DETERMINING THE RELATIONSHIP BETWEEN ADDED SUGAR INTAKE AND BODY MASS INDEX (BMI) AMONG UNDERGRADUATE STUDENTS BETWEEN THE AGES OF 18-25 YEARS STUDYING AT THE UNIVERSITY OF KWAZULU-NATAL, PIETERMARITZBURG CAMPUS

By

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ABSTRACT

Introduction: Chronic diseases of lifestyle are a major contributor towards the increased incidence of mortality and morbidity among individuals worldwide. In conjunction with this, dietary and lifestyle modifications have contributed towards the overweight and obesity problem. Recent but not conclusive evidence has suggested that the consumption of added sugars, particularly from sugar sweetened beverages (SSBs) could be the driving force behind this problem. University students are vulnerable to these dietary and lifestyle changes as they are exposed to a new environment in which independent food choices have to be made. Unfortunately the influence of the food environment often results in poor dietary habits.

Aim: Determining the relationship between added sugar intake and body mass index (BMI) among undergraduate students between the ages of 18-25 years studying at the University of KwaZulu-Natal (UKZN), Pietermaritzburg campus.

Objectives: To determine: the demographic characteristics of the students such as age, gender, race and place of residence; the BMI of the students; the dietary intake of added sugar from foods and beverages among the students; the association between the dietary intake of added sugar and the students' BMI; the consumption and consumption patterns of sugar sweetened beverages; the influence of demographic characteristics on the dietary intake of added sugars and the factors that influence the intake of SSBs.

Methods: A cross sectional study was conducted on 387 undergraduate students between the ages of 18-25 years attending UKZN, Pietermaritzburg. Non-probability sampling was used to recruit the students. A three part questionnaire was used to gather information on anthropometric measurements, demographic characteristics, and a 24 hour dietary recall and a Food Frequency Questionnaire (FFQ) was used to assess the added sugar intake among the subjects.

Results: The study population consisted of 33.1% male subjects and 66.9% female subjects. Most of the subjects were from the Black African race group (90.4%), followed by the Indian (7%), Coloured (2.1%) and White (0.5%) race group. A vast majority of the subjects lived away from home (76.7%). A significant number of the subjects were within the normal BMI classification (64.9%) and the mean BMI of the subjects was 23.5kgm^2.

The prevalence of overweight and obesity was higher among the female (22% and 11.5%) than male subjects (13.3% and 2.4%) and more male subjects were within the normal BMI category (77.3%). Significant differences were observed between the subjects BMI and the consumption of some food and beverage items listed in the FFQ. Subjects with a higher BMI consumed flavoured milks less often, and consumed a greater amount of ice cream and a smaller amount of hard boiled sweets. The frequency of consumption of the foods and beverages that contained added sugar was significantly higher among the female subjects, and the male subjects consumed significantly greater amounts of these foods and beverages. Differences were observed in the consumption of added sugars across the genders, races and place of residence. Subjects that lived at home and that were Indian and female consumed most of the food and beverage categories that contained added sugars more frequently. Taste and price significantly influenced the students' consumption of SSBs. The most frequent place of purchase and consumption of SSBs as reported by the subjects were supermarkets and on campus respectively.

Conclusion: Most of the subjects were within the normal BMI classification. Approximately one third of the subjects were overweight or obese, however there were more overweight subjects. The prevalence of overweight and obesity was higher among the female subjects. The subjects' diet lacked variety, and the frequency of consumption of added sugars from the various food and beverage categories was relatively high among the sample population. Differences with regards to the consumption of added sugars were observed across the categories of gender, race and place of residence. Factors such as taste and price greatly influenced the students' consumption of SSBs. Although significant differences between BMI and the intake of some sugar containing foods and beverages existed, this aspect requires further exploration among university students. The poor dietary habits among the university students as well as the prevalence of overweight and obesity among this population group, highlight the fact that there is a great need for strategies to be implemented in order to promote healthier dietary and lifestyle habits among young adults.

PREFACE

The work described in this dissertation was carried out in the School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, from February 2016 to December 2016, under the supervision of Dr Nicola Wiles.

Signed: _____ Date: _____

Ra'eesah Ismail Nakhooda

As supervisor of the candidate I agree to the submission of this dissertation.

Signed: _____ Date: _____

Dr Nicola Wiles (Supervisor)

DECLARATION OF ORIGINALITY

I, Ra'eesah Ismail Nakhooda, hereby declare that:

i. The research reported in this dissertation, except where otherwise indicated, is my original research.

ii. This dissertation has not been submitted for any degree or examination at any other university.

iii. This dissertation does not contain other persons" data, pictures, graphs or other information unless specifically acknowledged as being sourced from those persons.

iv. The dissertation does not contain other authors" writing unless specifically acknowledged as being sourced from other authors. Where other written sources have been quoted, then:

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Signed…… Dated…….

Ra'eesah Ismail Nakhooda (Candidate)

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1.1 Importance of the study

The incidence of overweight and obesity has increased among the South African population. According to a systematic analysis that was conducted on the prevalence of overweight and obesity at a global, national and regional level between the years 1998 and 2013, it was found that in South Africa, the combined rate of overweight and obesity among adult females and males was 69.3% and 38.8% respectively (Marie, Fleming, Robinson, Thomson, Graetz, Margono & Abraham 2014). Consequently, South Africans have been faced with a double burden of disease due to the co-existence of over- and under-nutrition. Overweight and obesity increases the chances of one developing several diseases of lifestyle or non-communicable diseases (NCDs) such as cardiovascular disease, diabetes and some cancers which can lead to morbidity and mortality. According to the estimates from the World Health Organisation (WHO), overweight and obesity has contributed towards the deaths of approximately 2.8 million people each year due to the health risks associated with overweight and obesity (WHO 2016a).

The causes of overweight and obesity are complex, however recent studies have indicated that changes in dietary habits could be held accountable for the rapid increase of these conditions (Shankar, Ahuja & Sriram 2013). Over the years, South Africans have undergone rapid changes in their lifestyles which has impacted on their dietary behaviour. The limited amount of information available on the dietary habits of South African adults, have indicated that South Africans have shifted towards consuming a diet that is high in fat and added sugar (Mchiza, Steyn, Hill, Kruger, Schönfeldt, Nel & Wentzel-Viljoen 2015). A study was conducted by Jaffer, Steyn & Peer (2011) in 2009 in order to determine the added sugar intake among South African adults. This study was conducted among 1010 South African male and female subjects between the ages of 18-60 that resided in the urban areas of Cape Town. Based on analysis of the results, it was found that the male subjects consumed 52g (15% of energy intake) of sugar per day and the female subjects consumed 51g per day (11% of energy intake), therefore indicating that the WHO recommendation of limiting added sugar to less than 10% of the total energy was exceeded (WHO 2015b).

Overweight and obesity has also become a problem among young adults particularly those who have transitioned from secondary to tertiary education (Vandeboncoeur, Townsend & Foster 2015). In 2013, a cross sectional study was conducted in order to determine the prevalence as well as the factors that contribute towards the development of overweight and obesity among university students. A total of 15 686 university students between the ages of 16-30 years from 22 different countries were included in the study. A high prevalence of overweight and obesity was observed among students attending universities in both developed and developing countries. In South Africa it was found that between 10.8% and 24.0% of the students were overweight or obese respectively (Peltzer, Pengpid, Samuels, Özcan, Mantilla, Rahamefy, Wong & Gasparishvili 2014). Studies have indicated a higher percentage of weight gain during the first year of study. A meta-analysis that consisted of 32 studies was conducted in order to investigate body weight changes among first year university students. The results revealed that more than half of the students gained weight during their first year of study and on average the students gained 3.38kg (Vadeboncoeur *et al* 2015).

In addition to the overweight and obesity problem, university students have also demonstrated poor dietary and lifestyle behaviours that could impact negatively on their health status during adulthood (Majeed 2015). Studies have shown that university students often adopt sedentary behaviours, do not consume the recommended quantities of vegetables and fruits, and instead consume excessive amounts of foods and beverages that are high in added sugar and fat (Van den Berg, Abera, Nel & Walsh 2012). Therefore, unhealthy dietary habits paired with decreased physical activity levels could result in the development of overweight and obesity and its associated complications (Van den Berg *et al* 2012). A multitude of factors influence the dietary and lifestyle habits of university students. Some of them include taste, cost, convenience, availability and accessibility, living arrangements, friends and family (Deliens, Clarys, De Bourdeaudhuij & Deforche 2014). Studies have also found differences in the dietary intake of students from different demographic characteristics (Lupi, Bagordo, Stefanati, Grassi, Piccinni, Bergamini & De Donno 2015). Therefore, understanding the internal, external and demographic factors that influence the dietary habits of university students could assist in the development of more tailored interventions that would improve the dietary habits of this population group (Deliens *et al* 2014).

The increased consumption of sugar sweetened beverages (SSBs) among various population groups worldwide has raised much concern with regards to their influence on health. Some

studies have indicated that the high consumption of SSBs could increase the chances of one developing dental caries, cardiovascular disease, diabetes and obesity. SSBs contribute a substantial amount of kilojoules (KJ) to an individual's total energy intake and many studies have associated the consumption of these beverages with the possible development of overweight and obesity (Te Morenga, Mallard & Mann 2012). There is a dearth of literature surrounding the added sugar intake from foods and beverages among university students in South Africa. Although studies that were conducted nationally and internationally have assessed the dietary habits of university students, there is a limited amount of studies that have particularly assessed added sugar intake as well as its influence on body weight. The following questions therefore arise:

- Are South African university students within a healthy body mass index (BMI) range?
- Is there a relationship between the intake of added sugar and the BMI of university students?
- What are the main factors that influence the intake of SSBs among university students?

It is anticipated that the results from this study will assist in determining the prevalence of overweight and obesity among undergraduate university students, the intake of added sugars and its influence on BMI, the influence of demographic characteristics on added sugar intake and the factors that influence the students' intake of SSBs. Since the University of KwaZulu-Natal (UKZN) consists of students from different race groups, genders and fields of study, the results from this study could be applied to other South African universities. An understanding of the dietary habits of university students and the factors that contribute towards the development of these habits can allow effective policies to be established in order to reduce the prevalence of overweight and obesity.

1.2 Statement of the problem

To determine the relationship between added sugar intake and BMI among undergraduate students between the ages of 18-25 years attending the University of KwaZulu-Natal in Pietermaritzburg.

1.3 Research objectives

The following objectives will be investigated in this study:

1.3.1 To determine the demographic characteristics of the students such as age, gender, race and place of residence.

1.3.2 To determine the BMI of the students.

1.3.3 To determine the dietary intake of added sugar from foods and beverages among the students.

1.3.4 To determine the association between the dietary intake of added sugar and the students' BMI.

1.3.5 To determine the consumption and consumption patterns of SSBs.

1.3.6 To determine the influence of demographic characteristics on the dietary intake of added sugars.

1.3.7 To determine the factors that relate to the purchases and intake of SSBs.

1.4 Hypotheses

Hypothesis 1:

The students' intake of added sugars are within the WHO recommendations regarding added sugar intake.

Null hypothesis 2:

There is no relationship between added sugar intake and BMI.

Null hypothesis 3:

There is no relationship between student demographics and the intake of foods and beverages that contained added sugar.

Hypothesis 4:

External factors including taste, price, marketing and opinions of family and friends influenced the decision to purchase SSBs.

1.5 Inclusion and exclusion criteria

The following students were included in this study:

- All male and female undergraduate students aged 18 to 25, of all race groups that studied at UKZN in Pietermaritzburg and consumed foods and beverages that contained added sugars.
- Students that had some involvement in the purchasing of the foods and beverages that they consumed.

The following students were excluded from this study:

- Students that did not consume foods and beverages that contained added sugars.
- Students that were not involved in purchasing of the foods and beverages that they consumed.

1.6 Definitions

24 hour dietary recall:	A dietary assessment method in which individuals are expected to recall all foods and beverages that were consumed over the past 24 hours (Thompson & Subar 2013, p7).
Added sugar:	Sugar that does not occur naturally in a food or beverage but is added during manufacturing and processing (Maclntyre, Venter, Kruger & Serfontein 2012).
Body mass index:	A tool that is used to classify adults as being underweight, overweight or obese using weight and height. It is measured by dividing the weight in kilograms (kg) by the height in metres squared (m^2) (WHO 1993, 2000, 2004).
Cross sectional study:	A cross sectional study is conducted over a short period of time without any follow up assessments and it is used to determine the prevalence of knowledge towards an aspect (Merrill 2012, p92).
Energy dense:	Energy density is the amount of kilojoules per 100gram of a food item. Energy dense foods have a high amount of kilojoules per bite (British Nutrition Foundation 2016).

Food frequency questionnaire:	A dietary assessment method which is used to determine usual food intake from a list of foods and beverages over a prescribed duration (Thompson & Subar 2013, p9).
Marketing:	The process in which information on products and services is delivered to customers or clients that have interest in that particular product or service (Chandon & Wansink 2012).
Non-communicable diseases:	Chronic diseases that usually have a slow progression and are not passed on through contact with another individual (WHO 2015c).
Nutrition transition:	Changes in dietary and lifestyle habits that result in the development of more contemporary lifestyles due to urbanisation and development (Maclntyre *et al* 2012).
Obesity:	A condition that is characterised as the excessive accumulation and storage of fat in the body and in an adult an individual is considered if the Body mass index is above 30kgm^2 (WHO 2015d).
Overweight:	A body mass index in adults between the range of 25-29.9kgm^2 is considered as being overweight (WHO 2015d).
Sugar sweetened beverages:	Beverages that have a high caloric value and that contain sucrose, high fructose corn syrup, glucose and other sweeteners (Mantzari, Hollands, Pechey, Jebb & Marteau 2015).

1.7 Abbreviations

BMI	Body Mass Index
DOH	Department Of Health
FAO	Food and Agricultural Organisation
FBDG	Food Based Dietary Guidelines
FFQ	Food Frequency Questionnaire
KJ	Kilojoules
NCDs	Non-Communicable Diseases
NFCS	National Food Consumption Survey
NHANES	National Health and Nutrition Examination Survey
RCTs	Randomised Control Trials
SANHANES-1	South African National Health and Examination Survey
SSBs	Sugar Sweetened Beverages
UKZN	University of KwaZulu-Natal
WHO	World Health Organisation

1.8 Assumptions

The following assumptions were made:

- Since the students were studying in English, they would able to read and understand the informed consent document, the questionnaire and complete a 24 hour dietary recall.
- The students spent most of their time during the day on campus.
- The students were honest when completing the questionnaire.
- The students were honest when recording the added sugar intake from foods and beverages when completing the 24 hour dietary recall and the food frequency questionnaire (FFQ).
- The anthropometric measurements (weight and height) of the students were taken accurately by the fieldworkers.
- The fieldworkers collected the data in a standardised and consistent manner as outlined during their training process.

1.9 Summary

The incidence of overweight and obesity has increased substantially among various populations worldwide and recent evidence has indicated that the consumption of added sugars, particularly from SSBs may contribute towards this problem. Studies that were conducted among adults and children have linked the consumption of SSBs to the development of overweight and obesity, diabetes and dental caries. Studies have shown a high prevalence of overweight and obesity among university students, and this in turn has contributed considerably towards the overweight and obesity statistics worldwide. The transition of students from secondary to tertiary education has negatively impacted on the nutritional habits of this population group as students tend to consume more foods and beverages that have little nutritional value. Multiple factors, such as the increased accessibility, availability and affordability of these foods and beverages have contributed towards the development of poor dietary behaviours among university students. It is anticipated that this study will shed light on the added sugar intake of university students and determine whether this has any impact on their BMI.

1.10 Dissertation overview

This dissertation consists of six chapters. The first chapter will provide information on the relevance and importance for conducting this study and it will also outline the objectives, hypotheses and parameters of the study. Chapter two will provide an overview of the current literature relating to the research problem and objectives. The third chapter will outline the methodology used in this study and the fourth chapter will present the results of the study after the statistical analyses of the results. The fifth chapter will discuss the results from this study in relation to previous studies based on the literature review in chapter two. The conclusions obtained from this study will be outlined in chapter six along with recommendations for further research based on the conclusions drawn from this study.

1.11 Referencing style

This dissertation has been written using the referencing style compiled by the Discipline of Dietetics and Human Nutrition at UKZN, Pietermaritzburg.

CHAPTER 2: REVIEW OF THE RELATED LITERATURE

The following chapter will provide a review of the existing literature that examines the relationship between added sugar intake and BMI among university students. The literature review has been divided into five parts. The first part will set the scene regarding the overweight and obesity problem worldwide. The trends in overweight and obesity among South African adults as well as the causes of overweight and obesity will be outlined in the second part. The third part will include information on added sugar intake among adults with a focus on SSB intake. The fourth part will include information on the prevalence of overweight and obesity among university students, the dietary habits of university students and the influence of added sugar intake on their BMI. Finally, a summary outlining the importance of this study will be provided.

2.1 Introduction to the overweight and obesity problem

The rapid increase in the prevalence of overweight and obesity among various populations worldwide has become a major health problem (WHO 2016e). According to a systematic analysis that was conducted on the prevalence of overweight and obesity among adults and children worldwide, it was found that between the years 1980 and 2013, the number of overweight and obese subjects increased from 921 million during the year 1980 to 2.1 billion during the year 2013 (Marie *et al* 2014). During the year 2014 more than one third of adults above the age of 18 were overweight and 13% were obese (WHO 2016e).

Along with the significant burden placed on health, overweight and obesity also impacts negatively on the economic system. Overweight and obesity as well as other NCDs decreases productivity, increases health care costs, increases absenteeism from work and this in turn impacts on the turnover of companies as employees still get paid despite being absent from work (Tugendhaft & Hofman 2014). According to a study that was conducted among 70 000 South African adults during the year 2010, it was found that moderate and severe obesity increased health costs by 11% and 23% respectively (Sturm, An, Marobo & Patel 2013).

2.2 Overweight and obesity

2.2.1 Trends in overweight and obesity in South Africa

Previously, overweight and obesity was considered to be a problem solely amongst developed countries and undernutrition or malnutrition was more common amongst developing countries. However, recent studies have indicated that the incidence of overweight and obesity has become increasingly common in developing countries (Micklesfield, Lambert, Hume, Chantler, Pienaar, Dickie, Puoane & Goedecke 2013). As a result, many developing countries have been faced with a double burden of disease as the prevalence of both under-and over-nutrition still remain high (Micklesfield *et al* 2013). Up until recently, Africa has been identified as the continent with the fastest growing rates of obesity as well as its associated complications. Therefore, this continent has been faced with a double burden of disease (Maclntyre *et al* 2012).

The prevalence of obesity differs greatly between the countries that are situated in Sub-Saharan Africa (Micklesfield *et al* 2013). It has been noted that among all of the countries that are situated in the Sub-Saharan Africa, South Africa has been identified as the country with the highest percentage of obese individuals (Micklesfield *et al* 2013). An analysis of three cross sectional surveys from the South African National Income Dynamic Study (SA-NIDS) was conducted by Sartorius, Veerman, Manyema, Chola & Hofman (2015) in order to determine the prevalence, contributing factors and trends of obesity among approximately 44000 South Africans 15 years and older between the years 2008 and 2012. This analysis revealed that the incidence of overweight for both male and female subjects increased from 23.6% to 28.5% between the year 2008 and 2012 and the incidence of obesity increased from 23.5% to 27.2% between the year 2008 and 2012. The high rates of overweight and obesity among subjects above the age of 18 years, indicates that young adults are also susceptible towards this problem. Various factors have been linked to the development of overweight and obesity. A brief outline of this will be provided in the next section.

2.2.2 Causes of overweight and obesity

Overweight and obesity is primarily caused by an imbalance in energy input and energy output system. The increased consumption of foods and beverages that are high in added sugars and fat paired with decreased physical activity levels contributes towards a positive energy balance thus resulting in weight gain (Hu & Malik 2010). However, studies have also suggested that genetics, socio-economic status, family and friends, culture and the food environment could also contribute towards this problem (Sartorius *et al* 2015).

2.2.2.1 Gender differences in overweight and obesity

Several studies that were conducted in South Africa and Sub-Saharan Africa found that obesity was more common among females (especially Black Africans) than males. The cross sectional analysis that was conducted by Sartorius *et al* (2015), revealed that 38.0% of females and 13.3% of males in South Africa were obese during the year 2012. These findings were in agreement with the systematic analysis conducted by Marie *et al* (2014) who also found that the prevalence of obesity among South African males and females above the age of 20 was 13.5% and 42.0% respectively during the year 2013.

Case & Menendez (2009) conducted a study between 2004 and 2005 on 500 households situated in an urban Black African township in Cape Town in order to determine the possible reasons for the differences in overweight and obesity among males and females. This study identified two factors that influenced gender differences in overweight and obesity: poverty during childhood; and an increase in the socio-economic status during adulthood. Although both men and women faced the same challenges of poverty during their childhood, this significantly influenced weight gain among the female subjects during adulthood. An increase in the socio-economic status of both males and females during adulthood was significantly associated with obesity among the females. This could be due to the fact that women with higher incomes have greater control over their resources and therefore have a greater influence on household food expenditure, thus their control over these resources results in weight gain (Case & Menendez 2009).

Studies have also indicated that females tend to engage in more sedentary behaviours and consume more sugar containing foods in comparison to their male counterparts (Kanter & Caballero 2012). According to the reports from the WHO, during the year 2010, worldwide more females than males above the age of 18 years were physically inactive and individuals from lower income countries demonstrated lower levels of physical activity in comparison to those from higher income countries (WHO 2016f). The decreased physical activity levels as well as the increased consumption of foods and beverages that are high in added sugar and fat among the females could also contribute towards the gender differences in overweight and obesity.

2.2.2.2 The influence of culture on overweight and obesity

Cultural factors could also influence the prevalence of overweight and obesity among individuals in developing and developed countries. Studies have shown that in developing countries some cultures, particularly Black Africans, prefer 'larger' body sizes as this is associated with prosperity and good health, whereas 'smaller' body sizes have been associated with sickness and poverty. Therefore, individuals from these population groups, particularly females, tend to develop dietary and lifestyle behaviours that promote the development of overweight and obesity (Kanter & Caballero 2012). In developed countries, obesity among men indicates prosperity and good health, however among females, a 'smaller' body size is often preferred (Kanter & Caballero 2012). Thus, male subjects residing in developed countries display higher rates of overweight and obesity.

2.2.2.3 The influence of socio-economic status on overweight and obesity

The analysis of cross sectional surveys that was conducted by Sartorius *et al* (2015) between 2008 and 2012 revealed that in Sub-Saharan Africa, obesity was more common among individuals that were from a higher socio-economic status. This study also indicated that urbanisation greatly influenced the prevalence of overweight and obesity in South Africa, especially among females as indicated in the study conducted by Case & Menendez (2009). During urbanisation and socio-economic development, individuals tend to adopt more contemporary lifestyles in which poor dietary and lifestyle habits are embraced as individuals tend to consume larger portions of food products that are high in sugar and fat, consume few vegetables and fruits and display poor levels of physical activity, thus contributing towards this obesogenic environment. According to this analysis, physical inactivity contributed 15% towards the obesity problem in South Africa (Sartorius *et al* 2015). Since diet has been identified as one of the factors that contributes towards the overweight and obesity problem, the next section will assess the dietary intake of South African adults.

2.2.3 Dietary intake related to overweight and obesity

2.2.3.1 Variations in the dietary intake of food and beverages among South African adults

There is a dearth of information available on the dietary habits of adults as the National Food Consumption Survey (NFCS) is the only large-scale survey that was conducted in 1999 among children between 1 and 9 years. Therefore a systematic review was conducted using studies that have assessed the dietary intake of adults (Mchiza *et al* 2015). This study included information from studies conducted in urban and rural areas in the North West province, KwaZulu-Natal,

the Free State, the Vaal region and urban areas in Cape Town and it included studies that were conducted on the dietary habits of adults between 2000 and 2015. According to the results from this study it was found that the most common food items consumed by South African adults residing in these areas were sugar, tea, maize porridge, bread, full cream milk, coffee, chicken, cakes and biscuits, sweets and chocolates, margarine, oil, potatoes, vegetables, fruits, soft drinks, eggs and rice. Although fruits and vegetables were listed among the common foods consumed, the consumption of these items was low. Based on analysis of these results, the consumption of staples, sugar and fat was relatively high among the adult population group in South Africa and their diets lacked variety (Mchiza *et al* 2015).

The dietary habits of South Africans has changed over the years as people have adopted more Westernised patterns of living and this has resulted in changes in the nutritional composition of the diet of many South Africans. The variations in the quality and quantity of foods and beverages that are being consumed has led to the development of several NCDs (Ronquest-Ross, Vink & Sigge 2015). Due to the cost and workload associated with gathering data on food changes and nutrient intake, there is a very limited amount of data available on food consumption patterns of adults in South Africa. A study was conducted using two sets of data sources; FAOSTAT food balance sheets and Euromonitor International© Passport in order to determine the variations in the dietary intake of foods and beverages among South Africans since 1994 (Ronquest-Ross *et al* 2015). Food balance sheets are used to analyse the countries food supply over a certain period of time (FAO 2014) and the Euromonitor International© Passport is a "Global market research database providing statistics, analysis, reports, surveys and breaking news on industries, countries and consumers worldwide" (Passport Euromonitor International 2016). The results from this study indicated that between 1994 and 2012, there were significant changes in the dietary habits of South Africans, as the consumption of SSBs, meat products, sweeteners, processed and packaged foods increased and the consumption of vegetables decreased. Adjustments to the quality and quantity of foods and beverages consumed between these time periods resulted in an increase in the total energy input as well as an increased intake of fats, sugar and salt. This has therefore raised many health concerns as these adjustments have contributed towards the overweight and obesity problem which in turn has contributed towards the development of several NCDs (Ronquest-Ross *et al* 2015). The evidence provided from these studies suggest that South Africa is at a point of transition therefore the habits adopted could contribute towards the overweight and obesity problem.

2.2.3.2 Nutrition transition

Nutrition transition has impacted on the dietary and lifestyle behaviour of individuals in developing countries. Urbanisation and economic growth has contributed towards nutrition transition and this has inevitably contributed towards the development of overweight and obesity as well as several NCDs. During economic growth as well as urbanisation, individuals tend to shift away from consuming traditional diets and increase their consumption of energy dense foods and beverages. The changes in the dietary and lifestyle factors that accompany nutrition transition, has resulted in a decrease in the physical activity levels and an increase in the dietary intake of foods and beverages that are high in fat and added sugars therefore contributing towards the overweight and obesity problem (Vorster, Kruger & Margetts 2011).

2.2.4 Factors that influence the food and beverage purchases and intake of consumers

In order to develop strategies to reduce the dietary intake of foods and beverages that contain added sugars, it is essential that the various factors that influence the consumers selection of these products are identified (Kit, Fakhouri, Park, Nielsen & Ogden 2013). Recent studies have indicated that multiple factors such as taste, affordability, social influences, availability, accessibility, advertising and marketing influences the consumers selection of foods and beverages and this in turn impacts on the type of foods and beverages consumed (Vanishree, Aman & Manasa 2012).

2.2.4.1 The influence of marketing and promotion on food and beverage purchases and intake

Promotions and marketing are the main factors that food and beverage companies use as a tactic to draw consumers to purchase various products. Since consumer purchases are easily influenced by taste, price and convenience; food and beverage companies spend a substantial amount of money in order to promote and market their products to meet the consumers' preferences as well as generate a profit. A large portion of this money is used to market foods and beverages that have very little nutritional value (Nestle 2013, p22). These products have been found to generate a large profit and are therefore deliberately positioned at an eye level on the shelves whereby they can be easily seen and accessed (Tugendhaft, Manyema, Veerman, Chola, Labadarios & Hofman 2015). Due to the impact that food marketing has on food intake, it has also been identified as one of the factors that contribute towards to the overweight and obesity problem (Chandon & Wansink 2012).

Several mediums such as the television, newspaper, magazines, radio, internet and outdoor advertising have been used to promote and market various food products. This influences consumer preferences, purchases, and consumption of foods and beverages that are high in added sugar and fat. These marketing schemes tend to inform consumers of the price of the product as well as the place of purchase (Chandon & Wansink 2012). Several other marketing schemes such as branding and labelling; offering discounts on products; buy one get one free promotions; end of aisle displays; health claims which can be easily misunderstood; sponsorships and celebrity endorsements can also directly influence the purchases of foods and beverages that have a low nutrient content (Tedstone, Targett & Allen 2015).

Food advertising is not the only factor that contributes towards unhealthy food choices as it interlinks with other marketing related factors such as price and place of purchase as well as other aspects not associated with marketing including social influences and taste (Chandon & Wansink 2012). Therefore a holistic approach is required in order to steer consumer purchases into a more positive direction.

2.2.4.2 The influence of branding and labelling on food and beverage purchases and intake

Branding and labelling of food products impacts greatly on consumer purchases as it determines the type of product that will be purchased and consumed. A substantial amount of time and money is spent by food and beverage companies in order to design products that will be most appealing to consumers and increase purchases (Chandon & Wansink 2012). According to the 2010 Coca-Cola annual reviews, in South Africa the consumption of Coca-Cola products increased by almost 50% between the year 1992 and 2010 and this was largely influenced by the branding and advertising of these products in various urban and rural areas (Coca-Cola Company 2010).

2.2.4.3 The influence of price on food and beverage purchases and intake

Consumer purchases of foods and beverages are greatly influenced by the price of the product, as pricing strategies will determine the type as well as the quantity of food products that will be purchased. Studies have indicated that the socio-economic status of a consumer will determine the type of foods and beverages that are consumed (Steenhuis, Waterlander & De Mul 2011). According to a cross sectional study that was conducted in the Netherlands among 159 adults that were 18 years and older, it was found that price was the most influential factor with regards to food purchasing among individuals that were from a lower socio-economic status as

consumers from this socio-economic level usually take price into account when doing shopping (Steenhuis *et al* 2011). This study used subjective sampling in order to recruit the subjects as subjects were recruited at the point of purchase.

Studies have indicated that foods and beverages that are high in sugar and fat such as SSBs, biscuits, cakes, sugar coated cereals and high fat snacks are usually sold at a lower and more affordable price in comparison to healthier food products. Therefore this results in an increase in the purchases as well as consumption of foods and beverages with little nutritional value (Waterlander, De Haas, Van Amstel, Albertine, Schuit, Twisk, Visser, Seidell & Steenhuis 2010). In South Africa, healthier food products cost approximately 69% more than food products usually consumed by South Africans, therefore due to financial constraints, a healthy diet that consists of more lean meat, low fat products and are high in fibre and nutrients may be unaffordable for many South Africans (Temple, Steyn, Fourie & De Villiers 2011).

The cross sectional study that was conducted in the Netherlands on 159 adults revealed that pricing strategies can also influence a consumer's dietary behaviour and that consumers prefer price changes that have more positive benefits. Various pricing strategies were tested in this study and it was found that among all the strategies, offering discounts on healthy food products and applying a lower Value Added Tax (VAT) rate to healthy food products was selected as the strategies that would have the greatest influence on the dietary habits of individuals from low and high socio-economic levels (Steenhuis *et al* 2011). The subjects indicated that these pricing strategies will increase their consumption of healthy food products but its influence on unhealthy food consumption was low. Therefore positive pricing strategies could further increase the total energy input and contribute to weight gain. Although the study conducted in the Netherlands had a few limitations with regards to the method of sampling as well as the type of subjects recruited, it provided information on the influence of price on consumer purchases. However, there is a need for more studies to be conducted on a larger study population over a longer period of time in order to measure the long term effects of pricing strategies on consumer purchases as well as determine which pricing strategies will be most influential on purchasing behaviour (Waterlander *et al* 2010).

2.2.4.4 The influence of the food environment on food and beverage purchases and intake

The food environment refers to any setting in which the availability and price of the food product will influence dietary behaviour and examples of such settings are restaurants, the home and supermarkets. Food environments aim at making food products more available and easily accessible at more affordable prices, therefore it tends to directly influence consumer purchases (Chandon & Wansink 2012). The availability of ready to eat food products particularly food products that have little nutritional value, has increased in developing countries since food environments have expanded and one can purchase these products at schools, universities, petrol stations, cafés and pharmacies. Due to the increase in the food supply of more convenience foods at affordable prices, the food environment also contributes towards the incidence of overweight and obesity (Chandon & Wansink 2012).

2.2.4.5 The influence of taste on food and beverage purchases and intake

Taste has a great influence on the type of food products that are consumed. Different taste preferences will influence the type of foods and beverages that are consumed among different age groups, races and cultures and this will in turn influence dietary habits, nutritional intake and the overall health status (Drewnowski, Mennella, Johnson & Bellisle 2012). Since taste impacts greatly on consumer purchases, food companies aim to make their food products more appetising and appealing to consumers in order to increase sales (Chandon & Wansink 2012).

The development of food habits usually begins during early childhood and these habits can be carried into adolescence and eventually into adulthood. Sweetness has been identified as the factor that has the strongest sensory appeal and is the most preferred (Drewnowski *et al* 2012). Therefore worldwide there has been an increase in the consumption of foods and beverages that contain added sugars and this in turn has contributed towards the increased rates of overweight and obesity (Drewnowski *et al* 2012). The intensity of sweetness preferred varies across different age groups, races and genders. Children tend to prefer food products with a higher intensity of sweetness in comparison to adults and according to Temple & Steyn (2013), a rapid increase in the consumption of added sugars was noted among the Black African population in South Africa.

2.2.4.6 Social influences on food and beverage intake

Apart from the provision of nutrients to the body, eating has also been considered as a social activity and a form of entertainment which can easily be influenced by extrinsic factors such as family, friends and the environment (Higgs & Thomas 2016). Dietary behavior has been perceived as being different when one eats alone or in company. When eating in company the type as well as quantity of foods or beverages consumed is easily influenced by the social group present. Thus, recent evidence has suggested that social norms could also influence the development of overweight and obesity (Higgs & Thomas 2016).

Dietary habits are usually molded by our surroundings, therefore the type of environment that individuals are exposed to will directly influence their food choices. According to a review that was conducted using 69 experimental studies that were conducted between 1974 and 2014 and included participants of different age groups, it was found that social factors can directly influence the type and amount of food products consumed as individuals tend to adjust the amount of food products consumed in accordance to those that are within their social group. A high frequency of consumption of food items that contained added sugar was observed among the subjects that participated in this study (Cruwys, Bevelander & Hermans 2015). It is therefore essential that the importance of adopting a healthy diet is emphasized in order to ensure that individuals across all age categories adopt healthier dietary behaviors.

2.3 The dietary intake of added sugar

Sugar is a compound that can be found in various food products either in its natural form such as in fruits, vegetables, dairy products and grains or it can be added into various products such as fruit juices, carbonated beverages, sauces, breakfast cereals and milk powders during manufacturing, processing and preparation of the product (Chun, Chung, Wang, Padgitt & Song 2010). As part of a healthy diet small amounts of sugar are required, however recent studies have indicated that the consumption of "free sugars" has increased among various population groups worldwide and this has resulted in the development of several NCDs (Chun *et al* 2010). The term "added sugar" has been defined differently by some organisations and nutrient databases. The Food and Drug Administration (FDA) has defined added sugar as "sugar and syrups that are added to food products during the manufacturing and preparation process and does not include natural sugars" (FDA 2016). The WHO uses the term "free sugars" and this includes added sugars as well as sugars naturally present in honey, syrups and fruit juices (WHO 2015b).

With regards to the consumption of added sugars, most studies have focused on the consumption of SSBs. SSBs includes all beverages that contain added sugars such as: carbonated soft drinks, fruit juices, juice concentrates, flavoured water and flavoured or sweetened dairy products. The increased consumption of these beverages have been linked with the development of various health problems including overweight and obesity (Beaglehole 2014). Therefore the next section will focus on assessing the SSB intake.

2.3.1 Sugar sweetened beverage intake

2.3.1.1 Sugar sweetened beverage intake internationally

Worldwide, the consumption of SSBs, particularly carbonated soft drinks has become increasingly common. A systematic analysis was conducted during 2010 in order to determine the global, regional and national intake of SSBs among adults above the age of 20 from 187 countries. This study found that worldwide, carbonated soft drinks were the most frequently consumed beverage when compared to fruit juices and milk drinks, and in comparison to higher and lower middle income countries, the consumption of carbonated soft drinks was higher among upper middle income countries. The consumption of fruit juices was higher among higher income countries, however slight differences were noted between the amounts consumed in higher and upper middle income countries (Singh, Micha, Khatibzadeh, Shi, Lim, Andrews, Engell, Ezzati & Mozaffarian 2015).

Similarly, an analysis that was conducted between 1997 and 2010 among adult male and female subjects between the ages of 20-79 years from 75 countries, revealed that the consumption of carbonated soft drinks is increasing in lower to middle income countries (Basu, McKee, Galea & Stuckler 2013). This analysis used data from the Euromonitor Global Market Information Database, the WHO, and the International Diabetes Federation and variables such as the energy input from other food items, income level, urbanisation and age were controlled for in this study. This analysis revealed that globally the average consumption of carbonated soft drinks increased from 35.96 litres per person during 1997 to 43.15 litres per person during 2010. The increase in consumption was found to be higher among lower to middle income countries as the average consumption in these countries increased from 24.98 litres per person during 1997 to 29.53 litres per person during 2010, whereas in higher income countries the consumption increased from 54.5 litres to 56.0 litres per person over this time period (Basu *et al* 2013). Among all of the countries that were included in this analysis, individuals residing in the United States had the highest consumption of carbonated soft drinks during 1998 (143.09 litres per

person). However the volume consumed decreased during 2010 (118.10 litres per person) and Mexico thereafter revealed the highest consumption rate of carbonated soft drinks (119.24 litres per person) (Basu *et al* 2013). Although the analysis by Basu *et al* (2013) revealed that in certain higher income countries there was a decrease in the volume of carbonated soft drinks consumed, the consumption of SSBs still remains high and contributes a significant amount of added sugars as well as kilojoules towards the overall dietary intake among several countries worldwide.

2.3.1.2 Sugar sweetened beverage intake in South Africa

The prevalence of nutrition transition in South Africa has led to the development of poor dietary habits, since food and beverages that have little nutritional value have become more available, affordable and can be easily accessed due to the expansion of markets into the informal areas. This phenomenon has been observed with the increased consumption of SSBs among lower income areas. Vorster, Kruger, Wentzel-Viljoen, Kruger & Margetts (2014) conducted a study in the North West Province on added sugar intake among South African adults over a 5 year follow up period between 2005 and 2010. Their findings revealed that the percentage contribution of added sugars to the subjects' diet exceeded the recommendations on sugar intake. This study also indicated that there was a significant increase in the number of individuals from rural areas that were consuming SSBs, thus indicating that nutrition transition is prevalent in South Africa. Although most South Africans consume approximately 40% of their total daily energy needs, their diets are still of poor nutritional quality due to the poor dietary habits that they have adopted. Thus resulting in overweight or obese individuals that have nutrient deficiencies (Tugendhaft *et al* 2015).

The study that was conducted on the variations in the dietary intake of foods and beverages among South Africans between 1994 and 2012 (Ronquest-Ross *et al* 2015) revealed that the total consumption of SSBs increased by 68.9% between this time period. Carbonated soft drinks were the most frequently consumed beverage, and this was followed by the fruit or vegetables juice category, in which 100% fruit juices was the most frequently consumed beverage. This study also revealed that the consumption of juice concentrates as well as energy drinks had rapidly increased between 1994 and 2012, and that the consumption of juice concentrates doubled between these time periods.

The increased consumption of SSBs among various countries has raised much concern with regards to its association with weight gain. Studies that have assessed this phenomenon have

generated different findings. This aspect will be further explained under section 2.3.3. The next section will address the differences in added sugar intake across the different demographic characteristics.

2.3.2 The influence of demographic characteristics on the dietary intake of added sugar

Apart from addressing the environmental factors that contribute towards the overweight and obesity problem, dietary habits across different genders, races and socio-economic statuses also need to be assessed in order to develop more specific guidelines to improve dietary behaviour. However, only a few international studies have assessed the added sugar intake across the different demographic characteristics (Thompson, McNeel, Dowling, Midthune, Morrissette & Zeruto 2009).

2.3.2.1 The dietary intake of added sugars according to gender

In order to determine the added sugar intake across adults of different genders, races, income levels and places of residence an analysis of cross sectional surveys was conducted using data from the NHANES (National Health and Nutrition Examination Survey) which was conducted between 2005 and 2010. This study assessed the consumption patterns of added sugars from foods and beverages among adults above the age of 20 that resided in the United States. Based on analysis it was found that the daily consumption of added sugars was higher among men than women (1401.64KJ and 999.98KJ respectively) (Ervin & Ogden 2013).

2.3.2.2 The dietary intake of added sugars according to race

The cross sectional analysis that was conducted using data from the NHANES, also indicated differences in the consumption of added sugars across the different race groups. This analysis found that non-Hispanic Black men and women consumed a higher amount of kilojoules from added sugars in comparison to non-Hispanic White and Mexican American men and women (Ervin & Ogden 2013). A study that was conducted by Han & Powell (2013) on the consumption patterns of three types of SSBs (carbonated soft drinks, fruit drinks and energy drinks) also revealed that the consumption these beverages differed across the different demographics and socio-economic levels. This study population consisted of children, adolescents and adults from the United States and data was derived from the NHANES which was conducted between 1999 and 2008. The data that was obtained from the NHANES included information on trends, a cross sectional analysis of a 24 hour dietary recall, demographic factors and socio-economic levels. The results from this study indicated that the consumption of SSBs

across all age groups was higher among Hispanics and individuals from the Black race group. When assessing consumption patterns by the type of SSB consumed, Han & Powell (2013) found that among all the categories of SSBs included in this analysis, fruit drinks contributed the most amount of kilojoules among children and that carbonated soft drinks contributed the most amount of kilojoules among the other age groups. In comparison to the White race group, Blacks and Hispanics across all age groups were more frequent consumers of fruit drinks and Black children and adolescents seldom consumed carbonated soft drinks and energy drinks.

2.3.2.3 The dietary intake of added sugar according to different places of residence

Ervin & Ogden (2013) found that the consumption of added sugars differed according to the subjects' place of residence. Most of the kilojoules from added sugars came from foods and beverages that were consumed at home as these food products contributed the most amount of added sugars towards the total energy input. However, in comparison to beverages, food items that contained added sugars contributed a greater amount of kilojoules towards the diet for subjects that lived at home.

2.3.2.4 The dietary intake of added sugar according to socio-economic levels

The cross sectional analysis that was conducted by Ervin & Ogden (2013), found that socio-economic status influences the intake of added sugars. Across both genders included in the study an increase in age and income level resulted in a decrease in the consumption of added sugars. Similarly, the study that was conducted by Han & Powell (2013) indicated that the consumption of SSBs was higher among individuals that were from a lower educational level and socio-economic status. With regards to the type of beverage consumed, individuals from lower socio-economic levels and that were less educated were more frequent consumers of carbonated soft drinks.

2.3.3 The association between added sugar intake and body weight

Weight gain can result from consuming diets that contain an excessive amount of foods and beverages that are high in energy as these contribute towards an increase in the overall energy input (Hendriksen, Boer, Du, Feskens & Van der 2011). Although the consumption of added sugars is not the only factor that contributes towards the incidence of obesity, recent studies have indicated that the consumption of added sugars, particularly from SSBs may contribute towards weight gain. These beverages contain empty calories, have a low satiety and therefore facilitates an increased intake of foods that have very little or no nutritional value (Temple &

Steyn 2013). SSBs contribute a significant amount of added sugar to the total energy intake. One 330ml can of a carbonated beverage contains an average of 8 teaspoons of sugar and fruit juices of the same serving size contains approximately 9 teaspoons of sugar, therefore many studies have focused on determining the relationship between the consumption of these beverages and weight change (Tugendhaft & Hofman 2014).

A modelling study was designed in order to determine the influence that an increased intake of SSBs will have on obesity levels among South Africans in years to follow should there be no interventions in place. Data with regards to the consumption of SSBs were obtained from the South African National Health and Nutrition Examination Survey (SANHANES-1)[1] and obesity statistics were obtained from the SA-NIDS. Based on the reports from these studies, it was projected that between 2012 and 2017 the annual consumption rate of SSBs is expected to increase by 2.4% among both genders of all age groups. On average it was found that during the baseline year South African adults above the age of 15 consumed 184ml of SSBs per day and that with age consumption decreased. Based on the projected increase, it is expected that by 2017 South Africans will be consuming 200ml of SSBs per day, however due to differences in consumption across different age groups, some age groups might even exceed this volume. It was also projected that with the increased consumption of SSBs over this 5 year period, the obesity rates will be further increased by 5.2% and 3.0% among men and women respectively (Tugendhaft *et al* 2015). Although the estimated average consumption of SSBs as calculated based on data from the SANHANES-1 appears to be lower than data from other sources possibly due to the number of SSBs included in the analysis as well as poor dietary recalls, the consumption of SSBs is high and will continue to increase based on the estimates from this modelling study (Tugendhaft *et al* 2015).

Studies that have been conducted on determining the association between added sugar intake and weight gain have produced inconsistent findings. A possible reason for the differences in the results could be due to the different methodologies that were used in conducting the studies. Some studies made use of a smaller sample size, the duration of follow up was over a shorter period of time and the data collection was influenced by other dietary habits and lifestyle factors

[1] Shisana O, Labadarios D, Rehle T, Simbayi L, Zuma K, Parker W, Maluleke T, Mchunu G, Naidoo P, David Y, Mokomane Z, Onoya D (2013). South African Health and National Nutrition Examination Survey (SANHANES-1). Cape Town: HSRC Press. For the purpose of this dissertation it will be referred to as SANHANES-1.

(Te Morenga *et al* 2012). Studies that have made use of a larger sample size and that were conducted over a longer period of time established a much stronger relationship between SSB consumption and weight gain.

Malik, Pan, Willett & Hu (2013) conducted a systematic review and meta-analysis of prospective cohort studies and Random Control Trials (RCT) on the association between SSB consumption and weight gain among adults and children. Thirty two articles were reviewed in the analysis; 20 in children and 12 in adults. Out of the 12 studies that were included for adults, seven were cohort studies with a study population of 174 252 and five were RCT with a study population of 292. The studies that were included in the analysis were those that made use of original research, looked at SSBs alone, studies that were previously conducted in adults and children and it did not include cross sectional or ecological studies. The prospective cohort studies that were conducted among adults revealed that an increase in the daily servings of SSBs resulted in an additional weight gain between 0.12 and 0.22kgs over a one year period, and the results from the RCTs indicated that an increase in SSB consumption corresponded with an increase in weight between 0.85 and 1.2kg. Hence, the findings from these studies have indicated a relationship between the consumption of SSBs and weight gain among adults and children.

Te Morenga *et al* (2012), also conducted a much larger meta-analysis on determining the association between sugar intake and body weight among adults and children that consumed diets with no strict control on the foods and beverages consumed. This analysis consisted of 30 RCTs and 38 cohort studies, of which 25 RCTs and 16 cohort studies included research on adults. The minimum period for the RCTs included in the analysis was two months and the minimum period for the cohort studies included was one year. According to pooled estimates from this meta-analysis, it was found that a decrease in the dietary sugar intake among adults resulted in a 0.80kg decrease in body weight and an increase in the dietary sugar intake among adults resulted in an increase in weight by 0.75kg. Due to the fact that only a few studies investigated the association between a reduced sugar intake and weight change for a period of more than ten weeks, one cannot infer that a reduced sugar intake would reduce the risk of obesity. Therefore more longitudinal studies are required in order to provide more substantial information on this aspect. However, this analysis did indicate that an increase in sugar intake resulted in a rapid increase in weight, therefore regulations regarding sugar intake should be formulated in order to reduce the prevalence of overweight and obesity. This analysis also found

that replacing dietary sugars with other carbohydrates or macronutrients results in no weight change since the energy input remained constant. Therefore, this analysis revealed compelling evidence that adjusting the sugar intake will influence the weight of an individual and that changes in body weight are greatly influenced by an imbalance in energy input and output (Te Morenga *et al* 2012).

An example of a study that was included in the meta-analysis by Malik *et al* (2013) and Te Morenga *et al* (2012) was a large cohort study that was conducted by Mozaffarin, Willet & Hu (2011) in order to determine the lifestyle and dietary factors associated with long term weight gain. The study was conducted using three separate cohort studies: The Nurses' Health Study, The Nurses' Health Study II and The Health Professionals Follow-up Study. A total of 120 877 men and women from the United States of America (USA) that were free of any chronic diseases and not obese initially were included in the study. The study was conducted over a period of 20 years (between 1986 and 2006) and subjects were followed up every four years. This study found a strong positive association between the consumption of potatoes, potato chips, SSBs, processed and unprocessed red meat and the subjects' weight. An increase in consumption of these foods and beverages resulted in an increase in weight. In comparison to fruit juices, a greater weight change of 0.454kg was observed among subjects that consumed SSBs. A strong negative association was observed between the subjects' weight and the consumption of fruits, vegetables, yoghurt and whole grains, as an increase in the consumption of these food items resulted in less weight gain. This could be due to the fact that these food products promote satiety and therefore reduce the intake of other foods and beverages. This study therefore indicated that alterations in the dietary habits could influence an individual's weight status, as an increase or decrease in the consumption of any food or beverage item will influence the total energy input. However, the extent to which this influences a change in weight will depend on the quantity as well as the type of foods and beverages consumed (Mozaffarin *et al* 2011).

Based on the evidence surrounding added sugar intake and its influence on health, recommendations with regards to the consumption of added sugars were established.

2.3.4 Recommended guidelines regarding added sugar intake

2.3.4.1 The Food Based Dietary Guidelines

The WHO together with the Food and Agricultural Organisation (FAO) developed the Food Based Dietary Guidelines (FBDGs) as part of their strategy to: address the problems surrounding nutrition transition; improve the health of individuals; reduce the incidence of food insecurity; and reduce the number of deaths related to poverty. In South Africa these guidelines were developed by various organisations such as the Nutrition Society of South Africa, Department of Health and the Medical Research Council (Vorster, Badham & Venter 2013).

The FBDGs were officially adopted by the Department of Health in South Africa in 2003. Eleven guidelines were developed and among these guidelines one was related to sugar usage stating that "Food and drinks containing sugar should be used sparingly and not between meals." Due to the fact that South Africans have been undergoing rapid changes in their dietary and lifestyle habits, it was stated that these guidelines would be revised frequently to ensure that they were still in line with recent scientific evidence. In 2012, the FBDGs were revised and the guideline regarding sugar intake was adjusted to "Use sugar and foods and drinks high in sugar sparingly". A possible reason for this slight adjustment was that sugar can be used during the preparation of meals, hence a more specific guideline was formulated (Vorster *et al* 2013).

2.3.4.2 The WHO recommendations on sugar intake

Due to the rapid increase of added sugar intake and its influence on health, recommendations with regards to sugar intake for adults and children were established by the WHO (WHO 2015b). The WHO recommends that the dietary consumption of free sugars for both adults and children should not exceed 10% of the total energy intake (WHO 2015b). However studies that were conducted among South African children and adults revealed that the consumption of added sugars exceeds this recommendation and that nutrition transition could be held responsible for this. According to the cohort study that was conducted by Vorster *et al* (2014) in the North West province, it was found that the mean intake of added sugars among rural men and women increased by almost 50% between the year 2005 to 2010, and the intake in 2010 exceeded the intake of added sugars among urban men and women. In both population groups the consumption of added sugars exceeded the WHO recommendations on sugar intake.

In order to further reduce the impact that added sugars have on health, the WHO developed a "conditional" recommendation that states that the "consumption of free sugars should be

reduced to less than 5% of the total energy intake." However only a few studies have been conducted on the impact of reducing the consumption of free sugar to less than 5% of the total energy intake and the quality of evidence is not considered strong enough on matters concerning public health. Therefore stronger evidence is required before this recommendation can be passed (WHO 2015b).

The changes in the dietary and lifestyle habits as well as the complications associated with these adjustments increase the need for interventions to be established in order to curb the development of various health related diseases. The next section will therefore address some of the strategies that could be implemented in order to improve dietary behavior.

2.3.5 Improving the dietary habits of consumers

Due to the fact that several factors have been found to influence the dietary habits of consumers and this has contributed towards poor dietary behaviour, it is important that a holistic approach is adopted in order to ensure that consumer purchases are steered into a more positive direction. Some of these strategies could involve altering the food environment by making healthier foods more available, accessible, affordable, increased marketing and promotion of healthier food products, educating consumers on making healthy food choices (Chandon & Wansink 2012) and possibly taxing of food products that are high in added sugars (Thow, Downs & Jan 2014).

2.3.5.1 Taxation of foodstuffs that contain added sugars

The negative association of poor dietary behaviours on health outcomes has increased the need for policies to be implemented in order to improve the quality of health. Recently, the government in the USA, Hungary, France and Mexico adopted fiscal policies in order to encourage healthy eating behaviours. As part of these policies, alterations in the price of energy dense foods products by levying taxes was found to be a step that could encourage healthier dietary habits in a similar manner in which taxation on tobacco influenced the incidence of smoking (Thow *et al* 2014).

In order to determine the effectiveness of tax and subsidies on consumer purchases a systematic review was conducted consisting of RCTs, surveys and modelling studies that were published between 2009 and 2012. Out of the 43 studies that were included in this review, sixteen studies modelled the effect of taxation on the purchases of SSBs and it revealed that levying taxes on these products resulted in a decrease in consumption and that the extent to which consumption

was affected was directly proportional to the percentage of tax that was levied. Six of these studies indicated that a tax rate between 10 and 30% resulted in a 10-25% decrease in the consumption of SSBs in subjects that did not substitute these products with others. Based on this review, taxing SSBs could influence a change in dietary behaviour and a tax rate of 20% or more generated more effective results (Thow *et al* 2014).

With regards to subsidising healthy food products, the results from the RCTs and modelling studies included in this analysis revealed that subsidies may not alter the total energy input, as some studies have indicated that altering the price of healthy food products increased its consumption but had little or no impact on the consumption of energy dense foods, and in some studies the energy input increased. However some studies revealed that if subsidies and taxes are concurrent there could be slight reductions in the total energy input (Thow *et al* 2014).

2.3.5.2 New policy on curbing added sugar intake in South Africa

Due to the increase in the incidence of overweight and obesity, the South African Department of Health (DOH) has implemented policies which aim at improving the health conditions of this population. In 2011 regulation 249 of the Foodstuffs, Cosmetics and Disinfectants Act (54/1972) was passed to limit the content of trans-fatty acids in foodstuffs to a maximum of 2% of the oil content (DOH 2011), and in 2013 regulation 214 of the Foodstuffs, Cosmetics and Disinfectants Act 1972 (Act 54 of 1972) was implemented to limit the salt content in various food products (DOH 2013). Based on the fact that recent evidence has suggested that an increased consumption of SSBs corresponds with an increase in the incidence of obesity, the South African DOH decided to adopt fiscal policies which aim at improving the health standards of the public (Manyema, Veerman, Chola, Tugendhaft, Sartorius, Labadarios & Hofman 2014).

Taxation of foods that are high in sugar was considered to be a cost effective approach in order to decrease the incidence of obesity, thus this regulation was passed by the Minister of Health and during the 2016 budget speech it was proposed that taxes will be proposed on SSBs and this policy will be implemented on 1st April 2017 through the Customs and Excise Act (Act 91 of 1964) (Gordhan 2016).

A modelling study was designed in order to determine the effect that a 20% tax rate on SSBs will have on the incidence of obesity among adults in South Africa. Three types of data were used: i) data from the SANHANES-1 which examined consumption patterns; ii) previous meta-

analyses that examined the influence of price of SSBs on energy intake; and iii) BMI estimates that were derived from the National Income Dynamic Study which included adults above the age of 15 years with valid height and weight measurements (Manyema *et al* 2014). The projected results from this study revealed that implementing a 20% tax rate on SSBs would result in a decline in the incidence of obesity by 3.8% and 2.4% among adult males and females respectively, and on average the daily energy input is expected to decrease by 30 kilojoules per person (Manyema *et al* 2014). The results from this study were congruent with other studies that examined the influence that taxation of SSBs will have on obesity. A similar study conducted in the United Kingdom revealed that a 20% tax rate on SSBs is expected to reduce the incidence of overweight and obesity by 0.9% and 1.3% respectively and that a 10% tax rate will have half of the effect of a 20% tax rate (Briggs, Mytton, Kehlbacher, Tiffin, Rayner & Scarborough 2013).

Although some studies have indicated that taxation of energy dense foods and beverages may be influential on the dietary habits of consumers, there has been much debate with regards to the effectiveness of this strategy on the purchases of food products with little nutritional value. It is important that the direct and indirect effects associated with tax be addressed as some studies have indicated that only individuals from lower socio-economic rankings are influenced by this policy. Consumers could continue to purchase the foods and beverages that have been taxed and decrease the purchases of other food products, or they could substitute the taxed product with a cheaper product that has a low nutritional value. In order to counteract the effect of taxation suppliers could also develop schemes in order to maintain their sales. The extent to which this policy impacts on consumer purchases needs to be measured in order to determine if there are any long term benefits as currently studies have only indicated short term changes (Cornelson, Green, Dangour & Smith 2014).

2.3.5.3 Changing the food environment to reduce the intake of added sugars

It's important that when developing strategies to improve dietary habits, the government also addresses other factors that help shape our eating habits. Apart from price changes, changing the food environment by educating consumers, imposing laws and legislations on labelling, advertising, promotion and adjusting package sizes should also be considered if countries wish to see a decrease in the incidence of various chronic diseases (Cornelson *et al* 2014).

As part of developing an integrated approach to curb the excessive consumption of SSBs, the Centre for Disease Control and Prevention (CDC) has developed their own strategies which aim at reducing the consumption of added sugars. These strategies include; increasing consumers access to clean and safe water, increasing the availability and accessibility of healthy beverages by decreasing the availability and accessibility of SSBs, decreasing the marketing and promotion of SSBs, price adjustments of both healthy and unhealthy beverages and ensuring that medical practitioners are capable of educating consumers on SSB consumption (CDC 2010).

A systematic review which consisted of 16 studies (eight peer reviewed published studies and eight unpublished studies) was conducted among 11 small supermarkets in urban areas and 5 in rural areas in the United States in order to determine if an alteration in the food environment will have any impact on consumer intake. This study revealed that increasing the availability of healthy food products whilst decreasing the availability of unhealthy food products and providing incentives to encourage consumers to purchase healthy food products resulted in an increase in the consumption of healthier foods (Gittelsohn, Rowan & Gadhoke 2012). Although this study had limitations due to the lack of data available on studies conducted in small supermarkets, it has provided useful information that could be used by small supermarkets to improve the dietary habits of consumers. However, there is still a need for more studies to be conducted in order to determine the most effective combined approaches to improve dietary behaviour (Gittelsohn *et al* 2012).

Due to the fact that the transition of students from secondary to tertiary education has resulted in body weight changes and that studies have indicated a high consumption of added sugars, particularly SSBs among adults above the age of 20, the following sections will now focus on assessing the dietary habits of university students and outline the factors that influence dietary behaviour.

2.4 The association between added sugar intake and overweight and obesity in university students

2.4.1 Trends in overweight and obesity among university students

Recent evidence has also indicated that the transition of students from secondary to tertiary education has contributed towards the increased prevalence of overweight and obesity among young adults. This transition results in various adjustments in the lifestyles of university students which also impacts on their dietary and lifestyle behaviour (Vandeboncoeur *et al* 2015). Studies that have assessed weight and BMI changes during the first year of study have indicated an increase in weight and BMI among the subjects, and a greater percentage of weight gain was observed during the first semester (Vandeboncoeur *et al* 2015). A prospective cohort study was conducted over a seven month period between 2008 and 2009 among 47 first year university students in Malawi in order to determine weight changes among university students. Significant weight as well as BMI changes were observed among the subjects. At baseline 32 subjects had a normal BMI, 11 were underweight, three were overweight and one was obese, however by the end of the study, there was a decrease in the number of subjects that were within the normal (n=29) and underweight (n=1) BMI category and there was an increase in the number of overweight (n=13) and obese subjects (n=3). Overall the subjects gained 8.5kg and the BMI increased by 3.3kgm^2. The male subjects significantly gained more weight than the female subjects (Takomana & Kalimbira 2012).

Similarly, an American study that was conducted by Gropper, Simmons, Connell & Ulrichin (2012) over a longer period of time in order to investigate the changes in body weight, composition and shape among 131 university students over a 4 year period also found differences in the subjects body weight. The students' measurements were taken during their first and fourth year of study. Over this four year period the mean weight gained among the subjects was 3kgs and their BMI increased by a mean value of 1.0kgm^2. The male subjects showed greater weight and BMI changes. Significantly, the male subjects gained more weight than the female subjects. The mean weight gained by the male subjects over this four year period was 5.9kgs whereas the mean weight gained for the female subjects was 1.7kgs. The BMI of the male subjects increased by 1.8kgm^2 whereas the BMI of the female subjects increased by 0.6kgm^2.

High rates of overweight and obesity have been examined among students attending national (Mogre, Nyaba, Aleyira & Sam 2015; Van den Berg, Abera, Nel & Walsh 2013; Van den Berg,

et al 2012; Peltzer & Pengpid 2012) as well as international universities (Mahfouz, Makeen, Akour, Madkhly, Hakami, Shaabi, Ageeli, Khawaj, Najmi, Hakami, Al-Ali 2016; Sofía, María, Pilar, Dario, Adame & Guillermo 2015; Salameh, Jomaa, Issa, Farhat, Salame, Zeidan & Baldi 2014). These results are presented in Table 2.1. Gender differences in the prevalence of overweight and obesity among the students have been observed, this will be discussed under section 2.4.4.

The increase in body weight among university students as well as the high prevalence of overweight and obesity among this population group emphasises the need for addressing the factors related to the development of overweight and obesity.

Table 2.1: Studies assessing the dietary habits and body weight of students attending universities nationally and internationally

Researcher	Objectives	Subjects	Methods	Results	Conclusions
Mahfouz *et al* (2016)	Assessing the dietary habits and the prevalence of underweight, overweight and obesity among students attending the University of Jazan, Saudi Arabia	436 students aged 19-25 years attending Medical, Science and other colleges -Female: 220 -Male: 216	Cross sectional study -BMI determined using weight and height measurements -Questionnaire: eating habits, lifestyle and socio-demographic characteristics Study conducted over the 2014 and 2015 academic year	BMI classifications: **Combined:** -Severely underweight: 5.0% -Underweight: 16.0% -Normal: 45.0% -Overweight: 20.0% -Obese: 14.0% **Female:** -Severely underweight: 8.5% -Underweight: 17.0% -Normal: 44.6% -Overweight: 15.6% -Obese: 14.3% **Male:** -Severely underweight: 1.9% -Underweight: 14.8% -Normal: 45.8% -Overweight: 24.5% -Obese: 13.0%	Poor dietary habits were observed among the students. The prevalence of underweight, overweight and obesity was high among the subjects. More males than females were overweight. More males than females consumed energy drinks and more females than males reported to consume snacks.
Sofía *et al* (2016)	Determining the association between different risk factors and the prevalence of overweight and obesity among university students in the health profession studying at a University in Mexico.	290 students -Female:203 -Male:87	A quantitative, correlational, and cross-sectional study -BMI determined using weight and height measurements -Questionnaire: Identify risk factors associated with obesity Study conducted in 2012 over a 7 month period	BMI classifications: **Combined:** -Normal: 71.7% -Overweight: 19.7% -Obese: 8.6% **Female:** -Normal: 75.4% -Overweight: 19.7% -Obese: 4.9% **Male:** -Normal: 63.2% -Overweight: 19.5% -Obese: 17.3%	The prevalence of overweight and obesity was significantly higher among the male than female subjects. Subjects that reported an average appetite were found to be overweight or obese. More than half of the students decreased their physical activity levels upon commencing university and this correlated with the incidence of overweight and obesity.

Table 2.1: Continued

Researcher	Objectives	Subjects	Methods	Results	Conclusions
Mogre et al (2015)	The association between general overweight and obesity and abdominal obesity and demographic factors, dietary habits and physical activity levels among students attending the University of Development Studies, School of Medicine and Health Sciences in Ghana	552 students aged 18-36 years -Female: 198 -Male: 354	Cross sectional study -BMI determined using weight and height measurements -Waist circumference -Questionnaire: Demographic characteristics, FFQ, physical activity levels	Mean BMI: **Combined**: 22.0 ± 3.2 **Females:** 22.8 ± 4.2 **Males**: 21.5 ± 2.4	The prevalence of overweight and obesity and abdominal obesity was higher among the female than male students. General overweight and obesity was lower among those involved in vigorous physical activity and higher among students that consumed fruits and vegetables more than 3 times per week. Abdominal obesity was higher among subjects that consumed alcoholic, non-alcoholic and roots and tubers more than 3 times per week.
Salameh *et al* (2014)	Examining the dietary patterns and their correlates among students attending private and public universities in Lebanon	3307 students -Female: 1969 -Male: 1332	Cross sectional study -BMI determined using weight and height measurements -Questionnaire: Demographic characteristics, FFQ Study conducted between 2010 and 2011	BMI classifications: **Combined:** -Underweight: 9.0% -Normal: 67.1% -Overweight: 16.5% -Obesity: 4.2% **Female:** -Underweight: 13.9% -Normal: 76.2% -Overweight: 8.5% -Obese: 1.5% **Male**: -Underweight: 2.6% -Normal: 59.4% -Overweight: 29.5% -Obese: 8.5%	The prevalence of overweight and obesity was high among the male subjects. The male subjects reported to consume more westernised diets, and the female subjects consumed a vegetarian diet. Therefore this could have influenced the gender differences in overweight and obesity.

Table 2.1: Continued

Researcher	Objectives	Subjects	Methods	Results	Conclusions
Van den Berg *et al* (2013)	Evaluating the lifestyle habits of South African students preparing for careers in health care attending the University of Free State, South Africa.	161 undergraduate students - Female: 122 - Male: 39 Median age 21.5 years	Cross sectional study -BMI determined using weight and height measurements -Waist and hip circumference and ratio -Structured interviewer administered questionnaires: Demographic characteristics 24hour dietary recalls, FFQ, physical activity levels, smoking and alcohol intake. Study conducted on students that enrolled into the university in 2007.	BMI classifications: **Combined:** -Underweight: 8.1% -Normal: 72.1% -Overweight or obesity: 19.8% **Female:** -Underweight: 10.7% -Normal: 67.2% -Overweight or obesity: 22.1% **Male:** -Underweight: 0% -Normal: 87.2% - Overweight or obesity: 12.8%	One in five students were overweight or obese. Poor dietary habits were prevalent with low vegetable and fruit consumption and high meat, sugar and fat intake. More than half reported to consume alcohol and smoked cigarettes. The students were at risk for developing NCDs at a later stage in life and this could negatively impact on their effectiveness as healthcare professionals.
Van den Berg *et al* (2012)	Assessing the weight status, eating practices and nutritional knowledge amongst nursing students attending the University of Fort Hare Eastern Cape, South Africa.	161 undergraduate students -110 female -51 male Median age 24.9 years	Cross sectional study -BMI determined using weight and height measurements -Waist and hip circumference and ratio -Structured interviewer administered questionnaire: Demographic characteristics, 24hour dietary recalls, FFQ	BMI classifications: **Combined:** -Underweight: 4.4% -Normal: 45.9% -Overweight: 31.7% -Obesity: 15% **Female:** -Underweight: 1.8% -Normal: 40% -Overweight: 36.4% -Obese: 21.8% **Male:** -Underweight: 9.8% -Normal: 58.8% -Overweight: 21.6% -Obese: 9.8%	A high prevalence of overweight and obesity particularly among the female students. Poor dietary habits with low daily consumption of vegetables and fruits and high daily intake of bread, sugar and margarine and oil. With regards to the assessment of nutritional knowledge, the students lacked knowledge on aspects relating to nutrition.

Table 2.1: Continued

Researcher	Objectives	Subjects	Methods	Results	Conclusions
Peltzer & Pengpid (2012)	Assessing the body weight and body image among South African male and female university students attending the University of Limpopo.	289 students that were not involved in health studies -Female:189 -Male: 100	Cross sectional study -BMI determined using weight and height measurements -Structured questionnaire: Demographics, physical activity levels, marital status, number of children, place of residence and a Multidimensional Body-Self Relations Questionnaire to assess body image	BMI classifications: **Female:** -Underweight: 9.6% -Overweight: 30.5% -Obese: 3.4% **Male**: -Underweight:15.2% -Overweight: 8.7% -Obese: 0.0%	Moderate rates of overweight and obesity were observed with a higher prevalence among the female students. More males were found to be underweight. A large proportion of the subjects incorrectly classified their BMIs.

2.4.2 Factors associated with overweight and obesity among university students

The transition of university students from secondary to tertiary education often results in an imbalance in the energy input and output. This transition results in various adjustments in the lifestyles of university students which impacts on their dietary habits and physical activity levels. If not corrected these habits are carried through subsequent years and are eventually adopted during adulthood. Some of the adjustments that students undergo include: an increase in workload, stress, financial and social pressure and changes in their place of residence (Vandeboncoeur *et al* 2015).

2.4.2.1 The influence of stress on the prevalence overweight and obesity among university students

The transition of students to tertiary education brings about various psychological changes that impact on the diet and health of the students. Stress has been identified as one of the factors that can directly influence the student's diet and this can result in changes in body weight (Papier, Ahmed, Lee & Wiseman 2014). Some studies have indicated that stress can result in an increase or decrease in the total energy input. A cross sectional study was conducted by Papier *et al* (2014), in order to determine the relationship between stress and dietary behaviour. A total of 728 undergraduate first year students above the age of 18 years attending a university in Australia were included in this study. More than half of the subjects that participated in this study suffered from stress and of these more were female. Subjects that were stressed reported to consume foods that were high in sugar and fat more frequently and this was more common among the male students. As a result, stress could impact more on the health of male than female subjects (Papier *et al* 2014).

2.4.2.2 The influence of time and financial constraints on the prevalence overweight and obesity among university students

Financial and time constraints, particularly among students who live away from home often results in the purchasing of cheap convenience foods with a low nutritional content. The increased workload associated with university often results in students spending more time on their academic achievements and less time taking part in physical activity (Majeed 2015). Therefore the increased intake of energy dense foods and beverages together with decreased physical activity levels has resulted in an increase in the prevalence of overweight and obesity among this population group (Van den Berg *et al* 2012).

2.4.2.3 The influence of place of residence on the on the prevalence overweight and obesity among university students

The body weight of university students can also be influenced by their place of residence. Studies that have assessed the dietary habits of those living at and away from have found that students that live at home adopt more favourable dietary habits in comparison to those that live away from home. Therefore a higher prevalence of overweight and obesity has been observed among students that live away from (Ansari, Stock & Mikolajczyk 2012). A study that was conducted by Brunt, Rhee & Zhong (2008), on 557 undergraduate students between the ages of 18-56 years attending an American university, indicated differences in the prevalence of overweight and obesity among the different places of residences. The prevalence of overweight and obesity was higher among the subjects that lived away from home and off campus residences. Thus higher rates of overweight and obesity were observed among the subjects that lived in private accommodation (Brunt *et al* 2008).

2.4.2.4 Gender differences in overweight and obesity among university students

Consistent with the findings that were observed among older adults, studies that were conducted among university students have also indicated gender differences with regards to the different BMI classifications as presented in Table 2.1. All three studies conducted in South Africa indicated that more females than males were overweight and obese (Van den Berg *et al* 2013; Van den Berg *et al* 2012; Peltzer & Pengpid 2012). In keeping with these findings the study conducted at a University in Ghana also found a higher prevalence of general overweight and obesity as well as central obesity among female students (Mogre *et al* 2015). Conversely, the studies that were conducted at universities in Saudi Arabia (Mahfouz *et al* 2016), Mexico (Sofía *et al* 2016) and Lebanon (Salameh *et al* 2014) indicated higher rates of overweight and obesity among the male students. Therefore the prevalence of overweight and obesity differed for students attending national as well as international universities. The perceived differences in overweight and obesity among male and female students could be linked with their diet and physical activity levels.

2.4.3 The dietary intake of university students

The transition from adolescence to young adulthood has resulted in alterations in the dietary habits of this population group. Studies have indicated alterations in the quality of the students' diets as most students are involved in making their own food choices (Majeed 2016). Due to

the lack of dietary knowledge, students often resort to poor dietary behaviours that do not meet the recommended daily intake of the various food groups (Van den Berg *et al* 2012).

Studies that were conducted among 161 medical students attending two universities in South Africa; the University of Free State and a University in the Eastern Cape (Table 2.1) have indicated poor dietary habits among this population group. Both of these studies used a FFQ and 24 hour dietary recalls to assess the amount and frequency of consumption of the various food groups. The study that was conducted among students attending the University of Free State found that on a daily basis only 18.6% of the students reported to consume vegetables, 29.8% consumed fruits and only a few students reported to consume staple foods. On a weekly basis approximately 80-90% of the students reported to consume foods that are high in sugar and fat, such as sweets, chocolates, cakes, biscuits and carbonated soft drinks (Van den Berg *et al* 2013). Similar trends in eating habits were observed among students attending a university in the Eastern Cape. This study found that only 12.4% of the students consumed vegetables, 23.6% consumed fruit and more than half of the students consumed food and beverages that contained added fats and sugar. In comparison to the study conducted among students in the Free State, the study conducted in the Eastern Cape indicated a higher consumption of staples, particularly bread, among the students (Van den Berg *et al* 2012).

A study that was conducted by Mahfouz *et al* (2016) among 436 students attending a university in Saudi Arabia, revealed that most students did not consume meals regularly (82.3%) and that the daily consumption of fruit was low as most of the subjects reported to consume one or less than one fruit on a daily basis (78.4%). The consumption of snacks (90.1%) and carbonated soft drinks (86.9%) was high among the sample population. Based on the findings from these studies, it can be deduced that traditional dietary habits have been replaced with Westernised diets. Therefore, university students have shifted away from consuming more vegetables and fruits and have increased their consumption of energy dense foods and beverages.

2.4.4 The influence of demographic characteristics on the dietary intake of added sugar among university students

2.4.4.1 The dietary intake of added sugars according to gender

Studies that were conducted on the dietary habits of university students have also indicated differences in the consumption of foods and beverages across the different genders. Two studies that were conducted among university students in England (Ansari *et al* 2012) and Italy (Lupi

et al 2015) found differences in the consumption of individual food and beverage items among the different genders. A cross country analysis was conducted by Ansari *et al* (2012) on 2402 first year undergraduate students from one university in Germany, Denmark, Poland and Bulgaria in order to determine the relationship between food consumption and living arrangements. Data was extracted from a survey conducted among these countries during the year 2005 and a FFQ consisting of 9 food groups was used. According to the results from this study, the female students consumed sweets, cakes, salads and fruits more frequently than the male students and that the frequency of consumption of fast foods, fish and meat was higher among the male than female students. A cross sectional study that was conducted among 258 undergraduate students attending a university in Italy also found that the female students had a higher mean weekly consumption of vegetables, fruits, cakes, coffee and tea than the male students, however a significant difference was only observed for vegetables. The mean weekly consumption of starchy foods, meat and meat products, fruit juices and carbonated soft drinks was higher the male subjects, however a significant difference was only observed for carbonated soft drinks (Lupi *et al* 2015). Both of these studies indicated that the female students consumed more vegetables and fruits than the male students, however the consumption of some food items that contained added sugar was higher among the female students.

A study that assessed the consumption of food categories also found differences in the consumption across the different genders. A cross sectional study that was conducted between 2010 and 2011 on dietary patterns of 3384 students attending a university in Lebanon, revealed that the female subjects consumed vegetarian and low energy diets and that the male subjects consumed more foods and beverages that were high in fat and added sugar (Salameh *et al* 2014). Gender differences in the dietary habits of university students could influence the differences in the prevalence of overweight and obesity among the different genders as indicated in the study conducted at a university in Lebanon (Salameh *et al* 2014).

2.4.4.2 The dietary intake of added sugars according to race

There is a limited amount of studies available on the added sugar intake by race among university students. A cross sectional study was conducted by West, Bursac, Quimby, Prewitt, Spatz, Nash, Mays & Eddings (2006) on 265 undergraduate students in order to determine the consumption of SSBs among university students in the United States. This study revealed that most of the Black students (91%) reported to consume SSBs on a daily basis and that only half of the White students reported a daily consumption of SSBs. Fruit juices were the most

frequently consumed SSB among the Black students. The daily energy input from SBBs was higher among the Black (3327.28) than White students (1659.46KJ).

2.4.4.3 The dietary intake of added sugar according to place of residence

Recent studies have also indicated that living arrangements also influence the dietary habits of university students. This could be due to the fact that students that live at home are more dependent on their families to provide for them as they are less involved in food purchases as well as food preparation. Students that live away from are often bound by factors such as time and money, therefore they resort to purchasing cheap convenience foods with low nutritional content (Ansari *et al* 2012). These foods often contribute a substantial amount of energy towards the total energy input and therefore results in negative changes in body weight. The analysis of cross sectional surveys that was conducted among students attending four universities in England (Ansari *et al* 2012) as well as a cross sectional study conducted among students attending a university in Italy (Lupi *et al* 2015) indicated differences in the dietary habits of students that live at or away from home. Both studies found a low frequency of consumption of fruits, vegetables and meat among the students that lived away from home. However, the study conducted by Ansari *et al* (2012) found no increase in the consumption of energy dense foods among students that lived away from home, whereas the study conducted by Lupi *et al* (2015) indicated a higher mean weekly consumption of packaged foods and fries among students that lived away from home.

Similarly, a study that was conducted by Bagordo, Grassi, Serio, Idolo & De Donno (2013) also indicated that the eating habits of university students differs in accordance to their place of residence. This study was conducted between January and April 2010 on 195 undergraduate students studying at a university in Italy and a self-administered questionnaire was used to gather information on demographic characteristics, social habits, culture and dietary intake. Most of the students in this study lived at home (72.5%) whilst only 27.5% of the students reported to live away from home. Students living at home reported to consume cooked vegetables, fish, meat products, chips, bread and pulses more frequently than those that lived away from home. A higher frequency of consumption of raw vegetables, frozen meals and ready prepared meals was observed among the students that lived away from home.

2.4.5 Factors that influence the food and beverage purchases and intake of university students

The prevalence of overweight and obesity has become increasingly common among university students and this could be attributed to poor dietary habits. However, various factors have been found to influence the dietary habits of university students. A study was conducted among 35 European university students from different years and fields of study in order to determine the factors that influence the eating behaviour of this population group (Deliens *et al* 2014). This study made use of focus group discussions and based on feedback from the students, it was found that the social environment (parents, friends and family); physical environment (availability, accessibility, appeal and cost of food); macro environment (media and advertising); university characteristics (place of residence, university lifestyle) and individual factors (taste, values, beliefs, time and convenience for preparing meals, physical activity levels and stress) were among the most common aspects that influenced the dietary habits of this sample population (Deliens *et al* 2014). Although this study made use of a small number of students and used voluntary participation, the results can be used to develop effective strategies to improve the dietary habits of university students.

2.4.5.1 The influence of price on the food and beverage purchases and intake of university students

The study that was conducted by Deliens *et al* (2014), on 35 European university students from a variety of fields of study, revealed that price influenced the students' dietary habits. Since university students, particularly those that live away from home are more self-dependant and are often on a strict budget, their food choices depend on the price of the product. Some of the students reported that purchasing food everyday could be very expensive whilst other students reported that ready prepared meals are cheaper to buy and consume. Therefore altering the price of foods and beverages could influence the diet quality of university students. However, there is a need for more studies to be conducted on university students in order to measure the effectiveness of pricing strategies on the dietary choices of university students (Deliens *et al* 2014).

2.4.5.2 The influence of the food environment on the food and beverage purchases and intake of university students

The food environment has also impacted on the dietary habits of university students and this could be due to the fact that students are exposed to several settings in which they can purchase food items. A limited amount of studies have been conducted on the influence of other food environments such as vending machines, café, meals prepared at home, and food outlets around the university on consumer purchases and dietary intake.

Since most studies have looked at the dietary intake of students that live on campus and have access to prepared meals, Pelletier & Laska (2013) conducted a study on students that do not reside on campus in order to determine the trends in the dietary habits as well as the frequency of consumption of products from other food outlets in and around the university. This study was conducted on 1059 students that were from universities that offer two year and four year graduate programmes in the United States. This study assessed the weekly purchases of foods and beverages from vending machines, campus dining halls and restaurants and stores around campus. According to the results from this study, approximately 45% of the students purchased foods and beverages from at least one of these facilities more than three times per week. In comparison to food, beverages were most frequently purchased by the students from facilities on or around the campus. Vending machines displayed the least amount of purchases as half of the subjects reported that they did not purchase foods and beverages from it. About 46% of students reported bringing meals from home and only 22% purchased food products from other franchises. With regards to the type of foods purchased and consumed, this study found that these students leaned towards purchasing unhealthy foods and beverages as their diets were high in fat and added sugar. Students that brought food from home consumed more fruits and vegetables and their sugar and fat intake was lower. This study therefore revealed that increased exposure of students to foods and beverages that have very little nutritional value on and around campus directly impacts on their dietary intake as consumers tend to purchase that which is available and can be easily accessed. Altering the food environment by increasing the availability and accessibility of healthier food products at various food outlets could be a strategy that can be implemented in order to improve the quality of the diet of university students (Pelletier & Laska 2013).

2.4.5.3 The influence of taste on the food and beverage purchases and intake of university students

Taste has also been perceived as an important factor that influences the food choices of university students. The study that was conducted by Deliens *et al* (2014) indicated that taste was regarded as an important factor when selecting any food or beverage. Another American study was conducted among 405 university students in order to determine the influence of gender and race on the factors that influence dietary habits. The results indicated that the students liking for a food or beverage item was greatly influenced by the good taste of the item and this was followed by convenience and low cost. Only one third of the students considered the nutritional value and quality of the product when consuming or purchasing it (Boek, Bianco-Simeral, Chan, & Goto 2012).

2.4.5.4 The influence of social factors on the food and beverage purchases and intake of university students

Since dietary habits are usually shaped during young adulthood and because university students often display poor eating habits due to various factors, a cross sectional study was conducted on 1000 American university students enrolled in a 2 year and 4 year university in order to determine the relationship between social factors on the perceived eating habits of the students. This study revealed that the students dietary habits were influenced by that of their family, friends and significant other, since the subjects consumed more fast foods, SSBs, fruits and vegetables if their families, friends and significant other did so (Pelletier, Graham & Laska 2014).

2.4.6 Sugar sweetened beverage intake among university students

According to the 2013 Behavioural Risk Factor Surveillance System (BRFSS) survey that was conducted among US adults above the age of 18 years, it was found that among all of the age categories, subjects that were between the ages of 18-24 years consumed SSBs more frequently (Park, Xu, Town & Blanck 2016). Due to the fact that the consumption of SSBs has increased worldwide, and that SSBs have been implicated for the increased prevalence of overweight and obesity, it is essential that the consumption of these beverages be assessed among university students. The cross sectional study that was conducted on 265 undergraduate university students in the United States assessed the frequency and amount of SSBs consumed using a 15 item survey instrument. Based on the analysis of the results, more than 50% of the students reported

to consume these beverages on a daily basis and that the average daily energy intake from SSBs alone was 2269.74KJ.

An analysis of a large cohort study was conducted in order to determine the influence of SSB consumption on weight change. This cohort study was conducted among Thai university students between the year 2005 and 2009. The analysis consisted of data from 59 283 university students between the ages of 15- 87 years that participated in the cohort study. A questionnaire was designed which included information on demographic characteristics, BMI and SSB intake. Based on analysis it was found that a higher frequency of consumption at the baseline year (2005) was associated with a greater weight gain over this four year period. Subjects that consumed the beverage once a day at baseline gained more weight over this time period in comparison to those that consumed the beverage monthly. The approximate weight gain for the subjects over the four year period was 1.9kgs. Subjects that increased their consumption from monthly consumption at baseline to daily consumption gained approximately 3kgs at the end of the four year period. A smaller weight gain of 1.5kgs was observed among the subjects that decreased their consumption to less than once a month over this time period (Lim, Banwell, Bain, Banks, Seubsman, Kelly Yiengprugsawan & Sleigh 2014).

Studies have also indicated an association between BMI and the dietary intake of various foods and beverages among university students. This aspect will be outlined in the next section.

2.4.7 The association between added sugar intake and BMI of university students

Studies that have been conducted among university students have indicated differences in the consumption of various foods and beverages across the different BMI categories. The study that was conducted among 161 students attending a university in the Eastern Cape revealed that the daily consumption of sweets and chocolates, chips and full cream milk was higher among subjects that were overweight or obese. Interestingly, the daily consumption of cakes and biscuits and carbonated soft drinks was higher among subjects that were within the normal and underweight BMI classification (Van den Berg *et al* 2012).

Studies that were conducted internationally have also indicated differences in the dietary intake across the different BMI classifications. A study was conducted by Gunes, Bekiroglu, Imeryuz & Agirbasli (2012) in order to determine the association between dietary intake and a high BMI among 2259 first year students between the ages of 18-22 years attending a university in Turkey.

A questionnaire which included information on demographic characteristics, BMI, dietary habits and the frequency of consumption of food items was used for data collection. The results from this study revealed that subjects that were overweight or obese consumed tea, coffee, carbonated soft drinks, red meat, organ meats and eggs more frequently than those that were underweight or within the normal BMI classification.

2.5 Summary

The increased prevalence of overweight and obesity among various populations has raised much concern due to the negative implications that it has on health. In the light of the matter, much attention has been focused on the association between added sugars, particularly from SSBs and weight gain however, the findings from these studies were inconsistent.

Recent studies have also indicated that university students are also susceptible towards becoming overweight or obese. The transition of students from secondary to tertiary education impacts on their dietary and lifestyle behaviours. Students, particularly those that live away from home are often required to make their own dietary choices however due to the lack of sound dietary knowledge, financial constraints, stress, as well as decreased time availability, students often adopt poor dietary and lifestyle behaviours which are later carried into adulthood. The food environment has also influenced the dietary behaviours of consumers, as studies have indicated that consumers generally purchase that which is available, affordable and palatable. Therefore, in order to improve the dietary habits of this population group, it is important to assess the dietary intake of the students as well as determine the factors that influence their dietary habits. Therefore the purpose of this study was to examine the dietary habits of the students by assessing the frequency as well as the amounts of added sugars consumed. In the light of the current evidence, this study will also assess the association between added sugar intake and BMI, determine the variations in the consumption of added sugars across the different demographic characteristics as well as determine the factors that influence SSB consumption.

The next chapter will outline the methodology that was used in order to achieve the objectives of the study.

CHAPTER 3: METHODOLOGY

In this chapter the sections relating to the methodology used in conducting this study will be outlined. The following sections will be presented: the literature supporting the methodology used; the training of the fieldworkers; the survey design and population and sample selection; the variables included in the study; the pilot study; statistical analyses of the data; as well as the ethical considerations of the study.

3.1 Type of study

A cross sectional study was conducted in order to determine the association between added sugar intake and BMI among 395 undergraduate students between the ages of 18-25 years studying at UKZN in Pietermaritzburg.

3.2 Background information on study site

UKZN is a multi-campus situated in Pietermaritzburg and Durban that accommodates national and international male and female students of different races and cultures. It comprises five campuses, Pietermaritzburg, Edgewood, Howard College, Nelson Mandela School of Medicine and Westville campus. The Pietermaritzburg campus offers several academic programmes in the areas of Science and Agriculture, Education, Human and Management Sciences and Law. Unique to this campus are the discipline of Agriculture, Theology and Fine Art. The campus offers seven residences to approximately 1640 students (UKZN 2016).

The race distribution of the country and province is presented in Table 3.1. According to the last census conducted in 2011, the majority of the population of KwaZulu-Natal (KZN) comprised Black Africans (86.8%), followed by the Indian and Asian race group (7.4%), the White race group (4.2%) and lastly the Coloured race group (1.4%) (Statistics of South Africa 2011). The race distribution at the UKZN campuses also indicated that the Black African race group formed the bulk of the sample population (Institutional Intelligence reports 2016).

Table 3.1: Percentage distribution of the South African population during the year 2011 (Statistics of South Africa 2011)

Location	Total population	Black African	Coloured	Indian/Asian	White	Other
KwaZulu-Natal	102 673 00	86.8%	1.4%	7.4%	4.2%	0.3%
South Africa	517 705 60	79.2%	8.9%	2.5%	8.9%	0.5%

This study was conducted using students from different fields of study and demographic characteristics. It was anticipated that the study population was reflective of those at other universities in South Africa. There is a limited amount of studies that have been conducted among university students in KwaZulu-Natal. Since the Pietermaritzburg campus offers a diverse range of programmes, this study site was considered most suitable in order to obtain information from students of different fields of study.

3.3 Study design

3.3.1 Cross sectional study

A cross sectional study is conducted over a short period of time without any follow up assessments and it is also used to determine the prevalence of knowledge and attitudes towards a specific concept or event (Merrill 2012, pp 92-93). The advantage of using a cross sectional study is that it is usually quick and easy to conduct. Subjects are usually seen only once, therefore there is no loss of subjects as no follow ups are required. Although measurements from the study population are obtained on one occasion, recruitment may take place over a longer duration of time (Sedgwick 2014). Questionnaire type surveys are generally used to collect information for this type of study design and they can be used to target a large study population. Cross sectional studies can be repeated at different times in order to generate trends in the results (Sedgwick 2014).

Although cross sectional studies have many advantages, they also have a few shortcomings. Cross sectional studies can be prone to non-response bias if the subjects that are willing to participate differ greatly to those that are not willing to participate. This may result in a sample that will not be representative of the study population (Sedgwick 2014). However in this study, it was ensured that students from all fields of studies, different genders and race groups were included during data collection in order to obtain a more representative sample. It has also been found that because data from each subject is only recorded once, the results from cross sectional studies will only indicate if there is an association between the factors under study. Therefore one cannot infer if a causal relationship exists (Sedgwick 2014).

In this study, a three part questionnaire (Appendix A, p126) was used. The first part included information on anthropometric measurements, demographic characteristics, SSB consumption. The second part included a food frequency questionnaire (FFQ) and the third part of the

questionnaire comprised of a 24 hour dietary recall. Since this study was conducted on a large sample of students, a questionnaire was the most suitable tool to use for data collection.

3.3.2 The use of a questionnaire

A questionnaire is a very effective tool that can be used to collect information from a large population over a short period of time (Jenn 2006). Questionnaires should be easy to understand and should be designed in a logical sequence with simple questions to ensure that the data collected will be reliable and valid. Questionnaires are made up of a list of questions that should include clear instructions on answering the questions as well as provide space to record answers. It should also be structured such that it covers the main objectives of the study, follows a logical sequence and subjects should be informed of the purpose of the project prior to answering the questions (Jenn 2006). Questionnaires are generally used to gather factual, straightforward information, assess attitudes or opinions towards an aspect and collect 'baseline' information which can be conducted over time to observe trends. However they are not suitable for controversial issues or for gathering information in great detail on complex aspects (Jenn 2006).

According to Jenn (2006), the following sequence should be used when structuring a questionnaire:

- A conceptual frame work should be designed which outlines the aim of the study as well as the variables that will be addressed for example demographic characteristics, anthropometric measurements and socio-economic levels.
- The study population and sample characteristics should be considered when designing the questionnaire.
- The methodology that will be used to collect and analyse the data should be considered when constructing the questionnaire.
- Only necessary and relevant questions should be included.
- Questions should be clear to avoid ambiguity and each question should address one concept.
- Questions should be set out in a logical sequence with clear instructions.
- The type of questions that will be used (open or close ended) should be appropriate for the response and sufficient space should be provided to record answers.
- The questionnaire should be reliable and valid.
- A pilot study should be considered before conducting the main study.

Questionnaire administration can take place in various forms including self-administered questionnaires or interviewer administered questionnaires (Jenn 2006). Self-administered questionnaires usually include written surveys completed on site or posted to the subject. These should include clear instructions and questions, and the questionnaire should be set out in a logical sequence. Information gathered from this type of questionnaire is more truthful as respondents are able to answer the questionnaire without any hindrance from the interviewer (Jenn 2006). Interviewer administered questionnaires can be conducted face to face or telephonically. The questions are usually more complex as the interviewer is present to assist with explanations. The truthfulness of responses obtained is questionable as subjects might give appropriate rather than honest answers (Jenn 2006).

As with many data collection tools, the use of questionnaires has advantages and disadvantages. Questionnaires are more efficient as they can be designed to collect data from a large population over a short period of time and it may also increase the truthfulness of the response if subjects are allowed to remain anonymous (Gillham 2008, p6). However, questionnaires can also be limiting as they depend on the subject's ability to read and write and also inaccurate data could be reported due to misunderstanding of the questions (Gillham 2008, p8).

Questionnaires can consist of closed and opened ended questions. Open ended questions enable the subjects to write down an answer without limiting them to a list of options and they can add new information if there is a limited amount of data on an aspect. However these type of questions can be difficult to analyse and require the answers to be grouped, they also require time from the respondent and the respondent should be able to write neatly and legibly (Jenn 2006). Closed ended questions comprise a list of options from which the respondents are expected to select the most appropriate answer. Closed ended questions are usually less time consuming and easy to administer as subjects are required to select an answer from a list of options. However, closed ended questions can be limiting as respondents are restricted to a list of options (Jenn 2006).

Closed ended questions are divided into a list of options such as multiple choice questions, "yes" or "no" questions or a Likert scale (usually 5 or 7 point scales). The options that are provided for multiple choice questions should be extensive as it should ensure that the respondents are able to select the most suitable answer. Likert scales are often used to measure the respondent's belief or attitude towards an aspect (Jenn 2006). The questionnaire used in the

study conducted used both closed and open ended questions. Closed ended questions were used to gather information on the demographic characteristics and dietary habits of the subjects. A five point Likert scale was used to assess the factors that influence the consumption of SSBs. An open ended response structure was used to gather information for the 24 hour dietary recall.

3.3.3 The use of a Food frequency questionnaire and 24 hour dietary recalls

In this study a Food frequency questionnaire (FFQ) and a 24 hour dietary recall was designed in order to obtain information on the dietary habits of the university students. For the FFQ (Appendix A, p130), the subjects were required to record the amount and frequency of consumption of various foods and beverages, and for the 24 hour dietary recall (Appendix A, p145), the subjects were required to indicate the type and amount of foods and beverages consumed over a period of 24 hours.

3.3.3.1 The use of a Food frequency questionnaire

FFQs are designed to determine the usual frequency of consumption of a list of foods and beverages over a duration of time (Thompson & Subar 2013, p9). The frequency of consumption can be assessed over a yearly, monthly, weekly or daily period (Thompson & Subar 2013, pp10-11), for the purpose of this study, the monthly, weekly and daily consumption was assessed. Some FFQs also include quantities in order to determine the portions of foods and beverages consumed (Thompson & Subar 2013, p9). The type and number of foods and beverages that are listed in a FFQ will depend on the research problem and the study population group (Thompson & Subar 2013, p10).

In comparison to other dietary recording methods, a FFQ is an inexpensive tool, it can be conducted using large populations and it calculates usual intake. The limitations of food frequency questionnaires are that the portion sizes included in the table may be difficult for the subjects to evaluate and that it does not capture day to day variations in the diet (Thompson & Subar 2013, p11). Therefore, FFQs are often paired with other dietary records such as 24 hour dietary recalls or food diaries to improve the estimated intake. Consequently, this study included a combination of a FFQ and a 24 hour dietary recall. A separate handout that consisted of pictures of household food measures (Appendix B, p153) was given to the subjects to assist with reporting of portion sizes consumed when completing both the FFQ and the 24 hour dietary recall.

3.3.3.2 The use of a 24 hour dietary recall

A 24 hour dietary recall is used to obtain information on the subject's dietary intake over a period of 24 hours. It can be administered electronically, telephonically or face to face and generally requires trained individuals (preferably Dieticians or Nutritionists) to assist subjects in completing it and to obtain sound information (Thompson & Subar 2013, p7). When completing 24 hour dietary recalls, subjects are expected to record the food or beverage consumed, the amount consumed and the method of preparation. Probing is often done to ensure that subjects do not forget to report any foods or beverages consumed. It is important that the individuals conducting the 24 hour dietary recall are familiar with the foods consumed by the population group and that household measurements are provided to ensure accurate reports of portion sizes consumed (Thompson & Subar 2013, pp7-8).

The advantage of using 24 hour dietary recalls is that it does not depend on the subject's level of literacy as the information can be recorded by a trained interviewer. It also provides information on the population's dietary habits and the information obtained can be representative of the whole population (Thompson & Subar 2013, p 8). However, 24 hour dietary recalls can also be limiting as they rely on the subject's memory; food items may also be omitted and portion sizes may also be incorrectly recorded, this could result in over- or under-reporting of the food and beverage items consumed (Thompson & Subar 2013, pp 8-9). Conducting several 24 hour dietary recalls can also be expensive as more resources are required (Ma, Olendzki, Pagoto, Hurley, Magner, Ockene, Schneider, Merriam, Hébert 2009). The exact number of 24 hour dietary recalls that should be used to estimate dietary intake has not yet been established as there is much debate as to whether subsequent recalls will improve the overall estimated intake (Ma *et al* 2009). However when deciding on the number of 24 hour dietary recalls that should be included in a study, one needs to assess the objectives of the study as well as determine the purpose of using this form of dietary assessment. If mean intakes are going to be estimated, a single 24 hour dietary could be used, however if usual intake is going to be assessed subsequent recalls should be conducted (National Institute of Health 2016). Some studies indicate that three 24 hour dietary recalls should be conducted to estimate usual intake as more than three recalls do not improve the estimated usual intake (Ma *et al* 2009). If the first 24 hour dietary recall is conducted well by administering portion sizes and ensuring that trained interviewers are present to assist with reporting, the information gathered from the first recall could provide a good estimate of mean intake (Ma *et al* 2009).

Since the mean estimated intake was assessed in this study, a single 24 hour dietary recall was conducted to gather information. A separate handout consisting of various portion sizes was issued to the subjects and the fieldworkers (Dietetic students) were present to assist the subjects with completing the 24 hour dietary recall. These measures were taken to ensure accurate mean intakes.

3.4 Study population and sample selection

3.4.1 Study population

The study population included undergraduate university students between the ages of 18-25 years that were studying at UKZN, Pietermaritzburg. The exact number of students included in the study was dependent on the number of undergraduate students that had registered at the beginning of 2016 (Institutional Intelligence reports 2016). Once this number was determined a statistician was consulted in order to determine the number of subjects required for the study to make the study sample more representative of the population. A sample size of 362 was calculated, however 395 students were selected to participate in the study to compensate for any incomplete data reporting that may have occurred.

Non-probability sampling which involved convenience sampling was used to select subjects for the study. Subjects were selected from different race groups, genders and fields of study to ensure that they were representative of the UKZN population. University students were selected for the purpose of this study, as the literature has indicated an increase in the prevalence of overweight and obesity among this population group. Changes in the dietary and lifestyle behaviours of this population group could be a contributing factor towards this problem. Assessing the dietary habits of university students is essential due to the long term effects that it could have on health. Therefore understanding the dietary habits of university students is important in order to establish effective strategies to improve the diet quality.

3.4.2 Sample selection

A non-probability sampling method which involved convenience sampling was used to recruit subjects for this study. This method of sampling involved selecting subjects present on the various Pietermaritzburg campuses. This form of sampling method has several advantages as it is inexpensive, convenient and can be conducted over a shorter period of time. Subjects were recruited by word of mouth and flyers were distributed around the campus. Students of all race groups were selected on the basis that: they were between 18 and 25 years; studying towards

an undergraduate degree; consumed foods and beverages containing added sugar; and were involved in purchasing the foods and beverages that they consumed.

3.4.3 Method of sampling and data collection

The following procedure was used during the data collection period:

1) The total number of undergraduate students that were registered and accepted at the Pietermaritzburg campus was obtained and a statistician determined the sample size required for the study to be representative.
2) Gatekeepers permission was obtained from the registrar in order to use the university premises and students to conduct the research (Appendix C, p162).
3) Ethical clearance was applied for and obtained (Appendix D, p163).
4) An informed consent document was formulated (Appendix E, p164) and the questionnaire was evaluated and validated by the statistician. The fieldworkers were trained on all of the necessary aspects relating to the study and training was done at the same time for all fieldworkers to ensure that there was consistency in data collection and recording.
5) A pilot study was conducted.
6) The researcher ensured that an equal amount of time was spent on each of the three campuses in Pietermaritzburg to ensure that a wide variety of students were sampled.
7) Students were approached before and after lectures and the questionnaire took approximately 15 minutes to complete.
8) Based on the findings from the pilot study, the study design and research methods were evaluated and adjusted accordingly. Thereafter it was submitted to the statistician for validation.
9) Once the questionnaire was finalised the main study was conducted. Thereafter data from the questionnaire were entered into a spread sheet on Microsoft Excel and coding was used for each question. Once completed the spreadsheet was submitted to the statistician for statistical analyses and the results from the study were evaluated and compared with the literature.

3.5 Study methods and materials

This section outlines the methods and materials that were used in collecting data for this study.

3.5.1 Measuring instruments

For the purpose of this study a questionnaire was used. The first and second part of the questionnaire was self-administered whereas the third part of the study was interviewer administered as the fieldworkers were present to assist the subjects with completing the 24 hour dietary recall (Appendix A, p126). The data collection tools were designed based on tools that were used in previous studies that assessed the demographic characteristics, BMI and dietary intake of university students.

3.5.1.1 Part one of the questionnaire

The first part of the questionnaire consisted of three sections assessing the anthropometric measurements, demographic characteristics and consumption of SSBs.

Section one: Anthropometric measurements (Appendix A, p126)

The anthropometric measurements including height and weight were assessed by trained fieldworkers using standardised methods. The students' height was measured using a free standing Leicester Height measure which was placed against a flat wall and the weight was taken using a portable SECA scale which was calibrated and placed on a level surface. The subjects were requested to remove any items that would have contributed extra weight such as shoes, jackets, bags, wallets. The height was measured to the nearest 0.5cm and the weight was measured to the nearest 0.1kg. Each measurement was taken three times and an average was calculated. The methodology used in taking the anthropometric measurements was adapted from the study conducted by Mogre *et al* (2015) who assessed general and abdominal obesity among university students. The BMI was determined using the formula weight (kg) divided by height (m^2) and it was interpreted using the International classification table for underweight (BMI $\leq$18.5kgm^2), normal weight (BMI 18.5-24.9kgm^2), overweight (BMI 25-29.9kgm^2), obese class I (BMI 30-34.9kgm^2) obese class II (BMI 35-39.9kgm^2) and obese class III (BMI $\geq$40kgm^2) BMI (WHO 1995, 2000, 2004). The measurements were entered onto the questionnaire and thereafter transported to a spread sheet designed on Microsoft Excel. All calculations were done using formulas on Microsoft Excel.

Section two: Demographic characteristics (Appendix A, p126)

Questions regarding the subjects' age, gender, race, field of study, place of residence and involvement in purchases of food items usually consumed were asked in order to define the demographic characteristics of the sample population. Similar criteria for assessing the demographic characteristics were used in studies conducted among university students both nationally and internationally (Mahfouz *et al* 2016; Mogre *et al* 2015; Van den Berg *et al* 2013; Van den Berg *et al* 2012).

Section three: Consumption of sugar sweetened beverages (Appendix A, p128)

Factors relating to the purchase of SSBs, such as price, taste, social influences, marketing and labelling; the most frequently consumed SSB; place of purchase and consumption were assessed in this section. The factors selected were adapted from two studies that assessed the factors that influence dietary behaviour of university students (Deliens *et al* 2014; Boek *et al* 2012). Since studies have also addressed the influence of pricing on consumer purchases, this factor was further evaluated in this study.

3.5.1.2 Part two of the questionnaire: Food frequency questionnaire

Previous studies that assessed the dietary intake of university students have either only used FFQs or FFQs and 24 hour dietary recalls. This study used both a FFQ and a single 24 hour dietary recall to assess dietary intake.

The frequency of consumption of foods and beverages were assessed using a FFQ (Appendix A, p130). A total of 15 food and beverage categories (beverages, sugar and milk flavourings and milk powders, spreads, sauces, breakfast cereals, desserts, cakes and biscuits, chocolates, sweets, starchy foods, starchy vegetables, vegetables, fruits, meat products, dairy products and oil and fats) were included and 83 food items were listed. The food and beverages that were listed in the FFQ were based on: food items that were sold at or around the university, data that was obtained from a previous study that assessed the dietary intake of South African adults (Mchiza *et al* 2015) and food items listed in studies conducted at local universities (Van den Berg *et al* 2013; Van den Berg *et al* 2012).

There were two sections to the FFQ one measuring the amount and another measuring the frequency of consumption of the food and beverages listed. An example was provided for the subjects in order for them to note what was expected. Household measures were used in order

to compile the section titled ‘How much is consumed?’ The section titled “How often consumed?” was measured as “never”, “less than once a month”, “about once a month”, “1-2 times per week”, “3-6 times per week”, “every day but just once a day” and “every day but more than once a day”. The layout of the FFQ was adapted from studies that assessed dietary intake among university students (Van den Berg *et al* 2013; Van den Berg *et al* 2012, Takomana & Kalimbira 2012; Gan WY Mohd Nasir MT, Zalilah MS & Hazizi AS 2011).

3.5.1.3 Part three of the questionnaire: 24 hour dietary recall

The 24 hour dietary recall consisted of three meals and three snacks in which subjects had to record the type and amount of a food or beverage consumed as well as the method of preparation (Boiled, baked, fried, grilled or steamed) (Appendix A, p145). Fieldworkers were trained to assist the students with this section. A list of the different food groups (starch, breakfast cereals, vegetables, fruit, dairy, meat products, beverages [hot and cold], sauces or oils or spreads, table sugar and milk flavourings (coffee, milo, hot chocolate), confectionary items [Biscuits, cakes, doughnuts], sweets or chocolates or chips, and desserts) were included in the 24 hour dietary recall table to assist with reporting and to ensure that students did not forget to record any food items consumed. An example was provided for the subjects in order for them to note what was expected. Pictures of household measures of food items were attached to assist the subjects in recording the portion sizes they consumed (Appendix B, p153).

3.6 Fieldworker recruitment and training

Five fieldworkers who were third year Dietetic students were recruited to collect data for this study. During the training process the fieldworkers were given a brief explanation of the study. The methodology that was used in conducting the study was explained in great detail to the fieldworkers to ensure that each of the fieldworkers had a good understanding of what needed to be done as well as what was expected. The study topic, aim and objectives as well as the inclusion and exclusion criteria of the study were emphasised.

The fieldworkers were given a detailed explanation of each section that was included in the questionnaire and each fieldworker was given a copy of the questionnaire in order for them to familiarise themselves with the questions. With regards to the 24 hour dietary recall, the fieldworkers were required to assist the subjects with completing this section to ensure accurate recording. Since the fieldworkers were Dietetic students they were familiar with 24 hour dietary recalls and this aided the training.

A demonstration on taking anthropometric measurements (taking height and weight) was conducted to ensure that all the fieldworkers were capable of taking the measurements accurately and to ensure consistency. Since the fieldworkers were Dietetic students they were familiar with measuring weight and height. The informed consent form (Appendix E, p164) was given to the fieldworkers, and an explanation of the document was provided so that the fieldworkers were aware of what was expected. The fieldworkers were required to read the document thoroughly. All fieldworkers were provided with the exact same training at the same time to ensure that the methods used in collecting data were consistent in order to reduce any form of bias. To ensure consistency, the weight and height measurements were taken by the same fieldworkers throughout the data collection period. All fieldworkers were actively involved with assisting the subjects with the 24 hour dietary recall.

3.7 Pilot study

The pilot study was conducted on ten students that met the inclusion criteria. Subjects were selected from the same population in which the main study was conducted. All of the subjects were given the same questionnaire and informed consent document to complete.

During the pilot study, the method in which anthropometric measurements were taken by the fieldworkers was observed and any inaccuracies or recommendations were noted. The fieldworkers and the researcher were involved in recording any questions that were unclear or ambiguous for the subjects. Any other weaknesses that were identified in the methods used to collected data were noted and the necessary adjustments were made to improve the study design for the main project. The subjects had taken approximately 15 minutes to complete the questionnaire for the pilot study.

3.7.1 The following modifications were made after conducting the pilot study:

- During the pilot study some subjects were recruited between lectures and were therefore not given sufficient time to answer the questionnaire. The fieldworkers were requested to recruit subjects for the main study that were available for approximately 15 minutes to complete the questionnaire.
- With regards to the questionnaire design, a few questions were rephrased as subjects were unsure of what was expected.

After making adjustments to the questionnaire based on the pilot study, a meeting was held with the fieldworkers to outline all the adjustments that were made. The fieldworkers were requested to check that all the subjects answered all the questions before leaving the study site.

3.8 Variables included in the study, data capturing and analysis

After data collection the information was collated by organising the questionnaire into numerical order and all the questionnaires were examined in order to assess which should be included and excluded from the study. A spreadsheet on Microsoft Excel was designed in order to record all the data and coding was used for certain questions. The data were entered twice into the database in order to cross check the results and make any adjustments if necessary. The 24 hour dietary recall was analysed using MRC Food Finder and the information was entered twice into the programme. The total energy and sugar intake was determined and entered into the spread sheet designed on Microsoft Excel. Thereafter the data was analysed using the Statistical Package for the Social Sciences (SPSS) database. Table 3.2 provides a summary of the objectives, the variables associated with each object as well as the statistical test applied in order to analyse the results.

Table 3.2: Data analysis of the objectives

	Objective	Variables required for analysis	Statistical test to be applied
1	To determine the demographic characteristics of the students such as age, gender, race and place of residence	- Age - Gender - Race - Place of residence	- Descriptive statistics - Chi-square goodness of fit test - Level of significance: $p<0.0005$
2	To determine the BMI of the students.	- Weight - Height	- Descriptive statistics - Chi-square goodness of fit test - Level of significance: $p<0.0005$
3	To determine the dietary intake of added sugar from foods and beverages among the students.	- FFQ - 24 hour dietary recall	- Descriptive statistics - Independent sample t-test: ▪ Lavenes test for equality of variances ▪ t-test for equality of means ▪ Level of significance $p<0.005$
4	To determine the association between the dietary intake of added sugar and the students' BMI	- BMI - Added sugar intake (FFQ and 24 Hour dietary recall)	- Pearson's correlation - Spearman's correlation - Level of significance $p<0.05$
5	To determine the consumption and consumption patterns of SSBs.	- Place of consumption - Place of purchase	- Binomial test - Level of significance $p<0.0005$
6	To determine the influence of demographic characteristics on the dietary intake of added sugars.	- Gender - Race - Place of residence -Added sugar intake (FFQ and 24 Hour dietary recall)	- ANOVA t test - Wilcoxon signed rank test - Kruskal Wallis test - Level of significance $p<0.05$
7	To determine the factors that relate to the purchases and intake of SSBs	- Taste - Price - Social influences (friends and family) - Marketing	- One sample t-test - Chi-square goodness of fit test - Central value of 3 - Level of significance $p<0.0005$

3.9 Data quality control

3.9.1 Reliability and validity of data

It is essential that the data collection in any study is reliable and valid in order to ensure that the results of the study are accurate. Reliability can be defined as the extent to which the questionnaire designed for the data collection process will produce results that are consistent when re-measured and it serves as a representation of the total population (Carmines & Zeller 1979, p11), whilst validity is used to determine if the questionnaire designed for the data collection process measures that which was intended (Carmines & Zeller 1979, p12).

Validity was ensured through the use of a pilot study that was conducted before the main study. Based on the feedback from the pilot study, the questionnaire was adjusted and the questionnaire was validated by the statistician before and after conducting the pilot study. The tools used in collecting data was adapted from previous studies that were conducted among university students.

To ensure reliability, all fieldworkers were given the same training at the same time and the same fieldworkers that were involved in taking the subjects weight, height, administering and supervising the completion of the informed consent and the questionnaire was used throughout the data collection process to avoid any form of bias and to allow for consistency. The weight and height measurements were also taken in accordance to the standard protocol that was used in other studies and the BMI was calculated and classified using the WHO classification table. All subjects were given the same questionnaire and the same amount of time was allocated for completion of the questionnaire. All the scales that were used in taking anthropometric measurements were calibrated and the height and weight measurements were taken three times and then an average was calculated.

3.9.2 Reduction of bias

Bias refers to "any action in any stage of a study that systematically distorts the findings." Bias can occur at any stage in a study whether it be during the study design, data collection, and data analysing and reporting. During the process of this research process a small amount of bias was introduced during the data collection process as convenience sampling was used and only subjects that agreed to participate in the study were selected. However, this form of bias was reduced as a variety of students were selected to participate in the study. To further reduce any other forms of bias the following aspects were considered:

- The fieldworkers were required to remain objective throughout the study and no unnecessary conversations were allowed.
- All fieldworkers were trained at the same time to ensure that all the data was collected in a similar manner and to reduce any incidence of bias.
- All subjects were allocated the same amount of time for completing the questionnaire.

3.10 Ethical considerations

Ethical approval was applied for and received by the Human and Social Sciences Research Ethics Committee. A copy of the ethics approval can be found on Appendix D, p163 (HSS/0175/016M). Gatekeeper's approval (Appendix C, p162) was also obtained from the UKZN registrar in order to use the facilities at the campus to conduct the study as well as recruit university students to participate in the study.

An informed consent form (Appendix E, p164) was designed and the students had to sign the form prior to participation. The consent form outlined the study topic, objectives and methodology involved. The students were informed that participation was voluntary and in order to ensure anonymity and confidentiality of information all subjects were given a unique code which was indicated on the questionnaire. The weight and height measurements were taken individually to ensure confidentiality and only the fieldworkers had access to such information.

All of the information gathered was stored in a secured office and only authorised personnel would have access to this information.

3.11 Summary

This chapter outlined the methodology used to calculate BMI and assess the dietary intake and behaviour of the subjects. This chapter examined the reasons behind using the data collection tools and any available literature on this aspect was outlined. It focused on outlining the steps that were taken in order to ensure that the results would be reliable and valid. Furthermore, it also outlined how any form of bias was avoided in order to produce accurate findings. The next chapter will focus on outlining the results of the study in relation to the objectives that were set.

CHAPTER 4: RESULTS

This chapter presents the results of the study. A description of the study sample characteristics will be presented to facilitate a better understanding of the study population selected. The results of the statistical analyses of the data will be presented in this chapter in accordance with the objectives of the study.

4.1 The demographic characteristics of the subjects

While a total of 395 undergraduate students were approached to participate in this study, only 387 students were included in the analyses. Eight subjects were excluded because they did not complete the questionnaire. Out of the eight subjects, six did not complete the FFQ and the 24 hour dietary recall and two had only partially completed these two sections.

The subjects' ages ranged from 18-25 years, with a median age of 20 years and a mean age of 20.31 (SD1.855) years. There were 128 (33.1%) male subjects and 259 (66.9%) female subjects. Black African subjects made up the majority of the sample population with 350 (90.4%) Black African subjects, followed by 27 (7.0%) Indian subjects, 8 (2.1%) Coloured subjects and 2 (0.5%) White subjects.

The chi-square goodness of fit test was conducted in order to determine which place of residence was most common among the subjects. Based on analysis there were statistically significant differences between the places of residence (χ^2 (3) = 126.230, $p<0.0005$). A significant number of the subjects (47.3%, n=183) lived at a residence on campus, followed by home (23.3%, n=90) and digs (22.0%, n=85). Only a few subjects selected the "other" option (7.5%, n=29) and specified that they lived at private apartments in urban locations.

The demographic characteristics of the subjects according to their place of residence is presented in Table 4.1. Most of the subjects reported to live away from home (76.7%, n=297) with almost half of the subjects reporting to live at a residence on campus (47.3%, n=183). More than half of the subjects that lived at a residence on campus were male (50.8%, n=65) and Black African (51.7%, n=181). With the exception of the Indian race group, a greater percentage of the subjects from the other race groups lived away from home (Table 4.1).

Table 4.1: The demographic characteristics of the study population according to their place of residence

	At home		Residence on campus		Digs		Other*	
	n	%	n	%	N	%	n	%
Gender								
Male (n=128)	30	23.4	65	50.8	28	21.9	5	3.9
Female (n=259)	60	23.2	118	45.6	57	22.0	24	9.3
Race								
Indian (n=27)	25	92.6	0	0.0	0	0.0	2	7.4
Black African (n=350)	61	17.4	181	51.7	82	23.4	26	7.4
Coloured (n=8)	4	50.0	2	25.0	1	12.5	1	12.5
White (n=2)	0	0.0	0	0.0	2	100	0	0.0
Total (n=387)	90	23.3	183	47.3	85	22.0	29	7.5

* Indicated by the subjects as a written comment on the questionnaire.

4.2 The anthropometric measurements of the study population

The anthropometric measurements of the subjects are presented in Table 4.2. The mean weight and height for the subjects was 63.0kg and 1.64m, however the male subjects weighed more (66.4kg verses 61.4kg) and were taller (1.72m verses 1.59m) than the female subjects.

Table 4.2: The anthropometric measurements of the study population

Anthropometrics	Mean	Median	Minimum	Maximum	Standard Deviation (SD)
Weight (kg)					
Combined (n=387)	63.0	61.6	38.3	146.3	13.1
Male (n= 128)	66.4	64.2	46.9	146.3	13.5
Female (n=259)	61.4	59.0	38.3	106.5	12.5
Height (m)					
Combined (n=387)	1.64	1.65	1.39	1.95	0.08
Male (n= 128)	1.72	1.71	1.51	1.95	0.07
Female (n=259)	1.59	1.60	1.39	1.81	0.06
BMI (kgm^2)					
Combined (n=387)	23.5	22.6	16.2	44.9	4.61
Male (n= 128)	22.5	22.0	16.3	44.9	3.93
Female (n=259)	24.0	23.3	16.2	42.6	4.84

The BMI results were furthered categorised to present the BMI classifications for the male and female subjects based in accordance with the WHO BMI classifications for adults (Table 4.3). According to the chi-square goodness of fit test, a significant number of subjects were within

the normal BMI classification (n=251; 64.9%) (χ^2 (3) = 695.217, p<0.0005), and a greater percentage of these subjects were male (77.3%, n=99). The mean BMI for the male and female subjects were within the normal BMI category as presented in Table 4.2. Almost one third of the subjects were overweight or obese (27.6%, n=107), however there were more overweight subjects (19.1%, n=74). The prevalence of overweight and obesity was found to be higher among the female subjects (22.0%, n=57 and 11.6%, n= 30 respectively). A relatively small percentage of the subjects were underweight (7.5%, n=29) and predominantly female (7.7%, n=20) (Table 4.3).

Table 4.3: The classification of the subjects according to the WHO BMI categories

BMI classification	**Male (n=128)**		**Female (n=259)**		**Combined (n=387)**	
	n	**%**	**n**	**%**	**n**	**%**
Underweight (<18.5kgm^2)	9	7.0	20	7.7	29	7.5
Normal (18.5-24.9kgm^2)	99	77.3	152	58.7	251	64.9
Overweight (25-29.9kgm^2)	17	13.3	57	22.0	74	19.1
Obese (Class 1) (30-34.9kgm^2)	1	0.8	19	7.3	20	5.2
Obese (Class 2) (35-39.9kgm^2)	-	-	7	2.7	7	1.8
Obese (Class 3) (≥40kgm^2)	2	1.6	4	1.5	6	1.6
Total obese (30- ≥40kgm^2)	**3**	**2.3**	**30**	**11.6**	**33**	**8.5**

Table 4.4 presents a cross tabulation of the BMI classification of the subjects according to their place of residence. Most of the subjects that lived away from home were within the normal BMI classification (65.0%, n=193), and more than two third reported to live at a residence on campus (70.5%, n=129). A lower percentage of the subjects that lived at a residence on campus were overweight (16.4%, n=30) and the prevalence of obesity (class 1, 2 and 3 combined) was lower among the subjects that lived at home (5.6%, n=5). Therefore, subjects that lived at digs and in private accommodation had higher rates of overweight and obesity. The prevalence of underweight was lower among the subjects that lived away from home (6.4%, n=19).

Table 4.4: The BMI classification of the subjects according to place of residence

BMI classification	At home (n=90)		Residence on campus (n=183)		Digs (n=85)		Other (n=29)		Total away from home (n=297)	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Underweight (<18.5kgm^2)	10	11.1	10	5.5	6	7.1	3	10.3	19	6.4
Normal (18.5-24.9kgm^2)	58	64.4	129	70.5	49	57.6	15	57.7	193	65.0
Overweight (25-29.9kgm^2)	17	18.9	30	16.4	20	23.5	7	24.1	57	19.2
Obese (Class 1) (30 -34.9kgm^2)	0	0.0	11	6.0	7	8.2	2	6.9	20	6.7
Obese (Class 2) (35-39.9kgm^2)	4	4.4	2	1.1	0	0.0	1	3.4	3	1.0
Obese (Class 3) (≥40kgm^2)	1	1.1	1	0.5	3	3.5	1	3.4	5	1.7
Total obese (30- ≥40kgm^2)	**5**	**5.6**	**14**	**7.7**	**10**	**11.8**	**4**	**13.8**	**28**	**9.4**
Total (n=387)	90	23.3	183	47.3	85	22.0	29	7.5		

4.3 The dietary intake of the study population

4.3.1 The total food and beverage consumption of the study population

The total frequency of consumption of the foods and beverages by all the subjects is presented in Table 4.5. For the purpose of this analysis most frequently consumed refers to consuming the food or beverage item more than once a week and a low frequency of consumption refers to consuming the beverage once a month or less and not consuming it at all.

Beverages:

Based on the analysis of the results from the FFQ, the most frequently consumed (more than once a week) beverages among the subjects were water (99.0%, n=383), juice concentrates (65.2%, n=252) and carbonated soft drinks (67.4%, n=261). Most of the subjects reported to consume water (29.2%, n=113) and juice concentrates (29.2%, n=113) on a daily basis and carbonated soft drinks (29.5%, n=114) were consumed by most of the subjects on a weekly basis. Although 100% fruit juices were not among the most frequently consumed beverages it was consumed by almost a third of the subjects on a weekly basis (25.8%, n=100). More than half of the subjects reported that they did not consume flavoured milks (61.2%, n=237) and Mague (maize based drink) (73.9%, n=286).

Sugar, milk flavourings and milk powder:

Table sugar (78.8%, n=305) and coffee (52.7%, n=204) were the only two items under the sugar and milk flavouring and milk powder category that were most frequently consumed by the subjects. Table sugar was used by more than one third of the subjects on a daily basis (46.0%, n=178) and most subject reported to consume coffee on a weekly basis (21.2%, n=82). More than half of the subjects reported that they did not consume Milo (55.8%, n=216) and hot chocolate (53.0%, 205). Nesquik (77.3%, n=299) and non-dairy creamers (71.6%, n=277) were the least consumed items under this category.

Sauces:

With the exception of mayonnaise and tomato sauce the frequency of consumption of the other sauces was low. More than half of the subjects reported to consume tomato sauce (51.2%, n=198) and mayonnaise (60.2%, n=233) frequently. Mayonnaise was consumed by most of the subjects on a daily basis (25.1%, n=97) and most subject reported to consume tomato sauce weekly (22.7%, n=88).

Breakfast cereals:

Cornflakes was the most frequently consumed breakfast cereal under this category (66.1%, n=256). In comparison to the other breakfast cereals, the weekly and daily consumption of Cornflakes was high, however most subject reported to consume Cornflakes on a daily basis (28.2%, n=109).

Starch:

With regards to the starch food group, a low frequency of consumption was observed for samp (52.8%, n=204) as more than half of the subjects reported that they did not consume it. With the exception of bread (57.6%, n=223), a low percentage of the subjects reported to consume the other food items under the starch food group on a daily basis. In comparison to the other starch items, the weekly consumption of Maize meal (28.2%, n=109) and rice (35.9%, n=139) was high. With regards to the starchy vegetables, potatoes were the most frequently consumed starchy vegetable (61.2%, n=237) with more subjects consuming it on a weekly basis (29.2%, n=113).

Vegetables and fruits:

The daily and weekly consumption of vegetables and fruits was low. Frozen mixed vegetables (63.0%, n=244), apples (71.6%, n=277) and bananas (57.9%, n=224) were the only items under the vegetable and fruit category that were most frequently consumed by the subjects. Frozen mixed vegetables was the only item under the vegetable category that was consumed by most subjects on a daily basis (24.3%, n=94). Tomatoes (28.2%, n=109), apples (32.0%, n=124) and bananas (31.0%, n=120) were among the few vegetables and fruits that were consumed by most subjects on a weekly basis. However, these results indicate that approximately one third of the study population consumed the above mentioned vegetables and fruits on a daily or weekly basis.

Meat:

The frequency of consumption of fish (60.5%, n=234), mutton (72.4%, n=280) and organ meat (74.4%, n=288) was low. Most of the subjects reported to consume chicken and beef with chicken being the most frequently consumed meat product (91.5%, n=354). The weekly consumption of chicken and beef was high as 35.9% (n=139) of the subjects reported to consume chicken 1-2 times per week and 35.4% (n=137) reported to consume beef 1-2 times per week.

Dairy:

Milk was the most frequently consumed item (70.8%, n=274). Although most subjects reported to consume milk (35.7%, n=138) on a daily basis this only accounted for just over a third of the subjects.

Fat:

Butter was the least consumed item as more than half of the subjects reported a low frequency of consumption (69.0%, n=267). Oil (85.8%, n=332) and margarine (77.0%, n=298) were most frequently used by the subjects, however oil was used by most of the subjects on a daily basis (44.7%, n=173).

The frequency of consumption of the items listed under the spreads, desserts, cakes and biscuits, chocolates and sweets category was relatively low as most subjects reported a low frequency of consumption of these food items listed in Table 4.5.

Table 4.5: The frequency of consumption of the food and beverage items from the FFQ

	Frequency of consumption												SD
	Never		<1/month		1/month		1-2/week		3-6/week		Daily		
	n	%	n	%	n	%	n	%	n	%	n	%	
Beverages													
Water	68	17.6	47	12.1	20	5.2	71	18.3	68	17.6	113	29.2	0.88
100% Fruit juices	41	10.6	70	18.1	91	23.5	100	25.8	49	12.7	34	8.8	1.502
Juice concentrates	68	17.6	47	12.1	20	5.2	71	18.3	68	17.6	113	29.2	2.032
Carbonated soft drinks	28	7.2	36	9.3	62	16.0	114	29.5	86	22.2	61	15.8	1.537
Energy drinks	149	36.2	73	18.9	90	23.3	47	12.1	17	4.4	11	2.8	1.398
Flavoured water	152	39.3	86	22.2	69	17.8	41	10.6	23	5.9	15	3.9	1.469
Flavoured milk	237	61.2	46	11.9	45	11.6	26	6.7	14	3.6	16	4.1	1.443
Magueu	286	73.9	60	15.5	27	7.0	6	1.6	4	1.0	3	0.8	0.886
Sugar, milk flavourings and milk powder													
Table sugar	33	8.5	24	6.2	25	6.5	60	15.5	67	17.3	178	46.0	1.852
Milo	216	55.8	57	14.7	41	10.6	40	10.3	20	5.2	13	3.4	1.475
Hot chocolate	205	53.0	76	19.6	40	10.3	41	10.6	17	4.4	8	2.1	1.354
Coffee	106	27.4	40	10.3	37	9.6	82	21.2	61	15.8	61	15.8	1.961
Nesquik	299	77.3	47	12.1	22	5.7	10	2.6	6	1.6	2	0.5	0.896
Non-dairy creamers	277	71.6	34	8.8	13	3.4	21	5.4	13	3.4	29	7.5	1.639
Sauces													
Tomato sauce	100	25.8	46	11.9	43	11.1	88	22.7	46	11.9	64	16.5	1.89
Mayonnaise	81	20.9	34	8.8	39	10.1	71	18.3	65	16.8	97	25.1	1.963
Sweet chilli sauce	205	53.0	36	9.3	49	12.7	41	10.6	31	8.0	25	6.5	1.709
BBQ sauce	247	63.8	47	12.1	40	10.3	31	8.0	15	3.9	7	1.8	1.311
Nandos sauce	213	55.0	44	11.4	57	14.7	38	9.8	16	4.1	18	4.7	1.553
Mustard sauce	305	78.8	35	9.0	18	4.7	18	4.7	7	1.8	3	0.8	1.023
Sweet chutney sauce	301	77.8	29	7.5	20	5.2	17	4.4	10	2.6	9	2.3	1.204
Breakfast cereals													
Powdered cereals	276	71.3	28	7.2	18	4.7	28	7.2	17	4.4	20	5.2	1.553
Coated cereals	255	65.9	23	5.9	28	7.2	30	7.8	19	4.9	32	8.3	1.731
Cornflakes	82	21.2	21	5.4	28	7.2	73	18.9	74	19.1	109	28.2	1.981
Rice Krispies	261	67.4	38	9.8	26	6.7	37	9.6	11	2.8	14	3.6	1.44
Starch													
Maize Meal	53	13.7	30	7.8	51	13.2	109	28.2	97	25.1	47	12.1	1.625
Rice	17	4.4	11	2.8	27	7.0	139	35.9	132	34.1	61	15.8	1.282
Samp	204	52.7	85	22.0	66	17.1	18	4.7	10	2.6	3	0.8	1.127
Bread	7	1.8	6	1.6	8	2.1	38	9.8	105	27.1	223	57.6	1.296
Bread rolls, burger buns	127	32.8	45	11.6	60	15.5	94	24.3	38	9.8	22	5.7	1.653
Butternut/pumpkin	159	41.1	53	13.7	81	20.9	67	17.3	20	5.2	7	1.8	1.391
Potatoes	43	11.1	40	10.3	65	16.8	113	29.2	81	20.9	43	11.1	1.523
Sweet Potato	231	59.7	92	23.8	42	10.9	11	2.8	9	2.3	2	0.5	1.011
Vegetables													
Tomatoes	92	23.8	46	11.9	67	17.3	109	28.2	55	14.2	18	4.7	1.539
Spinach	173	44.7	64	16.5	86	22.2	46	11.9	16	4.1	2	0.5	1.256
Cabbage	166	42.9	81	20.9	84	21.7	42	10.9	11	2.8	3	0.8	1.213
Beetroot	193	49.9	59	15.2	62	16.0	41	10.6	19	4.9	13	3.4	1.453
Mixed Veg	78	20.2	21	5.4	44	11.4	73	18.9	77	19.9	94	24.3	1.898
Fruit													
Apple	30	7.8	28	7.2	52	13.4	124	32.0	78	20.2	75	19.4	1.548
Banana	57	14.7	38	9.8	69	17.8	120	31.0	71	18.3	32	8.3	1.543
Pear	129	33.3	58	15.0	70	18.1	78	20.2	34	8.8	18	4.7	1.578
Plum	156	40.3	55	14.2	80	20.7	60	15.5	26	6.7	10	2.6	1.463
Oranges	107	27.6	81	20.9	92	23.8	69	17.8	23	5.9	15	3.9	1.422
Grapes	90	23.3	74	19.1	95	24.5	68	17.6	44	11.4	16	4.1	1.485

Table 4.5: Continued

	Frequency of consumption												SD
	Never		<1/month		1/month		1-2/week		3-6/week		Daily		
	n	%	n	%	n	%	n	%	n	%	n	%	
Meat													
Chicken	12	3.1	14	3.6	16	4.1	139	35.9	148	38.2	58	15.0	1.222
Fish	106	27.4	41	10.6	87	22.5	105	27.1	39	10.1	9	2.3	1.46
Mutton	170	43.9	43	11.1	67	17.3	75	19.4	24	6.2	7	1.8	1.457
Beef	72	18.6	20	5.2	69	17.8	137	35.4	72	18.6	17	4.4	1.5
Organ meat	171	44.2	49	12.7	68	17.6	58	15.0	23	5.9	8	2.1	1.448
Dairy													
Milk	69	17.8	17	4.4	27	7.0	66	17.1	70	18.1	138	35.7	1.987
Maas	142	36.7	45	11.6	78	20.2	74	19.1	34	8.8	14	3.6	1.555
Yoghurt (plain)	205	53.0	39	10.1	62	16.0	41	10.6	25	6.5	15	3.9	1.555
Fat													
Margarine	106	27.4	18	4.7	24	6.2	73	18.9	70	18.1	95	24.5	2.085
Butter	197	50.9	35	9.0	35	9.0	45	11.6	36	9.3	39	10.1	1.915
Oil	34	8.8	9	2.3	11	2.8	56	14.5	103	26.6	173	44.7	1.692
Spreads													
Jam	222	57.4	65	16.8	31	8.0	32	8.3	26	6.7	9	2.3	1.426
Honey	284	73.4	49	12.7	20	5.2	20	5.2	12	3.1	2	0.5	1.08
Golden syrup	313	80.9	40	10.3	14	3.6	13	3.4	7	1.8	-	-	0.849
Peanut Butter	140	36.2	43	11.1	52	13.4	67	17.3	48	12.4	37	9.6	1.823
Desserts													
Ice Cream	57	14.7	73	18.9	127	32.8	84	21.7	38	9.8	8	2.1	1.285
Canned Fruit	261	67.4	62	16.0	39	10.1	19	4.9	5	1.3	-	-	0.949
Custard	183	47.3	94	24.3	76	19.6	23	5.9	8	2.1	3	0.8	1.124
Jelly	240	62.0	93	24.0	42	10.9	8	2.1	3	0.8	1	0.3	0.857
Frozen Yoghurt	233	60.2	43	11.1	65	16.8	25	6.5	15	3.9	6	1.6	1.289
Flavoured Yoghurts	79	20.4	50	12.9	95	24.5	84	21.7	43	11.1	36	9.3	1.609
Popsicles	284	73.4	36	9.3	35	9.0	16	4.1	10	2.6	6	1.6	1.15
Cakes and biscuits													
Doughnuts	173	44.7	72	18.6	58	15.0	52	13.4	24	6.2	8	2.1	1.419
Cakes	62	16.0	52	13.4	108	27.9	92	23.8	52	13.4	19	4.9	1.447
Muffins	85	22.0	56	14.5	97	25.1	93	24.0	39	10.1	15	3.9	1.469
Biscuits Filling	87	22.5	51	13.2	89	23.0	82	21.2	58	15.0	20	5.2	1.57
Plain Biscuits	117	30.2	64	16.5	75	19.4	67	17.3	41	10.6	23	5.9	1.62
Chocolates													
KitKat	197	50.9	66	17.1	54	14.0	48	12.4	18	4.7	4	1.0	1.333
Barone	223	57.6	55	14.2	54	14.0	39	10.1	11	2.8	5	1.3	1.293
Lunch bar	170	43.9	59	15.2	75	19.4	56	14.5	16	4.1	11	2.8	1.432
Mars	339	87.6	20	5.2	16	4.1	7	1.8	1	0.3	2	0.5	0.747
Nikki	344	88.9	18	4.7	16	4.1	4	1.0	3	0.8	2	0.5	0.716
Bounty	354	91.5	17	4.4	9	2.3	4	1.0	1	0.3	2	0.5	0.636
Crunchie	297	76.7	33	8.5	33	8.5	14	3.6	5	1.3	5	1.3	1.051
Tex	298	77.0	31	8.0	27	7.0	16	4.1	11	2.8	4	1.0	1.114
Cadbury/Beacon slab	152	39.3	49	12.7	93	24.0	49	12.7	27	7.0	17	4.4	1.538
Sweets													
Soft sweets	178	46.0	57	14.7	51	13.2	60	15.5	30	7.8	11	2.8	1.526
Hard boiled sweets	236	61.0	37	9.6	35	9.0	35	9.0	23	5.9	21	5.4	1.636
Marshmallows	177	45.7	66	17.1	69	17.8	43	11.1	20	5.2	15	3.9	1.459

4.3.2 The consumption of added sugar

4.3.2.1 The added sugar intake from the 24 hour dietary recall

Based on the analyses of the results from the 24 hour dietary recall, it was found that over a 24 hour period, the mean added sugar intake for all subjects was 56.8g and the mean energy consumption was 6796.0KJ. The mean percentage contribution of added sugars to the mean energy input was 14.2%.

4.3.2.2 The mean frequency of consumption of added sugars from the food and beverage categories listed in the FFQ

The mean frequency of consumption of the foods and beverages categories that contained added sugar was calculated using the independent sample t-test and is presented in Table 4.6. The mean values in the table represent the responses under the "How often consumed?" category in the FFQ. Subjects were presented with the "How often consumed?" statement in which they could select a range of options from which 1 represented "Never" to 7 which represented "Everyday but more than once a day." Therefore a mean frequency of 2.79 for beverages falls in the third response under the "How often consumed?" category and is equivalent to consuming the beverage about once a month. Based on the analysis of the results, a higher mean frequency of consumption was observed for the beverage, sugar and milk flavourings and milk powder, and cakes and biscuits category. The mean frequency of consumption of these categories was once a month.

Table 4.6 The mean frequency of consumption of the food and beverages categories that contain added sugar

	n	Mean	SD	Standard error mean
Beverages	387	2.79	1.283	0.065
Sugar, milk flavourings and milk powders	387	2.75	1.508	0.077
Spreads	387	1.95	1.295	0.066
Sauces	387	2.35	1.522	0.064
Breakfast cereals	387	2.44	1.676	0.085
Desserts	387	2.10	1.180	0.06
Cakes and biscuits	387	2.88	1.505	0.077
Chocolates	387	2.05	1.289	0.066
Sweets	387	2.22	1.540	0.078

4.3.2.3 The mean amount of added sugars consumed from the food and beverage items listed in the FFQ

Differences were observed in the mean amount of added sugars consumed from each food and beverage category. These results are presented in Table 4.7. The "n" value in the table represents the number of subjects that consumed the food or beverage item. The mean values in the table represent the responses under the "How much consumed?" category in the FFQ. Subjects were presented with the "How much consumed?" statement in which they could select a range of options which indicated the amount of the food or beverage item consumed. Therefore a mean amount of 2.04 for 100% fruit juice falls in the second response under the "How much consumed?" category and is equivalent to consuming 250-500ml of the beverage. Due to the variations in portion sizes, each category was analysed separately.

Beverages:

In comparison to all of the sugar containing beverages, carbonated soft drinks were consumed by most of the subjects (92.5%, n=358) and the mean amount consumed was 250-500ml. Although Mague was the least consumed item under this category (25.8%, n=100) the mean amount consumed was equivalent to that of carbonated soft drinks.

Sugar milk flavourings and powder:

The mean amount of table sugar, Milo and hot chocolate consumed (1-2 heaped teaspoons) was higher than that of coffee and Nesquik (1-2 heaped level teaspoons). However table sugar (91.5%, n=354) and coffee (72.1%, n=279) were consumed by most of the subjects.

Spreads:

Peanut butter was consumed by more than half of the subjects (63.8%, n=247) and the mean amount consumed (1-2 heaped teaspoons) was higher than that of the other spreads listed. Golden syrup was consumed by the least number of subjects (19.1%, n=74) and the mean amount consumed was the lowest (1-2 level teaspoons).

Sauces:

In comparison to the other sauces listed, the mean amount of Mustard, BBQ and sweet chutney sauce consumed was the lowest (1-2 level teaspoons) and less than half of the subjects reported to consume these sauces. Mayonnaise (79.1%, n=306) and Tomato sauce (74.2%, n=287) were consumed by most of the subjects with a mean amount of 1-2 heaped teaspoons.

Breakfast cereals:

Cornflakes was consumed by most of the subjects (78.8%, n=305). However the mean amount consumed was equivalent to that of the other breakfast cereals listed (1-2 cups).

Desserts:

In comparison to all of the items listed under this category, ice cream was consumed by more than two thirds of the subjects (85.3%, n=330). However the mean amount consumed of all the desserts was 1-2 cups or scoops or popsicles.

Cakes and biscuits:

More than half of the subjects reported to consume all of the items listed under this category. However, in comparison to the other items listed the mean amount of biscuits (with and without filling) consumed was the highest (more than 2 but less than 3 each time).

Chocolates:

The number of subjects that consumed slabs of chocolate (28.4%, n=237) was double of those that reported to consume chocolate bars (61.2%, n=110), however the mean amount consumed was equivalent (more than 30gram but less than 60gram or half a slab).

Sweets:

Soft sweets and marshmallows were consumed by more than half of the subjects and the mean amount consumed (4-5 each time) was higher than that of hard boiled sweets.

Table 4.7: The mean amount of added sugars consumed from the items listed in the FFQ

	n	%	Mean	SD	Standard error mean
Beverages					
100% Fruit juices	343	88.6	2.04	0.807	0.044
Juice concentrates	319	82.4	2.15	0.921	0.052
Carbonated soft drinks	358	92.5	2.39	0.981	0.052
Energy drinks	237	61.2	1.90	0.697	0.045
Flavoured water	234	60.5	1.91	0.778	0.051
Flavoured milk	148	38.2	1.72	0.774	0.064
Mague	100	25.8	1.87	0.812	0.081
Sugar, milk flavourings, milk powders					
Table sugar	354	91.5	3.01	1.173	0.062
Milo	173	44.7	2.65	1.228	0.093
Hot chocolate	180	46.5	2.57	1.058	0.079
Coffee	279	72.1	2.34	1.074	0.064
Nesquik	85	22.0	2.40	1.115	0.121
Spreads					
Jam	165	42.6	2.36	1.059	0.082
Honey	102	26.4	2.23	1.098	0.109
Golden Syrup	74	19.1	2.16	.993	0.115
Peanut Butter	247	63.8	2.79	1.206	0.077
Sauces					
Tomato sauce	287	74.2	2.72	1.158	0.068
Mayonnaise	306	79.1	2.79	1.185	0.068
Sweet chilli sauce	182	47.0	2.54	1.150	0.085
BBQ sauce	138	35.7	2.33	1.142	0.097
Nandos sauce	173	44.7	2.65	1.185	0.090
Mustard sauce	80	20.7	2.44	1.168	0.131
Sweet chutney sauce	85	22.0	2.48	1.119	0.121
Breakfast cereals					
Powdered cereals	110	28.4	1.77	0.553	0.053
Coated cereals	132	34.1	1.89	0.609	0.053
Cornflakes	305	78.8	2.05	0.545	0.031
Rice Krispies	126	32.6	1.86	0.641	0.057
Desserts					
Ice Cream	330	85.3	1.94	0.683	0.038
Canned Fruit	125	32.3	1.50	0.591	0.053
Custard	204	52.7	1.73	0.704	0.049
Jelly	146	37.7	1.64	0.662	0.055
Frozen Yoghurt	154	39.8	1.81	0.687	0.055
Flavoured Yoghurts	308	79.6	1.95	0.688	0.039
Popsicles	103	26.6	1.50	0.640	0.063
Cakes and biscuits					
Doughnuts	214	55.3	1.92	0.714	0.049
Cakes	325	84.0	2.11	0.782	0.043
Muffins	301	77.8	2.20	0.869	0.050
Biscuits Filling	300	77.5	2.73	1.034	0.060
Plain Biscuits	270	69.8	2.74	1.074	0.065
Chocolates					
Bars (17-62g)	110	28.4	1.82	0.883	0.099
Cadbury/Beacon slab	237	61.2	2.31	0.944	0.061
Sweets					
Soft sweets	209	54.0	2.53	1.038	0.072
Hard boiled sweets	151	39.0	2.25	0.931	0.076
Marshmallows	210	54.3	2.52	0.929	0.064

4.4 The association between added sugar intake and body mass index

A Pearson's correlation test was run in order to assess the relationship between the added sugar intake from a 24 hour dietary recall and the BMI of the subjects. The results revealed that there was insufficient evidence to conclude that a significant linear relationship existed between BMI and the added sugar intake from the 24 hour dietary recall. The coefficient of correlation (r) was close to zero (r=0.026) indicating a very small and weak relationship and the p value was greater than 0.05 (p=0.604), therefore no significant correlation existed.

In addition to the Pearson's correlation test, a Spearman's correlation test was run in order to assess the relationship between added sugar intake from a FFQ and the BMI of the subjects. There were various foods and beverages under each food and beverage category, therefore only those that produced significant findings ($p<0.05$) were presented. Significant findings were observed for the beverage, dessert and sweet categories. Under the beverage category, flavoured milk was the only beverage that produced a significant finding. The Spearman's correlation indicated that there was a significant negative correlation between the subjects BMI and the frequency of consuming flavoured milk (rho=-0.154, p=0.002). Thus a higher BMI was associated with a lower frequency of consumption of flavoured milks. With regards to the dessert category, ice cream was the only dessert that produced a significant finding. A positive correlation was found between the subjects BMI and the amount of ice cream consumed (rho= 0.143, p=0.009). Therefore subjects with a higher BMI consumed larger portions of ice cream. Under the sweets category, hard boiled sweets were the only sweets that produced a significant finding. There was a significant negative correlation between BMI and the amount of hard boiled sweets consumed (rho=-0.237, p=0.003). Thus subjects with a higher BMI consumed smaller portions of these sweets.

4.5 The consumption and consumption patterns of sugar sweetened beverages

4.5.1 The most frequently consumed sugar sweetened beverage

In order to determine the most frequently consumed sugar sweetened beverage among the subjects as presented in Figure 4.1, the following SSBs were included in the study: carbonated soft drinks, energy drinks, flavoured water, fruit juices, juice concentrates and flavoured milks. Almost half of the subjects reported to consume carbonated soft drinks more frequently, and flavoured milk products were consumed less frequently (Figure 4.1). The chi-square goodness of fit test, revealed that a significant number of subjects reported to consume carbonated soft

drinks (49.1%, n=190) and juice concentrates (23.3%, n=90), (χ^2 (5) = 354.225, p<0.0005) more frequently.

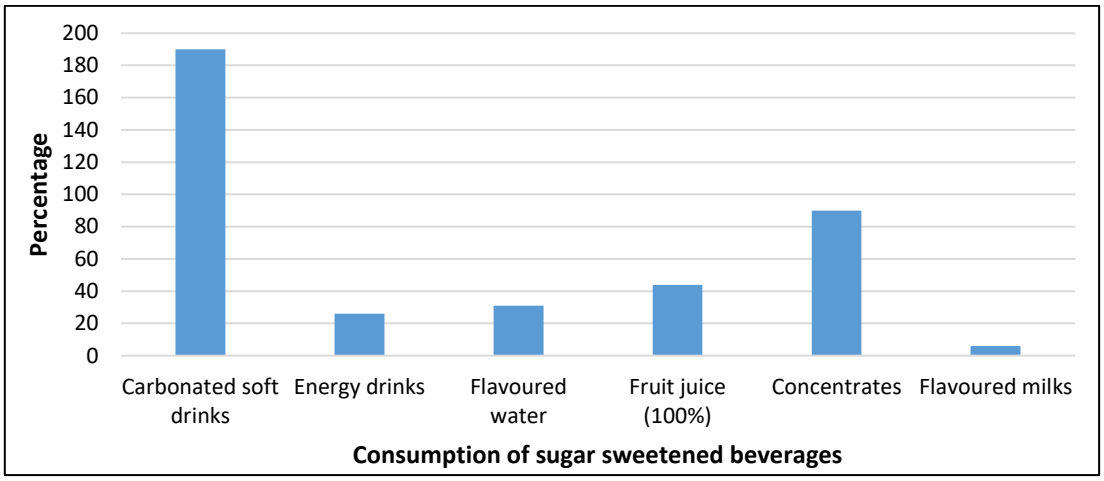

Figure 4.1: The frequency of consumption of SSBs as a percentage

4.5.2 The purchasing and consumption patterns of sugar sweetened beverages

There were various combinations of places selected by the subjects with regards to where the SSBs were usually purchased and consumed. The Binomial test was applied to both categories in order to determine the places in which a significant proportion of the subjects consumed and purchased the beverages. A significant proportion of the subjects purchased their beverages at supermarkets (n=369; 96.3%) and not from vending machines (n=8; 2.1%), restaurants or take aways (n= 66; 17.1%) and local cafés (n=28; 7.2%) (p<0.0005). Only one subject (n=1; 0.3%) selected the "other" option and specified that they usually purchase the beverage at tuck shops.

With regards to the usual place of consumption, it was found that a significant number of the subjects consumed the beverage on campus (n=243; 62.8%) and not at restaurants or take aways (n=115; 29.7%) or social events (n=66; 17.1%) (p<0.0005). A total of 25.1% (n=97) of the subjects selected the "other" option and specified that they usually consumed the beverage at home or at a private residence. Based on the analysis it can be concluded that most of the subjects purchased SSBs from supermarkets and most of them consumed the beverages on campus.

4.6 The relationship between demographic characteristics and added sugar intake among university students

The added sugar intake from the 24 hour dietary recall as well as the FFQ was analysed in order to investigate if demographic characteristics such as gender, race and place of residence had any influence on the consumption of added sugars. The ANOVA or independent t-test was used in order to determine if the mean intake of added sugar from the 24 hour dietary recall had differed across the different genders, races and places of residence. Non-parametric statistics were used in order to determine which food and beverage categories from the FFQ were most frequently consumed by the different genders, races and places of residence, this is also known as the mean rank.

4.6.1 The relationship between gender and added sugar intake

Based on the results from the 24 hour dietary recall, the mean consumption of added sugars among the male subjects (63.1g, SD=60.39) was greater than that of the female subjects (53.7g, SD= 55.73). Thus, the percentage contribution of the mean added sugar to the mean total energy input was higher among the male (15.8%) than female subjects (13.4%). However, the ANOVA test indicated no significant difference between the mean added sugar intakes for both genders ($p>0.05$). Consequently, these results indicated that there was no statistically significant difference between the mean added sugar intake for the male and female subjects.

In order to investigate the most frequently consumed food or beverage groups containing added sugars by the male (n=128) and female (n=259) subjects, the frequency of consumption of each food and beverage category in the FFQ was calculated and the results are presented in Figure 4.2. Based on the results from the Wilcoxon signed rank test there were differences in the frequency of consumption of the food and beverage categories that contained added sugars between the genders. The frequency of consumption of desserts ($Z=-2.959$, $p=0.003$); cakes and biscuits ($Z=-2.494$, $p=0.013$); chocolates ($Z=-3.315$, $p=0.001$) and sweets ($Z=-2.337$, $p=0.017$) was significantly higher among the female subjects. Although the male subjects consumed SSBs more frequently than the female subjects, no significant difference was observed.

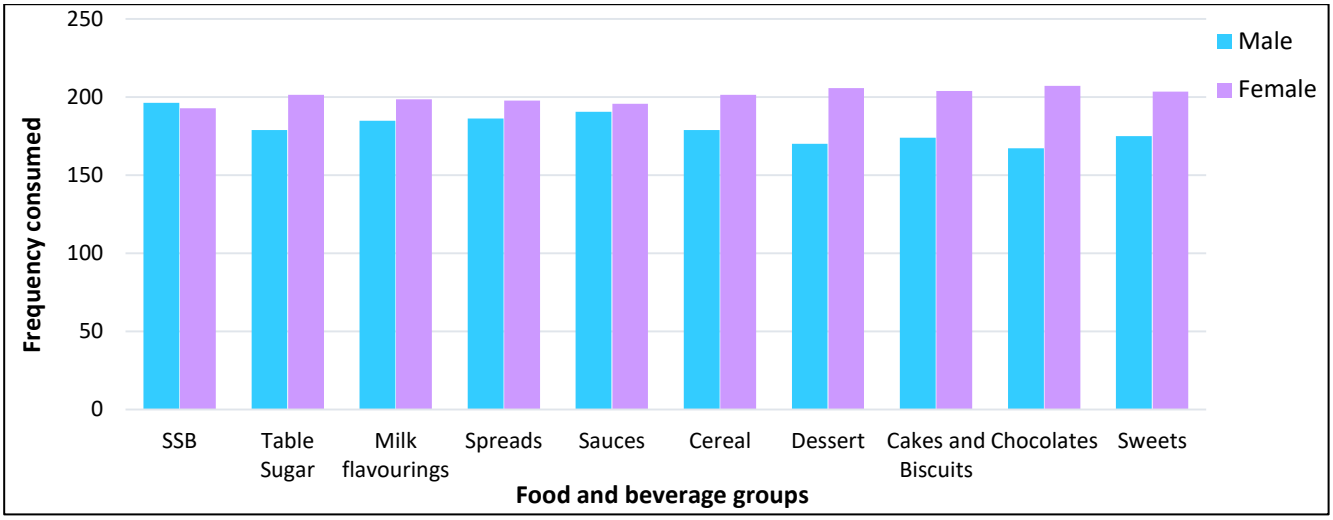

Figure 4.2: The frequency of consumption of added sugars according to gender

Differences were also observed in the amount and frequency of individual food and beverage items consumed by the male and female subjects. An independent sample t-test was conducted using the data in the FFQ and only results with significant findings ($p<0.05$) are presented. Table 4.8 presents the mean amount of added sugar consumed according to gender and Table 4.9 presents the mean frequency of consumption of added sugars according to gender. The mean amount and frequency columns presented in the tables represent the same values as explained under subsections 4.3.2.2 and 4.3.2.3.

Based on the analysis of the results, gender seemed to influence the amount of added sugars consumed (Table 4.8). Under the beverage category, a significant difference was observed between the mean amounts of carbonated soft drinks consumed across both genders. The male subjects consumed a significantly greater amounts of carbonated soft drinks (more than 500ml but less than 1 litre) in comparison to the female subjects (250-500ml). Under the table sugar and milk flavouring category, and the cakes and biscuits category, table sugar (1-2 heaped teaspoons) and doughnuts (1-2 each) were consumed in significantly greater amounts by the male subjects. With the exception of coated cereals the male subjects consumed significantly greater amounts of the other breakfast cereals listed. The “n” values presented in Table 4.8 represents the subjects that consumed the food or beverage item.

Table 4.8: The mean amount of added sugars consumed according to gender

	Male (n=128)				Female (n=259)				pValue	t	Df
	n	**%**	**Mean**	**SD**	**n**	**%**	**Mean**	**SD**			
Beverages											
Carbonated soft drinks	119	93.0	2.69	1.056	239	92.3	2.25	0.908	**0.000**	3.906	207.11
Sugar, milk flavourings, powder											
Table sugar	118	92.2	3.21	1.253	236	91.1	2.90	1.120	**0.024**	2.267	212.27
Breakfast cereals											
Powdered cereals	29	22.7	2.00	1.251	81	31.3	1.69	0.993	**0.005**	2.662	49.83
Cornflakes	102	79.7	2.16	0.540	203	78.4	2.00	0.540	**0.010**	2.467	202.46
Rice Krispies	33	25.8	2.06	0.659	93	35.9	1.78	0.623	**0.033**	2.152	124
Cakes and biscuits											
Doughnuts	55	43.0	2.11	0.809	159	61.4	1.85	0.667	**0.019**	2.354	212

The frequency of consumption of added sugars differed across both genders. Significant differences were observed for the sugar and milk flavourings and powder, sauces, breakfast cereals, desserts, cakes and biscuits and chocolate categories. Under the sugar and milk flavourings and powder category, the frequency of consumption of Milo (less than once a month) and Nesquik (less than once a month) was significantly higher among the female subjects. With regards to the sauces and breakfast cereals category, Nandos sauce and Rice Krispies were the only food items under these categories that were consumed more frequently by the female subjects (less than once a month). Significantly, all of the food items listed under the cakes and biscuits and sweets category were consumed more frequently by the female subjects. With the exception of frozen yoghurt and the Lunch bar chocolate, the frequency of consumption of the balance of the food items listed under the dessert and chocolates category was significantly higher among the female subjects.

Table 4.9: The mean frequency of consumption of added sugar according to gender

	Male (n=128)		Female (n=259)		p Value	t	Df
	Mean	SD	Mean	SD			
Sugar, milk flavouring, milk powders							
Milo	1.78	1.322	2.19	1.530	**0.007**	-2.709	288.55
Nesquik	1.24	0.626	1.48	0.993	**0.005**	-2.825	360.61
Sauces							
Nandos sauce	1.82	1.251	2.28	1.664	**0.003**	-3.027	324.30
Breakfast cereals							
Rice Krispies	1.59	1.207	1.95	1.532	**0.014**	-2.464	312.33
Desserts							
Ice cream	2.64	1.234	3.18	1.274	**0.000**	-3.971	385
Custard	1.75	0.958	2.04	1.187	**0.014**	-2.457	385
Flavoured yoghurt	2.83	1.431	3.39	1.661	**0.001**	-3.465	289.22
Cakes and biscuits							
Doughnuts	1.92	1.308	2.41	1.447	**0.001**	-3.301	277.26
Biscuits with filling	2.83	1.464	3.25	1.604	**0.013**	-2.487	385
Biscuits plain	2.55	1.425	2.95	1.695	**0.016**	-2.431	295.65
Chocolates							
Kit Kat	1.62	1.073	2.29	1.393	**0.000**	-5.206	318.09
Crunchie	1.33	0.795	1.56	1.151	**0.019**	-2.350	344.49
Tex	1.34	0.943	1.60	1.182	**0.022**	-2.293	309.06
Cadbury/Beacon Slab	2.05	1.318	2.72	1.592	**0.000**	-4.366	299.54
Sweets							
Soft jellies	2.02	1.417	2.49	1.556	**0.003**	-2.951	275.38
Marshmallows	1.95	1.273	2.38	1.526	**0.004**	-2.890	297.64

4.6.2 The relationship between race and added sugar intake

The analysis from the 24 hour dietary recall indicated that the mean added sugar intake was greater among the Indian race group (60.1g) and this was then followed by Black Africans (56.8g), Whites (51.8g) and Coloureds (49.1g). However, the ANOVA test indicated no significant difference between the mean added sugar intakes for all race groups ($p>0.05$). Therefore the average added sugar intake from the 24 hour dietary recall did not differ significantly across the different race categories.

Using the results from the FFQ, the frequency of consumption of each food and beverage category that contained added sugar was calculated for each race group in order to determine the frequency of consumption across the different races; Indian (n=27), Black (n=350), Coloured (n=8) and White (n=2), and these results are presented in Figure 4.3. Based on the results the frequency of consumption of added sugars differed for the race groups. According to the Kruskal Wallis test the frequency of consumption of the beverage, spreads and breakfast cereals category differed significantly by race. Significantly, the Black African and Coloured subjects consumed SSBs more frequently than the Indian subjects; and the Black African

subjects consumed SSBs more frequently than the White subjects ($\chi 2$ (3) =16.434, p=0.001). In comparison to the Black African and Coloured subjects, the frequency of consumption of spreads was higher among the Indian subjects ($\chi 2$ (3) =11.242, p=0.010). Significantly, the Black African subjects consumed breakfast cereals more frequently than the Indian subjects; and the Coloured and Black African subjects consumed breakfast cereals more frequently than the than the White subjects ($\chi 2$ (3) =10.073, p=0.018).

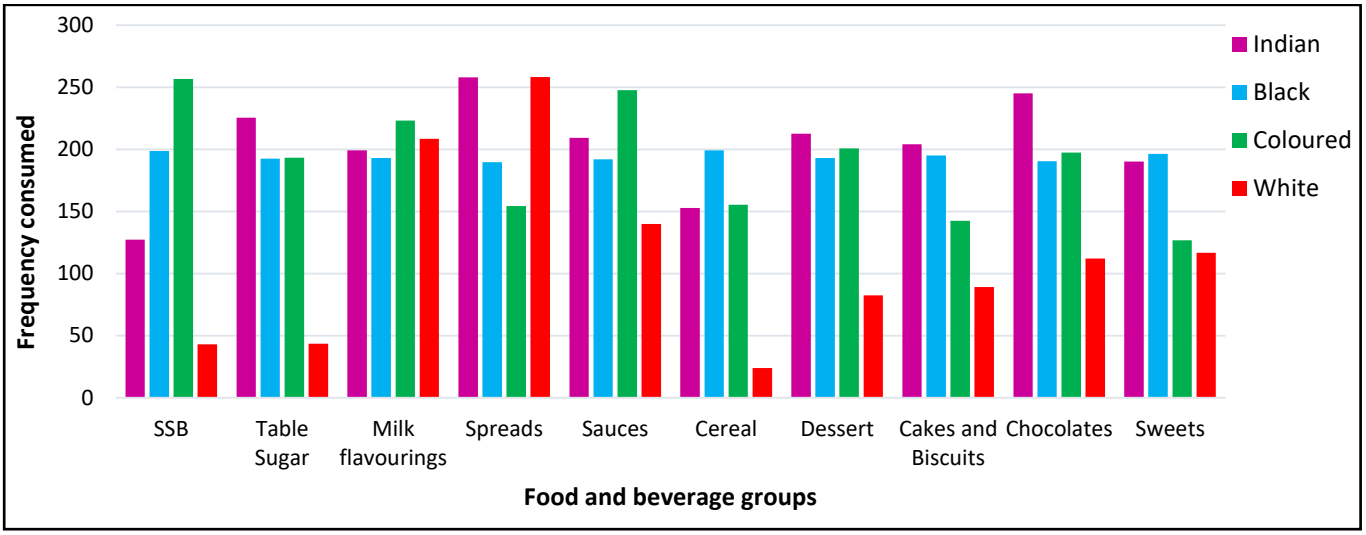

Figure 4.3: The frequency of consumption of added sugar according to race

4.6.3 The relationship between place of residence and added sugar intake

Based on the analysis of the results from the 24 hour dietary recall, it was found that subjects that lived away from home (n=297) had a greater mean daily intake of added sugars (61.7g) in comparison to the subjects that lived at home (n=90) (54.1g). However, the ANOVA test indicated no significant difference between the mean added sugar intake by the different categories of residence (p>0.05).

In order to investigate added sugar intake according to the subjects' place of residence, the frequency of consumption of added sugars was calculated using the results from the FFQ and is presented in Figure 4.4. Based on the analysis of the results, the frequency of consumption of added sugars differed according to the subjects' place of residence. The analysis from the Wilcoxon signed rank test indicated that the frequency of consumption of spreads (Z=-2.958, p=0.003) and desserts (Z=-2.274, p=0.023) was significantly higher among the subjects that lived at home. Although the subjects that lived away from home consumed SSBs, milk

flavourings, sauces and breakfast cereals more frequently than those that lived away from home, no significant difference was observed.

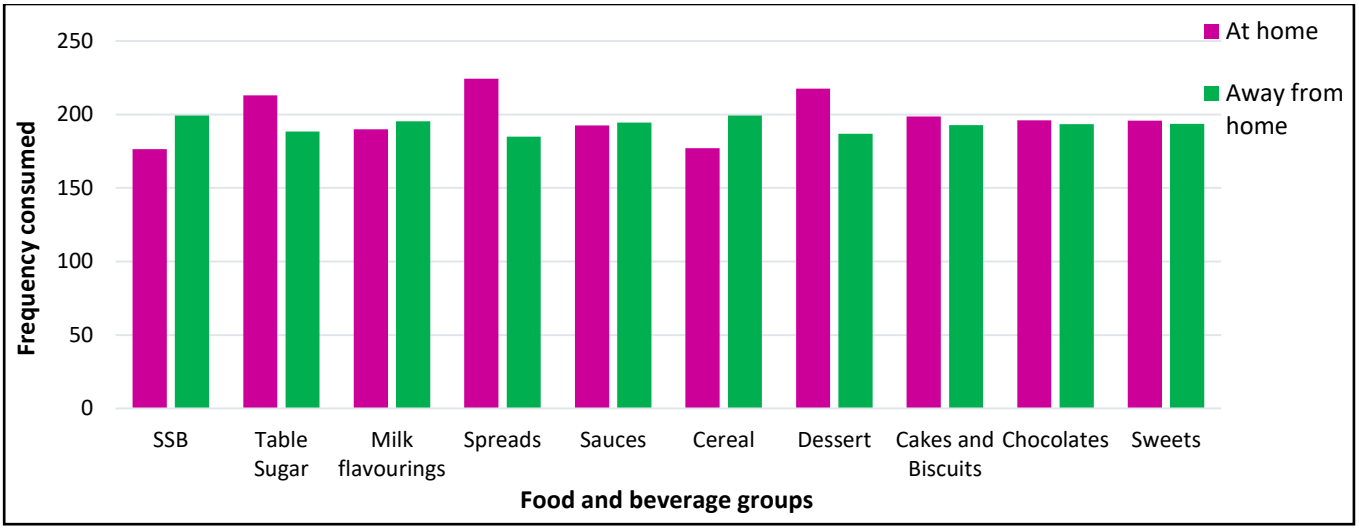

Figure 4.4: The frequency of consumption of added sugar according to place of residence

4.7 Factors related to the purchase and intake of sugar sweetened beverages

The following factors that could be related to the purchase and consumption of SSBs were investigated in this study: price, taste, marketing and labelling and social influences which included family and friends. The subjects were required to rate how important the factors were when purchasing SSBs. A rating scale from 1 to 5 was used, whereby the rating 1 was considered as not at all important and the rating 5 was considered as extremely important. Table 4.10 indicates the subjects rating for the factors listed above. Based on the analysis of the results it was found that 84.5% (n=327) of the subjects rated taste as the most important factor when purchasing SSBs, followed by price 70% (n=271), marketing and labelling 30.5% (n=118) and social influences (friends and family) 25.1% (n=97). Thus, marketing and labelling as well as social influences (family and friends) were considered the least important when purchasing SSBs.

The one sample t-test was used in order to determine which factor was significantly more important when purchasing SSBs. A mean was calculated for each factor and it was matched against a t-value of 3 (Table 4.10). Mean values that were below the t-value were considered as having a significant low importance and mean values above the t-value were considered as having a significant high importance in purchasing the beverage. A significant difference ($p<0.0005$) between the factors that influence consumer purchase and consumption of SSBs

was observed. Based on analysis, taste (t (386) = 29.815, p=0.000) and price (t (386) = 15.675, p=0.000) was significantly important when purchasing the beverage (p <0.0005) and factors relating to marketing and labelling (p=0.023) of the product as well as social influences (friends and family) (p=0.020) showed a significant low importance (p>0.0005), therefore these factors were not considered important when purchasing the beverage.

Table 4.10: The influence of each factor on the purchases of sugar sweetened beverages

Factors	Level of importance						
	Low		Moderate		High		Mean (t-value of 3)
	n	%	n	%	n	%	
Taste	19	4.9	41	10.6	327	84.5	4.42
Price	52	13.4	64	16.5	271	70	4.00
Marketing and labelling	160	41.3	109	28.2	118	30.5	2.84
Social influences (family and friends)	207	53.5	83	21.4	97	25.1	2.54

In conjunction with the factor related to price, this study also investigated the impact that a price increase would have on the purchases and consumption of SSBs. Based on analysis using the chi-square goodness of fit test, it was found that a significant number of subjects (n=150; 38.8%) (χ^2 (3) = 43.605, p<0.0005) indicated that if the price of the beverage increased they would purchase and consume the beverage less often, 24.8% (n= 96) indicated that price would have no influence on their consumption and purchase of SSBs, 18.6% (n=72) indicated that they would purchase and consume smaller amounts and 17.8% (n=69) indicated that they would purchase and consume healthier alternatives. Based on the t-test analysis as well as the chi-square goodness of fit test, it can be deduced that price does influence consumer purchases and consumption of SSBs.

4.8 Summary of results

The results of the questionnaire which was used to determine the association between added sugar intake and BMI was presented in this chapter by using various statistical analyses. The following are the most noteworthy results:

A total of 387 subjects were included in this study. The study population consisted of more female (66.9%, n=297) than male (33.1%, n=128) respondents and most of the respondents were from the Black African race group (90.4%, n=350). The mean age of the subjects was

20.31years. Most of the subjects had taken up residence away from home (76.7%, n=297) and of these most reported to live at a residence on campus (47.3%, n=193).

The minimum and maximum BMI for the female subjects was 42.6 kgm^2 and 44.9 kgm^2 respectively, and for the male subjects it was 16.2 kgm^2 and 16.3 kgm^2 respectively, therefore indicating that the BMI of the subjects ranged from underweight to obese (class III). Most of the subjects were within a normal BMI classification, however, more males were within this BMI category (77.3%, n=99). A higher prevalence of overweight and obesity was observed among the female subjects (22% and 11.5%). A relatively small percentage of the subjects were underweight and this consisted of more female subjects.

In comparison to the other foods and beverages, the consumption of foods and beverages that contained added sugar was high. The most frequently consumed beverage that contained added sugar was juice concentrates (65.2%, n=252) and carbonated soft drinks (67.4%, n=261). Table sugar (78.8%, n=305) and coffee (52.7%, n=204) were the only two items under the sugar and milk flavouring and powder category that were most frequently consumed by the subjects. More than half of the subjects reported to consume tomato sauce (51.2%, n=198) and mayonnaise (60.2%, n=233) frequently. Cornflakes (66.1%, n=256) was the only breakfast cereal that was most frequently consumed by the subjects. The frequency of consumption of the other food categories that contained added sugar was low.

There was no significant difference between the added sugar intake from the 24 hour dietary recall and the subjects BMI, however a significant correlation was found for some of the food and beverage items listed in the FFQ. Subjects with a high BMI consumed flavoured milk less often, however they consumed a greater amount of ice cream and a smaller amount of hard boiled sweets.

The most frequently consumed SSB among the subjects were carbonated soft drinks, and this was followed by juice concentrates. A significant number of the subjects indicated that that they usually purchase the beverage from supermarkets and consume it on campus.

The added sugar intake from the 24 hour dietary recall indicated that the mean percentage contribution of added sugar to the mean energy input for the male and female subjects was 15.8% and 13.4% respectively. Although there was no significant difference between the added

sugar intake from the 24 hour dietary and the demographic characteristics of the subjects (gender, race and place of residence), subjects that were male, Indian and that lived away from home had a greater daily intake of added sugars. Based on the analysis of the results from the FFQ, the added sugar intake from the various food and beverage categories differed by gender, race and place of residence. Subjects that were female, Indian and that lived at home consumed most of the foods and beverages categories that contained added sugar more frequently, however, significant differences were observed for some food and beverage groups across the different demographic characteristics. The frequency of consumption of the desserts, cakes and biscuits, chocolates and sweets category was significantly higher among female subjects. With regards to individual food and beverage items, the female subjects significantly consumed some food and beverage items that contained added sugars more frequently than the male subjects, however the male subjects consumed significantly greater amounts. Significantly, the Black African subjects consumed SSBs and breakfast cereals more frequently than the Indian and White race group; and the Coloured subjects consumed SSBs and breakfast cereals more frequently than the Indian and White subjects respectively. In comparison to the Black African and Coloured subjects, the frequency of consumption of spreads was significantly higher among the Indian subjects. Subjects that lived at home consumed spreads and desserts significantly more frequently than those that lived away from home.

External factors such as taste and price were found to be most influential on the purchases and consumption of SSBs among the subjects. Based on analysis, a significant number of subjects indicated that increasing the price of SSBs will result in a decrease in frequency and the amount purchased and consumed.

A discussion of the results from this study in relation to the findings from previous studies will be outlined in the next chapter.

CHAPTER 5: DISCUSSION

The purpose of this study was to determine the association between added sugar intake and the BMI of undergraduate students between the ages of 18-25 years studying at UKZN, Pietermaritzburg. This chapter will focus on discussing the results of each objective that were presented in Chapter 4. The results of the study will be compared to previous literature and discussed.

5.1 The demographic characteristics of the study population

Female (n=259; 66.9%) and Black African subjects (n=350; 90.4%) formed the bulk of the sample population. According to the demographics at the Pietermaritzburg campus, of the 2445 undergraduate students that registered in 2016, 46.0% were male, 54.0% were female, 85.4% were Black Africans, 10.1% were Indian, 2.4% were White and 2.2% were Coloured. The other four campuses that also fall part of UKZN (Edgewood, Westville, Nelson Mandela School of Medicine and Howard College) have also indicated the similar distribution of the students across the different genders and race groups. Therefore, the demographic characteristics of the students from this study were consistent with those of students from the other four campuses that are part of UKZN.

The 2011 census also indicated that out of the total South African population, Black Africans made up the vast majority (79.2%), and in KwaZulu-Natal, the 2011 Census revealed that out of a population of 102 673 00, 86.8% were Black Africans, 7.4% were Indian, 4.2% were White and 1.4% were Coloured (Statistics South Africa 2011). Although these statistics consisted of individuals from different age categories, the race distribution of the university students was consistent with the race distribution of the country and province.

5.2 The body mass index of the study population

5.2.1 The body mass index of the study population and the classification based on gender

The study population consisted of students of various BMI classifications. The mean BMI of the female and male subjects was within the normal BMI classification (24.0 kgm^2 and 22.5kgm^2 respectively). Similarly, a cross sectional study conducted at a University situated in Ghana, indicated that the mean BMI of the male and female students was within the normal BMI classification (21.5kgm2, SD±2.4 and 22.8kgm2, SD±4.2 respectively) (Mogre *et al* 2015). More than half of the study population at UKZN was within the normal BMI classification (64.9%; n=251). A total of 19.1% (n=74) of the subjects were overweight, 8.5%

(n=33) were obese and 7.5% (n=29) were underweight. Similar BMI classifications were observed among other studies that examined the nutritional behaviour of university students. Cross sectional studies that were conducted among students attending national (Mogre *et al* 2015; Van den Berg *et al* 2013; Van den Berg *et al* 2012; Peltzer & Pengpid 2012) as well as international universities (Mahfouz *et al* 2016; Sofía *et al* 2015; Salameh *et al* 2014) have also indicated that more students were within the normal BMI classification, and this was followed by the overweight and obese category and lastly the underweight category. With the exception of the study conducted by Mogre *et al* (2015) the gender distribution of the other studies was similar to the UKZN study with more females than male subjects. A more detailed explanation of these studies can be found in chapter 2, section 2.4.1, Table 2.1.

University students are often faced with various factors that influence their dietary and lifestyle behaviours which facilitate the development of overweight and obesity (Vandeboncoeur *et al* 2015). Their diet and physical activity levels are influenced by external factors such as stress, an increased workload, time and financial constraints. As a result students often do not have sufficient time and money to prepare meals or engage in physical activities, therefore they develop sedentary behaviour and purchase cheap convenience foods with low nutritional content (Vandeboncoeur *et al* 2015). These factors could therefore contribute towards the prevalence of overweight and obesity among university students.

With regards to the BMI classification by gender, the study conducted among UKZN students indicated that more males (77.3%, n=99) than females were within the normal BMI classification, however the prevalence of overweight, obesity and underweight was higher among the female subjects. This distribution pattern was similar among other South African studies. Studies that were conducted locally at the University of Free State, Eastern Cape and Limpopo indicated a higher prevalence of overweight and obesity among the female students (58.2%, 22.1% and 30.5% respectively). Similarly, the studies that were conducted at the University of Free State and at a university in the Eastern Cape indicated that the prevalence of underweight was higher among the female students and more males were within the normal BMI classification (58.8% and 87.2% respectively) (Van den Berg *et al* 2013 and Van den Berg *et al* 2012). On the contrary, the study conducted at the University of Limpopo indicated that more males (15.2%) than females (9.6%) were underweight (Peltzer & Pengpid 2012). The SANHANES-1 also reported a higher prevalence of overweight and obesity among female

(12.8% and 56.4% respectively) than male subjects (4.2% and 31.7% respectively) that were above the age of 15 years (SANHANES-1 2013).

In contradiction to the studies conducted nationally, studies that were conducted at international universities, indicated a higher prevalence of overweight and obesity among the male students. A study that was conducted at the University of Jazan in Saudi Arabia, indicated that the prevalence of overweight and obesity was higher among the male (37.5%) than female students (29.9%) (Mahfouz *et al* 2016). Similarly, studies that were conducted among students attending a University in Mexico (Sofia *et al* 2015) and Lebanon (Salameh *et al* 2014) also found a higher prevalence of overweight and obesity among the male students (36.8% and 38.0% respectively).

Factors such as culture, socio-economic status and nutrition transition could be held accountable for the gender differences in overweight and obesity. Some cultures, such as the Black African culture have associated body size with health and wealth, therefore having a 'larger' body size will mean that one is of good health and comes from a wealthy household (Kanter & Caballero 2012). Studies have also indicated that in comparison to men, women that are from a higher socio-economic status are more likely to be overweight or obese, this could be due to the fact that they have more control over the food purchases (Case & Menendez 2009). Rapid urbanisation due to the influence of nutrition transition has also resulted in an increase in the incidence of overweight and obesity among populations in developing countries due to the alterations in the dietary habits as well as lowered physical activity levels. Women have been found to more vulnerable to weight gain, as they often display more sedentary behaviour than men and they consume more energy dense foods. Thus, nutrition transition has contributed towards the gender differences in weight gain (Kanter & Caballero 2012). Based on the statistics obtained from the South African studies, it can be concluded that students attending universities in South Africa have a normal BMI classification and that the male students form a greater percentage of this normal BMI category. It can also be concluded that the prevalence of overweight and obesity is higher among female compared to male students.

5.2.2 The body mass index of the study population according to place of residence

Most of the subjects that lived away from home were within the normal BMI classification (65.0, n=193) and of these a greater percentage reported living at a residence on campus (70.5%, n=129). A higher percentage of subjects that lived at digs or in private accommodation were overweight or obese. Interestingly, the prevalence of underweight was higher among subjects

that lived at home (11.1%, n=10). Similarly, a study that was conducted by Brunt *et al* (2008) on 557 undergraduate students attending an American university, indicated that most students that lived at a residence on campus were within the normal BMI category (64.5%) and that the prevalence of overweight and obesity was higher among the subjects that lived in private accommodation. In comparison to the study conducted on UKZN students, the study in America revealed that the prevalence of underweight was lower among the students that lived at home (9.4%) (Brunt *et al* 2008).

5.3 The dietary intake of added sugars among the subjects

The 24 hour dietary recall was analysed in order to determine the energy and added sugar intake among the subjects. Based on analysis, the mean added sugar and energy intake was 56.8g and 6795.9KJ and the mean percentage contribution of added sugars to the total energy input was 14.2%. This indicates that the students exceeded the WHO recommendations that states that "a maximum of 10% of energy should come from free sugars" (WHO 2015b). A cohort study that was conducted between 2005 and 2010 on South African adults residing in the North West province (Vorster *et al* 2014) indicated that the consumption of added sugars among this population group increased over this time period, and that by the year 2010 individuals consumed more than 10% of their total energy from added sugars (Vorster *et al* 2014). The percentage contribution of added sugars to the diet was higher among individuals from rural areas according to the study conducted by Vorster *et al* (2014) as the consumption of SSBs increased by approximately 50% over the 5 year period. Consequently, the results from the study conducted in the North West province indicated that nutrition transition is evident among South Africans.

Although this study used the words "added sugar" and the WHO recommendations use the term "free sugars", both definitions are similar. The only difference is that free sugars refer to natural sugars present in fruit juices and concentrates, however, due to the limitation of the South African Food Composition Tables which do not give amounts for free sugars the total carbohydrate content in the fruit juices and the fruit concentrates were used to calculate the sugar the content as done by other researchers including Maunder, Nel, Steyn, Kruger & Labadarios (2015).

Due to the variations in the portion sizes for the food and beverage categories in the FFQ, the "how often consumed?" column was used to determine the frequency of consumption of the

food and beverages among the subjects. A similar approach was used in the studies that assessed the dietary intake of university students using a FFQ (Mogre *et al* 2015, Van den Berg *et al* 2013; Van den Berg *et al* 2012). The dietary intake among students attending the University of Free State (Van den Berg *et al* 2013) and a University in the Eastern Cape (Van den Berg *et al* 2012) have been compared with the dietary intake of the UKZN students.

The most frequently (more than once a week) consumed items under the beverage category was water (99.0%, n=383), juice concentrates (65.2%, n=252) and carbonated soft drinks (67.4%, n=261). Although water was consumed by most of the subjects, the number of subjects that consumed water and juice concentrates on a daily basis was equivalent (29.3%, n=113). Carbonated soft drinks (29.5%, n=114) and 100% fruit juices (25.8%, n=100) were the only beverages that were consumed by most subjects 1-2 times per week. Corresponding to these findings, the study conducted at the University of Free State indicated that carbonated soft drinks and 100% fruit juices were consumed by most of the subjects on a weekly basis (77% and 75.2% respectively). On the contrary the study conducted at a University in the Eastern Cape indicated that most students reported to consume carbonated soft drinks and 100% fruit juices on a monthly basis (72.1% and 68.9% respectively). Based on analysis the consumption of the following SSBs was relatively high among UKZN students: carbonated soft drinks, juice concentrates and 100% fruit juice. These beverages are sold at and around the university therefore, the availability of these products could have influenced the subjects' purchases and consumption.

Under the sugar and milk flavouring and powder category, the most frequently consumed items were table sugar (78.8%, n=305) and coffee (52.7%, n=204). Table sugar was consumed by a greater percentage of the subjects on a daily basis (46.0%, n=178). Similarly, the studies that were conducted at the University of Free State and Eastern Cape indicated that a greater percentage of students reported to consume sugar on a daily basis (Easter Cape 59.0%, Free State 57.1%).

Tomato sauce and (51.2%, n=198) and mayonnaise (60.2%, n=233) were the only sauces that were most frequently consumed by the subjects. With the exception of Cornflakes, more than two thirds of the sample population reported that they did not consume powdered breakfast cereals (71.3%, n=276), coated cereals (65.9%, n=255) and Rice Krispies (67.4%, n=261). Contrary to these findings, more than two thirds of the students attending the University of Free

State reported to consume powdered breakfast cereals weekly and more than two thirds of the students attending a University in the Eastern Cape reported to consume powdered breakfast cereals monthly.

Maize meal, bread and rice were most frequently consumed by more than half of the subjects, however a greater percentage of the subjects reported to consume bread on a daily basis (57.6%, n=223). Similarly, the study conducted at a University in the Eastern Cape indicated that a greater percentage of the subjects reported to consume bread on a daily basis (55.9%). However, the study conducted at the University of Free State indicated that a small percentage of students consumed bread (31.1%) on a daily basis. A possible reason for the high consumption of these food items, is that university students are faced with economic constraints and often purchase food products that are sold at affordable prices (DOH & UNICEF SA 2004-2007). Therefore this could explain why the consumption of these food items was high among the UKZN students. With regards to the starchy vegetables, potatoes were most frequently consumed by the subjects attending UKZN (61.2%, n=237). French fries are sold at the university as well as at take-aways around the campus, therefore this could have contributed towards the high frequency of consumption of potatoes among the subjects.

The daily and weekly consumption of vegetables was low among this population group as less than one third of the subjects reported to consume vegetables on a daily or weekly basis. Frozen mixed vegetables were the only items under the vegetable category that was most frequently consumed by the subjects (63.0%, n=244). Most subjects reported to consume frozen mixed vegetables on a daily basis (n=94; 24.3%), however this accounted for less than one third of the sample population. A possible reason as to why most subjects reported to consume frozen mixed vegetables in comparison to the fresh vegetables could be that frozen mixed vegetables are more cost effective to purchase and has a longer shelf life. Tomatoes (n=109; 28.2%) were consumed 1-2 times per week by most the subjects. Similar trends were observed for the consumption of fruits. However the daily consumption of all the fruits listed under the fruit category in the study conducted at UKZN were low and only one third of the subjects reported to consume apples (n=124; 32%) and bananas (n=120; 31%) 1-2 times per week. These fruits are sold at the university and they are generally cheaper than other fruits, therefore this could explain why these fruits were consumed by most of the subjects. Similar trends in the vegetable and fruit consumption were observed among students attending a university in the Eastern Cape and Free State. Less than one third of the subjects attending a University in the Eastern Cape and Free

State reported to consume fruits (Eastern Cape 23.6%, Free State 29.8%) and vegetables (Eastern Cape 12.4%, Free State 18.6%) on a daily basis. Most students at the University of Free State reported a high weekly consumption of vegetables and fruits and the monthly consumption of vegetables and fruits was higher among students attending a University in the Eastern Cape. However, in contrast to the findings from the study on UKZN students, the study conducted at a University in the Eastern Cape and Free State indicated that more subjects consumed fruits than vegetables on a daily basis.

Milk was the most frequently consumed dairy product (70.8%, n=274), however, slightly more than one third of the subjects reported to consume it on a daily basis (n=138; 35.7%). Therefore, indicating that a relatively small percentage of the subjects consumed milk daily.

Under the meat category, chicken was consumed most frequently by the subjects (89.1%, n=345) and this was followed by beef (58.4%, n=226). The high consumption of chicken among the subjects could be due to the fact that the students are exposed to many places at and around the university that sell chicken. Similarly, the study that was conducted on university students in Ghana, also indicated a high consumption of chicken among the students and this was due to the fact that there was an increase in the number of take-aways in the vicinity that sold chicken (Mogre *et al* 2015).

In comparison to butter, more than half of the subjects reported to use oil and margarine frequently. However, most of the subjects reported to use oil on a daily basis (44.8%, n=173). The low frequency of consumption of butter among the students could be related to the price of the product. The study that was conducted at the University of Free State indicated a higher weekly consumption of oil or margarine (57.8%) whereas the study conducted at a University in the Eastern Cape indicated a higher daily consumption of oil or margarine (68.3%).

A low frequency of consumption was observed for the items listed under the spreads, desserts, chocolates and sweets category as most of the subjects reported to consume it once a month or less than once a month and some reported that they did not consume these items. Consistent with these findings, the study that was conducted at a University in the Eastern Cape indicated that only a few students reported to consume sweets and chocolates (18.6%), and cakes and biscuits (2.5%) on a daily basis. Contrary, the study that was conducted in the Free State

indicated that most of the students reported to consume sweets and chocolates (92.5%), and cakes and biscuits (87.6%) on a weekly basis.

According to the study that was conducted by Mchiza *et al* (2015) on the dietary habits of South African adults sugar, bread, full cream milk, coffee, chicken, margarine, oil, potatoes, carbonated soft drinks and rice were the top ten food and beverages that were most frequently consumed by South African adults. The study on UKZN students also indicated that these food and beverage items were frequently consumed by the subjects. Concurrent with the evidence provided in the study that was conducted on the dietary shifts among South Africans since the year 1994 (Ronquest-Ross *et al* 2015), the study on UKZN students also indicated that the subjects' dietary behaviours have contributed towards an increase in the amount of kilojoules obtained from added sugars. The subjects have shifted away from consuming more vegetables and fruits and have instead increased their consumption of energy dense foods, vegetable oils and animal products. These dietary shifts could be responsible for the overweight and obesity rates among the subjects. Consequently nutrition transition could be held accountable for the shifts in the dietary habits of the subjects attending UKZN, Pietermaritzburg.

Based on the analysis of the 24 hour dietary recall, the subjects' intake of added sugars over a 24 hour period exceeded the WHO recommendations on added sugar intake. Therefore the results from this study did not concur with the hypothesis which stated that the students' dietary intake of added sugars would be within the WHO recommendations on added sugar intake. Therefore the hypothesis was rejected. The purpose of using a 24 hour dietary recall was to collect information on the mean usual intake of added sugar among the subjects. Therefore a single recall was sufficient to gather the information required.

5.4 The association between added sugar intake and body mass index

No significant findings were observed between the added sugar intake from the 24 hour dietary recall and the subjects BMI. With regards to the added sugar intake from the FFQ, a significant association was found between the subjects BMI and the consumption of some food and beverages that contained added sugars. Interestingly, a negative correlation was found between the subjects BMI and the consumption of flavoured milks and sweets, as subjects with a higher BMI consumed flavoured milks less frequently and consumed a smaller portion of hard boiled sweets. However, a positive correlation was observed between the subjects BMI and the consumption of ice cream, as subjects with a higher BMI consumed larger portions of ice cream.

A cross sectional study that was conducted among 161 students attending a university in the Eastern Cape (Van den Berg *et al* 2012) and 2259 students attending a university in Turkey (Gunes *et al* 2012), indicated differences in the consumption of added sugars across the different BMI categories. The study that was conducted at a University in the Eastern Cape, revealed that the daily consumption of sweets, chocolates and chips was significantly higher among the overweight or obese subjects. However, more subjects that were underweight and within the normal BMI classification reported to consume cakes and biscuits on a daily basis (Van den Berg *et al* 2012). The study that was conducted on students attending a university in Turkey (Gunes *et al* 2012) found a significant positive correlation between the students BMI and the consumption of tea, coffee and carbonated soft drinks, as students with a higher BMI (overweight or obese) consumed these foods and beverages more frequently.

Although the study conducted on UKZN students did not indicate an association between SSB consumption and BMI possibly due to the sample size and type of study conducted, studies that were conducted over a longer period of time and on larger population groups have indicated an association between SSB and body weight. A cohort study that was conducted over a four year period among 59 283 between the ages of 15-87 attending a university Thailand revealed that an increased consumption of SSBs over the four year period resulted in an increase in weight among the students (Lim *et al* 2014). Studies that were conducted among adults have also indicated a significant relationship between the consumption of some foods and beverages and the subjects' weight. A cohort study that was conducted by Mozaffarin *et al* (2011) over a 20 year period on 120 877 adults in the USA revealed that an increased consumption of SSBs, 100% fruit juices, potatoes, potato chips, refined grains, sweets or desserts, butter, processed and unprocessed red meat resulted in an increase in weight. Consistent with these findings, the meta-analysis that was conducted by Te Morenga *et al* (2012) as well as the systematic review and meta-analyses that was conducted by Malik *et al* (2013) found that an increase in the consumption of SSBs resulted in weight gain.

Based on the results from these studies, an increase or decrease in the consumption of any food and beverage item will alter the total energy input, however the extent to which it impacts on an individual's weight will depend on the quantity and quality of the food or beverage consumed. The low satiety of energy dense foods often facilitates an increase in the total energy input through the increased consumption of foods and beverages that have little or no nutritional

value Mozaffarin *et al* (2011). Therefore these foods and beverages have been associated with weight gain.

Based on the results from this study, it was found that there was a significant association between the subjects BMI and the consumption of some foods and beverages that contained added sugar. Consequently, the findings from this study did not concur with the null hypothesis that stated that there is no association between added sugar intake and BMI, thus the null hypothesis was rejected.

5.5 The consumption and consumption patterns of sugar sweetened beverages

The food environment plays a great role in determining the dietary habits of individuals as it aims at making products more available and affordable for consumption (Chandon & Wansink 2012). The food environment also impacts on the dietary habits of university students as they are exposed to various setting in which they can purchase food. Based on the results from this study, it was found that a significant number of subjects purchased their beverages from supermarkets (96.3%) and only a few subjects reported to purchase beverages from vending machines (2.1%), local café (7.2%) and restaurants or take-aways (17.2%). With regards to the place of consumption, it was found that a significant number of subjects consumed the beverage on campus (62.8%) and less than one third of the subjects reported to consume the beverage at social events (17.1%) and restaurants or take-aways (29.7%). A study that was conducted in the United States on the food and beverage purchases among 1059 students that resided off campus found that approximately 45% of the students reported to purchase foods or beverages from either vending machines, campus dining halls or restaurants and stores around campus. SSBs were the most frequently purchased items (Pelletier & Laska 2013). Consistent with the findings from the UKZN study, the study conducted in the United States also revealed that a substantial number of students did not purchase foods or beverages from vending machines (Pelletier & Laska 2013). With regards to the results from the study on UKZN students, a considerable number of subjects consumed SSBs on campus, this could be due to the fact that a greater percentage of the subjects lived at a residence on campus (47.3%) and these beverages are sold at and around the university.

5.6 The influence of demographic characteristics on the dietary intake of added sugars among the subjects

Due to the fact that previous studies have indicated differences between the dietary intake across students of different genders, races and place of residence, this study also aimed at determining the influence of these demographic characteristics on the consumption of added sugars among South African university students.

5.6.1 The influence of gender on the dietary intake of added sugars among the subjects

According to the 24 hour dietary recall, the mean energy intake from added sugars was higher among the male (1073.04KJ) than female (912.73KJ) subjects, however no significant differences were observed. An analysis that was conducted among adults above the age of 20 using data from the NHANES also revealed that the mean daily energy intake from added sugars was higher among the male than female subjects. The male subjects on average consumed 1401.64KJ from added sugars whereas the females consumed 999.98KJ (Ervin & Ogden 2013)

Based on analysis of the FFQ, the consumption of added sugars from the food and beverage categories differed by gender. The male subjects consumed SSBs more frequently than the female subjects, however no statistically significant difference was observed. The female subjects consumed the desserts, cakes and biscuits, chocolates and sweets categories significantly more frequently than the male subjects. Differences with regards to the amount and frequency of consumption of individual food and beverage items that contained added sugar were also observed across the male and female subjects attending UKZN. The male subjects consumed significantly greater amounts of added sugars whereas the female subjects consumed these food and beverage items significantly more frequently than the male subjects.

Under the beverage category, the male subjects consumed significantly greater amounts of carbonated soft drinks than the female subjects. Table sugar was the only item under the sugar and milk flavorings and powder category that was consumed in significantly greater amounts by the male subjects. In comparison to the female subjects, the male subjects consumed a significantly greater amounts of powdered cereals, Cornflakes and Rice Krispies. Doughnuts, were the only item under the cakes and biscuits category that was consumed in significantly greater amounts by the male than female subjects. Significantly, the female subjects consumed the milk flavorings: Milo and Nesquik more frequently than the male subjects. The frequency of consumption of Nandos sauce was significantly higher for the female subjects. Under the

breakfast cereals category, the frequency of consumption of Rice Krispies was significantly higher for the female subjects, and the frequency of consumption of ice cream, custard and flavored yoghurt under the dessert category was significantly higher for the female than male subjects. Significantly, the female subjects consumed doughnuts, biscuits with filling and biscuits plain more frequently than the male subjects. The frequency of consumption, Kit Kat, Crunchie, Tex, Cadbury or Beacon slabs; soft jellies and marshmallows under the chocolates and sweets category respectively were significantly higher for the female subjects.

In keeping with the findings from this study, studies that have assessed the dietary habits of university students also indicated an association between gender and the frequency of consumption of foods and beverages (Lupi *et al* 2015; Ansari *et al* 2012). Although these studies have indicated that the female subjects were more likely to consume healthier foods, the consumption of added sugars was also high among them. The analysis that was conducted by Ansari *et al* (2012) on the health behaviors of 2402 first year undergraduate students from one university in Demark, Germany, Poland and Bulgaria, who also found that the frequency of consumption of sweets and cakes was higher among the female students. A study that was conducted by Gan *et al* (2011), also indicated that the frequency of consumption of carbonated soft drinks was higher among the male than female students. Similarly, a study that was conducted on 258 undergraduate students attending an Italian university also found that the female students consumed cakes more frequently than the male students, and that the male students consumed fruit juices and soft drinks more frequently than the female students, however a significant difference was only observed for the consumption of carbonated soft drinks (Lupi *et al* 2015). In contrast to the findings from the UKZN study, the study that was conducted by Lupi *et al* (2015) revealed that the frequency of consumption of sugar containing sauces was higher among male than female students.

5.6.2 The influence of race on the dietary intake of added sugars among the subjects

According to the data from the 24 hour dietary recall, the mean energy consumed from added sugars was higher among the Indian race group (1021.53KJ) and this was then followed by the Black Africans (964.92KJ), Whites (880.6KJ) and Coloureds (835.21KJ). However, the consumption of added sugars did not differ significantly across the different race groups.

The frequency of consumption of each food and beverage that contained added sugar was analysed and it was found that the Indian subjects consumed desserts, chocolates, table sugar,

and cakes and biscuits more frequently than the other race groups. SSBs, milk flavourings and powders, and sauces containing added sugars were most frequently consumed among the Coloured subjects, the Black African subjects consumed breakfast cereals and sweets more frequently and the White subjects consumed spreads more frequently. However significant results for the race groups were observed for some of the food and beverage categories. Significantly, the Black African subjects consumed SSBs more frequently than the White subjects, the Indian and White subjects consumed spreads more frequently than the Black African and Coloureds, the Black African subjects consumed breakfast cereals more frequently than the Indian subjects and the Black African and Coloured subjects consumed breakfast cereals more frequently than the White subjects.

Diet related differences across the various race groups were observed in other studies. The SANHANES-1 revealed that a greater percentage of the Black subjects (44.7%) reported a low consumption of added sugars, and this was followed by the Coloured (34.8%), Indian (33.9%) and White (31.7%) race group. Conversely, a greater percentage of the White subjects (21.1%) reported a higher consumption of added sugars, and this was followed by the Black African (19.9%), Coloured (17.1%) and Indian race group (16.1%) (SANHANES-1 2013). Contradictory to the findings from the UKZN study, a cross sectional analysis that was conducted on adults above the age of 18 that participated in the 2005 US National Health Interview Survey (NHIS) revealed a higher consumption of added sugars among the Black race group and a lower consumption among the Indian or Asian race group (Thompson *et al* 2009).

There is a limited amount of studies that have assessed added sugar intake from various foods and beverages among the different race groups of university students. A cross sectional study that was conducted on SSB consumption among 265 undergraduate students in the United States revealed that Black subjects consumed SSBs more frequently than their White counterparts and fruit juices were the most frequently consumed SSB among the Black race group (West *et al* 2006). The findings from the UKZN study with regards SSB consumption were therefore consistent with the findings from the study conducted by West *et al* (2006).

5.6.3 The influence of place of residence on the dietary intake of added sugars among the subjects

Based on the analysis of the results from this study, the consumption of added sugars from the 24 hour dietary recall as well as the FFQ differed according to the subjects' place of residence. The results from the 24 hour dietary recall indicated a higher mean intake of added sugars among the subjects that lived away from home (61.67g) and lower mean intake among those that lived at home (54.09g), however there was no significant difference.

Although literature has suggested that university students that live away from home might develop more unhealthy eating habits in comparison to those that lived at home (Vandeboncoeur *et al* 2015), the study on UKZN students indicated that subjects that lived at and away from home consumed the different categories of foods and beverages that contained added sugars, however the frequency of consumption of each category differed. According to the results from the FFQ, the frequency of consumption of SSBs, milk flavourings and powders, sauces and breakfast cereals was higher among the subjects that lived away from home, and subjects that lived at home consumed table sugar, spreads, desserts, sweets, cakes and biscuits and chocolates more frequently. However, significant differences were observed for only two food categories. The frequency of consumption of spreads and desserts was significantly higher among the subjects that lived at home.

Previous studies that were conducted on the dietary habits of university students have also indicated differences in the consumption of foods and beverages for students that lived at home verses those that lived away from home. Consistent with the findings from this study, the Italian study that was conducted by Lupi *et al* (2015), found that students that lived at home consumed sweets and cakes more frequently than those that lived away from home. However in contrast to the findings from the study conducted on UKZN students, this study indicated a lower consumption of spreads and higher consumption of carbonated soft drinks and fruit juices among subjects that lived at home (Lupi *et al* 2015). However, no significant differences were observed. Similarly, the study that was conducted by Ansari *et al* (2012) in four European universities, also indicated that the students living arrangements did not influence their consumption of foods and beverages that contained added sugars as there was no increase in the consumption of these food items among students that lived away from home.

This study indicated significant differences in the consumption of added sugars across the different demographics. Although significant differences were observed for some foods and beverages that contained added sugars, this study still found that there was a relationship between the student demographics and the consumption of the different categories of added sugars. Therefore the null hypothesis did not concur with the findings from this study as it stated that there was no association between the demographic characteristics of the subjects and the consumption of added sugars. Thus the null hypothesis was rejected.

5.7 The influence of taste, price, marketing and family/friends on the purchases and intake of sugar sweetened beverages among the subjects

The increased prevalence of overweight and obesity due to the development of poor dietary habits has raised much concern among health authorities. Recent studies have suggested that consumer purchases are influenced by taste, price, marketing and family or friends. Based on the analysis of the results from this study, it was found that taste was most influential when purchasing SSBs (84.5%), and this was followed by price (70%), marketing and labelling (30.5%) and lastly friends or family (25.1%). A significantly high level of importance for taste and price was found, however a low level of importance for marketing and labelling and for friends or family was found. This indicates that the last two variables were not important when purchasing SSBs. Consistent with the findings form this study, a qualitative study that was conducted on 35 European university students from different years as well as fields of study, also found that family, friends, taste, cost, convenience and marketing were some of the common factors that influenced the dietary behavior of the students (Deliens *et al* 2014).

5.7.1 The influence of taste on the purchases and intake of sugar sweetened beverages among the subjects

According to the literature surrounding food preferences and taste, it has been found that taste has a great influence on the type of foods and beverages consumed. Different taste preferences influence the type of foods and beverages consumed by individuals of different ages, genders and races (Drewnowski *et al* 2012). Similarly, the findings from this study indicated that taste had the greatest influence on the consumption of SSBs by the subjects. The increased consumption of foods and beverages that contain added sugars could be due to the fact that the subjects have a strong hedonic appeal for sweetness.

5.7.2 The influence of price on the purchases and intake of sugar sweetened beverages among the subjects

According to the results from this study, price was the second most influential factor on the purchases of SSBs. A possible reason for this is that most of the subjects that participated in this study lived away from home. Studies have shown that students that live away from home become more independent, are often on a budget and therefore take price into consideration when doing grocery shopping (Deliens *et al* 2014). Since the cost of healthy foods and beverages outweighs the cost of energy dense foods and beverages (Waterlander *et al* 2010), the consumption of energy dense products was high among the subjects. In South Africa, it has been found that a healthy diet costs about 69% more than an unhealthy diet, and if South Africans had to resort to healthy eating, approximately 10-15% of their income would be spent on healthy foods (Temple *et al* 2011).

When assessing the influence of price alterations on the consumption of SSBs, it was found that a significant number (38.8%) of students reported that if the price of the beverage increased, they would purchase and consume the beverage less often, 24.8% indicated that price would have no influence, 18.6% indicated that they would purchase and consume smaller amounts and 17.8% (n=69) indicated that they would purchase and consume healthier alternatives. Consistent with the finding from this study, studies that have investigated the influence of fiscal policies such as taxation on the consumption of SSBs, have also revealed that an increase in price resulted in a decrease in the consumption of the beverage and the extent to which consumption was decreased was directly proportional to the percentage of tax that was levied (Thow *et al* 2014).

In South Africa, a recent decision was made with regards to implementing taxes on SSBs commencing in April 2017. To date, only modelling studies have been conducted in order to determine the effectiveness of this policy on the consumption of SSBs among South African. A modelling study that was conducted using a 20% tax rate, projected that a tax rate of this value is expected to decrease the prevalence of overweight and obesity among adult males and females, and the total daily energy input is expected to decrease (Manyema *et al* 2014).

Although taxation might be beneficial in decreasing the consumption of added sugars, there is much debate surrounding its implementation. Some studies have reported that mainly individuals from lower socio-economic statuses will be affected by this policy. Taxation will

not necessarily influence the consumption of added sugars as consumers could continue to purchase the product at the increased price, and decrease the purchases of other products. Food and beverage companies could also negate the impact of the taxes by absorbing some of the burden of the taxes in order to keep the prices low and still maintain sales (Cornelson *et al* 2014).

Other studies that have assessed the influence of positive pricing strategies on the consumption of energy dense food products have found minor differences in its consumption. A cross sectional study that was conducted on 159 adults in the Netherlands revealed that alterations in the price of food products would impact on consumer purchases (Steenhuis *et al* 2011). Positive pricing strategies that involved offering discounts and applying a lower VAT to healthy food products were the most attractive features among the Dutch subjects. Although the Dutch subjects indicated that these pricing strategies would increase the consumption of healthy food products its influence on unhealthy food consumption was found to be lower. Therefore, if subjects maintain the amount of energy dense foods consumed and increase their consumption of healthy foods this would result in a further increase in the total energy input and result in weight gain.

Although the study that was conducted on UKZN students found that more than 50% of the subjects reported that they would purchase the beverage less often or reduce the amount consumed, a relatively small percentage of the subjects reported that they would consume a healthier alternative. Consequently, subsidising healthy food products whilst imposing taxes on unhealthy food products could be one of the many strategies that could steer consumers' dietary habits into a more positive direction (Thow *et al* 2014). Therefore, in conjunction with these fiscal policies, government and health officials should also focus on the other cues that influence dietary and lifestyle behaviours.

5.7.3 The influence of marketing and labelling on the purchases and intake of sugar sweetened beverages among the subjects

Food companies often use good marketing and advertising techniques in order to promote their products as well as increase sales (Chandon & Wansink 2012). Various mediums such as the television, newspapers, radio, magazines, the internet and outdoor activities have been used in order to promote and market these products, and this in turn impacts on the dietary behavior of consumers as foods that are high in fat and added sugars are well promoted (Chandon &

Wansink 2012). Although only a small percentage of the subjects in the UKZN study indicated that marketing influenced their consumption of SSBs, these findings indicate that marketing does have some influence on the dietary habits of university students.

Food and beverage companies spend a substantial amount of time and money on the branding and labelling of their products as each company aims at creating or designing a product that will be most appealing to the consumer and that will attract sales (Chandon & Wansink 2012). Consumers often take brands and labels into consideration when purchasing foods or beverages as it aids in determining the type of product that will be purchased. By reading the information on the package certain expectations and perceptions of the product are created by the consumer. Based on the analysis of the results from this study, a small percentage of the subjects indicated that labelling influenced their consumption of SSBs, this could be due to the fact that university students generally work on a budget therefore their focus is more on the price than the labelling of the product.

The findings from this study indicated that carbonated soft drinks were the most frequently consumed beverage among the UKZN subjects. A possible reason for these findings could be that these products are well marketed and designed, therefore attracting sales. Similarly, the 2010 Coca Cola annual reviews also indicated that in South Africa the consumption of these beverages increased by almost 50% between the 1992 and 2010, and this was greatly influenced by the branding and marketing of these products in various areas (Coca-Cola Company 2010).

5.7.4 The influence of social factors on the intake of sugar sweetened beverages among the subjects

Apart from the provision of nutrients to the body, eating has also been considered as a social activity. Studies have indicated that external factors such as family and friends tend to influence the type and quantity of foods or beverages consumed. A cross sectional study that was conducted on 1000 American University, found that the dietary habits of the students were significantly influenced by that of their family, friends and significant other, as the students consumed a greater amount of fast foods, SSBs, fruits and vegetables if their family, friends or significant other did so (Pelletier *et al* 2014). Although only a small percentage of the subjects in the UKZN study reported that their friends or family influenced their consumption of SSBs, this study indicated that social factors influence the dietary habits of university students.

Although there were differences in the level of importance that each factor had on the students' purchases or consumption of SSBs, this study indicated that factors such as taste, price, marketing or labelling and social opinions of family and friends influenced their decision to purchase and consume SSBs. Therefore the hypothesis relating to this objective was accepted as it stated that external factors like taste, price, marketing and opinions of family and friends influenced the subjects' decision to purchase and consume SSBs.

5.8 Summary

The demographic characteristics of the subjects were consistent with that of the demographics of the other four UKZN campuses. A great percentage of the subjects in this study were within a normal BMI classification, however, nearly one third of the subjects were overweight and obesity. Distinct differences between the subjects BMI and gender were observed. The prevalence of overweight, obesity and underweight was higher among the female subjects and more males were within a normal BMI classification.

The consumption of added sugars was found to be high among the subjects. The 24 hour dietary recall indicated that the subjects exceeded the WHO recommendations on added sugar intake, and the FFQ revealed a higher frequency of consumption of the foods and beverages that contained added sugar. Significant differences were observed between the subjects BMI and the consumption of some foods and beverages that contained added sugars. Although this study did not find any significant association between the consumption of SSBs and the subjects BMI, previous studies that were conducted using a larger study population and that were conducted over a longer period of time have found significant associations between SSB consumption and weight gain. Differences with regards to the consumption of foods and beverages that contained added sugar were observed among the different genders, races and places of residence. A higher frequency of consumption of added sugars was observed among the female subjects, Indian subjects and subjects that lived at home as these subjects consumed most of the food and beverage categories that contained added sugar frequently. However significant findings were only observed for some food and beverage categories.

Taste and price were considered to be the most important factors that the subjects took into consideration when purchasing SSBs. Since most of the subjects indicated that taste greatly influenced their purchasing decision, it can be concluded that the subjects have a strong hedonic appeal for sweetness. University students that live away from home are often self-dependant

and work on a budget. Therefore, price was considered as been the second most important factor when doing grocery shopping. Price increases were also found to significantly influence the frequency and amount of SSBs purchased or consumed. However, only a small percentage of the subjects indicated that they would consider purchasing healthier alternatives. Therefore policies that would promote the consumption of heathier foods and beverages and decrease the consumption of energy dense products need to be established. The food environment also influenced the subjects' consumption of SSBs, as a great percentage of the subjects reported to purchase the beverage from supermarkets.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The increased prevalence of overweight and obesity has raised much concern with regards to its influence on health. Poor dietary habits paired with decreased physical activity levels have been linked with the development of overweight and obesity. Recent studies have indicated that young adults are also susceptible towards these changes. The transition to tertiary education often brings about various changes that influence the diet quality and lifestyle of university students. Due to the lack of sound dietary knowledge as well as various internal and external factors students have shifted away from consuming more traditional diets and have increased their consumption of energy dense foods. These habits if not corrected can have long term effects on health.

Recently, there has been a growing body of evidence indicating that the consumption of added sugars, particularly from SSBs could contribute towards the overweight and obesity problem. These foods and beverages contain empty calories, have a low satiety and facilitates an increase in the consumption of energy dense food items, thus contributing towards weight gain. Understanding the association between added sugar intake and body weight as well as the factors associated with the development of poor dietary habits is important in order to improve the dietary behaviour of university students.

This study focused on the determining the association between added sugar intake and BMI among undergraduate students between the ages of 18-25 years studying at UKZN, Pietermaritzburg. In conjunction with this, the subjects BMI was calculated and assessed, the added sugar intake from a 24 hour dietary recall and FFQ was analysed, differences with regards to the intake of added sugars among the different demographic characteristics were addressed, consumption patterns were analysed and the factors that influence the subjects' purchases and intake of SSBs were investigated.

This chapter concludes the findings of the study in relation to the objectives. Furthermore it will discuss the limitations of the study, recommendations for nutrition practice as well as implications for further research.

6.2 Conclusions of the study

6.2.1 The demographic characteristics of the subjects

The study population consisted of more female than male subjects and the Black race group made up a vast majority. These findings were consistent with the demographics of the other four campuses that fall part of UKZN as well as the 2011 Census. A significant number of subjects resided away from home and most of the subjects reported to live at the residence on campus.

6.2.2 The BMI of the subjects

The findings from this study showed that most of the subjects were within the normal BMI classification and that more males than females were within this BMI category. Almost one third of the subjects were overweight and obese, however there were more overweight subjects. The prevalence of overweight and obesity was higher among the female than male subjects. The prevalence of underweight was low among this sample population and more females than males were within this BMI category.

6.2.3 The dietary intake of foods and beverages that contain added sugar

Overall the subjects' diet lacked variety and the consumption of added sugars was relatively high among the sample population. The most frequently (more than once a week) consumed beverages were water, juice concentrates and carbonated soft drinks. Table sugar and coffee were the most frequently consumed food items under the table sugar and milk flavourings and powder category. Tomato sauce and mayonnaise were the only sugar containing sauces that were most frequently consumed by the subjects. With the exception of Cornflakes, the frequency of consumption of the other breakfast cereals was relatively low. Maize meal, rice and bread were the most frequently consumed food items under the starch group and potatoes was the most frequently consumed starchy vegetable. Frozen mixed vegetables; apples and bananas were the only items under the vegetable and fruit category respectively that were most frequently consumed by the subjects. The frequency of consumption of mutton, fish and organ meats under the meat category was relatively low. Under the dairy and fat category, the frequency of consumption of milk; and oil and margarine respectively was high.

6.2.4 The association between BMI and added sugar intake

No significant association between the added sugar intake from the 24 hour dietary recall and the subjects BMI was found. However, significant findings were observed between the subjects BMI and the consumption of some of the food and beverages listed in the FFQ. On analysis it was found that the frequency of consumption of flavoured milks was significantly lower among subjects with a higher BMI and that subjects with a higher BMI consumed significantly smaller portions of hard boiled sweets and larger portions of ice cream.

6.2.5 The consumption and consumption patterns of sugar sweetened beverages

Based on analysis it was found that most of the subjects reported to purchase the beverages from supermarkets and this was followed by restaurants or take-aways. With regards to the place of consumption a great percentage reported to consume the beverage on campus and this was followed by restaurants or take-aways.

6.2.6 The influence of demographic characteristics on the dietary intake of added sugars

The findings from this study indicated significant differences in the consumption of some sugar containing foods and beverages across the different genders, races and places of residence. The frequency of consumption of each food and beverage category that contained added sugar was analysed in order to determine the most frequently consumed food and beverage categories across the different demographics.

Based on analysis it was found that the frequency of consumption of desserts, cakes and biscuits, chocolates and sweets was significantly higher among the female than the male subjects. Differences in the amount and frequency of consumption of individual food and beverage items that contained added sugar were observed across both genders. On analysis it was found that that the male subjects consumed greater amounts of added sugars. Under the beverage category, it was found that the male subjects consumed significantly greater amounts of carbonated soft drinks in comparison to the female subjects. With regards to the table sugar and milk flavourings and powder category, it was found that the male subjects consumed significantly greater amounts of table sugar. With the exception of coated cereals, the frequency of consumption of the other breakfast cereals was significantly higher among the male subjects. Under the cakes and biscuits category, it was found that the male subjects consumed significantly greater amounts of doughnuts in comparison to the female subjects.

With regards to the frequency of consumption of added sugars, the female subjects consumed the food and beverage items that contained added sugar more frequently than the male subjects. The frequency of consumption of Milo and Nesquik under the table sugar and milk flavourings and powder category was significantly higher among the female subjects. Significantly, Nandos sauce and Rice Krispies were the only items under the sauces and breakfast cereals category respectively that were consumed more frequently by the female than male subjects. Under the desserts category, it was found that the frequency of consumption of ice cream, custard and flavoured yoghurt was significantly higher among the female subjects. The frequency of consumption of doughnuts, biscuits with filling and biscuits plain was significantly higher among the female than male subjects. Significantly, the frequency of consumption of Kit Kat, Crunchie, Tex and Cadbury or Beacon slabs; soft jellies and marshmallows under the chocolates and sweets category respectively, was higher among the female subjects.

Significantly, the Black African and Coloured subjects consumed SSBs more frequently than the Indian subjects; and the Black African subjects consumed SSBs more frequently than the White subjects. In comparison to the Black African and Coloured subjects, the frequency of consumption of spreads was significantly higher among the Indian and White subjects. The frequency of consumption of breakfast cereals was significantly higher among the Black African subjects than the Indian subjects; and the Coloured and Black African subjects consumed breakfast cereals more frequently than the White subjects. With regards to the subjects' place of residence, the frequency of consumption of spreads was significantly higher among the subjects that lived at home.

6.2.7 The influence of taste, price, marketing or labelling and social factors on the purchases and intake of sugar sweetened beverages

The findings from this study indicated that taste, price, marketing and labelling as well as social factors such as family and friends played a role in the purchases and intake of SSBs. On analysis it was found that taste had the greatest influence on the purchases and intake of SSBs among the subjects and this was followed by price. Factors such as marketing or labelling and family or friends had a significantly low importance on the purchases and intake of SSBs.

With regards to price increases, a significant number of subjects reported that if the price of the beverage increased they would purchase or consume it less frequently and that they would consume or purchase smaller amounts. A relatively small percentage of the subjects reported

that price increases would have no influence on their consumption or purchases and only a few subjects reported that they would consume or purchase healthier alternatives.

6.3 Study limitations

Due to time and financial constraints, a small sample size was selected for the purpose of this study and the study was limited to one university and only undergraduate students were included. However, in comparison to other South African studies that were conducted among university students, this study was not subjected to university students from one field of study. Although a pictorial guide was presented to the subjects with different portion sizes, the portions consumed could have been over- or under-estimated. However, trained fieldworkers were present to clarify any confusion regarding the use of the tool as well as the estimation of portion sizes.

6.4 Recommendations based on the results of the study

6.4.1 Recommendations for dietetic practice

The increased prevalence of overweight and obesity among individuals in developing countries has raised much concern due to the negative implications that it has on health. Recent studies have also indicated that these countries have been faced with the burden of both over- and under-nutrition. The fact that nutrition transition has become evident among the South African population, and that it has contributed towards the increased prevalence of overweight and obesity, there is a great need for strategies to be implemented in order to promote healthier lifestyles.

Recent studies have also indicated that young adults, particularly those that have transitioned from secondary to tertiary education are at risk for developing poor dietary and lifestyle behaviours. Based on the fact that there are various factors that influence their dietary behaviours there is a great need for educating consumers on the importance of developing healthier dietary and lifestyle habits as well as methods to improve these habits. In conjunction with this, creating an environment that encourages healthy eating practices as well as promotes physical activity is essential in order to improve the dietary and lifestyle habits of various populations. The active involvement of students in providing health education could also positively influence their dietary and lifestyle behaviours.

6.4.2 Recommendations on improving the added sugar intake among university students

6.4.2.1 The influence of educational institutions

The increased prevalence of overweight and obesity among university students could be linked with the poor dietary habits that are adopted by this population group. Therefore providing students with health education prior to as well as during their admission to tertiary education could equip the students with the necessary skills that would enable them to make wise dietary choices throughout their adulthood as well as enable them to prepare more nutritious meals. Educational campaigns should highlight the negative factors associated with poor dietary and lifestyle behaviours as well as outline the benefits of adopting more favourable dietary and lifestyle habits. Creating an enabling environment that promotes the concept of healthy eating is also essential in order for the students to apply the knowledge gained.

6.4.2.2 The influence of the food environment

Based on recent studies, the food environment plays a great role in determining the type of foods and beverages that will be purchased and consumed. Studies that have assessed the food and beverage purchases of university students have indicated that university students tend to purchase more foods and beverages that are high in fat and added sugar and this could be due to the availability, accessibility and affordability of these products. Since studies have indicated that price, taste and convenience greatly influence the purchases of university students, increasing the availability of healthier foods and beverage at more affordable prices at and around the university could positively impact on the dietary behaviour of this population group. In order to increase the availability of more nutritious foods and beverages, universities could increase the number of nutritious food options that are available at the cafeteria and vending machines, restaurants could increase the number of healthy food options available on their menus and supermarkets can alter the shelf arrangements of the products by displaying healthier food products on the front of the shelf and at eye-level. The pricing of all foods and beverages should be reviewed, and nutritious food items should be promoted and sold at more affordable prices.

6.4.2.3 The influence of government

In the light of the evidence surrounding the relationship between added sugar intake particularly from SSBs and weight gain, fiscal policies have been adopted by some countries in order to reduce the consumption of these beverages. South Africa is in the process of implementing these policies with the hope of reducing the incidence of overweight and obesity among the

South African population. Although some studies have indicated that taxation might be beneficial in reducing the consumption of added sugars there are still a few shortcomings. Since price does influence consumer purchases, implementing positive and negative pricing strategies on food and beverages could be more beneficial in improving the dietary habits of consumers. University students, particularly those that live away from home are often on budgets therefore increasing the price of food items that are high in added sugar and fat whilst decreasing the prices of more nutritious food items could improve the dietary habits of the students.

Along with these fiscal policies, government should also aim at developing regulations regarding the advertising and marketing of energy dense foods and beverages. Strategies that aim at advertising and marketing nutritious food products should be developed and these should covey enticing key messages that would promote good dietary behaviours.

6.4.2.4 The influence of the food industry

The food industry plays a great role in determining the type of food and beverages that are manufactured and made available for consumption. It is therefore essential that these companies are familiar with the regulations that have been set by the health organisations regarding the intake of added sugars.

Food labels play a great role in informing consumers about the nutritional composition of a product and if well designed it could influence the dietary intake of consumers. Since many studies have focused on assessing the relationship between added sugar intake and body weight, displaying the amount of added sugars and natural sugars present in a product could influence consumer purchases. The nutritional information presented on food labels should be simple, easy to read and understand. Indicating the amount of nutrients present in a product by using a colour coding system could be one of the many techniques that would guide consumers into making healthier dietary choices.

6.4.3 Recommendations for future research

Most of the South African studies that have assessed the dietary habits and weight changes among university students were conducted over a short period of time and the studies were restricted to subjects from one university and field of study. Therefore there is a need for more longitudinal studies to be conducted on larger study populations across different universities and fields of study in order to examine trends in the consumption of added sugars and its influence on body weight. Future studies should also be conducted at all five campuses that

fall part of UKZN as well as other South African universities. In conjunction with analysing the frequency of consumption of sugar containing foods and beverages among university students', studies should also examine the amounts consumed. More 24 hour dietary recalls should be conducted in order to establish trends in the consumption of added sugars. Physical activity levels should also be measured in order to generate more accurate reports on the subjects' weight status.

The influence of fiscal policies on the purchases and intake of healthy and unhealthy foods and beverages among university students should be further evaluated. Although this study did investigate the influence of price increases on the purchases and intake of SSBs, there is a need for more studies to be conducted in order to determine the long term effects of these policies on the dietary intake of various sugar containing foods and beverages as well as assess its influence on body weight. In conjunction with BMI, other measurements should also be considered when assessing body weight.

Since the food environment has also been identified as the driving force behind consumer purchases or consumption, further research should be conducted in order to establish strategies that would improve the food environment as well as the dietary habits of university students. Seeing that more than one approach may be required in order to improve the dietary and lifestyle behaviours of university students, further research should be done in order to investigate which strategies may be more influential on dietary behaviour.

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APPENDIX A: Questionnaire

QUESTIONNAIRE

CODE:			

Section A: Anthropometric measurements:

	Weight (Kg)	Height (cm)
1.		
2.		
3.		

Please complete the following questions as accurately and honestly as possible:

Wherever required, place a tick next to the correct answer

Example:

Do you live in South Africa?

Yes	✓
No	

Section B: Demographics

1. Please complete the information below:

1.1 **Age:**

1.2 **Gender:**

Male	
Female	

1.3 **Race:**

Indian	
Black	
Coloured	
White	
Asian	

1.4 **Degree:**

1.5 **Where are you currently living?** (Select ONE option only)

Residence on campus	
At home (please indicate if urban or rural area)	
In digs	
Other, please specify, and **also** indicate if urban or rural area	

1.6 **Are you involved in grocery shopping?**

Yes	
No	

Section C: Consumption of sugar sweetened beverages (SSB):

2.1 Which of the following Sugar sweetened beverages do you consume most often? (Please select only ONE option)

Soft drinks eg: Coke, Fanta, Sprite	
Energy drinks eg: Powerade, Red bull	
Flavoured Water eg: Vitamin water, aQuellé	
100% Fruit juices eg: Liquifruit, Ceres, Clover, Rhodes, Fruitree, Jabba	
Juice concentrates eg Oros	
Flavoured milks	

2.2 Various factors tend to play a role in consumer purchases. Based on the factors listed below please rate from 1 to 5 how important they are to you when purchasing the above mentioned beverage: 1 = not at all important and 5 = extremely important

Factors	**Importance rating**
2.2.1. The taste of the product	
2.2.2. The price of the product	
2.2.3. Marketing and labelling of the product	
2.2.4. Social influences (friends and family)	

2.3 From the list of options below please indicate how an increase in price will influence your selection of the beverage mentioned in question 2.1 (Please select only ONE option)

It will have no influence, I will continue to purchase and consume it	
I will purchase and consume it less often	
I will purchase and consume smaller amounts	
I will instead purchase and consume healthier alternatives	

2.4 Where do you usually purchase the beverage mentioned in question 2.1? (Tick ALL that apply)

2.4.1 Supermarkets	
2.4.2 Vending Machines	
2.4.3 Restaurants/ Take away	
2.4.4 Local café	
2.4.5 Other- Please specify _____	

2.5 Where do you usually consume the beverage mentioned in question 2.1? (Tick ALL that apply)

2.5.1 At restaurants/ take away	
2.5.2 On campus	
2.5.3 At social events	
2.5.4 Other- Please specify _____	

FOOD FREQUENCY QUESTIONNAIRE:

1) Please complete the following as honestly and accurately as possible

2) Please take note that there are TWO categories "How often" and "How much".

   For **BOTH categories** Place **ONE tick in the column that best describes** your answer for example if you eat apples less than once a month then place a tick under the "less than once a month" category under HOW OFTEN CONSUMED and if you eat 1 and a half apples each time than place a tick under the "More than 1 but less than 2 each" category under HOW MUCH CONSUMED EACH TIME.

3) If you select the **NEVER** option under the "how often consumed" category **DO NOT** place a tick under the "how much consumed" category

4) Please complete **All** of the required fields

5) A handout has been provided to assist with portion sizes

Example:

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)			
Fruits	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 1 each time**	**More than 1 but less than 2 each time**	**More than 2 but less than 3 each time**	**More than 3 each time**
Apples		✓							✓		

Food frequency questionnaire:

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)				
Beverages	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 250ml**	**250-500ml**	**More than 500ml but less than 1 litre**	**1-2 litres**	**More than 2litres**
Water												
100% Fruit juices eg. Liquifruit, Ceres												
Juice Concentrates eg: Oros												
Soft drinks eg: Coke, Fanta, sprite												
Energy drinks eg: Powerade, Red bull												
Flavoured water eg: Vitamin Water, aQuellé												
Flavoured milk eg: Steri stumpie/ Super M												
Mague (Maize drink)												

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)				
Sugar and Milk flavourings and powders	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 1 teaspoon**	**1-2 level teaspoons**	**1-2 heaped teaspoons**	**1-2 table-spoons**	**More than 2 tablespoons**
Table sugar												
Milo												
Hot chocolate												
Coffee												
Nesquik												
Non-dairy creamers												

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)				
Spreads	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 1 teaspoon**	**1-2 level teaspoons**	**1-2 heaped teaspoons**	**1-2 table-spoons**	**More than 2 tablespoons**
Jam												
Honey												
Golden syrup												
Peanut Butter												

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)				
Sauces	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 1 teaspoon**	**1-2 level teaspoons**	**1-2 heaped teaspoons**	**1-2 table-spoons**	**More than 2 tablespoons**
Tomato Sauce												
Mayonnaise												
Sweet chilli sauce												
BBQ sauce												
Nandos sauce												
Mustard sauce												
Mrs Balls chutney												

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)		
Breakfast cereals	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 1 cup**	**1-2 cups**	**More than 2 cups**
Powdered cereals eg: Maltabella										
Cereals with coating Eg: Cocoa pops, Fruit loops, Frosties										
Cornflakes										
Rice Krispies										

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)		
Desserts	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 1 cup/ scoop/ popsicle**	**1-2 cups/ scoops/ popsicles**	**More than 2 cups/ scoops/ popsicles**
Ice cream										
Canned fruit with syrup										
Custard										
Jelly										
Frozen yoghurt										
Flavoured Yoghurts										
Popsicles eg: Paddle pop, Eskimo pie, fruit loops										

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)			
Cakes and biscuits	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 1each time or Less than 1 slice (5cm)**	**1-2 each time or 1-2 slices**	**More than 2 but less than 3 each time or more than 2 but less than 3 slices**	**More than 3 each time or more than 3 slices**
Doughnuts											
Cakes											
Muffins											
Biscuits with filling eg: Romany creams											
Biscuits plain eg: Marie biscuits											

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)			
Chocolates	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 30g/ less than 6 pieces**	**More than 30g but less than 60g/ ½ a slab**	**60-100g/ 1 slab**	**More than 1 slab**
Kit Kat											
Bar one											
Lunch bar											
Mars											
Nikki											
Bounty											
Crunchie											
Tex											
Beacon/ Cadbury 80-100g Slabs											

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)			
Sweets	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**1 each time**	**2-3 each time**	**4-5 each time**	**More than 5 each time**
Soft, jellies											
Hard boiled sweets											
Marshmallows											

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)		
Starchy foods	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 1 cup/ less than 1 /less than 1 slice**	**1-2 cups/ 1-2 / 1-2 slices**	**More than 2 cups/ more than 2 / more than 2 slices**
Maize meal										
Rice										
Samp										
Bread										
Bread rolls/ burger buns										

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)		
Starchy Vegetables	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 1 cup**	**1-2 cups**	**More than 2 cups**
Butternut/ pumpkin										
Potatoes										
Sweet potato										

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)		
Vegetables	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 1 cup**	**1-2 cups**	**More than 2 cups**
Tomatoes										
Spinach										
Cabbage										
Beetroot										
Frozen mixed vegetables (Corn, carrots, green beans, peas)										

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)			
Fruits	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Up to 1/ up to 1 bunch**	**Up to 2/ up to 2 bunches**	**Up to 3/ up to 3 bunches**	**More than 3 / more than 3 bunches**
Apple											
Banana											
Pear											
Plum											
Oranges											
Grapes											

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)		
Meat products	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 30g or less than 2 pieces**	**30-90g or 2-6 pieces**	**More than 90g or more than 6 pieces**
Chicken										
Fish										
Mutton										
Beef										
Organ meats (Liver, kidney)										

*30g of meat or 2 pieces is equal to one small matchbox size

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)				
Dairy products	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 250ml**	**250-500ml**	**More than 500ml but less than 1 litre**	**1-2 litres**	**More than 2litres**
Milk, unflavoured												
Maas												
Yoghurt (plain)												

Type of item	How **often** consumed (select one option please)							How **much** consumed each time (select one option please)				
Oil and fats	**Never**	**Less than once a month**	**About once a month**	**1-2 times a week**	**3-6 times a week**	**Every day but just once a day**	**Every day but more than once a day**	**Less than 1 teaspoon**	**1-2 level teaspoons**	**1-2 heaped teaspoons**	**1-2 table-spoons**	**More than 2 table-spoons**
Margarine												
Butter												
Sunflower oil/ Canola oil/ olive oil												

24 HOUR RECALL:

1) Please complete the table below, by recording all the food and drinks that have being consumed over the past 24 hours. An example has been provided for your assistance.

2) For the **AMOUNTS** consumed please make use of **HOUSEHOLD MEASURES** for example teaspoons, tablespoons, cup measurements or units such as grams, litres (l) or millilitres (ml), each and indicate if it's a level/ heaped cup/ spoon etc..

3) Please indicate if the product is low fat, full cream, lite etc…

4) A handout has been provided to assist with portion sizes

5) Please indicate ONE food item per line and under the correct categories

Example:

Meal	Food items consumed		Amount consumed	Method of preparation (Boiled/baked/fried/grilled/ steamed)
Breakfast	Starch: Bread, Bread rolls, Buns/ Phuthu /Rice/ Vetkoek	Brown bread	2 slices	Toasted
	Breakfast cereals:	-	-	-
	Vegetables:	Lettuce Tomatoes	¼ cup 3 thin slices	-
	Fruit:	-	-	-
	Dairy: Cheese and eggs	Eggs	2each	Boiled
	Meat products: Fish/ Chicken/ Beef/ Mutton/ Wors/ Polony/ Russian/ Sausages/ Viennas	Polony	3 thin slices	Fried
	Beverages: Hot/ Cold	Tea Milk (Full cream)	1 cup tea ¼ cup milk	
	Sauces/Oil/ Spreads:	Mayonnaise, lite	2 tablespoon	
	Table sugar, milk flavourings and powder: Sugar/ Coffee/Milo/ Hot chocolate	Sugar	2 heaped teaspoons of sugar	
	Confectionary: Biscuits/ Cakes/ Doughnuts	Mari Biscuit	2 each	
	Sweets/Chocolates/ Chips	-	-	-
	Desserts: Custard/ Jelly/Ice cream/yoghurt	-	-	-

24 hour recall: Please indicate **ALL** the foods and beverages consumed **over a 24 hour period**

Meal	Food items consumed		Amount consumed	Method of preparation (Boiled/baked/fried/grilled/ steamed)
Breakfast	Starch: Bread, Bread rolls, Burger buns/ Phuthu /Rice/ Vetkoek			
	Breakfast cereals:			
	Vegetables:			
	Fruit:			
	Dairy: Cheese and eggs			
	Meat products: Fish/ Chicken/ Beef/ Mutton/ Wors/ Polony/ Russian/ Sausages/ Viennas			
	Beverages: Hot/ Cold			
	Sauces/Oil/ Spreads:			
	Table sugar, milk flavourings and powder: Sugar/ Coffee/Milo/ Hot chocolate			
	Confectionary: Biscuits/ Cakes/ Doughnuts			
	Sweets/Chocolates/ Chips			
	Desserts: Custard/ Jelly/Ice cream/yoghurt			

Meal	Food items consumed		Amount consumed	Method of preparation (Boiled/baked/fried/grilled/ steamed)
Snack	Starch: Bread, Bread rolls, Burger buns/ Phuthu /Rice/ Vetkoek			
	Breakfast cereals:			
	Vegetables:			
	Fruit:			
	Dairy: Cheese and eggs			
	Meat products: Fish/ Chicken/ Beef/ Mutton/ Wors/ Polony/ Russian/ Sausages/ Viennas			
	Beverages: Hot/ Cold			
	Sauces/Oil/ Spreads:			
	Table sugar, milk flavourings and powder: Sugar/ Coffee/Milo/ Hot chocolate			
	Confectionary: Biscuits/ Cakes/ Doughnuts			
	Sweets/Chocolates/ Chips			
	Desserts: Custard/ Jelly/Ice cream/yoghurt			

Meal	Food items consumed		Amount consumed	Method of preparation (Boiled/baked/fried/grilled/ steamed)
Lunch	Starch: Bread, Bread rolls, Burger buns/ Phuthu /Rice/ Vetkoek			
	Breakfast cereals:			
	Vegetables:			
	Fruit:			
	Dairy: Cheese and eggs			
	Meat products: Fish/ Chicken/ Beef/ Mutton/ Wors/ Polony/ Russian/ Sausages/ Viennas			
	Beverages: Hot/ Cold			
	Sauces/Oil/ Spreads:			
	Table sugar, milk flavourings and powder: Sugar/ Coffee/Milo/ Hot chocolate			
	Confectionary: Biscuits/ Cakes/ Doughnuts			
	Sweets/Chocolates/ Chips			
	Desserts: Custard/ Jelly/Ice cream/yoghurt			

Meal	Food items consumed		Amount consumed	Method of preparation (Boiled/baked/fried/grilled/ steamed)
Snack	Starch: Bread, Bread rolls, Burger buns/ Phuthu /Rice/ Vetkoek			
	Breakfast cereals:			
	Vegetables:			
	Fruit:			
	Dairy: Cheese and eggs			
	Meat products: Fish/ Chicken/ Beef/ Mutton/ Wors/ Polony/ Russian/ Sausages/ Viennas			
	Beverages: Hot/ Cold			
	Sauces/Oil/ Spreads:			
	Table sugar, milk flavourings and powder: Sugar/ Coffee/Milo/ Hot chocolate			
	Confectionary: Biscuits/ Cakes/ Doughnuts			
	Sweets/Chocolates/ Chips			
	Desserts: Custard/ Jelly/Ice cream/yoghurt			

Meal	Food items consumed		Amount consumed	Method of preparation (Boiled/baked/fried/grilled/ steamed)
Supper	Starch: Bread, Bread rolls, Burger buns/ Phuthu /Rice/ Vetkoek			
	Breakfast cereals:			
	Vegetables:			
	Fruit:			
	Dairy: Cheese and eggs			
	Meat products: Fish/ Chicken/ Beef/ Mutton/ Wors/ Polony/ Russian/ Sausages/ Viennas			
	Beverages: Hot/ Cold			
	Sauces/Oil/ Spreads:			
	Table sugar, milk flavourings and powder: Sugar/ Coffee/Milo/ Hot chocolate			
	Confectionary: Biscuits/ Cakes/ Doughnuts			
	Sweets/Chocolates/ Chips			
	Desserts: Custard/ Jelly/Ice cream/yoghurt			

Meal	Food items consumed		Amount consumed	Method of preparation (Boiled/baked/fried/grilled/ steamed)
Snack	Starch: Bread, Bread rolls, Burger buns/ Phuthu /Rice/ Vetkoek			
	Breakfast cereals:			
	Vegetables:			
	Fruit:			
	Dairy: Cheese and eggs			
	Meat products: Fish/ Chicken/ Beef/ Mutton/ Wors/ Polony/ Russian/ Sausages/ Viennas			
	Beverages: Hot/ Cold			
	Sauces/Oil/ Spreads:			
	Table sugar, milk flavourings and powder: Sugar/ Coffee/Milo/ Hot chocolate			
	Confectionary: Biscuits/ Cakes/ Doughnuts			
	Sweets/Chocolates/ Chips			
	Desserts: Custard/ Jelly/Ice cream/yoghurt			

THANK YOU FOR PARTICIPATING ☺

APPENDIX B: Household food measurements

POTATOES

BREAD

3 slices 2 slices 1 slice

Rice/ Phuthu

¼ cup ½ cup 1 cup

SUGAR

1 LEVEL TEASPOON

HEAPED TEASPOON

MASHED POTATOES

¼ cup

½ cup

1 cup

FRIED CHIPS

¼ cup ½ cup 1cup

RED MEAT/ CHICKEN

30 gram portion (Matchbox size)

VEGETABLES

¼ cup ½ cup 1 cup

CAKE

1 x 5cm slice (thin)

Thick slice

Plain cupcake

DOUGHNUTS

Small Doughnuts

Big Doughnut

ICE CREAM

1 scoops

2 scoops

3 scoops

BREAKFAST CEREALS

Sugar coated

¼ cup ½ cup 1cup

Porridge

¼ cup ½ cup 1 cup

CHOCOLATE

80 gram slab

46 grams

62 grams

25 gram

17 gram

40-50 gram chocolate bars

JUICE/ COKE

¼ cup ½ cup 1 cup

SAVOURY PIES

Small pies

Medium size pie

SALAD

½ bowl

1 full bowl

APPENDIX C: Gatekeepers permission

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

9 February 2016

Miss Raessah Ismail Nakhooda (SN 211502152)
School of Agricultural, Earth and Environmental Sciences
College of Agriculture, Engineering and Science
UKZN
Email: raeesah.nak@gmail.com

Dear Miss Nakhooda

RE: PERMISSION TO CONDUCT RESEARCH

Gatekeeper's permission is hereby granted for you to conduct research at the University of KwaZulu-Natal (UKZN), towards your postgraduate studies, provided Ethical clearance has been obtained. We note the title of your research project is:

"To determine the relationship between sugar intake and Body mass index (BMI) among undergraduate students between the ages of 18-25 years studying at the university of KwaZulu-Natal in Pietermaritzburg".

It is noted that you will be constituting your sample by approaching undergraduate students between the ages of 18-25 years and handing out questionnaires and having their height and weight measured by field workers on the Pietermaritzburg campus.

Please ensure that the following appears on your questionnaire/attached to your notice:

- Ethical clearance number;
- Research title and details of the research, the researcher and the supervisor;
- Consent form is attached to the notice/questionnaire and to be signed by user before he/she fills in questionnaire;
- gatekeepers approval by the Registrar.

Data collected must be treated with due confidentiality and anonymity.

Yours sincerely

MR SS MOKOENA
REGISTRAR

APPENDIX D: Ethical consideration

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

25 February 2016

Miss Ra'eesah Ismail Nakhooda 211502152
School of Agricultural, Earth and Environmental Sciences
Pietermaritzburg Campus

Dear Miss Nakhooda

Protocol reference number: HSS/0175/016M
Project Title: To determine the relationship between sugar intake and body mass index (BMI) among undergraduate students between the age of 18-25 years studying at the University of KwaZulu-Natal in Pietermaritzburg

Full Approval – Expedited Application

In response to your application received 22 February 2016, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Shenuka Singh (Chair)
Humanitities & Social Scinces Research Ethics Committee

/pm

Cc Supervisor: Dr Nicola Wiles
Cc Academic Leader Research: Professor Onisimo Mutanga
Cc School Administrator: Ms Marsha Manjoo

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

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APPENDIX E: Informed consent

Discipline of Dietetics and Human Nutrition

University of KwaZulu-Natal

Pietermaritzburg campus

PARTICIPANT INFORMATION AND INFORMED CONSENT

Dear Students,

My name is Ra'eesah I am Dietetics masters student studying at the University of KwaZulu-Natal in Pietermaritzburg, South Africa.

You are invited to consider participating in a research study that involves determining the relationship between sugar intake and Body mass index (BMI). The aims of the study are as follows:

- To determine the demographic characteristics of UKZN students.
- To determine the Body mass index (BMI) of UKZN students.
- To determine the added sugar intake of UKZN students
- To determine the association between BMI and added sugar intake
- To determine the consumption and consumption patterns of sugar sweetened beverages

The study is expected to enroll undergraduate students between the ages of 18-25 years studying at the University of Kwa Zulu natal in Pietermaritzburg. The study will take place over a month, however if you choose to enroll and remain in the study your participation will only be required once.

The following procedure will be used for conducting the study:

1. Participants will have their height and weight measured by the field workers. This information will be required in calculating their body mass index (BMI).
2. Participants will then be asked to complete a questionnaire.
3. Participants will then be required to complete a Food frequency questionnaire (FFQ) and a 24 hour dietary recall

This study will not expose you to any health risks as participants will only be required to complete the questionnaire, FFQ and 24 hour dietary recall. All of the information obtained will be kept confidential.

We hope that by conducting this study, participants will benefit by becoming familiar with the food products that contain added sugars. By completing the FFQ and the 24 hour dietary recall participants will also be able to take note of the amount of sugar that is consumed. However, we cannot guarantee that all participants will reap benefits from this study as it is subjected to the individual's interest.

The study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee.

Approval number HSS/0175/016M

In the event of any problems/ concerns/ questions you may contact my research supervisor Dr Nicola Wiles or the UKZN Humanities and Social Sciences Research Ethics Committee.

Contact details:

Research supervisor: Dr Nicola Wiles
Email: wilesn@ukzn.ac.za

Researcher: Ra'eesah Nakhooda
Email: raeesah.nak@gmail.com Phone number: 033 260 5430

UKZN Humanities and Social Sciences Research Ethics Committee.
Research office, Westville Campus
Govan Mbeki Building
Private bag X 54001
Durban
4000
KwaZulu-Natal, South Africa
Tel: 27 312604557 Fax: 27 312604609
Email: HSSREC@ukzn.ac.za

Participation in this study is voluntary and you have the right to withdraw your consent or discontinue participation at any time without any penalties or loss of benefits that you are normally entitled to. No prejudice will be held against those that do not wish to participate in this study. Your identity will remain confidential throughout the study period.

In order to maintain confidentiality, all personal data of the participants will be used solely for the purpose of the study and not disclosed to the public. No names will be used when drawing conclusions and/ or writing up results. Each participant will be given a code number to ensure confidentiality and results will be stored in a safe location at the university. Only authorised personnel will have access to the data.

DECLARATION

I…… (Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

SIGNATURE OF PARTICIPANT DATE

…… ……