Selected Clinical Risk Factors for Lifestyle Diseases in Relation to the Current Dietary Practices of Sponsored vs. Non-Sponsored African University Students in Durban

By

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DECLARATION

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

Signed: [redacted]

Date: 16 July 2019

This submission is the result of my own independent work/investigation except where otherwise stated. Other sources are acknowledged giving explicit references. A bibliography is appended.

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Date: 16 July 2019

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ABSTRACT

SELECTED CLINICAL RISK FACTORS FOR LIFESTYLE DISEASES IN RELATION TO THE CURRENT DIETARY PRACTICES OF SPONSORED VS. NON-SPONSORED AFRICAN UNIVERSITY STUDENTS IN DURBAN

Aim: This research study aimed to assess and compare the dietary practices of sponsored Durban University of Technology (DUT) students with those of non-sponsored DUT students. The study also aimed to determine whether the students had any clinical risk factors related to lifestyle diseases such as elevated blood pressure, raised blood glucose, abnormal blood lipids and overweight/obesity.

Methodology: Two-hundred-and-sixty African university students, aged 18-35 years, living in Durban were randomly selected for this survey. The socio-demographic and anthropometric profiles were recorded, and the dietary intake, blood pressure, fasting blood glucose, triglycerides, and total cholesterol of participants were measured and recorded. In order to determine the prevalence of risk markers, the World Health Organisation (WHO) cut-off points were used. Quantitative capacities comprised of socio-economic parameters through means of a socio-demographic questionnaires, were administered during the recruitment stage in order to determine the socio-economic profile of the participants.

Results: More sponsored males (58.46%; n=76) than females (41.54%; n=54) and more non-sponsored females (53.08%; n=69) than males (46.92%; n=61) participated in this study. The mean age of the non-sponsored participants was 20.33 years (±SD 2.22) and the mean age of the sponsored participants was 22.15 years (±SD of 3.26) indicating that most sponsored participants were older than the non-sponsored participants. Most (59.62%; n=155) of the participants were in their first year of study, 18.45% (n=48) were in their third year of study and 13.85% (n=36) were in their second year of study. The rest (8.08%; n=21) of the participants were either in their fourth year of study or at postgraduate level. More (86.92%; n=113) of the sponsored than non-sponsored participants (70.77%; n=92) stated that they had either seldom or never been in a situation where they did not have enough money to buy food. More (12.31%; n=16) non-sponsored than sponsored participants (5.38%; n=7) stated that they either always or often had a problem of not having enough money to buy food indicating that more sponsored than non-sponsored participants were food secure.

Overweight was defined as body mass index (BMI) ≥25 kg/m^2 and abdominal obesity was defined as a waist circumference (WC) of ≥94 cm for male participants and ≥80 cm for female participants. Hypertension was defined as systolic blood pressure (SBP) ≥130 mmHg or diastolic blood pressure (DBP) ≥85 mmHg and elevated fasting blood glucose was defined as ≥5.6 mmol/L. Hypertriglyceridemia was defined as >1.7 mmol/L and hypercholesterolemia was defined as ≥5.2 mmol/L. Body mass index higher than 25 kg/m² was recorded for 34.62% (n=45) of the non-sponsored participants and 27.69% (n=36) of the sponsored participants. More non-sponsored (17.69%; n=23) than sponsored participants (13.85%; n=18) were centrally obese. A SBP higher than 130 mmHg was recorded for 8.46% (n=11) of the non-sponsored participants and 9.23% (n=12) of the sponsored participants. DBP higher than 85 mmHg was recorded for 7.69% (n=10) of the non-sponsored participants and 10.77% (n=14) of the sponsored participants. Blood pressure results indicated that more sponsored than non-sponsored participants were hypertensive. Only 1.54% (n=2) of the non-sponsored participants and none of the sponsored participants had elevated fasting blood glucose levels. More (43.85%; n=57) non-sponsored than sponsored participants (38.46%; n=50) recorded elevated fasting blood triglyceride levels. More (4.62%; n=6) non-sponsored than sponsored participants (3.85%; n=5) recorded elevated total serum cholesterol levels.

The mean energy intake was lower than the recommended 12 881 kJ for males and 10 093 kJ for female for both sponsored and non-sponsored participants. Non-sponsored male participants had a mean energy intake of 5485 kJ and the sponsored male participants had a mean energy intake of 6414 kJ. Non-sponsored female participants had a mean intake of 5501 kJ while sponsored female participants had a mean intake of 4786 kJ. Sponsored compared to non-sponsored male participants recorded a higher total fat intake (52 g vs. 39 g) and a higher carbohydrate intake (196 g vs. 178 g). The carbohydrate intake was higher than the recommended intake of 100 g for both sponsored and non-sponsored male participants. Non-sponsored compared to sponsored female participants recorded a higher total fat intake (47 g vs. 40 g) and a higher carbohydrate intake (165 g vs. 143 g). The carbohydrate intake was also higher than the recommended intake of 100 g for both sponsored and non-sponsored female participants. The most popular food item consumed was bread for both males and females. The frequency intake of bread in 24 hours was 35 g for non-sponsored male participants and 65 g for sponsored male participants. The frequency intake of bread in 24 hours was 51 g for non-sponsored female participants and 39 g for sponsored female participants. The frequency intake of diluted cold drink in 24 hours was 28 for non-sponsored male participants and 21 for

sponsored male participants. However, the results also indicated that non-sponsored male participants consumed less (6328 g) carbonated cold drink than the sponsored group of male participants (9992 g). Non-sponsored males consumed more (90 g) of fruit and vegetables than sponsored male participants (73 g). Non-sponsored females also consumed more (70 g) of fruit and vegetables than sponsored female participants (61 g).

Conclusion: The overall results of the study indicated that the non-sponsored group possessed higher clinical risk markers for lifestyle diseases. However, sponsored male participants consumed more fat and energy compared to non-sponsored male participants. Non-sponsored female participants consumed more fat and energy than sponsored female participants. Such results suggest that most interventions aimed at modifying students' eating habits have met with varied success. This could be the result of the students' lack of understanding regarding components that govern dietary and physical activity principles and the behaviour of young people. It is evident that dietary modification an increased consumption of fruit and vegetables, and a decreased intake of fat and energy consumption is required. The data acquired from this research study is essential as it could be of assistance in designing nutrition education interventions for university students in order to deal with the problems that have been identified.

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LIST OF ABBREVIATIONS

24-Hour Food Recall	24HR
Acquired Immune Deficiency Syndrome	AIDS
Australasian Child & Adolescent Obesity Research Network	ACAORN
Bachelor of Technology	B.Tech
Body Mass Index	BMI
Blood Pressure	BP
British Medical Journal	BMJ
Cardiovascular Disease	CVD
Centers for Disease Control and Prevention	CDC
Centimetres	CM
Chronic Obstructive Pulmonary Disease	COPD
Coronary Heart Disease	CHD
Data Checker	DC
Development Bank of Southern Africa	DBSA
Emergency Nutrition Network	ENN
European Food Information Council	EUFIC
Faculty of Applied Sciences Research Committee	FRC
Food Agricultural Organisation	FAO
Food Group Diversity Score	FGDS
Food Frequency Questionnaire	FFQ
Food Variety Score	FVS
Durban University of Technology	DUT
Glycaemic Index	GI
Grams	G
Gross Domestic Product	GDP
Heart and Stroke Foundation South Africa	HSFSA
High-Density Lipoprotein	HDL
Human Immunodeficiency Virus	HIV

Institute for Health Metrics and Evaluation	IHME
Institutional Research Ethics Committee	IREC
Institutional Research Committee	IRC
International Federation of Medical Students' Associations	IFMSA
International Food Policy Research Institute	IFPRI
Kilograms	kg
Kilometre	km
KwaZulu-Natal	KZN
Low-Density Lipoprotein	LDL
Living Standards Measure	LSM
London School of Hygiene and Tropical Medicine	LSHTM
Mayo Foundation for Medical Education and Research	MFMER
Ministry of Women and Child Development	WCD
National Obesity Forum	NOF
Non-Communicable Diseases	NCDs
No Student Hungry	NSH
Nutrient Adequacy Ratio	NAR
Pan American Health Organisation	PAHO
Primary Health Care	PHC
Principal Investigator	PI
Quality Control	QC
Rands	R
South Africa	SA
Socioeconomic Status	SES
Standard Deviation	SD
Sugar Sweetened Beverages	SSB
United Nations Children's Fund	UNICEF
United States of America	USA
University of Free State	UFS
Waist Circumference	WC

Waist-to-Hip Ratio	WHR
Wireless Fidelity	Wi-Fi
World Food Programme	WFP
World Health Organisation	WHO

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CHAPTER 1: INTRODUCTION AND IMPORTANCE OF THE STUDY

1.1 INTRODUCTION

This chapter introduces the study and explains its importance, and then gives an overview of the research problem. The study is significant since it examines health implications associated with the transition of young individuals from high school to university. The background to the problem statement illustrates the impact of malnutrition (both over-nutrition and under-nutrition) on university students globally and in South Africa (SA) as well as recent studies which focus on the importance of addressing malnutrition within the university community.

1.2 IMPORTANCE OF THE STUDY

Ansary, Stock and Mikolajczyk (2012: 1) stated that there are a number of health implications associated with the transition of young individuals from school to university. At this stage, they have a greater responsibility for dietary choices and practices. Ansary, Stock and Mikolajczyk (2012: 1) revealed that the major issue concerning these individuals is dietary practices associated with nutritional risks which are specific to university students. Research indicates that there is an increase in the prevalence of obesity and risk factors of several lifestyle diseases in SA (Okeyo 2009: 5). It is in most commercial food establishments, campus food courts and street vendors that university students rely on, where most unhealthy fast-food items are made available to students daily (Feeley *et al.* 2012: 2).

Traditionally, sub-Saharan Africa has been affected by different maternal and perinatal diseases, infectious conditions, as well as nutritional deficiencies. Nevertheless, during recent years, the burden of NCDs, such as cardiovascular disease (CVD), diabetes, stroke, and hypertension has been added to the challenges faced by health systems within this region (Sampson, Amuyunzu-Nyamongo and Mensah 2013: 344). There has been a rapid increase in the prevalence of overweight and obesity with the emergence of an environment that has a tendency to cause obesity (Nguyen and Lau 2012: 326). Globalisation and urbanisation have contributed to environmental and social changes with succeeding alterations in dietary patterns (WHO 2018c). Subsequently, overweight and obesity have reached endemic magnitudes, with obesity overtaking tobacco as the largest preventable cause of disease burden in some regions.

The Southern African region is particularly affected by this rising trend in obesity, and within this region, South Africa (SA) shows an especially worrying picture (WHO 2018c). In 2008, the average BMI at population level was estimated at 26.9 kg/ m^2 among males (vs. a world average of 23.8 kg/m^2), and 29.5 kg/ m^2 among females (vs. a world average of 24.1 kg/ m^2) (Finucane *et al.* 2011: 563). The rate of growth that was calculated over the period between the year 2000 and 2008, was 2.9 kg/ m^2 per decade for males and 1.6 kg/ m^2 per decade for females (WHO 2018c). According to Jobert *et al.* 2007 (cited in Peer *et al.* 2014: 1), the proportions of diabetes, CVD and certain cancers which are attributable to excess body weight were higher in SA compared to the global estimates, especially in women. It was found that Body mass index (BMI) over 21 kg/m^2 was responsible for 87% of diabetes, 68% of hypertension and 45% of ischaemic stroke (Jobert *et al.* 2007 (cited in Peer *et al.* 2014: 1). Previous research (Peer *et al.* 2014: 5) indicated that the prevalence of overweight/obesity, at 82.8% among black women in Cape Town in 2008/2009, which has reached epidemic proportions. Not only is this the highest reported in Sub-Saharan Africa, it was even marked higher than in the United States (64.1% reported among 20-year-old women), which is known for a high prevalence in overweight and obesity (Gomes *et al.* 2010 (cited in Peer *et al.* 2014: 5). As stated by the WHO (2014b: 176), the prevalence of elevated blood pressure among adults in Africa is the highest in the world. According to the Central Intelligence Agency (2017 cited in Berry *et al.* 2), nearly 70% of individuals in SA reside in urban areas it was last estimated that the prevalence of hypertension was 31% for men and 36% for women aged 15 years and above.

It was stated that by by 2030, NCDs would cause 46%.7 Global Burden of Disease. Abegunde *et al.* 2007 (cited in Shona *et al.* 2011: 886) suggest that the age-standardised death rates from NCDs is higher in at least four SSA countries (Democratic Republic of the Congo, Nigeria, Ethiopia and SA) than in high income countries. According to Abegunde *et al.* 2007 (cited in Shona *et al.* 2011: 886), the population pyramid of most African countries is currently cone shaped, with a large base of young people whom are less than 20 years. This is different to high-income countries where it is usually closer to a cylinder and the median age is 44 years. Results from previous studies indicated that while few non-hospital-based studies of CVD risk factors in adults have been conducted in the sub-Saharan region, the prevalence of hypertension ranged from 6 to 48% overall, and was high in both urban and rural SA (Shona *et al.* 2011: 892). A noteworthy 34% black South African woman appeared to be obese (WHO 2018b). Data from one cohort in SA indicated that four of the top five most common causes of death in adults are NCDs (Shona *et al.* 2011: 895).

According to Dale (2010: 1), most of the university students are in the late stages of adolescence or early 20s, but young adults also make up a substantial percentage of the student population. Simpson (2008: 1) stated that there is a sequence of developmental shifts among university students, which can be organised into three overall categories: 1. Adolescence (younger than 19 years), 2. Young-adulthood (commonly defined as 19 to 25 years) and 3. Later-adulthood (generally defined as 26 years and older). There is no fixed definition of adolescence as the World Health Organisation (WHO: 2016) defines the state of adolescence as being between the ages of 10 – 19 years, whilst the American Academy of Paediatrics defines it as being between 13-18 years (Anabwani 2015: 2). The common understanding is that this period is characterised by rapid physical, emotional, social, sexual and mental development or maturation. Along with social factors, these characteristics render adolescents as well as young adults vulnerable to a variety of nutritional problems.

The youth are the future generation of any nation, thus the satisfaction of their dietary requirements is critical for the wellbeing of society. However, research reveals that for many years adolescents' health has been neglected as they are considered to be less susceptible to diseases compared to infants and the elderly (Vashist, Joyti and Goel 2009: 191). It is said that students have a tendency to change for the better thus dietary and health-related education can be helpful in improving their knowledge (Elhassan, Gamal and Mohammed 2013: 25). The knowledge of healthy dietary practices can be an influential factor in amending one's undesirable eating habits in order to adopt a healthy diet (Elhassan, Gamal and Mohammed 2013: 26), even though it may be insufficient to motivate healthy eating. It is therefore imperative that all aspects influencing eating behaviour be better understood in order to foster successful nutrition interventions designed to encourage healthy eating. Healthy dietary practices and physical activity throughout the life cycle, can prevent or delay physical and psychological deterioration, as well as the development of lifestyle diseases during the senior years. According to the Department of Health (2013: 12), if individuals are physically and intellectually healthy, they will be more productive and incur less healthcare-related expenses for themselves and the government. It is clear that healthy eating habits and appropriate physical activity give purpose to each day (Roth 2014: 283).

1.3 PROBLEM STATEMENT

A university's main goal should be to impart knowledge to its students, enhancing their nutrition status, knowledge, and practices. This goal is quite significant, as it should successfully proceed to create more cognisant and healthier students and to achieve this goal (Department of Health 2013 12); students need to have access to quality education, where lack of finances is not a barrier to admission.

The report of the Durban University of Technology (2015) states that in 2014 the Department of Financial Aid and Scholarships disbursed an amount of R300 009 930, funding 10 087 students. The number of sponsored students appeared to have decreased from the 11 650 students funded during the year 2013 (Durban University of Technology 2013). It was further reported that the DUT also received research grants and scholarships from various sources of funding including the National Research Foundation (NRF), which administered an amount of R4 350 000 to a total of 104 students enrolled for a degree of Bachelor of Technology (Durban University of Technology 2015). Nevertheless, the inadequate availability of finance for National Student Financial Aid Scheme (NSFAS) students continues to present a number of complexities, considering that most of the students come from underprivileged backgrounds (Durban University of Technology 2015).

Despite the fact that the government has pledged substantial support for education reform, the South African education system is below par because of disparities left by 40 years of apartheid (Villette 2016). In the Commission of Inquiry into Free Education, the South African Union of Students (SAUS) (2016: 3) explained that it has been more than 20 years since the rise of democracy and even though students possess political freedom, it is incomplete as the constitutional promise of economic equality and deliverance is yet to be realised. After enrolling at the university, the underprivileged individuals are overwhelmed by financial difficulties. It has been stated that approximately 30% of South African individuals enrolled in higher education drop out within their first year of study, with another 20% withdrawing in the succeeding two years (Styger 2014: 6).

It was reported in the Commission of Inquiry into Free Education (SAUS 2016: 6) that tuition and accommodation fees can amount to over R100 000 a year for one student, excluding textbooks, food and other living expenses. However, in order to qualify for a NSFAS loan, students need to prove that they come from families that earn less than R120 000 per year

(NSFAS 2016: 9) which condition overlooks students who do not meet this threshold but cannot afford university fees. One of the DUT's strategic objectives is to provide an accessible learning environment that would empower students and at the same time advance the intellectual, psychosocial, and emotional development and wellbeing of the students (Durban University of Technology 2017: 1). An excellent way of achieving these objectives would be to promote an understanding of decolonisation as well as the implications for engagement, teaching learning and research-innovation.

In the Commission of Inquiry into Higher Education and Training (SAUS 2016: 31), the NSFAS stated that the government has to take steps towards ensuring that higher education is accessible to everyone, and that no individual should be denied access to higher education on the basis of financial need. In terms of delivery, further education is expensive, and so forth, in a developing economy and profoundly imbalanced society like our own, and it is not only unaffordable but also not appropriate (SAUS 2016: 31). Many of the recent student protests have been because a considerable number of poor young individuals do not have access to universities (Muller 2016).

It has also been highlighted that while students are fighting for free education, they are also protesting for decolonised, free quality education. It was further stated in the Commission of Inquiry into Free Education (SAUS 2016: 8) that the decolonisation project is about repairing the current system that is intrinsically exploitative and exclusionary. Heleta (2016: 1) explained that the current higher education system seeks to exclude the poor black individual on all levels. It is not only about financial exclusion, it also includes academic, emotional, accommodation, and food security barriers (SAUS 2016: 8). Ultimately, the higher education environment has to be restructured in such a way that it provides student support on all levels to create a healthy environment that ensures the wellbeing one of all students. Research by Oldewage-Theron *et al.* (2008: 4) revealed that the increase in urbanisation among the African population in SA, has led to a substantial increase in non-communicable diseases (NCDs). In addition to the above statement, the report of United Nations (2008) revealed that between the years 2007 and 2050, the world's population is expected to escalate from 6.7 billion to 9.2 billion, and the biggest increase will transpire within the metropolitan areas of underdeveloped countries. There is evidence that the increase in urbanisation has led to, and will continue to lead to individuals assuming a modern lifestyle that embraces less physical activity and more hyper-palatable foods (Petermen 2014: 1).

During the past few decades, significant lifestyle modifications have been witnessed globally. These modifications have included diet changes, types of food consumed, cooking methods and times and other aspects relating to the availability, accessibility and the use of food (Elhassan, Gamal and Mohammed 2013: 25). According to Steyn (2010: 62), young adults often consume food that is high in energy and of poor quality in terms of necessary micronutrients. Briefel, Wilson and Gleason (2009: 79) further explained that this is due to factors such as low food consumption frequency, a high intake of beverages with added sugar, an increased consumption of foods high in energy, and the regular consumption of meals away from home. In addition to the above statement, Neslisah and Emine (2011: 117) explained that these unhealthy dietary practices are the main factors that cause nutrition-related problems. The increased risk of NCDs such as obesity and cardiovascular disease (CVD) is also likely to increase due to unhealthy dietary habits. Sedibe *et al.* (2014a: 1) also explained that a continuous increase in the prevalence of obesity is a clear indication that environmental factors and behaviours that are related to diet and physical activity are significant causes of obesity in adolescents. In addition, Van den Berg *et al.* (2013: 445) stated that several studies have acknowledged diet and lifestyle as amendable risk factors for several NCDs including obesity, diabetes, hypertension, and high cholesterol. To verify this statement, results from their study revealed that most students had poor food consumption practices, consisting of a low fruit and vegetable consumption, and a high protein, energy and fat intake. One in ten students smoked and made no effort to exercise regularly.

According to the WHO (2005: 3), risk factors for chronic lifestyle diseases are well established and well known. Modifiable risk factors include unhealthy diets, physical inactivity, excessive alcohol intake, and the use of tobacco, which impact on metabolic risk elements such as elevated blood glucose levels, irregular blood lipids, high blood pressure, as well as overweight or obesity. A study conducted during the year 2004 (Okeyo 2009: 10) revealed that black university students who were in their first year of study had a tendency to be more overweight or obese than their white equivalents. Results indicated that 26.8% of black students were underweight, 18.2% were overweight and 6.5% were obese, when evaluated against their white equivalents of whom 7.2% were underweight, 10% were overweight and 0.8% were obese. Such data suggests that ethnicity, on its own, has an influence on body weight. Despite the fact that nutritional requirements decrease with age, the adequate nutritional requirements for maintaining a constant status of exceptional health persists all the way through life. Adequate nutrition can prompt recovery from diseases and improve life expectancy (Roth 2014: 283).

According to Sedibe *et al.* (2014b: 115), facilitations aimed at modifying teenage eating habits have met with varied success. This could be due to a lack of understanding of the constituents that govern dietary and physical activity principles and the behaviour of young people.

1.4 PREVALENCE OF MALNUTRITION AMONG UNIVERSITY STUDENTS GLOBALLY, IN AFRICA AND IN SOUTH AFRICA

Rankin *et al.* (2010: 65) stated that adolescence is one of the most interesting and thought-provoking periods in life. This stage is characterised by rapid development and increased hormone production, which has an impact on all body parts, including the brain. During adolescence, adequate nutrition is essential, as it is required to support optimal growth and development. Gan (2011: 213) explained that adequate nutrition during the transition period from puberty to young adulthood is essential for health promotion and the preclusion of diseases. It is during this phase that individuals are more likely to acquire unhealthy dietary practices, abuse narcotic substances and have a low physical activity levels. University students are an important target group, for the promotion of a healthy lifestyle, as this may eliminate the risks of possible lifestyle-related diseases.

Results from a study undertaken by Peltzer *et al.* (2014: 7434), indicated that female obesity exceeded male obesity among university students in sub-Saharan Africa. Dissimilarity, in North Africa, male obesity surpassed female obesity. According to Hakim, Muniandy and Danish (2012: 77), the prevalence of overweight in Malaysian individuals between the ages of 18-59 years was 29.71%; this suggests that the prevalence of obesity in Malaysia is almost as severe as that for industrialised countries. Al-Hazzaa *et al.* (2014: 634) further highlighted that during the past thirty years, Saudi Arabia had gone through massive lifestyle-related transformations, and this had caused an increase in the prevalence of obesity observed among children and the youth. According to the Takomana and Kalimbira (2012: 132), the Malawi Demographic and Health Survey, administered during the year 2004, showed that 11.2% and 2.4% of 15–49-year-old females were overweight and obese, respectively. Urban dwelling and exposure to education and success were linked to overweight and obesity. Mogre, Aleyira and Nyaba (2014: 69) stated at the time that overweight and obesity remained conditions that affected societies in both industrialised and less industrialised countries. Research suggests that the prevalence of obesity is also increasing exorbitantly in the United States of America (USA).

Mogre, Aleyira and Nyaba (2014: 69) advised that by the year 2030, 86.3% of all adults globally will be overweight or obese.

Ogunkunle and Oludele (2013: 188) reported that the nutritional difficulties affecting adlescents worldwide, and Nigeria in particular, were deficiencies in iron, calcium, and vitamin A. According to Takomana and Kalimbira (2012: 132), urban dwelling and accumulative periods of exposure to education and affluence are associated with overweight and obesity. Sop *et al.* (2010: 749) also reported that malnutrition among adolescents is of great concern in developed countries and is now becoming a call for concern in developing countries like Cameroon because of its constantly increasing prevalence. The report on the South Africa Health Demographic Survey (SAHDS) (Department of Health, Medical Research Council and OrcMacro 2007) suggested that anthropometry of young individuals did not appear to have changed between the years 1998 and 2003. The mean weight, height, and body mass index (BMI) of male and female participants in the two surveys were very similar. In the year 2003, 24% of adolescent females were overweight or obese compared to 9% of adolescent males. The report further stated that urban females were more prone to being overweight and/or obese than non-urban females. African urban females had the highest average BMI (24 kg/m^2), whereas African non-urban females had the lowest average BMI (22 kg/m^2). Based on BMI score for South African women aged 15 – 34 years presented in SAHDS conducted by the National Department of Health *et al.* (2017: 45), approximately 49% were overweight and 23% were obese. In contrast, approximately 12% of men within the same age group were overweight and 4% were obese.

A recent study revealed that in urban Soweto, the mutual prevalence of overweight and obesity in girls and boys at the age of 17 years, was 27.3% and 6.9% respectively (Sedibe *et al.* 2014: 114). Van den Berg *et al.* (2013: 445) explained that the rising prevalence of NCDs in unindustrialised countries, including SA, was associated with the nutrition transition that emerges with urbanisation, and is characterised by a high intake of energy-dense fast food items, saturated fats, cholesterol, added sugars and sodium, and a reduced consumption of vegetables, fruit, fibre and legumes. This evolution is correspondingly allied to increased levels of obesity, idleness, smoking as well as extreme alcohol ingestion (Bourne, Lambert and Steyn 2002: 157). According to Okeyo (2009: 5), the increased prevalence of overweight and obesity denotes a significant public health alarm, as they are known risk elements of NCDs. A number of individuals may possibly be overweight or obese due to societal influences, poor eating

habits and an absence of nutrition awareness. This condition places these individuals at an increased risk for several diseases of lifestyle such as heart and respiratory ailments, obesity and diabetes (Okeyo 2009: 5).

This study was therefore carried out in an effort to evaluate and compare the dietary practices of sponsored with non-sponsored DUT students. The data acquired from this research study could be of assistance in designing nutrition education interventions for university students in order to deal with identified problems. This study could also contribute to the development of nutrition education and healthy dietary habits thus improving lecture attendance and academic outcomes.

1.5 THE HYPOTHESES

1.5.1 Hypothesis One

Dietary practices of university students are influenced by socio-demographic factors such as gender and socio-economic status (sponsorship and total income).

1.5.2 Hypothesis Two

It was hypothesised that sponsored students would be more food secure, compared to their non-sponsored counterparts and would thus have more access to fat and energy-dense fast food items. Therefore, sponsored students would consume more unhealthy foods than non-sponsored students would.

1.5.3 Hypothesis Three

It was hypothesised that sponsored students would possess higher clinical risk markers of lifestyle diseases than non-sponsored students. These clinical risk markers include overweight/obesity, elevated blood glucose levels, elevated blood lipid levels and elevated blood pressure.

1.6 AIM AND OBJECTIVES OF THE STUDY

This research study aimed to assess the socio-demographic characteristics of sponsored and non-sponsored DUT students, and determine the influence these factors would have on their dietary practices. The study also aims to assess and compare clinical outcomes between sponsored and non-sponsored students.

To achieve this aim, the specific study objectives were:

- To establish the demographic profile of study participants by administering socio-demographic questionnaires (Appendix A).
- To determine the diversity and nutritional adequacy of food consumed by students by completing three 24-Hour Food Recall (24HR) questionnaires (Appendix B).
- To determine the diversity of participants' diets by completing Food Frequency Questionnaires (FFQs) (Appendix C).
- To determine the participants' anthropometric status by measuring their weight, height and waist circumference using standardised techniques and equipment (Appendix D).
- To determine whether the participants possessed any intermediate risk factors for diseases of lifestyle by taking finger-prick blood samples using Accutrend equipment and blood pressure readings with a standard mercury sphygmomanometer.
- To compare the dietary practices and risk factors for NCDs between sponsored and non-sponsored participants.
- To identify any gaps in the research and make recommendations for future studies.

1.7 ASSUMPTIONS

1.7.1 It was assumed that one FFQ as well as three 24HRs (two weekdays and one weekend day) would serve as effective dietary evaluation tools for the determination of students' dietary intake.

1.7.2 Fieldworkers were given prior training on the collection of dietary and anthropometric data as well as the completion of questionnaires. It was therefore assumed that all fieldworkers would be able to assist the participants in accurately quantifying their dietary intake using food samples and/or portion sise measurements, that were included in the fieldworker training manual.

1.7.3 All questionnaires were available in English but fieldworkers involved in the collection of data were fluent in English, isiZulu and Xhosa. It was assumed that participants would be able to understand English as they were university students, but further explanations were provided in isiZulu and Xhosa to participants who had difficulty understanding some of the wording. It was thus assumed that there would be no language and cultural barriers, which could influence participants' responses.

1.7.4 Most sponsored students have access to meal allowances, which are loaded onto their student cards to enable purchasing of food within the campus food court, as well as at fast food outlets. It was therefore assumed that sponsored students would consume more

fat and energy-dense fast food items than non-sponsored students would. It was assumed that their lack of nutrition knowledge would have a considerable impact on their eating habits.

1.7.5 It was assumed that the information gathered from questionnaires, together with the anthropometric and biochemical results, would be sufficient to compare the eating habits and the health status of sponsored students with non-sponsored students.

1.7.6 It was assumed that participants' responses would be authentic, thus suggesting that data generated from the study would be a true reflection of participants' dietary practices. Moreover, the results obtained from the study could be used by the institution's health and wellness departments to plan and implement nutrition education interventions within the university community.

1.8 DELIMITATIONS

1.8.1 The study was limited to African university students who were registered at the DUT and therefore it did not attempt to determine the dietary practices and health status of all university students in DUT.

1.8.2 Further to the above statement, students who were registered with the Department of Food and Nutrition were excluded from the study. This was done to eliminate any potential bias as students may have felt pressured due to the research study being conducted by senior students and supervised by academic staff. Moreover, it was assumed that because these students were studying Nutrition and Food Science, and were thus exposed to nutrition education; their eating habits would differ from those of other university students.

1.8.3 Two pre-existing questionnaires were used to collect dietary intake data. Three 24-Hour Food Recall questionnaires were completed for three non-consecutive days. A validated FFQ, adapted by Oldewage-Theron and Kruger (2008) for a study on food variety and dietary diversity as indicators of dietary adequacy and health status of an elderly population in Sharpeville, SA was used.

1.8.4 A validated socio-demographic questionnaire that was adapted and used in a focus group discussion with 20 South African community members by Napier (2006) for the evaluation of a feeding programme in addressing malnutrition in a primary school, was

used to determine the socio-economic profile of the participants. The questionnaire was edited and piloted on sub-sample ten DUT students.

Finger-prick measurements of fasting blood glucose, total serum cholesterol, and triglycerides were taken by a registered nurse with the assistance of a postgraduate nursing student and the researcher. Anthropometric and blood pressure measurements were taken by the fieldworkers. The data was collected to determine whether the participants had any risk factors for lifestyle diseases.

1.9 CONCEPTUAL FRAMEWORK OF THE STUDY

Selected clinical risk factors for non-communicable diseases in relation to the current dietary practices of sponsored vs. non-sponsored African university students in Durban

Figure 1.1 below depicts the conceptual framework of the study established by the researcher with the assistance of the research supervisors.

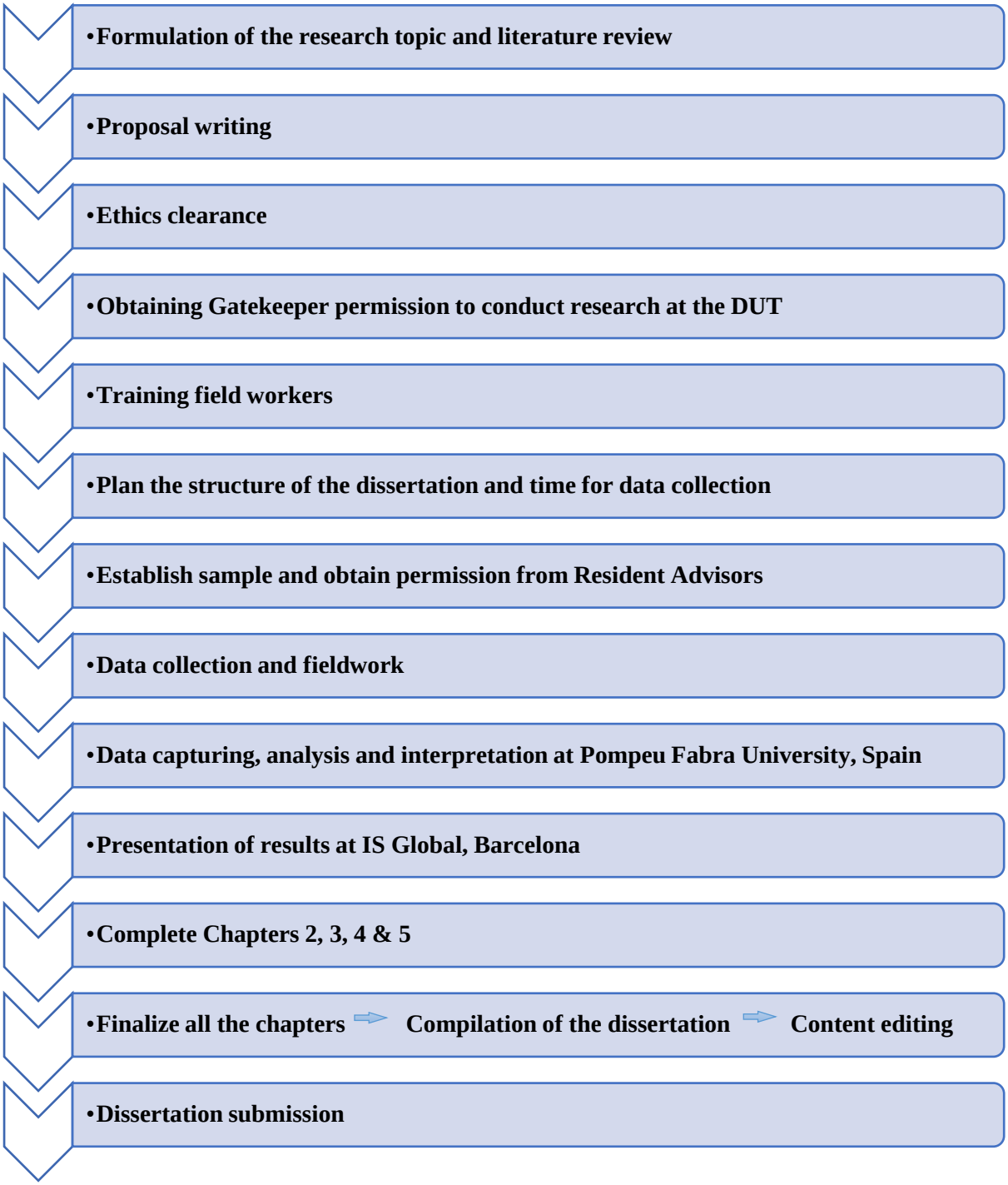


Figure 1.1: Conceptual Framework of the Study

1.10 DEFINITION OF TERMS

Biomass fuels: organic material such as crops and wood, which is produced in a renewable manner (WHO 2017: 1).

Clinical risk factor: an attribute of individual conduct, an ecological exposure, or an inherited attribute that is linked to an increase in the prevalence of a certain disease, injury, or other ailment (Centers for Disease Control and Prevention 2013: 8).

Cross-sectional study: research that determines the prevalence of health outcomes, establishing factors of health individually or mutually, within a population over a short period of time (Roundy 2014: 1).

Dietary practices: habitual decisions or food choices that are favoured by people in their daily life (Insight Medical Publishing 2019).

Face validity: the degree to which a test is instinctively seen as embracing the concept it intends to measure. Also known as logical validity (Johnson 2013).

Hyper-palatable food: food items that possess almost-addictive properties, thus causing a person to constantly consume more even at the state of satiety (Petermen 2014: 1).

Lifestyle diseases: medical conditions or disorders such as obesity that are associated with the way in which a person lives (Tabish 2017: 1)

Nutritional transition: urbanisation, modernisation, economic growth, and increased wealth that leads to predictable shifts in diets (Harvard University 2017).

Observer variation: failure by the observer in a study to evaluate or identify an occurrence accurately, thus resulting in error (Johnson 2013).

Reliability: the consistency or repeatability of study measures (Johnson 2013).

Sponsored: refers to a situation whereby an individual is provided with funds (University of South Australia 2018). In this case, the students which receive funds as a form of scholarship, bursary or student loan.

Stunting: impaired growth and development experienced by children due to inadequate nutrition, recurrent infection, and insufficient psychosocial encouragement (WHO 2017c).

Validity: an indication that accurate and detailed results are assimilated from the data collected (Johnson 2013).

Wi-Fi: A wireless networking modus operandi that allows gadgets to transmit data without using internet cords (Martindale 2018).

1.11 STRUCTURE OF THE DISSERTATION

Chapter 1: Introduction and Importance of the Study

The chapter includes the significance of the study as well as an overview of the research problem.

Chapter 2: Review of the Literature

A summary of the research studies which focus on the importance of addressing lifestyle diseases within the university community and relevant information pertaining to the topic.

Chapter 3: Study Design/Methodology

Research design, methods and tools used to carry out the study.

Chapter 4: Results and Discussions

Compilation of the data collected. Discussion of the outcomes relative to reviewed literature.

Chapter 5: Conclusion and Implications for Future Practice

Disparities in the research study and suggestions for future plans to address lifestyle diseases within the university community.

1.12 CONCLUSION

Adolescents and young adults, who form part of the university's student community have been identified as an at risk group for poor nutrition, which can lead to lifestyle dieases. It is therefore important that individuals are able to make informed choices when purchasing food thus ensuring optimal nutritional status. Generating a considerable amount of nutrition education information to expedite effective dietary practices and the procurement of food within the DUT environment will not only be beneficial to the students but to the institution as a whole. This study aims to assess the socio-demographic factors of sponsored and non-sponsored DUT students as well as the influence these factors would have on their dietary habits in order to determine food and nutrition security. The study also aimed to assess and compare clinical outcomes between sponsored and non-sponsored students. This would make it possible to reduce the risk for diseases of lifestyle in the long term through identifying socio-demographic factors that affect the students' dietary by generating information that would be scientifically sound, practical and culturally sensitive.

CHAPTER 2:

LITERATURE REVIEW

Chapter 2 exhibits a review of the literature relevant to the research study. The chapter begins with a general introduction, which includes a definition of malnutrition and then proceeds to explain the inherent impact of malnutrition on lifestyle diseases with particular reference to young adults.

2.1 INTRODUCTION

According to Mayosi and Benatar (2014: 1344), it has been more than 20 years since SA transitioned from a racially segregated society to a constitutional democracy and within this time, there has been considerable progress made towards overturning discriminatory practices that pervaded almost all aspects of life before the year 1994. The report (European Union 2016) indicates that despite the progress made thus far, socio-economic rights are still not accessible to a significant number of South African citisens, with SA being the second most unequal country in the world. To this day, the health status of most of the SA population is persistently overwhelmed by an unrelenting burden of communicable and NCDs, continuing social disparities, and insufficient numbers of healthcare workers to provide adequate care for the fast-growing population (Mayosi and Benatar 2014: 1344).

It is evident that NCDs are continuing to rise in the ranking of the top 10 causes of death since they constitute 60% of the 10 leading causes of death in SA. Figure 2.1 indicates that in the year 2016, NCDs accounted for approximately 40% of deaths in SA. Nojilana *et al.* (2016: 436) explained that this increase in mortality from NCDs as well as nutritional and blood disorders is possibly a result of urbanisation and lifestyle changes, and that an increasing number of South Africans are falling into the overweight and obese group.

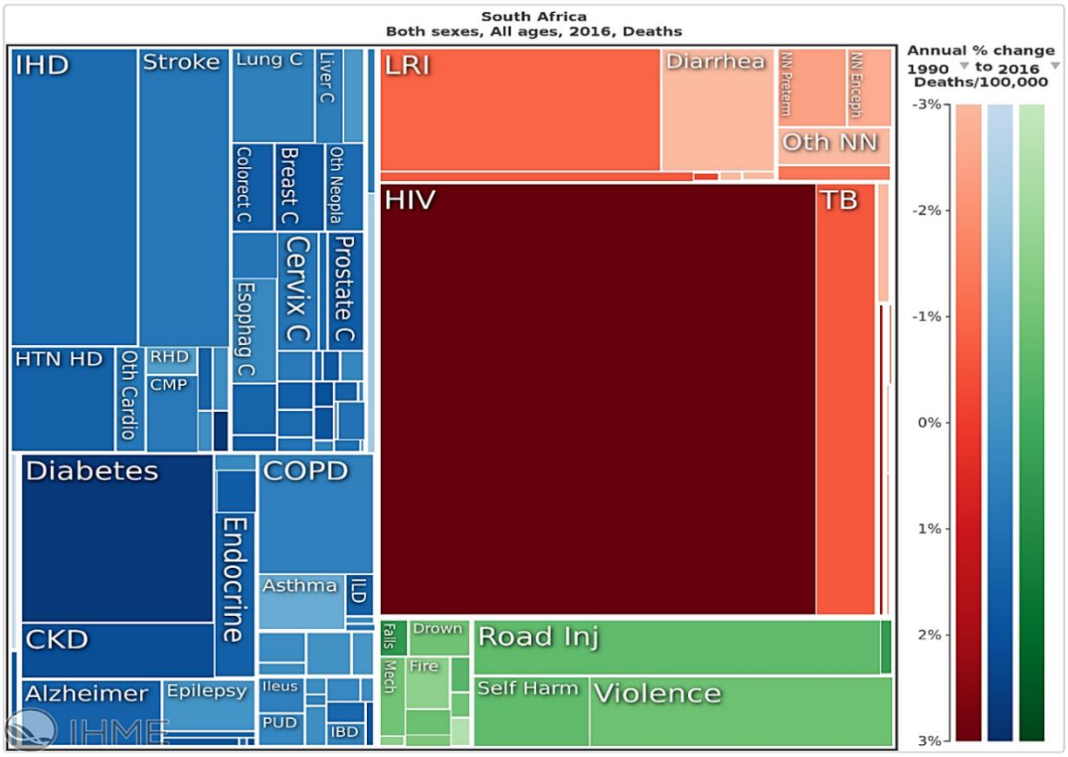


Figure 2.1: South African Deaths for Global Burden of Disease Level 3 Causes from 2016 (Institute for Health Metrics and Evaluation 2017)

Tathiah *et al.* (2013: 718) explained that the escalation of diet-related NCDs forms 28% of the burden of disease in SA. Such NCDs are connected with the process of social transition from a traditional rural lifestyle to embracing an urban lifestyle. Sunguya *et al*. (2014: 1) stated that developing countries have previously suffered from a high burden of malnutrition, primarily due to food insecurity, socio-economic and demographic detriments, high burdens of communicable diseases, and other biological and societal factors. However, recent rapid economic development has helped to increase food production. This has been complemented by a nutritional transition, which is defined by Harvard University (2017) as urbanisation, modernisation, economic growth and increased wealth that leads to predictable shifts in diets. Nutrition transition is often characterised by unhealthy modifications in food consumption patterns, consumption of tobacco and alcoholic beverages, and a reduction in physical activity (Tathiah *et al.* 2013: 718). It is further characterised by a transition from dietary regimes centred on essential grains, fruits and vegetables and minimal animal products towards processed foods and foods with high fat, sugar and salt content (Stupar *et al.* 2012: 199). The stages of the nutrition transition are well described in Figure 2.2.

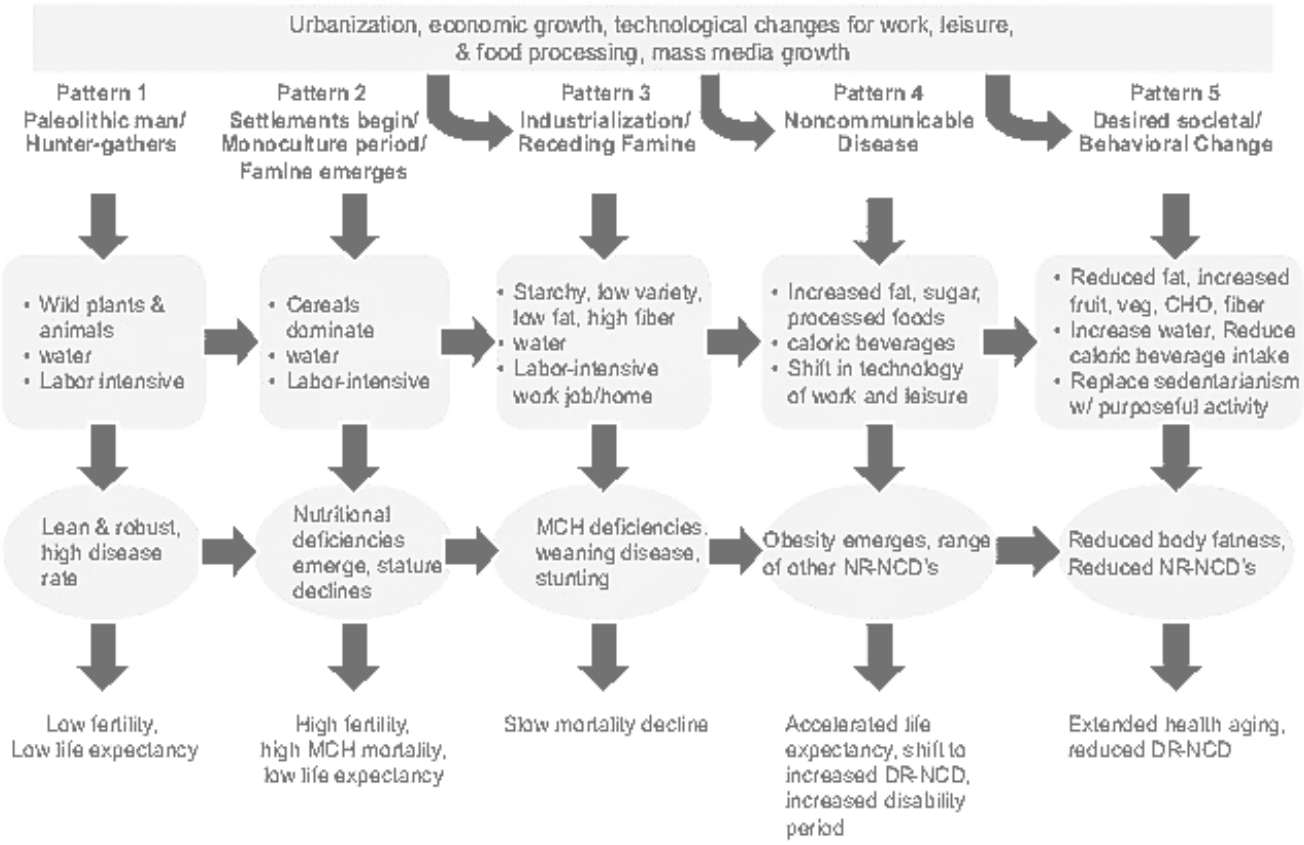


Figure 2.2 Stages of Nutrition Transition (Popkin 2002)

According to Sunguya *et al*. (2014: 2), the increasing need for urban relocation in conjunction with demographic transition, a reduction in physical activity as well as an increase in sedentary living, has resulted in the rising magnitude of overweight individuals in developing countries. The increase in economic disparity and inequality in these developing countries has led to food insecurity for some individuals and an abundance of food and a sedentary lifestyle for others. Although action to prevent NCDs is necessary at all levels, from global to municipal, the increased concentration of the world's population in metropolises and the association of urban settings with NCD risks, makes the metropolis a particularly essential arena for NCD prevention (Libman *et al*. 2015: 328). The Department of Health (2013: 11) explained that SA is undergoing a nutrition transition where micronutrient deficiencies and other forms of under-nutrition co-exist with the pervasiveness of obesity and other consequences associated with NCDs such as diabetes, hypertension, and CVD. Such health conditions, together with emergent over-nutrition, presents a complex series of challenges (Department of Health 2013: 11).

2.2 MALNUTRITION

According to Valentini and Schulzke (2011: 13), malnutrition is described as a condition where a disproportion of energy, protein and other nutrients triggers unfavourable outcomes on the sise, shape, and composition, performance, and clinical status of the body. As stated by Cusick and Kuch (2012: 441), the term malnutrition refers both to under-nutrition and over-nutrition, as it is considered a wide continuum of symptoms that occur when one or more nutrients are deficient in the diet.

Symptoms of malnutrition vary according to which nutrients are deficient and can result in an impairment of the essential organs and functions of the body (Mandal 2012: 1). Both over-nutrition and under-nutrition affect energy metabolism, with over-nutrition increasing energy expenditure and under-nutrition decreasing it (Pi-Sunyer 2000: 533). According to Kassier and Veldman (2013:250), the food insecure student population is generally subjected to poor nutrition (Fig. 2.3) because of poor quality diets that lack a variety of nutrients.

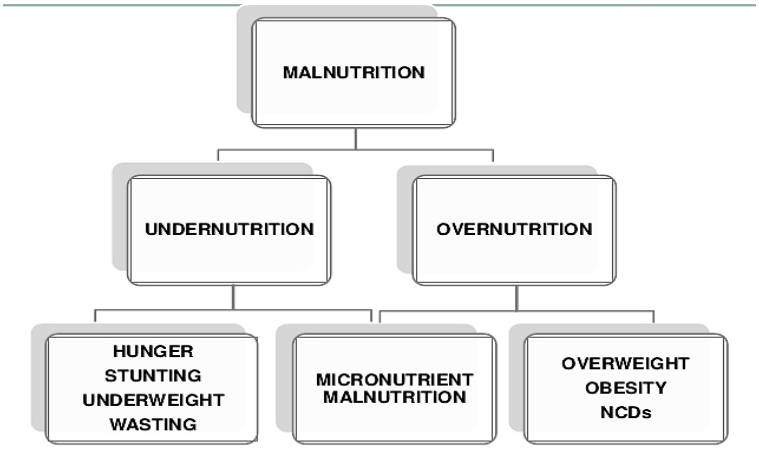


Figure 2.3 Categorizing Malnutrition (Harris and Kennedy 2013)

2.2.1.1 Over-nutrition

Parks (2015:1) explained that over-nutrition refers to frequent or consistent over-consumption of nutrients by eating too much food to the point that it turns out to be dangerous to one's health. The WHO report (2000) further elaborated that the distribution of fat that is stimulated by weight gain, influences the risks linked to obesity and the types of illnesses that result. In support of this statement, Faskunger and Hemmingson (2002: 100) stated that over-nutrition and a sedentary lifestyle are rudimentary components that assist in the manifestation of diseases

such as obesity, thus inducing a negative impact on the society's wellbeing. Subsequently, obesity increases the risk of lifestyle diseases, including CVD, hypertension, and type-2 diabetes (Unite for Sight 2012).

According to Kleinert and Horton (2015: 2326), an estimated 2.1 billion individuals were overweight globally. The Partnership for Maternal, Newborn & Child Health (2012: 2), stated that on an annual basis, billions of dollars are disbursed by the food industry to endorse the consumption of highly refined, energy-dense foods with either little or no nutritional significance. Adult obesity appears to precede child obesity. However, as reported in the International Food Policy Research Institute (IFPRI) discussion paper, Sachdev (2012: 4) indicated that absolute rates of escalation in overweight and obesity were more complex among adults than among juveniles in the seven countries studied.

2.2.1.1 Obesity

The WHO (2015b: 1) defined obesity as irregular or undue fat accretion in the body's insulation that could impair an individual's well-being. According to Otitoola, Oldewage-Theron and Egal (2015: 12), obesity can also be defined as excess overall weight with a BMI of more than 30 kg/m². Moreover, when compared to individuals with normal weight, obese individuals possess a dissimilar regional distribution of fat within the body (WHO 2015: 1).

The WHO report (2004) revealed that scientific data regarding obesity could actually be dated back as far as to the Graeco-Roman era; however, during this time, the progress made towards comprehension of the condition was minimal, until the 20th century. Until then, little evidence existed on the matter. The World Obesity Federation (2015: 5) confirmed that although little progress towards the most primitive identified deliberations on the need for an association that addresses obesity were instigated in Great Britain as early as the year 1961, it was not until the year 1966 that a steering committee was formed. Kleinert and Horton (2015: 2327) elucidated that obesity is a multifaceted issue in a world where globalisation is accompanied by an escalation of profit expectations and social development, which coexists with profound indigence. Modern websites and applications that facilitate consumers to create and share content as well as to participate in social networking give unrestrained prospects for advertising, thus posing real threats to our future (World Obesity Federation 2015: 5).

According to Wilson (2015: 1) young individuals are more exposed to environments which offer them energy-dense, high-fat foods that are readily available and generally presented to them looking tremendously delicious. As a result, these individuals have a higher possibility

of developing CVD risk factors such as hyperglycaemia, hypertension hypercholesterolemia, respiratory problems, and sleep apnoea. It seems as though the degree of the health and monetary burdens attributable to over-nutrition are extensively miscalculated from predictions centred on international anthropometric cut-offs (Sachdev 2012: 4). Moreover, the Partnership for Maternal, Newborn & Child Health (2012: 2) elucidated that obesity is gradually dominant among teenage girls and women as access to large quantities of economical, appealing, and convenient foods increases, particularly in low-income and fast developing countries.

Classifying obesity during childhood or adolescence is quite complex as the height of an individual is still increasing and body structure is constantly fluctuating. In addition to that, there are considerable global variances in the age at which sexual maturity commences and in the degree of difference in inter-individual proportions of fat accretion (WHO 2004). It is believed that BMI provides the most suitable, although basic, population-level measure of obesity. Bender (2009: 74) described BMI as an index of overweight and obesity, which is generally used to categorise underweight, overweight, and obesity. It is described as weight in kilograms (Kg) divided by one's height in meters squared (Caruso 2007: 159). The WHO (2004) identified the conditions that are classically associated with specific BMI ranges (Table 2.1).

Table 2.1 Scientific descriptions associated with BMI

SCIENTIFIC DESCRIPTIONS ASSOCIATED WITH BMI	
BMI (kg/m²)	**Classification**
≥40	**Morbidly Obese**
35.00 – 39.99	Obese Class II
30.00 – 34.99	Obese Class I
≥30	**Obese**
25.00 – 29.99	Pre-Obese
≥25.00	**Overweight**
18.50 – 24.99	**Normal**
<18.50	**Underweight**
17.00 – 18.49	Mild thinness
16.00 – 16.99	Moderate Thinness
<16.00	Severe Thinness

An individual with a BMI less than 18.50 kg/m² is considered underweight or malnourished while a BMI ranging between 18.50 kg/m² and 24.99 kg/m² depicts that the individual's weight is normal. Once the BMI is over 25 kg/m², stretching to 30 kg/m², the individual is deemed

overweight or pre-obese. If an individual's BMI ranges between 30 kg/m² and 40 kg/m², then he/she is classified as obese. A BMI greater than 40 kg/m² shows that the individual is morbidly obese.

Even though it can be anticipated that people with a BMI of 30 kg/m² or above possess surplus body fat, BMI does not make a distinction between weight in relation to muscle and weight in relation to fat (WHO 2004). Therefore, the relationship between BMI and body fat differs as per an individual's body shape and proportion. It is therefore important that BMI values are deduced with caution if assessments of body fat are required. According to Haworth (2015: 3), BMI is generally used to assess an individual's weight status as it is a less time-consuming, economical and convenient way to examine which weight classification an individual may fall under. Individuals that are classified as obese or overweight have been linked to an augmented risk of NCDs such as diabetes, hypertension and heart ailments, and for that reason, the examination of BMI is essential in pre-emptive care, as it is not indicative of such health conditions.

According to Malan (2014: 1), SA had the most siseable overweight and obese individuals in sub-Saharan Africa, which commands great concern. The map below (Haworth 2015: 3) illustrates regions that exhibit a large amount of obese individuals. In 2015, 30–40% of the adults in SA were obese (Haworth 2015: 3).

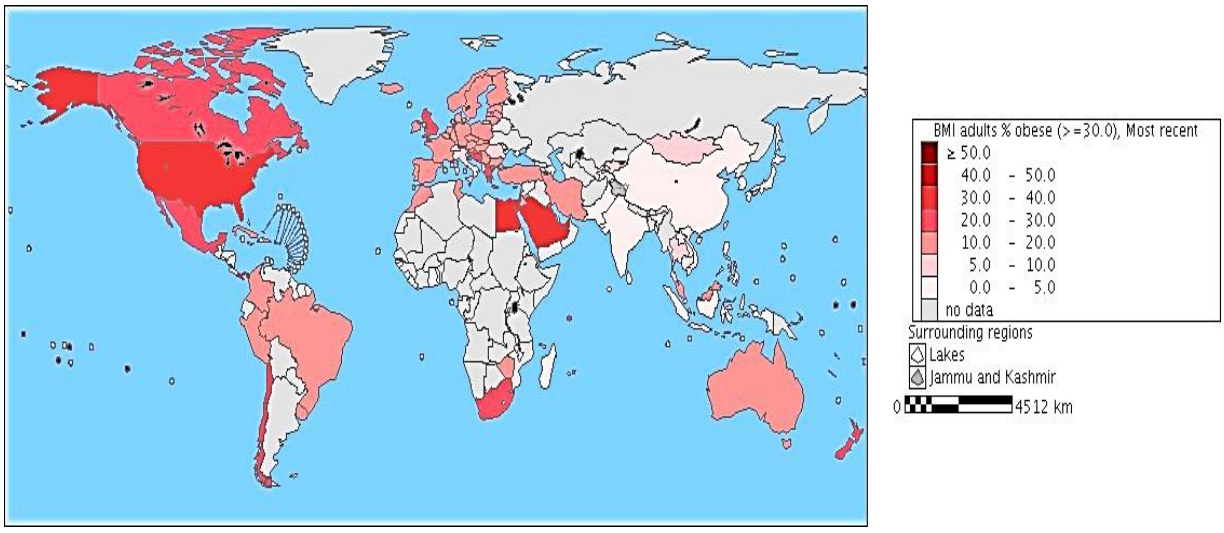


Figure 2.4 BMI Map (Haworth 2015)

In addition to measuring BMI, other methods are useful in identifying people who are at a greater risk for developing diseases that are related to obesity. Waist circumference (WC) is

another simple and reasonable measurement that can be used to measure abdominal fat accumulation (Haworth 2015: 3). Using a measuring tape, positioned at belly button level, one can obtain measurements with little to no difficulty – unless obese. Casais and Casais (2014: 2) revealed that a WC larger than 88 cm for women and 102 cm for men has also been linked with NCDs such as type II diabetes, hypertension, and CVD. Mercola (2011: 1) explained that WC provides a more accurate way than BMI to predict chronic lifestyle diseases. It was further stated that measuring the WC is convenient and straightforward; as it is not linked to height, but relates to BMI and waist-to-hip ratio (WHR) (WHO 2004). WC is also an estimated index of one's internal fat deposits (Virtual Medical Centre 2014).

2.2.1.2 Under-nutrition

According to the Global Health Advocates (2016: 2), undernutrition is caused by inadequacy in the amount and/or quality of food consumed, and/or recurring infection or disease resulting in inadequate assimilation of essential nutrients. It manifests itself in different forms. There are four comprehensive sub-structures of undernutrition: being underweight, muscle wasting, stunting, and micronutrient deficiencies (WHO 2017c). During 2014, nearly 462 million adults globally were underweight and in 2016 the South African Department of Health (2013: 11) stated that undernutrition in SA had been more or less constant since the early 1990s. Even though several indicators demonstrate improvement, there are still nutritional conditions that seem to have deteriorated over the past years.

2.3 CAUSES OF MALNUTRITION

There are three causes of malnutrition (WHO 2017c): basic causes, underlying causes, and immediate causes (Fig 2.6). These causes of malnutrition are further explained in the chapter.

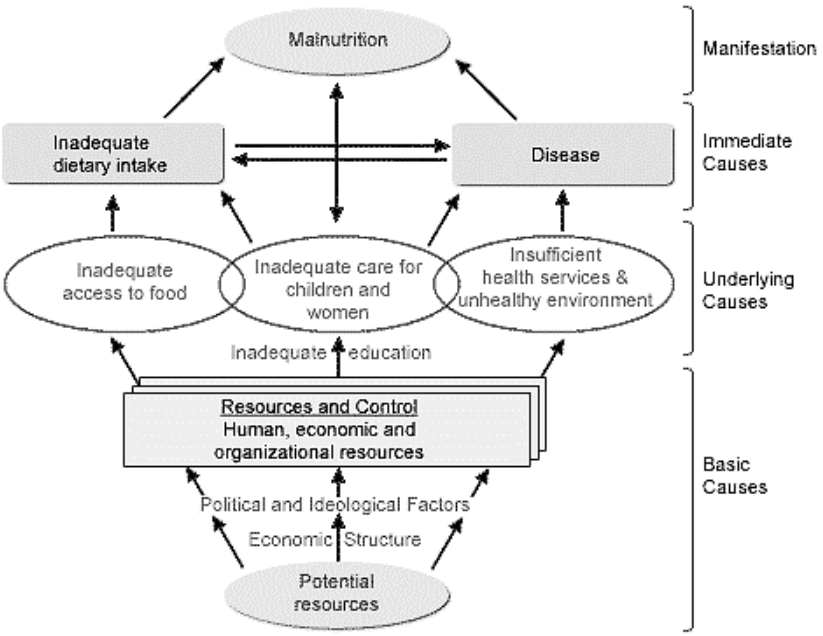


Figure 2.5 **Conceptual Framework of Malnutrition** [United Nations Children's Fund (UNICEF) 1998)]

2.3.1 Basic Causes of Malnutrition

According to Piniel (2016: 31), the basic causes of malnutrition refers to potential human, structural and financial resources available and how these resources are used under the influence of political, ideological and cultural factors. These can be thought of as the real reasons behind the underlying causes. Basic causes act on the entire society but have a greater or lesser impact on specific groups within society (Emergency Nutrition Network (ENN) 2011a: 3).

2.3.1.1 Economic Structure

Poverty is indisputably an influential element in the lack of resources to procure food. Individuals living in poverty often struggle to meet the expense of nutritious food for themselves and their families (Adams 2018). The underprivileged often lack access to imperative agricultural inputs such as seeds and fertilisers, making it virtually impossible to plant and grow crops that could feed their families. Economic relegation is also one of the rudimentary causes of malnutrition in many urgent situations. In countries prone to disasters, the most unfortunate members of society are usually the most severely affected (ENN 2011a: 4).

2.3.1.2 Political and Ideological Factors

Political, conceptual, legal, and cultural influences may impede or defeat efforts to attain good nutrition (ENN 2011a: 4). These factors include the extent to which the rights of women and children are protected by laws and customs, the control that women have over available resources, the political and monetary system that governs how revenue and assets are distributed as well as the beliefs, policies and ideologies that preside over social sectors. Inequity can lead to the relegation or segregation of minority groups from food distribution systems and other support services. Discrimination is often aggravated during a crisis, thus leading to a deterioration in the nutritional status of vulnerable group. It is such political and socioeconomic barriers that give rise to the greater part of food insecurity globally (Adams 2018).

2.3.1.3 Inadequate Education

An individual's level of education, as well as that of the caregiver, affects the quality of care given. This is because erudite individuals are capable of acquiring appropriate skills and understanding nutrition-related information. Educated individuals display more positive, caring behaviours than uneducated or less educated individuals (Mushaphi 2011: 38).

The level of maternal education is one of the most significant factors impelling the nutritional status of women and children around the world. This is because food-related decisions, domestic hygiene practices, and disease-management decisions are regularly made by the mother. Therefore, maternal education is essential for improving the health status of the family (Adams 2018). Nonetheless, in various environments where there are limited resources, educational achievement may be low and accompanied by a relative lack of knowledge regarding nutrition. When there is lack of knowledge regarding the importance of nutrients, many families fail to consume available, low-priced foods that are rich in essential vitamins and nutrients (Mushaphi 2011: 38).

2.3.2 Underlying Causes of Malnutrition

Underlying factors such as household food insecurity, inadequate care, insufficient health-care services along with hygiene and sanitation, all contribute to the prevalence of malnutrition. Such underlying factors can lead to the basic causes of malnutrition, which in turn lead to immediate challenges such as disease and infection as well as insufficient dietary intake (WHO 2017c).

2.3.2.1 Household Food Insecurity

Malnutrition is primarily the result of household food insecurity, which is directly linked to poverty and consequently, poor academic performance (Bizcommunity 2016). Limited income for acquiring and producing higher quality foods can at times pose obstruction to the achievement of better dietary diversity, particularly in the case of underprivileged people, thus leading to malnutrition (WHO 2013: 12). As stated by Meko and Jordaan (2016: 116), SA, as a state, is food secure, however, 50% of the population suffers from food insecurity at an individual and household level. A large number of students attending South African institutions of higher education and learning emerge from vulnerable communities; therefore, food insecurity is anticipated to be high in South African universities (Meko and Jordaan 2016: 116).

As stated by Kassier and Veldman (2013: 250), previous research revealed that young adult women who were found to be food insecure had a higher BMI compared to women who were food secure. It was also reported that individuals of both genders who came from households that were food insecure were found to be more obese and had also put on more weight over a one-year period compared to those coming from food secure homes.

2.3.2.2 Inadequate Care

As stated by the London School of Hygiene and Tropical Medicine (2018: 6), caring practices are dependent on resources such as time and income along with cultural factors and attitude to current health services, water supply and hygiene. Economic constraints also influence the frequency of feeding and the variety of nutritious food available for children. The availability of time for mothers to play with and stimulate their children in early life is also essential for cognitive development and can have life-long effects (London School of Hygiene and Tropical Medicine 2018: 6).

An individual's nutritional knowledge also affects the way they care for themselves as well as those close to them, and consequently affects their nutritional status. A report by (UNICEF 1990) suggested that poor nutrition knowledge and inadequate care play a significant role in inadequate dietary intake and unhealthy dietary practices.

2.3.2.3 Insufficient Health Services and Unhealthy Household Environment

Prüss-Ustün et al. (2016: 4) explained that societal and environmental elements of health are intimately connected. Social elements are functions of the conditions in which people live, and these conditions are predominantly formed by the distribution of resources and power. These

social elements are connected to and facilitate exposure to environmental risk factors such as adequate housing, water and sanitation, satisfactory working conditions and a healthy lifestyle. The WHO (2017b) stated that nearly three billion individuals worldwide are continuously dependent on pollutants such as biomass fuels, coal, and kerosene for their energy needs. The use of such fuels increases the level of household air pollution.

Gaedei and Versteeg (2011: 101) described SA as having an established and advanced, vigorous social security system including disability, care dependency, and old-age grants, which is superior to other African countries. Such grants perform a vital role in the subsistence of many households. Modifications to the system such as making access to certain healthcare services, for example, the provision of antiretroviral drugs as well as maternal and child care, free of charge, have been significant steps in eliminating barriers to access to healthcare. Nevertheless, Blecher *et al.* (2017: 36) stated that there are still considerable disproportions in the distribution of skilled healthcare workers in SA. Some primary healthcare facilities have a huge amount of work and not enough staff to execute the work, while other facilities are comparatively under used. As stated by Bradshaw *et al.* (2011: 4), the general absence of healthcare professionals, predominantly in rural areas, has a huge impact on all aspects of healthcare. Primary healthcare (PHC) in SA is not well programmed to deliver preventative or therapeutic services for NCDs and SA has a long way to go when it comes to delivering integrated PHC. Access to procedures conducted by specialists is not optimal (Bradshaw *et al.* 2011: 4).

2.3.3 Immediate Causes of Malnutrition

The ENN (2011b: 2) stated that the immediate causes of malnutrition are insufficient dietary intake and disease. The manifestation of malnutrition in this case is due to the disparity concerning the amount of nutrients required by the body and the amount of nutrients absorbed by the body. This occurs because of insufficient food intake or having an infection, which increases the body's need for nutrients, reduces the desire for food, or decreases the absorption of nutrients from the gut (ENN 2011b: 6).

2.3.3.1 Inadequate Dietary Intake

As stated by the Netherlands Royal Dutch Mines (2017: 2), individuals who consume an insufficient proportion of micronutrients, especially children, are at a high risk of experiencing cognitive and physical difficulties for the rest of their lives. Conditions such as stunting, which

is displayed through the inability to achieve linear growth capability because of insufficient nutritional intake, remain a major public health matter in quite a number of unindustrialised countries, including many in sub-Saharan Africa (Netherlands Royal Dutch Mines 2017: 2).

According to Kassier and Veldman (2013: 250), food insecure university students in SA face the adversity of poor nutrition because of an inadequate diet that lacks diversity, and is of poor quality. Moreover, in situations of food insecurity, food consumption becomes inconsistent. Oddly enough, students who suffer from food insecurity also often suffer from overweight and obesity, which increases the risk for NCDs. This is because underprivileged students choose low-priced foodstuffs, which are high in energy and have a low nutrient density. Healthier options such as fruit and vegetables with a higher nutrient content are usually more expensive, and thus consumed less. If a person does not consume a diet that provides adequate nutrition required for optimal health, they are likely to suffer from malnutrition (Banca 2015: S27). Inadequate intake of nutrients can be triggered by illness or injury. It may also persist during the individual recovers (Nordqvist 2017).

2.3.3.2 Disease

According to the London School of Hygiene and Tropical Medicine (2018: 6), infection plays a significant role in increasing the body's requirement for nutrients, reducing the desire for food, and decreasing the rate of absorption of the nutrients from the intestine. Malnutrition and infection often occur simultaneously. Mushaphi (2011: 35) further explained that insufficient dietary intake might not be the only cause of malnutrition, since the prevalence of illnesses may reduce the bioavailability of nutrients or increase the loss of nutrients. Figure 2.6 illustrates how undernutrition can increase the risk of infection even as infection can result in undernutrition, thus leading to a cycle of undernutrition and infection.

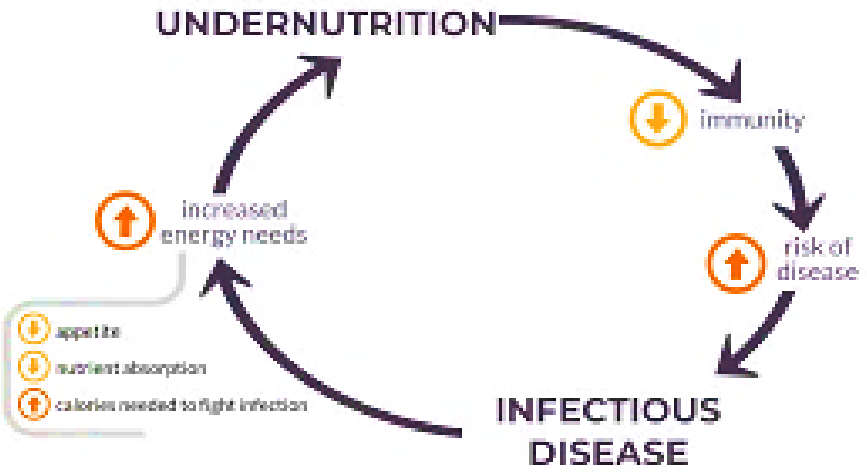


Figure 2.6 The Vicious Cycle of Undernutrition and Infection (The Voice 2013)

There are many illnesses, which contribute to the development of malnutrition (Jupiter Medical Specialists 2018), and these include:

- Liver disease and cancer – these medical conditions can cause a lack of appetite due to insistent pain or nausea.
- Crohn's disease or ulcerative colitis – such conditions interrupt the body's ability to absorb nutrients or assimilate food.
- Dysphagia – a health condition that makes it hard for one to swallow food.
- Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS) – nutritional adjustments that result in malnutrition are common side effects of HIV infection. The progression of malnutrition in this case depends on a number of aspects and includes food consumption-related disorders, nutrient absorption, and intermediary metabolism (Katona and Katona-Apte 2008: 1585). HIV and AIDS have turned out to be a major source of severe malnutrition in unindustrialised countries (Rose, Hall and Martinez-Alier 2014: 546). There are also other illnesses and infections which are directly associated with severe malnutrition such as tuberculosis, measles and diarrhoea. An individual who is infected with HIV is more prone to severe malnutrition than a healthy individual. Anti-retroviral drugs only work effectively when taken with a sufficient and consistent diet.

2.4 LIFESTYLE DISEASES IN SOUTH AFRICA

With increased levels of underweight and nutritional deficiencies, SA is subjected to an increase in the prevalence of NCDs, which places a substantial burden on health-care services (Puoane *et al*. 2017: 171). Correspondingly, a constant increase has been noted in the per capita food supply of protein, fat and total calories in SA (Igumbor *et al.* 2012: e1001253). Even salt consumption levels appear to be in excess of levels that are said to be ideal for human health.

According to Ng *et al.* (2014: 777), within the sub-Saharan African region, South African women had the highest prevalence of obesity as defined by a BMI over 30 kg/m², as 42% of women were found to be obese in 2013. Claasen, Van der Hoeven and Covic (2016: 1) stated that obesity is regarded as one of the most important elements contributing to the high prevalence of NCDs in SA. Non-communicable diseases constitute 37% of all-cause death, for the most part being heart disease, type II diabetes and specific cancers. Both rural and urban black South African societies have traditionally encountered diverse public health problems including an increasing prevalence of NCDs, linked to over-nutrition in urban-dwelling societies (Micklesfield *et al*. 2013: 370).

Allen *et al.* (2017: 227) revealed that lifestyle diseases, also known as NCDs, accounted for about 70% of global mortalities. The disproportionate concentration of premature deaths from such diseases in developing countries has been referred to as the issue of societal impartiality in our generation. According to the Institute for Health Metrics and Evaluation (IHME) (2017: 2), four of the top ten leading mortality causes in SA during the year 2016 were due to NCDs namely, diabetes mellitus, cerebrovascular diseases, chronic obstructive pulmonary disease (COPD) and ischemic heart disease. A recent nationwide study (Shisana *et al.* 2013: 145) indicated that 28% of the population were also at risk of starvation and 26% were found to be food insecure. Therefore, eradicating malnutrition requires the provision of food environments that will address it within the South African context (Shisana *et al.* 2013: 145).

2.5 RISK FACTORS FOR LIFESTYLE DISEASES

The Centers for Disease Control and Prevention (CDC) (2013: 8) described a risk factor as either a distinct attribute of conduct, which can be an environmental exposure, or an inherited attribute, which is linked to an increase in the prevalence of a certain disease, injury, or other

ailment. Lifestyle diseases such as Type II diabetes, chronic lung disease, stroke, and heart disease are mutually accountable for approximately 70% of all mortalities globally. Nearly 75% of all fatalities caused by lifestyle diseases, and about 13 million premature deaths, occur in underdeveloped and unindustrialised countries (WHO 2017g).

2.5.1 Modifiable Risk Factors

NCDs are primarily linked to four key risk factors including physical inactivity, the use of tobacco, alcohol abuse, and unhealthy eating habits (Namusisi *et al.* 2011: 48). These social risk factors contribute to the significant metabolic modifications that increase the risk of NCDs. The correct dose of medication is vital for treating these illnesses and there is an equally significant role that a wholesome diet and physical exercise play an equally significant role in the promotion of good health (Adhikari and Adak 2012: 36). Scientific evidence suggests that unhealthy eating habits, physical inactivity, and the use of substances such as tobacco and alcohol are major global determinants of NCDs.

2.5.1.1 Physical Inactivity

Ekpenyong *et al.* (2012: 251) confirmed that approximately 3.2 million individuals die each year due to inadequate physical activity. Individuals who are physically inactive or do not exercise enough, have a 20-30% added risk of premature death. Exercising regularly reduces the risk of obesity, CVDs, hypertension, and diabetes. Several risk factors including inadequate physical activity and total fat consumption are highest in industrialised countries; however, excessively high levels have been established in certain developing countries, particularly among women (Alwan *et al.* 2011: 6). Bradshaw *et al.* (2011: 2) revealed that that the South African population have high sedentary levels with 48% of men and 63% of women considered as physically inactive. Women were found to have higher physical inactivity levels than men Bradshaw *et al.* (2011: 2).

2.5.1.2 Tobacco Use

According to the Centre for Health Protection (2016: 1), cigarettes release several elements including nicotine, asphalt, and carbon monoxide, which causes harm to the human body. Individuals who smoke cigarettes are at a greater risk of developing melanomas, specifically lung cancer, cerebrovascular disease, and heart disease. Environmental tobacco smoke also triggers an increase in the risk for developing lung cancer and heart diseases. Smoking is the

most avertable risk factor (University of California, San Francisco 2017). People who smoke cigarettes have twice the probability of developing CVDs. Smoking generally eliminates 13 years of life for a male smoker and 14 years for a female smoker. Being exposed to smoke also escalates the risk even for people who do not smoke. According to Ekpenyong *et al.* (2012: 251), nearly six million deaths annually were linked to tobacco use, both from direct tobacco smoke and environmental tobacco smoke. It has been estimated that by the year 2020, this number will escalate to 7.5 million. Bradshaw *et al*. (2011: 2) revealed that approximately 35% of South African men and 10% of women smoked tobacco.

2.5.1.3 Alcohol Abuse

According to the International Federation of Medical Students' Associations (IFMSA) (2015: 1), alcohol is a widely used psychoactive substance with properties that produce reliance and is used in many cultures. The detrimental use of alcohol generates disease as well as a social and economic burden within the communities. Alcohol is a main cause of death, illness, and injury to the user and their surroundings. Alcohol's effect on societies is influenced by the capacity of alcohol consumed; consumption practices and infrequently, by the quality of alcohol consumed (WHO 2017a). Alcohol intake is a contributing aspect to more than 200 injuries and illnesses. The consumption of alcohol has been linked to the possibility of developing cerebral and behavioural disorders, including alcohol dependency, NCDs such as CVDs, liver cirrhosis, certain cancers, and injuries due to violence and road accidents (WHO 2017a).

The harmful use of alcoholic beverages results in the death of 3.3 million individuals, globally, each year. Alcohol has been found to play a significant causal role in 60 different types of diseases, whilst causing harm to the health and well-being of people around the person who drinks alcohol (WHO 2017a). During the year 2010, the total global consumption of alcohol for individuals who were 15 years and older equated to 13.5 g of pure alcohol per person per day. Unrecorded consumption of alcohol accounted for 25% of the total global consumption, which was either homemade, produced illegally or sold outside normal government controls (WHO 2014).

2.5.1.4 Unhealthy Diets

Poor eating habits contribute about 2.8 million mortalities globally, each year. These habits also increase BMI, which in turn increases the risk of CVDs, stroke and diabetes (Ekpenyong

et al. 2012: 252). An exceptionally high number of South Africans displayed unhealthy eating habits through excessive consumption of foods high in sugar and fat (Scott *et al.* 2017: 81). In support of the above statement, Bradshaw *et al.* (2011: 2) stated that the South African population was proceeding to consume a classic Westernised, diet embracing foods high in calories, sugar, saturated fat and animal protein along with low consumption of unprocessed carbohydrates and fibre. Scott *et al.* (2017: 81) reported that the most significant influence on food-purchasing choices was food price and it was clear that judicious economic and social factors supported the shift to processed and packaged food items, which are high in salt, sugar, and fat. Fresh food was found to be more expensive than processed foods, when matched on an energy and weight basis.

2.5.2 Non-Modifiable Risk Factors

2.5.2.1 Age

According to Tagurum *et al.* (2015: 228), chronic lifestyle diseases were regularly associated with the elderly; however, it has since been confirmed that more than nine million of all mortalities linked to NCDs transpire before 60 years of age. Ninety percent of these mortalities occurred in underdeveloped and developing nations. Mitu (2017: 16) revealed that the likelihood of developing hypertension and Type II diabetes increases with age. Through early middle age, elevated blood pressure levels are more frequent in males, whereas females have a tendency to develop hypertension after 65 years of age. The older a person becomes, they are more likely to develop hypertension. As an individual ages, their blood gradually loses its elastic quality, which in turn elevates blood pressure (American Heart Association 2014: 6).

According to National Institute on Ageing (2018: 1), as an individual grows older, the heart cannot beat as fast during physical activity or stressful time as it did when they were younger. This however does not change the heart rate with normal aging. Heart disease is often caused by the build-up of fatty deposits in the walls of arteries over several years (American Heart Association 2017). Because plaque accumulates inside the walls of a person's arteries which then over time, hardens and narrows the arteries and consequently reduces the flow of oxygen-rich blood to one's organs and other parts of the body (National Institute on Ageing 2018). Over time, the heart muscle can become weakened and/or damaged, resulting in heart failure.

According to the WHO (2009: 5), heart damage can be caused by heart attacks, long-standing high blood pressure, diabetes mellitus, and chronic heavy alcohol use.

2.5.2.2 Gender

As a risk factor, gender is a sexual characteristic that refers to the socially fabricated features including the customs, responsibilities, and associations that exist among them. Gender norms, roles, and relations have a huge impact on the health outcomes of people including individuals with transgender or intersex identities (WHO 2015a). According to Adhikari, Gupta and Koshy (2014: 88), the burden of NCDs has not only been disproportionately distributed among diverse social classes but the risk factors of such NCDs also show variation between genders. For women, the rapid rise in NCDs directly affects their health and has a severe impact on their anticipated gender-role as caregivers of the sick. Gender also has a significant impact on vulnerability and exposure to specific risks to mental health.

According to the Pan American Health Organisation (PAHO) (2012: 1), men and women possess dissimilar levels of exposure and susceptibility to risk factors of NCDs. Women have a significantly higher probability of becoming obese than men. Men and women exhibit several NCD symptoms and risks differently. The majority of studies conducted on the diagnosis of NCDs have mostly been undertaken on men, thus women may be less likely to be diagnosed with a NCD at the early stages. Women are also subject to less apparent symptoms of CVD than men are and, as a result, are less likely to be diagnosed and treated earlier (PAHO 2012: 1).

2.5.2.3 Race

Racial and ethnic disparities in healthcare, and the prevalence and risk factors of diseases create serious challenges for the public health sector which mostly affects minority groups, the less fortunate as well as indigenous groups. These disparities in healthcare are somewhat due to a preconceived notion, uncertainty, socioeconomic dissimilarities, and health seeking attitudes, along with social and environmental determinants of health (Kufe *et al.* 2016: 2). According to the American Heart Association (2014: 6), African Americans tend to develop and suffer from hypertension more often than their white counterparts. The British Heart Foundation (2016: 22) also added that South Asian and black African individuals are at a higher risk of developing CHD and stroke. People from South Asian backgrounds are predisposed to weigh-gain around their waist, thus increasing their risk of developing CHD, stroke and diabetes (American Heart Association 2014: 6).

2.5.2.4 Family History

In developed countries, the risk of developing hypertension for an individual with a family history of hypertension has been projected to be up to four times higher than average (Mitu 2017: 12). Coming from a family with a history of type-2 diabetes is additionally considered as a causal factor for acquiring the disease. The risk increases if anyone in the family has pre-diabetes, which is a precursor to type II diabetes, or if a parent or sibling suffers from type IIdiabetes (Namusisi *et al.* 2011: 48). According to American Heart Association (2017: 1), heredity and diet have a significant influence on an individual's low-density lipoproteins (LDL) and total cholesterol levels. This can increase the risk of atherosclerosis, a condition caused by the accumulation of cholesterol-containing fatty deposits on the walls of the arteries. One in every 500 adults has inherited abnormality in the way that they process LDL cholesterol. They have high blood cholesterol levels even with a diet with only average fat intake (American Heart Association 2017: 1).

2.5.3 Metabolic Risk Factors

According to the CDC (2013: 12), the term "metabolic" refers to the biological processes concerning the body's natural functioning. Modifiable risk factors can lead to metabolic modifications. The WHO has prioritised the following four metabolic risk factors: elevated blood pressure, total cholesterol, blood glucose levels; overweight and obesity. These are discussed in the following section.

2.5.3.1 Elevated Blood Pressure

Elevated blood pressure is thought to be a major risk for CVD. A systolic blood pressure (SBP) greater than 115 mmHg has been projected to contribute to approximately 54% of all strokes and 47% of all ischemic heart diseases. Consequently, the encumbrance of disease and fatality due to high blood pressure and associated NCDs is presently one of the most pressing public health challenges worldwide (Drozdz and Kawecka 2014: 1507).

According to the American Heart Association (2014: 6), having high blood pressure as a child is significantly linked to the development of hypertension as an adult, thus implying that children with elevated blood pressure levels are at higher risk for developing hypertension and associated illnesses as adults. Bradshaw et al. (2011: 3) revealed that the significant increase

in hypertension in SA, during the past decade, along with the inadequate diagnosis and control of raised BP predicts an increase in CVDs in the years to come.

2.5.3.2 Raised Blood Glucose

Abnormally high blood glucose level, also known as hyperglycaemia is dependent on the indicative standards employed in epidemiological surveys. Hyperglycaemia is described as a fasting blood glucose level greater than 7.0 millimoles per litre (mmol/L), that contribute to the global prevalence of diabetes which was estimated to be 8.5% during the year 2014 (WHO 2017e). Mitu (2017: 6) stated that high blood sugar levels do not trigger warning signs until glucose levels are considerably high and above 11 mmol/L. Indicators of hyperglycaemia progress at a slow pace over a number of days or weeks. As the glucose levels are elevated for an extended period, the more severe the symptoms become.

As stated by the WHO (2017: 1), the risk of CVD constantly increases with increasing levels of fasting blood glucose, albeit below levels diagnostic of diabetes. Abnormal (higher-than-ideal) blood glucose level was accountable for an additional 2.2 million mortalities worldwide, due to increased risk of other NCDs. Besides increasing the risk of CVD, diabetes has been linked to the damage of the kidneys, nerves and eyes, which in turn leads to other complications. Furthermore, in the case of diabetes, Atun *et al.* (2017: 626) indicated that nationwide, representative observed biomarker data on diagnosis was unavailable in 21 countries in sub-Saharan Africa. Nevertheless, excessive, persistent postprandial blood glucose peaks are a grave setback for individuals who suffer from diabetes, owing to the risk of micro- and macro-vascular complications (Nnadi and Keshinro 2016: 93).

2.5.3.3 Raised Total Cholesterol

According to Perry (2015: 30), some cholesterol is required to aid in different body processes. This includes the formation of bile acids that promote the digestion of food in the intestine as well as the formation of Vitamin D. Elevated blood cholesterol levels eventually lead to dyslipidaemia which refers to high levels of lipids and cholesterol in the blood (Hossain 2017: 20). Such elevated cholesterol levels increase the risk of CVD, and are responsible for approximately 33% of all global ischemic heart diseases and have been estimated to be the cause of 2.6 million deaths globally (WHO 2017d). Excessive concentrations of total and LDL cholesterol as well as low levels of high-density lipoprotein (HDL) cholesterol predict the risk of CVD in both men and women. The risk of CVD rises by an average of 2% for each consistent 1% increase in total serum cholesterol (Hossain 2017: 20).

Recent studies indicate that there is a trend of increasedblood cholesterol levels worldwide (Htet 2014: 9), and the prevalence of elevated total cholesterol rose remarkably in line with the revenue of the country (WHO 2017). Diets high in saturated fat together with low physical activity levelscan cause elevated blood cholesterol levels (Htet 2014: 9). It was estimated that a reduction of blood cholesterol levels by the age of 40 yearscan reduce the risk of ischemic heart disease by 50% by the age of 40, and by 20% at the age of 70. CVD is a serious cause for concern worldwide, particularly in a country with a fast-growing economy (Mitu 2017: 7). As stated by Bradshaw *et al.* (2011: 3), an increase in influential factors such as unhealthy diets and physical inactivity resulting in overweight and obesity, certainly contributes to the rising prevalence of diabetes and dyslipidaemia.

2.5.3.4 Overweight and Obesity

Overweight and obesity are the leading causal factors to chronic lifestyle diseases such as CVD and type II diabetes. As the level of excess weight increases, so does the risk of developing such NCDs. Obesity can also hinder the body's ability to control chronic illnesses (Mitu 2017: 6). Bukelo *et al.* (2015: 284) stated that obesity, physical inactivity and unhealthy eating habits are instilled during the adolescence stage and these lifestyle changes linger into adult life. It is already evident that approximately 75% of obese adolescents remain obese throughout and into adulthood, thus increasing the risk of NCDs. Bradshaw *et al.* (2011: 2) revealed that women in SA have exceedingly high levels of overweight and obesity. Over 70% of females over the age of 35 years are overweight or obese. During the preceding decade, a substantial increase in overweight and obesity among men has been observed and over 45% of those men over 35 years were overweight or obese. Moreover, the fast-increasing rates of overweight and obesity during childhood and the adolescence stage are leading to increased diagnoses of NCDs at a younger age (University of Auckland 2017).

2.6 DIETARY PRACTICES OF UNIVERSITY STUDENTS

According to the McGinnis, Gootman and Kraak (2006: 91), the dietary practices of individuals are influenced by a number of factors that may be characterised as physiological factors, psychological influences, food accessibility, and food characteristics. In due course, a combination of these elements determines what, how and why food is consumed. Adolescents and young adults acquire their food from several sources such as the home, school, university

and in the community and for this reason they are at risk of developing poor dietary practices (Feeley *et al*. 2012: 2).

Tee *et al.* (2015: 81) stated that adolescents are at an exceptionally high risk of health-compromising practices, such as increased fast food intake, increased physical inactivity, and frequently skipping breakfast. Health-promoting activities such as adequate exercise and sleep, not smoking or moderate alcohol intake, and eating breakfast on a regular basis, decline dramatically in the transition to young adulthood. Lupi *et al.* (2015: 154) stated that owing to significant lifestyle changes, young adults are positioned alter their eating habits negatively in terms of variety, fruit and vegetables intake, and the frequency of food intake. The years devoted to the university environment represent a crucial period that is capable of influencing both the quality of life as well as the eating habits of the succeeding adulthood (Lupi *et al.* 2015: 154).

2.6.1 Skipping Breakfast

Meal skipping is the exclusion of one or more of the customary main meals such as breakfast, lunch, or dinner during the day. Regularly skipping breakfast has been linked to poorer diet quality, lower nutrient intake, an added risk of central obesity, indicators of insulin impediment and cardio-metabolic risk factors (Pendergast *et al.* 2016: 125).

According to Tee *et al.* (2015: 81), the consumption of breakfast by adolescents on a regular has been linked to a lower risk of obesity and NCDs, improved intellect and improved nutrient consumption. Nevertheless, research has revealed that breakfast intake is declining globally. The reported prevalence of adolescents skipping breakfast in SA ranges from 13-36%. Furthermore, skipping breakfast has conversely been linked to adverse influences on intellectual capacity, academic enactment, university attendance, psychosocial behaviour, and mood in young people (Sun *et al.* 2013: 1). Estimated frequencies of skipping meals by young adults fluctuate between 24 and 87%, with young adults constantly recording higher meal skipping frequencies compared to children and adults (Pendergast *et al.* 2016: 125).

2.6.2 Snacking

The main purpose of snacking is to decrease the level of pre-mealtime hunger without exceeding daily energy requirements. This is known as mindful snacking, which involves the consumption of a nutritious, well-portioned snack when hunger strikes (Campbell 2018).

Unhealthy snacking, in contrast, can easily exceed one's daily energy needs while offering little to no nutritional benefit and contributing to the development of a variety of health complications.

According to Tanton *et al*. (2015: 1), university students are commonly described as individuals who participate in unhealthy lifestyle behaviours comprising of unhealthy eating habits such as an increased intake of snacks and the consumption of fast foods. During the past few years, an increase in the retailing and procurement of just about all kinds of packaged foods in SA has been observed. The retailing of snack bars, noodles and ready-to-eat-meals increased by more than 40% between the years 2005 and 2010 (Igumbor *et al.* 2012: e1001253).

The impact of the sudden increase in snacking habits will be massive, shaping the way enterprises produce, promote, and serve food. Such an impact will also influence food marketers' decisions on what kind of food items will be produced going forward (Horovitz and Gelles 2014). It was found that 45% of consumers, globally, use snacks to replace traditional main meals. Approximately 52% of consumers stated that they occasionally replace breakfast meals with a snack, 43% consumed a snack during lunch, and 40% replaced supper with a snack. As stated by Feeley *et al*. (2012: 2), the practice of snacking while watching television increases with age. It was also found that females consistently consume more snacks while watching television as opposed to males.

As stated by Barnes and Noble College (2015: 3), when it comes to students, snacking is mostly not about the when, but it is about the why. When the College fielded a survey to gain perspective on the snacking habits and dietary preferences of students, many indicated that they ate simply because they were hungry. However, approximately half of the students indicated that their tendency to snack was directly correlated to what they were doing at the time. It was further reported that 51% of the student population had the tendency to pick up a snack when they were bored. On the other end of the spectrum, 50% of the students indicated that snack consumption helped them to concentrate when they were busy studying. It was also found that 46% of the students used snacks as meal replacements. According to Nickols-Richardson *et al.* (2014: 695), irregular snacking behaviour poses a great risk to the health adolescents. Such risks include cardiovascular, neurological, and metabolic complications. Mithra *et al.* (2018: 1) further stated that irregular eating habits are usually endorsed by factors like peer influence, parental behaviour, and influence of western food. The Barnes and Noble College (2015: 2)

also revealed that 70% of students eat two or three snacks in a day, 52% of students snack on the go and 94% of students are interested in free snack samples at the campus bookstore.

2.6.3 Fast Food Consumption

Convenience meals and fast foods often have low nutritional value, while being high in energy (Tanton *et al.* 2015: 1). The increased consumption of fast foods has been linked to a low fruit and vegetable intake and lower diet quality. According to Bipasha and Goon (2016: 61), take-away and fast food consumption has continued to rise in Western societies. Such eating habits are predominantly extensive among adolescents and young adults. When young individuals transition into university life, they are in control of their decisions, especially with regard to preferred dietary practices and the food choices they make.

As stated by Hossain (2017: 28), the increased production of processed foods, impulsive urbanisation, and the modification in dietary habits contributes to an increased consumption of salt. This further contributes to elevated blood pressure and also increases the risk of CVDs. Feeley *et al*. (2012: 3) found that fast-food preferences were the same for South African male and female adolescents, with the five most preferred foods items being fried chips, battered fried fish, vetkoek (deep-fried dough rings/balls), pies and boerewors rolls. These food items accounted for more than 74% of total fast foods consumed. Evidence showed that there was a significant connection between the campus food environment and the eating habits of university students. As stated by Meko and Jordaan (2016: 116), the university food setting's effect on students' dietary practices can be either constructive or destructive. Claasen, Van der Hoeven and Covic (2016: 11) confirmed that fast food consumption patterns were comparable across all ethnic groups with black (21.4%), coloured (26.8%), Indian (30.1%), and white (28.3%) South African individuals consuming takeaways at least two or three times per month.

A recent national assessment of fast food and street food consumption revealed that 11.3% of South Africans purchased food from street vendors and 6.8% from fast food outlets and at least two times a week (Igumbor *et al.* 2012: e1001253). Vending machines are widespread on university campuses and have been linked to students' unhealthy food choices (Ali *et al*. 2015: 2). Meko and Jordaan (2016: 116) found that the UFS food outlets reserved for students within the university environment consisted of one tuck shop, one diner, two take-away food stores, and three cafeterias. It was found that none of these food outlets sold legumes. Results indicated that foods with a high sugar content amounted to about 30% of the food items offered, with

starches being the second largest food group offered by these shops (Meko and Jordaan (2016: 116).

2.6.4 Low Fruit and Vegetable Consumption

Fruits and vegetables are a vital constituent of a nutritious diet. These food items are said to be effective sources of protective nutrients, vegetable proteins and dietary fiber, which aids in the prevention of constipation (Layade and Adeoye 2014: 3). Despite the countless benefits of fruits and vegetables, research has indicated that fruit and vegetable intake in Africa is low, when evaluated using the recommended daily consumption.

It is said that a low fruit and vegetable intake is linked to poverty, lack of purchasing authority and increasing age (Aryal *et al.* 2015: 3); therefore, low-income societies are more predisposed to unbalanced diets as well as a low fruit and vegetable intake. Nevertheless, having more money does not ensure that an individual will consume a healthier diet, but it can ensure access to a variety of food items and allows the individual to decide which item to consume more often [European Food Information Council (EUFIC) 2016]. Research conducted within universities in the USA, indicated that students were not consuming the recommended amount of fruit and vegetables, yet they were eating increased amounts of foods high in fat (Deliens *et al.* 2014: 2).

Approximately 1.7 million (2.8%) global mortalities are linked to low fruit and vegetable intake (WHO 2017f). Estimations of fruit and vegetable consumption in sub-Saharan Africa varies from 70 to 312 g per capita each day, which is much less than the WHO recommendation of 400g per person each day (Layade and Adeoye 2014: 3). Kjøllesdal *et al.* (2016: 1) stated that a low consumption of fruit and vegetables is associated with NCDs such as CVDs, cancer and diabetes, and the risk factors associated with such diseases. Most studies are conducted in Western countries and there is not much known regarding the relationship concerning fruit and vegetable consumption and NCD risk factors in developing countries.

2.6.5 Sugar Sweetened Beverages

Sugar sweetened beverages (SSBs) are a major source of sugar for children and young people. This includes any beverage that contains added sugar such as flavoured milk drinks, cordials, soda drinks, sports drinks and other drinks labelled fruit juice, and contain added sugars (University of Auckland 2017).

Sugar sweetened beverages are deemed as high glycaemic index (GI) fluids that boost post-prandial blood glucose levels, reduce insulin sensitivity and reduce satiety levels, thus resulting in gorging (Hoffman 2012: 7). Many young adults and university students who frequently consume SSBs in increased quantities, have traditionally consumed these beverages since they were children. Previous and current living situations along with parenting practices during childhood are major aspects that influence SSB intake. The domestic environment and living conditions have a strong impact on the typical diet, as well as the promotion of healthy food choices of children and young adults (Hoffman 2012: 7).

During the year 2010, the South African population consumed 254 Coca-Cola goods per capita. This was an increase of approximately 130 during the year 1992 and 175 during 1997, paralleled with a global average of 89 products annually (Scott *et al.* 2017: 81). Fizzy beverages are currently the third most frequently ingested foodstuff by young urban children in SA. Fast food consumption and large portion sises are distinctive dietary practices of university students and such eating habits have been associated with increased SSB intake. In the past three decades, SSB intake has escalated in all age groups from multiple suppliers including supermarkets, restaurants, fast-food enterprises, and vending machines (Hoffman 2012: 7).

2.7 FACTORS AFFECTING FOOD INTAKE

According to Perera and Madhujith (2012: 261), young adults aged between 18 and 24 years are at a point in life where they often make their own food choices. Furthermore, many students enter the university environment at this stage. Dietary practices and food preferences of university students are often controlled by a collaboration of several different elements.

2.7.1 Physiological Factors

According to McGinnis, Gootman and Kraak (2006: 97), physiological elements that influence the consumption of food include age, gender, metabolic rate, physique and the level of physical activity, health conditions, pregnancy, drug use, and other biological analogies. Sommer (2013: 6), stated that people start eating as a reaction to signals indicating the reduction of energy stores to lower than some critical level, and stop eating as soon as they receive signals of satiety. The feeling of satiety is emitted when food is detected, consumed, and absorbed. Moreover, the metabolic state of the body is controlled by the central nervous system, which either

increases or decreases appetite or food intake. Epuru and Al Shammary (2014: 68) stated that to most young adults, age denotes an idealistic sense of confidence relating to the ability to control their health, whilst believing that they are at a less significant risk to vulnerabilities compared to children and the elderly. This therefore puts young adults at risk of believing that the quality of their diet is high and consequently they may not consider healthy eating as a vital element. Furthermore, according to Kassier (2016: 5) figuring out that males and females are physically extremely different is logical. Therefore, their body structures, compositions and the amount of food recommended for consumption differs significantly.

Physical activity can prevent the development of obesity. Being physically active increases energy expenditure and regulates eating behaviour through endocrine intermediaries. Physical activity can therefore affect total food intake in adolescents and adults, which additionally reduces the overall energy balance (Horsch *et al.* 2015: 2).

2.7.2 Psychological Factors

According to McGinnis, Gootman and Kraak (2006: 97), psychological factors affecting food intake may be associated with moods, emotions, and incidents. The selection of certain food items may be associated with, among others, celebration, sadness, illness and security. Food may also be consumed or avoided only on certain occasions.

Stress among university students, particularly first-year students transitioning into university life, is a major challenge, which affects one's overall health. First-year students, particularly those living away from home, face the pressure of making new friends, taking responsibility and accountability for their own financial decisions and managing the challenges of a heavier workload (Hoffman 2012: 11). These individuals have to do all of the above with little supervision or direction. Therefore, stress amasses when these students struggle to cope with new prospects in addition to the pursuit of individuality, independence, and tenacity.

According to Smith (2015: 1), when one falls ill, the brain's interaction changes due to the increase in the production of cytokines. Such chemicals have the ability to reduce one's appetite, which aids in the conservation of energy to combat short-term illnesses. There is also a psychological inclination to embrace a larger body sise among black South African females resulting in the consumption of larger food portions to gain more weight. Micklesfield *et al.* (2013: 373) stated that this preference results from a collection of culture-bound principles, which encourage lifestyle habits generally associated with obesity. Socialisation shapes the

body image of these women throughout the stages of life, and may possibly vindicate why this preference is preserved from early childhood into adulthood.

2.7.3 Lifestyle and Social Factors

On a social basis, indigenous populations are disadvantaged. Therefore, they experience high rates of deprivation, increased unemployment rates, low education, overcrowded households, and corresponding poor diets. Such diets consist of foods high in carbohydrates and sugar and with low fruit and vegetable intake – leading to a higher rate of infectious disease burden and a higher burden of lifestyle-related NCDs among adults (Kufe *et al.* 2016 2). This is because these societies are experiencing a transition from a traditional to a modern way of life.

Access to food is frequently dictated or limited by the standard of living and environmental situations. As stated by McGinnis, Gootman and Kraak (2006: 105), individuals residing with their families or other groups normally have basic access to food that is acquired and/or prepared by whomever this duty is delegated to. The main food buyers and those who prepare the food have additional authority around what food items should be acquired and how that food is prepared, although this may be subjected to the preferences of other household members. Individuals such as students and workers, have a lifestyle that imposes the consumption of institutional or restaurant foods (McGinnis, Gootman and Kraak 2006: 105).

2.7.4 Economic Factors

According to Statistics SA (2015: 1), the World Bank ranked SA's economy as being upper-middle income and was considered as one of the leading economies on the African continent, in terms of financial prudence. The South African economy was previously built on primary and secondary commerce, such as excavation (mining) and production, but in recent years, development has moved towards the tertiary industries (Brand South Africa 2014: 4). Currently, industries that promote the economy consist of business services, finance, property and manufacturing as well as wholesale and retail trade. However, in the face of extended phases of positive economic development, unemployment continues to be one of the main challenges faced by SA (Statistics SA 2015: 1).

The South African financial system shifted into a downturn, with a decline of 0.7% in gross domestic product (GDP) for the duration of January to April 2017 accounted for, following a 0.3% reduction in the fourth quarter of 2016. According to Faber and Drimie (2016: 53), the cost of a basic food basket in SA escalated from R485 to R514 between the years 2014 and

2015. The underprivileged are predominantly vulnerable to the effects of increasing food prices. As a result, the quality of their diet is influenced by the rise in food prices (Faber and Drimie 2016: 53). The EUFIC (2016: 1) explained that food prices are without a doubt the primary determinant of food choice. The amount of money available to buy food is profoundly dependent on income and socio-economic status. Not having enough money to meet the expense of food can reduce access to adequate nutrition (Rose 2017: 1).

2.7.5 Nutrition Knowledge

Environmental factors that affect food consumption include acquaintance with traditions and cultural practices associated with food, influence of parents and peers, and mass media broadcasts and promotions. Nutrition knowledge as well as the awareness of diet and health relationships greatly influences food choice and how food is consumed (McGinnis, Gootman and Kraak 2006: 123).

Nutrition knowledge is an essential element that promotes healthy dietary practices which can aid in meeting the nutrition requirements throughout the life cycle, thereby maintaining appropriate body weight and preventing obesity (Nani 2016: 36). Notwithstanding the broad scope of nutrition education programmes, it is rather surprising that the impact of nutrition knowledge on food intake is still considerably unexplored (Spronk *et al.* 2014: 1713). Even though nutrition knowledge is one constituent of health literacy, it is a fundamental aspect as inadequate food consumption is strongly associated with all major NCDs, and accounts for the majority of health expenditure in developed countries (Spronk *et al.* 2014: 1714).

2.7.6 Urbanisation

Urbanisation and globalisation have led to populations increasingly assuming a modern lifestyle, typically neglecting physical activity, and embracing a tendency to eat foods lacking nutrients. There has been a transition from consuming traditional foods, which are high in fiber and contain minimal fat, to unhealthy diets, which are characterised by excessive levels of saturated fats and trans-fats, as well as high quantities of salt and sugar (Htet 2014). The increase in NCDs and related risk factors in unindustrialised countries are also considered to be due to an increase in urbanisation characterised by such transitions (Murphy *et al.* 2013: 1741). More and more individuals consume energy-dense foods, semi-processed food items, and foods that are high in saturated sugars fats and cholesterol (FAO 2012: 25).

Foods that contain high levels of sugar and fat stimulate obesity, which is the main risk factor for diabetes and CVD (Htet 2014: 6). Nevertheless, the effect of these evolutions on health is

asymmetrical in all sectors of the population and there is no much known about the socioeconomic distribution of NCDs and related risk factors in underdeveloped and developing countries (Murphy *et al.* 2013: 1741). Research among adults in the North-West Province of SA presented a transference, with an increase in disposable income, from an habitual diet loaded with carbohydrates and a low fat content, to a diet high in fat, where staples such as maize were replaced by animal products and other cereal foods (Igumbor *et al.* 2012: e1001253).

2.7.7 Eating Away From Home

Eating food away from home is said to be one of the causal factors of inadequate nutrient intake. A report by Todd, Manancino and Lin (2012), suggested that customers might have a strong preference for procuring unhealthy food when eating in restaurants. The frequency of meal consumption in restaurants and food outlets is one of the dietary practices linked to urbanisation and commercialisation, as well as to overweight and obesity. The sources of food-away-from-home foods vary, depending on the environment. Such sources include restaurants, street vendors, and fast food outlets (Shisana *et al.* 2013: 182). Research attributed this link to an inadequate dietary intake, embracing high energy and lower nutrient density. It is clear that the link between eating food away from home and food intake may be subjective to food selection, and portion sizes preferred by individuals when eating out.

2.8 STRATEGIES TO ADDRESS LIFESTYLE DISEASES

2.8.1 Food Based Dietary Guidelines

According to Vorster, Badham and Venter (2013: S5), food based dietary guidelines (FBDGs) are science-based policy recommendations that are constructed as a form of guidelines for healthy dietary intake. Food based dietary guidelines make nutrition less complicated, shifting away from scientific terminology and thus making them easier to follow. These guidelines are a conversion of the evidence-based nutrient recommendations into guidelines that aim to encourage the general population to make improved food choices, to improve their health and aid in the prevention of NCDs (Nestle 2018). The risk of over-nutrition and inadequate dietary intake have a direct relationship with risk factors that promote NCDs. Claasen, Van der Hoeven and Covic (2016: 17) stated that the FBDGs are meant to be relevant to SA's diverse population, with distinct cultural upbringings and income levels. Nevertheless, evidence is

required as to whether the interpretation of SA's diverse diets, as depicted in the FBDGs, provides an eloquent educational instrument for healthy eating.

2.8.2 Food Fortification

Micronutrient fortification of staple foods has the potential to help reduce the magnitude of malnutrition, improving health and nutritional status (Netherlands Royal Dutch Mines 2017: 1). According to Ndiyeze (2015: 2), food fortification is one of the cost-effective tools designed to improve the nutritional value of staple food products, including wheat flour and salt. The fortification process involves the addition or replacement of essential nutrients such as vitamin A, iron, zinc, folic acid, and iodine, which may have been lost during processing.

The WHO (2013: 12) revealed that even though food fortification is likely to have a gradual impact when compared to food supplementation and diversification, it has a much wider and more sustained impact. In order to be effective, the fortified food item must be ingested in sufficient quantities by a large number of the targeted persons in a population. It is also important to obtain and make use of fortificants that are well absorbed and have no effect on the sensual aspects of foodstuffs (WHO 2013: 12).

2.8.3 Food Supplementation

According to the Federal Ministry for Economic Cooperation and Development (2012: 2), food supplements are substantially condensed nutrients manufactured by medicinal companies in the form of pills or injections, and distributed through health-care and as part of specific nutrition campaigns. Supplementation retains the benefit of being proficient in providing a sufficient quantity of a particular nutrient or nutrients in an extremely absorbable structure, and is usually the quickest method to manage insufficiency in people that lack such nutrients (WHO 2013: 13). The WHO (2013: 11) further stated that of the three options (supplementation, fortification and diversification) that are intended for increasing micronutrient intake, programmes that deliver micronutrient supplements are usually the most effective in improving micronutrient status.

2.8.4 Dietary Diversification

According to the Ministry of Women and Child Development (WCD) (2018: 1), dietary diversification is a strategy implemented to increase access to, ease use of, and the consumption of foods high in nutrients. Diversification entails modifications in manufacturing procedures, food selection behaviour, and customary domestic approaches to the preparation and processing of indigenous food.

The purpose is to expand food agronomy and create a broader selection of foods that are high in nutrients and make those foods available for acquisition so that consumers can prepare diverse meals and thus consume a nutritionally balanced diet (Trentmann, Reinhard and Vierk 2012: 3). Dietary diversification is generally considered the most appropriate and sustainable alternative, however, it takes longer to instigate when compared to food fortification and supplementation (WHO 2013:12). Intensifying dietary variety is an ideal method of enhancing the nutritional status of a populace because it retains the prospective of improving the consumption of various essential nutrients simultaneously.

2.8.5 Nutrition Education

McNulty (2013: 5) defined nutrition education as any sequence of informative strategies through environmental provisions that are aimed at advancing the voluntary adoption of healthy food choices and other food- and nutrition-associated behaviours that support the well-being of the people. Nutrition education can be disseminated through numerous settings and may involve activities, which are aimed at individual, public, and policy levels. Vorster (2018) stated that in addition to ensuring food, and nutrition security through ensuring the availability and affordability of nutritious food, there is a genuine need to inform, educate, and inspire consumers to make the right food and beverage decisions that will lead to a healthy dietary intake. A healthy diet will ensure that all nutrient and energy requirements are sustained without leading to over-nutrition and subsequent increased risk of NCDs.

Nutrition education programmes offer at-risk populations information, proficiency and tools to assist in reducing barriers of limited resources, thus improving food security. Effective education can be presented through better resource management skills and innovative clinical indicators of disease, when directed at individuals who are food insecure (Farrell 2013: 16). Nutrition education as a strategy can alleviate or prevent food insecurity as well as the health outcomes associated with it, therefore improving long-term, optimal health in at-risk, low-income societies.

2.8.6 Sponsorship

According to Kassier and Veldman (2013: 249), previous research confirmed that students on financial aid are more at risk for food insecurity than those who are not receiving financial aid. The South African Government delivers monetary support to university students through the NSFAS and intends to generate change by offering a viable financial support system for

scholarships, bursaries and study loans. It is envisioned that students will as a result be able to conclude their studies, which, sequentially, will increase their employment prospects and subsequently give rise to financial ffreedom and food security. Meko and Jordaan (2016: 116) revealed that in an attempt to fight student starvation, universities and colleges introduced several support systems, such as offering food baskets and coupons to underprivileged students. The purpose of such programmes is to ensure that students are able to obtain and consume adequate food on a regular basis.

The No Student Hungry (NSH) movement is also one of several initiatives designed to fight student malnutrition at the University of Free State (UFS) in Bloemfontein, SA. The NSH offers disadvantaged students a stipend that can be spent on meals at designated food stores within the university grounds. Students were initially given food grants in April 2011 and they buy meals on a daily basis at the Bloemfontein Campus using their student cards. The NSH campaign was then extended to the Qwaqwa Campus in April 2013 and the South Campus in April 2014. By then, a total number of 864 students had been supported and those students had contributed more than 34 560 community hours back to South African societies (UFS 2017). On the personal monthly estimated budget for one student during 2016, Stellenbosch University suggested that students would need an estimated R2800 per month for food (Stellenbosch University 2016) and a minimum of R3000 per month during the year 2018 (Stellenbosch University 2018).

2.9 Conclusion

The literature reviewed in this chapter was centred on the health, nutritional and behavioural aspects of university students. Current trends in malnutrition indicate that although the nutritional status is improving globally, developing countries including SA are being left behind and this is affecting young adults. Research indicated that the transition of young individuals from school to university is associated with various socio-economical, dietary, and behavioural changes. Many of these university students are unable to acquire nutritionally adequate food to meet their dietary and nutritional requirements. This situation is said to be an outcome of numerous aspects that are mutually dependent on each other. These can either be financial, social, or environmental factors. Even though lifestyle diseases may occur later on in life, maximising optimal health at a young age is essential.

CHAPTER 3: METHODOLOGY

3.1 INTRODUCTION

Chapter three elucidates the procedures that were followed in the investigation of the study objectives. The study design, study area, the selection of participants and sampling techniques are also explained. The methods used for administering questionnaires are described and included as appendices. The process of training fieldworkers along with the statistical analysis methods are also included in the chapter, in addition to the relevance of the design structure used to gather relevant data. The chapter then concludes with quality control and reduction of bias and ethical considerations.

3.2 STUDY DESIGN

The study utilised a cross-sectional, epidemiological design by administering questionnaires on a face-to-face basis with sponsored and non-sponsored students (18-35 years), attending the DUT, eThekwini region. The main objectives of the study design were to be able:

Objective 1: To assess the socio-demographic factors of sponsored and non-sponsored DUT students as well as the influence these factors would have on their dietary habits to determine food and nutrition security.

Objective 2: To determine whether the students showed any clinical risk markers related to lifestyle diseases such as overweight/obesity, raised blood glucose levels, abnormal blood lipids and elevated blood pressure.

Due to the nature of the study, the cross-sectional, epidemiological design was chosen as the most suitable strategy to investigate the research objectives. There was no intention to conduct experimental procedures, where the investigator would not be able to control any study variables. It was, however possible that partiality could have arisen during the selection of the participants, therefore associations were carefully considered. Roundy (2014: 1) stated that cross-sectional investigations promote working with groups of societies who differ in the variable of concern but share added attributes, such as ethnicity and educational background. The British Medical Journal (BMJ) (2016) as well as Morroni and Myer (2007: 85) stated that

cross-sectional research evaluates the prevalence of health outcomes or influential elements of one's health status, or both, in a populace over a short interval of time (Figure 3.1).

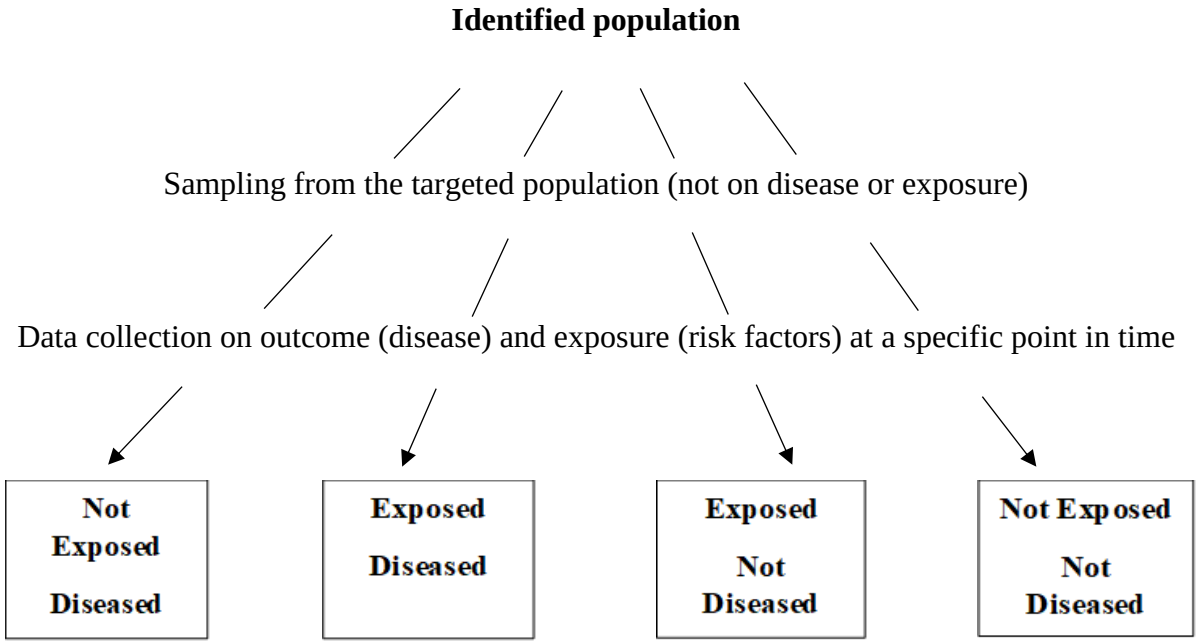


Figure 3.1 Design of a cross-sectional study (Morroni and Myer 2007: 86)

3.3 PLANNING AND ADMINISTRATION

3.3.1 Permission and Consent

Prior to the inception of this study, a research protocol was presented to and ratified by the DUT Faculty of Applied Sciences Research Committee (FRC) during 2015. After obtaining Gatekeeper's permission (Appendix G) to conduct the research on the DUT premises, ethical clearance was obtained from the Institutional Research Ethics Committee (IREC) 77/15 (Appendix I) on 03 December 2015.

Permission was also obtained from the Director of Student Housing and Residence Life, via email, to undertake the research in selected residences. Thereafter, the researcher held meetings with the Residence Advisors to explain the study and become acquainted with all parties involved in the day-to-day running of each residence. Participants were given a letter of information (Appendix E) outlining the aim and expectations of the study, which could be

discussed further if, required. Permission was then obtained from the individuals that were interested in participating through a signed a letter of informed consent (Appendix F).

3.3.2 Training of Fieldworkers

Twelve fieldworkers were recruited from the 3rd year DUT Food and Nutrition Department as well as two students from the Auditing and Taxation Department to form part of the research group. Six of these students were trained during December 2015 and the rest were trained in February 2016. On both occasions, training was done on a Saturday, from 09h00 in the morning to 16h00 in the afternoon. English was the language used as a form of communication on each training session. A training manual (Appendix J) was created for the fieldworkers to use and refer to as required. The training manual was compiled in English.

The fieldworkers were trained on how to complete socio-demographic questionnaires, and obtain a 24HR and FFQ. Moreover, the fieldworkers were also trained on how to take anthropometric measurements such as weigh, height and WC. After each training session, fieldworkers were asked to demonstrate how anthropometric measurements should be taken and how the dietary questionnaires would be administered. This was done do the researcher could assess if the fieldworkers were adequately trained. During the data collection phase, the researcher would then observe and assess how the fieldworkers were administering questionnaires and taking the required measurements.

3.4 SAMPLE

3.4.1 Study Area and Population

The participants comprised of DUT-registered African male and female students, aged 18-35 years, attending lectures at any of the three Durban regional campuses during 2016 and who formed part of the eThekwini Municipality population. A map of the eThekwini Municipality is illustrated in Figure 3.2. According to Statistics South Africa (Stats SA) (2011), Durban is located on the eastern coastline of SA within the KZN province and covers a region of an estimated 2 297 km² and is home to 3 723 435 people (South Africa, eThekwini Metropolitan Municipality 2017). The metropolis comprises of a distinct society, which is exposed to several social, economic, environmental, and governance challenges (Stats SA 2011).

The DUT was formed during 2002 by the amalgamation of ML Sultan Technikon and Technikon Natal and is said to be the first choice for higher education in KwaZulu-Natal (KZN), SA (DUT 2016). According to the Development Bank of Southern Africa (DBSA) (2016: 1), the DUT is a multi-campus institute that has facilities stretched over five campuses in Durban and two in Pietermaritzburg. The central campus is the Steve Biko campus situated in Durban. It was previously known as the Durban Institute of Technology and four years later became the DUT. A report from the (Durban University of Technology 2015) indicated that during 2014, the number of registered students was 26 472. In 2015, the total headcount increased by 544, thus making the total of registered students 27 016, of which 80.5% were African.

When categorizing the total headcount by gender in 2015, it was found that 51% of the students were male and 49% were female. The main reason for the selection of the DUT area (Figure 3.2) for the research project was that it was representative of African university students from different categories of the Living Standards Measure (LSM).

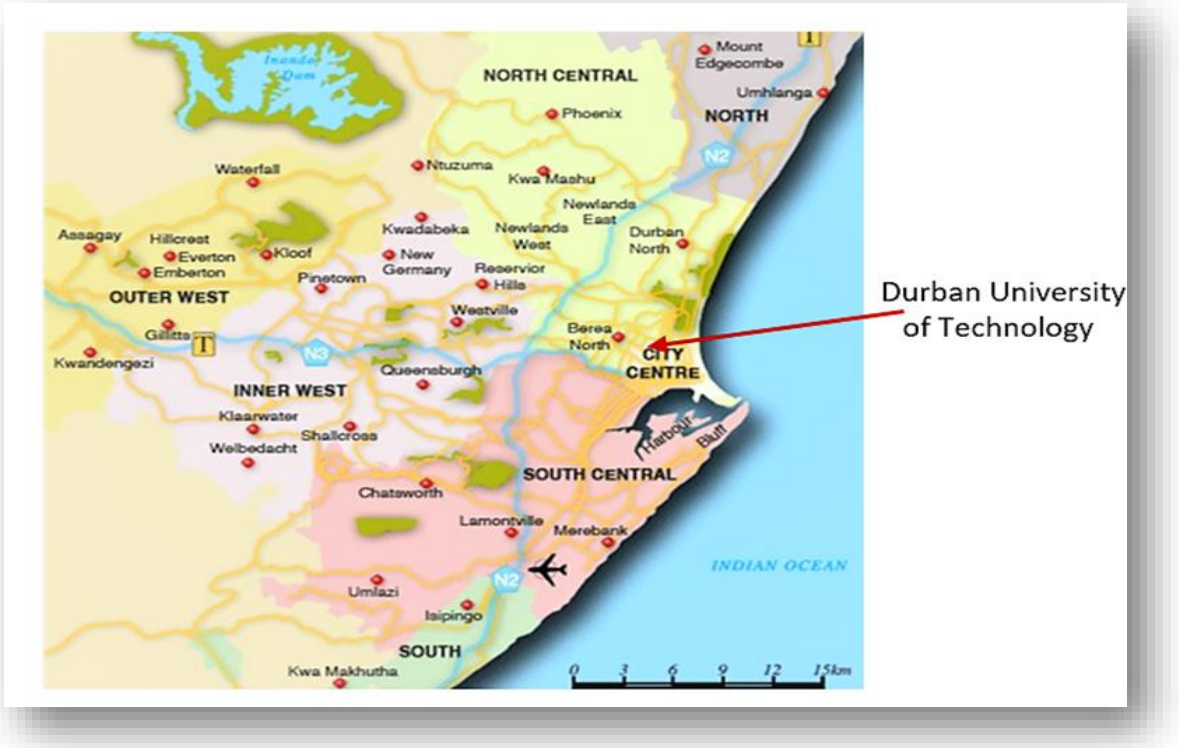


Figure 3.2 Map of Durban (source: eThekwini – Durban Accommodation 2016).

3.4.2 Sampling Procedure

The sample population was drawn from four residences that were within a 1.5 km radius of the Steve Biko campus. This was done to ensure ease of access for the research team and ensure that the participants would not have a problem getting to the university clinic for the necessary tests. The residences, which met this criterion, included the Berea Residence, Stratford Hall, Persada Court and Corlo Court. These four residences accommodated 745 students (Durban University of Technology (DUT) 2014: 1). The study focused on African bursary and grant recipients versus students who were not sponsored with any form of monetary funding.

A random cross-section process was used to draw the number of individuals required in order to allow the researcher to select participants who met the inclusion criteria. Students were approached through direct one-on-one encounter engagement, and asked whether they were receiving any meal allowances as a form of sponsorship through a loan, bursary or grant. Students who met this criterion were invited to participate in the study until all the students residing in the four residences had been approached. Due to the sample sise of 260 participants not being reached, as recommended by the statistician (Appendix H), the same procedure was then repeated on the Steve Biko campus as permitted by the Institutional Research Committee (IRC) until a sample sise of 130 sponsored participants was reached. Similarly, students who did not receive any form of funding were requested to participate in the study until the sample sise of 130 participants was reached (for the non-sponsored sample). Every participant was informed that there was to be no financial gain, and would not incur any costs by taking part in the study. After the study was explained to the potential participants, they were given a letter of information (Appendix E) outlining the aim and expectations of the study, which could be discussed further if required. This was done to allow the participants to read the information, and have the opportunity to ask questions and raise any concerns. Students that were interested in participating were asked to sign a letter of informed consent (Appendix F). The research inclusion and exclusion criteria are given in the following section.

Inclusion criteria:

- African students attending the DUT
- Students aged between 18 – 35 years
- Both males and females
- Bursary and grant recipients sponsored with meal allowances

- Non-sponsored students (not receiving any bursary or grant).

Exclusion criteria:

- Individuals not registered to study at the DUT
- Non-African students
- Individuals under 18 years
- Individuals over 35 years
- Students registered with the Department of Food and Nutrition.

3.5 RESEARCH DESIGN

The measuring instruments used in this study were the following questionnaires: socio-demographic questionnaire (Appendix A), 24-HR (Appendix B), FFQ (Appendix C) and an anthropometric and biochemical measurement form (Appendix D). Descriptions follow, and each tool is discussed in detail thereafter:

3.5.1 Socio-demographic Questionnaire

Lee and Schuele (2012: 2) explained that demographic information provides information concerning participants and is essential for determining whether the participants in the research study are a true representative sample of the target population. The socio-demographic questionnaire included questions that defined the participants by measures of age, gender, socio-economic status, basic living conditions, such as the structure of the dwelling, water provision, and toilet facilities. The questionnaire also included questions relating to income, the method and frequency of procuring food, mode of transport used, language spoken and access to educational resources.

In this case, a pre-tested and validated socio-demographic questionnaire adapted by Napier (2006), was utilised to collect data pertaining to the socio-economic status of each participant. This questionnaire comprised of questions concerning living arrangements, work and monetary status, total revenue and money spent on food on a monthly basis, education, language, and access to certain media resources. Owing to the nature of the study as well as the target population, some questions were excluded and some were added to the questionnaire.

In the pilot study (n=10 participants), the socio-demographic questionnaire was tested with students who formed a focus group discussion to determine whether they could understand the added questions. The intervention was held with African second year students selected in terms of language, culture and socio-economic status of the homogeneous group. The interview was held at the Food Science laboratory at the Department of Food and Nutrition at DUT. The discussion was led by the researcher who served as a facilitator and made notes of the discussion, which took place in English. A moderator as well as a voice recorder were utilised for the focus group discussion, after consent to record, the discussion was obtained from the participants before the session started.

The focus group discussion lasted for 60 minutes and participants were seated as if they were attending a lecture (Figure 3.3) in order to make it more flexible for the researcher to conduct the interview and successfully record the discussion. The researcher read out each question in English to determine the participants' understanding. Key words that formed part of the questions were also read out to the participants and they were asked whether they understood the words; this was done to verify their perceptions. The students who were part of the pilot study were not included in the main study as they fell under the exclusion criteria.

Figure 3.3 Focus Group Discussion with Students at the DUT Food Science Lab

Stated below are the questions that were either rephrased or added to the questionnaire and tested in the preliminary study:

a) Please indicate whether you are a sponsored or non-sponsored student.
b) What is your level of study?
c) What are your living arrangements?
d) Where do you buy food?
e) How do you get to university?
f) Where do you eat most of your meals?
g) Do you have access to the internet (where you live)?
h) Do you have a personal laptop/desktop?
i) Do you have a mobile device (cell phone) that has internet access?
j) Do you have access to the following media resources (television and radio)?

3.5.2 24-Hour Food Recall

According to Gibson (2005: 42), the 24HR is a retrospective method of assessing dietary intake during which participants have to remember all food items, nutritional supplements, and beverages consumed during a 24-hour period meticulously. Walsh and Joubert (2007: 293) stated that a trained interviewer is required to administer the 24HR on single or multiple occasions whilst assisting the participants to assess the portion sises of all food items consumed. The Australasian Child & Adolescent Obesity Research Network (ACAORN) (2010: 5) revealed that the advantages of using a 24HR were as follows:

- It is quick and inexpensive.
- It places less burden on participants.
- It can be used to evaluate current or past food intake. It can be repeated to assess daily variation and enhance accuracy.
- Participants are less likely to modify their eating habits due to the brief collection time.
- Participants do not need to be literate.
- The questionnaire can be administered on broad populations of different ethnicity.
- The questionnaire can be successfully administered in a face-to-face encounter or over the phone.

Walsh and Joubert (2007: 294) further mentioned that a 24HR would have limitations such as preconceptions resulting from recollection errors, observation, and problems with determining correct portion sises. In addition to these limitations, there is the tendency for participants to over-report low intakes and under-report high intakes of food items.

Based on a review of literature and considering the distinctive attributes of the South African populace, a well-designed 24HR questionnaire, (Oldewage-Theron *et al*, 2005) was selected as one of the primary tools to assess the dietary intake of participants. The purpose of using this questionnaire was to relate each participant's usual dietary practices to their health status or outcomes. A single administration of the 24HR questionnaire would not be suitable for this type of research as each person's food consumption differs considerably from day-to-day therefore consumption on any single day would not be a good estimation of the participant's usual intake. For this reason, the 24HR questionnaire was administered three times.

This method of dietary assessment requires meticulous recalling of intake. The method also relies on the participant to not under-/over report, and the ability of the interviewer to aid the participant in estimating the portion sises correctly. The interviewers assisted by encouraging the participants to recall food and beverage consumption episodes by time periods (e.g. when they got up in the morning), or linking them to day-to-day events (e.g. arriving on campus). In addition, the interviewers simultaneously used food models to help the participant to estimate food portion sises consumed and to identify specific food items.

The 24HR questionnaires included one weekend day and two weekdays, over a period of one to two weeks per participant. Each interviewer recorded the dietary data, which was checked for oversights. Certain specifics such as the time of day, how food was prepared, which ingredients were used, what measurements were used, and brand names of the food items were mandatory. Another limitation of the 24HR is that the previous day's dietary intake might not have accurately reflected a participant's usual diet. The 24HR questionnaire was validated by using a FFQ.

3.5.3 Food Frequency Questionnaire

According to Walsh and Joubert (2007: 295), a FFQ is a pre-printed list of food items that are essential contributors to a person's energy and nutrient consumption. The researcher can use an existing questionnaire or compile one that will explicitly meet the objective of assessment and the situation of the targeted population. The FFQ is a reflective review of food consumption frequency per day, per week or per month. Furthermore, Sauvageot *et al.* (2013: 1) stated that

the FFQ is one of the most common tools used in large-scale, population-based research studies in order to determine whether there is a link between diet and disease, due to its effortless administration and low cost. FFQs were completed to determine the diversity of participants' diet and customary food intake during the past seven days. The list of food items were categorised into nine food groups obtained from the recommended list of food groups by the FAO (Kennedy, Ballard and Dop 2013: 8), which are listed in Figure 3.4 below:

GROUP NUMBER	CATEGORY
1	Flesh Foods (Meat, Poultry, Fish) Diversity
2	Eggs Diversity
3	Dairy Products Diversity
4	Cereals, Roots and Tubers Diversity
5	Legumes and Nuts
6	Vitamin A Rich Fruits and Vegetables Diversity
7	Other Fruits (and Juices) Diversity – Deciduous Fruits
8	Other Vegetables Diversity (including onion and tomatoes)
9	Oils and Fats Diversity

Figure 3.4 FFQ List of Food Groups Diversity

The FFQs were administered by means of a face-to-face interview situation by trained fieldworkers. Participants were requested to point out the food items they had eaten within the previous seven days. As a reference method, the FFQs were tested for proportional validity against the three 24HR questionnaires. The FFQ was also used to assess the variety of food consumed by students. Although the FFQs were validated against the 24HRs, other factors such as the participant's memory and the accuracy of nutrient information could have affected the validity of the FFQ and could have influenced the reference method.

3.5.4 Anthropometric and Biochemical Tests

An anthropometric and biochemical form (Appendix D) was used to record results from the physical tests and examinations. These tests included anthropometric measurements, biochemical tests and blood pressure measure measurements. Anthropometric measurements

were used to determine the participants' physical status by measuring their weight, height and WC using standardised techniques and instruments. Biochemical tests were done to determine whether the participants displayed any intermediate risk factors for lifestyle diseases by assessing fasting blood glucose, cholesterol, and triglyceride levels. Blood pressure levels were also measured and included as part of the risk factors of lifestyle diseases. Procedures for conducting these tests and examinations are mentioned in the following section. All measurements except those for blood and blood pressure were taken twice by a skilled researcher and fieldworkers that were trained and assessed regarding the procedures (Gibson 2005: 235) and recorded on the anthropometric and biochemical form (Appendix D). Finger-prick blood samples as well as blood pressure measurements were taken twice by a registered nurse and a postgraduate nursing student.

3.5.4.1 Weight

A portable electronic physician scale (Scales 2000) which had been calibrated was used to measure the participant's weight in kilograms (kg). All measurements were rounded-off to the nearest gram (g). The scale was re-calibrated after each use. For calibration purposes, the scale was placed on a flat and firm surface and set to zero and a dumbbell weighing 5 kg was placed on top of the scale to determine the reading on the scale. During the process of weighing the participants, each participant was asked to remove any excess clothing and heavy items in their pockets, which may possibly add extra weight such as jackets and coats, caps and hats, cell phones, wallets, and coins. Participants also removed their shoes prior to being weighed. To ensure accuracy, the weight of each participant was taken twice.

The measuring method used was the same as the method recommended by the WHO and used for the SANHANES study (Shisana *et al.* 2013: 50). The scale was placed on a smooth, flat surface area as illustrated in Figure 3.9 and was switched on until it reflected zero (0.0). Participants were requested to stand in an upright position on the scale with both feet flat and apart whilst looking straight ahead. The participants had to stand still until the measurements were recorded on the form by the fieldworker. Thereafter, the participant was asked to step off the scale and the fieldworker waited to ensure that the scale reflected zero before taking the second measurement. The weight measurements were combined and the average was documented if any difference was observed.

3.5.4.2 Height

A portable stadiometer (Scales 2000 - SA) was used to measure the height of each participant to the nearest 0.5 centimetres (cm). The stadiometer was placed on a flat surface as illustrated in figure 3.5. The participant was requested to remove their shoes, and hats and caps. If a female participant had tied her hair into a bun, she was asked to untie the hair (refer to figure 3.5). As suggested by Gibson (2005: 235), each participant was asked to stand up straight facing the researcher or fieldworker with the head in an upright position, as portrayed in Figure 3.5. Height measurements were recorded two times with the stadiometer (Frankfort Plane) touching the head and were recorded in (cm) in the applicable section on the anthropometric and biochemical form.

Figure 3.5 Participant's Height Being Measured

3.5.4.3 Waist Circumference

Waist circumference was taken at the midway section between the upmost circumference of the iliac apex and the lower circumference of the rib cage (Figure 3.6), using a non-stretchable tape placed around the body in a flat position. The tape was held firmly, maintaining its straight position around the abdomen at the level of the midway point, whilst ensuring that the tape was loose fitted enough to allow the fieldworker to place one finger between the tape and the participant's body. The participant was requested to take normal breaths and the measurement was then taken after breathing out (Gibson 200: 284) and (Heart and Stroke Foundation South Africa [HSFSA] 2016). Heavy clothing was removed before the fieldworker could take measurements. As recommended by the WHO (2000 cited in Gibson 2005), the ideal cut-off points followed in this study were < 80 cm for women and < 102 cm for men. Measurements above those specified indicated a risk for CVDs. The procedure was repeated twice for each participant and thereafter, the fieldworker recorded each measurement to the nearest 0.1 (cm).

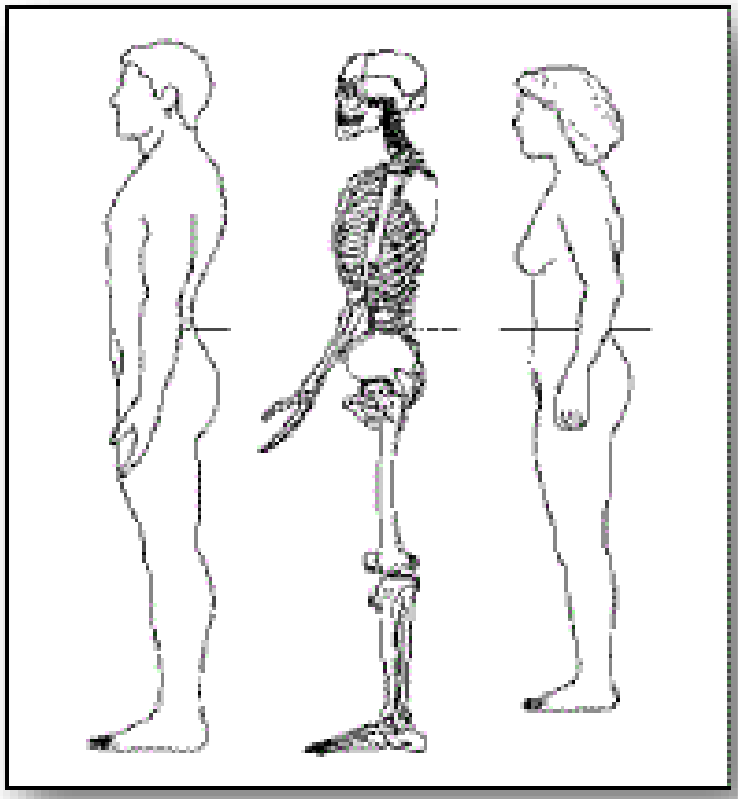


Figure 3.6 Measuring tape position for waist circumference (National Obesity Forum 2016)

3.5.4.4 Blood Pressure

Blood pressure was taken and recorded by a registered nurse and a post-graduate nursing student who assisted. Using the Omron M6 comfort blood pressure monitor as illustrated in Figure 3.7, each participant's blood pressure was measured, and the results were recorded on the anthropometric and biochemical form separately as systolic and diastolic results. The Omron's M6 unique Intelli Sense wrap cuff reduced the imprecision caused by improper cuff positioning, which is known to be the primary source of error in blood pressure measurement (Omron 2016). The pre-formed cuff was easy to place on the participant's arm thus, making blood pressure measurement much simpler.

Prior to blood pressure measurement, each participant was requested to sit down and rest on a chair with their arm resting on a table and their feet flat on the floor for 10-15 seconds, until they felt relaxed and comfortable to normalise the blood pressure (American Heart Association 2016). Two measurements were taken during this procedure and the readings were taken one minute apart. Both readings were recorded by the fieldworker on the anthropometric and biochemical form.

Figure 3.7 Measuring the participant's blood pressure

3.5.4.5 Biochemical Measurements

Participants were asked not to eat anything for 12 hours prior to the procedure. Initially, participants were requested to report to the DUT Isolempilo Campus Health Clinic. However, due to the opening times clashing with lecture periods and working times, participants preferred weekend visits at their residences. Arrangements were also made with participants to meet in front of the Allan Plettenburg Library at the Steve Biko Campus during the week. All biochemical tests were conducted during the morning between 07:00 am and 10:30 am by a registered nurse and a postgraduate student registered with the DUT Nursing Department. Finger-prick fasting blood glucose, total cholesterol, and triglycerides were measured using the following tools (refer to Figure 3.8):

- Two Accutrend Plus instruments
- Accutrend glucose test strips
- Accutrend cholesterol test strips
- Accutrend triglyceride test strips
- Button Activated safety lancets
- Latex gloves
- Cotton balls.

Figure 3.8 Tools Used for Biochemical Tests

To conduct the biochemical tests successfully, the recommended procedure for measuring the fast blood glucose, cholesterol, and triglyceride was followed (Roche 2012: 59). Once the Accutrend Plus instrument was switched on and coded, the instrument was then ready for the user to insert the test strip. Prior to performing the test, the nurse and/or nurse's assistant was required to check that, the battery symbol did not appear on the instrument's screen, as it would be a sign that the batteries had to be replaced as soon as possible. Before starting the glucose measurement, the nurse had to check the feedback area on the back of each glucose test strip for staining or discoloration. Any form of discoloration meant that the strip was unusable, therefore, the test strip was discarded. After these checks, the nurse/ nurse's assistant would then begin the test following these steps:

1. The strip was inserted into the test strip guide. When the test strip had reached the accurate position, the instrument beeped twice.
2. The nurse then opened the measurement chamber flap and lanced the outer side of the participant's fingertip using the safety lancet to obtain a large drop of blood.
3. A large drop of blood from the finger was then directly applied to the sample presentation area of the test strip. Each drop of blood was applied onto the test strip immediately after the fingertip was lanced. For each test, the nurse had to wipe off the first drop and immediately apply the second drop of blood as recommended on the Accutrend user manual.
4. The capacity chamber flap was then closed and the test was initiated. The amount of time required to evaluate each sample varied according to the test parameter.

When the measurement had been taken. the results that were displayed on the instrument were then recorded onto the anthropometric and biochemical form. Results that fell beyond the meter measurement range were presented as *Hi* (if it was above the measurement series) or *Lo* (if it was below the measurement series). The measurement ranges were specified for glucose (1.1 – 33.3 mmol/L), cholesterol (3.88 – 7.76 mmol/L), and Triglycerides (0.80 – 6.86 mmol/L) in the user manual.

3.6 FIELD SUPERVISION

For ethical and quality control purposes, and to ensure that the procedures specified in the training manual were followed, all fieldwork activities were supervised by the researcher. Whenever possible, the research supervisor also oversaw fieldwork activities. Figure 3.9 illustrates typical fieldwork activities during data collection.

Figure 3.9 Fieldwork Activities

3.7 STATISTICAL ANALYSIS

Data from completed socio-demographic questionnaires, FFQs and anthropometric and biochemical measurement forms were capyured on a Microsoft Excel® spreadsheet by the researcher, with the assistance of three data capturers. Subsequently, the data was exported and analysed using STATA version 13 and the descriptive statistics were determined. The results were presented in graphs and tables with frequencies and percentages. The correlations were performed by the researcher with the use of the ANOVA arithmetical test, which was designed to verify whether a considerable difference existed among multiple sample means. The Pearson's correlation coefficient was also used to put quantitative terms into correlation implied by scatter plots of the two variables. However, in statistical significance testing, the *p*-value is the probability of acquiring a test statistic score at least as great as the one that was detected, assuming that the null hypothesis is true. Significant *p*-values were regarded as >0.050.

3.7.1 Socio-demographic Questionnaire

Subsequent to data collection, the socio-demographic questionnaires (n=260) were organised and checked for completeness and accuracy by the researcher and data capturers. No questionnaires were found to be incomplete. Descriptive statistics were determined using STATA version 13. Data was treated as categorical and therefore presented in frequencies and percentages for various categories. All results were presented in tables.

3.7.2 24-Hour Food Recall

Data was captured and analysed by a food and nutrition research assistant using the MRC Food Finder version 3.0 computer software, based on the South African Food Composition Table of South Africa (Langenhoven, Kruger, Gouws and Faber 1991 and Food Finder 3, 2002). The participants' nutrient intake and the list of most commonly consumed food items for two-week days and one weekend day was captured. Statistical analysis was performed by the researcher, correlations were drawn with certain variables, and tables were used to illustrate the results by means and standard deviation for interpretation of the prevalence of the nutrient intake. The nutrition status was compared to 100% of the DRIs for individuals between the ages of 18 and 35 years. The Estimated Average Requirements (EAR) was used as the reference measure and if not available, Adequate Intake (AI) as the Recommended Daily Allowance (RDA) is indicated for use in individuals and not groups of people (Institute of Medicine, Food and Nutrition Board, USA 2000). The most consumed food items were determined and presented in total intake, mean intake, and frequency.

3.7.3 Food Frequency Questionnaire

Completed FFQs were checked by the researcher for accuracy and completeness, and (n=260) were found to be in order. The data was captured on a Microsoft Excel® spreadsheet by the researcher and then analysed by using the STATA version 13 software program for descriptive statistics. The different dietary diversity (DD) measures, namely, food group diversity score (FGDS) and food variety score (FVS), were calculated as follows: (1) overall variety score (sample count of food items), (2) variety score between all nine food groups and (3) a variety score within every food group. These scores were calculated for a reference period of seven days and were used together to reflect DD in different ways. The FVS consisted of a simple count of single food items and food groups, similar to previous studies undertaken in

developing countries. A low variety was indicated when less than 30 food items were consumed within a period of seven days, compared to a medium variety with 30 to 60 foods or a high variety with more than 60 foods consumed within the same period. All DD scores were calculated from the seven-day FFQs (n=260). Tables were drawn up with percentages of different variables included in the questionnaire. Data was presented in terms of frequencies, percentages, and standard deviation for the various categories. The FGDS and the nutrient adequacy ratios (NARs) were correlated to determine whether nutrient adequacy improves as the food group variety increases.

3.7.4 Anthropometric measurements and Blood pressure

The weight, height, WC and blood pressure of all the participants (n=260) were captured on a Microsoft Excel® spreadsheet. The weight and height were used to determine the BMI in order to classify the participants into appropriate weight status categories. The BMI was calculated by dividing weight in kilograms (kg) by height in m^2.

Body mass index outcomes were presented in the following categories: underweight (BMI <18.50 kg/m^2), normal weight (BMI 18.50-24.99 kg/m^2), overweight (BMI 25.00-29.99 kg/m^2) and obese (BMI ≥30.00 kg/m^2). The BMI was used as a predictor of underweight, overweight and obesity within the population and the risks associated with weight status. Results for WC were presented in the following categories: 'ideal' (WC <94cm for males and <80 cm for females), 'a greater risk for the development of CVD' (WC 94.0 – 101.9 cm for males and 80.0 – 87.9 cm for females) and 'high risk for the development of CVD' (WC ≥102 cm for males and ≥88 cm for females). Systolic blood pressure and diastolic blood pressure (DBP) results were used to determine the prevalence of hypertension according to the WHO cut-off points. Data was presented in the following categories: normal blood pressure (SBP <120mmHg or DBP <80 mmHg), pre-hypertension (SBP 120-139 mmHg or DBP 80-89 mmHg), stage one hypertension (SBP 140-159 mmHg or DBP 90-99 mmHg), and stage two hypertension (SBP ≥160 mmHg or DBP ≥100 mmHg) (WHO/ISH 2003).

3.7.5 Biochemical measurements

The fasting blood glucose, cholesterol and triglycerides results of all the participants (n=260) were captured on a spreadsheet using Microsoft Excel® and analysed by the researcher, using the STATA version 13 software. Impaired fasting blood glucose was defined as blood-glucose

≥5.6 mmol/L. Hypertriglyceridemia was defined as triglyceride >1.7 mmol/L and hypercholesterolemia was described as cholesterol ≥5.2 mmol/L (WHO n.d.).

3.8 FORMAL EVALUATION OF MEASUREMENT ERROR: RELIABILITY AND VALIDITY

3.8.1 Improving and evaluating reliability

Reliability is a measure of the consistency of test scores (Glen 2016). Katzenellenbogen and Joubert (2007: 117) further stated that reliability, which can also be referred to as precision, is the degree of similarity of the results obtained when the measurement is repeated on the same participant or the same target population.

The instrument variation was reduced by standardisation and calibration of data collection tools. All measuring scales were calibrated before the measuring sessions. When choosing instruments to be used when collecting data, the researcher also considered the ease with which each instrument could be used. Observer variation was reduced by setting exact ways of measuring (e.g. standardisation of measurements and interviews), appropriate selection of fieldworkers (e.g. Food and Nutrition students who were familiar with the data collection tools and methods), intensive training for all fieldworkers and supervision of interviews during the data collection phase. Subject variation due to biological variation (e.g. blood pressure varies during the day) was reduced by taking repeated measurements and taking the mean value.

3.8.2 Improving and evaluating validity

Validity is defined as the degree to which a tool quantifies what is intended to be measured (Heale and Twycross 2015: 56). There are two known principal forms of validity, which are said to be internal and external. Internal validity denotes the validity of the measurement and type of assessment itself, whereas external validity represents the capability to generalise results to the target population. As a procedure, this type of validation also includes the collection and analyses of data to measure the precision of an instrument.

In addition to conversing in English, the fieldworkers were expected to be familiar with the language and culture of the participants (e.g. conversing in IsiZulu, Xhosa, SeSotho and SiSwati), so that they would be able to explain certain questions to the participant in their language. This was done to improve face validity.

3.9 DATA QUALITY CONTROL AND REDUCTION OF BIAS

This section includes all the processes and procedures that were followed to ensure that all the data collected could be used to make accurate inferences about the health status of the DUT university students living in Durban.

Quality control (QC) of research data is essential in all types of research and occurs in numerous stages, including the collection of the data, data capturing, data inspection, and data analysis (United Kingdom Data Service 2016). According to Kimmie, Delany and Khumalo (2007: 195), data quality control takes place at several levels. The first stage involves the supervisor, whose main task is to ensure that the data collection was conducted correctly. The second stage involves the tracking and checking of all the questionnaires by the research team. The third and final stage takes place after the data has been captured through electronic means. The quality control measures aim to ensure that:

- Accurate sampling techniques have been adhered to
- Each interview has taken place; and that
- The data was collected and completed during the interviews.

3.9.1 Data collection

During data collection, the researcher, who was given referred to as the Principle Investigator (PI) by the data collection team, ensured that the documented data was a true reflection of details, responses, and events. The data collection stage was documented in detail.

Quality control measures that were taken during data collection stage were as follows:

- The chosen sampling method was random sampling. It was the most appropriate for the research objectives and it was applied correctly.
- Calibration of the equipment to assess the accuracy, partiality, and scale of measurement.
- Assuming that more than one measurement, observation, or sample was necessary.
- Relevant ethical requirements (participants' privacy and the right to withdraw) were complied.

The tools necessary for assessing the quality of the study included all the questionnaires, as well as the anthropometric and biochemical forms. Qualitative information about the experiences of and procedures undertaken by the researcher and the fieldworkers as well as the adherence to the study protocol were also considered, as tools that were required for quality assessment.

To ensure quality control during the biochemical measurements, the following points were also taken into consideration:

1. The nurse was required to check the expiration date for all test strips. None of the test strips had reached the expiration.
2. The nurse had a responsibility to ensure that each code strip used was the one required for each test conducted.
3. The nurse did not remove test strips from their containers until they were needed for the test. This was done to avoid contamination of the test strips.

The QC team comprised of the Research Supervisor, the researcher – also referred to as the PI, the Research Assistant, the nurse, a post-graduate nursing student, data checkers, and the data capturer. The definitive conclusion of the QC processes was a clean combined dataset that could be submitted to the researcher and the research assistant.

3.9.2 Data Capturing

Quality was ensured by consistent procedures for data entry with clear instructions. The design of the questionnaires was discussed with the data capturer to take into account how the data should be coded (converted into numbers or categories). A data capture sheet was created, containing variables listed together with the code numbers to be used for each variable. Every variable collected had a set of values with which responses were coded. The coding was done by the researcher and adequate time was allocated for the process. The data capturing process also served as a form of supervision and checking to assess the accuracy of the data.

3.9.3 Data checking

Before any type of analysis was conducted, the data was carefully checked in order to detect any odd values and mistakes, which may have arisen from the original source document, during dictation or data capturing. The following procedures were followed:

1. All data was checked using one variable at a time; the researcher checked for implausible codes such as the use of alphabetic instead of numerical values.
2. Data was also checked for missing values.
3. Values such as weight and height values were checked to ensure they fell in a plausible range.
4. If the same information, for example, demographics was asked for more than once, the researcher checked to see that the answers were the same.
5. Related questions were also checked to ensure they did not give implausible results.
6. All queries resulting from the data-checking procedure were investigated by referring back to the questionnaires.

3.9.4 Roles and Responsibilities Specific to QC Management and Maintenance

3.9.4.1 The Research Supervisors

The research supervisors worked closely with the Researcher as well as the Food and Nutrition Research Assistant to ensure quality control at all points of the survey. The procedure was as follows:

- Review and ensure that all instruments developed for the survey (questionnaires, letters of information, consent forms, and participant information list) were clear and easy to understand.
- Participation in the training of the fieldworkers to ensure that the training had been provided to all field staff was sufficient to equip them for data collection.
- Liaise with the Researcher to ensure that all team members were adhering to their roles and responsibilities as outlined in the training manual.
- Ensure that the clinic that was hired was equipped with the necessary equipment as well as the consumables required.

3.9.4.2 Research Assistant

The Food and Nutrition Research Assistant worked closely with the Researcher and the research supervisors to ensure quality control at the initial and final points of the study. The procedure was as follows:

- Capturing and analysing the 24HR questionnaires.
- Ensuring that all documents (questionnaires, anthropometric and biochemical forms) developed for the survey were printed and ready for collection.
- Ordering and issuing of biochemical equipment and other consumables.
- Calibration of equipment.
- Ensuring quality control regarding the storage of data collected.

3.9.4.3 The Principal Investigator

Among many responsibilities, the PI, who is the Researcher for the current study supervised all fieldwork activities to ensure that they were conducted according to the standard operating procedures in the training manuals. This included:

- The selection of the data collection points.
- Gaining entrance to the selected residences.
- Obtaining informed consent from the participants as well as the completion of consent forms.
- Making appointments for the participants at the DUT Isolempilo Clinic.
- Anthropometric and blood pressure measurements.
- Assisting the nurse and post-graduate nursing student with biochemical measurements.
- Completion of the questionnaires and examination forms.
- Data management included:
    - Ensure the checking of all documents received from the field.
    - Ensure quality control of documents sent out for data collection.
    - Ensure quality control of data collection procedures.
    - Ensure quality control regarding the storage of data that had been collected.
    - Ensure quality control when analysing the data.
    - Ensure quality control when presenting the survey findings.

The QC functions of the PI therefore involved the systematic verification of all questionnaires including anthropometric and biochemical forms.

3.9.4.4 The Nurse and Post-graduate Nursing Student

- Finger-prick tests (fasting blood glucose, cholesterol, and triglycerides).
- Blood pressure measurements.
- Assist the data collection team with taking anthropometric measurements if needed.

3.9.4.5 The Team Leader

The Team Leader, together with the PI was responsible for the correctness of all questionnaires and clinical examination forms. The Team Leader also ensured that:

- There was a consent form for each completed questionnaire.
- The first page of each questionnaire was accurately completed.
- The information of the fieldworker was correctly entered on each questionnaire.
- Demographic information on each questionnaire matched information on the anthropometric and biochemical form, with corresponding participant codes.

3.9.4.6 Fieldworkers

The PI assigned specific roles to all fieldworkers in the team on a random or rotation basis. The fieldworkers were responsible for interviewing the participants regarding their dietary intake and well as taking anthropometric measurements. Fieldworkers were also expected to ensure that:

- There was a signed consent form for each completed questionnaire pack. Checked consent forms were to be witnessed by the fieldworker before being given to the PI to sign.
- Each participant's code was accurately entered on all the questionnaires.

3.9.4.7 Data Checker/Capturer

The PI ensured that all the documents received from the field reached the Data Checker (DC) and were documented and signed for by both the PI and the DC. The main responsibility of the

DC was to verify the correctness of all documents received from the field and initiate the correction of errors wherever possible by liaising with the PI. In addition to checking documents from the field, the DC, together with the PI were responsible for the storage of the questionnaires, anthropometric and biochemical forms before and after the data capturing stage. Specific elements to check were that:

- There was a consent form for each completed questionnaire pack.
- The participant's code was accurately entered.
- All pages in each questionnaire accurately completed.
- Each questionnaire was numbered correctly as per the participant's code.
- Participants' demographic information (identity code, address, gender, race, and age) was provided correctly on the questionnaires.

3.9.4.8 Data Analysis Team

The researcher and the Food and Nutrition Research Assistant formed part of the data analysis team. Before any formal statistical analysis was done, the data was explored through graphical display to ensure that the data analysis team was familiar with the data. This made it possible to detect strange errors and values, as well as unexpected patterns and relationships in the data. Data analysis was done using a computer by means of statistical software – this was the quickest and most accurate way of obtaining results. Suitable data analysis software was selected for the different types of data. Back-up plans for possible technical problems such as power or battery failure were in place to avoid loss of information.

3.10 ETHICAL CONSIDERATIONS

Prior to conducting the study, the researcher submitted a research proposal, which was submitted to the Faculty of Applied Sciences Research Committee (FRC), the proposal was reviewed and accepted. The researcher also obtained gatekeeper permission to conduct the research on the DUT premises and thereafter, ethical clearance was obtained from the Institutional Research Ethics Committee (IREC), notifying the researcher to commence with data collection. Permission was also obtained from all management involved with the targeted residences.

During the recruitment stage, interested participants were given a letter of information pertaining to the research study and once the participant understood the context of the information letter, they were asked to sign a consent form. Each participant understood that participating in the study would be on a voluntary basis. Participants were also made aware that all the information gathered during the research study was confidential, and they could withdraw from the study whenever they felt the need to do so. In order to ensure anonymity, participants were assigned numbers to be used instead of their names during the course of the study.

All the information collected from the study will be stored in a locked cabinet at the DUT Food and Nutrition department for a period of five years and only the researcher and supervisors will have access to it. After five years, the information will be destroyed by shredding the questionnaires and all electronic data will only be accessible to selected staff members, who have been given the password.

3.11 CONCLUSION

This chapter explained in detail the research process used in the study. All the data collection instruments that were used to establish the socio-economic, health and nutritional status of the students have been discussed in this chapter. The tools that were utilised in the study were suitable for collecting information to realise the objectives of the study. The researcher ensured that every effort was taken to ensure that the methods and procedures used to conduct this study were ethically, academically, and scientifically sound. Results pertaining to this study will be presented in the next chapter.

CHAPTER 4:

RESULTS AND DISCUSSIONS

4.1 INTRODUCTION

The purpose of the study was to assess the socio-demographic factors and dietary practices of sponsored and non-sponsored DUT students residing within the Durban Metropolitan area to determine the interaction between the socio-economic conditions, eating behaviour, nutritional adequacy, and dietary diversity. Furthermore, the study also aimed to determine the influence of these factors on the health status relating to the risk factors of chronic lifestyle diseases (hypertension, overweight and central obesity, raised blood glucose, abnormal blood lipids) and thus compare the selected clinical outcomes between sponsored and non-sponsored students.

This chapter narrates and reports on the results of the processed data, which have been tabulated, interpreted, and evaluated. Descriptions are provided regarding the socio-demographic status of the study sample, anthropometric and biochemical results, the food frequency score, dietary intake and nutritional adequacy. Sampling techniques resulted in (n=260) participants forming part of the sample with 100 percent participants which included (n=130) non-sponsored participants and (n=130) sponsored participants aged between 18 and 35 years. The sample included all the participants who accepted the invitation to participate in the study. The results are reported according to study objectives as previously outlined and presented using means and standard deviation (SD). Results are also presented in percentages (%) which also reflects the numbers (n) as 100% students participated, unless otherwise stated.

4.2 RESULTS

4.2.1 SOCIO-DEMOGRAPHIC RESULTS

A total of 260 participants, consisting of 130 sponsored and 130 non-sponsored male and female students either residing in the DUT residences situated in the central part of Durban or living in private accommodation situated either within or outside the Durban central area participated in the study. An overview of the socio-demographic characteristics of the study group are presented in the form of tables and categorised in percentages and numbers according to gender, age, home language, level of study, socio-economic status, accommodation,

amenities, food security, food consumption patterns, transport usage and available educational resources.

4.2.1.1 Personal Information

Table 4.1 presents an overview of the socio-demographic characteristics of the study group including the mean age, gender, and languages spoken. All participants (n=260), which accepted the invitation to participate in the study, completed the study of which (n=123) were female participants and (n=137) were male participants. The data was presented in a systematic method that compares non-sponsored participants (n=130) with sponsored participants (n=130).

Table 4.1: Sample description

Variables	% Non-Sponsored Sample (n=130)	% Sponsored Sample (n=130)	p-value
Gender			0.062
Male	46.92 (n=61)	58.46 (n=76)	
Female	53.08 (n=69)	41.54 (n=54)	
Language*			0.019
Zulu	72.31 (n=94)	80.77 (n=105)	
Xhosa	16.15 (n=21)	5.38 (n=7)	
Other	11.54 (n=15)	13.85 (n=18)	
Age 18 - 35 (y)	**Mean ± SD**	**Mean ± SD**	
Whole group***	20.23 ± 2.22	22.15 ± 3.26	<0.001
Male participants**	20.41 ± 2.40	22.45 ± 3.55	0.002
Female participants*	20.07 ± 2.06	21.72 ± 2.76	0.023
Pearson chi-squared test; ANOVA ***** = *p*< 0.001; ** = *p*< 0.01; * = *p*< 0.05**			

There were slightly more sponsored males (58.46%; n=76) than females (41.54%; n=54) and more non-sponsored females (53.08%; n=69) than males (46.92%; n=61), but this difference was not significant (p=0.062). Most participants (76.54%; n=199) spoke isiZulu, followed by Xhosa (10.77%; n=28) while (12.69%; n=33) spoke other languages. These languages included Swati, Sotho, English, Ndebele, Venda, Tsonga, Tswana, Sepedi, Shona, Igbo and Rivyankole. The difference between the languages spoken by the sponsored and non-sponsored group was significant (p=0.019).

The mean age of the non-sponsored participants was 20.33 years with a ±SD of 2.22 and the mean age of the sponsored group was 22.15 years with a ±SD of 3.26. The results indicated that the sponsored group was older than the non-sponsored group (p=<0.001). When controlling for gender between the two groups, the mean age of the non-sponsored males was

20.41 years with a ±SD of 2.40 and the mean age for sponsored males was 22.45 years with a ±SD of 3.55. The mean age of non-sponsored females was 20.07 years with a ±SD of 2.06 and the mean age for sponsored females was 21.72 years with a ±SD of 2.764. The difference observed between the mean age of non-sponsored and sponsored study participants was statistically significant for male participants (p=0.002) as well as for female participants (p=0.023).

4.2.1.2 Accommodation and Living Conditions

Table 4.2 presents an overview of the living conditions of the study sample.

Table 4.2: Living conditions

Variables	% Non-Sponsored Sample (n=130)	% Sponsored Sample (n=130)	p-value
Place of residence			0.328
DUT residences in Durban	91.54 (n=119)	94.62 (n=123)	
Private accommodation	8.46 (n=11)	5.38 (n=7)	
Living with other people			0.099
Yes	92.31 (n=120)	96.92 (n=126)	
No	7.69 (n=10)	3.08 (n=4)	
Water source			0.081
Tap inside the house	97.69 (n=127)	100 (n=130)	
Tap outside the house (in the yard)	2.31 (n=3)	0 (n=0)	
Toilet facilities			0.316
Pit latrine	0.77 (n=1)	0 (n=0)	
Flush/sewage	99.23 (n=129)	100 (n=130)	
Waste removal			1.000
Yes	100 (n=130)	100 (n=130)	
Access to electricity			1.000
Yes	100 (n=130)	100 (n=130)	

Most non-sponsored (91.54%; n=119) and (94.62%; n=123) sponsored participants lived in DUT residences. The rest resided in private accommodation such as their homes, flats, and communes around Durban. This group comprised of (8.46%; n=11) of non-sponsored and (5.38%; n=7) of sponsored participants. The difference between the places where the groups resided was not significant (p=0.328). More of the sponsored participants (96.92%; n=126) than non-sponsored participants (92.31%; n=120) lived with other people and the rest which included 7.69% (n=10) non-sponsored participants and 3.08% (n=4) of the sponsored participants lived alone. The differences between the two groups were not significant (p=0.099). All (100%; n=130) sponsored participants and 97.69% (n=127) of the non-

sponsored participants had taps inside the house. The rest (2.31%; n=3) of the non-sponsored participants only had taps outside the house, but still within the same yard. Furthermore, all (100%; n=130) sponsored participants and 99.23% (n=129) of the non-sponsored participants were using toilet facilities that consisted of a flush toilet that was connected to a sewerage system. Only 0.77% (n=1) of the non-sponsored participants was using a pit latrine system. The whole (100%; n=260) sample had access to waste removal services and electricity. The difference observed between the use of amenities by sponsored and non-sponsored participants was not statistically significant (p>0.050).

4.2.1.3 Socioeconomic status (SES)

Table 4.3 presents an overview of the SES of the participants.

Table 4.3: Socioeconomic Status of Non-sponsored and Sponsored Participants

Variables	% Non-Sponsored Sample (n=130)	% Sponsored Sample (n=130)	p-value
Level of study* **			<0.001
1st Year	87.69 (n=114)	31.54 (n=41)	
2nd Year	6.15 (n=8)	21.54 (n=28)	
3rd Year	3.85 (n=5)	33.08 (n=43)	
4th Year and postgraduate	2.31 (n=3)	13.85 (n=18)	
Currently employed			0.302
Yes	4.62 (n=6)	7.69 (n=10)	
No	95.38 (n=124)	92.31 (n=120)	
Currently looking for employment			
Yes	14.62 (n=19)	20.00 (n=26)	0.251
No	85.38 (n=111)	80.00 (n=104)	
Total income per month **			0.005
R0 - R500	26.15 (n=34)	15.38 (n=20)	
R501 - R1000	33.08 (n=43)	28.46 (n=37)	
R1001 - R2500	35.38 (n=46)	38.46 (n=50)	
> R2500	5.38 (n=7)	17.69 (n=23)	
Pearson chi-squared test ***** = p< 0.001; ** = p< 0.01**			

The results indicate that most (59.62%; n=155) of the study participants were in their first year of study, 18.45% (n=48) of the participants were in their third year of study and 13.85% (n=36) were in their second year of study. The rest (8.08%; n=21) of the participants were either in their fourth year of study or at postgraduate level. Students who were enrolled for a degree of Bachelor of Technology (B.Tech) or for postgraduate studies were not funded by the NSFAS, they were only funded through bursaries, student loans and scholarships. The difference

observed between the level of study of non-sponsored and sponsored participants was quiet significant (p<0.001).

More (95.38%; n=124) non-sponsored than sponsored (92.31%; n=120) participants were unemployed. The group of employed participants consisted of 4.62% (n=6) of the non-sponsored participants and 7.69% (n=10) of the sponsored participants however, the difference was not significant (p=0.302). Nevertheless, most (82.69%; n=215) of the participants were not actively looking for employment. It was only 17.31% (n=45) of the sample that was actively looking for employment. The difference between the amount of participants looking for employment between the two groups was also not significant (p=0.251). Most (36.92%; n=96) participants received a total income which ranged between R 1001.00 and R 2500.00 per month, followed by 30.77% (n=80) who received a total income which ranged between R 501.00 to R 1000.00 per month and 20.77% (n=54) who received R 500.00 or less. The rest (11.54%; n=30) of the participants received a total income which was greater than R 2500.00 per month. The difference observed between the total income (Table 4.3) for non-sponsored and sponsored participants was significant (p=0.005).

4.2.1.4 Food Security Status

Table 4.4 in the next page, presents an overview of the food security status of the study sample. Most (66.92%; n=174) participants purchased their food either two or three times a month, followed by the 15.77% (n=41) who purchased their food once a week and the 8.85% (n=23) who purchased their food once a month. A few (8.46%; n=22) participants purchased food daily, but the differences between the two groups were not significant (p=0.074). More (97.69%; n=127) non-sponsored than sponsored participants (91.54%; n=119) purchased their food at the supermarket and more sponsored (8.46%; n=11) than non-sponsored participants (2.31%; n=3) purchased their food from the DUT campus food court. The difference between the sponsored and non-sponsored participants was significant (p=0.028).

Table 4.4: Food Security Status

Variables	% Non-Sponsored Sample (n=130)	% Sponsored Sample (n=130)	p-value
Frequency of purchasing food			0.074
Every day	6.92 (n=9)	10.00 (n=13)	
Once a week	20.00 (n=26)	11.54 (n=15)	
Once a month	11.54 (n=15)	6.15 (n=8)	
2-3 times a month	61.54 (n=80)	72.31 (n=94)	
Where food is frequently purchased*			0.028
Supermarket	97.69 (n=127)	91.54 (n=119)	
Campus food court	2.31 (n=3)	8.46 (n=11)	
The amount of money spent on food per month			0.126
R0 - R400	25.38 (n=33)	20.77 (n=27)	
R401 - R800	62.31(n=81)	58.46 (n=76)	
R801 - R1200	10.77 (n=14)	13.85 (n=18)	
> R1200	1.54 (n=2)	6.92 (n=9)	
Shortage of money to buy food**			0.006
Always or often	12.31 (n=16)	5.38 (n=7)	
Sometimes	16.92 (n=22)	7.69 (n=10)	
Seldom or never	70.77 (n=92)	86.92 (n=113)	
Number of meals consumed per day			0.830
1	2.31 (n=3)	2.31 (n=3)	
2	29.23 (n=38)	32.31 (n=42)	
3	52.31 (n=68)	53.08 (n=69)	
>3	16.15 (n=21)	12.31 (n=16)	
The place where most meals are eaten			0.162
Home	12.31 (n=16)	5.38 (n=7)	
Friend's place	3.85 (n=5)	3.08 (n=4)	
University residence	82.31 (n=107)	87.69 (n=114)	
Campus food court	1.54 (n=2)	3.85 (n=5)	
Number of meals consumed per day			
Pearson chi-squared test **** = $p< 0.01$; * = $p< 0.05$**			

More (60.38%; n=157) participants used an amount which ranged between R 401.00 and R800.00 to buy food, followed by the 23.08% (n=60) who used R 400.00 or less and the 12.37% (n=32) who used an amount which ranged between R801.00 and R1200.00 to buy food. The rest (4.23; n=11) used an amount greater that R1200.00 to buy food. The difference between the amount of money used by non-sponsored and sponsored participants to purchase food between was not significant (p=0.126). More (86.92%; n=113) of the sponsored than non-sponsored participants (70.77%; n=92) stated that they had either seldom or never been in a situation where they did not have enough money to buy food. More (12.31%; n=16) non-sponsored than sponsored participants (5.38%; n=7) stated that they either always or often had a problem of not having enough money to buy food. The difference observed for the shortage

of money to buy food between non-sponsored and sponsored participants was statistically significant (p=0.006).

Most (52.69%; n=137) of the participants had three meals a day, followed by the 30.77% (n=80) who ate two meals, and 14.23% (n=37) of the participants who had more than three meals a day. The rest (2.31%; n=6) of the participants ate only one meal per day, but the difference between the sponsored and non-sponsored group was not significant (p=0.830). Most (85.00%; n=221) of the participants ate most of their meals at the university residence, followed by the 8.85% (n=23) of who ate most of their meals at home, and the 3.46% (n=9) who ate most meals at a friend's place. The rest (2.69%; n=7) of the participants ate most of their meals at the DUT campus food court however, but the difference between the two groups was also not significant (p=0.162). Although results (Table 4.4) indicated that 2.31% (n=3) of the non-sponsored participants and 8.46% (n=11) of the sponsored participants purchased most of their food at the campus food court, a few those participants only bought the food at the campus food court, but consumed it elsewhere.

4.2.1.5 Media Resources

Table 4.5 presents an overview of the sample's access to certain media related resources.

Table 4.5: Media Resources

Variables	% Non-Sponsored Sample (n=130)	% Sponsored Sample (n=130)	p-value
Access to the internet where you stay* **			<0.001
Yes	64.62 (n=84)	87.69 (n=114)	
No	35.38 (n=46)	12.31 (n=16)	
Do you have a personal laptop/desktop? **			0.001
Yes	43.08 (n=56)	63.08 (n=82)	
No	56.92 (n=74)	36.08 (n=48)	
Do you have access to the television where you stay?			1.000
Yes	99.23 (n=129)	99.23 (n=129)	
No	0.77 (n=1)	0.77 (n=1)	
Do you have access to a mobile device, which has Wi-Fi and internet access?			1.000
Yes	92.31 (n=120)	92.31 (n=120)	
No	7.69 (n=10)	7.69 (n=10)	
Pearson chi-squared test ***** = p< 0.001; ** = p< 0.01**			

More (87.69%; n=114) of the sponsored than non-sponsored participants (64.62%; n=84) had access to wireless fidelity (Wi-Fi) and internet services and more (35.38%; n=46) non-sponsored than sponsored participants (12.31%; n=16) did not have access to Wi-Fi and

internet services at their place of residence. Such differences between the two groups were statistically significant (p<0.001). More (63.08%; n=82) of the sponsored than non-sponsored participants (43.08%; n=56) either owned a laptop or desktop computer and more (56.92%; n=74)) non-sponsored than sponsored participants (36.08%; n=48) neither owned a laptop nor desktop computer. The difference between the number of sponsored and non-sponsored participants owning either a laptop or desktop computer was statistically significant (p=0.001). Most (99.23%; n=258) of the participants had access to a television and the rest (0.77%; n=2) did not have access to a television where they resided. Most (92.31%; n=240) of the participants owned a mobile device which had Wi-Fi and internet access and the rest (7.69%; n=10) did not. No difference was observed between the non-sponsored and sponsored participants (Table 4.5), having access to a television where they resided or owning a mobile device that had access to the WiFi and internet (p=1.000).

4.2.2 ANTHROPOMETRIC AND BIOCHEMICAL MEASUREMENTS

4.2.2.1 Anthropometric Findings

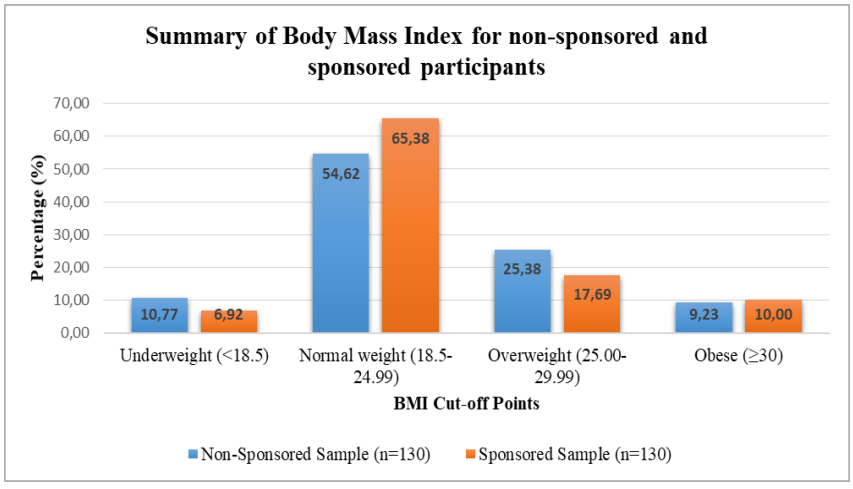
Table 4.6 presents an overview of the anthropometric profile of the sample.

Table 4.6: Anthropometric findings for non-sponsored and sponsored participants

Variables	Non-Sponsored Sample (n=130) Mean ± SD	Sponsored Sample (n=130) Mean ± SD	p-value
Weight (kg)			
Whole group	64.69 ± 14.71	64.22 ± 13.81	0.476
Male participants	65.26 ± 12.68	65.68 ± 12.27	0.791
Female participants	64.19 ± 16.38	62.17 ± 15.62	0.716
Height (m)			
Whole group	1.65 ± 0.09	1.66 ± 0.09	0.639
Male participants	1.70 ± 0.07	1.70 ± 0.07	0.493
Female participants	1.61 ± 0.09	1.59 ± 0.08	0.466
BMI (kg/m^2)			
Whole group	23.74 ± 5.34	23.43 ± 4.75	0.183
Male participants	22.71 ± 4.26	22.73 ± 3.99	0.603
Female participants	24.65 ± 6.03	24.42 ± 5.53	0.513
Waist circumference (cm)			
Whole group	77.27 ± 10.57	76.06 ± 9.47	0.215
Male participants	77.17 ± 9.50	76.04 ± 9.15	0.756
Female participants	77.35 ± 11.50	76.10 ± 10.00	0.286
ANOVA			

The non-sponsored participants recorded a higher mean weight (64.69 kg) than the sponsored participants (64.22 kg), but the difference was not significant (p=0.476). The sponsored participants recorded a higher mean height (1.66 m) than the non-sponsored participants (1.65 m), but the difference was also not significant (p=0.639). The non-sponsored participants recorded a higher mean BMI (23.74 kg/m²) than the sponsored participants (23.43 kg/m²), but difference observed between the mean BMI of the non-sponsored and sponsored participants was not significant (p=0.183). A similar pattern was observed for the WC as well (Table 4.6), as the non-sponsored participants recorded a higher mean WC (77.27 cm) than the sponsored participants (76.06 cm), again, the difference between the two groups was not significant (p=0.215).

Figure 4.1 presents a summary of the BMI for the sample. More (10.77%; n=14) non-sponsored than sponsored participants (6.92%; n=9) were underweight. The difference observed between non-sponsored and sponsored participants who were underweight was not statistically significant (p=0.275). More (65.38%; n=85) sponsored than non-sponsored participants (54.62%; n=71) fell under the normal weight category. Within the non-sponsored group, 63.93% (n=39) of the males and 46.38% (n=32) of the females had a normal weight. Within the sponsored group, 67.11% (n=51) of the males and 62.96% (n=34) of the females had a normal weight. The difference observed between non-sponsored and sponsored participants who fell under the normal weight category was not significant (p=0.076).

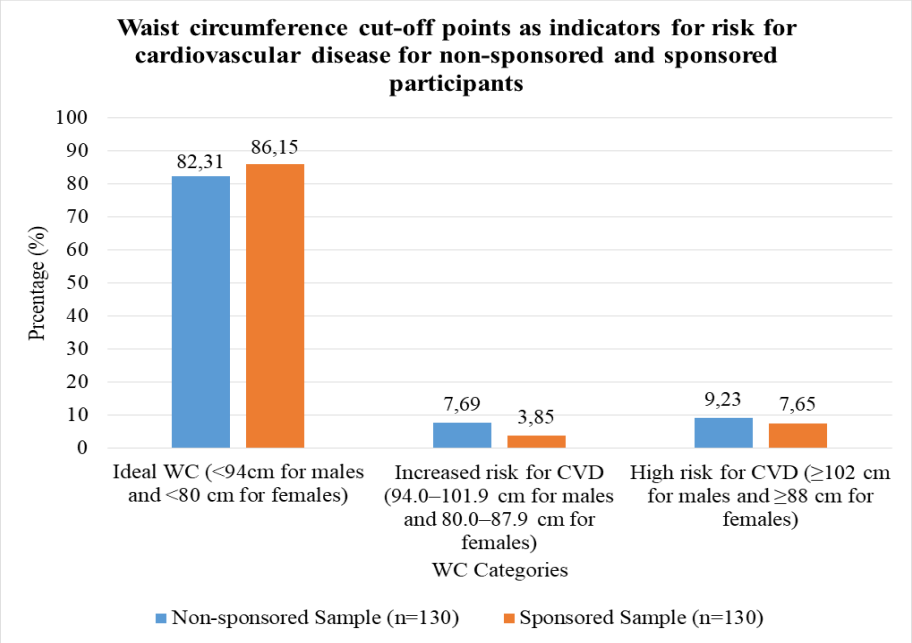


BMI = body mass index

Figure 4.1: Summary of BMI for non-sponsored (n=130) and sponsored (n=130) participants

More (25.38%; n=33) non-sponsored than sponsored participants (17.69%; n=23) were overweight. Within the non-sponsored group, 21.31% (n=13) of the males and 28.99% (n=20) of the females were overweight. Within the sponsored group, 18.42% (n=14) of the males and 16.67% (n=9) of the females were overweight, but the difference was not significant (p=0.131). Furthermore, more (10.00%; n=13) sponsored than non-sponsored participants (9.23%; n=12) were obese. Within the non-sponsored group, 3.28% (n=2) of the males and 14.49% (n=10) of the females were obese. Within the sponsored group, 6.58% (n=5) of the males and 14.81% (n=8) of the females were obese, but difference between the non-sponsored and sponsored participants (Figure 4.1) was not significant (p=0.833).

Figure 4.2 represents the WC parameters for the entire non-sponsored and sponsored groups. Although the WC range of male participants is different to that of females, the results were combined and represented in Figure 4.2.



WC = waist circumference; CVD = cardiovascular disease

Figure 4.2: Waist circumference cut-off points as indicators for risk for CVD for non-sponsored (n= 130) and sponsored (n=130) participants

Figure 4.2 indicates that more (86.15%; n=112) sponsored participants than non-sponsored participants (82.31%; n=107) showed an abdominal fat distribution within the recommended cut-off point (<94cm for male participants and <80 cm for female participants), but the difference was not significant (p=0.395). More (7.69%; n=10) non-sponsored that to sponsored participants (3.85%; n=5) recorded a WC which rendered them at risk for developing CVD (94.0–101.9 cm for male participants and 80.0–87.9 cm for female participants). The results

further indicated that 7.69% (n=10) of the non-sponsored participants and 3.85% (n=5) of the sponsored participants showed an abdominal fat distribution within the increased high-risk category, but the difference between the two groups was not statistically significant (p=0.184). Furthermore, the results also indicated that more (9.23%; n=12) non-sponsored than sponsored participants (7.69%; n=10) recorded a WC which placed them at a high risk for the development of CVD (≥102 cm for male participants and ≥88 cm for female participants). The difference observed between non-sponsored and sponsored participants who had a high risk for developing CVD was not statistically significant (p=0.656).

4.2.2.2 Clinical Profile

In Table 4.7, the results of the clinical parameters are reported for the entire sample, divided into non-sponsored and sponsored groups and for males and females separately.

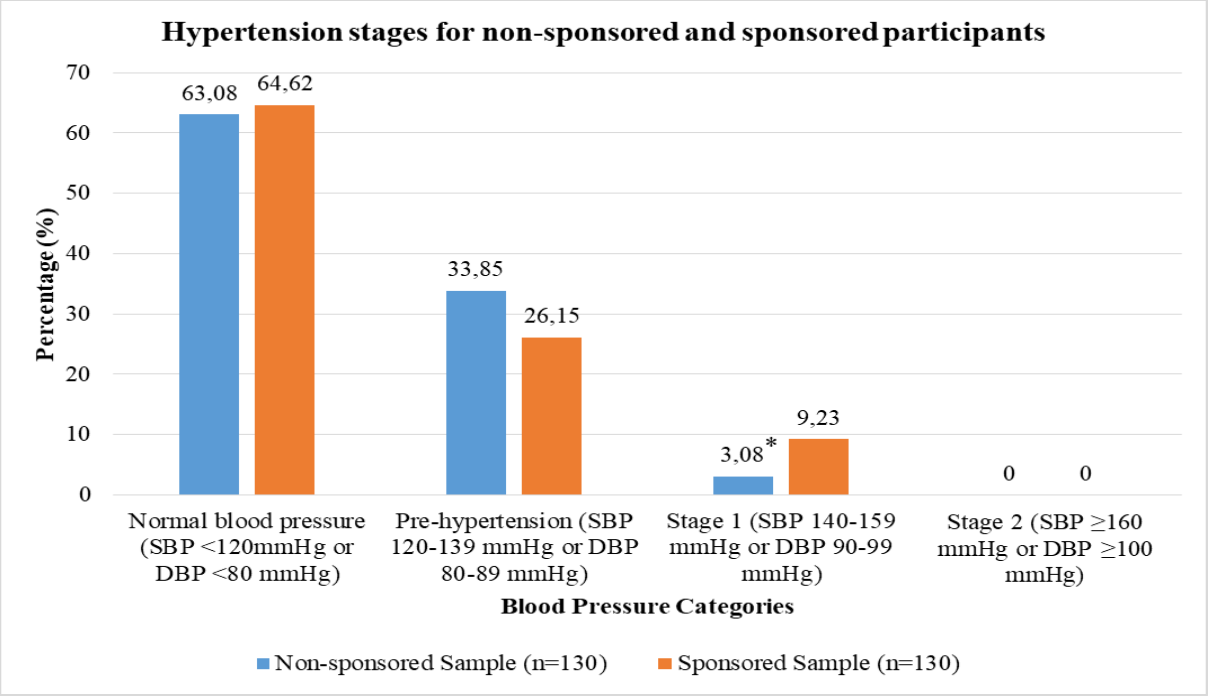
Table 4.7: Clinical parameters of sponsored and non-sponsored participants

Variables	Non-Sponsored Sample (n=130) Mean ± SD	Sponsored Sample (n=130) Mean ± SD	p-value
Systolic blood pressure (mmHg)			
Whole group	112.87 ± 12.76	112.27 ± 12.83	0.949
Male participants	118.56 ± 10.76	117.09 ± 11.92	0.405
Female participants	107.84 ± 12.33	105.48 ± 10.93	0.356
Diastolic blood pressure (mmHg)			
Whole group	72.57 ± 9.56	72.79 ± 9.92	0.673
Male participants	74.86 ± 8.92	74.63 ± 9.55	0.580
Female participants	70.54 ± 9.70	70.20 ± 9.93	0.856
Fasting blood glucose (mmol/L)			
Whole group	2.54 ± 1.19	2.28 ± 1.15	0.072
Male participants	2.49 ± 1.13	2.38 ± 1.21	0.579
Female participants*	2.58 ± 1.25	2.13 ± 1.06	0.037
Total serum cholesterol (mmol/L)			
Whole group**	4.18 ± 0.71	3.90 ± 0.82	0.004
Male participants	4.05 ± 0.65	3.95 ± 0.90	0.478
Female participants**	4.29 ± 0.75	3.83 ± 0.68	0.001
Triglycerides (mmol/L)			
Whole group	2.09 ± 1.65	1.91 ± 1.78	0.429
Male participants	1.83 ± 1.27	1.79 ± 1.78	0.899
Female participants	2.32 ± 1.91	2.09 ± 1.77	0.512
ANOVA **** = p< 0.01; * = p< 0.05**			

The mean SBP for non-sponsored participants was 112.87 mmHg and 112.27 mmHg for sponsored participants. The means for SBP between the sponsored and non-sponsored groups

were very close to each other. No statistical significance was observed for SBP difference between the two groups (p=0.949). Non-sponsored participants recorded a higher (72.57 mmHg) DBP than the sponsored participants (72.79 mmHg) however, the difference was not significant (p=0. 673). The mean fasting blood glucose for the non-sponsored participants was higher (2.54 mmol/L) than that of sponsored participants (2.28 mmol/L), but the difference between the two groups was not significant (p=0.072). However, the difference between non-sponsored and sponsored females (Table 4.7), was significant (p=0.037) as non-sponsored females recorded a higher (2.58 mmol/L) mean fasting blood glucose than sponsored females (2.13 mmol/L).

Furthermore, non-sponsored participants recorded higher (4.18 mmol/L) total serum cholesterol (TSC) levels than sponsored participants (3.90 mmol/L) and the difference was significant (p=0.004). When controlling for gender, the difference between the non-sponsored and sponsored females was significant (p=0.001). The difference observed between the male participants (Table 4.7) was not significant (p=0.478). Non-sponsored participants also recorded higher (2.09 mmol/L) mean triglyceride levels than sponsored participants (1.91 mmol/L), but the difference was not significant (p=0.429).

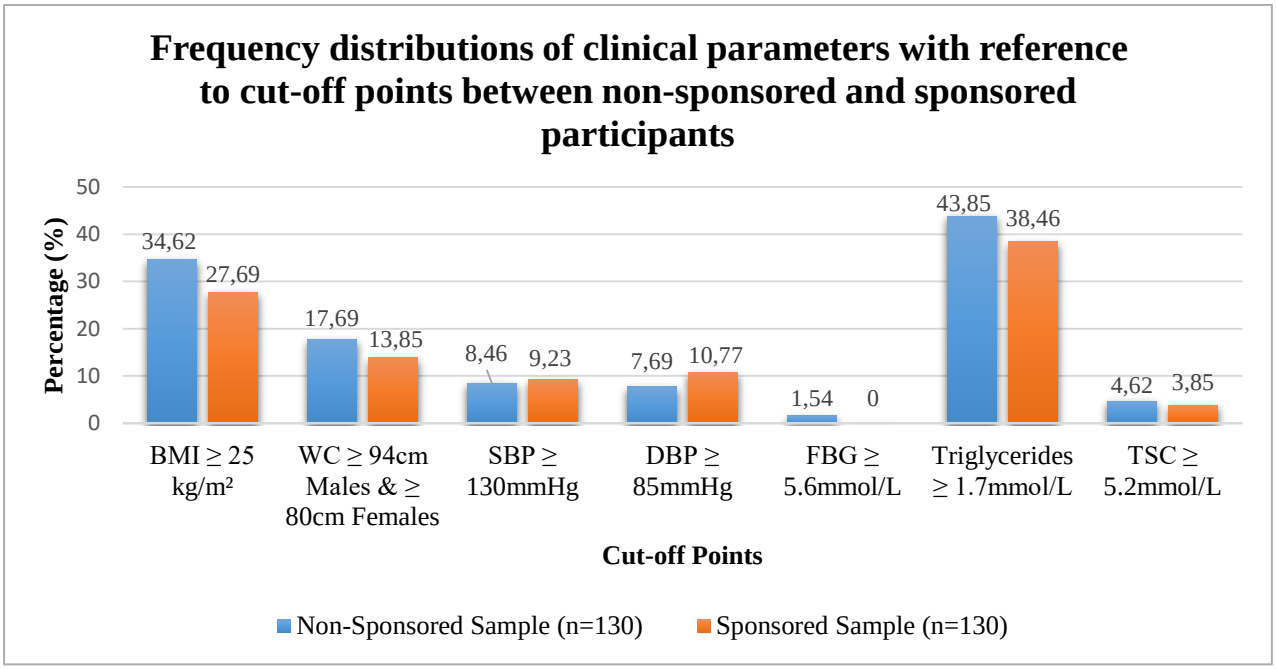


ANOVA
****=p< 0.001; ** = p< 0.01; * = p< 0.05*

Figure 4.3: Hypertension stages for non-sponsored and sponsored participants

Figure 4.3 presents the stages of hypertension from normal to stage two as defined by the American Heart Association (2017), recorded using blood pressure results of the participants. Slightly similar results were observed between the two groups. Nonetheless more (64.62%; n=84) sponsored than non-sponsored participants (63.08%; n=82) recorded a normal blood pressure (SBP <120mmHg and DBP <80 mmHg), but the difference was not significant (*p*=0.796).

More (33.85%; n=44) non-sponsored than sponsored participants (26.15%; n=34) recorded blood pressure levels indicating a pre-hypertension stage (SBP 120-139 mmHg and DBP 80-89 mmHg), however the difference was not significant (*p*=0.176). On the contrary, more (9.23%; n=12) sponsored than non-sponsored participants (3.08%; n=4) recorded a blood pressure levels indicating stage one hypertension (SBP 140-159 mmHg and DBP 90-99 mmHg). The difference between the groups was statistically significant (*p*=0.039).



BMI = body mass index; WC = waist circumference; SBP = systolic blood pressure; DBP = diastolic blood pressure; FBG = fasting blood glucose; TSC = total serum cholesterol

Figure 4.4: Frequency distributions of clinical parameters with reference to cut-off points

Cut-off points for clinical parameters used in this study were defined in chapter 3. Overweight was identified as BMI ≥25 kg/m^2 and abdominal obesity was identified as WC ≥94 cm for male participants and ≥80 cm for female participants. Hypertension was demarcated as SBP ≥130

mmHg or DBP ≥85 mmHg and elevated fasting blood glucose was demarcated as ≥5.6 mmol/L. Hypertriglyceridemia was defined as >1.7 mmol/L and hypercholesterolemia was demarcated as ≥5.2 mmol/L. Figure 4.4, presents the frequency distributions of clinical parameters for the entire sample. BMI ≥25 kg/m² was recorded for 34.62% (n=45) of the non-sponsored participants and 27.69% (n=36) of the sponsored participants, the difference was not significant (p=0.228). A WC ≥94 cm for male participants and ≥80 cm for female participants was recorded for 17.69% (n=23) of the non-sponsored participants and 13.85% (n=18) of the sponsored participants. The difference between the two groups (Figure 4.4), was not significant (p=0.395).

A SBP >130 mmHg was recorded for 8.46% (n=11) of the non-sponsored participants and 9.23% (n=12) of the sponsored participants. DBP measurements above the cut-off value were recorded for 7.69% (n=10) of the non-sponsored participants and 10.77% (n=14) of the sponsored participants. The difference between the groups was not significant for both the SBP (p=0.827) and DBP (p= 0.391).

None of the sponsored participants and only a few (1.54%; n=2) non-sponsored participants recorded a fasting blood glucose level >5.6 mmol/L. More (43.85%; n=57) non-sponsored than sponsored participants (38.46%; n=50) recorded raised triglyceride levels (>1.7 mmol/L). More (4.62%; n=6) non-sponsored than sponsored participants (3.85%; n=5) recorded TSC levels >5.2 mmol/L. The difference observed between the biochemical results of non-sponsored and sponsored participants) was not statistically significant for fasting blood glucose levels (p=0.156), triglyceride levels (p= 0.378) and TSC levels (p= 0.758).

4.2.3 DIETARY ASSESSMENT RESULTS

Dietary assessment was conducted by means of three 24-Hour food recall (24HR) questionnaires including two week days and one weekend day and a Food Frequency Questionnaire indicating variety over a seven-day period. Results were recorded for nutrient intake, the most common foods consumed, energy distribution, fruit and vegetable intake, food variety score (FVS) and food group diversity score (FGDS), as well as the nutrient adequacy ratio (NAR).

4.2.3.1 Nutrient Intake

This section presents the macro- and micro-nutrient intake of non-sponsored and sponsored participants aged between 18 and 35 years, as measured by the 24HR. The dietary reference intake (DRIs) of the group was compared to the DRIs as presented by the Institute of Medicine, Food and Nutrition Board, USA (2000).

Table 4.8 and Table 4.9 reflects the mean daily nutrient intake for non-sponsored and sponsored male participants and female participants respectively. The EER for energy in the male group was recommended at 12 881kJ. The sponsored males recorded a higher (6414.22 kJ) mean energy intake than the non-sponsored male participants (5485.13 kJ).

Table 4.8: The dietary intake nutrients analysis of non-sponsored and sponsored male participants assessed by using the average of three 24HRs

Nutrients p/day	Non-sponsored males (n=61) Mean ± SD	% Non-sponsored males consuming <100% of DRIs	Sponsored males (n=76) Mean ± SD	% Sponsored males consuming <100% of DRIs	DRIs
Energy (kJ) EER	5485.13 ± 2147.910	100.00	6414.22 ± 2172.726	98.68	12881 kJ
Total protein (g)	47.32 ± 21.807	67.21	54.97 ± 21.224	60.53	56 RDA
Total fat (g)	38.72 ± 22.279		51.58 ± 23.638		
Carbohydrates (g)	177.88 ± 70.175	11.48	196.36 ± 72.525	6.58	100 EAR
Total dietary fibre (g)	13.22 ± 6.134	100	13.72 ± 6.111	98.68	38 AI
Calcium (mg)	308.35 ± 212.197	100	327.34 ± 223.145	98.68	1000 AI
Iron (mg)	10.41 ± 4.199	16.39	12.48 ± 5.175	3.95	6 EAR
Magnesium (mg)	157.58 ± 62.693	100	173.72 ± 66.301	98.68	330 EAR
Phosphorus (mg)	658.55 ± 281.257	40.98	757.23 ± 304.401	34.21	580 EAR
Zinc (mg)	8.43 ± 3.918	60.66	9.62 ± 3.920	53.95	9.4 EAR
Selenium (µg)	21.03 ± 17.136	86.89	22.10 ± 15.123	93.42	45 EAR
Iodine (µg)*	30.26 ± 26.700	100.00	34.10 ± 33.327	100.00	95 EAR
Vitamin A (µg)*	477.97 ± 579.271	100.00	607.37 ± 748.830	100.00	625 EAR
Thiamin (mg)	1.06 ± 0.459	45.90	1.21 ± 0.515	38.16	1 EAR
Riboflavin (mg)*	1.03 ± 0.617	60.66	1.29 ± 1.041	55.26	1.1 EAR
Niacin (mg)	18.83 ± 8.847	22.95	22.58 ± 8.476	7.89	12 EAR
Vitamin B6 (mg)	2.84 ± 1.671	16.39	3.53 ± 1.662	6.58	1.1 EAR
Folate (µg)	227.11 ± 116.056	77.05	276.85 ± 120.215	65.79	320 EAR
Vitamin B12 (µg)	3.49 ± 6.215	50.82	4.25 ± 7.083	48.68	2 EAR
Pantothenate (mg)	4.09 ± 2.783	77.05	4.54 ± 2.596	65.79	5 AI
Biotin (µg)*	21.22 ± 12.712	78.69	25.41 ± 26.074	82.89	30 AI
Vitamin C (mg)*	24.39 ± 23.648	93.44	35.05 ± 42.336	85.53	75 EAR
Vitamin D (µg)	2.92 ± 2.846	75.41	3.46 ± 3.580	80.26	5 AI
Vitamin E (mg)*	6.65 ± 4.297	91.80	8.74 ± 5.664	78.95	12 EAR
Vitamin K (µg)*	26.69 ± 93.982	98.36	24.30 ± 44.855	97.37	120 AI

EER - Estimated Energy Requirements. RDA - Recommended Dietary Allowance. EAR - Estimated Average Requirements. AI - Adequate Intake used where EAR is not available.
* = $p < 0.05$

The mean protein intake was 47.32 g for non-sponsored males and 54.97 g for sponsored male participants, which was lower than the RDA (56 g) for both groups. Sponsored male participants recorded a higher mean total fat intake than the non-sponsored male participants (51.58 g vs. 38.72 g). The EAR for carbohydrates in this group was recommended at 100 g, but both groups consumed more than what was recommended. Carbohydrate intake was 177.88 g for non-sponsored and 196.36 g for sponsored participants.

The total dietary fibre intake for both non-sponsored (13.22 g) and sponsored (13.72 g) participants was much less than the recommended AI of 38 g. Results also indicated very low levels of calcium intake between the non-sponsored (308.35 mg) and the sponsored (327.34 mg) participants, which was also much less than the recommended intake of 1000 mg. On the contrary, iron intake was very high among the non-sponsored (10.41 mg) and the sponsored male participants (12.48 mg) compared to the recommended EAR of 6 mg. Phosphorus intake was higher than the EAR of 580 mg for both the non-sponsored (658.55 mg) and sponsored participants (757.23 mg). Nevertheless, low magnesium intake was noted for both non-sponsored and sponsored participants at 157.58 mg and 173.72 mg respectively compared to the recommended 330 mg.

Zinc intake was lower for non-sponsored participants (8.43 mg) but higher for sponsored participants (9.62 mg) than the recommended intake of 9.4 mg. A low intake of selenium in both non-sponsored and sponsored participants was noted at 21.03 µg and 22.10 µg respectively, compared to the recommended 45 µg (EAR). Iodine intake was also low for non-sponsored (30.26 µg) as well as for sponsored participants (34.10 µg), whereas the recommended EAR for iodine in this group was 95 µg. Vitamin A intake was also found to be low for non-sponsored (477.97µg) as well as for sponsored participants (607.37µg) compared to the recommended intake of 625 µg (EAR).

Thiamin intake was slightly higher than the recommended intake of 1 mg for both the non-sponsored (1.06 mg) and the sponsored participants (1.21 mg). Riboflavin intake was slightly lower for non-sponsored participants (1.03 mg), but higher for sponsored participants (1.29 mg) compared to the recommended intake of 1.1 mg. On the contrary, niacin intake was much higher for both non-sponsored (18.83 mg) and sponsored (22.58 mg) participants compared to the recommended intake of 12 mg (EAR). Similarly, non-sponsored participants consumed 2.84 mg and sponsored participants consumed 3.53 mg of vitamin B6, which was higher than the recommended intake of 1.1 mg (EAR). Folate intake for non-sponsored participants was

227.11 µg and 276.85 µg for sponsored participants, which was lower than the recommended intake of 320 µg (EAR). Vitamin B12 consumption was high for both non-sponsored (3.49 µg) and sponsored participants (4.25 µg), as the EAR for vitamin B12 in this group was recommended at 2 µg. On the other hand, the intake of pantothenate for non-sponsored participants was 4.09 mg and 4.54 mg for sponsored participants, which was lower than the recommended EAR of 5 mg. A low intake of biotin was also noted for both non-sponsored (21.22 µg) and sponsored participants (25.4 µg) compared to the recommended 30 µg (AI).

A significantly low vitamin C intake was noted for both the non-sponsored (24.39 mg) and sponsored participants (35.05 mg), yet the recommended EAR for vitamin C was 75 mg. The EAR for vitamin E in this group was recommended at 12 mg. The non-sponsored participants had a mean intake of 6.65 mg and the sponsored participants had a mean intake of 8.74 mg. Vitamin D intake was also not sufficient for both non-sponsored and sponsored participants at 2.92 µg and 3.46 µg respectively compared to the recommended 5 µg. Vitamin K intake was significantly low for both non-sponsored and sponsored participants at 26.69 µg and 24.30 µg respectively, compared to the recommended intake of 120 µg (AI). With regard to the macronutrients, the difference between the groups (Table 4.8) was significant for energy (p=0.013), fat (p=0.002) and carbohydrates (p=0.049). For the micronutrients, the difference was only significant for iodine (p=0.029), vitamin A (p=0.040), riboflavin (p<0.001), biotin (p<0.001), vitamin C (p<0.001), vitamin E (p=0.027) and vitamin K (p<0.001).

Table 4.9 represents the dietary intake nutrients analysis of non-sponsored and sponsored female participants, which were assessed by using the average of three 24HRs. The EER for energy in the female group was recommended at 10 093 kJ. Non-sponsored females had a mean intake of 5501.29 kJ and `sponsored females had a mean intake of 4786.38 kJ. The RDA of protein for this particular group was 46 g and non-sponsored females consumed just enough (46.10 g) protein while the sponsored female participants consumed less (41.35 g). Total fat intake for non-sponsored females was a bit higher (46.91 g) than that of sponsored female participants (39.69 g). Carbohydrate intake was high for both non-sponsored (164.68 g) and sponsored participants (143.38 g), whereas the EAR for carbohydrates in this group was recommended at 100 g.

Table 4.9: The dietary intake nutrients analysis of non-sponsored and sponsored female participants assessed by using the average of three 24HRs.

Nutrients p/day	Non-sponsored females (n=69) Mean ± SD	% Non-sponsored females consuming <100% of DRIs	Sponsored females (n=54) Mean ± SD	% Sponsored females consuming <100% of DRIs	DRIs
Energy (kJ) EER*	5501.29 ± 1738.436	98.55	4786.38 ± 1250.080	100.00	10093 kJ
Total protein (g)	46.10 ± 16.808	57.97	41.35 ± 13.676	68.52	46 RDA
Total fat (g)*	46.91 ± 21.763		39.69 ± 14.478		
Carbohydrates (g)*	164.68 ± 51.098	7.25	143.38 ± 39.406	12.96	100 EAR
Total dietary fibre (g)	10.76 ± 4.689	98.55	10.44 ± 5.240	96.30	25 AI
Calcium (mg)*	346.09 ± 235.333	98.55	271.90 ± 178.433	98.15	1000 AI
Iron (mg) *	10.10 ± 4.187	65.22	23.19 ± 35.578	25.93	8.1 EAR
Magnesium (mg)	141.75 ± 46.022	98.55	131.68 ± 41.618	100	255 EAR
Phosphorus (mg)	622.16 ± 263.513	46.38	562.09 ± 211.063	57.41	580 EAR
Zinc (mg)*	7.08 ± 2.545	52.17	97.90 ± 208.504	50.00	6.8 EAR
Selenium (µg)	18.34 ± 11.297	97.10	15.44 ± 8.793	100.00	45 EAR
Iodine (µg)*	24.54 ± 20.413	100.00	20.74 ± 14.815	100.00	95 EAR
Vitamin A (µg)*	481.09 ± 603.075	100.00	319.41 ± 340.635	100.00	500 EAR
Thiamin (mg)*	0.94 ± 0.385	55.07	18.64 ± 47.091	37.04	0.9 EAR
Riboflavin (mg)	1.42 ± 0.924	34.78	1.81 ± 0.789	53.70	0.9 EAR
Niacin (mg)	17.51 ± 7.105	14.49	15.68 ± 5.819	22.22	11 EAR
Vitamin B6 (mg)*	2.56 ± 1.269	11.59	3.12 ± 2.168	3.70	1.1 EAR
Folate (µg)	203.10 ± 105.437	89.86	169.05 ± 84.627	94.44	320 EAR
Vitamin B12 (µg)*	4.81 ± 7.044	36.23	13.95 ± 28.463	53.70	2 EAR
Pantothenate (mg)	3.35 ± 1.700	84.06	3.18 ± 1.945	88.89	5 AI
Biotin (µg)*	18.52 ± 16.869	91.30	15.14 ± 10.080	98.15	30 AI
Vitamin C (mg)	34.67 ± 48.082	81.16	34.25 ± 44.335	77.78	60 EAR
Vitamin D (µg)*	3.97 ± 4.297	76.81	4.53 ± 9.961	79.63	5 AI
Vitamin E (mg)	7.21 ± 4.348	86.96	5.58 ± 3.378	94.44	12 EAR
Vitamin K (µg)*	15.10 ± 12.945	100.00	11.48 ± 9.409	100.00	90 AI

EER - Estimated Energy Requirements. RDA - Recommended Dietary Allowance. EAR - Estimated Average Requirements. AI - Adequate Intake used where EAR is not available.
* = $p < 0.05$

The total dietary fibre intake for both non-sponsored (10.76 g) and sponsored participants (10.44 g) was less than the recommended AI of 25 g. Results also indicated very low levels of calcium intake among the non-sponsored (346.09 mg) as well as the sponsored participants (271.90 mg), compared to the recommended AI of 1000 mg. On the contrary, iron intake was quite high (10.10 mg) for non-sponsored females and even higher (23.19 mg) for sponsored female participants compared to the recommended intake of 8.1 mg (EAR).

Furthermore, the results indicated that phosphorus intake was higher (622.16 mg) for non-sponsored, but lower (562.09 mg) for sponsored participants compared to the EAR of 580 mg. Low magnesium intake was also noted for both non-sponsored and sponsored participants at 141.75 mg and 131.68 mg respectively compared to the EAR of 255 mg. Zinc intake was

slightly higher (7.08 mg) for non-sponsored participants, but very high (97.90 mg) for sponsored participants compared to the recommended intake of 6.8 mg (EAR). A low intake of selenium in both the non-sponsored and sponsored participants was noted at 18.34 µg and 15.44 µg respectively, compared to the recommended intake of 45 µg (EAR). Iodine consumption levels were very low for both non-sponsored (25.54 µg) and sponsored females (20.74 µg), whereas the recommended EAR for iodine in this group was 95 µg. The EAR of vitamin A for this group was recommended at 625 µg. However, non-sponsored females recorded a mean intake of 481.09 µg and sponsored female participants recorded a mean intake of 319.41 µg.

Thiamin intake was higher than the recommended intake of 0.9 mg (EAR) in non-sponsored (0.9 mg) and even higher in sponsored participants (18.64 mg). Riboflavin intake was also higher for both non-sponsored (1.42 mg) and sponsored participants (1.81 mg) compared to the recommended intake of 0.9 mg (EAR). Moreover, the consumption of niacin too, was high for both non-sponsored (17.51 mg) and sponsored participants (15.68 mg) compared to the recommended intake of 11 mg. In comparison, the non-sponsored participants consumed 2.56 mg and the sponsored participants consumed 3.12 mg of vitamin B6, which was also higher than the EAR intake of 1.1 mg. Folate intake for non-sponsored females was 203.10 µg for non-sponsored and 169.055 µg for sponsored participants, which in both cases, was lower than the recommended intake of 320 µg (EAR). Vitamin B12 consumption was high (4.81 µg) for non-sponsored participants and considerably higher (13.95 µg) for sponsored participants, where the EAR for vitamin B12 in this group was recommended at 2µg. The intake of pantothenate for non-sponsored females was 3.35 mg and 3.18 mg for sponsored female participants, which was lower than the recommended AI of 5 mg.

The intake of biotin was also low for both non-sponsored (18.52 µg) and sponsored (15.14 µg) participants compared to the recommended 30 µg (AI). Low vitamin C intake was also noted for non-sponsored participants (34.67 mg) as well as for sponsored participants (34.25 mg); this was low compared to the recommended EAR of 60 mg. The EAR for vitamin E in this group was recommended at 12 mg. The non-sponsored participants had a mean intake of 7.21 mg and the sponsored participants had a mean intake of 5.58 mg. Vitamin D intake was lower for both non-sponsored and sponsored participants at 3.97 µg and 4.53 µg respectively compared to the recommended 5 µg (AI). Vitamin K intake was also much lower for both non-sponsored participants (15.10 µg) and sponsored participants (11.48 µg) compared to the

recommended intake of 120 µg (AI). The difference observed between non-sponsored and sponsored participants' nutrient intake (Table 4.9) was statistically significant for energy (p=0.013), total fat (p=0.002), carbohydrates (p=0.049), calcium (p=0.037), iron (p<0.001), zinc (p<0.001), iodine (p=0.016), vitamin A (p<0.001), thiamin (p<0.001), vitamin B6 (p<0.001), vitamin B12 (p<0.001), biotin (p<0.001), vitamin D (p=0.027) and vitamin K (p=0.016).

4.2.3.2 Top Ten Food Items Consumed

The top ten most frequently consumed foods are presented based on the total intake by non-sponsored and sponsored participants aged between 18 and 35 years. The top ten foods consumed by the male and female groups were selected from the average food intake over three days. Results include the frequency (the number of times the food item was consumed by the group), mean intake and per capita intake (average consumption per person). The main source of food for both male and female groups was from the cereal and meat foods groups. The most popular food item was bread for both males and females. Tables 4.10 and 4.11 present a summary of the top ten most consumed food items and the average daily intake consumed over two weekdays and one weekend day included in the 24HR by the non-sponsored and sponsored male and female participants groups.

Table 4.10: Top ten most frequently consumed food items by non-sponsored (n=60) and sponsored (n=76) male participants over three days as measured by three 24HRs

	Non-sponsored Males (n=61)		**Sponsored Males (n=76)**	
Food Item	**Mean Intake for 1 day (g)**	**Frequency for 1 day by the group**	**Mean Intake for 1 day (g)**	**Frequency for 1 day by the group**
Bread/rolls	5776.67	35	9951.67	65
Rice	3303.33	29	3709.33	34
Maize meal	4456.67	29	4761.67	32
Chicken (curried/stewed/ boiled)	2412.33	23	3288.33	30
Diluted squash/cold drink	8013.33	28	6080.00	21
Sugar	489.33	21	487.17	26
Milk	4337.33	23	4831.67	22
Carbonated cold drink	6328.33	15	9991.67	28
Margarine	153.33	13	360.00	20
Polony (processed meat, pork/mixed)	261.67	13	285.00	16
The frequency consumed (the number of times the food item was consumed by the group). The mean intake (the average amount consumed by the whole group).				

Table 4.10 represents the mean intake of the entire non-sponsored (n=61) and sponsored male participants (n=76). Results indicate that the male group consumed a substantial amount of food from the cereal group (bread/rolls, rice, and maize meal) that are mostly carbohydrates. Bread was on top of the list with a mean intake of 5776.67 g for non-sponsored males and 9951.67 g for sponsored males. This was followed by rice, with a mean intake of 3303.33g for non-sponsored males and 3709.33 g for sponsored males. The mean intake for maize meal was 4456.67 g for non-sponsored males and 4761.67 g for sponsored males. Results (Table 4.10) suggested that sponsored male participants had a higher intake of food items from the cereal group than their non-sponsored counterparts did.

Chicken (curried, stewed, or boiled) was fouth with a mean intake of 2412.33 g for non-sponsored males and 3288.33 g for sponsored males. Polony, which is a type of processed meat, was placed at number ten being the least frequently consumed item with the non-sponsored males having a mean intake of 261.67 g and the sponsored males having a mean intake 285.00 g. Results suggested that sponsored male participants had a higher intake of food items from the meat group (chicken, processed meat) than their non-sponsored counterparts. Milk was seventh, with non-sponsored participants having a mean intake of 4337.33 g and for sponsored males; the mean intake was 4831.67 g. Even though sponsored males consumed milk less frequently than non-sponsored males, the sponsored male group still had a higher intake of milk than the non-sponsored males (Table 4.10).

Diluted squash (8013.33 g for non-sponsored males and 6080 g for sponsored males), sugar (489.33 g for non-sponsored males and 487.17 g for sponsored males) and carbonated cold drink (6328.33 g for non-sponsored males and 9991.67 g for sponsored males) appeared fifth, sixth and eighth respectively. Results indicated that the non-sponsored males had a higher intake of diluted squash and sugar than the sponsored males; however, the sponsored males had a much higher intake of carbonated cold drink than the non-sponsored males. Margarine appeared ninth with a mean intake of 153.33 g for non-sponsored and 360 g for sponsored males. Results (Table 4.10) suggested that sponsored male participants had a higher intake of margarine than their non-sponsored counterparts did.

Table 4.11: Top ten most frequently consumed food items by non-sponsored (n=69) and sponsored (n=54) female participants females over three days as measured by three 24HRs

	Non-sponsored females (n=69)		Sponsored females (n=54)	
Food Item	**Mean Intake for 1 day (g)**	**Frequency for 1 day by the group**	**Mean Intake for 1 day (g)**	**Frequency for 1 day by the group**
Bread/rolls	5713.33	51	4593.33	39
Diluted squash/cold drink	12793.33	47	4491.67	14
Milk	4627.33	27	4970.33	27
Sugar	337.33	22	234.33	20
Rice	2581.67	26	1198.33	14
Maize meal	2725.00	20	1713.33	15
Chicken, curried/stewed/boiled (with skin)	1705.00	17	755.00	8
Margarine	259.33	16	145.00	14
Savoury snack/potato crisps	786.83	19	390.17	10
Corn flakes	739.00	17	366.67	10
The frequency consumed (the number of times the food item was consumed by the group). The mean intake (the average amount consumed by the whole group).				

Table 4.11 represents the mean intake of the entire non-sponsored (n=69) and sponsored female participants (n=54). Results indicate that the female group also consumed a substantial amount of foods from the cereal group (bread/rolls, rice, maize meal) that are mostly made up of carbohydrates as well as foods high in sugar, fat and salt. Bread was the most frequently consumed food item with a mean intake of 5713.33 g for non-sponsored females and 4593.33 g for sponsored females. Rice (2581.67 g for non-sponsored females and 1198.33 g for sponsored females) and maize meal (2725 g for non-sponsored females and 1713.33 g for sponsored females) and corn flakes (739 g for non-sponsored females and 366.67 g for sponsored females) appeared fifth, sixth and tenth respectively. These results (Table 4.11) indicated that non-sponsored female participants had a higher intake of food items from the cereal group than their sponsored counterparts did.

Chicken (curried, stewed, or boiled) was seven with a mean intake of 1705 g for non-sponsored females, and 755 g for sponsored females. Results suggested that non-sponsored female participants had a higher intake of chicken than their sponsored counterparts did. Milk was the third most frequently consumed item with non-sponsored participants having a mean intake of 4627.33 g and sponsored females having a mean intake of 4970.33. In contrast to the aforementioned food items, the sponsored female participants had a higher intake of milk than the non-sponsored females (Table 4.11).

Diluted squash (12 793.33 g for non-sponsored females and 4491.67 g for sponsored females) and sugar (337.33 g for non-sponsored females and 234.33 g for sponsored females) was second and fourth, respectively. Results indicated that the non-sponsored females had a much higher intake of diluted squash and sugar than the sponsored females. Margarine (259.33 g for non-sponsored females and 145 g for sponsored females) and savoury snack/potato crisps (786.83 g for non-sponsored females and 390.17 g for sponsored females) were eight and nineth, respectively. Results (Table 4.11) suggested that non-sponsored female participants had a higher intake of food items from the fats and oils group than their sponsored counterparts did.

Table 4.12: The fruit and vegetable intake measured by three 24HRs

Variables	Non-Sponsored Sample (n=130) Mean intake (g)	Sponsored Sample (n=130) Mean intake (g)
Gender		
Males	90.41 g	72.18 g
Females	69.56 g	61.29 g

Table 4.12 presents the fruit and vegetable intake as a mean of the three 24HRs. The results indicated that the entire sample consumed less than the ≥ 400 g per day as recommended by the WHO (2003). The overall frequency of fruit and vegetable consumption was very low and the portion sizes of the fruit and vegetables by both non-sponsored and sponsored males was very small, at 90.41 g for non-sponsored males and 72.18 g for sponsored males. Furthermore, the overall frequency of fruit and vegetable consumption was also far too low for both non-sponsored and sponsored females at 69.56 g for non-sponsored females and 61.29 g for sponsored females. Results indicated that the non-sponsored group consumed more fruit and vegetables than the sponsored group. Nevertheless, the amount consumed by both groups did not meet the recommended intake of at least 400 g, or five or more portions, of fruit or vegetables a day.

Table 4.13: The percentage of energy distribution of the macronutrients from the average of three 24HRs

Macronutrients	Non-Sponsored Sample (n=130) Mean ± SD	Mean % Energy Contribution	Sponsored Sample (n=130) Mean ± SD	Mean % Energy Contribution	WHO (2003) Goal
Males					
Total fat (g)	38.72 ± 22.279	26.12	51.58 ± 23.638	29.75	15-30 %
Protein (g)	47.32 ± 21.807	14.67	54.97 ± 21.224	14.57	10-15 %
Carbohydrates (g) & fibre (g)	191.10 ± 76.309	59.23	210.08 ± 78.636	55.68	55-75 %
Females					
Total fat (g)	46.91 ± 21.763	31.55	39.69 ± 14.478	30.68	15-30 %
Protein (g)	46.10 ± 16.808	14.25	41.35 ± 13.676	14.69	10-15 %
Carbohydrates (g) & fibre (g)	175.44 ± 55.787	54.21	153.82 ± 44.646	54.63	55-75 %

Table 4.13 presents the results of the energy distribution of the macronutrients from the average of the three 24HRs according to the WHO dietary factor goals (2003). The total fat intake for both non-sponsored (n=61) and sponsored males (n=76) was within the goal recommended by the WHO (15-30%), with non-sponsored males obtaining 26.12% and sponsored males obtaining 29.75% of energy from fat. On the contrary, the total fat intake for both non-sponsored and sponsored females was slightly higher than the goal recommended by the WHO (15-30%), with non-sponsored females obtaining 31.55% and sponsored females obtaining 30.58% of energy from fat. Results thus indicated that sponsored males consumed more fat than non-sponsored males, but within the female category, the non-sponsored females consumed more fat that the sponsored females.

Carbohydrates contributed 59.23% to the total intake for non-sponsored males and 55.68% for sponsored males of the daily energy needs in the group. Moreover, carbohydrates contributed 54.21% for non-sponsored females and 54.63% for sponsored females, well within the levels recommended by the WHO (55-75%). Protein contribution was 14.67% for non-sponsored males, 14.57% for sponsored males, 14.25% for non-sponsored females and 14.69% for sponsored females. This therefore indicates that the contribution of protein to total daily energy intake for all the groups was within the WHO recommendation (10-15%). As a result, this proves that the average male participant consumed a balanced diet in terms of the macronutrient intake. The female participants, however, consumed a slighly imbalanced diet with the fat contribution being higher than the WHO recommendation. Carbohydrates were the main source of food consumption for all groups (Table 4.13).

Table 4.14: Household food access for non-sponsored participants as measured by food variety within the food groups consumed over a period of seven days (n=130)

Flesh Foods Group (n=12)	Egg Group (n=1)	Dairy Group (n=5)	Cereal Group (n=10)	Legumes Group (n=5)	Vitamin A-Rich Fruit and Vegetable Group (n=8)	Other Fruit and Juices (100%) Group (n=16)	Vegetable Group (n=12)	Fats and Oils Group (n=7)	Total Individual Food Items Eaten from all Groups (n=75)
0=1	0=43	0=10	0=1	0=65	0=45	0=16	0=4	0=1	5-20=37
1=7	1=87	1=30	1=1	1=44	1=40	1=22	1=12	1=10	21-24=63
2=9		2=42	3=6	2=15	2=21	2=22	2=15	2=30	30-52=30
3=42		3=32	4=23	3=4	3=11	3=18	3=25	3=42	
4=27		4=14	5=33	4=1	4=9	4=13	4=25	4=30	
5=24		5=2	6=29	5=1	5=4	5=18	5=25	5=14	
6=13			7=28			6=11	6=10	6=3	
7=3			8=7			7=7	7=3		
8=3			9=2			8=1	8=2		
9=1						9=1	9=7		
						13=1	11=1		
							12=1		

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

Table 4.14 presents the food group variety consumed by non-sponsored participants. The Food Variety Score (FVS) consists of a count of single foods within the nine nutritional food groups. The Food Group Diversity Score (FGDS) indicates the number of food groups consumed over a period of seven days, as measured by the FFQ. In total, a maximum of 52 different individual food items were consumed within the seven-day period by any one participant. The total range of individual food items consumed by individuals during the seven-day data collection period was between 5 and 52 food items. The highest number of individual food items consumed by most of the non-sponsored participants was between 21 and 24 individual foods (48.46%; n=63), followed by 5 – 20 individual foods (28.47%; n=37). The minority (23.08%; n=30) consumed between 30 and 52 individual food items (Table 4.14).

The food group with the most variety was the other fruit and juices group. Thirteen different food items in the other fruit and juices group were consumed by 0.77% (n=1) participants. The majority (87.69%; n=114) of the participants consumed one to thirteen food items from the other fruit and juices group and 12.31% (n=16) of the non-sponsored participants did not consume any food item from the other fruit and juices group. This was followed by the meat food group, which also consisted of twelve food items and 99.23% (n=129) of the participants consumed one to nine food items from the group. A mere 0.77% (n=1) of the participants did

not consume any food item from the flesh foods group. From the vegetable group, which consisted of twelve food items, the majority (96.92%; n=126) of the participants consumed one to twelve food items and only 3.08% (n=4) of the participants did not consume any food items from the vegetable group (Table 4.14).

The cereal group comprised of nine different food items and 99.23% (n=129) of the participants consumed one to nine food items from the group. A small minority (0.77%; n=1) did not consume any food items from the cereal group. The fats and oils group had seven different food items, and 99.23% (n=129) of the participants consumed one to six food items and 0.77% (n=1) did not consume any food items from the fats and oils group. The dairy group consisted of five food items and 92.31% (n=120) of the participants consumed one to five food items and 7.69% (n=10) of the participants did not consume any dairy products. The food group with the least consumed food items was the legumes group with 50% (n=65) of the participants consuming legumes during the seven-day period. The vitamin A-rich fruit and vegetable group consisted of eight food items and 65.38% (n=85) of the participants consumed one to five food items and 34.61% (n=45) of the participants did not consume any food items from the group. A sizable (66.92%; n=87) number of non-sponsored participants consumed eggs and 33.08% (n=43) of the participants did not consume eggs (Table 4.14).

Table 4.15: Household food access for sponsored participants as measured by food variety within the food groups consumed over a period of seven days (n=130)

Meat Food Group (n=12)	**Egg Group (n=1)** **81**	**Dairy Group (n=5)**	**Cereal Group (n=10)**	**Legumes Group (n=5)**	**Vitamin A-Rich Fruit and Vegetable Group (n=8)** **92**	**Other Fruit and Juices (100%) Group (n=16)**	**Vegetable Group (n=12)**	**Fats and Oils Group (n=7)**	**Total Individual Food Items Eaten from all Groups (n=75)**
1=11	0=49	0=15	1=3	0=71	0=38	0=12	0=3	0=5	6-20=52
2=21	1=81	1=36	2=5	1=44	1=36	1=16	1=14	1=14	21-29=51
3=32		2=43	3=8	2=9	2=28	2=33	2=27	2=27	30-62=27
4=28		3=26	4=19	3=5	3=14	3=25	3=23	3=35	
5=24		4=7	5=37	5=1	4=6	4=16	4=19	4=29	
6=6		5=3	6=28		5=5	5=13	5=15	5=18	
7=5			7=22		6=2	6=4	6=13	6=2	
8=3			8=4		8=1	7=4	7=5		
			9=3			8=3	8=4		
			10=1			9=2	9=4		
						12=1	10=2		
						16=1	11=1		

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

Table 4.15 presents the food group variety consumed by sponsored participants. The FVS consisted of a count of single foods within the nine nutritional food groups. The FGDS indicates the number of food groups consumed over a period of seven days, as measured by the FFQ. In total, a maximum of 62 different individual food items were consumed within the seven-day period by any one participant. The total range of individual food items consumed by individuals during the seven-day data collection period was between 6 and 62 food items. The highest number of individual foods consumed by most of the non-sponsored participants was between 6 and 20 individual foods (40%; n=52), followed by 21 – 29 individual foods (39.23%; n=51). A minority (20.77%; n=27) consumed between 30 and 62 individual food items (Table 4.15).

The food groups with the most consumed food items were the cereal group and the meat food group. All (100%; n=130) of the sponsored participants consumed at least one to ten food items from the cereal group and one to eight food items from the meat food group. This was followed by the vegetable group where 97.69% (n=127) of the participants consumed one to eleven food items from the vegetable group and only 2.31% (n=3) of the participants did not consume any food item from the vegetable group. With regard to the fats and oils group, 96.15% (n=125) of the participants consumed one to six food items from the group. A minority (3.85%; n=5) did not consume any food items from the fats and oils group. Furthermore, 90.77% (n=118) of the participants consumed one to eight food items from the other fruit and juices group and 9.23% (n=12) of the participants did not consume any food item from the other fruit and juices group. Pertaining to the dairy group, 88.46% (n=115) of the participants consumed one to five food items and 11.54% (n=15) of the participants did not consume any dairy products (Table 4.15).

The food group with the least consumed food items was the legumes group with 54.62% (n=71) of the participants not consuming any legumes during the seven day period. Regarding the vitamin A-rich fruit and vegetable group, 70.77% (n=92) of the participants consumed one to eight food items and 29.23% (n=38) of the participants did not consume any food item from the group. A considerable number of non-sponsored participants (62.31%; n=81) consumed eggs and 37.96% (n=49) of the participants did not consume eggs (Table 4.15).

Table 4.16: Summary of Food Variety Score within the Food Groups (n=260)

FOOD GROUP	Non-Sponsored Sample (n=130) Mean ± SD	Range of Scores	Sponsored Sample (n=130) Mean ± SD	Range of Scores	p-value
Meat (meat, poultry, fish)	3.93 ± 1.605	0-9	3.66 ± 1.626	1-8	0.883
Eggs	0.67 ± 0.472	0-1	0.62 ± 0.486	0-1	0.737
Dairy products	2.12 ± 1.162	0-5	1.87 ± 1.164	0-5	0.981
Cereals, roots and tubers	5.54 ± 1.490	0-9	5.30 ± 1.664	1-10	0.210
Legumes and nuts	0.73 ± 0.930	0-5	0.63 ± 0.873	0-5	0.472
Vitamin A-rich fruit and vegetables	1.35 ± 1.370	0-5	1.56 ± 1.560	0-8	0.141
Other fruit and juices	3.13 ± 2.344	0-13	3.14 ± 2.439	0-16	0.652
Other vegetables	4.04 ± 2.277	0-12	3.85 ± 2.328	0-11	0.803
Fats and oils	3.12 ± 1.215	0-6	3.01 ± 1.384	0-6	0.142
Total food items	24.59 ± 7.810	0-52	23.64 ± 8.846	1-62	0.158
The range of scores indicates the range of individual food items consumed within each food group Pearson chi-squared test					

In Table 4.16 a summary of the food group variety is presented for the entire participants, divided into non-sponsored and sponsored groups. A mean ±SD of 24.59 (±7.810) was observed for the total food items consumed from all the food groups by non-sponsored participants and 23.64 (±8.846) by sponsored participants, over a period of seven days. This indicated a low food variety score which is achieved by consuming <30 total food items.

The other fruit and juices group was reported to have the highest ranging score for both non-sposored (0-13) and sponsored (0-16) participants. This was followed by other vegetables, with a mean FVS ±SD of 4.04 (±2.344) for non-sponsored participants and 3.85 (±2.328) for sponsored participants. Non-sponsored participants achieved a score of 0-9 for the cereal group and the sponsored participants achieved a score of 1-10, with a mean FVS ±SD of 5.54 (±1.490) for non-sponsored participants and 5.30 (±1.664) for sponsored participants. Non-sponsored participants achieved a score of 0-9 for the meat food group and the sponsored participants achieved a score of 1-8 with a mean FVS ±SD of 3.93 (±1.605) for non-sponsored participants and 3.66 (±1.626) for sponsored participants. Non-sponsored participants achieved a score of 0-5 for the vitamin A-rich fruit and vegetables group and the sponsored participants achieved a score of 0-8 with a mean FVS ±SD of 1.35 (±1.370) for non-sponsored participants and 1.56 (±1.560) for sponsored participants (Table 4.16).

Both non-sponsored and sponsored participants achieved a score of 0-6 for the fats and oils group with a mean FVS ±SD of 3.12 (±1.215) for non-sponsored participants and 3.01 (±1.384) for sponsored participants. Both non-sponsored and sponsored participants achieved a score of 0-5 for the dairy products group with a mean FVS ±SD of 2.12 (±1.162) for non-sponsored

participants and 1.87 (±1.164) for sponsored participants. Both non-sponsored and sponsored participants achieved a score of 0-5 for the legumes and nuts group with a mean FVS ±SD of 0.73 (±0.930) for non-sponsored participants and 0.63 (±0.873) for sponsored participants. A mean FVS ±SD of 0.67 (±0.472) for non-sponsored participants and 0.62 (±0.486) for sponsored participants was reported for the eggs group (Table 4.16).

Table 4.17: Summary of Food Group Diversity (n=260)

Number of food groups consumed (n=9)	**Non-Sponsored Sample (n=130)**		**Sponsored Sample (n=130)**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
0-3	1	0.77	0	0
4 to 5	3	2.31	6	4.62
6 to 9	126	96.92	124	95.38
TOTAL	130	100	130	100.00

In Table 4.17 the majority of the non-sponsored (96.92%; n=126) and sponsored (95.38%; n=124) participants attained a high dietary diversity score (DDS) for FGD, as the participants consumed food from six to nine different food groups. This was followed by a medium DDS attained by 2.31% (n=3) of non-sponsored and 4.62% (n=6) of sponsored participants, who consumed food from four to five different food groups. The lowest dietary diversity score was attained by 0.77% (n=10) of the non-sponsored participants who consumed food from zero to three different food groups. However, 25.38% (n=33) of the non-sponsored participants and 20% (n=26) of the sponsored participants consumed all the nine food groups during the seven-day data collection period. It is important to consider that even though the mean food variety score for both non-sponsored (24.59) and sponsored participants (23.64) was low (Table 4.17), the DDS was high with a consumption of foods from six to nine food groups by the majority of the non-sponsored and sponsored participants.

Table 4.18: Pearson partial correlations* for clinical risk markers

Variable		WC	SBP	DBP	FBG	TSC	Trig	BMI
WC	Total		0.170*	0.099	0.169*	-0.002	0.058	0.870*
	Non-sponsored		0.253*	0.002	0.108	0.012	0.027	0.864*
	Sponsored		0.068	0.216*	0.251*	-0.054	0.105	0.878*
SBP	Total	0.170*		0.604*	0.090	-0.001	-0.121	-0.159*
	Non-sponsored	0.253*		0.626*	0.098	-0.101	-0.173	-0.207*
	Sponsored	0.068		0.595*	0.056	0.075	-0.073	-0.102
DBP	Total	0.099	0.604*		-0.061	-0.063	0.079	-0.030
	Non-sponsored	0.002	0.626*		0.001	-0.011	0.113	-0.005
	Sponsored	0.216*	0.595*		-0.122	-0.063	0.034	-0.084
FBG	Total	0.169*	0.090	-0.061		0.330*	0.213*	-0.115
	Non-sponsored	0.108	0.098	0.001		0.128*	0.225*	-0.049
	Sponsored	0.251*	0.056	-0.122		0.466*	0.165	-0.206*
TSC	Total	-0.002	-0.001	-0.063	0.330*		0.107	-0.035
	Non-sponsored	0.012	-0.101	-0.011	0.182*		-0.003	-0.066
	Sponsored	-0.054	0.075	-0.063	0.466*		0.175	0.028
Trig	Total	0.058	-0.121	0.079	0.213*	0.107		-0.023
	Non-sponsored	0.027	-0.173	0.113	0.225*	-0.003		-0.021
	Sponsored	0.105	-0.071	0.034	0.165	0.175		0.042
BMI	Total	0.870*	0.159*	-0.030	-0.115	-0.035	-0.023	
	Non-sponsored	0.864*	-0.207	0.005	0.049	-0.066	-0.021	
	Sponsored	0.878*	-0.102	-0.084	-0.206	0.028	-0.042	

***Significant at p<0.05**
WC = waist circumference; SBP = systolic blood pressure, DBP = diastolic blood pressure; FBG = fasting blood glucose; TSC = total serum cholesterol; Trig = triglycerides; BMI = body mass index

Table 4.18 presents the Pearson partial correlation analysis between clinical risk markers for the total sample, non-sponsored participants and sponsored participants. Significant correlations were found between the WC and BMI of the total sample (p=0.870), the non-sponsored participants (p=0.864) and the sponsored participants (p=0.878). There were also significant correlations between the WC and SBP for the total sample (p=0.170) and the non-sponsored participants (p=0.253) as well as the WC and DBP of sponsored participants (p=0.216). Significant correlations were also found between the SBP and DPB of the total sample (p=0.604), the non-sponsored (p=0.626) participants and the sponsored participants (p=0.595). Moreover, there were significant correlations between the SBP and WC of the total sample (p=0.170) and the non-sponsored participants (p=0.253). In addition to the significant correlation when compared to the SBP of all groups, there was a significant correlation between the DBP and WC for the sponsored participants (p=0.216) only.

Significant correlations were found between the glucose and cholesterol levels of all three groups (p=0.330 for the total sample, p=0.128 for the non-sponsored group and p=0.466 for the sponsored group). Significant correlations were found between the glucose and WC of the total sample (p=0.169) and sponsored participants (p=0.251) as well as the FBG and

triglycerides of the total sample (p=0.213) and non-sponsored participants (p=0.225). In addition to the significant correlation when compared to the WC of all groups, there was a significant correlation between the BMI and SBP of the total sample (p=0.159) only. Triglycerides had the fewest significant correlations with other clinical risk markers, as 43.85% of non-sponsored participants and 38.46% of the sponsored participants had raised blood triglyceride levels (Figure 4.4).

Table 4.19: Pearson partial correlations* between reported energy and nutrient intakes and clinical risk markers for the entire non-sponsored and sponsored sample (n=260)

Variable		WC	SPB	DBP	FBG	TSC	Trig	BMI
Energy (kJ)	Non-sponsored	-0.031	0.120	-0.089	-0.066	0.156	-0.027	-0.088
	Sponsored	0.120	0.267*	-0.048	-0.060	0.101	0.075	-0.122
Total protein (g)	Non-sponsored	-0.004	0.151	-0.133	0.051	0.111	-0.002	-0.104
	Sponsored	0.127	0.302*	-0.088	0.011	0.107	-0.014	-0.030
Total fat (g)	Non-sponsored	-0.036	0.040	-0.036	-0.162	0.205*	-0.009	-0.050
	Sponsored	0.097	0.199*	-0.006	-0.077	0.101	0.069	-0.080
Carbohydrates (g)	Non-sponsored	-0.034	0.115	-0.071	0.002	0.077	-0.039	-0.078
	Sponsored	0.119	0.224*	-0.043	-0.068	0.078	0.112	-0.176
Dietary fibre (g)	Non-sponsored	-0.051	0.255*	-0.204*	-0.074	0.135	-0.043	-0.027
	Sponsored	-0.029	0.240*	-0.081	0.023	-0.003	-0.030	0.001
***Significant at p<0.05** **WC = waist circumference; SBP = systolic blood pressure. DBP = diastolic blood pressure; FBG = fasting blood glucose; TSC = total serum cholesterol; Trig = triglycerides; BMI = body mass index**								

Table 4.19 presents the results of the association of energy and nutrients with clinical risk markers for the entire sample. The results were categorised between non-sponsored participants and sponsored participants. SBP showed the most significant association with all the variables for the sponsored participants (p=0.267 for energy; p=0.302 for protein; p=0.199 for total fat; p=0.224 for carbohydrates; p=0.240 for dietary fibre). A significant association was shown between the SBP and dietary fiber intake, as well as the DPB and dietary fibre intake of non-sponsored participants (p=0.255). There was also a significant association found between the TSC and the total fat intake of non-sponsored participants (p=0.205) as more (4.62%) non-sponsored participants than sponsored participants (3.85) had raised TSC levels (Figure 4.4).

Table 4.20: Pearson partial correlations* between reported energy and nutrient intakes and clinical risk markers for non-sponsored and sponsored male participants (n=137)

Variable		WC	SPB	DBP	FBG	TSC	Trig	BMI
Energy (kJ)	Non-sponsored	0.021	0.165	-0.142	-0.126	0.110	0.035	-0.163
	Sponsored	0.063	0.404*	-0.223	-0.184	0.056	0.225	-0.018
Total protein (g)	Non-sponsored	0.022	0.220	-0.185	0.075	0.002	0.036	-0.072
	Sponsored	0.037	0.461*	-0.289	-0.100	0.145	0.021	0.158
Total fat (g)	Non-sponsored	-0.018	0.154	-0.049	-0.161	0.186	-0.052	-0.078
	Sponsored	0.044	0.364*	-0.180	-0.198	0.080	0.176	0.023
Carbohydrate (g)	Non-sponsored	0.017	0.107	-0.130	-0.111	0.038	0.086	-0.186
	Sponsored	0.093	0.303*	-0.164	-0.164	-0.001	0.273*	-0.136
Dietary fibre (g)	Non-sponsored	-0.047	0.227	-0.290	-0.054	0.131	0.038	-0.028
	Sponsored	-0.058	0.314*	-0.197	0.010	0.068	-0.082	0.099

Table 4.20 presents the results of the association of energy and nutrients with clinical risk markers for non-sponsored male participants and sponsored male participants. Within this group, SBP also showed the most significant association with all variables for the sponsored male participants (p=0.404 for energy; p=0.461 for protein; p=0.364 for total fat; p=0.303 for carbohydrates; p=0.314 for dietary fibre). There was also a significant association found between the triglycerides and carbohydrates intake of sponsored male participants (p=0.273).

Table 4.21: Pearson partial correlations* between reported energy and nutrient intakes and clinical risk markers for non-sponsored and sponsored female participants (n=123)

Variable		WC	SPB	DBP	FBG	TSC	Trig	BMI
Energy (kJ)	Non-sponsored	-0.041	0.057	-0.031	-0.006	0.178	-0.106	-0.069
	Sponsored	0.170	-0.360	0.305*	0.055	0.106	-0.085	-0.177
Total protein (g)	Non-sponsored	-0.046	0.056	-0.039	0.073	0.164	-0.048	-0.104
	Sponsored	0.270	-0.267	0.265	0.127	-0.010	-0.089	-0.205
Total fat (g)	Non-sponsored	0.017	0.076	-0.044	-0.191	0.140	-0.046	-0.128
	Sponsored	0.210	-0.358	0.336*	0.060	0.081	-0.078	-0.213
Carbohydrate (g)	Non-sponsored	-0.067	0.007	0.006	0.139	0.161	-0.144	0.004
	Sponsored	0.050	-0.293	0.211	0.006	0.140	-0.025	-0.100
Dietary fibre (g)	Non-sponsored	-0.098	0.096	-0.075	-0.073	0.178	-0.095	0.046
	Sponsored	-0.099	-0.098	0.073	-0.023	-0.165	0.022	0.042

Tables 4.21 presents the results of the association of energy and nutrients with clinical risk markers for non-sponsored female participants and sponsored female participants. A significant association was found between the DBP and the energy intake of sponsored female participants (p=0.305) and also between the DBP and total fat intake of sponsored participants (p=0.336).

4.3 DISCUSSION OF RESULTS

Further discussions of the results are presented in line with the hypotheses.

4.3.1 Hypothesis One

It was hypothesised that the dietary practices of university students are influenced by socio-demographic factors such as gender and socio-economic status. In support of this hypothesis, Sorden (2017: 6) explained that food selection and health behaviour motivation tend to vary among genders, ethnicities, and social groups. Therefore, data collection was conducted to establish the demographic profile of the study participants by administering socio-demographic questionnaires. With regard to the hypothesis, the difference between the non-sponsored and sponsored participants was quite significant when comparing where food was frequently purchased. There is a multifaceted interaction of personal aspects and environmental aspects, which influence students' dietary practices and weight. University students are known to decide on food items based on taste, time schedule, convenience, budget and physical or social environments (Horacek *et al.* 2012: 1186). Table 4.4 indicated that most (97.69%; n=127) non-sponsored participants and 91.54% (n=119) of the sponsored students often purchase their food at the supermarket while the minority comprising of 2.31% (n=3) of the non-sponsored participants and 8.46% (n=11) of the sponsored participants purchased their food from the DUT campus food court. According to Steyn *et al.* (2012: 230), it is due to the fact that a large percentage of the population do not have access to land in South Africa, and therefore, people have to rely on foods bought from supermarkets, street vendors, tuck shops and fast food outlets.

A number of studies have also underlined gender as a crucial aspect in different food selections made by university students. According to Nani (2016: 17) a certain study on university students indicated that males were less likely to consider information written on food labels and were less concerned about their food choices than their female counterparts. Furthermore, Sommer (2013: 8) also agreed that social background and cultural practices are dominant stimuli affecting an individual's dietary practices. It has been said that cultural background is possibly the best indicator for the adoption of food preferences, as it tends to determine what food item will end up on one's plate and when it will appear.

As stated by Abraham, Noriega and Shin (2018: 13), a large number of undergraduate students purchased food from the campus food-court vendors and they ate most meals at the university dining facilities, which together, offer only limited healthy food options. Most meals offered

at the DUT campus food court are high in fat and sugar, and this could explain why sponsored male participants recorded a higher total fat intake than the non-sponsored males, with a total of 38.72 g recorded by non-sponsored participants and 51.58 g recorded by sponsored participants. In contrast, non-sponsored female participants recorded a higher total fat intake than the sponsored males with a total of 46.91 g recorded by non-sponsored participants and 39.69 g recorded by sponsored participants. Previous research on South African university students shows that students are often physically inactive and consume a diet that is low in fruit and vegetables and high in added sugar and fat (van den Berg *et al.* 2012: 4); (van den Berg *et al.* 2013: 457). According to Deliens *et al.* 2014 (cited in Nakhooda and Wiles 2018: 1), there are many internal and external factors that affect the dietary and lifestyle habits of university students.

University food environments can either endorse or impede a healthy diet (Abraham, Noriega and Shin (2018: 14). Most students also lack knowledge about purchasing healthy food as they are now in a different environment compared to where they may have come from (van den Berg *et al.* 2012: 4). Previous research indicated that female students living in university residences gained more weight due to on-site dining during their first academic year compared to their counterparts with access to off-site dining (Horacek *et al.* 2012: 1187). It was further stated that first year students living on campus were found to gain more weight than students who lived at home. A review of the nutrition transition within the South African black community indicated that even though diets met practical dietary guidelines, there was a general trend for an increase in fat intake in urban areas (Goedecke and Jennings 2005: 548).

A solid upturn in the per capita food supply of fat, protein, and total energy in SA has been noted and the consumption of salt appears to be over the recommended levels. Such modifications in nutrient consumption appear to be aligned to changes in dietary practices. According to Igumbor *et al.* (2012: e1001253), a study on adults in the North-West Province indicated a shift with increasing wealth from a customary high carbohydrate–low fat diet to higher fat intake and a diet in which staple foods were substituted by red meat and other cereal foods. Carbohydrate intake in this study was high for both non-sponsored (177.88 g) and sponsored (196.36 g) male participants. These results indicated that sponsored male participants had a higher intake of carbohydrates than non-sponsored male participants did. Carbohydrate intake was also high for both non-sponsored (164.68 g) and sponsored female participants (143.38 g), thus indicating that non-sponsored female participants consumed more

carbohydrates than sponsored female participants. The EAR for carbohydrates for both males and females is recommended at 100 g. It is no surprise that the carbohydrate intake was very high for both male and female participants as the main source of food for both the male and female groups was from the cereal food group.

The most popular food item was bread for both males and females. Students preferred to eat bread most of the time as it was readily available, and sandwiches could be ready in a matter of minutes. Table 4.10 indicated that the male group consumed a substantial amount of cereals. Bread was on top of the list with a mean intake of 5776.67 g for non-sponsored males and 9951.67g for sponsored males. The frequency of intake of bread in one day was 35 for non-sponsored male participants and 65 for the sponsored male participants. Results from a previous study (van den Berg *et al.* 2012: 4) indicated that bread was also found to be popular among university students as 55.9% of the participants consumed bread on a daily basis. Bread was followed by rice, as non-sponsored males had a mean intake of 3303.33 g and sponsored males had a mean intake of 3709.33. The frequency of intake of rice in one day was 29 for non-sponsored male participants and 34 for the sponsored male participants. The mean intake for maize meal was 4456.67 g for non-sponsored males and 4761.67 g for sponsored males. The frequency intake of maize meal in one day was 29 for non-sponsored male participants and 32 for the sponsored male participants. Results suggested that sponsored male participants had a higher intake of food items from the cereal group than their non-sponsored counterparts did. Results from a study conducted by Ndlovu (2016: 114) indicated that maize meal, bread, and rice were the most frequently consumed food items on the list of top twenty foods consumed by male students in Durban. The frequency intake for these three food items in one day was 89, 88, and 74 respectively. These results are similar to the results of the current study and are only higher because the male participants were not divided into two groups as in the current study.

Table 4.11 indicated that the female participants also consumed a substantial amount of cereals as well as foods high in sugar. Bread was the most frequently consumed food item with a mean intake of 5713.33 g for non-sponsored females and 4593.33 g for sponsored females. The frequency intake of bread in one day was 51 for the non-sponsored female participants and 39 for the sponsored female participants. Rice (2581.67 g for non-sponsored females, with the frequency intake being 26 and 1198.33 g for sponsored females, with the frequency intake being 14). Maize meal (2725 g for non-sponsored females, with the frequency intake being 20 and 1713.33 g for sponsored females, with the frequency intake being 15). Corn flakes (739 g

for non-sponsored females with the frequency intake being 17 and 366.67 g for sponsored females with the frequency intake being 10) appeared at fifth, sixth, and tenth respectively. These results indicated that non-sponsored female participants had a higher intake of food items from the cereal group than their sponsored counterparts did. Similar results were also noted from a study conducted by Ndlovu (2016: 117) indicated that bread and rice were the most frequently consumed food items on the list of top twenty foods, consumed by first generation female students in Durban. The frequency of intake for bread in one day was 168 and it was 141 for rice. These results are similar to the results for the current study, and are only higher because the female participants were not divided into two groups as in the current study. A study conducted by van den Berg *et al.* (2012: 4) on nursing university students also indicated that 68.3% of the participants reported that they consumed margarine, oil or fat, 59.0% reported that they consume sugar and 55.9% reported that they consume bread on a daily basis.

Abraham, Noriega and Shin (2018: 14) agreed that several unhealthy dietary practices and eating habits have been observed among university students in a number of recent studies. An experimental study was conducted on a university campus where vending machine sales were observed. Results from this experiment indicated that most university students tended to select food items according to price, convenience, taste and time rather than the item's nutritional value. Most university students will choose quick and tasty food options, which are usually available from the vendors and stores on the campus food court. The living situations of university students have also been perceived to affect nutritional intake. Results from this study indicated that 94.62% (n=123) of sponsored participants and 91.54% (n=119) non-sponsored participants resided in DUT residences within the urban setting of Durban. In practice, this would have meant that more sponsored participants would have higher energy intakes. A previous study also found that there was no significant difference between the distributions of students according to their place of residence. Results indicated that a significant proportion of Black African students reported living in a residence on campus (Nakhooda and Wiles 2018: 3).

Table 4.8 indicated that non-sponsored males had a mean energy intake of 5485.13 kJ whilst sponsored males had a mean energy intake of 6414.22 kJ. This may be because students living off campus are more likely to purchase food items from fast food restaurants to meet their dietary needs. Similar results were also observed in a study conducted by Ndlovu (2016: 111), which indicated that first generation male students had a mean energy intake of 7245.75 kJ and non-first generation male students recorded a mean energy intake of 8230.44 kJ. Nevertheless,

the results suggest severe under-reporting as the energy intake of both groups did not meet the recommended intake, yet the participants were found to consume fat and energy-dense food items within their daily lives. As stated by Nyangweso 2009 (cited in Steyn *et al.* 2012: 229), many people in developing countries, including SA at a household and individual level, are exposed to food insecurity due to a diet that is low in energy and essential nutrients. One of the major causes of this is the consumption of a diet with limited diversity.

The EER for energy in this group was recommended at 12 881 kJ. The EER for energy in the female group was recommended at 10 093 kJ; however, the non-sponsored females had a mean intake of 5501.29 kJ, whilst the sponsored females had a mean intake of 4786.38kJ. Similar results were also observed in a study conducted by Ndlovu (2016: 112), which indicated that first generation female students had a mean energy intake of 6642.14 kJ and non-first generation female students recorded a mean energy intake of 6676.10 kJ. These results suggest a high instance of under-reporting, which could be due to inaccurate portion sizes and skipping breakfast. Similar results were seen on a previous study (Nakhooda and Wiles 2018: 2) conducted on university students where the mean added sugar and dietary energy intake from the 24-hour food recall was 56.8 g and 6 796.0 kJ, respectively. It was further reported that on average, added sugars contributed 14.2% to the total energy intake (Nakhooda and Wiles 2018: 2). With limited funds, the amount of food consumed may have also been limited and hence the low intake reflects the budget that participants had available. This could also be due to failure to remember the variety and amounts of food consumed, withholding or modifying information by the participants, incorrect size estimation, or lengthy questionnaire administration, which may also have caused participants to be irritable and impatient. Horacek *et al.* (2012: 1186) stated that the lack of knowledge when it comes to portion size might create problems.

Results pertaining to food expenditure indicated that the majority of the participants, comprising of 62.31% (n=81) of non-sponsored participants and 58.46% (n=76) of sponsored participants spent R 401.00 to R 800.00 on food per month. It was further found that 25.38% (n=33) of non-sponsored participants and 20.77% (n=27) of sponsored participants spent an amount ranging between R 0.00 to R 400.00 per month to purchase food. Results also indicated that 1.54% (n=2) of non-sponsored participants and 6.92% (n=9) of sponsored participants spent an amount greater that R 1200.00 to purchase food on a monthly basis. A study conducted by Job (2014: 44) revealed that the mean amount of monthly food expenditure was R558.40 ± R211.12 and therefore suggested that the monthly food expenditure did not affect the students'

food security status. Van den Berg and Raubenheimer (2015: 163) stated that 26% of the students reported that they always had enough money for food and 7% reported that they never had enough money for food were almost all food insecure. It was further indicated that most (87%) students reported that they borrowed money for food from friends, relatives (16%) or parents (14%). More than 50% of the students reported that they asked someone else for food, 9% reported that they had had to sell some of their possessions to procure food money, and 2% that they had stolen food. Importantly, most of these students were severely food insecure.

It has been said most African university students based in countries such as SA, students are suffering from hunger, starvation, malnutrition and-or fear of facing food shortages (Sawahel 2018). With regards to a study previously conducted by Van Zyl, Steyn and Marias (2010: 125) on university students, approximately half of the participants earned less than R5 000 per month however, they spent at least R200 a month on fast foods. Twenty-eight percent consumed fast foods two to three times a month. They found that the most popular food items were burgers, pizza, and fried chicken, while soft drinks were the most common beverage consumed.

Moreover, 16.15% (n=21) of non-sponsored participants and 12.31% (n=16) of sponsored participants consumed more than three meals a day. This could be an indication that more non-sponsored participants than sponsored students frequently felt hungry therefore having to eat more often as the meals that they were having did not provide long enough periods of satiety. Research conducted by Barzegari *et al.* (2011:1012) indicated that most of the students (83.6%) ate three meals a day on a regular basis and there was no difference between males and females. Even though 85.6% of the participants in this study reported being familiar with the importance of consuming balanced, nutritious foods, only 7% of the participants practised this concept in their diet. Similar results were seen from a recent study (van den Berg *et al.* 2012: 4), where most (59%) of the participants consumed three meals a day and 23.6% reported eating fewer than three meals per day.

According to Sorden (2017: 9), living arrangements also influence students' health and eating behaviours. Previous research showed that students who lived in private accommodation such as communes and flats were more likely to be overweight or obese than those who lived on campus or with parents. Table 4.4 indicated that 12.31% (n=16) of non-sponsored participants and 5.38% (n=7) of sponsored participants ate most of their meals at home, whilst 1.54% (n=2) of the non-sponsored participants and 3.85% (n=5) of the sponsored participants ate most of their meals at the DUT campus food court. A study conducted by Horacek *et al.* (2012: 1193)

revealed that on-campus dining places offered healthier food options than off-campus places; nevertheless, differences were observed in the on-campus dining environment according to institution size.

The dietary patterns of university students are usually affected by their workload, an erratic schedule, and varying sleeping patterns. Due to this, quite a number of university students develop a pattern of mindless snacking during the course of the day to shortly satisfy their desire for food. Nani (2016: 16) stated that students purchase snack items from on-campus vendors and convenience stores due to the need for convenience, and the desire to save time. This may be a causal factor for the consumption of unhealthy food items generally seen among university students. Several university students regarded the need to remain energised, motivated and in good shape as a reason for choosing to keep healthy, and would therefore consume an increased amount of energy drinks (Nani 2016: 16).

4.3.2 Hypothesis Two

It was hypothesised that sponsored students were more food secure compared to their non-sponsored counterparts and would thus have more access to fat and energy-dense fast food items. Therefore, it could be said that sponsored students consume more unhealthy foods than non-sponsored students do. Data was collected to determine the participants' food security status by administering socio-demographic questionnaires. Data was also collected to determine the diversity and nutritional adequacy of food consumed by getting the students to complete three 24HRs; and the diversity of the participants' diets could be determined by getting them to complete FFQs.

The study results partially supported the hypothesis as it was found that a high number of sponsored participants (86.92%; n=113) stated that they either seldom or never had the problem of not having enough money to buy food, when compared to non-sponsored participants (70.77%; n=92). Furthermore, only 5.38% (n=7) of the sponsored participants and 12.31% (n=16) of the non-sponsored participants stated that they either always or often had a problem of not having enough money to buy food. The difference between the two groups was significant (p=0.006). According to Durojaye 2013 (cited in Sawahel 2018), many would agree that the problem in SA is pervasive however, research to quantify the extent of food insecurity at is inadequate. Data to assess vulnerability to food insecurity from a sample of 1,083 students at the University of KwaZulu-Natal found that 20.8% of the students were vulnerable to food insecurity, 16.1% reported serious levels of vulnerability, and 4.7% experienced severe to

critical levels of vulnerability to food insecurity. Previous research (van den Berg and 2015: 163) on food insecurity among students at UFS revealed that 65% of the students were identified as food insecure. A more sensitive, multi-item measure that was used identified food insecurity "without hunger" in 25%, and food insecurity "with hunger" in 59%, of the students. Van den Berg and Raubenheimer (2015: 163) found that students who were studying while employed experienced much lower food insecurity (46%) than sponsored students. Which was 61% food insecurity for merit bursaries, and 71% food insecurity for other bursaries and loans (81% food insecurity), paying for themselves (66% food insecurity), or having the financial backing of family or benefactors (61% and 68% food insecurity, respectively).

It is said that food insecure university students are a fast-growing problem in SA and this is a crafty situation due to the stigma that has been attached to being hungry, especially amongst university students. It seems that there quite a lot of students facing hunger, but are not coming forward (Sawahel 2018). Students funded by the NSFAS receive some of their bursary funds in the form of vouchers, which are sent to their mobile phones. These are called sBux vouchers, which are redeemable only at registered merchants usually situated within the campus food court, or within walking distance to the university campus. To corroborate that sponsored students usually do not have enough money to sustain themselves, research revealed that students who needed quick cash or wanted to buy items not available at sBux merchants, resorted to selling their sBux vouchers to other students for cash, usually at a discount (Badenhorst 2018). In respect of the results opposing the abovementioned hypothesis, a study conducted by Job (2014: 44) revealed that only 22% of students on financial aid were food secure and the majority (78%) were either food insecure, severely food insecure or at risk of being food insecure. Kassier and Veldman (2013: 250) further stated that the poor nutrition that is experienced by the student population, which is considered food insecure, is due to an inadequate diet that lacks diversity and is of a poor quality.

According to Sorden (2017: 1), researchers have stated that the university-campus food environment is heavily populated with inexpensive, appetising, large-portioned items, which are high in kilojoules. Such environmental settings obviously contribute to unhealthy eating behaviours and ultimately over-nutrition during this vulnerable time in young adult lives. On the note that sponsored students consume healthier food items than non-sponsored participants, results from the top ten frequently consumed food items by males indicated that the non-sponsored group of males consumed more (8013.33 g) diluted cold drink per day, than the sponsored group of males (6080.00 g). The frequency of intake of diluted cold drink in one day

was 28 for non-sponsored male participants and 21 for the sponsored male participants. However, results also indicated that non-sponsored male participants consumed less (6328.33g) carbonated cold drink than the sponsored group of males (9991.67g). The frequency of intake of carbonated cold drink in one day was 15 for non-sponsored male participants and 28 for the sponsored male participants. Similar findings were seen on a very recent study conducted by Nakhooda and Wiles (2018: 4), where carbonated soft drinks were most frequently consumed by the students, and of those that consumed these beverages, 29.5% consumed carbonated soft drinks on a weekly basis. These two food items were also observed from a list of top 20 frequently consumed food items by male students in a study conducted by Ndlovu (2016: 114). Carbonated cold drink ranked sixth on the list with the frequency of intake per day being 51. Diluted cold drink ranked seventh on the list with the frequency of intake per day being 48. This shows that university students in SA have similar food preferences and this could be due to what is made available to them. As stated by Nielsen, Siega-Riz and Popkin 2002 (cited in Van Zyl, Steyn and Marias 2010: 124), there are two age groups that seem to have undergone the most dramatic changes in eating habits over the past years. These are adolescents, which are aged between 12 and 18 years, and young adults aged 19 to 29 years.

Igumbor *et al.* (2012: e1001253) stated that in 2010, up to 50% of young individuals consumed fast foods, carbonated cold drinks and confectionaries at least four days a week. Carbonated cold drinks at that time were the third most frequently consumed foodstuff among South Africans including urban children (aged between one and two years), which was less than staple food and brewed tea but more than milk. A study conducted by Price *et al.* (2018: 212) revealed that an intake of more than an amount of six teaspoons of sugar per day in sweetened beverages was popular among male participants with a rural background. It was further stated that more than half of the individuals from both urban and rural areas resided in a household where each individual's consumption of salt that was used during the preparation of meals or added at the table exceeded 5 g per day. Similarly, a recent study conducted among 17 year olds in the Birth to Twenty cohort in Soweto and Johannesburg found that 30% of the participants consumed fast foods five to seven times a week with another 20% having it two to four times a week (Steyn *et al* 2011: 2). This confirms that there has been a shift in diet, with fat and saturated fat, added sugar, and sodium increasing with urbanisation; while fibre intake decreases (Satia 2010 (cited in Steyn *et al.* 2012: 229).

As stated by Horacek *et al.* (2012: 1186), and has been repeatedly emphasised, the dietary practices of university students are generally poor and unhealthy, and nutritious meals are often

not a high priority for these students. As mentioned in the discussion following Hypothesis one, university students select foods based on taste, time, convenience, cost, the environment, and some for health or weight control reasons. Obesogenic environmental influences such as an abundance of large-portioned and generally inexpensive unhealthy food items increases the chances of weight gain among students. According to Sorden (2017: 5), the typical university student consumed foods that are high in sugar, salt, and fat but low in valuable nutrients. It is true that dining environments on campus can either endorse or inhibit healthy eating and weight control plans adopted by young adults. Research by Nani (2016: 19) revealed that female students living in university residences with access to campus dining gained more weight during their first year, than their counterparts who did not have an on-campus dining experience. It was further stated that first year students living on campus gained more weight than students who were commuting from home (Nani 2016: 19).

In a study conducted by El Hakeem *et al.* (2015: 1319), it was found that the frequency of drinking carbonated beverages three or more times per week was reported by 38.3% of university students. The prevalence of fast food consumption three or more times in a week was reported by 41.3% students and 50% reported consuming fast foods once or twice a week. Furthermore, only 0.4% of the students reported never eating snacks. It is worth mentioning that the majority (84.8%) of the student population reported eating snacks three or more times per week. Even though this study was not conducted in SA, among black university students, it shows that university students around the world may not eat exactly the same way, but they have similar preferences and practices when it comes to fast foods. Horacek *et al.* (2012: 1186) made a good example by indicating that only one in twenty students ate the recommended five or more daily servings of fruit and vegetables. It is further indicated that an unhealthy diet was negatively correlated with the weight status of university students, with more than 30% of these individuals being overweight or obese. In the current study, it was found that non-sponsored male participants consumed less (261.33 g) processed meat than the sponsored group of males who consumed 285.00 g. Nonetheless, a very important factor to be considered is that the number of sponsored male participants (n=79) was higher than the number of non-sponsored male participants (n=60). This could be the reason for the amount of processed meat consumed is higher. Research conducted in SA has shown that a large proportion of urban Black South African adolescents consume fast food items, most days of the week, which may contribute to more than 50% of their daily energy intake (Pradeilles, Rousham and Griffiths 2016). The three most common fast food items consumed were sandwiches that were composed of a quarter loaf

of white bread, fried chips, processed cheese and sausages, a fried egg and sauces); chips and a traditional South African fried dough bread. It is therefore evident that adolescents tend to choose local fast food products, which are high in energy instead of food prepared at home, thus leading to a poor-quality diet.

According to Nani (2016: 13), several studies indicated that university students consumed fat and energy-dense food items. An increase in the consumption of alcohol was also evident and this therefore directly contributed to an elevation in overall energy intake, which was associated with a greater consumption of unhealthy food items. A recent study (van den Berg *et al.* 2012: 4) on university nursing students also showed that more than nine out of ten participants did not meet the minimum daily requirements for vegetables (97.5%) and 42.2% did not consume the minimum recommended amount of fruit. Results further suggested that university students found the consumption of fruit and vegetables to be quite unusual. The entire sample did not consume much fruit and vegetables. The overall frequency of fruit and vegetable consumption was very low and the portion size of the fruit and vegetables by both non-sponsored and sponsored males was too small, at 90.41 g for non-sponsored males and 72.18 g for sponsored males. Results from a recent study (van den Berg *et al.* 2012: 7) revealed that Black university students reported low intakes of fruit, vegetables, and dairy. This was one of the characteristics of the nutritional transition reported by numerous studies amongst urbanised Black South African communities (Bourne, Lambert and Steyn 2002: 159), (Steyn *et al.* 2006: 271), (van den Berg *et al.* 2012: 4) (van den Berg *et al.* 2013: 447).

Nani (2016: 13) stated that although a number of research studies found an increase in fruit and vegetables consumption, the quantity consumed was still below the recommended amount of five servings per day. University student's diets have also been found to contain very little variety, which may lead to significant nutrient deficiencies. The overall frequency of fruit and vegetables consumption was also far too low for both non-sponsored and sponsored females, at 69.56 g for non-sponsored females and 61.29 g for sponsored females. This indicates that the amount consumed by both groups did not meet the recommended intake of at least 400 g, or five or more fruit or vegetables items, a day. Even though the participants in this study did not consume enough fruit and vegetables, it is important to note that male participants consumed more fruit and vegetables than their female counterparts did. This was no surprise as the females tend to have a high preference for sugar and fat (Bennett, Peters and Woodward 2018: 3) and (Hallam *et al.* 2016: 163). Another study conducted by Sorden (2017: 7), found that male participants consumed more fruit, vegetables, fiber, fat and fast food compared to

their female counterparts. However, the females were more likely to read nutrition facts on labels and consider the energy content before choosing what to buy, and ate breakfast more consistently compared to the males (Sorden 2017: 7).

As stated previously, results from the top ten food items frequently consumed by the female students indicated that the non-sponsored female participants consumed more (12793.33 g) diluted cold drink than the sponsored female participants (4491.67g). The frequency of intake for diluted cold drink in one day was 47 for non-sponsored female participants and a rather low 14 for sponsored female students. It was also found that the non-sponsored female participants consumed more (786.83 g) savoury snacks and potato crisps than the sponsored female participants (390.17 g). The frequency of intake for savoury snacks and potato crisps in one day was 19 for non-sponsored female participants and ten (10) for sponsored female students. Conversely, these results then disprove the hypothesis that sponsored students consume more unhealthy foods than non-sponsored students do; in fact, the results prove otherwise.

It is evident that the typical diet of university students consists of foods that are high in sugar, fat and salt. Such findings further suggest that the diets of university students are lacking in fruit and vegetables, which, along with their other detrimental eating habits, may affect their health status in the future. Such dietary practices could be linked to undesirable future illnesses such as overweight and obesity, diabetes mellitus, hypertension, CVD, hyperlipidaemia and other NCDs. It is important to note that university students also have an assortment of alternatives apart from the on- and off-campus dining halls from which to choose such as food courts, snack bars, franchises, vendors, and stores. Even though there are grocery stores near DUT campuses as well as the university's own dining hall, which provides a wide variety of healthy alternatives as well as convenience stores near the campus, students still opt to get food from the campus vendors and fast food stores that provide only a few or no healthful foods.

4.3.3 Hypothesis Three

It was hypothesised that sponsored students would possess higher clinical risk markers of lifestyle diseases than non-sponsored students. These clinical risk markers include overweight/obesity, elevated blood glucose levels, abnormal blood lipid levels, and high blood pressure. Cut-off points for clinical parameters used in this study were defined in Chapter 3. Overweight/obesity was defined as a BMI ≥25 kg/m² and abdominal obesity was defined as a

WC ≥94 cm for males and ≥80 cm for females. Hypertension was defined as SBP ≥130 mmHg or DBP ≥85 mmHg and impaired fasting blood glucose was defined as blood glucose ≥5.6 mmol/L. Hypertriglyceridemia was defined as triglycerides >1.7 mmol/L and hypercholesterolemia was defined as cholesterol ≥5.2 mmol/L. The results are discussed according to the abovementioned clinical risk markers:

Overweight/ obesity

According to Sorden (2017:1), the university environment tends to be an environment where many students are predisposed to weight gain. Quite a number of interventions have been conducted, but there has been little progress in preventing obesity amongst university students (Sorden 2017:1). Several elements that may possibly support students' predisposition to weight gain include changes in peer and/or family networks, a number of social demands, academic stressors, as well as the campus food environment. In order to determine the prevalence of overweight and obesity as risk markers for NCDs, the anthropometric means and frequencies presented in Table 4.7 and Figures 4.1 and 4.4 using WHO cut-off points, were used. A study on university students conducted by El Hakeem *et al.* (2015: 1318) revealed that among the participants, 27.4% were underweight and 47% were classified as being of normal weight. Overweight students made up 16% and 9.6% of the sample were categorised as obese. Sorden (2017: 1) mentioned that possible factors, which contribute to student weight gain, include academic stressors, changes in peer and/or family networks, a number of social pressures, and the university-campus food environment.

Sorden (2017:5) has identified early adulthood as a high-risk period for weight gain, the accumulation of body fat and potential obesity. Degree-seeking students were shown to gain significantly more weight than age-matched fellows not attending university did. In this study, a high number of non-sponsored participants were found to be overweight when compared to sponsored participants. Results indicated that 25.38% (n=33) of the non-sponsored group was overweight and 17.69% (n=23) of the sponsored group was overweight. However, Figure 4.1 indicated that more sponsored participants fell into the obese category compared to non-sponsored participants. According to the results, 9.23% (n=12) of the non-sponsored group were obese and 10.00% (n=13) of the sponsored group were obese. The difference between the number of obese non-sponsored participants and sponsored participants is, however, significantly low. A BMI ≥25 kg/m² indicating overweight and obesity was recorded for 34.62% (n=45) of the non-sponsored participants and 27.69% (n=36) for the sponsored

participants. This suggests that more non-sponsored participants were overweight/obese than sponsored participants.

The possible explanation for excess weight gain during the first year in university could be the increase in calories due to poor dietary choices made by students, as well as a decrease in physical activity (Woodhall 2014: 3). The level of physical activity and the dietary practices of many university students predispose them to weight gain and future health problems (Aceijas *et al.* 2016: 430). Unhealthy lifestyle habits during this transitional period from high school to university may well underscore overweight and obesity in adulthood (Woodhall 2014: 3). Obesity is a problem that it is not being managed not only in SA but in other parts of the world too (Bradshaw *et al.* 2011: 2). According to Nani (2016: 30), researchers estimated that the prevalence of obesity among American university-aged individuals increased from 12% during 1991, to as high as 36% in 2004. Without a doubt, obesity in adolescence is the leading indicator of obesity during adulthood. Just like modern unhealthy dietary practices, this additional weight, most of which is excess body fat, has shown an increased risk for the development of NCDs over a lifetime. Nevertheless, lifestyle modifications can significantly reduce the risk of developing such NCDs (Bradshaw *et al.* 2011: 2). As stated by the World Heart Federation (2017), a strong connection between sugar and obesity is evident, thus concluding that one in five South Africans consume an excessive amount of sugar. Hence, it is no surprise that on the current study, sugar appeared on the participants' top ten most frequently consumed products. With sugar, ranking sixth position for male participants (Table 4.10) and third for female participants (Table 4.11).

Evidence presented in the 2016 South Africa Health Demographic Survey (SAHDS) conducted by the National Department of Health *et al.* (2017: 45) indicated that based on BMI score, 68% of women in SA were overweight or obese, 3% were underweight and 30% are in the normal BMI range. In contrast, 31% of men were overweight or obese, 10% were underweight, and 59% of men had a BMI, which was within the normal range. In the current study, the mean BMI for the non-sponsored males was 22.71 kg/m² and 24.65 kg/m² for females. Furthermore, the mean BMI for the sponsored males was 22.73kg/m² for males and 24.42 kg/m² for females. Although the comparison was between sponsored and non-sponsored participants, the difference between the two genders was quite substantial. These results indicated that female participants had a higher BMI compared to their male counterparts. Price *et al.* (2018: 212) also agreed that females were more likely to be overweight or obese than were males at all ages. It was further noted that the risk of being overweight or obese was much higher among

urban residents than those living in a rural setting were, but was most notable among younger age groups.

Central obesity

Waist circumference has been documented as the best indirect clinical index of basic abdominal fat accumulation. As stated by Deshpande *et al* (2013: 291), university students are highly exposed to obesity due to living away from home and transitioning to independent living and making their own food choices. Students have typically irregular routines and they are often side tracked by exciting new lifestyle changes, which often result in an imbalanced diet. As stated in Chapter 2, the diet is a major contributor to obesity in young adults.

According to Amirabdollahian and Haghighatdoost (2018: 2), central (abdominal) adiposity is of particular importance among metabolic conditions of metabolic syndrome, as it independently predicts the risk of other disorders and metabolic conditions. Results in Figure 4.2 suggested that more non-sponsored participants showed an abdominal fat distribution, which placed them at an increased risk for the development of CVD (94.0 – 101.9 cm for males and 80.0 – 87.9 cm for females) compared to sponsored students. Results indicated that 7.69% (n=10) of the non-sponsored participants and 3.85% (n=5) of the sponsored participants showed an abdominal fat distribution within the increased risk category. According to Kruger *et al.* (2013: 503), the increase in obesity in adolescents living in developing countries such as SA has been linked to nutritional transition, with increasingly physically inactive lifestyles and higher energy content of diets than previously. Therefore, a growing interest in abdominal obesity in adolescents has been seen and documented as WC is regarded as a decisive factor, in the diagnostic guidelines for metabolic syndrome in adolescents. This is due to the association of WC with visceral fat distribution (Zimmet *et al.* 2007: 304).

Furthermore, results also indicated that more non-sponsored participants showed abdominal fat distribution, which placed them at high risk for the development of CVD (≥102 cm for males and ≥88 cm for females), compared to sponsored students. Results indicated that 9.23% (n=12) of the non-sponsored participants and 7.69% (n=10) of the sponsored participants showed an abdominal fat distribution within the increased high-risk category. A WC ≥94 cm for males and ≥80 cm for females was recorded for 17.69% (n=23) of the non-sponsored participants and 13.85% (n=18) of the sponsored participants, as clearly indicated in Figure 4.4. These results therefore suggested that non-sponsored participants possessed higher clinical risk markers of CVD than sponsored participants. Santhoshakumari and Sneha (2018: 4) stated that the

increasing prevalence of obesity, including central obesity in young adults could be due to the nutritional shift, life style changes such as lack of adequate sleep and addiction to sedentary activities such as watching television as well as smart phone and computer usage.

The use of WC as a biomarker is related to the health implications of centrally deposited fat, which is a strong risk factor for CVD and type II diabetes. Nevertheless, quite a few reports have been published on the prevalence of abdominal obesity in adolescents living in SA and other sub-Saharan countries and there is no appropriate cut-off points for WC to indicate abdominal obesity in black adolescents from Africa (Kruger *et al.* 2013: 503). It is therefore not clear if the international cut-off points for abdominal obesity were appropriate to detect increased metabolic risk in the current study. This is because both non-sponsored and sponsored participants recorded a mean age of 20.23 ± 2.2 and 22.15 ± 3.26 respectively. Such results indicate that most of the participants were still in their adolescent years.

Elevated blood glucose levels

Literature in Chapter 2 suggests that a blood sugar level beyond the body's utilisation capacity could eventually lead to serious life-long health consequences and NCDs, such as diabetes. According to Table 4.7, the means recorded for fasting blood glucose levels were higher in the non-sponsored group compared to the sponsored group. Results indicated that the mean fasting blood glucose for the non-sponsored group was 2.54 mmol/L, which was further categorised into 2.49 mmol/L for non-sponsored males and 2.58 mmol/L for non-sponsored females. The sponsored group recorded a mean fasting blood glucose of 2.28 mmol/L, with males recording a mean of 2.38 mmol/L and females 2.13 mmol/L. Although there was not much difference observed between the fasting blood glucose levels of non-sponsored and sponsored participants, the difference was quite significant when comparing the fasting blood glucose levels of non-sponsored female participants to sponsored female participants, who recorded lower blood glucose levels than their non-sponsored counterparts. Figure 4.4 indicated that 1.54% (n=2) of the non-sponsored participants had impaired fasting blood glucose levels (≥ 5.6 mmol/L), while none of the sponsored participants recorded impaired fasting blood glucose levels, therefore not supporting the hypothesis. Results from a previous study (Hossain *et al.* 2017: 2665) on Bangladeshi public university students indicated that 94.2% of the students were non-diabetic (≤6.0 mmol/L), 5.4% of students were pre-diabetic (6.1 mmol/L – 6.9 mmol/L) and 0.4% of students were diabetic patients (≥ 7.0 mmol/L).

According to Razzak *et al.* (2018: 1), the human brain uses glucose as its only energy source, except in cases of prolonged starvation and therefore lacking fuel stores, therefore making the continuous supply of glucose essential for the brain's normal function and survival. Particularly during complex cognitive processing, during an individual's time at university, the demand for glucose is high, and glucose and energy intake is increased in parallel with the increased neural activity. In contradiction, elevated blood glucose levels can have damaging effects on cognition, with the most common indicators of cognitive insufficiency being neural slowing, attention deficit as well as decreased executive functioning and learning and memory (Razzak *et al.* 2018: 1). Previous research (Mitu 2017: 16), as stated in Chapter two, indicated that the prevalence of diabetes increases with age, regardless of whether a person comes from a rural or urban setting. Only two non-sponsored participants, who had already been diagnosed with diabetes, recorded high fasting blood glucose levels. It is significant that the presence of overweight and obesity among these participants also predicts obesity later in life, thereby increasing the risk for CVD, hypertension and diabetes.

Abnormal blood cholesterol levels

In an attempt to identify complications of dyslipidaemia, Brandão, Pimentel and Cardoso (2011: 57) conducted a survey among university students and found that exposure to university life greatly increased their levels of cholesterol. The authors found that 28.6% of students who had recently entered higher education suffered from dyslipidaemia and 44.0% of students who had already been exposed to academic life for some time, suffered from dyslipidaemia. Clearly, the university environment has a significant influence on the students' health status. According to Table 4.7, the non-sponsored participants recorded higher results than the sponsored participants did. The mean TSC for the non-sponsored group was 4.18 mmol/L, which was further categorised as 4.05 mmol/L for non-sponsored males and 4.29 mmol/L for non-sponsored females. The sponsored group had a mean TSC of 3.90 mmol/L, with males recording a mean of 3.95 mmol/L and females 3.83 mmol/L. The difference observed between the TSC levels of the non-sponsored and the sponsored participants was significant, even when comparing non-sponsored female participants with sponsored female participants. There was not much difference observed between the TSC levels of the non-sponsored and the sponsored male participants; however, raised TSC levels indicating dyslipidaemia were recorded for 4.62% (n=6) of the non-sponsored participants and 3.85% (n=5) of the sponsored participants. These findings corroborate the strong link between a poor diet and high cholesterol levels in the blood.

Margarine and potato crisps appeared in the top ten most consumed items by female participants. Results indicated that non-sponsored female participants consumed more margarine and potato crisps than sponsored female participants did. Both food items contain trans-fat (also known as partially hydrogenated oils), which is defined as man-made fat that aids in increasing the shelf life of foodstuffs, but is known to increase LDL cholesterol whilst decreasing HDL cholesterol levels (University of Pennsylvania 2018). Therefore, it is not surprising that the non-sponsored female participants reported higher blood cholesterol levels than the sponsored females. In addition, a positive, significant correlation was found between the total fat consumed by non-sponsored participants and the TSC results reported for non-sponsored participants.

Saturated fats occur naturally in many food items, especially those of animal origin including meat and dairy products. Participants frequently consumed such food items, which in turn increased the level of total cholesterol in their blood. Non-sponsored participants consumed more food items, which contained saturated fats, hence they were found to have higher fasting blood cholesterol levels than sponsored participants. The principal conclusion here is that cholesterol levels are associated with a high intake of animal source food items. Furthermore, such results disagree with the hypothesis as the non-sponsored participants had higher cholesterol levels than the sponsored participants. According to Pignone *et al.* 2003 (cited in van den Berg *et al.* 2012: 2), counselling interventions are effective in reducing risk and burden of disease in individuals with hyperlipidaemia and other risk factors for CVD. Since the public views primary care providers as valuable sources of nutritional guidance and lifestyle advice to prevent and treat NCD, health care professionals play a key role in this regard through patient education. (Berg *et al.* 2012: 2)

Abnormal blood triglyceride levels

Although the liver produces triglycerides, dietary intake may also contribute to increased triglyceride levels (American College of Cardiology 2016). After a person eats, the excess calories that the body does not require at that instant are transformed into triglycerides, which are stored in fat cells. These triglycerides are later released and circulated in the bloodstream to be used as energy by cells. Most dietary fats are triglycerides and too many of these can be harmful (American College of Cardiology 2016).

The mean triglyceride levels were found to be higher among the non-sponsored group compared to the sponsored group (Table 4.7). Results indicated that the mean triglyceride level

for non-sponsored participants was 2.09 mmol/L, which was further categorised into 1.83 mmol/L for non-sponsored males and 2.32 mmol/L for non-sponsored females. The sponsored group had mean triglyceride levels of 1.91 mmol/L, with males recording a mean of 1.79 mmol/L and females 2.09 mmol/L. There was not much difference observed between the triglyceride levels of non-sponsored and sponsored participants; however, raised triglyceride levels indicating hypertriglyceridemia were recorded for 43.85% (n=57) of the non-sponsored participants and 38.46% (n=50) of the sponsored participants. There are many causes of high triglycerides and as stated in Chapter 2, the condition may be genetic or may be the result of following a poor diet. The carbohydrate intake was very high for both the sponsored and the non-sponsored participants and this could be the reason for such high triglyceride levels. Non-sponsored female participants were found to consume more unhealthy food items then their counterparts, indicating that their diet had a significant influence on the triglyceride levels in the body.

Food items, which are high in refined carbohydrates and saturated fats, are widely available at the campus food court where most students purchased their meals at lunchtime. Results indicated that more sponsored (8.46%; n=11) than non-sponsored participants (2.31%; n=3) purchased their food from the DUT campus food court (Table 4.4). It is therefore evident that the food consumed by the participants was directly linked to the high triglyceride levels recorded. Although foods, which contain unrefined carbohydrates, are available at supermarkets where most students purchased their groceries, students found these food items to be expensive so they opted for cheaper food items containing unrefined carbohydrates, which quickly satisfied their hunger.

Sugar was one of the top ten most consumed food items among both the non-sponsored and the sponsored male participants. Results indicated that non-sponsored males consumed more sugar than sponsored male participants did. It has been found that the human body uses alcohol, surplus calories, or sugar to produce triglycerides (University of Pennsylvania 2018). Even though it is insignificant, Table 4.19 indicates that a positive correlation was found between the energy intake of sponsored participants and their triglyceride levels. Apart from diet and genetic influences, there are many other elements which contribute to elevated blood triglyceride levels, such as physical inactivity, cigarette smoking and drinking too much alcohol (Moll 2018) – such lifestyle behaviour is very common among university students.

According to the Mayo Foundation for Medical Education and Research (MFMER) (2018), increased triglyceride levels may not appear to contribute to triggering atherosclerosis directly, but research has revealed that elevated triglyceride levels may increase the risk of suffering from CVD. Extremely high triglyceride levels may also increase the risk of developing a pancreatis, which occurs when the pancreas becomes inflamed (Moll 2018). It was further stated that high triglyceride levels are often a sign of other disorders that increase the risk of heart disease and stroke, including obesity and metabolic syndrome (MFMER 2018). It is thus evident that such high triglyceride levels among the study participants could also be the reason behind elevated blood pressure readings, high WC measurements, high blood sugar, and abnormal cholesterol levels.

High blood pressure

According to Price *et al.* (2018: 209), hypertension together with overweight and obesity, as well as diabetes are already highly prevalent on the African continent. These illnesses, which have been habitually associated with ageing, a privileged lifestyle and living in urban communities, are increasingly being found in young adults living in rural locations, and in low-income countries where access to health-care is inadequate. The mean recorded SBP for the non-sponsored participants was 112.87 mmHg, with males having a mean of 118.56 mmHg and females 107.84 mmHg. The mean recorded SBP for the sponsored group was 112.27 mmHg, with males having a mean of 117.09 mmHg and females 105.48 mmHg. The means for SBP recorded for both the non-sponsored and the sponsored participants were almost the same. However, the DBP results in Table 4.7 indicated a slight variation between the two groups, with the non-sponsored participants having a higher DBP than the sponsored participants. The mean DBP for the non-sponsored group was 72.57 mmHg, with males having a mean of 74.86 mmHg, and for the females, it was 70.54 mmHg. The mean DBP for the sponsored group was 72.79 mmHg, with males having a mean of 74.63 mmHg and females having a mean of 70.20 mmHg.

Furthermore, Figure 4.3 indicated that more non-sponsored participants recorded blood pressure levels indicating a pre-hypertension stage, thus being at increased risk for the development of CVD (SBP 120-139 mmHg and DBP 80-89 mmHg), compared to the sponsored students. On the contrary, more sponsored participants recorded blood pressure levels indicating stage one hypertension (SBP 140-159 mmHg and DBP 90-99 mmHg), than non-sponsored participants. The difference was quite significant when comparing the blood

pressure levels indicating the first stage of hypertension between non-sponsored participants and sponsored participants. Nonetheless, Figure 4.4 indicated that a SBP >130 mmHg was recorded for 8.46% (n=11) of the non-sponsored participants and 9.23% (n=12) of the sponsored participants. DBP measurements above the cut-off value were recorded for 7.69% (n=10) of the non-sponsored participants and 10.77% (n=14) of the sponsored participants. These results therefore suggested that more sponsored participants were hypertensive than non-sponsored participants.

Findings from a study conducted by Price *et al.* (2018: 209) indicated that hypertension was highly prevalent among urban and rural adults from a young age, despite it being a very low-income country affected by undernutrition and food insecurity. This indicated that NCDs also affect poor people and those who are not financially stable (Price *et al.*2018: 209). Considering the blood pressure recordings of non-sponsored participants (Figure 4.3 and Figure 4.4) who were food insecure (Table 4.4), it is evident that even the poor have an increased risk of hypertension, diabetes and obesity. Such results could also be due to the participants' increased sodium intake. Nevertheless, most cases of hypertension and diabetes remain undiagnosed, untreated, or inadequately controlled. This is quite worrying as the WHO reported that with regard to attributable deaths, the leading metabolic risk factor globally is elevated blood pressure (to which 19% of global deaths are attributed), followed by overweight and obesity, and raised blood glucose (WHO 2018c).

A study that was previously conducted on the South African student population showed slightly comparable results to the current study. Smit and Essop (2009: 179) found that fasting glucose and total serum cholesterol levels were within the normal ranges (below the threshold for metabolic syndrome risk) for both male and female students. However, average fasting triglyceride levels were above the threshold in both gender groups, with 35% of male and 37% of female individuals exhibiting high fasting triglyceride levels. Moreover, the average blood pressures (both systolic and diastolic) in males exceeded cut-off points in 44% of the participants, while 20% of females had increased systolic and/or DBP.

4.4 CONCLUSION

In this chapter, the results of the study were discussed in relation to the hypotheses, beginning with the determination of socio-demographic factors and their influence on dietary practices then further assessing the prevalence of risk markers of NCDs. Evidence suggests that

urbanisation together with the related daily lifestyle and environment modifications are significant drivers of NCDs.

Furthermore, the outcomes evaluated in this chapter suggest that university students face pressing issues such as at-risk health indicators, food and nutrition insecurity and financial insecurity (non-sponsored university students). Poor of nutritious food is a major threat for university students due to their low income and the unhealthy food that is made widely available within the university environment. Further conclusions that supplement the results in this chapter will be addressed in Chapter 5.

CHAPTER 5

CONCLUSION AND IMPLICATIONS FOR FUTURE PRACTICE

5.1 INTRODUCTION

The aim of this study was to assess the socio-demographic factors of sponsored and non-sponsored DUT students as well as the influence these factors would have on their dietary habits in order to determine food and nutrition security. The study also aimed to evaluate and compare clinical outcomes that are regarded as risk markers of NCDs between sponsored and non-sponsored students. This was done by assessing the current socio-economic and health status as well as the dietary intake of the abovementioned sample. The results of the study were discussed in the previous chapter in relation to the hypotheses of this study. In this chapter, the strength and limitations of the study are discussed as well as the main findings of the study. Thereafter, the significance of the study is discussed and the results gathered in this study may aid in formulating applied implications for future practice, which could also serve as a reference for viable and consistent intervention strategies to improve the nutritional status of individuals within the higher education and training community. Conclusions are then drawn from the data gathered from the entire study.

The reason for selecting Durban, specifically the DUT, for this study was that Durban is the largest city in KZN and the third largest city in SA, which also embodies the physiognomies of a typical African community of young adults in SA. Durban is known to be a cultured cosmopolitan city, which is home to approximately 3.5 million people. The city is said to be the home of Africa's best-managed, busiest port and is a major centre of tourism, attracting many youngsters due to the city's warm subtropical climate and widespread beaches. In order to propose strategies aimed at integrated programmes designed for prevention of NCDs, it is important to view the current prevalence of malnutrition and other factors contributing to the development of NCDs among university students, globally, in Africa and more specifically in SA. Moreover, in order to ascertain that the strategies are based on indigenous specificity, inferences, and recommendations from the young adult diaspora and from the African continent will prove valuable.

5.2 STRENGTHS

The study was sufficiently large to explore risk markers of lifestyle diseases that young adults could possibly possess. Rigorous and consistent protocols and quality control procedures were followed during the data collection phase. It is also imperative to note that the link between the risk (lifestyle) factors and the risk markers of NCDs was investigated in a relatively large population representative of the African student community with different living standards in Durban and from urban, peri-urban, township, and rural areas. The study therefore accounted for the age structure of the population in risk estimates to enable external comparisons thus the results can be generalised at least to African university students in DUT.

5.3 LIMITATIONS OF THE STUDY

A number of limitations were taken into account when processing the data during the entire course of study. The primary limitation was that the study utilised a cross-sectional design, which is not entirely suitable for assessing the causal effect relationship between the diet and NCDs. This is because the cross-sectional approach only allowed the researcher a snapshot of a single moment in time. Therefore, we cannot be sure that participants did not possess clinical risk markers of NCDs before being exposed to university life. A longitudinal study could be the best fit for evaluating the role of lifestyle factors in the development of NCDs and its risk factors, as the researcher would be able to detect changes in the characteristics of the participants at both the group and the individual level and as a result, establish sequences of events. However, due to time constraints, the cross-sectional design was selected as it could be completed more quickly than a longitudinal study.

Four questionnaires were administered to determine the sociodemographic status, dietary intake, anthropometric and biochemical profile of participants. This process was heavily contingent on compliance and involvement on the part of the participants in terms of time and memory. The data collection process was time consuming for the participants, therefore increasing the prevalence of non-responses, and influencing the constancy and reliability of the responses. The FFQ was self-reported and the composition of the questionnaire was generalised. A new questionnaire, specific to the students' and the campus food environment could have been developed or more food items could have been added to the FFQ. This would have aided in accurately determining the variety in the food consumption patterns of the

participants. However, doing this increased the participants' burden terms of the participants' willingness to spend more time being interviewed.

The data was cross-sectional and relied on self-reported measures for lifestyle factors and the risk of developing NCDs. Therefore, the data could not preclude the possibility of recall bias, particularly because physical activity, smoking, and alcohol intake were not measured. Consequently, poor health status caused by behavioural and lifestyle factors could have distorted the results as well as the link between such behaviours and the outcomes. The risk of developing metabolic syndrome could not be determined because HDL cholesterol, which is one of the features of metabolic syndrome, could not be assessed using finger-prick blood samples, which was the only means that could be managed due to a lack of suitable infrastructure. Most individuals in this study unconsciously reacted to waist measurements by sucking in the abdominal wall and therefore had to be reminded that a relaxed posture was required for taking WC measurements. It was found that when participants lowered the tension of the abdominal wall the WC would increase, whereas when participants sucked in the air, ultimately increasing the tension, their WC was reduced.

Ethnic homogeneity in addition to the study area also warrants consideration as the study only included non-sponsored and sponsored African students in the DUT community; hence, the results may not be generalised to SA university students as a whole. The study was limited to the dietary practices, the monetary impact of such practices and the clinical risk markers of NCDs displayed by African students attending only the DUT.

5.4 THE HYPOTHESES

During the time lapse since the data collection and the write-up, the dietary practices and nutrient intake of the participants have probably not changed.

5.3.1 Hypothesis One

It was hypothesised that the dietary practices of university students are influenced by socio-demographic factors such as sex and socio-economic status (sponsorship and total income). The influence of these variables was noted. The literature and the current research results (Chapter 4, Table 4.3: 81) support this hypothesis.

5.3.2 Hypothesis Two

It was hypothesised that sponsored students were more food secure, compared to their non-sponsored counterparts and would thus have more access to high fat and energy-dense fast food items. Therefore, it was hypothesised that sponsored students consumed more unhealthy foods than non-sponsored students did.

This hypothesis was rejected as the literature proved otherwise. Current results (Chapter 4, Table 4.11: 98) indicated that the non-sponsored female participants were the group that actually consumed more unhealthy food items than the sponsored female participants. More results (Chapter 4, Table 4.10: 97), however, indicated that sponsored male participants had more access to, and frequently consumed more unhealthy food items compared to non-sponsored male participants.

5.3.3 Hypothesis Three

It was hypothesised that sponsored students would possess higher clinical risk markers of lifestyle diseases than non-sponsored students. These clinical risk markers include overweight/obesity, elevated blood glucose levels, abnormal blood lipid levels, and high blood pressure. This hypothesis was rejected as it was proven that the majority of the sponsored participants recorded a better health status than their non-sponsored counterparts. Current results (Chapter 4, Figure 4.1: 86) indicated that more sponsored participants recorded a normal weight status than the non-sponsored participants did. More non-sponsored participants were found to be overweight when compared to their sponsored counterparts. However, more sponsored participants (due to slight differences between the results), were found to be obese when compared to their non-sponsored counterparts.

Furthermore, results in Chapter 4, Figure 4.2: 87 indicated that more non-sponsored participants recorded high WC measurements than their sponsored counterparts. These results indicated that more non-sponsored participants were at an increased and higher risk for developing CVD than sponsored participants. Current results (Chapter 4, Figure 4.3: 89) indicated that more sponsored participants recorded normal blood pressure than non-sponsored participants did. In addition, more non-sponsored participants were at the pre-hypertension stage compared to their sponsored counterparts. However, more sponsored participants were found to be at the first stage of hypertension than their non-sponsored counterparts were.

The frequency distributions of clinical parameters with reference to cut-off points (in Chapter 4, Figure 4.4: 96) indicated that more non-sponsored participants recorded a BMI ≥ 25 kg/m² than sponsored participants. More non-sponsored participants recorded a WC ≥ 94 cm for males and ≥ 80 cm for females. The case of blood pressure was, however, different as more sponsored participants recorded a SBP ≥130 mmHg and DBP ≥85 mmHg than their non-sponsored counterparts did. More non-sponsored participants recorded FBG of ≥ 5.6 mmol/L, triglyceride levels ≥ 1.7 mmol/L and TSC ≥ 5.2 mmol/L than sponsored participants.

5.5 IMPLICATIONS FOR FUTURE PRACTICE

It is evident that an epidemiological evolution is occurring in SA, with an increase in the burden of NCDs among young adults including CVD and metabolic disorders, which are driven by common risk factors. Non-communicable diseases, which include CVD, cancer, and diabetes, were estimated to account for 51% of all deaths in SA during the year 2016 (WHO 2018b). The leading risk factors for such NCDs in SA as described in the NCD country profiles (WHO 2018b) included obesity, physical inactivity, elevated blood pressure, raised blood glucose levels and smoking in that order.

Given that one of the main goals of universities is to broaden the knowledge of individuals in society, including their knowledge of and attitude towards nutrition, knowledge about the food practices of students has high importance. This will subsequently lead to a more food-conscious society and a healthier population. Nutrition education to enhance their knowledge can therefore be helpful for the community, but there are many other aspects to consider before undertaking this intervention. Specific details regarding an intervention for the students at the DUT, along with the other universities in SA can only be formulated once attitudes, outlooks, knowledge, and factors affecting food intake in the targeted participants have been determined. It is therefore recommended that before proposing specific details regarding potential interventions, further research be conducted into the attitudes, perceptions, knowledge, and factors affecting food intake in the higher education and training community. Moreover, it is recommended that randomised control trials be carried out to determine the impact of such interventions.

Taking the results of the current study into consideration, it is evident that most students within the university campus environment do have an understanding of how their current dietary practices may affect their health in the future, especially since most of the students do not experience the ill effects of their unhealthy eating habits at a young age. For that reason, rather than concentrating on the future ill effects of today's unhealthy eating habits, it may be more effective to recognise and attend to the current factors that motivate and affect university students when choosing to eat healthy food and the challenges they face when attempting to do so. Since some students, males in particular, are less likely to respond to nutrition education, strategies such as decreasing or even eliminating the availability of unhealthy food items, reducing the cost of healthy food items, and offering samples of healthy food, should be considered. Healthy food options are already offered by restaurants run by certain departments such as the Department of Food and Nutrition at DUT, and this practice should be expanded to the campus food court.

It is a well-established fact that dietary habits are established in childhood and such habits can dramatically change during the transition from high school to university. It is therefore also recommended that childhood risk factors in the South African young adult community be investigated due to the early onset of NCDs in certain communities. Furthermore, determining the onset and progress of increased WC from adolescence to adulthood would be valuable to assess what triggers the increase in WC. Additionally, the contribution of risk markers not measured in this study, including novel markers such as C-reactive protein (CRP), adiponectin, haemostatic factors and plasma homocysteine, should be added to the battery of risk markers measured in the South African young adult community.

5.6 CONCLUSION

The concept of adolescence has evolved. A better understanding of human neurobiology has revealed that we should extend the concept of the developing adult to at least 24 years of age. A broadening of the concept of adolescence emphasises its criticality as a step towards adulthood and results are already demonstrating that although they are still young, a number of university students already have risk factors for NCDs.

Although there is evidence of a relationship between the campus food environment and students' dietary habits and weight, there is insufficient evidence regarding the causal linkages and a lack of clarity on how to define and describe the campus-dining environment. Grocery stores near the DUT campus provide a wide array of nutritious alternatives, but convenience stores on and near campus as well as on-site vendors, provide only a few healthy food items that are not obesogenic.

Results from the current study verify that the students' monetary status plays a huge role in determining the food they consume, as foods high in fats and sugar cost less, but healthier food items cost more. It can be conclude that constrained financial circumstances are linked to unhealthy eating practices and thus, inevitably, to poor health. It should also be noted that students are invariably under pressure as they face academic responsibilities that may generate stress, which can in turn lead to unhealthy modifications to the diet. It is also probable that students' dietary practices are affected by characteristics such as the typical university lifestyle, including projects, tests, and examinations as well as and student activities embracing social justice and party politics. It is also important to note that the health and economic burden of NCDs is significant and increasing. Literature shows that it is proliferated by early-life under-nutrition and later-life adiposity, decreasing physical activity, increasing sedentary behaviour, poor dietary diversity, and intergenerational factors. However, future studies should assess this.

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APPENDICES

A. **SOCIO-DEMOGRAPHIC QUESTIONNAIRE**
B. **24-HOUR FOOD RECALL**
C. **FOOD FREQUENCY QUESTIONNAIRE**
D. **ANTHROPOMETRIC AND BIOCHEMICAL MEASUREMENTS FORM**
E. **LETTER OF INFORMATION**
F. **LETTER OF INFORMED CONSENT**
G. **GATEKEEPER'S PERMISSION**
H. **SAMPLE SISE CALCULATION**
I. **ETHICAL CLEARANCE**
J. **FIELDWORKER'S TRAINING MANUAL**

APPENDIX A

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?

.....

Please indicate if you are a sponsored or non-sponsored student.

Sponsored	Non-sponsored

2. PERSONAL INFORMATION

2.1. Level of study:

1st year		**2nd year**		**3rd year**		**4th Year**		**Post grad**	

2.2. How old are you? _____ years

2.3. Gender:

Male	Female

3. ACCOMMODATION

3.1. Living arrangements

At home	Renting room	University residence	Flat	Commune	Other, specify ……..

3.2. Do other people live in the house with you?

Yes	No

3.3. How many people are permanent residents living in the accommodation 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+

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

< 1 year	1-5 years	>5 years

3.5 In what type of accommodation are you staying?

Brick	Clay	Grass	Wood	Zinc/shack

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

Yes	No

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

3.7.1 Water

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

3.7.2 Toilet facilities

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

Waste removal	Yes	No	3.7.3
Access to electricity	Yes	No	3.7.4

3.7 To what extent do you have problems with the state of your accommodation (e.g. sise, repairs, damp, etc.)?

Minor	
Mild	
Moderate	
Major	

3.10 Do you have problems with the following?

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

3.11. What is the floor inside your house/accommodation 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 4.3.

4.2. If NO, Are you actively looking for paid employment at the moment?

Yes	No

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

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

4.4. How long have you been employed?

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

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

Yes	No

4.6 What is the exact title of your current job?
(Including self-employed)

4.7 What is your total allowance or earnings 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		

4.8 How often does it happen that you do not have enough money to buy food for you and your family?

Always	Often	Sometimes	Seldom	Never

4.9 How often do you buy food?

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

4.10 Where do you buy food?

Tuck shop	Street vendor	Wholesalers	Supermarket	Campus food court	Other, specify ……

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

Taxi	
Bus	
Train	
Own car	
Bicycle/ Motorbike	
Other Specify	

4.12 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?

Standard 10	1st Year	2nd Year	3rd Year	4th Year	Post graduate

5.2 What language is your home language?

Zulu	Xhosa	English	Afrikaans	SeSotho	Other, specify ……

5.3 How do you get to University?

Walk	Bus	Taxi	Parents car	Train	Other, specify ……

5.4 How many meals do you eat per day?

0	1	2	3	> 3

5.5 Where do you eat most of your meals?

Home	Friends	University Residence	Campus Food Court	Other, specify…….

6. RESOURCES

6.1. Do you have access to the internet (where you live)?

Yes		No	

6.2. Do you have access to the following media resources?

6.1.1

Television	Yes	No

6.1.2

Radio	Yes	No

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

APPENDIX B

24 – HOURS RECALL

Subject ID number: _____ Interviewer: _____

Name: _____ Date: _____ / _____/ _____

Address: _____

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 (tablets or syrup)		Yes	1	No	2 X
Give the brand name and dose of the vitamin/tonic:					

APPENDIX C

FOOD AND NUTRITION CONSUMER SCIENCES

FFQ LIST OF FOODS AND FOOD GROUPS DIVERSITY

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, Lamb)		
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)		
Seafood (Prawns, Mussel's, Calamari, Crab, Shrimp, Crayfish)		
GROUP 2: Eggs Diversity	**Y**	**N**
Eggs		
GROUP 3: Dairy Products Diversity	**Y**	**N**
All Milk		
Evaporated milk (Unsweetened)		
Condensed milk		
Maas/ Inkomasi		
All Cheese		
Custard		
Ice Cream		
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)	**Y**	**N**
Potatoes		
GROUP 5: Legumes and Nuts	**Y**	**N**
All Beans Dried		
Dried Peas		
Lentils		
Peanuts and Nuts		
Soya		
GROUP 6: Vitamin A Rich Fruits and Vegetables Diversity	**Y**	**N**
Pumpkin		
Carrots		
Wild Leafy Vegetables Fresh and Dried		
Spinach		
Butternut		
Apricots (Appelkoos)		
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		
Kiwi fruit		
Watermelon		
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	**Y**	**N**
Green beans (fresh)		

Peas (fresh)		
Cauliflower		
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		
Margarine		
Lard		
Salad dressing/oil		
Potato Crisps		
Coffee Creamer (Cremora, Ellis Brown)		

APPENDIX D

FOOD AND NUTRITION CONSUMER SCIENCES

Anthropometric and Biochemical Measurements Form

Section A:

1. Number/Name of the subject……

2. Residence:……..…

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 (cm)	3. Waist Circumference (cm)	4. Blood pressure (mmHg)	4. Blood pressure (mmHg)
cm	cm	/	/

5. Fasting Blood Glucose (mmol/L)	5. Fasting Blood Glucose (mmol/L)	6. Fasting Blood Cholesterol (mmol/L)	6. Fasting Blood Cholesterol (mmol/L)
mmol/L	mmol/L	mmol/L	mmol/L

6. Fasting Blood Triglycerides (mmol/L)	6. Fasting Blood Triglycerides (mmol/L)		
mmol/L	mmol/L		

APPENDIX E

LETTER OF INFORMATION

Dear participant

Thank you for allowing us the time to talk to you about our project that will be of benefit to the university students attending at the Durban University of Technology.

Why is it important to do this project?

We are all aware of the fact that university students have a high exposure to energy-dense fast foods because these food items are also available in campus food courts as well as street vendors. Through this project, the researcher would like to determine the diversity and nutritional adequacy of the food consumed by students to see if they are nutritionally secure. The researcher will then determine if the students possess any risk markers for diseases of lifestyle, due to current practices in their diet. After all the relevant information has been collected, the researcher will make recommendations that will contribute to the university community's healthy eating habits that shall give purpose to each day. The outcome of the results may also be used to develop nutritional interventions that will benefit the university.

What will it involve?

- We will ask you to sign a consent form to indicate that you agree to participate in the study after the researcher has explained all the procedures to you.
- If you agree, you will be asked to avail yourself for the day of data collection. The information will be collected in an interview situation and you will be asked to take biochemical tests which will require a registered nurse to take a sample of your blood by pricking your finger in order to determine your fasting blood glucose, cholesterol and triglyceride levels. You will also be asked to complete a Socio-Demographic Questionnaire, a 24 Hour Food Recall, a Food Frequency Questionnaire and take Anthropometric measurements (for weight, height, BMI and blood pressure).
- Please ensure that you have not had anything to eat in 12 hours prior the interview session.
- Pictures will be taken during the interview session so that they can be attached to the dissertation under the methodology section.
- Participation is voluntary and you can withdraw at any time with no penalty.

- There will be no risks as your personal data will be treated confidentially and only the researchers will have access to it. You will be given a participant number so no names will be used in the study.
- All the information obtained will be reported for the study group and your name will not be mentioned in any of the reports.
- No pay will be given to the participants.
- It won't cost you anything to participate in the study.
- There will be no discomfort and refreshments will be served after the biochemical tests have been taken.

Benefits to the university community:

The information generated will have the potential to play a significant and distinctive role in sponsoring the development of a viable process for the construction of a consistent set of university-specific nutrition education messages that may be more suitable for university students. After the study has been concluded, the results will be shared with the participants, if required. The dissertation will be available at the DUT library.

For any questions or concerns, please feel free to contact our Ethics committee.

Principal investigator/researcher:

Miss Zibuyile Mposula.

Persons to contact in the event of any problems or queries:

Researcher: Zibuyile Mposula BTech: Consumer Science Food and Nutrition.
0744436395 lehsucre@gmail.com

Supervisor: Dr Ashika Naicker PhD: Nutrition.
031 373 2333 ashikan@dut.ac.za

Co-Supervisor: Prof. Carin Napier DTech: Food service Management.
031 373 2326 carinn@dut.ac.za

The Institutional Research Ethics administrator: 031 373 2900

Complaints can be reported to the DVC: TIP, Prof S Moyo Moyos@dut.ac.za or 031 373 2382.

APPENDIX F

Letter of Informed Consent

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Zibuyile Mposula, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: 77/15.
- 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, Zibuyile Mposula 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

APPENDIX G

Directorate for Research and Postgraduate Support
Durban University of Technology
Tromso Annexe, Steve Biko Campus
P.O. Box 1334, Durban 4000
Tel.: 031-3732576/7
Fax: 031-3732946
E-mail: moyos@dut.ac.za

2nd December 2015

Ms Zibuyile Angel Mposula
c/o Department of Food and Nutrition Consumer Science
Durban University of Technology

Dear Ms Mposula

PERMISSION TO CONDUCT RESEARCH AT THE DUT

Your email correspondence in respect of the above refers. I am pleased to inform you that the Institutional Research Committee (IRC) has granted permission for you to conduct your research "Selected clinical risk factors for lifestyle diseases in relation to the current dietary practices of sponsored vs. non-sponsored African university students in Durban" at the Durban University of Technology.

We would be grateful if a summary of your key research findings can be submitted to the IRC on completion of the project.

Kindest regards.
Yours sincerely

[redacted]

PROF. S. MOYO
DIRECTOR: RESEARCH AND POSTGRADUATE SUPPORT

APPENDIX H

Sample sise

The student wants to do a survey to DUT students staying at residences that are around Steve Biko campus (1.5km radius). She found that there 745 students staying in those residences (information from student housing).

She then had chosen her confidence level to be 95%. She calculated sample sise she will use and got n=260.

I will check this sample sise using Niles (2006) approach

Confidence interval = $1/\sqrt{n} = 1/\sqrt{260} = 0.06207$

Therefore, the confidence interval in this case is roughly 6%.

This means that if for example, if 60% of the students have the risk markers, then there is 95% chances that between 64% and 76% of the total population of students staying at residences have risk markers. And I think this is a good sample sise which will reflect the population.

Sizwe V. Mbona (Statistics Lecturer)

Department of Statistics, Mariam BEE, Ground floor

Tell: 031 373 5703

E-mail: sizwem@dut.ac.za

APPENDIX I

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

3 December 2015

IREC Reference Number: **REC 77/15**

Ms Z A Mposula
P O Box 141264
Madadeni
2951

Dear Ms Mposula

Selected clinical risk factors for lifestyle diseases in relation to the current dietary practices of sponsored vs. non-sponsored African university students in Durban

The Institutional Research Ethics Committee acknowledges receipt of your gatekeeper permission letter.

Please note that Full Approval is granted to your research proposal. You may proceed with data collection.

Yours Sincerely,

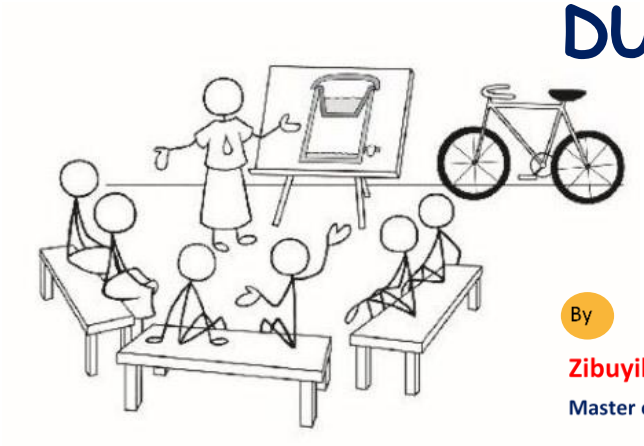
[redacted]

Professor J K Adam
Chairperson: IREC

DUT DURBAN UNIVERSITY OF TECHNOLOGY
2015 -12- 03
INSITUTUTIONAL RESEARCH ETHICS COMMITTEE
P O BOX 1334 DURBAN 4000 SOUTH AFRICA

APPENDIX J

SELECTED CLINICAL RISK FACTORS OR LIFESTYLE DISEASES IN RELATION TO THE CURRENT DIETARY PRACTICES OF SPONSORED VS. NON-SPONSORED AFRICAN UNIVERSITY STUDENTS IN DURBAN



By

Zibuyile Mposula

Master of Applied Science

FIELD WORKERS TRAINING MANUAL

TABLE OF CONTENT

1. PROGRAMME

TIME	PROGRAMME
08:00 – 08:30	Introduction
	➢ Purpose of the Study
	➢ Objectives
	➢ Literature Review
09:00 – 09:15	Describing the Sample and Design Methods
09:15 – 09:30	Objectives of the Training Session the Purpose of this Manual
09:30 – 10: 00	The Fieldworker Code Of Conduct
10:00 – 10:30	Tea
10:30 – 11:30	The Behaviour of the Fieldworker and How to Conduct the Interview
11:30 – 12:00	Measuring Instruments
12:00 – 13:00	Lunch
13:00 – 14:00	Dietary Assessment
14:00 – 16:00	Administration of Questionnaires

2. INTRODUCTION

Purpose of the Study

This research study aims to assess and compare the dietary practices of sponsored with non-sponsored Durban of Technology (DUT) students. The study also aims to determine if the students have any clinical risk factors related to lifestyle diseases such as elevated blood pressure, raised blood glucose, abnormal blood lipids and overweight/obesity.

Objectives

- To determine the demographic profile of the participants by completing socio-demographic questionnaires.
- To determine the diversity and nutritional adequacy of food consumed by students by completing three 24 Hour Food.
- To ascertain the assortment of participants' diet using Food Frequency Questionnaires.
- To determine the participants' anthropometric status by measuring their weight, height and waist circumference using standardised techniques and instruments.
- To determine if the participants possess any intermediate risk factors for diseases of lifestyle by assessing blood pressure, using a standard mercury sphygmomanometer. Finger-prick blood samples will be done using a biochemical test meter and strips to measure fasting blood cholesterol, glucose and triglyceride levels.
- To compare the dietary practices and risk factors of lifestyle diseases between sponsored and non-sponsored participants.
- To identify gaps in the research and make recommendations for future studies.

Literature Review

In the recent decades, there have been significant changes in human lifestyle throughout the world, more specifically in recent years. These modifications appear in diet, types of food, cooking time and other aspects relating to the availability, accessibility and the use of food (Elhassan, Gamal and Mohammed 2013: 25). Considering that one of the universities' main goals is to intensify the society's knowledge, enhancing the nutrition insolences, knowledge and practice of students is of great importance as it will successively lead to a more food-conscious society and healthier students. The report (Durban University of Technology 2013) suggests that in the year 2013, the Department of Financial Aid and scholarships funded a total of 11650 students in terms of donor criteria of the National Student Financial Aid Scheme (NSFAS), NSFAS loans and bursaries, Non-Governmental Organisation (NGO) bursaries as well as DUT bursaries and scholarships. It was therefore hypothesised that all students that were sponsored financially were food secure, but the question was that 'are they nutritionally secure?'.

Neslisah and Emine (2011: 117) explained that these unhealthy dietary practices are the main factors which cause nutritional problems. Wahlqvist (2004 cited in Neslisah and Emine 2011: 117) also explained that the risk of chronic lifestyle diseases such as obesity and cardiovascular disease may be increased due to unhealthy nutrition. Eisenberg et al. (2005 cited in Sedibe et

al. 2014: 1) also explained that an increase in the prevalence of obesity is a clear indication that environmental factors and behaviours relating to diet and physical activity are significant to the cause of obesity in adolescents. In addition, Abegunde et al. (2007 cited in Van den Berg et al. 2013: 445) stated that several studies have identified diet and lifestyle as amendable risk factors for many non-communicable diseases such as obesity, diabetes, hypertension, and high cholesterol.

According to the World Health Organisation (WHO) (2005: 3), risk factors of chronic lifestyle diseases are well established and well known. Risk factors that are modifiable include diet, physical activity and tobacco use, impacts on intermediate risk factors in particular raised blood pressure, elevated blood glucose levels, abnormal blood lipids and the state of being overweight or obese. A study done by Cilliers (2004 cited in Okeyo 2009: 10), revealed that black first year university students were more likely to be overweight or obese compared to their white equivalents. Results indicated that 26.8 % of black students were underweight, 18.2 % were overweight and 6.5 % were obese, compared to their white counterparts of whom 7.2 % were underweight, 10 % were overweight and 0.8 % obese. These results serve as proof that ethnicity on its own, has an influence on body weight. Furthermore, Kearney (2010: 9) stated that the consumption of food is mostly affected by a wide range of aspects, such as the availability and accessibility of food, as well as food choice.

Heald (1992 cited in Sedibe et al. 2014: 115) explained that mediations aimed at altering teenage eating practices have met with mixed success, which, partially, may be because of insufficient comprehension of the factors that govern the eating and physical activity principles and behaviour by adolescents. To some extent, the students had knowledge of obesity and non-communicable disease risks. The researchers also found that the consumption of less healthily meals was favoured in community, family and school settings owing to the cost, convenience and availability of such food.

3. THE SAMPLE

The study will focus on university sponsored vs. non-sponsored African university students. After obtaining permission to undertake the research, students will be approached through direct one-to-one encounter engagement, and asked if they receive any meal allowances as a form of sponsorship through a loan, bursary or grant. Students who meet this criteria will be requested to participate in the study until the quota of 130 participants has been reached (for the sponsored sample) and the purpose of the study has been explained. Similarly, students who do not receive any form of funding will be requested to participate in this study until the quota of 130 participants has been reached (for the non-sponsored sample). As recommended by the statistician, our sample sise will be 260. Signed informed consent will be obtained from the participants after explanation of the study and discussion of the information letter. The four residences which the researcher has targeted, accommodates a total of 745 students.

- The study will only include African students attending at DUT.

- Only students aged between 18 – 35 years will be included.
- Both males and females will be included in the study.
- Bursary and grant recipients who are sponsored with meal allowances will be included.
- Non-sponsored students (do not receive any bursary or grant) will be included.
- Students that are studying Nutrition at the university will be excluded from the study.

4. DESIGN AND METHODS

A random sampling method and purposive sampling method will be used in order to allow for a selection of key individuals from the random sample spectrum with the aim to form a focus group for discussing the topic. All participants will have signed a letter of consent before inclusion in the study. Data collection shall take place on student residential premises and on Steve Biko campus grounds. The interview session will take 30 – 45 min.

5. OBJECTIVES OF THE TRAINING SESSION:

At the end of the training session, the fieldworkers must be able to:

1. Understand the purpose of the study as well as its objectives.
2. Comprehend the significance of the study.
3. Realise the role and the purpose of the fieldworkers.
4. Understand the fieldworker Code of Conduct.
5. Identify characteristics of a good fieldworker.
6. Comprehend the procedures involved when conducting a survey.
7. Understand the general procedure to be followed when administrating questionnaires.
8. Understand all the guidelines noted on each questionnaire.
9. Use the dietary assessment kit effectively when administering the QFFQ and the 24-hour recall.
10. Complete an interview with respondents successfully.

6. THE PURPOSE OF THIS MANUAL:

- Guide the fieldworker during data collection.
- Make the fieldworker attentive and ensure that they are prepared for various scenarios that might possibly prevail during data gathering.
- Train and guide the fieldworker in administrating questionnaires and use of visual aids.

7. THE FIELDWORKER

What is a Field Worker?

According to Diniz and Schüklenk (2013: 2), a field worker's major role is face-to-face engagement with respondents. Usually, fieldworkers are those individuals who usually speak the participant's first language, who are from or live in the study areas, and whose work entails moving around the study areas. Govender (2011: 3) also explained that field workers are the

individuals who must interview the respondents in order to obtain accurate data. Respondents should feel comfortable with the field worker, never should they feel defenceless or coerced. It is important that respondents answer all questions willingly and to the best of their capacity, without feeling pressured or intimidated. Schnetler and Geldenhuys (1992 cited in Naicker 2009: 262) commented that the fieldworker plays an important role in determining quality of responses obtained from the study sample, this suggests that the quality of the data that is collected, is highly influenced by the fieldworker..

8. FIELDWORKER CODE OF CONDUCT

8.1 BEHAVIOUR

In order to be a successful interviewer, Govender (2011: 7) indicated that a field worker should possess the following attributes:

- **Pleasantness:** the field worker should be capable of making each respondent feel at ease.
- **Respect:** it is important that the field worker treats every respondent with respect throughout the interview process. The field worker must greet the respondents courteously and also thank the respondents for their time and collaboration. As a field worker, one must never demonstrate that he/she disagrees with the respondent.
- **Serenity:** all respondents must be asked questions in the same way. The field worker must never display any unpleasant emotions or impatience, even when the respondents take a while to answer.
- **Dependability:** field workers should be reliable, she/he must pay attention to detail, record all answers accurately and not skip over questions or make up answers.
- **Eagerness:** field workers are expected to be passionate about the research. People should participate in the study because they really want to do it.
- **Flexible:** a proficient field worker shall be able to adjust to certain situations. One has to be aware that things will not always work out as planned, thus meaning that one may have to work under unpleasant conditions.
- **Neat Appearance:** field workers need to look neat and they must be well groomed. Here are some guidelines for field workers to follow:
    - Wear clean, comfortable clothes. Remember to be neat at all times.
    - Do not wear emblems of certain unions, institutes or churches. Such material may affect the way respondents respond to you.
    - Wear appropriate clothing so that the respondent will focus on the discussion and not on your clothing.

8.2 CONDUCTING THE INTERVIEW

Govender (2011: 8) suggested that the field work remembers that in certain situations, questions may need to be translated in order for the respondent to understand. Field workers must be careful not to alter the direction of the question.

8.2.1 How the field worker may begin?

- ✓ Greet the respondent graciously and acquaint yourself with the respondent.
- ✓ Find out what language the respondent prefers to speak.
- ✓ Elucidate what the discussion is about. Let the respondent ask questions about the study. Assure the respondent that his/her answers are private and that neither the respondent nor his or her residential address will be disclosed.
- ✓ Make the respondent comfortable. Be thoughtful and considerate. Some of the respondents may be anxious so in such circumstances, try and talking about something common like the weather in order to try and put the respondent at more relaxed state.

8.2.2 How to go about conducting the interview.

- Ask all questions precisely as they are written on each questionnaire. Keep your tone at a clear, relaxed level all the time. You may have to clarify a question or alter some of the words if the respondent cannot comprehend what you are saying.
- Ask questions in the sequence that they appear on the questionnaire. Record everything, even if refuses to answer what you ask him/her, note the lack of response and proceed to the next question.
- Adhere to all the instructions on every questionnaire. If it seems that the respondent has already answered a question when he/she responded to the previous question the field worker may start by saying: "We have already mentioned this, but…".
- Never try to influence the way the respondent responds. Keep your facial appearance as neutral and friendly as possible. Keep your opinions to yourself.
- The tone of the interview should be conversational at all times. Try not to make the respondent feel as if he/ she is being investigated. Questionnaires are designed to keep the amount of writing to a minimum, nevertheless, if a respondent gives a lengthy response, ask him/her to excuse you while you write down their response.
- Do not let the respondent go off track and start inappropriate or unconnected discussion. If this happens, gently bring the respondent back to the discussion.
- Give the respondent time to meditate, do not rush him/her to respond. Nevertheless, if the respondent is silent for too long, ask the question again. For instance, you could say 'you have told me how you prepare cabbage; now please tell me how you cook your gem squash.
- Record all answers, as well as negative answers or any refusal to answer.
- Ensure that you have written down the respondent's number. Do not write down their names or disclose any personal information!

8.2.3 How do I end the interview?

- o Let the respondent know that the interview has come to an end.
- o Reassure the respondent that everything that was discussed is private.
- o Thank the respondent for their time as well as their co-operation. Lead the respondent to the next phase of the interview process.

9. MEASURING INSTRUMENTS:

- **Questionnaires:**
  - ✓ **Socio-demographic questionnaire:** A validated socio-demographic questionnaire that was adapted and used in a focus groups discussion with 20 community ladies by Napier (2006) for the assessment of a feeding programme in tackling malnutrition in a primary school.
  - ✓ **Food Frequency Questionnaire:** A validated FFQ that was adapted by Oldewage-Theron and Kruger (2008) for a study on food diversity as one of the indicators of dietary sufficiency and health status of an elderly populace residing in Sharpeville, South Africa.
  - ✓ **Three 24 Hour Food Recalls:** These questionnaires will be completed for three non-consecutive days, with one of those days being on the weekend.

- **Anthropometric Measurements**

Weight, height and waist circumference will be measured using standardised techniques and instruments. All instruments will be checked for reliability at the start of each session.

- **Biochemical Measurements**

Blood pressure will be recorded using a standard mercury sphygmomanometer. Finger-prick blood samples will be done using Accutrend or Accu-Check meters and test strips to measure fasting blood cholesterol, glucose and triglyceride levels.

10. INTERVIEW EXAMPLE

In her training guide, Govender (2011: 9) shared a few examples for when conducting interviews and taking down respondents' portion sises. These are transcribed below.

24-Hour Food Recall Questionnaire

The 24-hour recall is an inquiry form based on finding out what the respondent has consumed over a 24 hour period of time. This questionnaire is used to find out whether the QFFQ is valid or not. Responses to the 24-hour recall have to be as detailed as possible. The field worker will have to ask what the respondent has consumed and drunk, what kind of food or drink is consumed, the brand name, how the food item was prepared and what quantity of the food item was consumed. Include spreads like margarine, sugar and milk to tea or coffee, sauces and seasonings.

In this case: The interviewer asks the respondent what she had in the morning on waking up.

I: What is the first thing you had in the morning after you woke up?

R: I drank some tea and then I had porridge.

I: How did your take your tea?

R: I always take my tea with 2 sugars and some milk.

I: How big is the spoon you used and was it level or heaped? (*Showing the respondent the teaspoon*).

R: It is like this spoon, the spoon was levelled.

I: What type of porridge did you eat and how much eat? (*Showing a bowl or cup*).

R: I had soft Maltabela porridge and I had about 2 of those cups to the fill in a bowl.

I: Do you put anything else in the porridge?

R: Yes, 2 spoons of brown sugar, and about 1 spoon of margarine.

I: At about what time was this meal?

R: At 7:00 am.

I: Where did you have this meal?

R: 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					
7:00 am	**Home**	**Tea, Joko**	**1 cup/mug**		
		With milk, low fat	**little milk – 2 tablespoons**		
		And sugar, brown	**2 levelled tsp**		
		Maltabela porridge	**2 cups**		
		With sugar, brown	**2 levelled tsp**		
		And soft margarine	**1 tsp**		

11. PORTION SISES

The table below will assist the field workers in recording precise food servings (Govender 2011: 10).

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

FOOD	Smaller than smallest	Between small and medium	Between medium and large	Between large and very large	Larger than large/very large
Rice	70 g	105 g	190 g		310 g
French fries	30 g	90 g	185 g		340 g
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

FOOD	Smaller than smallest	Between small and medium	Between medium and large	Between large and very large	Larger than large/very large
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
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
Atchar	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

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