study. The outcomes of the study include the socio-demographic factors, anthropometric results, dietary intake and academic results. A total of 260 students participated in the study, of which 130 students were first generation, and 130 were non-first generation. The response percentage was 100% for the sample.

4.1 SOCIO-DEMOGRAPHICS RESULTS

The socio-demographic results of the study population included the full sample of the first generation group (FG) and the non-first generation group (NFG) in percentages in the following categories:

- Sample size and group distribution
- Accommodation
- Work status and income
- Food security
- Level of education, language, and children
- Food preparation and consumption
- Household assets.

4.1.1 SAMPLE SIZE AND GROUP DISTRIBUTION

According to figure 4.1, women made up the majority of respondents from both the FG and NFG groups (63%, n=164), while only 37% (n= 96) of the respondents were men. The group with the least percentage of respondents was the NFG men (17%, n=44), and the group with the majority of respondents was the NFG women with 33%. All the participants in the study were black, which is inclusive of all groups.

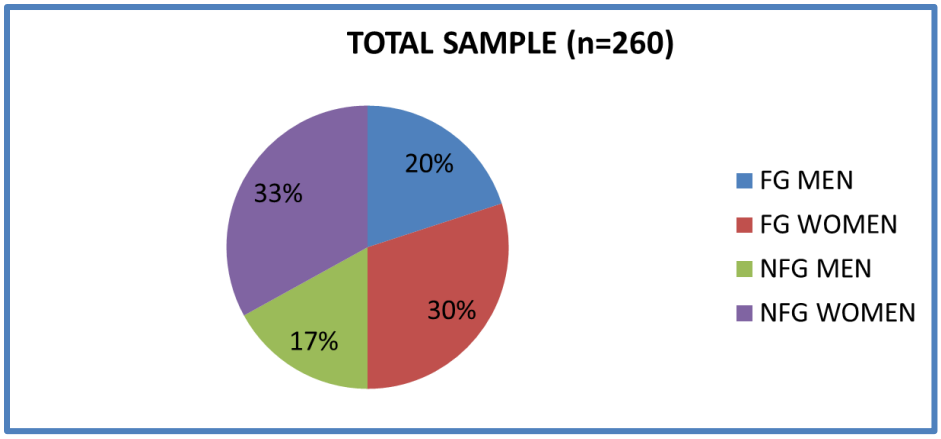

Figure 4.1: Sample distributions according to group and gender

4.1.2 ACCOMMODATION

Table 4.1 illustrates that although the majority of the respondents in both the groups lived in a township, the highest number that lived in a township were FG students. The number of respondents that lived in a rural village was greater for the FG group (17%; n=23) compared to NFG (9.2%; n=12), while the number of respondents living in a town or city was greater for the NFG (20%; n=26) compared to the FG group (11.5%; n=15).

In both groups, the majority of the respondents resided in students' residences while studying, however, the percentage of NFG respondents living in student residences was greater (81.5%; n=106), compared to FG respondents (76.8%; n=100). More FG respondents (6.2%; n=8) rented a house or flat (see Table 4.1) compared to NFG respondents (1.5%; n=2).

Table 4.1: Home area type and accommodation while studying

	First generation		Non-first generation	
Variables	%	(n=130)	%	(n=130)
Home area type				
Town or city	11.5	15	20	26
Informal settlement	2.3	3	3.8	5
Rural village	17.7	23	9.2	12
Hostel	4.6	6	6.2	8
Township	63.1	82	59.2	77
Suburb	0.8	1	1.6	2
Accommodation while studying				
Home	16.2	21	15.4	20
Living with relatives	0	0	0.8	1
Student residence	76.8	100	81.5	106
Squatter home	0.8	1	0.8	1
Rented house/flat	6.2	8	1.5	2

Table 4.2 shows that for both the FG and NFG groups, the household size of between one to five was the most common with 60.8% (n=79) and 54.6% (n=71) respectively. The FG group had a greater household size of more than ten (3.1%; n=4), compared to the NFG group (0.8%; n=1). The majority of respondents in both groups lived in brick houses, while the majority of the FG respondents (40%; n=52) lived in a house with three to four rooms and the majority of the NFG respondents (44.6%; n=58) lived in houses which had five or more rooms.

Table 4.2: Family size, type of house and number of rooms per household

	First generation		Non-first generation	
Variables	%	(n=130)	%	(n=130)
Household size				
One – Five	60.8	79	54.6	71
Six – Ten	36.1	47	44.6	58
Above Ten	3.1	4	0.8	1
Type of house				
Brick	96.2	125	96.9	126
Clay	0.8	1	0	0
Grass	1.5	2	0.8	1
Wood	1.5	2	0	0
Zinc/Shack	0	0	2.3	3
Number of rooms				
1 – 2 Rooms	38.5	50	17.7	23
3 – 4 Rooms	40	52	37.7	49
≥5 Rooms	21.5	28	44.6	58

According to Table 4.3, 88.5% (n=115) of the FG respondents had a tap in the house compared to 85.4% (n=111) of NFG respondents, and more NFG respondents (3.8%; n=5) sourced water from a borehole with none of the FG respondents doing so. The percentage (4.6%; n=6) of NFG respondents that had no access to a toilet facility was greater compared to 2.3% (n=3) of FG respondents. The number of respondents with a flush toilet was 96.2% (n=125) for the FG respondents and 91.5% (n=119) for the NFG respondents. The majority of the respondents in both groups had access to electricity and also had access to waste collection services.

Table 4.3: Access to water, toilet, waste removal, and electricity

	First generation		Non first generation	
Variables	%	(n=130)	%	(n=130)
Water Supply				
Tap in the House	**88.5**	**115**	**85.4**	**111**
Tap outside the House	11.5	15	10.8	14
Borehole	0	0	3.8	5
Toilet Facility				
None	2.3	3	4.6	6
Pit Latrine	1.5	2	3.8	5
Flush/Sewerage	**96.2**	**125**	**91.5**	**119**
Waste Removal				
Waste collected	**98.5**	**128**	**99.2**	**129**
Waste not collected	1.5	2	0.8	1
Electricity				
Electricity	**96.9**	**126**	**100**	**130**
No Electricity	3.1	4	0	0

Figure 4.2 illustrates that coakroaches were the most prevalent pest for both the FG (73.8%; n=96) and NFG (67.7%; n=88) group, followed by mosquitoes (37.7%; 41.5%), and mice and rats (36.2%; 30.8%) respectively. The least common household pests were snakes and fleas for both groups.

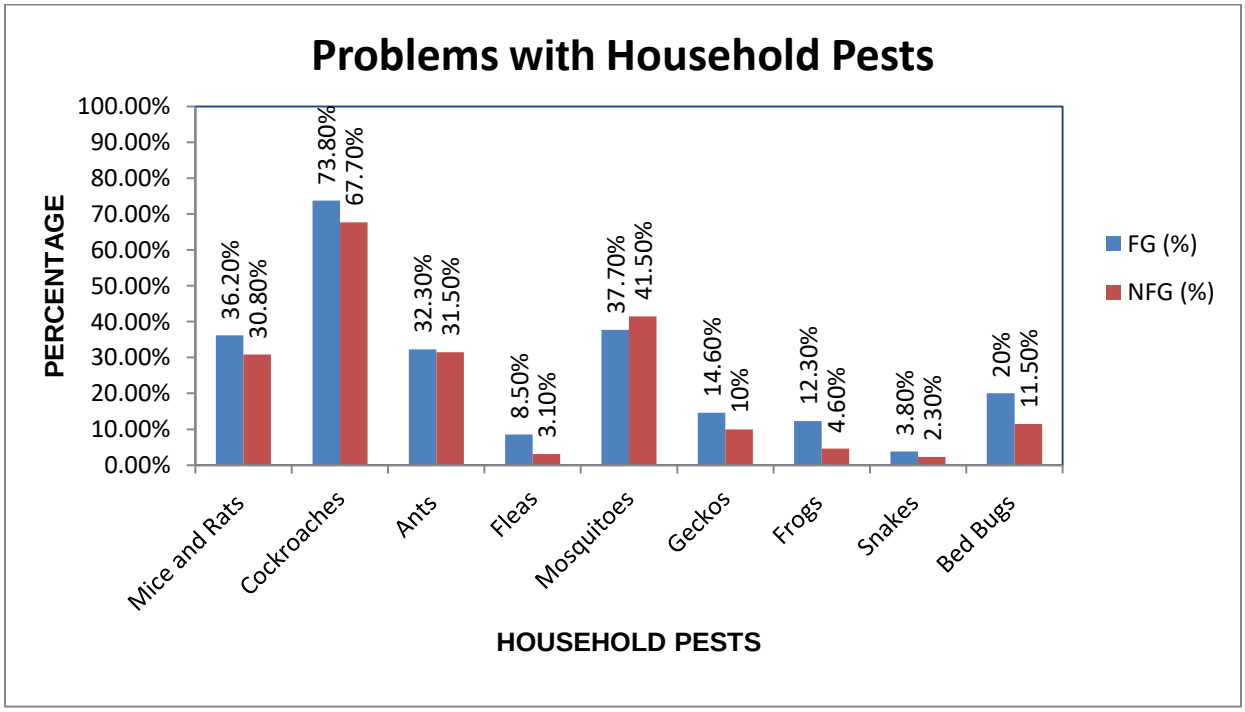

Figure 4.2: Problems with household pests

4.1.3 CURRENT WORK STATUS AND INCOME

An equal number (96.2%; n=125) of FG and NFG respondents were unemployed, and the majority (FG 60.7%; n=79 and NFG 49.3%; n=64) of the respondents from both groups used a study loan as a main source of income while studying (see Table 4.4). A higher percentage of NFG respondents (5.4%; n=7) were on a bursary compared to FG respondents (1.5%; n=2). The percentage of FG respondents that relied on family for income was 36.2% (n=47) and 42.3% (n=55) of the NFG respondents. A large percentage of the FG respondents (38.5%; n=50) had a household income of R0-R500 a month, while 37.7% (n=49) of the NFG respondents had an income of R500-R1000. None of the FG respondents had a household income of more than R10 000 per month, while 3.8% (n=5) of the NFG respondents had a household income of more than R10 000. None of the FG respondents received social or foster grants, while 3.1% (n=4) of the NFG respondents received a child grant, and one (0.8%) received a foster grant.

Table 4.4: Current work status and income

	First generation		Non first generation	
Variables	%	(n=130)	%	(n=130)
Current Employment Status				
Employed	3.8	5	3.8	5
Unemployed	**96.2**	**125**	**3.8**	**125**
Source of Income				
Bursary	1.5	2	5.4	7
Study Loan	**60.7**	**79**	**49.3**	**64**
Employment	0.8	1	1.5	2
Spouse	0.8	1	1.5	2
Family	36.2	47	42.3	55
Total Household Income				
R0-R500	**38.5**	**50**	28.5	37
R501-R1000	36.9	48	**37.7**	**49**
R1001-R1500	13.1	17	15.4	20
R15001-R3000	5.4	7	7.7	10
R3001-R5000	3.8	5	4.6	6
R5001-R10000	2.3	3	2.3	3
R10000+	0	0	3.8	5
Social Grants				
None	**94.6**	**123**	**100**	**130**
Child Grant	3.1	4	0	0
Disability Grant	1.5	2	0	0
Foster Grant	0.8	1	0	0

4.1.4 HOUSEHOLD FOOD SECURITY

Table 4.5 illustrates that a large percentage (FG 43.8%; n=57 and NFG 48.5%; n=63) of the respondents in both groups sometimes lacked money to buy food. The percentage of respondents that never lacked money to buy food was 26.2% (n=34) of FG respondents and 27.7% (n=36) of the NFG respondents. A greater percentage of FG respondents (6.9%; n=9) always lacked money to buy food compared to the NFG respondents at 3.8% (n=5). In both groups, the greatest percentage of respondents bought food once a month (FG 78.5%; n=102 and NFG 79.2%; n=103), and bought food at a supermarket (FG 93.1%; n=121 and NFG 95.4%; n=124). Twenty five point four percent (n=33) of the FG respondents and 26.2% (n=34) of the NFG respondents spent between R401-R500 per month on food. A greater percentage 9.2% (n=12) of FG respondents spent between R0-R200 on food compared to 3.8% (n=5) of the NFG group. Only one (0.8%) of the FG respondents spent more than R2000 on food compared to four (3.1%) of the NFG group.

Table 4.5: Current food availability

	First generation		Non first generation	
Variables	%	(n=130)	%	(n=130)
Frequency of lack of money to buy food				
Always	6.9	9	3.8	5
Often	16.9	22	13.8	18
Sometimes	**43.8**	**57**	**48.5**	**63**
Seldom	6.2	8	6.2	8
Never	26.2	34	27.7	36
Frequency of Food Purchases				
Every day	1.5	2	3.1	4
Once a week	11.5	15	10.8	14
Once a Month	**78.5**	**102**	**79.2**	**103**
3 times a Month	1.5	2	0	0
Fortnightly	6.9	9	6.9	9
Where Food is Purchased				
Tuck shop	0.8	1	0	0
Street vendor	2.3	3	0.8	1
Student Canteen	3.8	5	3.8	5
Supermarket	**93.1**	**121**	**95.4**	**124**
Money Spent on Food per Month				
R0-200	9.2	12	3.8	5
R201-R300	21.5	28	21.5	28
R301-R400	20	26	20.8	27
R401-R500	**25.4**	**33**	**26.2**	**34**
R501-R600	6.2	8	8.5	11
R601-R1000	13.1	17	10	13
R1001-R1600	3.8	5	3.1	4
R1600-R2000	0	0	3	4

>R2000	0.8	1	3.1	4

4.1.5 LEVEL OF EDUCATION, LANGUAGE AND NUMBER OF CHILDREN

The results presented in Table 4.6 indicate that 97.7% (n=127) of the FG and 96.9% (n=126) of the NFG respondents had matric as the highest qualification, and isiZulu was spoken by 92.3% (n=120) of the FG respondents and 86.2% (n=126) of the NFG respondents. A higher percentage (76.9%; n=100) of NFG respondents had no children compared to 74.6% (n=97) of the FG respondents.

Table 4.6: Level of education, language and number of children

	First generation		Non first generation	
Variables	%	(n=130)	%	(n=130)
Highest Education Level				
Matric	**97.7**	**127**	**96.9**	**126**
College/FET	1.5	2	0.8	1
Bridging Course	0.8	1	1.5	2
Diploma/Degree	0	0	0.8	1
Language				
isiZulu	**92.3**	**120**	**86.2**	**112**
isiXhosa	5.4	7	12.3	16
SiSwati	1.5	2	0	0
English	0.8	1	0	0
Sesotho	0	0	1.5	2
Number of Children				
None	**74.6**	**97**	**76.9**	**100**
1	20	26	17.7	23
2	3.8	5	5.4	7
3	1.5	2	0	0

4.1.6 CURRENT FOOD PREPARATION AND CONSUMPTION

The majority (68.5%; n=89) of the FG and NFG (73.1%; n=95) respondents were responsible for their own food preparation (Table 4.7). The majority (62.3%; n=81) of the FG and NFG (63.8%; n=83) respondents were also responsible for the type of food bought in the household. A large percentage (56.9%; n=74) of FG and NFG (63%; n=83) respondents were responsible for deciding on the amount of money spent on buying food.

Table 4.7: Current food preparation and consumption of FG and NFG students

	First generation		Non first generation	
Variables	%	(n=130)	%	(n=130)
Responsible for food preparation in household				
Student	**68.5**	**89**	**73.1**	**95**
Roommate	1.5	2	0	0
Mother	20.8	27	16.2	21
Father	1.5	2	0	0
Grandmother	0.8	1	2.2	3
Aunt	3.8	5	3.8	5
Friend	0	0	0.8	1
Residence kitchen	0.8	1	0	0
Sister	1.5	2	3.1	4
Cousin	0.8	1	0.8	1
Who decides on the type of food purchased in household				
Student	**62.3**	**81**	**72.3**	**94**
Roommate	0.8	1	0	0
Mother	26.9	35	19.2	25
Father	1.5	2	0	0
Grandmother	2.3	3	1.5	2
Aunt	3.8	5	3.1	4
Friend	0.8	1	0.8	1
Student	0.8	1	0	0
Everyone	0	0	0.8	1
Sister	0	0	2.3	3
Cousin	0.8	1	0	0
Who decides on the money spent on food?				
Student	56.9	74	63.8	83
Roommate	0.8	1	0.8	1
Mother	29.2	38	21.6	28
Father	6.2	8	3.8	5
Grandmother	2.3	3	2.3	3
Uncle	0.8	1	3.1	4
Aunt	3.1	4	1.5	2
Friend	0	0	0.8	1
Sister	0	0	2.3	3
Cousin	0.8	1	0	0

Table 4.8 indicates that the majority (51.5%; n=67) of the FG respondents and 48.5% (n=63) of the NFG group consumed two meals a day and the greater number of respondents (53.1%; n=69) and 41.5% (n=54) respectively consumed their meals at the students' residence.

Table 4.8: Meals consumed per day

Variables	First generation %	First generation (n=130)	Non first generation %	Non first generation (n=130)
Number of meals consumed per day				
0	0.8	1	0.8	1
1	8.5	11	2.2	3
2	**51.5**	**67**	**48.5**	**63**
3	33.8	44	43.1	56
>3	5.4	7	5.4	7
Where most meals are consumed				
Home	29.2	38	40.8	53
Friend's home	0.8	1	2.3	3
Work	0.8	1	0	0
University	16.2	21	15.4	20
Student Residence	**53.1**	**69**	**41.5**	**54**

4.1.7 HOUSEHOLD ASSETS

Table 4.9 indicates that 94.62% (n=123) of the FG respondents and 97.69% (n=127) of the NFG respondents had an electric stove, and 82.31% (n=107) and 89.23% (n=116) respectively had a microwave oven. Ninety nine percent of both groups had cell phones, and 79.23% (n=103) of the FG and 83.85% (n=109) of the NFG respondents owned a television set, 82.31% (n=107) and 96.92% (n=126) owned a refrigerator, 45.38% (n=59) and 54.62% (n=71) owned a laptop, and 99.23% (n=129) and 98.46% (n=128) owned a bed with a mattress.

Table 4.9: Household assets

Variables **ELECTRICAL ASSETS**	First generation %	First generation (n=130)	Non first generation %	Non first generation (n=130)
Electric stove				
Yes	94.62	123	97.69	127
Microwave oven				
Yes	82.31	107	89.23	116
Hot plate				
Yes	25.38	33	20.77	27
Radio				
Yes	53.85	70	46.15	60
Television				
Yes	79.23	103	83.85	109
Refrigerator				
Yes	82.31	107	96.92	126

Freezer				
Yes	27.69	36	50.00	65
Telephone/Cell phone				
Yes	99.23	129	99.23	129
Laptop/Desktop				
Yes	45.38	59	54.62	71
Printer				
Yes	8.46	11	10.00	13
Personal Internet				
Yes	18.46	24	28.46	37
Electrical iron				
Yes	97.69	127	95.38	124
Electrical kettle				
Yes	88.46	115	89.23	116
NON ELECTRICAL ASSETS				
Gas stove				
Yes	9.23	12	7.69	10
Primus stove				
Yes	7.69	10	5.38	7
Bed with mattress				
Yes	99.23	129	98.46	128
Mattress only				
Yes	26.92	35	28.46	37
Lounge suite				
Yes	23.08	30	25.38	33
Dining room suite				
Yes	30.77	40	32.31	42
Car				
Yes	13.08	17	16.92	22
Bicycle				
Yes	0.77	1	3.08	4

The results presented in Table 4.10, reported that all (100%) of the NFG respondents used electricity as the main source of energy, compared to 98.5% (n=128) of the FG respondents with 1.5% (n=2) also using gas as a source of energy.

Table 4.10: Energy sources used

	First generation		Non first generation	
Variables	%	(n=130)	%	(n=130)
Fuel used				
Electricity	98.5	128	100	130
Gas	1.5	2	0	0

4.2 ANTHROPOMETRIC INDICES

4.2.1 BODY MASS INDEX (BMI)

Table 4.11 and Table 4.12 present descriptive anthropometric characteristics of respondents and prevalence of overweight according to BMI. The majority of the men (FG 86.54%; n=45 and NFG 72.73%; n=32) were of normal weight (BMI 18.5-24.99), and more NFG men (6.83%; n=3) were underweight (BMI <18.5) compared to FG men (1.92%; n=1). A higher percent of NFG men (18.18%; n=8) were overweight (BMI 25-29.99) compared to FG men (11.54%; n=6), and the mean (±SD) BMI of overweight NFG men was slightly higher (26.00±1.582) compared to 25.71 (±0.800) of FG men. Only one (2.27%) NFG man was class I obese (BMI 30-34.99) and none of the FG men were class 1 obese.

The majority of the FG women (58.97%; n=46) were overweight (BMI 25-29.99) with a mean (±SD) BMI of 27.00 (±1.114), while a large percentage of the NFG women (45.35%; n=39) were of normal weight (BMI 18.5-24.99) with a mean (±SD) BMI of 22.55 (±1.82). A low prevalence of underweight (BMI <18.5) was observed among the NFG women (3.49%; n=3), with none of the FG women being underweight. There was also a higher prevalence of class I obesity among the NFG women (13.95%; n=12), compared to FG women (3.85%; n=3). Four comma six five percent (n=4) of the NFG women were classified as class II obese (BMI 35-39.99), with none of the FG women in this category.

T-test correlations were conducted to determine if any correlations existed between the BMI of the FG and NFG groups and indicated that there was no statistical significance between the BMI of FG and NFG men (*p*=0.450), and the BMI of FG and NFG women (*p*=0.412). Statistical significance differences were observed, however, between the BMI of FG men and women (p=0.000), and the BMI of NFG men and women (p=0.000).

Table 4.11: Summary of men's Body Mass Index

	First generation			Non first generation		
Parameter	**Mean±SD**	**%**	**(n=52)**	**Mean±SD**	**%**	**(n=44)**
BMI (kg/m²) classifications, (WHO 2004)						
Underweight <18.50	17.00±0.000	1.92	1	18.04±0.341	6.83	3
Normal weight 18.50-24.99	**22.00±2.068**	**86.54**	**45**	**21.80±1.223**	**72.73**	**32**
Overweight ≥25.00-29.99	25.71±0.800	11.54	6	26.00±1.582	18.18	8
Obesity Class I 30-34.99	0±0.000	0	0	34.06±0.000	2.27	1

Table 4.12: Summary of women's Body Mass Index

Parameter	First generation Mean±SD	%	(n=78)	Non first generation Mean±SD	%	(n=86)
BMI (kg/m²) classifications, (WHO 2004)						
Underweight <18.50	0±0.000	0	0	17.81±0.072	3.49	3
Normal weight 18.50-24.99	23.00±1.084	37.18	29	**22.55±1.821**	**45.35**	**39**
Overweight ≥25.00-29.99	**27.00±1.114**	**58.97**	**46**	27.33±1.162	32.56	28
Obesity Class I 30-34.99	30.00±1.412	3.85	3	31.97±1.384	13.95	12
Obesity Class II 35.00-39.99	0±0.000	0.00	0±0	39.04±5.911	4.65	4

4.2.2 WAIST CIRCUMFERENCE (WC) AND WAIST TO HEIGHT RATIO (WHTR)

Table 4.13 presents the waist circumference (WC) and waist to height ratio (WHtR) for all the groups. The WHtR is calculated by dividing the waist circumference by the height measurements in centimeters, and is a risk indicator for metabolic syndrome (Lear *et al* 2010: 42). The results in Table 4.13 indicate that none of the FG men exceeded the WC cut-off points (>102cm), compared to 1.82% (n=1) of the NFG men. However, a higher percent of FG men (21.15%; n=11) were above the cut-off points for WHtR (>0.5) compared to NFG men (10.57%; n=5). A higher percent of NFG women (32.61%; n=28) exceeded the WC cut-off points (>88cm), compared to 20.51% (n=16) of FG women. Similarly, more NFG women (63.74%; n=55) exceeded the WHtR cut-off points (>0.5) compared to FG women (60.25%; n=47). In summary, the FG men show a higher BMI (overweight) and WHtR than the NFG men but the NFG women have a higher BMI (obesity), WC and WHtR than the FG women.

T-test correlations were conducted to determine if any correlations existed between the WHtR of FG men and women, and the WHtR of NFG men and women. A statistical significance was observed between the WHtR of FG men and women (p=0.000), WHtR of NFG men and women (p=0.000).

Table 4.13: Cut off points for waist circumference and waist to height ratio for men and women

VARIABLE		WAIST CIRCUMFERENCE (WC) ≤CUT-OFF POINT % (n) ≤88cm/102 cm	WAIST CIRCUMFERENCE (WC) >CUT-OFF POINT % (n) >88cm/102 cm	WAIST TO HEIGHT RATIO (WHtR) ≤CUT-OFF-POINT % (n) ≤0.5	WAIST TO HEIGHT RATIO (WHtR) >CUT OFF-POINT % (n) >0.5
FG MEN	**(n= 52)**	100	0	78.85 (41)	21.15 (11)
NFG MEN	**(n= 44)**	98.18 (43)	1.82 (1)	89.43 (39)	10.57 (5)
FG WOMEN	**(n= 78)**	79.49 (62)	20.51 (16)	39.74 (31)	60.25 (47)
NFG WOMEN	**(n= 86)**	67.39 (58)	32.61 (28)	36.26 (31)	63.74 (55)

4.3.1 DIETARY INTAKE NUTRIENT ANALYSIS

Table 4.14 indicates the mean of three 24 hour recall nutrients analyses for both FG and NFG men. The energy contributions showed that NFG men consumed a higher mean energy intake (8 230.44kJ±2 943.664) compared to FG men (7 245.75kJ±2 368.621). Furthermore, 100% (n=52) of the FG men and 95.45% (n=42) of NFG men consumed <100% of the Estimated Energy Requirement (EERs). Thirty six comma five four percent (n=19) of the NFG men and 86.36% of the FG men consumed <100% of the Recommended Daily Allowance (RDA) for protein. The mean carbohydrate intake of the men in both groups (FG 251.42g±83.135 and NFG 288.93g±101.817) was significantly higher than the daily requirements, but even so, 1.92% (n=1) of the FG men consumed <100% of the Estimated Average requirements (EARs) for carbohydrates. Table 4.14 also shows that 96.15% (n=50) of the FG men and 97.73% (n=43) consumed <100% of Adequate Intake (AI) for fibre.

A low mean intake of calcium (FG 250.28mg±128.870; NFG 268.01mg±202.641), magnesium (FG 105.95g±64.176; NFG 220.66g±87.993), vitamin C (FG 35.64mg±32.296; NFG 47.01mg±56.338), and vitamin D (FG 2.46µg±2.522; NFG 2.27µg±1.786) was observed amongst the men. Although the mean intake of phosphorus exceeded the EAR, 98.01% (n=51) of the FG men consumed <100% of the DRI for phosphorus, and only 11.36% (n=5) of the NFG men. All the men (both FG and NFG) consumed <100% of the DRI for vitamin K.

Table 4.14: Dietary Intake Nutrient Analysis of First generation (n=52) and Non-first generation (n=44) men measured using the average of three 24 hour Recall (IoM 2006)

	First generation		Non first generation			
Nutrients p/day	(n=52) mean ±SD	< 100% OF DRI	(n=44) mean ±SD	< 100% OF DRI	DRI's	
Energy (kJ)	7 245.75±2 368.621	100	8 230.44±2 943.664	95.45	12 881	EER
Total Protein (g)	62.62±21.984	36.54	70.98±25.534	86.36	56	RDA
Total Fat (g)	43.68±21.323	-	48.75±18.178	-	-	-
Carbohydrate (g)	251.42±83.135	1.92	288.93±101.817	0	100	EAR
Total Dietary Fibre (g)	17.70±7.602	96.15	18.11±8.117	97.73	38	AI
Calcium (mg)	250.28±128.870	100	268.01±202.641	97.73	1 000	AI
Iron (mg)	13.52±5.216	7.69	14.71±6.377	6.82	6	EAR
Magnesium (g)	105.95±64.176	96.15	220.66±87.993	86.36	330	EAR
Phosphorus (mg)	866.21±278.451	98.08	954.37±369.837	11.36	580	EAR
Zinc (mg)	11.69±4.087	32.69	13.07±5.813	22.73	9.4	EAR
Selenium (µg/day)	25.19±16.115	88.46	24.43±13.501	90.91	45	EAR
Iodine (µg/day)	26.09±17.649	88.46	25.72±15.758	100	95	EAR
Vitamin A (µg/day)	674.57±1 033.923	75	591.42±740.425	72.73	625	EAR
Thiamine (mg)	1.36±0.515	23.08	1.45±0.658	18.18	1	EAR
Riboflavin (mg)	1.25±1.130	61.54	1.04±0.542	59.09	1.1	EAR
Niacin (mg)	23.80±10.406	17.31	27.54±12.299	6.82	12	EAR
Vitamin B6 (mg)	3.26±1.680	7.69	3.67±1.970	4.55	1.1	EAR
Folate (µg/day)	340.43±217.269	55.77	374.21±210.118	45.45	320	EAR

Vitamin b12 (µg)	4.49±12.094	51.92	2.70±2.979	54.55	2	EAR
Pantothenate (mg)	6.24±3.645	38.46	7.60±4.432	34.09	5	AI
Biotin (µg/day)	33.59±34.082	55.77	34.47±30.844	59.09	30	AI
Vitamin C (mg)	35.64±32.296	90.38	47.01±56.338	84.09	75	EAR
Vitamin D (µg/day)	2.46±2.522	84.62	2.27±1.786	86.36	5	AI
Vitamin E (mg)	7.00±4.011	88.46	8.44±4.521	88.63	12	EAR
Vitamin K (µg)	17.66±14.212	100	19.90±20.847	100	120	AI

Table 4.15 reports on the nutrient analysis obtained from the mean average of three 24 hour recalls conducted among FG and NFG women. The energy contributions showed that 92.31% (n=72) of FG women and 95.35% (n=82) of NFG women consumed a diet that supplied <100% of the EARs. The women in both groups consumed a significantly high mean intake of carbohydrates (FG 214.21kJ±79.128; NFG 223.05kJ±68.302), and 2.56% (n=2) of the FG women consumed <100% of the EAR, while none of the NFG women consumed <100% of the EAR for carbohydrates. Thirty four comma six two percent (n=27) of FG women consumed <100% of the RDA for protein compared to 31.40% (n=27) of the NFG women. A similar percent of FG women (93.59%; n=73) and NFG women (93.02%; n=80) consumed <100% of the AI for dietary fibre.

A low mean intake of calcium (FG 280.33mg±178.789; NFG 363.97mg±221.804), selenium (FG 23.70µm±14.007; 24.49µm±15.490), and iodine (FG 26.44µm±16.666; 26.93µm±17.238) was consumed by the women. Furthermore, all the women (FG and NFG) consumed <100% of the EAR for iodine. Although the mean intake for phosphorus was exceeded for women of both groups (FG 779.70mg±298.958; NFG 827.65mg±299.852), 25.64% (n=20) of the FG women, and 19.77% (n=17) of the NFG women consumed <100% of the EAR for phosphorus.

T-test correlations were conducted to determine if any correlations existed between the calcium, iron and zinc intakes of FG and NFG men, and FG and NFG women. The results indicated that there was no statistical significance between the calcium intake of FG and NFG men (p=0.618), iron intake of FG and NFG men (p=0.327) and women (p=0.215), and the zinc intake between FG and NFG men (p=0.188). A statistical significance existed for the calcium intake between FG and NFG women (p=0.009), and the zinc intake of FG and NFG women (p=0.000).

Table 4.15: Dietary Intake Nutrient Analysis of First generation (n=78) and Non-first generation (n=86) women measured using the average of three 24 hour Recall (IoM 2006)

	First generation		Non-first generation			
Nutrients p/day	(n=78) mean ±SD	< 100% OF DRI	(n=86) mean ±SD	< 100% OF DRI	DRI's	
Energy (kJ)	6 642.14±2 471.363	92.31	6 676.10±2 048.927	95.35	10 093	EER
Total Protein (g)	57.97±23.248	34.62	55.94±18.397	31.40	46	RDA
Total Fat (g)	47.78±23.619	-	45.29±19.242	-	-	-

Carbohydrate (g)	214.21±79.128	2.56	223.05±68.302	0.00	100	EAR
Total Dietary Fibre (g)	14.24±6.156	93.59	15.14±7.011	93.02	25	AI
Calcium (mg)	280.33±178.789	100	363.97±221.804	97.67	1 000	AI
Iron (mg)	11.63±4.701	21.8	12.65±5.769	20.93	8.1	EAR
Magnesium (g)	184.87±66.669	87.18	186.79±63.312	90.70	255	EAR
Phosphorus (mg)	779.70±298.958	25.64	827.65±299.852	19.77	580	EAR
Zinc (mg)	10.00±4.295	21.79	28.76±29.366	0.00	6.8	EAR
Selenium (µg/day)	23.70±14.007	91.03	24.49±15.490	89.53	45	EAR
Iodine (µg/day)	26.44±16.666	100	26.93±17.238	100.00	95	EAR
Vitamin A (µg/day)	439.81±445.658	79.49	677.93±1 238.316	76.74	500	EAR
Thiamine (mg)	1.20±0.550	29.49	1.23±0.539	30.23	0.9	EAR
Riboflavin (mg)	1.39±1.061	35.9	1.60±1.019	31.40	1.1	EAR
Niacin (mg)	22.13±8.802	10.26	21.17±7.970	10.47	11	EAR
Vitamin B6 (mg)	3.31±1.375	7.7	3.16±1.334	4.65	1.1	EAR
Folate (µg/day)	267.19±132.667	73.08	289.00±204.573	67.44	320	EAR
Vitamin b12 (µg)	2.79±3.224	51.28	5.01±9.661	41.86	2	EAR
Pantothenate (mg)	6.04±3.634	37.18	5.15±2.546	52.33	5	AI
Biotin (µg/day)	28.27±18.778	66.67	29.96±37.484	73.26	30	AI
Vitamin C (mg)	43.50±65.956	80.77	54.46±77.436	74.42	60	EAR
Vitamin D (µg/day)	2.82±2.240	87.18	3.56±3.519	74.42	5	AI
Vitamin E (mg)	7.09±3.381	91.03	7.12±3.368	89.53	12	EAR
Vitamin K (µg)	45.82±125.933	93.31	37.38±65.802	87.80	90	AI

4.3.2 TOP 20 FOODS

Table 4.16 and Table 4.17 represent the top 20 most popular food items and the average daily intake of FG and NFG men, who consumed these foods for two week days and one weekend day included in the 24-Hour Recall. The data is presented as mean intake for one day, frequency consumed during a 24 hour period, mean intake per frequency, and per capita intake presented if everyone in the sample consumed that particular food item. Among the FG men, the top three food items consumed included maize meal porridge, bread/rolls and rice, and among the NFG men, the top three foods included rice, bread/rolls, and maize meal porridge. The total intake for carbohydrates was high, with a capita intake per day of 213.78g and a mean intake per frequency of 124.91g of maize meal porridge for FG men, and a per capita intake per day of 94.65g and a mean intake per frequency of 55.93g for breads/rolls. Similarly, for the NFG men, the per capita intake of rice was 216.25g and the mean intake per frequency was 108.13g, and the per capita intake per day of bread and rolls was 107.24g, and the mean intake per frequency was 58.98.

The first animal source of protein was at number four (chicken curry or stew) for both the FG and NFG men with a mean intake per frequency of 74.49g consumed 62 times among FG men, and a mean intake per frequency 71.37g consumed 73 times among the NFG men. Plant sources of protein were ranked at number 11 (baked beans) with a mean intake per frequency of 43.64g consumed 22 times, and in 15th position (vegetable curry) with a mean intake per frequency of 13.77g consumed 19 times among FG

men, and for the NFG men at number 19 (baked beans stew) with a mean intake per frequency of 32.98g consumed 14 times. Other sources of protein included polony (8th) with a mean intake per frequency of 6.17g consumed 45 times, milk (9th) with a mean intake per frequency of 57.84g consumed 37 times, and sausage (14th) with a mean intake per frequency 28.08g consumed 20 times among FG men, and polony (8th) with a mean intake per frequency of 6.22g consumed 41 times, beef curry/stew (10th) with a mean intake per frequency of 63.25g consumed 39 times, milk (12th) with a mean intake per frequency of 100.71g consumed 28 times, and cheese (17th) with a mean intake per frequency of 4.94g consumed 18 times among NFG men.

A high sugar intake is of great concern especially in changing diets, and among the young adults, carbonated drinks consumed are of special interest. Table sugar was in 5th position among the FG men, with a daily intake of 368.53g consumed 61 times with a 6.04g mean intake per frequency in 24 hours followed by carbonated cold drink at number 6 with a mean intake per frequency of 117.94g consumed 51 times, and diluted squash at number 7 with a mean intake per frequency of 92.19g consumed 48 times. Similarly, among the NFG men, sugar ranked 5th with a mean intake per frequency of 4.97g consumed 56 times, followed by carbonated cold drinks which ranked 6th with a mean intake per frequency of 122.96g consumed 51 times, and diluted squash cold drink which ranked 9th with a mean intake per frequency of 88.89g consumed 39 times in 24 hours.

Fruit consumption was very low for both groups of men. Among the FG men, the first vegetable food source on the top 20 foods list was vegetable curry (15th) consumed 19 times, and a mean intake per frequency intake of 13.77g and the only fruit (apple) appeared in 19th position, consumed 16 times with a mean intake per frequency of 45.21g. No vegetable food sources were present for the NFG men group, and the only fruit on the list was an apple (15th) which was consumed 18 times with a mean intake per frequency of 34.72g. The per capita intake/day of fruit and vegetables was small and did not meet the WHO recommended intake of ≥400g/ 5 portions of fruit and vegetables per day (WHO, 2015).

Table 4.16: Top 20 food items ranked by the mean intake portion size by the number of first generation men as measured by three 24-Hour Recall (n=52).

TOP TWENTY FOODS CONSUMED BY FIRST GENERATION MEN (n=52)						
RANK	**ITEM**	**TOTAL INTAKE (3 days) (g)**	**TOTAL INTAKE (1 day) (g)**	**FREQUENCY**	**MEAN INTAKE PER FREQUENCY (g)**	**PER CAPITA INTAKE PER DAY (g)**
1	**Maize meal pap**	33350	11116.67	89	124.91	213.78
2	**Bread/Rolls**	14766	4922.00	88	55.93	94.65
3	**Rice**	24981.25	8327.08	74	112.53	160.14
4	**Chicken stew**	13855	4618.33	62	74.49	88.81

5	**Sugar**	1105.6	368.53	61	6.04	7.09
6	**Carbonated cold drinks**	18045	6015.00	51	117.94	115.67
7	**Diluted Squash drink**	13275	4425.00	48	92.19	85.10
8	**Polony**	832.6	277.53	45	6.17	5.34
9	**Milk (full cream)**	6420	2140.00	37	57.84	41.15
10	**Vetkoek**	1980	660.00	24	27.50	12.69
11	**Baked Beans stew**	2880	960.00	22	43.64	18.46
12	**Margarine**	237.5	79.17	22	3.60	1.52
13	**Beef Curry stew**	4175	1391.67	21	66.27	26.76
14	**Sausage (Beef)**	1685	561.67	20	28.08	10.80
15	**Vegetable Curry**	785	261.67	19	13.77	5.03
16	**Maltabella**	5705	1901.67	18	105.65	36.57
17	**Potato Chips (Fried)**	3895	1298.33	17	76.37	24.97
18	**Cheese (Cheddar)**	222.5	74.17	17	4.36	1.43
19	**Apple**	2170	723.33	16	45.21	13.91
20	**Egg, Fried in Sunflower Oil**	2100	700.00	16	43.75	13.46

Table 4.17: Top 20 food items ranked by the mean intake portion size by the number of non-first generation men as measured by three 24-Hour Recall (n=44).

TOP TWENTY FOODS CONSUMED BY NON-FIRST GENERATION MEN (n=44)						
RANK	**ITEM**	**TOTAL INTAKE (3 days) (g)**	**TOTAL INTAKE (1 day) (g)**	**FREQUENCY**	**MEAN INTAKE PER FREQUENCY (g)**	**PER CAPITA INTAKE PER DAY (g)**
1	**Rice**	28545	9515.00	88	108.13	216.25
2	**Bread/ Rolls**	14156	4718.67	80	58.98	107.24
3	**Maize meal pap**	33135	11045.00	78	141.60	251.02
4	**Chicken stew**	15630	5210.00	73	71.37	118.41
5	**Sugar, white**	834.5	278.17	56	4.97	6.32
6	**Carbonated cold drink**	18813	6271.00	51	122.96	142.52
7	**Margarine**	398	132.67	41	3.24	3.02
8	**Polony**	765	255.00	41	6.22	5.80
9	**Diluted Squash drink**	10400	3466.67	39	88.89	78.79
10	**Beef stew**	7400	2466.67	39	63.25	56.06
11	**Vetkoek**	2480	826.67	32	25.83	18.79
12	**Milk, whole**	8460	2820.00	28	100.71	64.09

13	**Potato Chips, fried**	3645	23.00	23	1.00	27.61
14	**Tea, brewed**	5860	1953.33	22	88.79	44.39
15	**Apple**	1875	625.00	18	34.72	14.20
16	**Corn Flakes**	746	248.67	18	13.81	5.65
17	**Cheese (Cheddar)**	267	89.00	18	4.94	2.02
18	**Coffee, instant**	4185	1395.00	16	87.19	31.70
19	**Baked Beans stew**	1385	461.67	14	32.98	10.49
20	**Mayonnaise**	278	92.67	13	7.13	2.11

Table 4.18 and Table 4.19 represent the top 20 most popular food items and the average daily intake of first generation and non-first generation women, who consumed these foods on two week days and one weekend day included in the 24-Hour Recall.

Women in both the FG and NFG group consumed a large amount of carbohydrate based foods. Among the FG women, carbohydrate rich foods appear three times within the top five foods on the list, with bread/rolls (1st) with a mean intake per frequency of 43.52g consumed 168 times, rice (2nd) with a mean intake per frequency of 81.34g consumed 141 times, and maize meal porridge (5th) with a mean intake per frequency of 91.53g consumed 99 times in 24 hours. Among the NFG women, carbohydrate rich foods appear twice within the top five foods on the list, with bread/rolls (1st) with a mean intake per frequency of 42.03g consumed 202 times and rice (3rd) with a mean intake per frequency of 87.62g consumed 128 times in 24 hours. Bread/Rolls were the most popular food item for both groups of women, with a per capita intake of 93.73g per day among FG women, and a per capita intake of 98.72g per day for NFG women.

Six different protein rich foods appeared on the top 20 list for women in both groups; however, none of the protein food sources were plant based for both groups. Chicken curry/stew was ranked the highest protein source (4th) among FG women with a per capita intake of 80.68g, and among NFG women, milk was the highest ranked protein source, ranked 5th, with a per capita intake of 112.64g per day.

Sugar was ranked 6th with a mean intake per frequency of 6.03g consumed 90 times among FG women, and 4th among NFG women, with a mean intake per frequency of 3.85g consumed 116 times in 24 hours. Interestingly, NFG women consumed diluted squash (ranked 2nd) more frequently (138 times) than sugar (116 times), and the same trend was observed among FG women where the diluted squash ranked 3rd (consumed 112 times) compared to sugar ranked 6th (consumed 90 times). Carbonated drinks were number eight on the list for both groups of women. Although FG women consumed carbonated drinks less frequently (73 times) compared to NFG women (78 times), FG women had a greater per capita intake (106.07g/day) compared to NFG women (96.95g/day).

No vegetable food source featured on the list for both groups of women, and only two fruit sources appeared on the list for both groups of women. An apple was ranked 15th with a per capita intake of 16.58g/day and a banana was ranked 20th with a per capita intake of 7.18g/day for the FG women, while for the NFG women, an apple ranked 12th with a per capita intake of 19.30g/day, and fruit juice was 19th with a per capita intake of 37.52g/day.

Table 4.18: Top 20 food items ranked by the mean intake portion size by the number of first generation women as measured by three 24-Hour Recalls (n=78).

TOP TWENTY FOODS CONSUMED BY FIRST GENERATION WOMEN (n=78)						
RANK	ITEM	TOTAL INTAKE (3 days) (g)	TOTAL INTAKE (1 day) (g)	FREQUENCY	MEAN INTAKE PER FREQUENCY (g)	PER CAPITA INTAKE PER DAY (g)
1	Bread/Rolls	21933	7311.00	168	43.52	93.73
2	Rice	34405	11468.33	141	81.34	147.03
3	Diluted Squash Cold Drink	28770	9590.00	112	85.63	122.95
4	Chicken Curry/ Stew/ Boiled	18880	6293.33	106	59.37	80.68
5	Maize meal, porridge	27185	9061.67	99	91.53	116.18
6	Sugar	1628	542.67	90	6.03	6.96
7	Milk	17982	5994.00	75	79.92	76.85
8	Carbonated cold drink	24821	8273.67	73	113.34	106.07
9	Margarine	563.5	187.83	59	3.18	2.41
10	Polony	991	330.33	51	6.48	4.24
11	Potato Chips	6995	2331.67	44	52.99	29.89
12	Beef Curry/ Stew/ Boiled	7210	2403.33	43	55.89	30.81
13	Snack, Savory	1652	550.67	37	14.88	7.06
14	Corn Flakes	2126	708.67	36	19.69	9.09
15	Apple	3880	1293.33	35	36.95	16.58
16	Egg, Fried in Sunflower Oil	3190	1063.33	31	34.30	13.63
17	Mayonnaise	600	200.00	28	7.14	2.56
18	Cheese	472	157.33	26	6.05	2.02
19	Vetkoek	2120	706.67	24	29.44	9.06
20	Banana	1680	560.00	23	24.35	7.18

Table 4.19: Top 20 food items ranked by the mean intake portion size by the number of non-first generation women as measured by three 24-Hour Recalls (n=86).

TOP TWENTY FOODS CONSUMED BY NON-FIRST GENERATION WOMEN (n=86)						
RANK	ITEM	TOTAL INTAKE (3 days) (g)	TOTAL INTAKE (1day) (g)	FREQUENCY	MEAN INTAKE PER FREQUENCY (g)	PER CAPITA INTAKE PER DAY (g)
1	Bread/Rolls	25471	8490.33	202	42.03	98.72
2	Diluted Squash Cold Drink	34365	11455	138	83.01	133.20
3	Rice	33645	11215	128	87.62	130.41
4	Sugar, white	1341.5	447.17	116	3.85	5.20
5	Milk, whole	29060	9686.67	105	92.25	112.64
6	Maize meal, porridge	24605	8201.67	85	96.49	95.37
7	Chicken Curry/ Stew/ Boiled	12160	4053.33	79	51.31	47.13
8	Carbonated Cold Drink	25013	8337.67	78	106.89	96.95
9	Margarine	517	172.33	68	2.53	2.00
10	Snack, Savoury	1853	617.67	53	11.65	7.18
11	Polony	985	328.33	51	6.44	3.82
12	Apple	4980	1660	50	33.20	19.30
13	Egg, Fried in Sunflower Oil	4445	1481.67	44	33.67	17.23
14	Corn Flakes	2068	689.33	42	16.41	8.02
15	Beef Curry/ Stew/ Boiled	6720	2240	41	54.63	26.05
16	Cheese, Cheddar	688	229.33	39	5.88	2.67
17	Potato Chips, fried	6650	2216.67	37	59.91	25.78
18	Coffee, instant	8060	2686.67	30	89.56	31.24
19	Fruit Juice, diluted	9680	3226.67	29	111.26	37.52
20	Weet-bix, bricks	1587.5	529.17	25	21.17	6.15

Table 4.20 presents the fruit and vegetable intake, as a mean (±SD) of three 24-Hour Recalls and indicates that both men and women from FG and NFG groups consumed far less than the ≥400g/day recommended by the WHO. However, the FG men consumed a slightly higher per capita intake of fruits and vegetables (234.4g) compared to NFG men (196.86g). Similarly, FG women consumed a marginally higher per capita intake of fruits and vegetables (259,11g) compared to NFG women (246.60g).

Table 4.20: Fruit and vegetable intake measured by three 24-Hour Recalls (WHO, 2015) for first generation and non-first generation men and women.

Group	Mean ±SD	Per Capita Intake (g)
First Generation Men (n=52)	107.52±95.466	234.4
Non-First Generation Men (n=44)	75.98±71.268	196.86
First Generation Women (n=78)	80.97±74.990	259.11
Non-First Generation Women (n=86)	77.40±73.381	246.60

In table 4.21, the results of the energy distribution of the macronutrients, Acceptable Macronutrient Distribution Range (AMDR), from the 24-Hour Recalls are reported in relation to the WHO Healthy Diet fact sheet (2015). All the men and women from both the first generation and non-first generation group were within the range for total carbohydrate intake of 55-75%; with 63.14% for FG men, 63.42% among NFG men, 58.77% among FG women, and 60.65% among NFG women, the total protein intake 10-15%; FG men 14.69%, NFG men 14.66%, FG women 14.91% and NFG women 14.24%, and total percentage of fat 15-30%; FG men 22.30%, NFG men 21.92%, FG women 26.74%, and NFG women 25.10%. Although the diet intakes were deficient, the meals were balanced.

4.21: Percentage of AMDRs from the average of three 24-Hour Recalls (WHO, 2015) for first generation and non-first generation men and women.

Macronutrients	Energy %	WHO Goal
First Generation Men (n=52)		
Protein (g)	14.69	10-15%
Total fat (g)	22.30	15-30%
Carbohydrates(g) & Fibre (g)	63.14	55-75%
Non-First Generation Men (n=44)		
Protein (g)	14.66	10-15%
Total fat (g)	21.92	15-30%
Carbohydrates(g) & Fibre (g)	63.42	55-75%
First Generation Women (n=78)		
Protein (g)	14.91	10-15%
Total fat (g)	26.74	15-30%
Carbohydrates(g) & Fibre (g)	58.77	55-75%
Non-First Generation Women(n=86)		
Protein (g)	14.24	10-15%
Total fat (g)	25.10	15-30%
Carbohydrates(g) & Fibre (g)	60.65	55-75%

4.3.3 FOOD VARIETY SCORE, DIETARY DIVERSITY SCORE AND NUTRIENT ADEQUACY

The food variety score (FVS) consists of a count of single foods within the nine nutritious food groups as presented by the FAO (Badari, Arcot, Haron, Paim, Sulaiman and Masud 2012: 267), while the Food Group Diversity Score (FGDS) indicates the number of food groups consumed over a period of seven days measured by the FFQ. The nine food groups with a count of the single foods within the groups were reported in the food variety scores summarized in Tables 4.22 to Table 4.25.

Table 4.22 and Table 4.23 indicate that the food variety scores for men in both groups had a number of food items consumed that were similar. The FG men consumed 58 different individual food items and the NFG men consumed 60 different food items in seven days. The total range of foods consumed was also similar for the men in both groups; however the majority of the FG men (67.31%: n=35) consumed 21-40 individual food items in seven days while 88.63% (n=39) of the NFG men consumed between 13-40 individual foods in seven days. The food group with the highest variety was the fruit group for both FG (n=14) and NFG (n=14) men; while the food group which had the second highest food variety was the cereal group (n=10) for FG men, and the meat group (n=11) for the NFG men. The eggs group was the least consumed food group for men in both groups, with 40.38% (n=21) of FG men consuming no eggs and 59.62% (n=31) consuming one egg in seven days, while 43.18% (n=19) of NFG men did not consume any eggs, and 56.82% (n=25) of NFG consuming only one egg in seven days.

Table 4.22: Household food access as measured by the food variety score within the food consumed over a period of seven days of First generation men (n=52).

FG MEN									
Flesh Group (n=9)	Egg Group (n=1)	Dairy Group (n=7)	Cereal Group (n=10)	Legumes Group (n=3)	Vitamin A Rich Group (n=5)	Fruit Group (n=14)	Vegetable Group (n=9)	Fat Group (n=7)	Total Individual Food Items Eaten from all Groups (n=58)
0=2	0=21	0=4	0=0	0=12	0=6	0=2	0=0	0=1	0-12=2
1=3	1=31	1=11	1=0	1=29	1=25	1=2	1=1	1=4	13-20=9
2=7		2=10	2=0	2=8	2=6	2=9	2=4	2=8	21-30=23
3=11		3=13	3=3	3=3	3=7	3=9	3=7	3=10	31-40=12
4=9		4=6	4=10		4=2	4=12	4=13	4=17	41-50=4
5=11		5=3	5=8		5=6	5=4	5=9	5=9	51-58=2
6=5		6=4	6=14			6=5	6=7	6=2	
7=2		7=1	7=9			7=4	7=7	7=1	
8=1			8=5			8=3	8=2		
9=1			9=2			9=0	9=2		
			10=1			10=0			
						11=0			

						12=0			
						13=1			
						14=1			

Dietary Diversity: Low=0-3 food groups or <30 individual foods. Medium=4-5 food groups or 30-60 individual foods. High=6-9 food groups or >60 individual foods

Table 4.23: Household food access as measured by the food variety score within the food consumed over a period of seven days of Non-first generation men (n=44).

					NFG MEN				
Flesh Group	Egg Group	Dairy Group	Cereal Group	Legumes Group	Vitamin A Rich Group	Fruit Group	Vegetable Group	Fat Group	Total Individual Food Items Eaten from all Groups
(n=11)	(n=1)	(n=7)	(n=9)	(n=3)	(n=7)	(n=14)	(n=8)	(n=7)	(n=60)
0=0	0=19	0=5	0=0	0=18	0=8	0=3	0=0	0=0	0-12=1
1=0	1=25	1=11	1=0	1=17	1=8	1=7	1=3	1=6	13-20=10
2=7		2=11	2=1	2=7	2=16	2=7	2=5	2=5	21-30=18
3=9		3=6	3=2	3=2	3=7	3=9	3=7	3=3	31-40=11
4=12		4=8	4=6		4=4	4=9	4=10	4=12	41-50=2
5=6		5=0	5=12		5=0	5=5	5=8	5=12	51-60=2
6=3		6=2	6=10		6=0	6=1	6=2	6=5	
7=3		7=1	7=7		7=1	7=0	7=7	7=1	
8=2			8=4			8=0	8=2		
9=1			9=2			9=0			
10=0						10=1			
11=1						11=0			
						12=0			
						13=1			
						14=1			

Dietary Diversity: Low=0-3 food groups or <30 individual foods. Medium=4-5 food groups or 30-60 individual foods. High=6-9 food groups or >60 individual foods

Tables 4.24 and Table 4.25 indicate that within the FG women's group, a total of 61 different individual foods were consumed in seven days, while within the NFG women's group 62 single foods were consumed. The total range of individual foods consumed during the seven day data collection period was similar for women in both groups, with a range of 10-61 for the FG group, and 16-62 for the NFG group. The majority of the FG women (84.62%; n=66) consumed 13-40 individual food items in seven days, while the majority of NFG women (74.42%; n=64) consumed 21-40 individual foods in seven days. The fruit group had the most variety consumed by women in both groups, with the highest number of FG women (38.46%; n=30) consuming 3-4 types of fruit in seven days, while the highest number of NFG women (47.67%; n=41) consumed 3-4 types of fruit in seven days. The food groups that had the least variety among women in both groups were eggs and legumes, with 75.64% (n=59) of FG women and

29.07% (n=25) of the NFG women not consuming any eggs in seven days, and 41.03% (n=32) of FG women and 44.19% (n=38) of NFG women not consuming any legumes in seven days.

Table 4.24: Household food access as measured by the food variety score within the food consumed over a period of one week of first generation women (n=78).

FG WOMEN									
Meat Group	Egg Group	Dairy Group	Cereal Group	Legumes Group	Vitamin A Rich Group	Fruit Group	Vegetable Group	Fat Group	Total Individual Food Items Eaten from all Groups
(n=10)	(n=1)	(n=7)	(n=10)	(n=3)	(n=7)	(n=14)	(n=10)	(n=6)	(n=61)
0=0	0=59	0=4	0=0	0=32	0=9	0=4	0=3	0=4	0-12=2
1=2	1=19	1=18	1=0	1=35	1=26	1=7	1=3	1=5	13-20=17
2=13		2=21	2=1	2=10	2=20	2=10	2=4	2=14	21-30=32
3=7		3=13	3=5	3=1	3=5	3=15	3=14	3=16	31-40=17
4=20		4=10	4=14		4=10	4=15	4=14	4=20	41-50=6
5=21		5=4	5=13		5=3	5=11	5=5	5=17	51-60=3
6=9		6=6	6=20		6=4	6=5	6=15	6=2	61=1
7=4		7=2	7=16		7=1	7=3	7=10		
8=1			8=4			8=2	8=6		
9=0			9=4			9=2	9=3		
10=1			10=1			10=0	10=1		
						11=1			
						12=0			
						13=1			
						14=2			

Dietary Diversity: Low = 0-3 food groups or < 30 individual foods. Medium = 4-5 food groups or 30-60 individual foods. High= 6-9 food groups or > 60 individual foods

Table 4.25: Household food access as measured by the food variety score within the food consumed over a period of one week of non-first generation women (n=86).

NFG WOMEN									
Meat Group	Egg Group	Dairy Group	Cereal Group	Legumes Group	Vitamin A Rich Group	Fruit Group	Vegetable Group	Fat Group	Total Individual Food Items Eaten from all Groups
(n=9)	(n=1)	(n=7)	(n=9)	(n=3)	(n=7)	(n=14)	(n=9)	(n=6)	(n=62)
0=0	0=25	0=0	0=0	0=38	0=10	0=1	0=0	0=0	0-20=13
1=1	1=61	1=11	1=0	1=31	1=15	1=5	1=4	1=1	21-30=40
2=9		2=21	2=1	2=13	2=30	2=11	2=7	2=9	31-40=24
3=16		3=25	3=5	3=4	3=21	3=23	3=12	3=19	41-50=7
4=22		4=15	4=14		4=5	4=18	4=14	4=25	51-60=1
5=22		5=9	5=12		5=2	5=16	5=17	5=20	61-62=1

6=8	6=4	6=18	6=1	6=4	6=19	6=12
7=3	7=1	7=22	7=2	7=2	7=7	
8=4		8=9		8=1	8=5	
9=1		9=5		9=2	9=1	
				10=1		
				11=0		
				12=0		
				13=1		
				14=1		

Dietary Diversity: Low = 0-3 food groups or < 30 individual foods. Medium = 4-5 food groups or 30-60 individual foods. High= 6-9 food groups or > 60 individual foods

In Table 4.26 the FVS (±SD) for all foods consumed from all the food groups in seven days indicates that the FG men had a mean FVS (±SD) of 28.56 (±10.079) and 27.41 (±10.342) for NFG men, indicating a low food variety score for both groups of men. The cereal group had the highest individual mean FVS of 5.85 (±1.638) for both groups of men, followed by the vegetable group, and the fruit group with 4.84 (±1.862), and 4.48 (±2.636) respectively, while the cereal group with a FVS of 5.7 (±1.579) was followed by the meat group and then the vegetable group with 4.41 (±2.050) and 4.34 (±1.928) respectively for the NFG men.

Table 4.26: Summary of food variety scores within the food groups for FG men (n=52) and NFG men (n=44)

Food Group	Mean	±SD	Range of Scores	Mean	±SD	Range of Scores
	FG MEN			**NFG MEN**		
Flesh	4.04	1.784	0-9	4.41	2.050	1-11
Eggs	1	0.000	0-1	1	0.000	0-1
Dairy	2.92	1.622	0-7	2.62	1.549	0-7
Cereals	5.85	1.638	1-10	5.7	1.579	1-9
Legumes	1.35	0.622	0-3	1.42	0.643	0-3
Vitamin A rich fruit and vegetables	2.09	1.443	0-5	2.33	1.219	0-7
Fruits	4.48	2.636	0-14	3.71	2.839	1-14
Vegetables	4.85	1.862	1-9	4.34	1.928	1-8
Fat and Oils	3.57	1.375	0-7	3.86	1.651	1-7
Total Food Items	28.56	10.079	11-58	27.41	10.342	11-60

Dietary Diversity: Low=0-3 food groups or <30 individual foods. Medium=4-5 food groups or 30-60 individual foods. High=6-9 food groups or >60 individual foods

The mean Food Variety Scores (FVS) (±SD) for all foods consumed from all the food groups in seven days as summarized in Table 4.27, were 28.67 (±10.775) for FG women and 29.92 (±8.549) for NFG women, indicating a low dietary diversity for both groups of women. The cereal group reported the highest

individual mean FVS (±SD) of 5.74 (±1.647), followed by the vegetables group and the fruits group with 5.05 (±2.130) and 4.38 (±2.812) respectively for the FG women, and among the NFG women, the cereal group had the highest individual mean FVS (±SD) of 5.95 (±1.651), followed by the vegetables group, and then the flesh group with 4.73 (±1.850) and 4.36 (±1.608) respectively.

Table 4.27: Summary of food variety scores within the food groups for FG women (n=78) and NFG women (n=86)

Food Group	Mean	±SD	Range of Scores	Mean	±SD	Range of Scores
	FG Women			**NFG Women**		
Flesh	4.28	1.674	1-10	4.36	1.608	1-9
Eggs	1	0.000	0-1	1	0.000	0-1
Dairy	2.82	1.666	0-7	3.07	1.404	1-7
Cereals	5.74	1.647	2-10	5.95	1.651	2-9
Legumes	1.26	0.491	0-3	1.44	0.649	0-3
Vitamin A rich fruit and vegetables	2.42	1.603	0-7	2.47	1.280	0-7
Fruits	4.38	2.812	0-14	4.11	2.299	0-14
Vegetables	5.05	2.130	0-10	4.73	1.850	1-9
Fat and Oils	3.49	1.295	0-6	4.05	1.245	1-6
Total Food Items	28.67	10.775	10-61	29.92	8.549	16-62

Dietary Diversity: Low=0-3 food groups or <30 individual foods. Medium=4-5 food groups or 30-60 individual foods. High=6-9 food groups or >60 individual foods

Table 4.28 and Table 4.29 report on the food group diversity for both groups of respondents. None of the men in either group were classified with a food group diversity score (Table 4.28). Six comma eight one percent (n=3) of the NFG men were classified as having a medium food group diversity score (4-5 food groups) compared to 1.92% (n=1) of the FG men. The majority of the men in both groups were classified as having a good food group diversity score (6-9 food groups) (FG=98.08%; n=51 and NFG=93.18%; n=41).

Table 4.28: Summary of food diversity of FG men (n=52) and NFG men (n=44)

Number of food groups consumed n=9	Frequency	Percentage	Frequency	Percentage
	FG Men		NFG Men	
1-3	0	0	0	0
4	0	0	1	2.3
5	1	1.9	2	4.5
6	3	5.8	3	6.8
7	11	21.2	10	22.7
8	13	25	11	25
9	24	46.2	17	38.6
Total	52	100	44	100

Dietary Diversity: Low=0-3 food groups or <30 individual foods. Medium=4-5 food groups or 30-60 individual foods. High=6-9 food groups or >60 individual foods

The majority of the FG women (94.9%; n= 74) had a high food group diversity score (6-9 food groups) and all (100%; n=86) the NFG women could be classified with a good food group diversity score (Table 4.29). The number of FG women who were classified with a medium food group diversity score (4-5 food groups) was 5.2% (n=4), while none of the women in either group were considered to have a low food group diversity score.

Table 4.29: Summary of food diversity of FG women (n=78) and NFG women (n=86)

Number of food groups consumed n=9	Frequency	Percentage	Frequency	Percentage
	FG Women		NFG Women	
1-3	0	0	0	0
4	2	2.6	0	0
5	2	2.6	0	0
6	4	5.1	4	4.7
7	8	10.3	14	16.3
8	29	37.2	34	39.5
9	33	42.3	34	39.5
Total	78	100	86	100

Dietary Diversity: Low=0-3 food groups or <30 individual foods. Medium=4-5 food groups or 30-60 individual foods. High=6-9 food groups or >60 individual foods

CORRELATIONS BETWEEN FOOD GROUP DIVERSITY SCORE (FGDS) AND NUTRIENT ADEQUACY RATIOS (NARs)

Figures 4.3 to 4.10 illustrate the relationship between the food group diversity score (FGDS) and nutrient adequacy ratios (NARs) of energy, protein, selected minerals and vitamins for both men and women in both groups (FG and NFG). The NARs were calculated by working out the percentage of the average intake in relation with the DRIs.

Figures 4.3 and 4.4 report that for all nutrients, an increase in the NAR with an increase of FGDS was apparent. Figure 4.3 also illustrates a higher increase in NARs, especially for iron; however, between a FGDS of six to seven, there is a slight decrease for all nutrients. Calcium and energy still remained below 100%, with calcium continuing to decrease slightly between eight and nine food groups consumed.

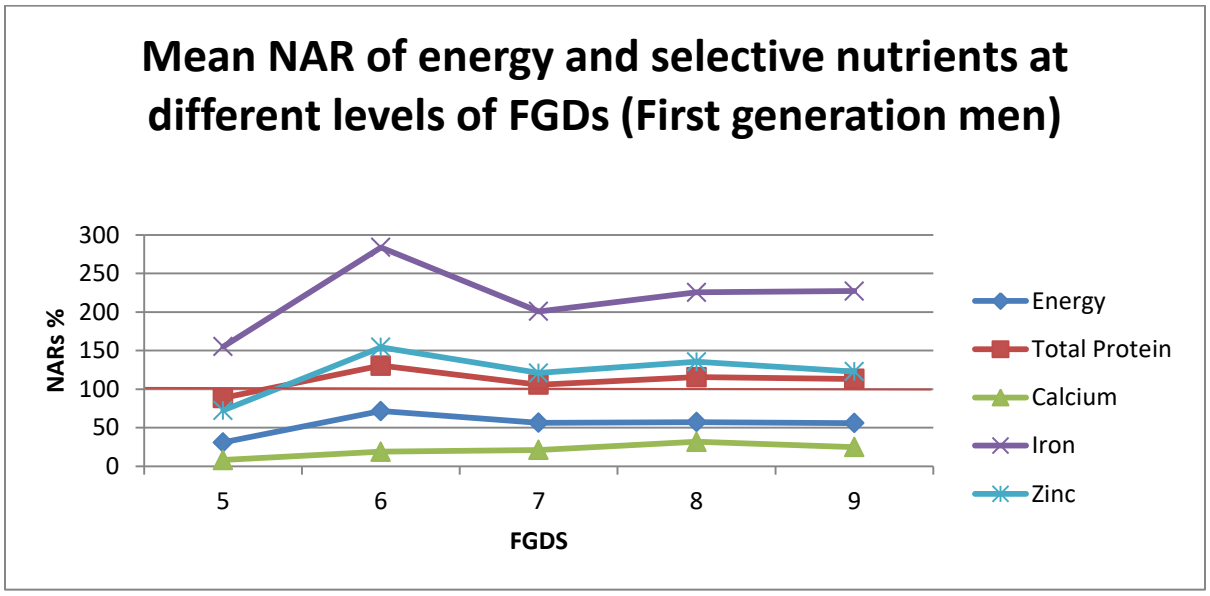

Figure 4.3: Mean Nutrient Adequacy Ratio (NAR expressed as %) of energy and nutrients at different levels of Dietary Diversity Score (DDS) for First Generation men

Figure 4.4 illustrates that there were no significant fluctuations that occurred for nutrients consumed between the different FGDS, except for vitamin B6 which peaked at a FGDS of six. However, in a FGDS of nine, all nutrients were above 100% of NARs, except for vitamin C.

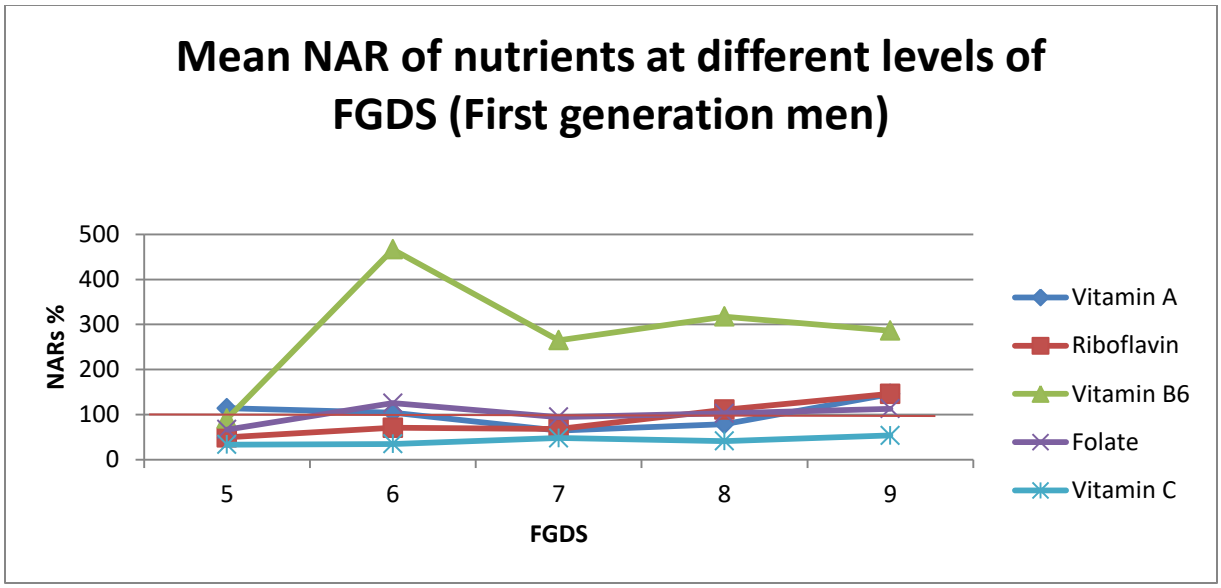

Figure 4.4: Mean Nutrient Adequacy Ratio (NAR expressed as %) of selected Vitamins at different levels of Dietary Diversity Score (DDS) for First Generation men

Figure 4.5 and 4.6 indicate that there is a gradual increase of the NARs as the FGDS increases. Similar to the trend observed among FG men, energy and calcium among the NFG men was also below 100%, with iron peaking at a FGDS of eight (figure 4.5). Figure 4.6 shows that the NARs for vitamin B6 peaked at over 300% at a FGDS of six, which is a similar trend observed among the FG men. The NARs for vitamin A, riboflavin, and vitamin C fluctuated above and below 100%.

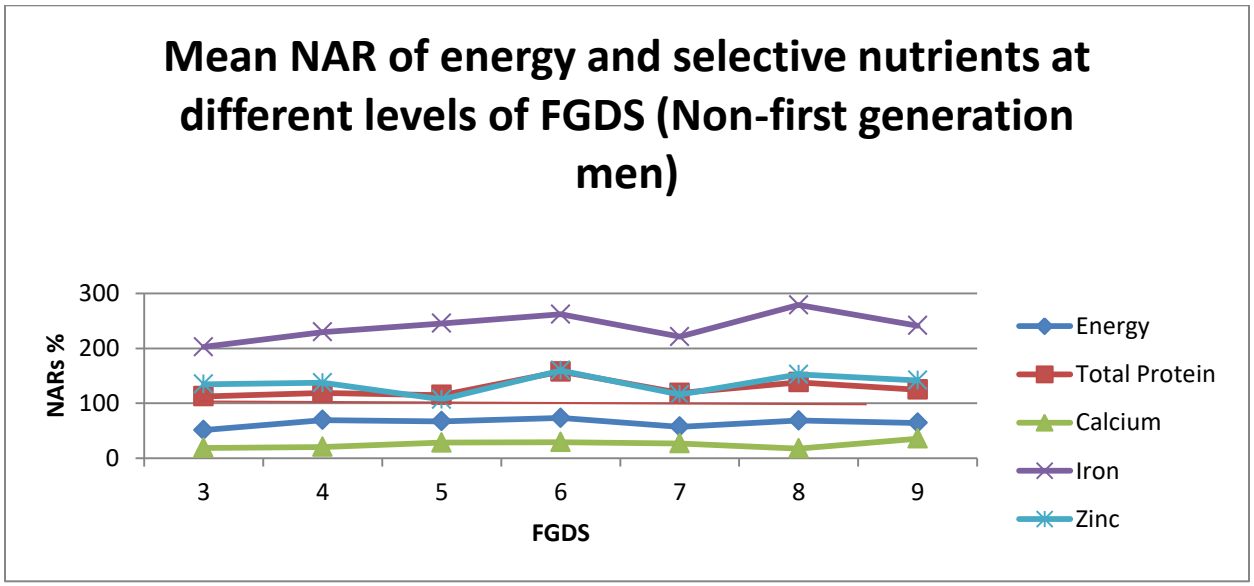

Figure 4.5: Mean Nutrient Adequacy Ratio (NAR expressed as %) of energy and nutrients at different levels of Dietary Diversity Score (DDS) for Non-First Generation men

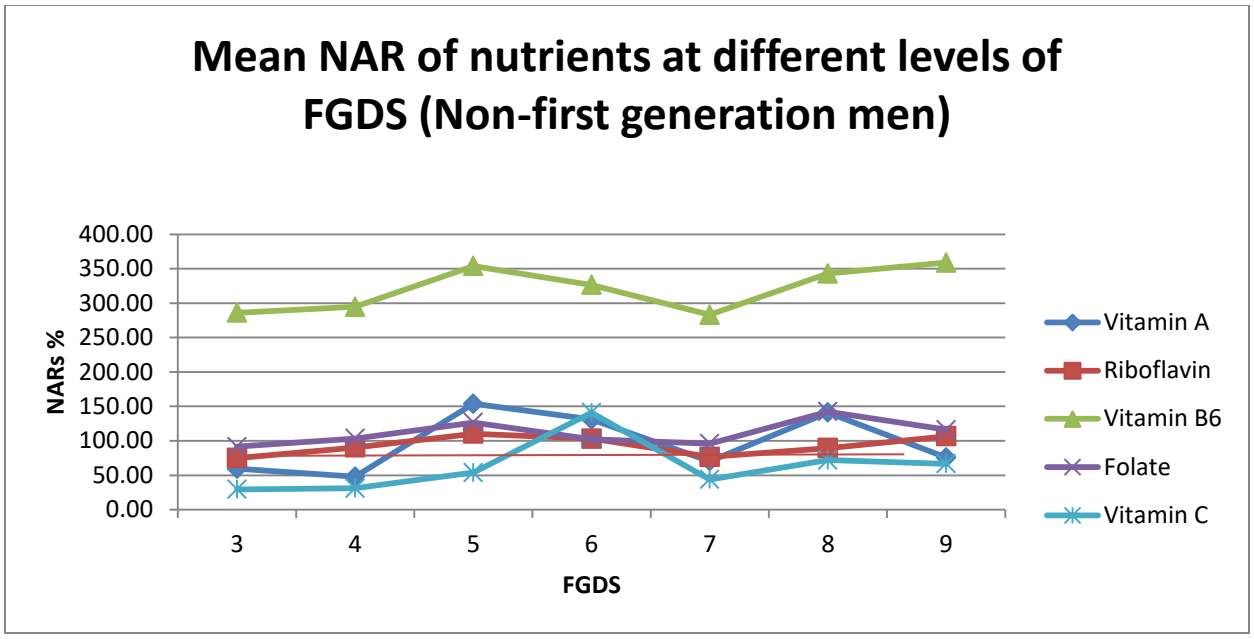

Figure 4.6: Mean Nutrient Adequacy Ratio (NAR expressed as %) of selected vitamins at different Levels of Dietary Diversity Score (DDS) for Non-first Generation men

According to figure 4.7, all nutrients reached and maintained the NARs consistently except for energy and calcium, with protein reaching the NARs at a FGDS of five for the FG women. Figure 4.8 shows that only vitamin B6, vitamin C, and folate started off with a NAR of above 100%. However, as the FGDS increased, most of the nutrients' NARs % decreased, with vitamin A, folate and vitamin C falling below the NARs of 100%.

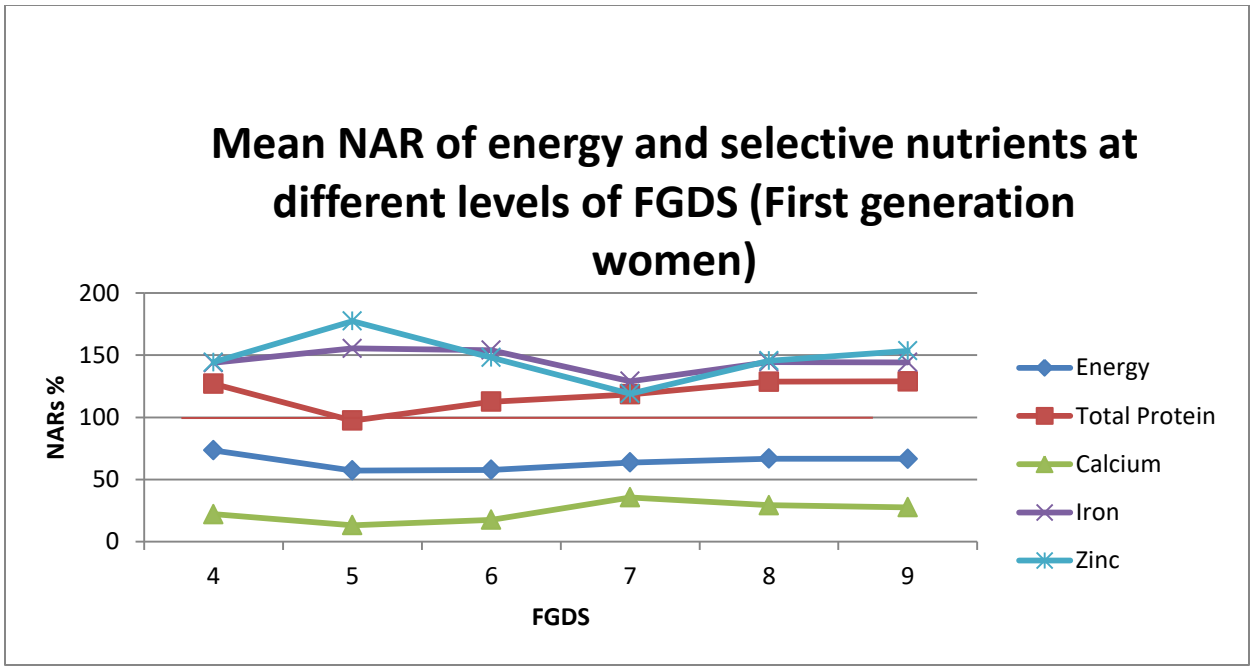

Figure 4.7: Mean Nutrient Adequacy Ratio (NAR expressed as %) of energy and nutrients at different levels of Dietary Diversity Score (DDS) for First Generation women

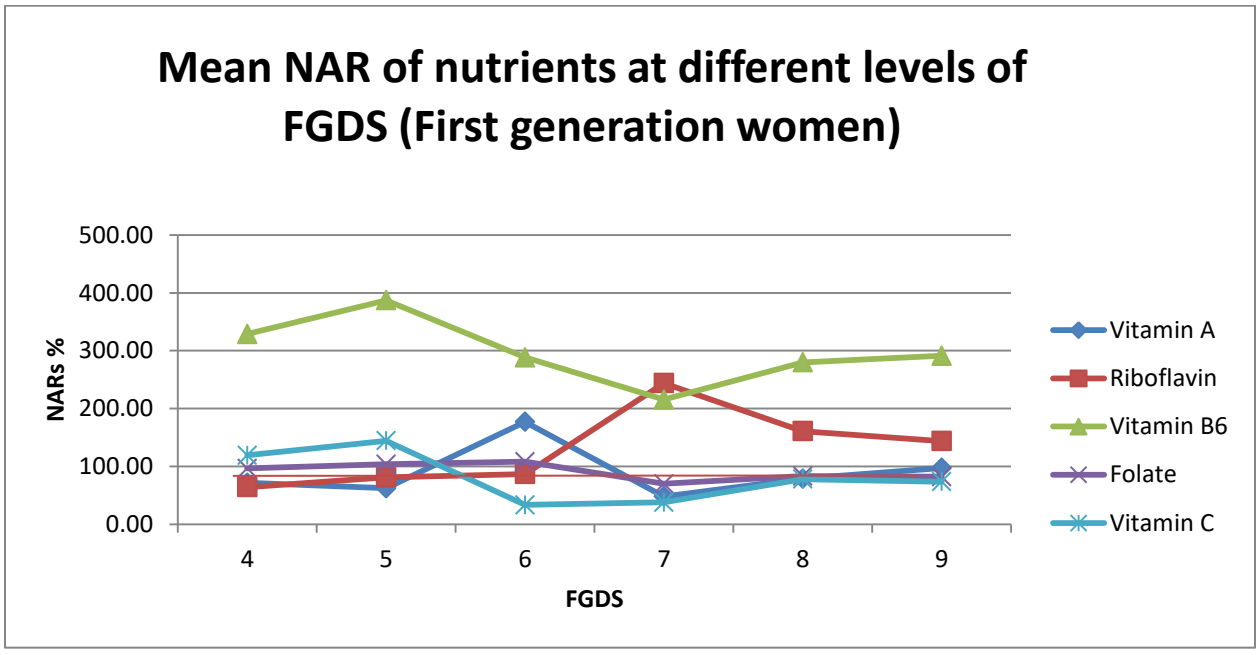

Figure 4.8: Mean Nutrient Adequacy Ratio (NAR expressed as %) of selected vitamins at different levels of Dietary Diversity Score (DDS) for First generation women

The results depicted in Figures 4.9 and 4.10 relate to the mean NARs at different levels of FGDS of NFG women. According to figure 4.9, an increase in FGDS did not impact the NARs % for energy, total protein,

calcium and iron; however a negative trend was observed for zinc. As the FGDS increased, the NARs % decreased, but the decline was never below NARs % of 100. Figure 4.10 also reports an increase in NARs was detected for all nutrients except for vitamin C, which still fell below the NAR of 100 % at a FGDS of nine.

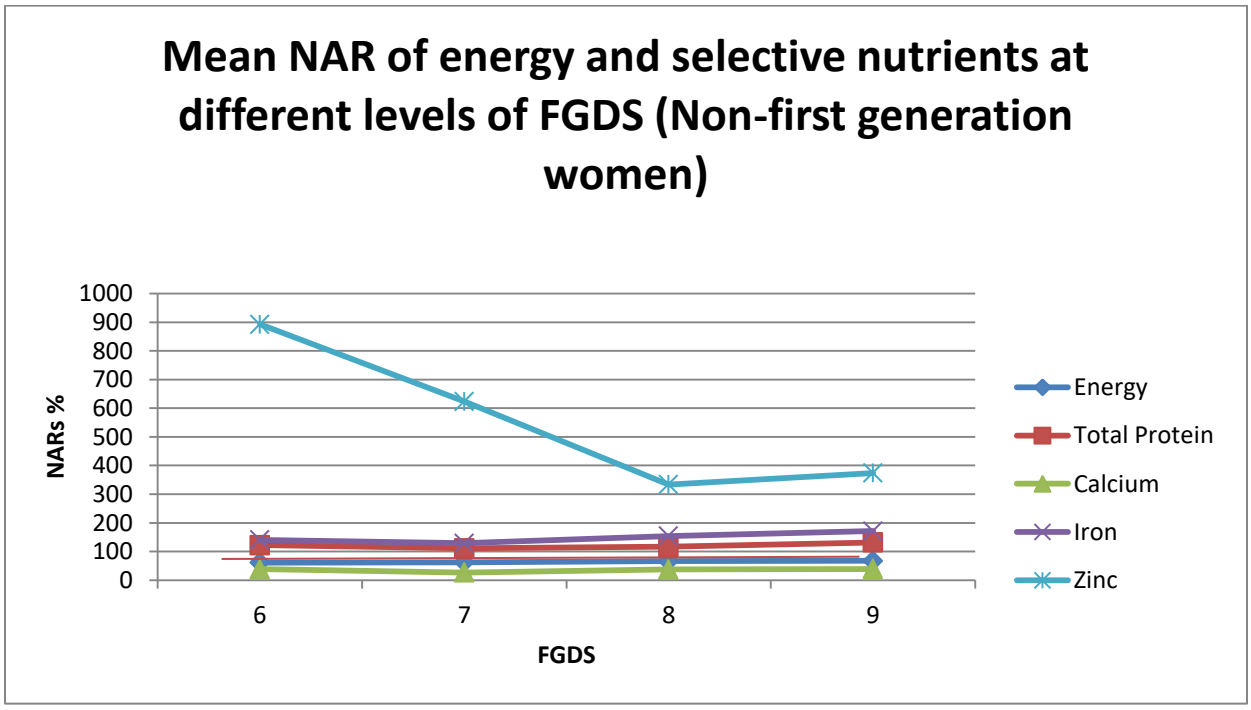

Figure 4.9: Mean Nutrient Adequacy Ratio (NAR expressed as %) of energy and nutrients at different levels of Dietary Diversity Score (DDS) for Non-First Generation women

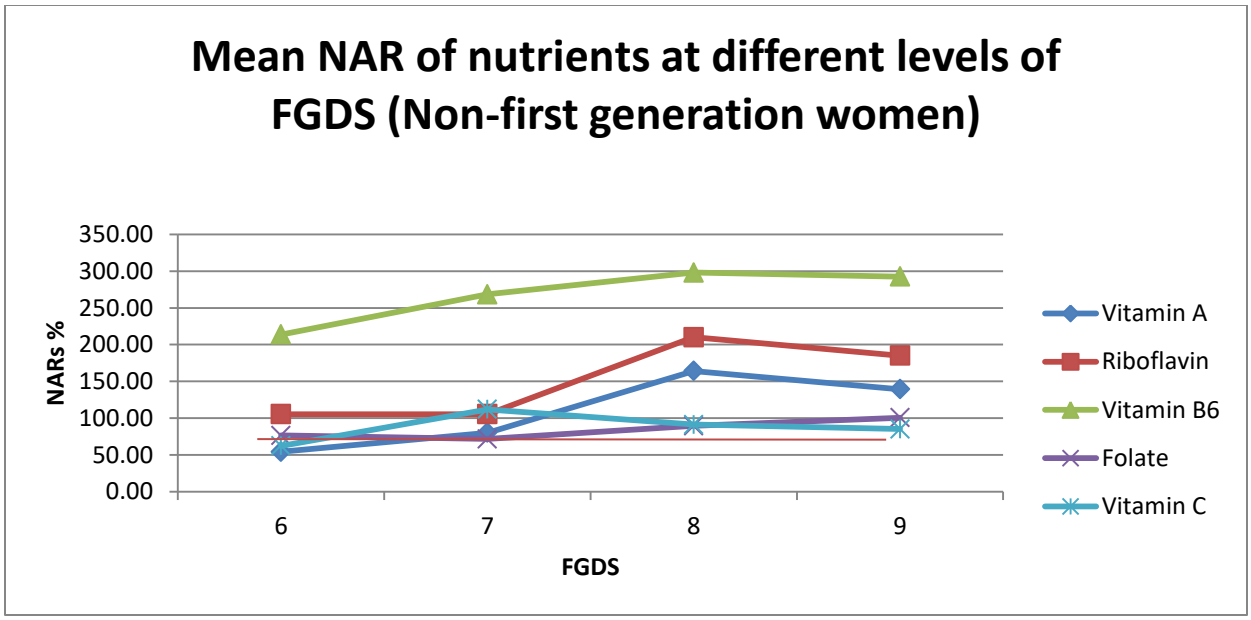

Figure 4.10: Mean Nutrient Adequacy Ratio (NAR expressed as %) of selected vitamins at different levels of Dietary Diversity Score (DDS) for Non-First generation women

4.4. ACADEMIC PERFORMANCE

Table 4.30 illustrates that all the men from both the FG and NFG groups passed matric with a competence rating of 3-6, which is indicative of moderate to meritorious achievement. Furthermore, none of the men (FG and NFG) obtained a distinction pass in matric. The first year results indicate that more NFG men (11.4%; n=5) failed the first academic year of university compared to 5.8% (n=3) of FG men. The majority of men (FG 92.31%; n=48 and (NFG 86.36%; n=38) passed the first year of study with a percentage rating of between 51-74%. One (1.92%) of the FG men and one (2.27%) of the NFG men obtained a distinction pass (75-100%).

Table 4.30: Summary of matric and first year academic results for FG men (n=52) and NFG men (n=44)

MATRIC RESULTS (Rating)	First generation (%)	First generation (n=52)	Non first generation (%)	Non first generation (n=44)
FAIL (1-2)	0	0	0	0
PASS (3-6)	100	52	100	44
DISTINCTION (7)	0.00	0	0.00	0
ACADEMIC RESULTS (%)	**First generation** (%)	(n=52)	**Non first generation** (%)	(n=44)
FAIL (0-49)	5.77	3	11.36	5

PASS (51-74)	92.31	48	86.36	38
DISTICTION (75-100)	1.92	1	2.27	1

Table 4.31 shows that all of the women (FG and NFG) passed matric with a competence rating of 3-6, whilst none of the women from both groups obtained a qualification with a distinction pass (7 rating). The first year academic results indicated that a higher percentage of NFG women (10.47%; n=9) failed the first academic year in university (0-49%) compared to FG women (5.13%; n=4). However, more NFG women (4.65%; n=4) obtained a distinction pass within the first year of study at university compared to FG women (1.28%; n=1). The first year academic results indicated that 93.9% (n=73) of FG women and 84.88% of NFG women passed with a 51-74%.

T-test correlations were conducted to determine if any correlations existed between the matric and academic results of FG and NFG women. None of the following were statistically significant: matric results of FG and NFG men (p=0.462), matric results of FG and NFG women (p=0.084), first year results of FG and NFG men (p=0.574), and first year results of FG and NFG women (p=0.810). A statistical significance was observed between the matric results and first year results of FG men (p=0.004), FG women (0.010), NFG men (p=0.000), and NFG women (p=0.000).

Table 4.31: Summary of matric and first year academic results for FG women (n=78) and NFG women (n=86)

MATRIC RESULTS	FG WOMEN PERCENTAGE (%)	FG (n=78)	NFG WOMEN PERCENTAGE (%)	NFG MEN (n=86)
FAIL (1-2)	0.00	0	0	0
PASS (3-6)	100.00	78	100	86
DISTINCTION (7)	0.00	0	0.00	0
ACADEMIC RESULTS	**FG WOMEN PERCENTAGE (%)**	**FG (n=78)**	**NFG WOMEN PERCENTAGE (%)**	**NFG MEN (n=86)**
FAIL (0-49)	5.13	4	10.47	9
PASS (51-74)	93.59	73	84.88	73
DISTICTION (75-100)	1.28	1	4.65	4

4.5 CORRELATIONS

Correlations were conducted using SPSS software version 21.0. The Pearson correlation co-efficient was used to establish whether an association existed between different variables for both men and women in both FG and the NFG groups. Only the statistically significant correlations are presented in figure 4.32.

Table 4.32: The relationship between variables that showed statistical significance in relation to group and gender

VARIABLES	GROUP AND GENDER	r-value	*p*-value
BMI AND ENERGY	NFG WOMEN	0.651	0.050
FVS AND BMI	NFG MEN	0.956	0.009
FIRST YEAR ACADEMIC AND MATRIC RESULTS	FG MEN AND WOMEN	0.617	0.044
FIRST YEAR ACADEMIC AND MATRIC RESULTS	NFG MEN ND WOMEN	0.734	0.030
MATRIC RESULTS AND MONEY SPENT ON FOOD	FG MEN AND WOMEN	0.874	0.014
NO MONEY TO BUY FOOD AND FIRST YEAR RESULTS	FG MEN AND WOMEN	0.903	0.011
NO MONEY TO BUY FOOD AND FIRST YEAR RESULTS	NFG MEN AND WOMEN	0.674	0.037
BMI AND MATRIC RESULTS	FG MEN	0.945	0.010
BMI AND FIRST YEAR RESULTS	NFG MEN	0.999	0.000
BMI AND MATRIC RESULTS	NFG WOMEN	0.700	0.042
WHtR AND FIRST YEAR RESULTS	FG MEN	0.759	0.044
WHtR AND FIRST YEAR RESULTS	NFG MEN	0.971	0.006
WHtR AND MATRIC RESULTS	NFG WOMEN	0.680	0.045

Table 4.32 indicates that few significant relationships observed were able to discern characteristics between men and women of both generations. The majority of the correlations were able to distinguish inter-gender characteristics between men and women of the same generation.

Significant relationships existed between having no money to buy food and the first year academic results for FG men and women (r=0.903, *p*=0.011), and NFG men and women (r=0.674, *p*=0.037). Among the FG men and women, a significant relationship existed between the matric results and the amount of money spent on food (r=0.874, p=0.014). It is clear from table 4.32, that the amount of money available to buy food impacts the type of food consumed, which affects the academic results of the students. A significant relationship also existed between the BMI and matric results of FG men (r=0.945, p=0.010) and NFG women (r=0.00, *p*=0.042), and BMI and first year academic results of NFG men (r=0.999, *p*=0.000). The results also indicated that a significant relationship also existed between the WHtR and matric results among NFG women (r=0680, *p*=0.045), WHtR and first year academic results of FG men (r=0.759, *p*=044) and NFG men (r=971, *p*=0.006). These results indicate that the nutrition status may impact the academic performance of the students.

5. DISCUSSION

The comprehensive data collected in this research study describes the various factors that impact on the academic performance of university students at Mangosuthu University of Technology. All the students that participated in the study were African, which is indicative of most universities situated in South African townships. The sample was fairly representative of both (FG and NFG) groups of students and both genders.

The socio-demographic profile of FG students has been described as students who fall within minority or previously disadvantaged groups, live in poor communities, and fall within a low income class (Sorina and Stebleton 2012: 679) compared to NFG students. In the current study disparities between the two groups of students were minimal, with the majority of the students from both groups coming from townships (FG 63.1%; n=82 and NFG 59.2%; n=77), which is not consistent with studies conducted in the United States of America (USA), which indicate that FG students are more likely to come from under-developed and poverty stricken parts of the country compared to non-first generation students who are likely to come from more affluent suburban communities (Mehta *et al* 2011: 20-24).

The results indicated that NFG students encountered similar financial challenges to FG students, with the highest percentage of students of both groups of students depending on student loans (FG 60.7%; n=79 and NFG 49.3%; n=64) to pay for university fees; even so, a higher percentage of FG students depended on student loans than NFG students. The socio-demographic results also showed that NFG students had more financial support from family (42.3%) compared to FG students (36.2%), indicating that the families of NFG students had more capacity to assist the students financially, more so than the families of FG students.

The majority of the students that participated in this study, both FG (76.8%; n=100) and NFG (81.5%; n=106) lived in university residences. According to Shah *et al* (2013: 356), the majority of university students that reside in university residences face financial challenges which may lead to food insecurity. The highest number of FG students had a monthly household income of between R0-R500 (38.5%; n=50), whereas the highest number of NFG students had a household income of between R501-R1000 (37.7%; n=49). This indicates that a higher percent of FG students are living below the poverty line of $1.90 a day - a new threshold adopted by the World Bank (Kakwani and Son 2016: 173) compared to NFG students. With this said, there were a few disparities in terms of the food insecurity of students while residing in university residences. Almost half of the students (FG 43.8%; n=57 and NFG 48.5%; n=63) indicated that they sometimes lacked money to buy food, which was consistent with the highest percentage of both groups of students spending between R401-R500 per month (FG=25.4%; n=33 and NFG=26.2%; n=34).

The nutrition status of the students was determined using three nutrition indicators, namely body mass index (BMI), waist circumference (WC), and weight to height ratio (WHtR). The results indicated that the higher percent of NFG students (men=72.73%; n=32 and women =45.35%; n=39) fell within the normal weight range (BMI 18.50-24.99), while among the FG students, the highest number of men, (86.54%; n=45), fell within the normal weight range (BMI 18.50-24.99), and the highest percentage of women fell within the overweight range (BMI ≥25.00-29.99). Non-first generation students were affected by obesity more so than NFG students, with one (2.27%) NFG man 13.92% (n=12) affected by obesity class I (BMI 30-34.99), and 4.65% (n=4) NFG women falling within the obesity class II range (BMI of 35-39.99), compared to none of the FG men affected by obesity, and only 3.85% (n=3) of the FG women affected. Furthermore, a higher number of NFG students exceeded the WC cut-off point for men (102cm) and women (88cm) compared to FG students, with none of the FG men exceeding the cut-off point for men, compared to 1.82% of NFG men, and only 20.51% of FG women exceeding the cut-off point for women compared to 32.61%. The WHtR also indicated that a higher percent (63.74%) of NFG women exceeded the cut-off point (>0.5) compared 60.25% of FG women. These results indicate that NFG students are at a higher risk of obesity and obesity related diseases compared to FG students (Barakat, Barakat and Baaj 2012: 145)

The abovementioned results also indicate that a higher percentage of women (FG and NFG) were at risk of overweight and obesity compared to men. These results are in accordance with the results reported by SANHANES (2014), which indicated that in South Africa, 25.3% of women between the ages of 15-24 were overweight, and 36.3% of women between the ages of 25-34 years were obese, which is higher than the percentages (19.2% and 8.1% respectively) reported for men in the same age groups. Factors that impact the risk of being obese include the quantity and quality of food consumed and the level of physical activity, and good dietary knowledge being associated with better food choices (Son *et al* 2014: 205-207). Literature indicates that non-first generation students come from families where either the parents or siblings have previously attended an institution of higher learning (Mehta *et al* 2011: 20-24), which would suggest they have better nutrition knowledge. A study conducted among dietetic and non-dietetic students in a South African university, however, indicated that dietetic students were more likely to experience distorted eating compared to non-dietetic students (Kassier and Veldman 2014: 112), which would suggest that nutrition education alone may not translate into better eating choices among university students.

Numerous studies have also linked the increased incidences of obesity among young adults (especially among university students) to increased energy intake, and in particular the consumption of energy drinks (Han and Powell 2011: 130-131). In this particular study, a significant relationship existed between BMI and energy intake (r=0.651; and *p*=0.050) among NFG women, with a high energy intake resulting in a higher BMI. Although a positive correlation was established among NFG students only, this result supports the higher risk of obesity observed among NFG students, in relation to BMI, WC, and WHtR.

This is of particular interest, especially since the most prevalent non-communicable diseases (NCDs) among the youth and adult population in South Africa are high blood pressure, diabetes, stroke and heart disease (DoH, 2013: 4), which, according to the DoH, could be attributed to low levels of nutrition education, among many South Africans.

Factors that impact on food intake include affordability, and the results are concurrent with literature and socio-demographic results, which reported that NFG students are more likely to come from households that have a better economic position (Van den Berg and Raubenheimer 2015: 165). This would translate to better household food security and would explain the higher prevalence of obesity among this group of students compared to the FG group. Similar levels of food insecurity were observed among men and women of both groups (based on money spent on food per month) in this particular study, which is consistent with a study conducted at the University of the Free State that reported that 60% of the students experienced food insecurity with hunger and 26% experienced food insecurity without hunger (Van den Berg and Raubenheimer 2015: 161). Furthermore, the highest prevalence of food insecurity was among black and coloured first generation students, and students who were on financial aid (NSFAS), which is consistent with a higher number (60.7%; n=79) of FG students on NSFAS compared to NFG (49.3%; n=64). This would suggest that although similar amounts of money were spent on food per month by both groups of students, FG students are at more risk of food insecurity compared to NFG students. This would support the higher incidence of obesity among NFG students compared to FG students.

The socio-demographic results also indicated that although the majority of students (FG=51.5%; n=67 and NFG=48.5%; n=63) consumed two meals a day, a higher percentage (8.5%; n=11) of FG students consumed one meal a day compared to NFG students (2.2%; n=3), while more NFG students (43.1%; n=56) consumed three meals a day compared to FG students (33.8%; n=44). This would suggest that NFG students on average consume more food compared to FG students, which would explain the higher prevalence of obesity within the NFG group of students. These results are also consistent with results indicating that a higher percent of FG students lived below the poverty line (less than $1.90), which would explain the less frequent meals consumed by FG students compared to NFG students.

Literature has questioned the effectiveness of BMI, while anthropometric measurements involving central adiposity have been greatly favoured, especially in establishing cardiovascular risk (Stevens, Katz and Huxley 2010: 6). In this particular study, however, all three anthropometric measurements were able to determine that NFG students are more susceptible to obesity compared to FG students.

Papier *et al* (2015: 324-326) reported on significant dietary changes that come with the transition from high school to university, and with increased independence, which among first year university students is associated with a higher energy intake, with high carbohydrate foods and snacks taking precedence. The top 20 foods list indicated that the carbohydrate intake of FG and NFG students followed a similar trend,

with the top three foods being carbohydrate rich food sources (maize meal, bread/rolls and rice), and with the exception of the women, two of the top three foods were carbohydrate based (rice and bread/rolls). Furthermore, there were minimal disparities with regard to the per capita intake per day, and mean intake per frequency, with the top food among FG men being maize meal pap, with a per capita intake of 213.78g and a mean intake per frequency of 124.91g consumed 89 times in 24-hours, while among the NFG men, the most popular food was rice, with a per capita intake of 216.25g and a mean intake per frequency of 108.13g consumed 88 times in 24 hours. Similarly, among the FG and NFG women, the most popular food was bread/ rolls with a per capita intake of 93.73g for FG men and 98.72g for NFG women, and a mean intake per frequency of 43.52g (FG women) and 42.03g (NFG women) consumed 168 times in 24 hours for FG women, and 202 times in 24 hours for NFG women.

The dietary nutrient analysis supported the higher prevalence of obesity among NFG students, indicating that this particular group had a higher mean (SD) energy intake (men=8 230.44kJ±2 943.664 and women=6 676.10kJ±2 048.927) compared to the FG men (7 245.75kJ±2 368.621) and the women (6 642.14kJ±2 471.363), although the differences were not as pronounced among the women. The NFG men also consumed a higher mean (SD) intake of fat (48.75g±18.178) and protein (70.98g±25.534) compared to FG men with a mean intake of (43.68g±21.323 and 62.62g±21.984) respectively. The mean carbohydrate intakes were more than double the RDI for carbohydrates (100g) for both men and women of both groups, which accounts for carbohydrate based foods falling within the top three foods in the top 20 foods lists. Furthermore, although both FG and NFG students exceeded the carbohydrate EARs, NFG students also consumed higher mean intakes of 288.93g±101.817 (NFG men) and 251.42g±83.135 (FG men), and among women, 223.05g±68.302 (NFG) and 214.21g±79.128 for (FG).

The majority of the carbohydrate based foods consumed by the students were refined carbohydrates, and the fact that over 90% of the men and women from both groups failed to meet the AI (men 38g and women 25g) for dietary fibre emphasizes the low quality of carbohydrates consumed by students. The consumption of whole grains has been associated with reduced risk of obesity and obesity related diseases (Song *et al* 2014: 54), and unfortunately, the students that participated in this particular study consumed predominately refined carbohydrates. Fruits and vegetables also contribute to dietary intake. The lack of fruits and vegetables on the top 20 foods list corroborates the low mean intakes of fibre observed among FG students (men=17.70g±7.602 and women=14.24g±6.156) and NFG students (men=18.11g±8.117 and women=15.14g±7.011). Furthermore, all the students from both groups failed to meet the World Health Organization (WHO) recommendation of consuming ≥400g of fruit and vegetables a day; however, FG men (234.40g) and women (259.11g), showed a slightly higher per capita intake of fruit per day than NFG men and women (196.86g and 246.60) respectively. Several factors impact on fruit and vegetable intake, with the most important being availability/accessibility and price (Deshpand and Basil 2009:145), and the few disparities that exist between both groups of students' fruit and vegetable intakes are consistent with the socio-demographic results which indicated that the highest percent of both

FG (25.4%; n=33) and NFG (26.2%; n=34) students spent the same amount of money per month on food (R401-R500).

Many research studies have attributed the low consumption of fruits and vegetables to the cost associated with these food groups and according to Ronquest-Ros, Vink and Siggie (2015: 64), a healthier diets costs up to 69% more than the traditional South African diet. This can be attributed to the low fruit and vegetable consumption on the part of the general public, and which is significantly reflected among university students (Desphande and Michael 2009: 145). While both the FG and NFG students showed a low fruit and vegetable intake, the fruit group in particular, however, displayed the highest food variety within a food group across the board, with 14 different fruits consumed in one week by all the students who participated. The results were not consistent with the fruit intake reported by the 24 hour recalls, which indicated that the male and female students from both groups are not consuming enough fruit and vegetables, as also seen in the top 20 foods list, which showed that at most, only two fruit and vegetable food items were found, for both male and female students of both groups. This inconsistency could be attributed to the fact that the 24 hour recalls were only over a three day period, while the food frequency questionnaire document foods were consumed over seven days, and the mean intake was about four fruits for both FG and NFG students. Also, although the fruits appear on the top 20 foods list, the fruits were consumed in small quantities with the per capita intake for apples being 13.91g-16.58g for FG students, and 14.20g-19.30g for NFG students.

Both the FG and NFG students reported low food variety scores (<30 individual foods), and minimal differences existed between the FVS of both groups of students, with FG men reporting a slightly higher mean (SD) FVS (28.56±10.079) compared to 27.41±10.342 of NFG men. Among the women, however, NFG women reported a higher mean (SD) FVS (29.92±8.549) compared to 28.67±10.775 (FG women). No significant differences were noted between the FG and NFG group with regard to food diversity scores, with the majority of men (FG=98.08%; n=51 and NFG=93.18%; n=41) and women (FG=(94.9%; n= 74 and NFG=100%; n=86) from both groups reporting a high food diversity score (6-9 food groups). Jaawardena *et al* (2012: 314) reported that an inverse relationship existed between food diversity and obesity, indicating that when food diversity increased, more food was consumed among Sri Lankan adults (>18 years of age). Furthermore, the study showed that higher variety scores were associated with increased risk of obesity, especially, when the highest FVS was for high energy foods. Non-first generation women reported a higher FVS and food diversity scores compared to FG women, and also reported a higher incidence of obesity class I and class II combined (18.60%; n=16) compared to 3.85%(n=3). These result are consistent with those indicated by the Sri Lankan university students, and although minimal differences existed between the FG and NFG students as a group, among women, NFG women reported a higher FVS and diversity score, which shows that inter-gender differences existed.

The food group with the highest FVS was the cereal group for all students involved in the study, with NFG women reporting a slightly higher mean (SD) FVS within this particular food group (5.95±1.651) compared

to FG women (5.74±1.647), which is consistent with the overall FVS for both groups of women. The Pearson co-efficient correlations also reported that a significant relationship existed between FVS and BMI (r=0.956; *p*=0.009) among the NFG men, with an increased FVS resulting in a higher BMI. This result is consistent with results reported from the Sri Lankan study, and further highlight that few inter-group differences existed between FG and NFG students, but rather that inter-gender differences existed between the FG and NFG students. Although the majority of the FG and NFG students related a high food diversity score across the board, the nutrient analysis indicated that the majority of the students, regardless of the group they fell under, failed to meet the RDI for most micronutrients. Between 80-100% of the male students (both FG and NFG) failed to meet the RDI's for calcium, magnesium, and vitamins C, D, E, and K. A similar trend was observed among the female students of both groups.

The top 20 foods indicate that milk and cheese were the only food sources of calcium that were consumed by all students. The NFG students reported a higher per capita intake and mean intake per frequency for both milk and cheese compared to the FG students, except for the mean intake per frequency of cheese of the women, which was slightly higher among the FG women (6.05g) compared to 5.88g for the NFG women. All the FG students (100%) and about 97% of the NFG students failed to meet the DRI for calcium (1000mg/day). However, the nutrition analysis also indicated that NFG students consumed a higher mean (SD) (men 268.01±202.641 and women 363.97±221.804) intake of calcium compared to FG students (men 250.28±128.870 and women 280.33±178.789), which is consistent with the top 20 foods. Many studies have failed to make a link between dairy consumption and obesity. This was reiterated in a study conducted among female medical students at a Chinese university which found no association between the consumption of calcium rich foods and obesity and central obesity (*p*=>0.05) (Bank, Ghanjali, Ghalaeh and Azadbakht 2013: 1). Crichton and Alkerwi (2014: 936) stated that in a study sample among Luxembourg's adult population, the increased consumption of full cream dairy products (milk, cheese and yoghurt) resulted in a lower likelihood of obesity (p=<0.01) compared to adults that consumed lower fat varieties. The calcium food sources consumed by both FG and NFG students were full fat. Non-first generation students consumed a higher intake of calcium based foods, and were more affected by obesity compared to FG students, which is not consistent with the study conducted among the Luxembourg adult population.

A statistically significant relationship was established between the calcium intake of FG women and NFG women (*p*=0.009). However, the mean intake per frequency indicated that small portions of both milk and cheese were consumed per portion, which is consistent with a nutrition analysis indicating that between 97-100% of both the FG and NFG students showed an intake of <100% of RDI for calcium. More concerning was that the majority of all the students from both groups and genders reported an intake of <100% of the DRI for vitamin D, which plays an important role in calcium metabolism and good bone health (Hong, Kim and Lee 2013: 409). A deficiency of both calcium and vitamin D simultaneously may maximize age related bone density loss, which hastens the onset of osteoporosis. The top 20 food lists

also reported that none of the already limited food sources of vitamin D were evident. The dairy group also showed a low FVS (0-3 foods) across the board for both FG (men 2.92±1.622 and women 2.82±1.666) and NFG (men 2.62±1.549 and woman 3.07±1.404), which is consistent with the results from the top 20 foods list and nutrition analysis for calcium and calcium rich food sources.

Adepoju and Ojo (2015: 2209) reported on the increased intake of fat and sugar among university students, with strong emphasis on and concern about the amount of carbonated drinks and energy drinks consumed. In a sample of Ibadan university students, 52.1% of the students consumed at least one can of energy drink a day. The main sugar sources for all students in the current study according to the top 20 foods list were table sugar, carbonated cold drinks and diluted squash drink. These three sugar sources were among the top 10 foods for both FG and NFG students suggesting that these foods are consumed more frequently. Carbonated drinks were 6th on the list for both FG and NFG men, with NFG men reporting a higher per capita intake per day (142.52g) compared to FG men (115.67g). Among the women, carbonated drinks ranked 8th on the top 20 food list, with a per capita intake per day of 106.07g (FG) 96.95g (NFG). The excessive amount of added sugars found in carbonated cold drinks has been linked to a higher prevalence of overweight and obesity and currently, carbonated cold drink consumption is the only method to measure the amount of added sugar consumed by an individual in epidemiology studies. Additionally, Adepoju and Ojo (2014: 2211) further highlighted a positive correlation between increased energy drink consumption and weight gain. Non-first generation (NFG) male students consumed a higher (122.96g) mean intake per frequency of carbonated drinks compared to FG male students (117.94g) with both groups consuming carbonated drinks 51 times in 24 hours, while FG women consumed a higher (113.34g) mean intake per frequency (consumed 73 times in 24 hours) compared to 106.89g consumed by NFG women (78 times in 24 hours). These results further report subtle differences between FG and NFG students in relation to carbonated drinks intake.

All the students (both FG and NFG) fell within the WHO's percentage of 10-15% protein contribution towards the total energy intake. Although NFG students had fewer protein food sources on the top 20 foods list compared to FG students, NFG men reported a higher mean (SD) intake of protein (70.98g±25.534) compared to 62.62g±21.984 by FG men. Among the women, however, FG women showed a slightly higher mean intake of protein (57.97g±23.248) compared to (55.94g±18.397). Both the FG and NFG students exceeded the RDI for protein (56g and 46g for men and women respectively). Even though NFG men presented a higher mean intake of protein compared to FG men, the majority of the NFG men (86.36%) reported a total mean intake of protein which was <100 of the DRI compared to 36.54% of FG men, while among the women, the percent of those not meeting the DRI for protein were similar for both FG and NFG. These results indicate that the 13.64% of NFG men that met the RDI for protein consumed higher portions, which is consistent with the results presented by the top 20 foods list that reported that the top protein source food was chicken stew for both FG and NFG men. The mean intake per frequency for chicken was 74.49g consumed 62 times in 24 hours for FG students (n=52),

compared to 71.37g consumed 73 times by NFG(n=44) students. This shows that although the mean intakes per frequency were similar, the number of servings indicates that a higher number of the NFG students consumed more than one portion of the chicken stew in 24 hours compared to the FG students.

Red meat costs more than white meat in South Africa (excluding some fish varieties); however, there were no disparities in the amount of money spent on food for both FG and NFG students, which could have explained the affordability of red meat of one generation group over another. There was a slightly higher FVS for the meat group among the FG students compared to the NFG group, and this supports the higher total mean intake of protein reported for the NFG men compared to the FG men. Red meat consumption increases the risk of CVD and colon cancer, especially when non-lean cuts are consumed (McAfee, McSorley, Cuskelly, Moss, Wallace, Bonham and Fearon 2010: 6), which in most cases are more affordable compared to leaner cuts. Additionally, red meats are associated more with saturated fat, which is associated with obesity. Non-first generation men consumed a higher per capita intake of beef stew (56.06g), compared to FG men (26.76g). This would suggest that the NFG men consumed a higher intake of saturated fat, which has been associated with overweight and obesity (Foster, Alaunyte, and Amirabdollahian 2015: 320), and this is consistent with the BMI and WC results that indicate that a higher percent (18.18%; n=8) of NFG men were classified as being overweight (BMI 25-29.99) compared to FG students (11.54%; n=6); obese (BMI >30) 2.27% (n=1) compared to zero % of FG men; and 1.82% (n=1) of NFG exceeding the WC cut-off point (>88cm) compared to zero % of FG men. A higher percent of the FG students failed to meet the DRIs for iron (men 7.69% and women 21.8%) and zinc (men=32.69% and women=21.79%) compared to the NFG students (men 6.82 and women 20.93%) (men 22.73% and women 0.00%), which are sourced from animal sources of protein.

In this particular study, no inconsistencies were observed with regard to the matric results, as all the students, regardless of gender and group, passed matric with a rating of between 3-6, and none of the students passed matric with a distinction pass (7 rating). Bearing in mind that the study was carried out in a university located in a township, this would then suggest that the profile of the students attracted by such universities is a student that comes from a disadvantage schooling system. Longmire-Avital and Miller (2015: 375) also report that FG students make up the majority of the population in predominantly black universities in the United States of America. This is consistent with the socio-demographic results which indicated that the majority of the students that participated in the study lived in townships, with a greater percentage (63.1%; n=82) of FG students living in townships compared to NFG (59.2%; n=77) students.

Correlations conducted between money spent on food and matric results and BMI and matric results indicate that a statistically significant relationship existed between the money spent on food and matric results between FG men and women (r=0.874; p=0.014); similarly, a statistically significant relationship also existed between the BMI and matric results of FG men (r=0.945; p=0.010), BMI and matric results of NFG women (r=0.700; p=0.042), and WHtR and matric results of NFG women (r=0.680; p=0.045). The

amount of money spent on food impacts diet quality, and the results suggest that diet quality and nutrition status have an impact on academic performance. In a study conducted among university students in Chile, no significant relationship was established between academic performance and nutrition status; however, an association was made between the students' low level of fitness and low academic performance (p<0.050) (Godoy, Valdes, Farina, Garcamo, Medina, Meneses, Gedda and Duran 2014: 1722). A Korean study conducted among adolescents, however, reported that obesity among boys was associated with poor academic performance (p=<0.001), and among girls, a statistically significant relationship existed between obesity and poor academic performance (p<0.001) (Kim and So 2013: 380). Both studies support the results from the current study, that is, the association between nutrition status and academic performance. However, no relationship was established between nutrition status and matric results between FG students and NFG students, as positive correlations did not apply to the full sample of students (i.e. FG and NFG men and women).

According to Sorina and Stebleton (2012: 679), first generation students face many challenges that may impact their academic performance at university, and these include lower family income, being unprepared for university or college, and having dependents. Furthermore, first generation students are 45% less likely to return for the second year of study. The first year results, however, showed that a higher number of NFG (11.36%; n=5) men and women (10.47%; n=9) failed the first year of university compared to the FG men (5.77%; n=3) and women (5.13%; n=4). These results are not consistent with literature which suggests that FG students were more likely to fail the first year of university, hence supporting the low retention rates among FG students (Horwedal 2008: 11-12).

In terms of the first year results, correlations in this study indicated that a significant relationship existed between not having money to buy food and first year results between FG men and women (r=0.903; p=0.011) and NFG men and women (r=0.674; p=0.037). Additionally, a significant relationship existed between the BMI and first year results of NFG men (r=0.999; p=0.000), and between WHtR and first year results of FG men (r=0.759; p=0.044) and NFG men (r=0.971; p=0.006). These results highlighted the fact that there were more inter-group gender differences compared to group differences (whether FG or NFG) in this particular study. The majority of the men and women from both groups passed with a pass of between 51-74%. This would indicate that there are no clear differential characteristics between the FG and NFG groups in terms of academic performance; however, the slightly higher failure rates observed among the NFG students may indicate that academic performance may be dependent on other related factors, and not only on whether a student is a FG students or NFG student.

Employment while enrolled in university is one of the main reasons attributed to the low pass rate among students, and in particular FG students. Deliens *et al* (2013: 123), however, stated that although employment may have an impact on the academic performance of university students, students that work in a job that is related to their field of study may perform better than other students who are not employed at all during their years of study. A small equal percentage of FG (3.8%; n=5) and NFG (3.8%; n=5)

students were employed while studying, which does not support the study conducted by Mamiseishvilli (2010: 65), which indicated that FG students are more likely to be employed compared to NFG students. Furthermore, under preparedness and lower familiarity with the university culture was cited as a major reason for the low retention and failure rates among FG students. This did not have a noticeable impact on the FG students involved in this particular study, based on the academic results of both the FG and NFG students. One of the major reasons could be the wealth of information available in the media, which is sufficient to give prospective students relevant information and which may make them more prepared for university life. The socio-demographic results indicated that the majority of students, irrespective of their group, had access to a radio, television, cellphone and a laptop and computer. A greater number (28.46%; n=37) of NFG students, however, had access to personal internet than FG (18.46%; n=24) students, which would suggest that NFG students have access to more information than FG students. Media platforms also enable any prospective students to research and familiarize themselves with student life and culture and the facilities offered at different universities, which explains why unpreparedness for university would not be a determining factor of the academic performance of both groups of students that participated in the study.

Various correlations strengthened the relationship that exists between diet and nutrition status and the academic performance of the students, although the relationships were not significant for both groups of students simultaneously. No noticeable differences were observed to differentiate the impact of diet quality and nutrition status on academic achievement between FG and NFG students, which could be attributed to the fact that in predominately black universities, the margin that separates the characteristics between FG and NFG students has become minimal, and possible differences could be observed if the study was conducted in a university that attracts students from varying economic backgrounds and races.

4.7 CONCLUSION

This chapter presented the results of the study conducted among university students, with the aim of discerning characteristics specific to two groups of students: first generation students and non-first generation students. The results were in line with the study objectives of establishing the diet quality, nutrition status and the academic performance of the students. The majority of the students from both groups resided in university residences, and most students originated from townships. Although income per month was higher among the NFG students, the amount of money spent on food per month was similar. Contrary to claims made in literature resulting from previous studies, few differences in relation to the socio-demographic profile between FG and NFG students were observed. The overall diet quality of all the students was not good, since the majority of students failed to meet the RDIs for most micronutrients. The FVS and dietary diversity scores between the men and women of both groups were similar. Nutritionally, there was a higher prevalence of obesity among NFG students compared to FG students, with a higher prevalence among the women of both groups. No noticeable differences were

reported with regard to matric and first year results, with only a slightly higher number of NFG students failing the first year of university compared to FG students, which is not consistent with the differences depicted in literature regarding the two groups of students.

CHAPTER 5 – CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

In chapter four, the results of the study were discussed and with reference to other studies consistent with the main objectives of the study. A discussion of these results followed in order to identify the objectives required to develop effective nutrition programmes tailored to promote good physiological and mental health. Literature has indicated the significance of nutrition programmes in yielding positive academic results for university students and has also highlighted the possible challenges that might impact the effectiveness of the nutrition programmes. The limitations which outlined the process of the study and the recommendations outlining future prospects will also be discussed in this chapter.

5.2 LIMITATIONS OF THE STUDY

- The first limitation was the students' unwillingness to participate in the study due to time constraints. Most students felt that the time required to complete all the questionnaires was too long, especially since students were in-between classes. Many students could not complete the questionnaires due to being late for the next class, and most students did not return to complete them.
- Completing the 24 hour recall questionnaire was a challenge for many students as most of them do not really keep track of what they eat. Many students found it easy to recall what they had eaten the previous day, but it was a challenge recalling what was eaten two days previously and this may have resulted in over- or under reporting.
- Relatively, only a few South African studies have looked specifically at university students and the factors that affect their academic performance; as a result this has limited the literature review to more of a global outlook.

5.3 MAIN FINDINGS

5.3.1 LITERATURE

Literature available on university students indicates that diet changes as a result of the transition from high school to university can have a detrimental impact on their eating habits. The majority of the studies emphasized the role of independence, in the form of living alone in a rented flat or university residence, and changed eating habits. Food insecurity, especially among students living away from home is prevalent, and few measures have been put in place to address the problem. Although the National Students Financial Aid (NSFAS) contributes towards ensuring students are able to pay for fees and accommodation, there has been little progress in addressing the food insecurity that exists among

students. Institutional programmes, such as university food banks, have attempted to eradicate this problem; however, such programmes are not given support financially.

The lack of nutrition knowledge is considerable among university students, and this is inclusive of medical and nutrition students. The impact of nutrition knowledge on subsequent food choices seems inconclusive, with some studies acknowledging a positive impact on diet and nutrition status, and others placing emphasis on the importance of early family eating practices as having a greater influence on food choices in later life. The biggest obstacle in developing nutrition tools for this particular section of the population group is the rapidly changing trends and areas of interest; however, social media via technological platforms, has been shown to be effective, as the majority of university students are on at least one or more social media application .

Although no known study has previously been conducted to discern the eating habits of first generation verses non-first generation students, the majority of the research indicates that university students generally consume a processed diet, with an abundance of saturated fat, sugar and salt. Energy drinks and carbonated soft drinks, which are laden with added sugars, are also popular among university students, and this contributes to an incidence of overweight and obesity among students. Carbohydrate consumption is also high, with refined carbohydrates making up the majority of the students' energy intake. Fast food is consumed by the majority of students, with convenience being the motivating factor towards fast food consumption versus home-cooked food. Furthermore, fast food is more readily available, and in some instances may be relatively inexpensive compared to healthy food choices.

Unhealthy food choices impact on nutrition status, and with limited physical activity, the number of overweight and obese students is steadily increasing. The role that socio-economic status plays in making students susceptible to being overweight or obese is still unclear. Some studies indicate that affluent communities are more prone to overweight and obesity due to increased food availability, while other studies suggest that low income communities would be at higher risk due to their limited food budget which makes it difficult to afford healthy foods, and so they rather settle for high energy and high fat foods, which are in most cases cheaper. The increase in overweight and obesity numbers impacts on the prevalence of non-communicable diseases, which include heart disease, diabetes, and hypertension.

The literature also states that academically, first generation (FG) students are more inclined to do well, compared to non-first generation (NFG) students. Research indicates that family responsibilities, financial burden, and the unpreparedness for university are the factors contributing to the low retention of FG students. Furthermore, FG students are more likely to work while enrolled at university, and this may play a significant role in the high dropout rate among FG students.

5.3.2 SOCIO-DEMOGRAPHIC PROFILE

The socio-demographic results indicated that few disparities existed with regard to the students' backgrounds, with the majority of FG and NFG students originating from townships. The majority of both the FG and NFG students stayed in university residencies for the duration of their studies. A higher number of FG students depended on student loans than NFG students, with more NFG students receiving additional financial assistance from family than FG students. The percentage of FG students living below the World Bank's poverty threshold of $1.90 per day was higher compared to NFG students, although the amount spent on food per month by both groups of students was similar, and with almost half of both FG and NFG students indicating that they sometimes lacked money to buy food.

5.3.3 ANTHROPOMETRIC INDICATORS

Body Mass Index (BMI) and WC measurements indicated that NFG students reported a higher incidence of obesity (BMI >30) and central obesity (exceeding cut-off points of 88cm and 102cm for men and women). These results also imply that NFG students are at greater risk of obesity related diseases such as CVD and diabetes. Gender differences, however, indicated that women (FG and NFG) were most affected by overweight and obesity compared to men.

5.3.4 DIETARY AND NUTRITION ADEQUACY

The findings of this study indicated minimal differences between FG and NFG students with regard to diet and nutrition adequacy. The results reported that carbohydrate based foods made up the majority of both the FG and NFG students' diets, and the carbohydrates consumed lacked dietary fibre, as reported by both the nutrition analyses and the top 20 foods list. Fruit consumption was also low among both groups of students, with none of the student groups meeting the WHO's recommendation of consuming ≥400g fruits and vegetables per day, even though a slighter higher per capita intake was observed among FG men and women. A similar pattern was observed with regard to FVS and food diversity scores, where few disparities existed between the two groups of students. The majority of both the FG and NFG students met the DRIs for most of the nutrients; however the most concerning finding was that all the FG students and 97% of the NFG students failed to meet the DRI for calcium. A consistent pattern continued with no substantial differences being observed with regard to sugar intake and protein intake among both FG and NFG students.

Apparent differences were noted, however, among male and female students of both generations for dietary diversity and nutrition adequacy; however the differences were not consistent for males nor across all measured variables. Non-first generation males, for example, consumed a higher mean intake of macronutrients compared to FG males, while among the female students, subtle differences existed. While with regard to FVS, FG males reported a higher FVS compared to NFG males, among the females, NFG females reported a higher FVS compared to FG females, while no notable differences were

observed among the males and females of both generations. No notable differences were observed between the micronutrient intakes of either the males (FG and NFG) or the females.

5.3.6 ACADEMIC PERFORMANCE

All the men and women (FG and NFG) passed matric with a competency rating of 3-6 and none of the students obtained a distinction pass (7) in matric. Similarly, the first year academic results also indicated that the majority of the men and women, both (FG and NFG), passed (51-74%), with more NFG students failing the first year (men and women), compared to the FG students.

The results indicated that a significant correlation exists between the money spent on food and matric results and first year academic performance, and a positive relationship was reported between nutrition indices i.e. BMI and WHtR, and matric and first year results. Although no direct correlations were observed between diet quality and academic performance, these results suggest that diet and nutrition status have an impact on academic performance, even though the results were not able to specifically differentiate the impact between the FG and NFG students.

5.4 CONCLUSION

This study has found that diet and nutrition status have an impact on the academic performance of university students in a university in Durban. However, due to the lack of diversity with regard to socio-demographic factors, including socio-economic profile and race, no notable differences were observed except in the case of nutrition status, where a higher incidence of obesity was observed among NFG students compared to FG students. Inter-gender differences were more apparent compared to inter-generation differences

5.5 RECOMMENDATIONS

Young adults are our future, and any obstacle that hinders the students' academic performance, ability to complete a degree in a specified time-frame, or gain employment, and achieving social and economic emancipation should be given high priority. Interventions aimed at alleviating challenges that face students that may impact academic performance are dependent on partnerships within and outside institutions of higher learning. These interventions would most likely involve government; non-governmental organizations, private business entities as well as various institutions of higher learning. These strategies should not only focus on implementing corrective measures, but also put structures in place to manage existing interventions to ensure their effectiveness and promote progress.

5.5.1 RECOMMENDATION 1: POLICY MAKERS

- Government Initiatives

  Government has worked very hard to ensure that good quality education is available for young South Africans. This has been made possible by introducing the National Students Financial Aid Scheme (NSFAS), which provides deserving underprivileged South African students with loans to pay for tuition, textbooks, accommodation and food. Munro, Micheals, Heather and Shelly (2013: 168) reported that students on financial aid in South Africa were actually found to be more food insecure compared to those who did not receive financial aid, highlighting the ineffectiveness of this intervention. Food allowances alone are not enough to ensure that students consume nutritionally adequate diets. Therefore, it is important to re-evaluate the financial aid benefit to ensure the amount given to students is in line with rising food prices and the high cost of living, and also to regulate whether students actually buy food with the allowance.

- **Revising the Integrated Nutrition Programme (INP)**

  In South Afica, the INP is mainly focused on children, mothers and the elderly. This programme also includes HIV and AIDS and Tuberculosis sufferers. Unfortunately, nutrition programmes that focus on the young specifically are not available, and any available national programmes are not reaching the youth due to the inappropriate media platforms being used. Furthermore, the INP co-ordinators need to take the youth into consideration when developing nutrition strategies to address under-nutrition and over-nutrition, and choose appropriate methods to reach this particular population group.

- **Institutions of Higher Education and Nutrition Initiatives/Interventions**

  Institutions of higher learning have a crucial role to play in addressing nutrition problems faced by students. More emphasis should be placed on students' health, especially during the orientation week for first year students. The role of diet and nutrition status on academic performance and overall quality of life should be addressed and good eating habits and national nutrition strategies to address malnutrition should be presented.

  Student affairs personnel within the institutions of higher learning should be responsible for monitoring outsourced catering with regard to the quality of food being sold, with an emphasis being placed on food variety, and checks should be in place to ensure that the majority of foods sold at the outsourced catering establishments are in line with the institutional goals of promoting nutritionally adequate foods. Outsourced catering can be expensive, especially for students,

therefore, in this regard, pricing of foods also needs to be monitored so that students are not forced to pay more than they should be paying, especially with regard to healthy foods.

Institutions of higher learning could implement strategies that have been effective in other countries, which include issuing eligible students with food vouchers aimed at promoting the consumption of healthy foods including fruits and vegetables, dairy and healthy protein sources. The provision of the vouchers could be managed responsibly and ethically. Fruits could be made complimentary as part of a meal and subsidized by the institution to promote fruit intake since vegetables are usually part of the menu. Healthier meal options could also be emphasized on the menu board with more detailed descriptions, for example, nutrition information could be included.

Healthy food consumption could be promoted on campus, by introducing discounts on healthy foods and also having weekly specials to promote dietary diversity. This may also be applicable to on-campus catering vendors, as they are directly accountable to the institution's management.

Students need to be taught life skills which include money management, as this will enable them to make better monetary decisions. Budgeting and saving should be advocated to ensure that money is used effectively and priority is given to purchasing good quality food.

5.5.2 RECOMMENDATION 2: AGRICULTURAL ACTIVITY

Agriculture plays an important role in reducing hunger and impacts the cost of food immensely (WHO, 2011). Furthermore, the level and intensity of agricultural activities impacts food costs, which impacts diet quality and quantity. The Department of Agriculture within MUT is involved in numerous research projects that aim to increase food production in the areas of crops and animals. Subsequently, as part of students' practical development, food (fresh fruit and vegetables) is planted and animals (chickens) are reared. As part of interventions to promote healthy eating among students, these foods could be sold to students at a reduced price, especially fresh vegetables. The university could make more land available to this department to ensure that more produce is grown for food. High food prices are an obstacle to a healthy diet and when healthy food is made available to students this may have a positive impact on the students' overall diet quality and nutrition status.

5.5.3 RECOMMENDATION 3: NUTRITION EDUCATION INTERVENTION

- **Nutrition education**

The majority of the students who participated in the study stayed in the university residences, and the transition from living at home to living away from home has been associated with changed eating patterns, which are mostly negative. Many of the university residences offer self-catering facilities; however, students living on their own in university residences should be taught basic cooking skills by the wardens who can facilitate student gatherings. This will enable them to cook their own meals. Many students opt to buy fast foods, not because of convenience alone, but also due to their inability to cook their own meals. Interventions which equip students with the ability to cook their own meals should be introduced and facilities within the residences must be adequate to accommodate students cooking in small groups to enable them to share the facilities.

Universities have their own in-campus clinics, which are used by students and staff. Nurses should be trained to give basic nutrition education to students, with the emphasis on a healthy BMI. Furthermore, topics which include healthy weight management and/or weight loss should also be incorporated. This initiative can be done in collaboration with the KZN National Department of Health to address issues of non-communicable diseases. The acquisition of basic nutrition knowledge, especially during orientation week, would be recommended for students to encourage them to buy healthy food.

During HIV testing, campaigns conducted by various groups e.g. Love life, BMI screening can also be conducted since the HIV initiatives are more frequent at higher academic institutions.

- **Physical activity**

The prevalence of overweight and obesity within the study population emphasizes the need for rigorous promotion of an active lifestyle among university students. Lepp, Barkley, Sanders, Rebold and Gates (2013: 80) attributes the high sedentary lifestyle of university students to excessive cell phone use, and this has a negative impact on cardiorespiratory fitness. Although student gyms are available at many universities, students' interest in using these facilities is poor. There needs to be increased dissemination of information in order to create awareness about the availability of the facilities and to promote the inclusion of exercise as part of the students' daily routine.

Group exercise sessions may be more effective for students in university residences. Residence wardens should organize group sessions in the morning or afternoon, and incorporate fun walks and fitness competitions as part of encouraging a sense of community among the students

5.5.4 RECOMMENDATIONS FOR FUTURE RESEARCH

- Differences between FG and NFG students are based on the parents and/or siblings having tertiary education, therefore it is important for future studies to determine the education level and the current job description of the parent or sibling with a tertiary education.
- The use of self-reported questionnaires possibly hinders the reliability of data, due to the respondent's inability to clearly remember what was consumed three day to seven days prior to being interviewed. More reliable nutrition tools which include food diaries may be effective in establishing more accuracy, especially when attempting to establish the differences between two groups of students.
- Future studies should also look at the students' level of physical activity, especially when determining their nutrition status.
- Further studies need to take place in universities that attract students from various socio-economic backgrounds, which are inclusive of all races and from varying academic backgrounds.
- More research needs to be conducted to identify the coping strategies implemented by the two groups of students identified.
- More research needs to be conducted into the diet and nutrition differences between students living in university residences and those living at home, and how diet quality is affected at times when students are away during university holidays.
- Students' nutrition knowledge and its impact on food choices needs to be further researched, in order to identify the extent of the problem, and to ensure nutrition programmes aimed at students are appropriate and address relevant nutrition challenges.
- Further studies should aim to observe the impact of diet and nutrition status throughout the duration of the students' undergraduate study period, to establish whether current diet and nutrition status is maintained from year to year.
- Monitoring the students' progress throughout the duration of the qualification will also assist in establishing the success and dropout rates of both the FG and NFG students.

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Annexure A

DUT
DURBAN UNIVERSITY OF TECHNOLOGY

Institutional Research Ethics Committee
Faculty of Health Sciences
Room MS 49, Mansfield School Site
Gate 8, Ritson Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2900
Fax: 031 373 2407
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

22 September 2014

IREC Reference Number: **REC 56/14**

Ms N P Ndlovu
P O Box 611
Nagina
3604

Dear Ms Ndlovu

Relationship between diet quality, nutritional status and academic performance of first and non-first generation university students in Durban

I am pleased to inform you that Full Approval has been granted to your proposal REC 56/14.

The Proposal has been allocated the following Ethical Clearance number **IREC 066/14**. Please use this number in all communication with this office.

Approval has been granted for a period of one year, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's. In addition, you will be responsible to ensure gatekeeper permission.

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely

[redacted]

Prof J K Adam
Chairperson: IREC

Annexure B

Mangosuthu
University of Technology

17 June, 2014

Ms N. Ndlovu

Community Extension

Dear Ms. Ndlovu

It is my pleasure to inform you that permission to conduct survey titled: "*Relationship between diet quality, nutritional status and academic performance of first and non-first generation university students in Durban.*" Amongst MUT students has been granted.

Permission to conduct the survey is granted on the condition that any changes to the project must be brought to the attention of the MUT Research Ethics Committee as soon as possible.

Good luck with your research.

Yours faithfully,

[redacted]

Dr. Anette Mienie

Director: Research

031 9077354/7450

anette@mut.ac.za

Annexure C

INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC)
CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, _____ (name of researcher), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

_____	_____	_____	_____
Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I, _____ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

_____	_____	_____
Full Name of Researcher	**Date**	**Signature**
_____	_____	_____
Full Name of Witness (If applicable)	**Date**	**Signature**
_____	_____	_____
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

Annexure D

Letter of information

Dear Mangosuthu student

Thank you for allowing me to explain to you my research study for your consideration.

The title of my study is “Comparative study of the socio- demographic profile and nutritional status of the first generation university students (Umlazi) in relation to their academic performance

Principal investigator/s/researcher:

I, Ntombenhle Ndlovu, (BTech: Consumer Sciences: Food and Nutrition) will be the main researcher. I am supervised by Professor Carin Napier (D Tech Food Service Management).

It is very important to do this study because the future of our South African economy depends on the availability of a sustainable supply of skilled and educated people entering the job market. Students predominantly fall into this group. However, there has been a decrease of students who actually complete their studies in South Africa. This study will help identify some the factors that contribute to the decline of student academic success. The focus will be on students that are the first to attend university from their families. The study will look at whether where the student comes has any impact on how well they perform a school.

This research aims to investigate the socio- demographic profile, nutritional status, and academic performance of students registered at Mangosuthu University of Technology (MUT).

We will need 260 MUT students to participate in the study. This will provide valuable information that will assist in developing ways in which we can improve student academic performance within the university.

What will it involve?

- Ethical clearance was obtained from DUT
- I would need for you to sign a consent form to indicate that you agree to participate in the study, after I have explained the procedures to you.
- If you agree, you will be asked to complete 3 questionnaires in an interview situation and anthropometric measurements. It could take 40 minutes
- The questionnaires will include
    1. Socio-demographic questionnaire
    2. 3 x 24 hour recall questionnaires
    3. Food frequency questionnaire
- I will also be required to access to your matric results and first year academic record. These records will be required to understand and compare academic progression form matric and during the first year of university.
- You will not be required to remove any clothing except for shoes and jerseys when being measured

- Participation will be voluntary and you can withdraw at any time with no penalty

You will not feel any discomfort. All measurements and weighing will be done at MUT premises. You will be asked to remove shoes and jackets and jerseys only and you will not have to undress.

The rresults of the study will be shared with the Durban University of Technology and MUT after the study has been concluded. Your name will not be mentioned, with the hope that interventions can be planned in the University for any Identified Problems. If you have any personal nutrition questions or concerns we are prepared to come back to you after the data collection to assist you.

Please note the following:

- Participation is voluntary and you can withdraw at any time with no penalty.
- No pay will be given to any of the participants.
- It won't cost you anything to participate in this study.
- You will be given a participant number so no names will be used in the study**.**

Research-related injuries

No research related injuries are expected in this study**.**

For any questions or concerns please feel free to contact my supervisor or our Ethics committee

Your participation will be greatly appreciated and thank you for allowing us to explain this study to you.

Kind Regards

Ntombenhle Ndlovu

Persons to Contact in the Event of Any Problems or Queries:
Supervisor: Prof. Carin Napier
Researcher: Ntombenhle Ndlovu 0739557480/0840733322
Supervisor contact: 031 373 2326 carinn@dut.ac.za
The Institutional Research Ethics administrator: 031 373 2900

Complaints can be reported to the DVC: TIP, Prof F. Otieno on 031 373 2382 or dvctip@dut.ac.za

Annexure E

DURBAN UNIVERSITY of TECHNOLOGY

FACULTY: APPLIED SCIENCES

DEPARTMENT OF FOOD AND NUTRITION CONSUMER SCIENCES

NATIONAL DIPLOMA: CONSUMER SCIENCES FOOD AND NUTRITION

Fieldworker Guide

CONTENTS **PAGE**

1. INTRODUCTION

Welcome to Fieldwork, this is a stimulating opportunity to work with the Department of Food and Nutrition researchers and their communities around Durban. Research fieldwork in communities cannot be conducted without the assistance of fieldworkers.

Fieldworkers are the key to the success of community studies. They act as interviewers, collect physical measurements or observe features in the participants. Often in community studies fieldworkers can also enter people's homes and interview them there. Data collection in the community is often hard work; if people are not available repeat visits need to be made. Fieldworkers should be well trained in the survey methods being used in a specific study, to ensure reliable data. As part of Work Integrated Learning all 3rd year Food and Nutrition Consumer Sciences students must take part in data gathering of one or more research project in the department.

What is a Field Worker?

The field worker is an extremely important person in this project. In fact, this research would not be possible without the field workers. The field workers are the individuals who must interview the subjects (the people chosen to take part in the research) and get correct and accurate information from them. The subjects must feel at ease with the field worker so that they will not feel threatened or intimidated and will willingly answer the questions to the best of his or her ability.

2. ENQUIRIES

The following staff members are concerned with field work:

Senior Lecturer/Researcher : Prof C. Napier
S9 Level 3, Room 312

Tel. No. : 031 373 2326
E-mail : carinn@dut.ac.za

Research Assistant : Ms. S. Memela
S9 Level 3, Room 314

Tel. No. : 031 373 2961
E-mail : researchFN@dut.ac.za

3. FIELDWORK REQUIREMENTS

- All 3rd year students will be expected to attend a fieldworker training course separately or as part of Nutrition 3.
- Each student must complete at least 10hours of fieldwork in one or more of the current research projects in the department of Food and Nutrition Consumer Sciences, a time sheet will be signed by the researcher in charge of the project to control the hours worked.
- Fieldworkers will **NOT** be remunerated for the 10 hours of fieldwork completed; any fieldwork completed by a fieldworker over and above the10 hours will be paid at a rate per hour.
- The researcher in charge of the project will complete an assessment sheet for mark allocation for this part of the Work Integrated Learning (WIL) Module.
- Fieldwork marks adds up to **10%** of the final mark for **WIL**.
- Students can be expected to do any of the following tasks as part of their 10 hours:
    - Fieldwork in a community
    - Data capturing
    - Participating in a community upliftment project
    - Assisting with other research activities, e.g. Departmental Research Day

Details regarding the logistics will be discussed at the training session and each researcher will inform participating students of dates, times and venues.

4. ASSESMENT CRITERIA

DEPARTMENT OF FOOD AND NUTRITION CONSUMER SCIENCES

SUBJECT: Work-integrated Learning

LECTURER/RESEARCHER ASSESSMENT: Academic Service Learning component

Student name: _____

Student number: _____

ASSESSMENT CRITERIA	Very good 10 - 9	Good 8 - 6	OK 5	Poor 4 - 3	Unacceptable 2 - 0	Your mark
Arrived timeously						
Professional appearance						
Approached task in an organised manner						
Worked effectively as a team member						
Patience and respect shown towards subjects						
Anthropometrical measurements were correctly applied (if applicable)						
Accurate and detailed recording of information						
All details included in completion of forms						
Followed the task through to the end						

Number of hours completed: _____

General comments:

_____

_____

_____

Researcher Signature: _____ Date: _____

Print name: _____

5. FIELDWORKER CODE OF CONDUCT

5.1 BEHAVIOUR

In order to be a successful interviewer, a field worker must have (or develop) the following characteristics:

1. **Friendliness**: the field worker must be able to make each subject feel relaxed and not threatened in any way. The subject must feel that the field worker sees him or her as a person, not just another number that must be dealt with.

2. **Respect**: the subject must be treated with respect at all times. For example, he must be greeted politely, thanked for his time and co-operation; he must not be forced to answer a question that he is not willing to answer. The field worker must never show if she disagrees with something the subject has said.

3. **Patience**: each subject has to be asked the same questions in the same way. This means that the field worker must ask the same questions over and over, which can be very tiring and irritating. However, the field worker may never show that she is impatient or irritated even when the subjects are slow to answer or when they do not understand the questions. She must be able to control her own feelings and hide them when necessary.

4. **Reliability**: the field worker must be reliable, she/he must pay attention to detail, record all answers accurately, not skip over questions or make up answers.

5. **Enthusiastic and Motivated**: the field worker must be enthusiastic about the research. She should be doing it because she really wants to and not just because it's just a job.

6. **Flexible**: a good field worker is able to adapt to circumstances. She is aware that things do not always work out as planned and sometimes she will have to work under difficult and uncomfortable conditions.

8. **Neat Appearance**: the field worker must always look neat and well groomed, but never overdressed. The following guidelines for dress should be followed:
   - wear neat, simple and comfortable clothes
   - do not wear badges or emblems of organisations, churches, etc. as these may influence the way subjects answer.

- dress so that the subject will concentrate on the interview and not on the way you are dressed.

5.2 CONDUCTING THE INTERVIEW

If the subjects in a project are children, the parents and/or caregivers will need to be involved in the interview process to verify information that is needed for the questionnaires. If the subjects are adolescents they can usually remember what they ate and can answer their own questions. If the questions need to be translated the interviewers must be careful not to change the focus of the question.

1. How do I begin?

- Greet the subject politely and introduce yourself.
- Ask what language the subject would prefer to speak.
- Explain what the interview is about. Let the subject ask questions about the research. Reassure the subject that the answers are confidential and that neither the subject nor his or her address will be identified.
- Put the subject at ease. Be flexible and sensitive to the subject. Some subjects may be tense or apprehensive. In such cases, talking about something general, e.g. the weather may put the subject at ease.

2. How do I conduct the interview?

- During the interview direct the questions to the subject, but if it is a child and he or she cannot answer, ask the parent/caregiver for the information needed.

- Ask the questions exactly as they are written on the questionnaire. Try even to keep your tone of voice the same for each subject so as not to lead the subject or to give him an idea of how you want him to answer. You may have to explain a question or use different wording if the subject cannot understand it.

- Ask the questions in the order that they appear on the questionnaire. If the subject refuses to answer the question, record the lack of response and go on to the next question.

- Follow the instructions on the questionnaire. Sometimes it may seem that a subject has already answered a question when he answered a previous one, but the interviewer must still answer the question. For example, the questions about polony and atchaar. Start the question: “We have already mentioned this, but…”.

- Do not lead the respondents. Do not try to influence the way the subject answers. Keep your facial expression friendly, but neutral. Never show surprise or shock or approval to the subject’s answers. Try to avoid unconscious reactions such as nodding the head, frowning, raising the eyebrows. Never give your own opinions.

- Keep the tone of the interview conversational. Be friendly and courteous. Do not make the subject feel as if he or she is taking an examination or is on trial be familiar with the questionnaire so that you can ask questions conversationally rather than reading them stiffly. The questionnaire is designed to keep the amount of writing to a minimum. However, if a subject gives a long response to an 'other' question, say, 'excuse me while I write that down'. Don't make the subject feel as though you have forgotten he is there.

- Keep control of the interview. Do not let the subject go off into irrelevant conversation. If he or she does, bring him or her gently back to the interview.

- Allow the subject time to think; do not hurry him to answer. However, if he is silent for too long, repeat the question, or 'prompt' him. For example, say 'you have told me how you cook cabbage; now please tell me how you cook pumpkin.

- Follow the instructions on the questionnaire for recording the responses. Record all responses, including negative responses or refusals to answer.

- **Make sure that you have written in the subject's number.**

3. How do I end the interview?

- Tell the subject that you have finished the interview.
- Reassure him that everything he has told you is confidential.
- Thank him for his time and cooperation. Direct him to the next stage. Greet him.

6. INTERVIEW EXAMPLE

24-HOUR FOOD RECALL QUESTIONNAIRE

The 24-hour recall is a questionnaire on what the subject has eaten the day before over a 24 hour period. Often the 24-hour recall is used to establish whether the QFFQ is valid or not. It is important to think of the 24-hour recall questionnaire as being a totally separate questionnaire and not a cross-reference to the QFFQ. Therefore, the answers to the questionnaire need to be very detailed. You will need to ask what is eaten and drunk, what type of food or drink is consumed, the brand name, the preparation method and the quantity consumed. Remember to include spreads, sugar and milk to tea / coffee, snacks, sweets, juices, sauces, salts and other condiments.

Example: The subject is asked what she has in the morning on waking up.

I: What do you have in the morning when you wake up?

S: I drink tea and then have porridge.
I: How do you take your tea?
S: With 2 sugars and a little milk.
I: How big is the spoon and is it level or heaped? (*Showing the teaspoon*).
S: It is like that spoon and I also have it heaped.

I: What type of porridge did you eat and how much did you have? (*Showing a bowl or cup*).
S: I had soft mealie meal porridge and I had about 2 of those cups to the fill in a bowl.
I: Do you put anything else in the porridge?
S: Yes, 2 spoons of sugar, like my tea, and a little margarine about 1 spoon.
I: At about what time was this meal?
S: At 6 am.
I: Where did you have this meal?
S: At home.

Time (approximately)	Place (Home, school, etc)	Description of food and preparation method.	Amount	Amount in g (office use Only)	Code (office use only)
From waking up to going to work, or starting day's activities					
6 am	**Home**	**Tea, rooibos**	**1 cup/mug**		
		With milk, full cream	**little milk – 2 tablespoons**		
		And sugar, white	**2 heaped tsp**		
		Soft mealie meal porridge	**2 cups**		
		With sugar, white	**2 heaped tsp**		
		And margarine, hard brick	**1 tsp**		

7. PORTION SIZES

FOOD	**Smaller than smallest**	**Between small and medium**	**Between medium and large**	**Between large and very large**	**Larger than large/very large**
Stiff porridge	125 g	275 g	425 g	600 g	800 g
Soft porridge	125 g	275 g	425 g		575 g
Samp and beans	100 g	200 g	375 g	600 g	800 g
Rice	70 g	105 g	190 g		310 g
French fries	30 g	90 g	185 g		340 g

FOOD	Smaller than smallest	Between small and medium	Between medium and large	Between large and very large	Larger than large/very large
Fried beef	15 g	45 g	80 g		120 g
Beef with bone	45 g	75 g	120 g		180 g
Meat stew	55 g	165 g	275 g		385 g
Sausage/ Wors	20 g	50 g	90 g		135 g
Offal	20 g	60 g	100 g		140 g
Pilchards	15 g	45 g	90 g		150 g
Mashed pilchards	15 g	45 g	90 g		240 g
Fried fish	50 g	70 g	105 g		155 g
Cabbage, potato and onion	15 g	45 g	75 g		105 g
Spinach, potato	15 g	45 g	75 g		105 g
Tomato and onion gravy	10 g	30 g	60 g		100 g
Pumpkin	15 g	35 g	60 g		80 g
Carrots, potato	45 g	65 g	80 g		95 g
Green mealie	50 g	110 g	180 g		260 g
Beetroot salad	10 g	30 g	65 g		85 g
Fat cake	20 g	50 g	70 g		90 g
Bread	15 g	45 g	80 g		120 g
Margarine	2,5 g	7,5 g	12,5 g		17,5 g
Dumpling	20 g	70 g	125 g		175 g
Apple	70 g	130 g	195 g		265 g

FOOD	Smaller than smallest	Between small and medium	Between medium and large	Between large and very large	Larger than large/very large
Banana	40 g	60 g	95 g		130 g
Canned peaches	30 + 10 g	70 + 15 g	110 + 25 g		150 +35 g
Custard	5 g	20 g	35 g		65 g
Atjar	10 g	45 g	80 g		120 g
Polony	5 g	15 g	30 g		45 g
Peanuts	5 g	20 g	60 g		105 g
Cheese curls	6 g	18 g	38 g		62 g

8. Other Questionnaires

The researcher may also use any of the following questionnaires:

- Food Frequency Questionnaire
- Socio-demographic questionnaire
- Nutrition knowledge questionnaires
- Health questionnaires
- Smaller questionnaires drawn up by each individual researcher e.g. lunch box content of school children.

Annexure F

Food and Nutrition Consumer Sciences

SOCIO-DEMOGRAPHIC QUESTIONNAIRE

This questionnaire covers certain aspects of your life, including work and personal details, health and illness, lifestyle and social life that is relevant to health. The answers to these questions will be kept strictly confidential and the information will not be identifiable on any reports or publications.

1. GENERAL INFORMATION

Participant number:……..……. Date: ……

Fieldworker name: ……

Please answer all questions by marking the correct answer with **X,** except where otherwise indicated.

Where do you live?

.....

2. PERSONAL INFORMATION

2.1 When were you born? Year: Month: Day:

2.2 How old are you? _____years

2.3 Gender:

Male	Female

2.4 Marital status

Single	In relationship	Married	Divorced

3. ACCOMMODATION AND FAMILY COMPOSITION

3.1 Do you live in?

Town/City	Farm	Squatter camp	Rural village	Hostel	Township	Other, specify……..

3.2 How are you currently living?

Home	
Homeless	
Living with relatives	
Living with friends	
Student Residential Place	
Squatter home	
Rented house/flat	
Own house/flat	
Employees Properties	
Other, specify…….	

3.3 Do other people live in the house with you?

Yes	No

3.4 How many people are permanent residents living in the house with you? (Only if these people eat and sleep in this house at least 4 days a week?)

1	2	3	4	5	6	7	8	9	10	10+

3.5 How long have you been staying permanent in this house?

< 1 year	1-5 years	>5 years

3.6 In what type of house are you staying?

Brick	Clay	Grass	Wood	Zinc/shack

3.7 How many rooms does your house have?

1 room	2 rooms	3 rooms	4 room	>5 rooms

3.8 Are there other houses/shacks within the same yard of the main house?

Yes	No

3.9 Do you have the following facilities/ services at home?

3.9.1 Water

Tap in the house	
Tap outside the house (in yard)	
Borehole	
Spring / river / dam water	
Fetch water from elsewhere	

3.9.2 Toilet facilities

None	
Pit latrine	
Flush / sewage	
Bucket system	
Other, specify…….	

Waste removal	Yes	No	3.9.3
Tarred road in front of house	Yes	No	3.9.4
Gravel road in front of house	Yes	No	3.9.5
Access to electricity	Yes	No	3.9.6

3.10 To what extent do you have problems with the state of your house (e.g. size, repairs, damp, etc.)?

……
……

3.11 Do you have problems with the following?

Mice/ Rats	
Cockroaches	
Ants	
Flees	
Mosquitoes	
Geckos	
Frogs	
Snakes	
Bed Bugs	

3.12. What is the floor inside your house made of?

Cement	

Tiles	
Carpet	
Dirt	
Sand/mud	
Dung	
Other, please state	

4. **WORK STATUS AND INCOME**

4.1. Are you currently employed?

Yes	No

If YES, go to Question 4.5.

4.2. If NO, how would you describe your current status (tick one box only)?

Unemployed	Retired	Housewife	Student	Other, specify……

4.3. Are you actively looking for paid employment at the moment?

Yes	No

4.4. How long have you been unemployed?

< 6 months	6-12 months	1-3 years	> 3 years

4.5. If YES (question 4.1) is your current job a:

Permanent position	Temporary position	Fixed term contract	Other, specify……..

4.6. Are you doing part time jobs as a second job on weekends and school vacations?

Yes	No

4.7 **.** Where is your income sourced?

Bursary	Study loan	Employment	Spouse	Family	Other, Specify ……

4.8. What is the total income in the household per month?

R0- R500	R501-R1000	R1001-R1500	R1501-R2000	R2001-R2500	R2501-R3000

R3001-R3500	R3501-R4000	R4001-R4500	R4501-R5000	R5001-R6000	R6001- R7000
R7001- R8000	R8001- R9000	R9001- R10 000	>R10 000		

4.9. Please specify the monthly income in the household (if willing)……..

4.10 Do you receive any of the South African Government social grants?

Child grant	Disability grant	Foster grant	Other ,Specify

4.11. How often does it happen that you do not have enough money to buy food?

Always	Often	Sometimes	Seldom	Never

4.12. How many people e.g. partner, relatives & others (including yourself) contributed to your household income from any source, (including wages/salary from paid employment, money from second or odd jobs income from savings investments, pension, rent or property, benefits and or maintenance etc.) in the last 12 months?

People	0	1	2	3	4	5	6	7	8	9

4.13. How often do you buy food?

Every day	Once a week	Once a month	Other, specify……

4.14. Where do you often buy food?

Tuck shop	Street vendors	Student Canteen	Supermarket	Other, specify……

4.15 What type of transport do you use to get around?

Taxi	
Public bus	
University bus	
Own car	
Train	
Other Specify	

4.16 How much money is spent on food PER MONTH? (Tick only one box)

R 0 – R 200	R 201 – R 300	R 301 – R 400	R 401 – R 500	R 501 – R 600	R 601 – R 700	R 701- R800	R801- 1000

R1001-R1200	R1201-R1400	R1401-R1600	R1601-R1800	R1801-R2000	>R2001		

5 EDUCATION AND LANGUAGE

5.1. What is your highest education level?

Matric	College/FET	Completed a bridging course	Diploma or Degree in a different field	Other, Specify

5.2 What language is spoken mostly in the house?

Zulu	Xhosa	SiSwati	English	Afrikaans	Other, specify……

5.3 How many child/children do you have?

None	1	2	3	4	5	6	7	8	All

5.4 Has any children in your household died in the past?

Yes	No

Reason: ……..

5.5 Number of children attending school

None	1	2	3	4	5	6	7	8	All

5.6 How do the children get to school?

Walk	Bus	Taxi	Parents car	Other, specify…….

Food practices in the household

Tick one block for every question:	Student	Roommate	Mother	Father	Grandmother	Grandfather	Uncle	Aunt	Friend	Student Res Kitchen	Other
5.7 Who is mainly responsible for food preparation in the house?											
5.8 Who decides on what type of food is bought for the household?											
5.9 Who is mainly responsible for feeding/serving the children?											
5.10 Who is the head of this household?											
5.11 Who decides how much is spent on food?											

5.12 How many meals do you eat per day?

0	1	2	3	> 3

5.13 Where do you eat most of your meals?

Home	Friends	Work	University	Other, specify…….

5.14 Where do your children eat most of their meals?

Home	Friends	School	Other, specify…….

6. ASSETS

6.1 Does your home have the following items and how many?

	Yes
Electrical stove	
Gas stove	
Primus or paraffin stove	
Microwave	
Hot plate	
Radio	
Television	
Refrigerator	

Freezer	
Telephone/ Cell phone	
Laptop/Desktop	
Printer	
Personal Internet Access(Moderm)	
Bed with mattress	
Mattress only	
Lounge suite	
Dining room suite	
Electrical iron	
Electrical, kettle	
Car	
Bicycle	
Motorbike	

6.2 What type of fuel do you usually use for food preparation?

Wood fire	Paraffin	Electricity	Gas	Coal/Charcoal	Other, specify……

Thank you very much for your co-operation. We appreciate the time.

Annexure G

FOOD AND NUTRITION CONSUMER SCIENCES

Anthropometric Measurements

Section A:

1. Number/Name of the caregiver……

2. Community:……..…

3. Date of birth	Year	Month	Day

4. Gender	Male	Female

Section B:

1. Body weight (kg)	1. Body weight (kg)	2. Height/Length (cm)	2. Height/Length (cm)
kg	kg	cm	cm

3. Waist circumference	3. Waist Circumference	4. Blood pressure	4. Blood pressure
cm	cm	/	/

Annexure H

24 – HOUR RECALL

Subject number: _____ Interviewer: _____

Date: _____ / _____ / 20___

Tick what the day was yesterday:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday

Would you describe the food that you ate yesterday as typical of your habitual food intake?

Yes	1	No	2

If not, why? _____

I want to find out about everything you ate or drank yesterday, including food you pick from the veld. Please tell me everything you ate from the time you woke up to the time you went to sleep. I will also ask you where you ate the food and how much you ate.

Time (approximately)	Place (Home, school, etc)	Description of food and preparation method.	Amount	Amount in g (office use Only)	Code (office use only)
From waking up to going to work, or starting day's activities					
During the morning at work or at home					

Time (approximately	Place (Home, school, etc)	Description of food and Preparation method.	Amount	Amount in g (office use Only)	Code (office use only)
Middle of the day (Lunch time)					
During the afternoon					
At night (dinner time)					

Time (approximately	Place (Home, school, etc)	Description of food and preparation method.	Amount	Amount in g (office use Only)	Code (office use only)
After dinner, before going to sleep					

* Do you take any vitamins or supplements (tablets or syrup)	Yes	1	No	2
Folate				
Iron				
Other				
Give the brand name and dose of the vitamins/tonic:				

Annexure I

FOOD AND NUTRITION CONSUMER SCIENCES

FFQ LIST OF FOODS AND FOOD GROUPS DIVERSITY

Subject number: _____ Interviewer: _____

Date: _____

PLEASE INDICATE THE FOOD YOU ATE DURING THE PAST SEVEN (7) DAYS BY AN (X)

GROUP 1: Flesh Foods (Meat, Poultry, Fish) Diversity	Y	N
Meat (Chicken)		
Meat (Beef)		
Meat (Mutton)		
Meat (Pork)		
Meat (Goat)		
Dried Meat (Biltong)		
All Mince		
All Tribe/Offals/Runners and Heads		
Fish (fresh / whole)		
Tinned Fish (Pilchards/Tuna)		
Processed Meats (Viennas / Polony, Russians, Boerewors Sausage)		
GROUP 2: Eggs Diversity	**Y**	**N**
Eggs		
GROUP 3: Dairy Products Diversity	**Y**	**N**
All Milk		
Condensed milk		
Maas/ Inkomasi		
All Cheese		
Custard		
Ice Cream		
Yogurt		
GROUP 4: Cereals, Roots and Tubers Diversity	**Y**	**N**
All Rice		

Maize (Pap, Mealie Rice, Mealie Meal, Samp, Porridge, Corn on the cob, Popcorn, Sweet Corn)		
Macaroni/Pasta/Spaghetti		
All Bread (White/ Brown/ Whole Wheat)		
Dumpling/Steamed Bread/Fat Koek		
Scones/Biscuits		
Mageu		
Breakfast Cereals (Corn Flakes, Oats, Weet Bix, Matabela)		
All Tubers/Roots (Amadumbe, Sweet Potato)		
Potatoes		
GROUP 5: Legumes and Nuts	**Y**	**N**
All Beans dried including bean sprouts		
Lentils		
Peanuts and Nuts		
GROUP 6: Vitamin A Rich Fruits and Vegetables Diversity	**Y**	**N**
Pumpkin		
Carrots		
Wild Leafy Vegetables Fresh and Dried – includes fresh herbs		
Spinach		
Butternut		
Peach (yellow cling)		
Mango		
GROUP 7: Other Fruits (and juices) Diversity	**Y**	**N**
Deciduous Fruits		
Apple		
Peaches		
Pear		
Grapes (black/green)		
Plum		
Sub – Tropical Fruit	**Y**	**N**
Lemon		
Orange		
Naartjie		
Banana		
Pineapple		
Avocado		
Guava		
Paw- Paw		
Juices	**Y**	**N**
Juice (100% pure juice e.g. Ceres/Liquifruit)		

GROUP 8: Other Vegetables Diversity	**Y**	**N**
Onions		
Cabbage		
Beetroot		
Tomatoes		
Chili (red/green)		
Lettuce		
Green\ Yellow\ Red Pepper		
Frozen Vegetables (Mixed)		
Ginger & Garlic (Fresh)		
GROUP 9: Oils and Fats Diversity	**Y**	**N**
Butter		
Sunflower oil		
Olive oil		
Margarine		
Salad dressing/oil - mayonnaise		
Potato Crisps		
Coffee Creamer (Cremora, Ellis Brown)		

Annexure J

For attention:

Prof Carin Napier

Department of Food and Nutrition

Durban University of Technology

Declaration re Editing of Masters Dissertation: Ms N P Ndlovu

As requested by yourself I have edited Ms N P Ndlovu‘s Dissertation as follows:

Checked and corrected sentence structure

Corrected use of vocabulary, spelling and punctuation

Checked for grammatical correctness and made corrections where necessary.

In addition, I inserted comments for Ms Ndlovu to attend to where:

Meaning was not clear and in my opinion further clarity was required

Information seemed to be incorrect and needed to be checked and corrections made where necessary

I felt additional information or comment was required.

I used the track changes application and requested Ms Ndlovu to attend to my comments, make corrections where necessary, and then accept all changes before returning the text for me to check and make further corrections; and she did so.

I again checked the document and made further corrections and again returned the document to Ms Ndlovu for her to accept the new corrections and attend to my additional comments, which she has done.

Michael Vermeer

Editor