Dietary intake practices associated with diabetes and obesity among black South Africans in the Prospective Urban Rural Epidemiological Study

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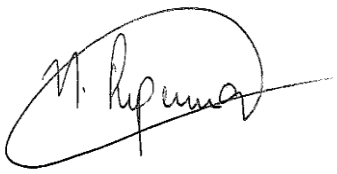
DECLARATION

I declare that "*Dietary intake practices associated with diabetes and obesity among black South Africans in the Prospective Urban Rural Epidemiological Study*" is my own work, that it has not been submitted before for any degree or examination in any other university and that all the sources I have used or quoted have been indicated and acknowledged as complete references.

Name: **Nomandlakayise Pupuma** **30 November 2018**



DEDICATION

To my family, my mother (Nonkululeko Princess Pupuma), my sisters, close friends and classmates who always supported me throughout the journey. Certainly, it was not a smooth sailing journey, but I managed to finish it, through your unwavering support, amidst all of life's events that could easily have swayed my focus.

"Sometimes staying strong feels impossible, but giving up is not an option" – Nishan Panwar

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LIST OF SYMBOLS, ACRONYMS AND ABBREVIATIONS

BMI Body mass index

CI Confidence interval

CDC Centres for Disease Control and Prevention

DRIs Dietary reference intakes

FFQ Food frequency questionnaire

FBDGs food-based dietary guidelines

IDF International Diabetes Federation

kg/m^2 Kilograms per metre squared

LDL Low density lipoprotein

NCDs Non-communicable diseases

OR Odds ratio

PURE Prospective Urban Rural Epidemiological

SD Standard deviation

SSA Sub-Saharan Africa

SAMRC South African Medical Research Council

WHO World Health Organisation

ABSTRACT

South Africa is undergoing epidemiological transition characterised by large shifts in dietary patterns. Modern societies seem to have adopted a "Western diet" which is high in saturated fats, sugar, salt, refined foods and low in fibre. Poor dietary intake practices are closely linked to the development of non-communicable diseases (NCDs), which are the leading causes of death globally. Among the prevalent NCDs is diabetes, which is closely associated with obesity. South Africa is not spared the widespread increase in diabetes and obesity, in both rural and urban settings.

Aim: The aim of this study is to investigate the prevalence and the risk factors of diabetes and obesity, with special focus on dietary intake practices, among black urban South Africans residing in Cape Town, Western Cape, and black rural South Africans residing in Mount Frere, Eastern Cape.

Methods: A quantitative, cross-sectional descriptive study design was utilised which involved the analysis of baseline data collected in 2009 and 2010 from the Cape Town cohort of the Prospective Urban and Rural Epidemiological (PURE) study. The study included a total of 2038 black South Africans, men and women, rural and urban, who were from the ages 35 to70 years. The PURE adult questionnaire was used to collect socio-demographic, anthropometric and medical history data. Dietary intake data was also collected using a standardised food frequency questionnaire from the PURE study. Data analysis was done using SPSS (version 25.0) and Stata (version 14.0) statistical programmes. Data on nutrient intake was summarised as means and standard deviations. Pearson correlation and multivariate regression analysis were performed to assess the relationship between dietary intake practices, diabetes, and obesity, and to predict risk.

Results: A minority (9.7%) of participants were diabetic with a higher proportion in urban (12.0%) than rural (7.3%) areas**.** A higher proportion (51.9%) was aged 56 years or older**.** A minority of participants had a family history of diabetes from the paternal (4.7%) and maternal (11.9%) sides**.** The majority (85%) of participants diagnosed with diabetes were also overweight and obese. The proportion of the participants who were obese was 48.6% with a higher proportion in urban (57.2%) than rural (43.0%) areas. The proportion of participants who were obese was similar among all age categories, i.e., 33.6%, 32.8% and 33.7% among

35 to 45 year-olds, 46 to 55 year-olds, and 56 years or older, respectively. The majority of females (81.6%) were obese compared to males (35.9%). The proportion of participants who were obese and smoked was 16.0%. Meat and meat products consumption was 7 times more likely to have an effect on diabetes (OR = 7.1; $p < 0.05$). The consumption of fish and fish products decreased the likelihood of diabetes by 90% (OR = 0.10; $p < 0.05$).

Conclusion: The prevalence of diabetes was higher in urban than rural areas. The age group 56 years and older was found to have a higher proportion of participants diagnosed with diabetes than the younger age groups. The majority of participants diagnosed with diabetes were overweight and obese. Almost half the participants in the study were obese, especially females, with the highest proportion in urban than rural areas**.** The consumption of meat and meat products were significantly associated with the prevalence of diabetes in both urban and rural settings, which is cause for concern. The consumption of fish and fish products seemed to have a protective effect on diabetes.

Key words: non-communicable diseases, diabetes, obesity, dietary intake practices, urban, rural

CHAPTER ONE

STATEMENT OF THE PROBLEM

1.1. Introduction

The epidemic of non-communicable diseases (NCDs) is rising exponentially in many parts of the world (Nojilana *et al*., 2016).WHO estimated that 65% of the world's 54 million deaths were attributed to NCDs, and 75% of those deaths occurred in low and medium income countries (Hyder,Wosu, Gibson, Labrique & Pariyo, 2017). A mortality report released by Statistics South Africa revealed that 5.5% of deaths, due to natural causes, were attributed to diabetes (Statistics South Africa, 2016). The International Federation of Diabetes (IDF) report shows that the prevalence of diabetes among the population aged 20 to 79 years in South Africa is 5.4% (IDF, 2017). The IDF estimates that the prevalence of diabetes in South Africa will increase to 6.2% in 2045 (IDF, 2017). The South African Medical Research Council (SAMRC) stated that the rising prevalence of diabetes in South Africa is attributed to the high incidence of obesity (SAMRC, 2017). In South Africa, the high incidence of NCDs is associated with urbanisation (Puoane, Tsolekile, Sanders & Parker, 2011). Urbanisation is a phenomenon characterised by population migration from rural to urban areas (Satterthwaite, McGranahan & Tacoli, 2010). This has led to the adoption of a "Western diet", which comprises of processed foods high in calories, saturated fats, refined sugar and salt (Pretorius & Sliwa, 2006).

Diet and nutrition play a central role in the development of NCDs, such as diabetes and some cancers (Steyn et al., 2016), that are steadily rising in South Africa (SAMRC, 2017). Diet and nutritional factors are considered modifiable risk factors (Spires *et al*., 2016). In developing countries, there has been notable nutrition transition, which has a negative impact on nutrition and health outcomes, especially on obesity (Pham, Worsley, Lawrence & Marshall, 2017). Nutrition transition is characterised by sedentary lifestyles and the increased consumption of processed foods high is unhealthy fat, salt and added sugars (Pham *et al*., 2017). Poor dietary intake practices generate more NCDs than physical inactivity, tobacco and cigarette smoking combined (Spires *et al*., 2016).

Dietary patterns, including increased sugar consumption, are also changing in rural areas (Vorster, Kruger,Wentzel-Viljoen, Kruger & Margetts, 2014). Some studies stated that the risk of rural dwellers developing NCDs and metabolic syndrome was no different to that of urban dwellers (Oladapo *et al*., 2010; Oyebode *et al*., 2015).

Cardio-metabolic risk factors were reported to have increased in a population-based survey among the rural Yoruba population in South Western Nigeria (Oladapo *et al*., 2010). Similar results were reported in a cross-sectional study focusing on middle-income countries, wherein migrants and urban dwellers had similar cardiovascular risk factors to rural dwellers (Oyebode *et al.*, 2015). The results from the Prospective Urban Rural epidemiological (PURE) cohort study revealed that the sugar intake of rural dwellers increased rapidly in recent years (Vorster *et al*., 2014). Another study revealed that rural dwellers were at a higher risk of developing chronic diseases of lifestyle and metabolic syndrome than urban dwellers (Van Zyl, Van der Merwe, Walsh, Groenewald & Van Rooyen, 2012).

In fulfilling the mandate of improving the life-expectancy of South Africans, the South African National Department of Health developed a strategy for the prevention and control of NCDs (Department of Health of the Republic of South Africa, 2013). The strategy focuses on healthy eating, getting regular exercise and maintaining a healthy body weight. Considering the various risk factors that are associated with the development of NCDs, there is a need for awareness programmes which identify the risk factors that can be controlled through interventions, that are affordable, varied, culturally appropriate and aligned with the food-based dietary guidelines (FBDGs) of South Africa (Pretorius & Sliwa, 2011). The FBDGs form part of the FAO/WHO strategy to promote appropriate diets by recommending dietary patterns and healthy lifestyles, and calls on governments to provide evidence-based advice to the public in the form of guidelines they can understand, embrace and apply (Vorster, 2012).

South Africa is faced with the challenge of a dearth of national data on the dietary intakes of South Africans (Mchiza *et al*., 2015). More research on dietary intake that is representative of all South Africans is needed in order to effectively inform the strategy on the prevention and control of diabetes and obesity.

1.2. Statement of the Problem

Currently, the prevalence of NCDs is increasing in both urban and rural areas (Mayosi *et al*., 2009). In South Africa, there is inadequate data on dietary intake, in both rural and urban areas, which makes it difficult to plan interventions aimed at reducing the morbidity and mortality due to NCDs (Mchiza *et al*., 2015). Therefore, the purpose of the present study is to investigate the risk factors of diabetes and obesity that are related to dietary intake practices among urban and rural communities.

1.3. Aim of the Study

The aim of this study is to investigate the prevalence and risk factors of diabetes and obesity with special focus on dietary intake practices, among black urban South Africans residing in Cape Town, Western Cape, and black rural South Africans residing in Mt Frere, Eastern Cape.

1.4. Objectives of the Study

The objectives of the study are the following:

- To determine the prevalence of diabetes in urban South Africans between the ages of 35-70 years residing in Cape Town, Western Cape, and rural South Africans residing in Mt Frere, Eastern Cape.
- To determine the prevalence of obesity in urban South Africans between the ages of 35-70 years residing in Cape Town, Western Cape, and rural South Africans residing in Mt Frere, Eastern Cape.
- To determine the risk factors of diabetes with special focus on dietary intake practices of urban South Africans between the ages of 35-70 years residing in Cape Town, Western Cape, and rural South Africans residing in Mt Frere, Eastern Cape.
- To determine the risk factors of obesity with special focus on dietary intake practices of urban South Africans between the ages of 35-70 years residing in Cape Town, Western Cape, and rural South Africans residing in Mt Frere, Eastern Cape.
- To determine the relationship between the prevalence and the risk factors of diabetes, specifically related to the dietary intake practices in urban South Africans between the ages of 35-70 years residing in Cape Town, Western Cape, and rural South Africans residing in Mt Frere, Eastern Cape.
- To determine the relationship between the prevalence and the risk factors of obesity, specifically related to the dietary intake practices in urban South Africans between the ages of 35-70 years residing in Cape Town, Western Cape, and rural South Africans residing in Mt Frere, Eastern Cape.

1.5. Hypothesis

It was hypothesised that:

- The prevalence of diabetes and obesity will be high among black South Africans residing in urban than rural areas.
- There will be a positive relationship between the prevalence of diabetes and the risk factors for developing diabetes, specifically related to dietary intake practices.

- There will be a positive relationship between the prevalence of obesity and the risk factors for developing obesity, specifically related to dietary intake practices.
- The dietary intake practices will be a strong predictor for developing diabetes and obesity among black South Africans residing in rural and urban areas.

1.6. Significance of the Study

Diabetes and obesity are major global and national health burdens that are increasing exponentially, which need urgent attention (Manyema, Veerman, Chola & Tugendhaft, 2015). In South Africa, there is inadequate data on dietary intake, in both rural and urban areas, which makes it difficult to plan interventions aimed at reducing morbidity and mortality, due to NCDs (Mchiza *et al*., 2015). Therefore, the results of this study could be useful in providing advice on the dietary intake practices of South Africans. The results of the research could also assist researchers in designing appropriate health promotion programmes that are effective and efficient in South Africa.

1.7. Delimitations of the Study

1.7.1. Inclusion Criteria

The age range of the participants included in the study was between 35 to 70 years. For participants to be selected, they were categorised as "usual resident" which implies that a person ate and slept in a fixed dwelling on most days of the week and for most weeks of the year, and considered the dwelling as his/her primary place of habitation over the long-term.

1.7.2. Exclusion Criteria

Individuals who lived in villages in the rural area of Mt Frere, which were not located within a 45 km distance of the health facility, were excluded. Individuals classified as "migrant residents" were also excluded from the study. These were individuals who lived in fixed dwellings for less than two days per week, even though they considered those dwellings as their primary places of habitation, and were currently eating or sleeping in different physical locations, because of the need to work, study or undergo training.

1.8. Definitions of Terms

Non-communicable diseases (NCDs) are medical conditions, also known as chronic diseases of lifestyle, which are not infectious and transmissible from person to person (Kim & Oh, 2013). They are of long duration and generally slow progression (Salam, 2016). These include cardiovascular disease (coronary heart disease, stroke), diabetes, obesity and others (Kim & Oh, 2013).

Body mass index (BMI) is a measure of an individual's weight divided by the square of their height (Centers for Disease Control and Prevention, 2017). A high BMI can be an indicator of high body fatness. A person is considered overweight and overfat, if they have a BMI in a range from 25 to 29.9 kg/m². A BMI from 18.5 to 24.9 kg/m² is considered healthy (Nuttall, 2015).

Obesity is a condition wherein a person has accumulated too much body fat that it might have a negative effect on their health (Abdelaal, le Roux & Docherty, 2017). It is defined as a BMI of 30 kg/m² or higher. It is frequently subdivided into three categories, namely:

- Class 1 obesity: BMI of 30 to 34.9 kg/m²
- Class 2 obesity: BMI of 35 to 39.9 kg/m²
- Class 3 obesity: BMI of 40 kg/m² or higher. Class 3 obesity is sometimes categorised as "extreme" or "morbid" obesity (Abdelaal, le Roux & Docherty, 2017).

Diabetes is a group of medical diseases associated with abnormally high levels of blood glucose, due to the inadequate production of insulin or the insensitivity of body cells to the action of insulin (American Diabetes Association, 2010).

Urbanisation is the process where there is an increase in the population in urban areas, due to migration from rural to urban areas (Satterthwaite, McGranaham & Tacoli, 2010). It also refers to the gradual increase in the proportion of people living in urban areas and the population shift from rural to urban areas (Allender, Hutchinson & Arambempola, 2008)

1.9. Outline of the Mini-thesis

In chapter two, the literature review is presented on the prevalence of diabetes and obesity globally, as well as nationally, the risk factors for developing diabetes and obesity, the risk factors related to dietary intake practices of South Africans, and the relationship between dietary intake practices and the prevalence of diabetes and obesity. Chapter three outlines the research methodology with an overview of the study design, a description of the study setting, the process of data collection, the statistical techniques of data analysis and the ethical considerations used in the study. In chapter four, the results are presented with a focus on both significant and non-significant outcomes. Chapter five presents the discussion of the study results, the conclusion and the recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This section analyses the literature and focuses on the different risk factors associated with diabetes and obesity among black South Africans.
The first section outlines the description of diabetes and obesity. The next section presents the prevalence of diabetes and obesity globally and the burden of these conditions in the Sub-Saharan African region.

The following section focuses on the risk factors for type 2 diabetes and obesity, environmental and socio-economic determinants of diabetes and obesity. The last section focuses on the relationship between the prevalence of diabetes and the risk factors of diabetes related to dietary intake practices, and the relationship between the prevalence of obesity and the risk factors of obesity related to dietary intake practices.

2.2. Description of Diabetes Mellitus and Obesity

The American Diabetes Association (2010) describes diabetes as "a group of metabolic diseases characterized by hyperglycemia, resulting from defects in insulin secretion, insulin action, or both". There are two basic types of diabetes: (1) type 1 diabetes which develops in the early years of life, and mainly occurs in children or adolescents (with about 5% of the population diagnosed with type 1 diabetes); and (2) type 2 diabetes which occurs most frequently in adults older than 45 years, and accounts for approximately 90-95% of all diabetes cases worldwide (Punthakee, Goldenberg & Katz, 2018). Type 2 diabetes is often associated with obesity, as most individuals diagnosed with diabetes are obese (American Diabetes Association, 2010).

Obesity is a condition wherein a person has accumulated too much body fat (usually 20% above the normal body weight) that it might have a negative effect on their health (Agha & Agha, 2017). Obesity is caused by multiple factors, including genetic predisposition (Jiang, Lu, Zong, Ruan & Liu, 2016). Obesity is mostly associated with the excess intake of a calorie-dense diet and a sedentary lifestyle, and increases the risk of atherosclerotic cerebrovascular disease, coronary heart disease, colorectal cancer, hyperlipidemia, hypertension, gallbladder disease, and diabetes mellitus, as well as a higher mortality rate (Zhang *et al*., 2014).

2.3. Prevalence of Diabetes and Obesity

2.3.1. Global Prevalence of Diabetes and Obesity

The International Diabetes Federation (IDF) estimates that the total number of people with diabetes globally will increase exponentially from 425 million in 2017 to 629 million by 2045 (IDF, 2017). Table 2.1 depicts the global prevalence of diabetes in 1980 and 2014.

Table 2.1 Estimated global prevalence and number of people with diabetes (adults over 18 years) in 1980 and 2014.

WHO Region	Prevalence (%)		Number (million)	
	1980	2014	1980	2014
African Region	3.1	7.1	4	25
Region of the Americas	5.0	8.3	18	62
Eastern Mediterranean Region	5.9	13.7	6	43
European Region	5.3	7.3	33	64
South-East Asian Region	4.1	8.6	17	96
Western Pacific Region	4.4	8.4	29	131
Total	4.7	8.5	108	422

Source: WHO Global Report on Diabetes 2016

Similar to diabetes and other chronic diseases of lifestyle, WHO also declared obesity a chronic disease (Van de Merwe & Pepper, 2006). Obesity is an epidemic in both adults and children, and the number of people with morbid obesity is becoming larger than the overweight population (Lavie, McAuley, Church, Milani & Blair, 2014). Globally, it was estimated that 1.9 billion people were overweight, while 650 million people were obese in 2016 (WHO, 2018). If the increase in obesity continues maintaining a similar trend, by 2030 an estimated 38% of the world's adult population will be overweight and 20% will be obese (Hruby & Hu, 2015).

2.3.2. Prevalence of Diabetes and Obesity in Sub-Saharan Africa

The prevalence and burden of diabetes in sub-Saharan Africa **(**SSA) are growing rapidly (Pastakia, Pekny, Manyara & Fischer, 2017). In the twenty first century, diabetes has emerged as a major public health problem, which was virtually unknown in Africa at the beginning of the twentieth century (Peer *et al*., 2012).

Historically, type 2 diabetes was perceived as a rare condition or undocumented in rural Africa, but in recent years it has emerged as an important NCD in SSA (Mbanya, Motala, Sobngwi, Assah & Enoru, 2010). Pastakia *et al*. (2017) argue that the high prevalence of diabetes in SSA is attributable to a lack of resources to combat NCDs, i.e., a scarcity of research studies, an absence of management protocols that are population-specific, health disparities between rural and urban communities, and inequities between the private and public health care sectors. On the other hand, Mbanya *et al*. (2010) suggest that the high prevalence of NCDs in the SSA region could be attributed to the rapid rate of urbanisation, which has an impact on lifestyle behaviour. While mortality in the African region is dominated by communicable diseases, there is an epidemiological shift that will see NCDs becoming the leading cause of death by 2030, as predicted by WHO (Nojilana *et al*., 2016). In the African region, the prevalence of diabetes has increased dramatically from 3.1% in 1980 to 7.1 % in 2014 (WHO, 2014). In SSA, the prevalence of diabetes varies across the region, however, there is limited data to establish the extent of the rise (Mbanya *et al.*, 2010).

In South Africa, the political transition since the democratic era has been accompanied by a rise in NCDs in urban and rural areas (Mayosi *et al*., 2009). A report released by the South African Medical Research Council (SAMRC, 2017) suggests that the prevalence of diabetes has increased in men from 3.4% in 1980 to 8.5% in 2014. The prevalence has also increased steadily in women from 4.15% in 1980 to 8.9% in 2014 (SAMRC, 2017). The report further highlights that the rising prevalence of diabetes is attributed to the high incidence of obesity (SAMRC, 2017). In South Africa, the high incidence of NCDs is associated with urbanisation and demographic transition (Puoane *et al*., 2011).This has led to the adoption of a "Western diet," which comprises of processed foods high in calories, saturated fats, refined sugar and salt (Pretorius & Sliwa , 2011).

Similar to high income countries, SSA is also facing the challenge of a dramatic increase in the prevalence of obesity (Biadgilign *et al*., 2017). However, there is sparse data on the prevalence of obesity and overweightness (Biadgilign *et al*., 2017). The South African Medical Research Council report stated that South Africa ranks the highest for obesity in the SSA region (SAMRC, 2014). According to the South African Demographic and Health Survey (SADHS) report, two-thirds (68%) of women in South Africa were overweight or obese, 3% were underweight, and 30% were normal weight (SADHS, 2017). In contrast, 31% of men were overweight or obese, 10% were underweight, and 59% had a BMI in the normal range. Severe obesity was more prevalent among coloured and black women (26% and 20%, respectively) (SADHS, 2017).

2.4. Risk Factors Associated with Diabetes and Obesity

A risk factor may be defined as a distinguishing trait that can be used to assess an individual's probability of developing a particular disease (Wal, Wal, Saraswat, Singh & Bajpai, 2013). Risk factors for developing a disease can be either modifiable, implying the possibility of that risk factor to be changed, if there is an alteration in the implicated lifestyle factors, or unmodifiable risk factors that cannot be changed (Wal *et al*., 2013).

2.4.1. Unmodifiable Risk Factors Associated with Diabetes and Obesity

2.4.1.1. Age and Gender

Both age and gender are unmodifiable risk factors of diabetes and obesity (Choi & Shi, 2001). In 2010, the International Diabetes Federation estimated that most people develop diabetes between the ages of 40–59 years, but by 2030, the highest prevalence will be in the oldest age-group of 60–79 years (Mbanya *et al*., 2010). Both males and females are at risk of developing diabetes with advancing age, due to the steadily increasing blood glucose levels over time (Choi & Shi, 2001). It can be concluded that gender has little effect on the development of diabetes globally, with no recognisable trend evident even in SSA (Mbanya *et al*., 2010). Globally, the diabetes prevalence for men and women was similar, although in men above 60 years and in older women it was slightly higher (Wild, Roglic, Green, Sicree & King, 2004). The National Population Health Survey (NPHS) showed that the risk of contracting diabetes was 9% per year, and that there was a higher prevalence amongst males of all ages (Choi & Shi, 2001). Most reports suggest that the peak age at onset of diabetes in SSA is 65 years (Mbanya *et al*., 2010).

2.4.1.2. Heredity or Genetics

As early as 1946, hereditary factors have been identified as conducive to the development of diabetes (Joslin, Root,White, Marble & Bailey, 1946). Various factors are associated with the development of type 2 diabetes, including genetics and environmental factors (Hu, 2011). Recent developments in the genome-wide association studies (GWAS) identified common genetic variants for increasing the risk of developing diabetes (Hu, 2011). There are at least 40 genetic loci that have been associated with type 2 diabetes (Hu, 2011). However, GWAS suggests that these loci have limited effect on the clinical prediction of diabetes compared to the conventional risk factors, such as obesity, physical inactivity, and an unhealthy diet (Hu, 2011).

The results from studies conducted in Sudan and in rural South Africa reported that a positive family history was an independent risk factor for developing type 2 diabetes, (Mbanya *et al*., 2010). Similarly, a study conducted in South Africa amongst blacks identified family history as one of the significant independent variables for developing diabetes (Motala, 2008). Genetics and environmental factors could contribute to an individual's susceptibility for diabetes in the presence of dietary and lifestyle factors (Motala, 2008).

2.4.1.3. Ethnicity

A significant association exists between ethnicity and diabetes (Cowie, 2006). Even though there is notable variation in the prevalence of diabetes among ethnic groups, the reasons for the differences are not clearly understood, i.e., whether they are due to genetic susceptibility or the environment, inclusive of behavioural factors (Oldroyd, Banerjee, Heald & Cruickshank, 2005).

In South Africa, the Indian population has the highest prevalence of diabetes, followed by the Coloured population, whose ancestry is about 32-43% Khoisan, 20-36% black, 21-28% white, and 9-11% Asian (Erasmus *et al*., 2012). Indians are more likely to develop insulin resistance than other ethnic groups, which makes them more susceptible to developing diabetes (Puoane *et al*., 2011). Even though several reports showed that individuals of Indian ethnicity have a strong genetic predisposition to diabetes, results from the South African National Health and Nutrition Examination Survey showed that the prevalence of diabetes complications was not associated with ethnicity (Mutyambizi *et al*., 2017).

2.4.2. Modifiable Risk Factors Associated with Diabetes and Obesity

2.4.2.1. Physical Inactivity

Among the risk factors contributing to the development of NCDs is a lack of physical activity (Assah, Ekelund, Brage, Mbanya & Wareham, 2011). Sedentary behaviours also increase the risk of diabetes and obesity (Hu, 2011). Independent of obesity, increased physical activity is associated with good blood glucose control and, therefore, contributes to a reduction in diabetes prevalence (Choi & Shi, 2001). Among other factors, the obesity epidemic is attributed to physical inactivity, a lack of participation in sport, and automation of labour-intensive devises in the home (Chambers & Swanson, 2010). A decline in physical activity is also associated with urbanisation, where individuals could be having more sedentary employment, residing in an environment with limited outdoor space for physical activity or residing in neighbourhoods with a high rate of street violence that makes outdoor physical activity challenging and unsafe (Stern, Puoane & Tsolekile, 2010).

2.4.2.2. Cigarette Smoking

The results from a meta-analysis showed that smokers were 45% more likely to develop diabetes compared to non-smokers (Hu, 2011). Smoking was closely linked to diabetes-associated complications, including heart disease, peripheral vascular disease and lower extremity amputations (Choi & Shi, 2001). The Framingham study revealed that after the age of 40 years, the presence of obesity and smoking reduced life-expectancy (Wild & Byrne, 2006).

A study in Dutch women showed that smoking was associated with a lower BMI, but an increased waist circumference (i.e., central obesity), while discontinuation of smoking was associated with weight gain (Wild & Byrne, 2006). Central obesity in smokers is thought to be associated with increased cortisol levels, due to stimulation of the sympathetic nervous system (Hu, 2011). The Prospective Urban and Rural Epidemiological (PURE) study revealed that smoking cessation was associated with income level and level of education (Teo, 2013). The cessation rate was highest (74.9%) in high-income countries and lowest (38.1%) in low-income countries (Teo, 2013). Similarly, those who were better educated, were more likely to stop smoking (Teo, 2013).

2.4.2.3. Obesity as a Risk Factor of Diabetes

There is a strong association between obesity and the development of type 2 diabetes (Wild & Byrne, 2006). A study conducted in Scotland among people who were diagnosed with type 2 diabetes showed that 85% were overweight and obese with a body mass index (BMI) more than 25 kg/m² (Wild & Byrne, 2006). A BMI of more than 35 kg/m² classifies an individual as class 2 obesity and poses an even greater risk of developing diabetes (Wild & Byrne, 2006).

2.4.2.4. Dietary Intake Practices

Even though obesity is a condition characterised by the interplay of various risk factors, such as genetics, environmental and psychosocial factors, nevertheless dietary intake and lifestyle behaviours remain at the centre of the obesity epidemic (Chew, 2014). Dietary intake is a major risk factor for developing NCDs (Puoane et al., 2011). Poor dietary intake is characterised by a diet high in calories, saturated fat, and refined carbohydrates and sugars (Steyn *et al*., 2016). Excessive calorie intake plays a substantial role in the development of obesity and type 2 diabetes (Leitner *et al*., 2017).

It is important to note that diet quality is an independent risk factor in the development of type 2 diabetes and obesity, for example, the quality of fat and carbohydrates in the diet are independent of other risk factors, such as BMI (Hu, 2011). A study showed that the consumption of diets high in trans-fatty acids and low in polyunsaturated fat was associated with an increased risk of developing diabetes (Hu, 20110. The quality of carbohydrates, in the context of their effect on postprandial glucose, is usually attributed to glycemic index (GI), which measures the ability of a carbohydrate-rich food to raise blood glucose level (Lee, Song & Song, 2018). Low-GI diets have shown beneficial effects on post prandial glucose control in patients with type 2 diabetes, although the long-term effects are not clear (Eleazu, 2016).

The GI makes it possible to classify foods with carbohydrates according to their blood glucose-raising potential relative to glucose or white bread, i.e., high GI (>70 arbitrary units), intermediate GI (55 - 70 arbitrary units) and low GI (<55 arbitrary) (Eleazu, 2016). The GI of foods is affected by the starch composition or properties, dietary fibre insulin response, protein contents, processing, variety, particle size, fat and acidity (Eleazu, 2016).

During the last century, significant changes in dietary intake, nutritional status, disease patterns and life-expectancy were noted (Abrahams, Mchiza & Steyn, 2011). Globally, nutrition transition has contributed to poor dietary intake, physical inactivity and, thus, an increase in the prevalence of diabetes and obesity (Popkin, 2003). Popkin (2003) describes the nutrition transition in three stages, as follows:

Stage1: Famine began to decline as income increased.

Stage 2: Dietary intake and physical activity levels started to change, resulting in the development of new diseases, and increased disability.

Stage 3: Populations started to adopt behavioural patterns aimed at reducing the intake of dietary fat, increasing fruit and vegetable intake, dietary fibre intake and physical activity levels in order to improve health and extend life-expectancy.

Research evidence shows that South Africa is a rapidly urbanising country that is between stages 2 and 3 of the nutrition transition (Nnyepi, Gwisai, Lekgoa & Seru, 2015).

Popkin (2015) argues that macroeconomic and technological factors greatly contribute to the nutrition transition. These factors focus on saving labour costs, enabling the quick processing of food, the provision of faster transportation and increasing the availability of sedentary behaviour-promoting devices, such as television-viewing (Popkin, 2015).

In SSA, rapid urbanisation is associated with the epidemiological transition, characterised by an increased prevalence of NCDs (Assah *et al*., 2011). Wild (2004) estimates that, even if the prevalence of diabetes stabilises by 2030, the number of people with diabetes will continue to increase, due to urbanisation and the aging population.

South Africa is one of the most urbanised countries in the SSA region, with approximately 62% of its population living in urban areas (Turok, 2012). With urbanisation, there have been changes in dietary patterns from a traditional healthy diet towards a "Western" diet high in fat and refined carbohydrates (Steyn *et al*., 2016).

2.5. Environmental and Socioeconomic Determinants of Diabetes and Obesity

It is reported that the changes in dietary and physical activity patterns that contribute to the high prevalence of obesity are associated with changes in the economic, social and physical environments of populations (Sturm & An, 2014). Individual behaviours are not only influenced by individual beliefs, but also by the surrounding environment (Saarloos, Kim & Timmermans, 2009). Hence, it is beneficial to include environmental factors in order to establish strategic guidelines to change an individual's behaviour (Yoon & Kwon, 2013).

Spires *et al*. (2016) argue that communities who cannot afford to buy healthy food have poor dietary intake and are at a higher risk for diet-related diseases. They concluded that unhealthy food environments promote poor dietary intake, which is seen in communities with low-income and low socioeconomic status (Spires *et al*., 2016). The development of obesity is associated with the inaccessibility to affordable healthy foods, which leads to the consumption of unhealthy fast foods, high in fats and sugars (Stern *et al*., 2010).

Cultural factors also play a role in the increased prevalence of obesity, especially amongst black Africans who associate obesity with beauty, wealth and the absence of disease, such as HIV/AIDS (Stern *et al*., 2010). Cross-sectional studies have shown that there is a preference for a larger body size among black South African women (Micklesfield *et al*., 2013). As revealed by the results from the SADHS, the larger body size among black South African women could be attributable to the fact that they were more likely to underestimate their body size compared to women of other ethnic groups (Puoane *et al*., 2002). Physical inactivity and a lack of desire to lose weight have been established among South African black women in both rural and urban areas (Micklesfield et al., 2013).

The high prevalence of NCDs was previously associated with high-income countries and more affluent populations, but recent data shows an increasing prevalence in poorer countries (Islam *et al*., 2014). Diabetes

mellitus together with other NCDs are causing an increase in the burden of disease in developing countries (Animaw & Seyoum, 2017).

This is due to rapid industrialisation, urbanisation, international trade with high-income countries and lifestyle changes in developing countries (Dagenais *et al*., 2016). In developing regions, poor dietary intake is usually accompanied by inadequate micronutrient intake, causing nutritional health problems, which ultimately adds to the burden of disease (Steyn *et al*., 2016). In Africa, this epidemiological transition poses serious threats to public health and affects mainly the poor, who are food insecure (Crush, Frayne & McLachlan, 2011). It is, therefore, important to consider social inequities in dietary intake, when planning prevention and management strategies for NCDs in low-to-medium-income countries (Mayen, Marques-Vidal, Paccaud, Bovet & Stringhini, 2014). It is important to point out that studies done on dietary intake in the black population in SSA focused more on eating habits, food preferences and the influence of urbanisation on diets than on other factors causing obesity and type 2 diabetes (Puoane, Matwa, Bradley & Hughes, 2006).

2.6. Relationship Between the Prevalence of Diabetes and the Risk Factors of Diabetes Related to Dietary Intake Practices

Poor dietary intake practices and physical inactivity are major contributing factors for the rapidly rising incidence of diabetes (Sami, Ansari, Butt & Hamid, 2017). A healthy balanced diet plays a major role in the prevention and management of diabetes, because it is associated with improved glycaemic control and insulin sensitivity, thereby, improving an individual's quality of life (Anders & Schroeter, 2015). A quality diet that is low in sugar and consists of fresh fruits and vegetables, whole grains, and complex carbohydrates is inversely related to the risk of type 2 diabetes (Shrestha, Karmacharya, Khudyakov, Weber & Spiegelman, 2018). High carbohydrate diets, comprising less dietary fibre and more refined carbohydrates, are associated with diabetes and metabolic syndrome (Lee, Song & Song, 2018). Metabolic syndrome is a physiological disorder characterised by dyslipidaemia, hyperglycaemia, central obesity and metabolic inflammation (Ludwig, Hu, Tappy & Brand-Miller, 2018). Several studies showed that the consumption of added sugars was associated with diabetes and obesity (Rippe & Angelopoulos, 2016). The results from various studies suggested that high meat consumption was associated with the increased risk of developing type 2 diabetes (Mari-Sanchis *et al*., 2016) and so too was a high fat intake, particularly the consumption of saturated fatty acids (Nagao, Asai, Sugihara & Oikawa, 2015).

2.7. Relationship Between the Prevalence of Obesity and the Risk Factors of Obesity Related to Dietary Intake Practices

Even though obesity is a condition characterised by the interplay of various factors, such as genetics, environmental and psychosocial factors, dietary intake and lifestyle behaviours are at the centre of the obesity epidemic (Chew *et al*., 2014). Obesity is mainly as a result of the overconsumption of calories and the practice of sedentary lifestyles (Zhang *et al*., 2014). Obesity is associated with urbanisation, which exposes poor people to unfavourable environments that lead to poor food choices comprising of cheap fast foods that are high in saturated fat, trans-fats, added sugar, salt and refined carbohydrates (Stern *et al.*, 2010). Fast foods, therefore, are associated with high insulin levels in the body, leading to insulin resistance, obesity and cardiovascular diseases (Rouhani, Mirseifinezhad, Omrani, Esmaillzadeh & Azadbakht, 2012).

A study showed that the consumption of high-caloric, energy-dense food, such as sugary and alcoholic beverages, was associated with obesity-related eating disorders (Muñoz-Pareja, Guallar-Castillion, Mesas, Lopez-Garcia & Rodríguez-Artalejo, 2013). Added sugars including sugary beverages, sweets, desserts and others provide high energy, without the essential nutrients and, thus, provide empty calories that contribute to the development of obesity (Bovi *et al*., 2017). In contrast, the consumption of adequate amounts of vegetables, fruit, legumes, nuts and complex carbohydrates rich in dietary fibre has been inversely associated with obesity and cardiovascular diseases (Romieu *et al*., 2017).

CHAPTER THREE

RESEARCH METHODS

3.1. Introduction

This chapter outlines the methodology used in the study, including the research design, population and sample, research instruments, data collection techniques, data analysis, and ethics considerations.

3.2. Study Setting

The study involved a secondary analysis of data collected from the Prospective Urban Rural Epidemiological (PURE) cohort study of black South Africans in the urban setting of Langa township in Cape Town, and in the rural setting of Mt Frere, Eastern Cape.

Langa township is located on the Cape Flats, 11 km south-east of Cape Town in the Western Cape Province. It is one of the oldest suburbs in Cape Town that was established specifically for black Africans during the apartheid era (Environment and Heritage Resources Management Branch, 2014). A large percentage of the Langa township population is predominantly black Africans (99.6%). Langa township has a population size of about 52 401 (Statistics South Africa, 2011). According to Statistics South Africa (2011), the average employment rate was 40.21 % with only 40% of those aged 20 years or older completed Grade 12 or higher in Langa township. The proportion of households that had an income of R3200 or less was 72%. Only 58% of the households were formal dwellings. The proportion of households that accessed piped water in their dwelling or inside their yard was 67%, while 72% of households had access to flushing toilets that was connected to the public sewerage system. The majority (98%) of households use electricity for lighting in their dwelling.

In contrast, Mt Frere is located in the Umzimvubu municipality within the Alfred Nzo district in the Eastern Cape Province. Alfred Nzo District Municipality (2018) highlighted that the district has been identified as the most impoverished and underdeveloped of all the integrated sustainable rural development programme nodes in the country. The development plan shows that the district is faced with poor access to healthcare services for primary healthcare purposes (Alfred Nzo District Municipality, 2018). In the plan high poverty rate is highlighted with 40% of the population in the district living below the poverty of R800 or less per month. The

district is faced with huge social backlogs, including lack of access to clean and safe water, proper sanitation and electricity, which are complicated by high illiteracy levels, high prevalence of HIV / AIDS and slow delivery of land reform programme.

Mt Frere is comprised of rural areas predominantly, with the majority of the population (86.58%) being Xhosa-speaking (Statistics South Africa, 2011).

3.3. Study Population

The study sample comprised of two communities of participants that initially totalled 2084 black South Africans (both men and women), with 1 003 participants residing in the rural community of Mt Frere, and 1 081 participants residing in the urban settlement of Langa township. Random sampling was used in the urban setting and cluster sampling was used in the rural setting in the PURE cohort study that focused on recruiting a relatively stable (non-migratory) black population. The age range of the participants was from 35 to 70 years. For participants to be selected, they were categorised as "usual resident" which implied that a person ate and slept in a particular household on most days of the week and most weeks of the year, and considered the household as his/her primary place of habitation over the long-term. Individuals classified as "migrant residents" were not included in the study.

Within the urban area, households were grouped according to the areas where the participants lived. Langa township comprises of three areas, namely the "Zones", the "hostels", and old Langa. The "Zones" and "hostels" were grouped together, as they were resource-poor areas compared to old Langa that was well-established and had established municipal amenities.

A street map, obtained from the City of Cape Town, was used to randomly select streets in each of the three areas. Once a street was selected, a systematic procedure of every second house was identified for possible inclusion in the study. Door-to-door recruitment of all households with eligible individuals was done by trained field workers in selected urban areas.

The above-mentioned sampling approach was not possible to follow in the rural community (Mt Frere), as there was no established municipal infrastructure with designated streets and roads. Therefore, a cluster sample of houses in the community was done, according to the division of areas by the recognised clan heads.

The sampling approach generated 437 households in the urban community (with 1 081 participants, and 329 households in the rural community (with 1 003 participants), giving a total of 2 084 individuals. Following an analysis of the dietary intake data, and the data extracted from the PURE adult questionnaire, 2038

individuals were selected. The individuals with missing data on dietary intake and demographics (n = 46) were excluded from the study.

Figure 3.1 depicts the process followed in selecting participants for the study, starting from a point where all participants in the PURE study were included to a point where some participants were excluded because of missing demographic and dietary intake data in the rural and urban area.

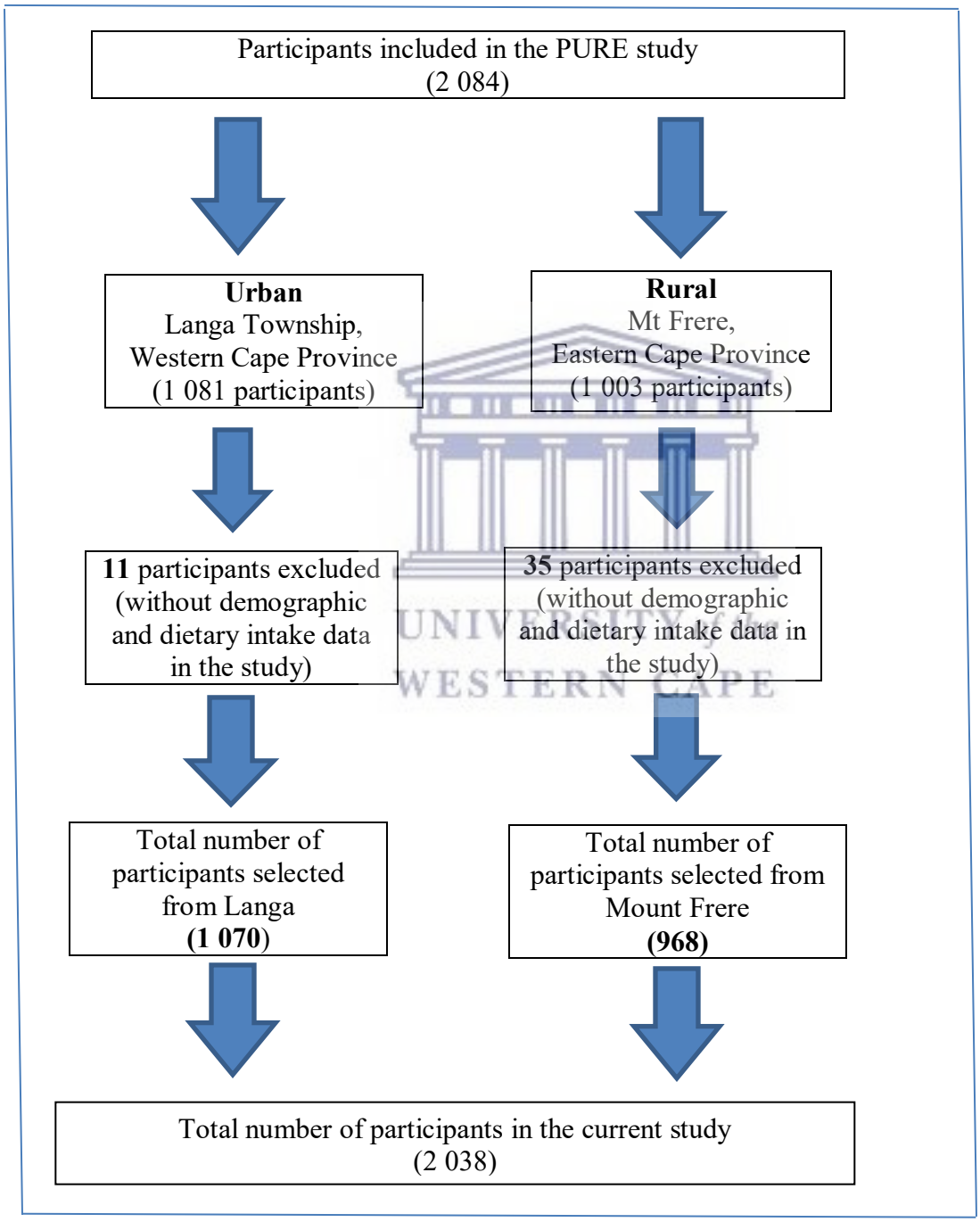


Figure 3.1. Flow chart of participant sampling in the current study.

3.4. Study Design

A quantitative, descriptive cross-sectional study design was used in which demographic, socioeconomic, and anthropometric measurements, as well as disease profile information were collected. The study involved an analysis of the baseline data collected in 2009 and 2010 from the Cape Town cohort of the Prospective Urban and Rural Epidemiological (PURE) study. The PURE population-based cohort study initially included a total of 2084 black South Africans, men and women, who were in the age category of 35 to70 years.

3.5. Data Collection

A standardised and validated questionnaire developed for the PURE study (see Appendix A for the PURE adult Questionnaire) was used to collect data on participant demographic characteristics (age, sex), medical history (diabetes), level of education and various socioeconomic factors.

Dietary intake data was also collected using a modified food frequency questionnaire (FFQ) developed for the PURE study (see Appendix B for the FFQ) that was adapted for use in the South African population (McMaster University, 2007). The culturally sensitive FFQ used in this study was previously validated and assessed for its reproducibility (Wentzel-Viljoen, Laubscher, & Kruger, 2011). The FFQ is a valid tool and a reasonably reliable measure of dietary intake (Roumelioti & Leotsinidis, 2009)

The questionnaires were administered by fieldworkers who were previously trained in administering the questionnaires. The questionnaires were administered in the households of the participants in a relaxed atmosphere to minimise participant-anxiety and distraction. In order to allow for flexibility in accessing all participants at variable times of the day, in instances where participants were missed at scheduled times of the day, there were repeat visits to these households. Participants were sent messages a day before their scheduled household visit, as a reminder, in order to minimise low turn-out rates.

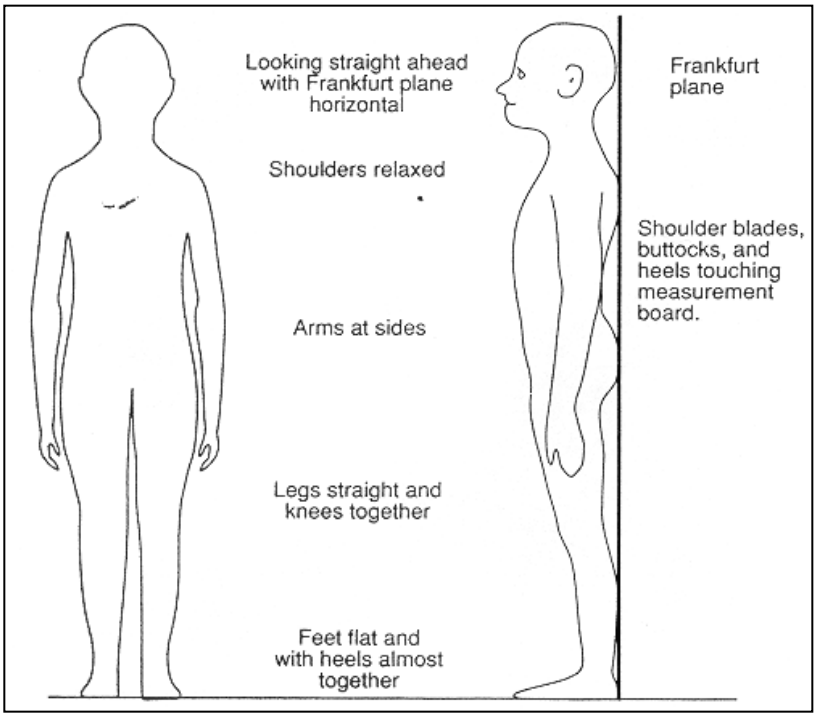
Anthropometric measurements [i.e., height, weight, and body mass index (BMI)] were done according to the PURE study procedures. Trained research assistants were responsible for performing the anthropometric measurements that were conducted in areas convenient for the participants, such as schools, community halls and churches, while still observing the privacy of the participants at all times. Body mass (weight) and height were measured according to the procedures indicated below, and BMI was calculated from these measurements.

3.5.1. Body Weight

Lahner (2018) defines body weight as "the measurement taken using a calibrated scale, when the subject is able to stand unassisted. Body weight was measured to the nearest 0.1 kg using a portable electronic scale (Masskot model UC 321 scale) with a measurement range from 0 to 150 kg. The scale was calibrated to zero, before body weights were measured. The participants had to wear minimal clothing, take off their shoes, and remove all heavy items from their pockets, such as cellular phones, keys etc. This was done in order to obtain consistent and accurate measurements. The final body weight measurement was obtained using the average of two measurements which were 0.1 kg of each other.

3.5.2. Height

The participants were measured against a flat wall and the measurement was taken with a non-distensible measuring tape. The participants had to take off their shoes, with arms hanging freely at the side. The participants were required to put their feet together with the medial (inner) borders of the feet at an angle of 60 degrees. The shoulder blades, buttocks and heels had to be in contact with the wall. The participants had their heads held in the Frankfort plane (represented by a line between the margin of the orbit of the eye and the tragion. The height measurements were recorded to the nearest 0.1 cm, after participants inhaled fully and maintained an erect position. In that position, research assistants made a horizontal mark on the wall using a headboard that was used to indicate the participant's height, and the measurement was recorded. Similarly, the average of two measurements was taken as the final measurement, provided that the measurements were 1 cm of each other.



Source: PURE Instructional Manual 2007

Figure 3.2. Positioning of participant for height measurement

3.6. Data Interpretation

3.6.1. Sociodemographic Variables

In order to describe the study sample, four sociodemographic variables were assessed, namely, gender, age, employment status and level of education. Age was divided into three categories (1 = 35 - 45 years, 2 = 46 - 55 years, and 3 ≥ 56). In men, the risk of developing type 2 diabetes and cardiovascular disease increases at age 45 years in contrast to women at age 55 years (National Institutes of Health, 2000). Gender had two categories (1 = female, and 2 = male). Employment status was divided into two categories (unemployed =1, and employed = 2). Level of education was divided into two categories (1 = primary education or none, and 2 = secondary education or higher). Marital status was divided into three categories (1= single, 2 = married or living with a partner, and 3 = widowed/separated/divorced).

3.6.2. Determining the Prevalence of Diabetes

The prevalence of type 2 diabetes was determined by participant self-report. The participants self-reported being either diagnosed with diabetes at some point by a healthcare professional or on prescribed diabetic medication. The diagnosis of diabetes was divided into two categories (1 = not diagnosed with diabetes, and 2 = diagnosed with diabetes or on prescribed diabetes medication).

3.6.3. Determining the Prevalence of Obesity

The prevalence of obesity was assessed manually in the participants. BMI was used to indicate obesity in participants. BMI categories were classified as four types (1 = underweight, 2 = normal weight, 3 = overweight, and 4 = obese). BMI was calculated by dividing the weight in kilograms by height in metres squared, using the following formula:

$$BMI = \text{Weight (kg)} \div \text{Height (m}^2\text{)}$$

3.6.4. Determining the Risk factors of Diabetes

For the purpose of this study, five risk factors of diabetes were assessed, namely, age, a family history of diabetes, smoking status, obesity and nutritional intake. In men, the risk of developing type 2 diabetes and cardiovascular disease increases at age 45 years in contrast to women at age 55 years (National Institutes of Health, 2000). Having a parent or a sibling with type 2 diabetes is also a risk factor for developing the disease (Centres for Disease Control and Prevention, 2018). Family history was assessed by whether the mother, father and/or sibling (brother or sister) were diagnosed with diabetes (1 = no family history, 2 = positive family history, and 3 = family history unknown).

Smoking is also associated with diabetes. Smoking is closely linked to diabetes-associated complications, including heart disease, peripheral vascular disease and lower extremity amputations (Choi, 2011). In a meta-analysis study showed that smokers were 45% more likely to develop type 2 diabetes (Choi, 2011). Smoking status was assessed by categorising participants who were diabetic and smoked (1 = diabetic and smoked, and 2 = diabetic and did not smoke).

Among other risk factors for developing diabetes is overweightness (BMI = 25.0 - 29.9 kg/m²) and obesity (BMI ≥ 30 kg/m²), which were estimated by the WHO as being responsible for 44% of diabetic cases (Leitner

et al., 2017). Obesity, as a risk factor for diabetes, was assessed by categorising the participants who were diabetic and overweight/obese (1 = diabetic and overweight/obese, and 2 = diabetic and not overweight/ obese).

Another risk factor for developing type 2 diabetes is the consumption of a diet high in calories, saturated fat, refined carbohydrates and added sugar (Steyn *et al*., 2016), red meat and low fibre food (Hu, Shilpa, Koning & Hu, 2014). Nutritional intake focused on quantifying the mean intake and standard deviation of the macronutrients, namely, carbohydrates (i.e., total carbohydrates and added sugars), proteins and fats (i.e., mono-unsaturated and polyunsaturated fats). Nutritional intake, as a risk factor for diabetes, was assessed by using DRIs with which to compare the mean nutritional intakes of participants.

3.6.5. Determining the Risk Factors of Obesity

Three risk factors were assessed, namely, age, smoking and nutritional intake. Increasing age is a risk factor for developing diabetes, due to hormonal changes and decreased muscle mass resulting in decreased metabolic rate and, ultimately, difficulty in losing weight (Mayo Clinic, 2018). Age, as a risk factor, generally increases with advancing age. Unlike cardiovascular disease and diabetes that have designated ages in men and women that indicate the onset of risk, there are no similar age criteria for indicating the onset of obesity. Therefore, age was assessed by categorising participants who were diagnosed with overweightness/ obesity according to age. There were three categories of age (1 = 35 - 45 years, 2 = 46 - 55 years, and 3 ≥ 56 years). Quitting smoking is associated with weight gain which may progress to obesity in the long run (Mayo Clinic, 2018). Smoking, as a risk factor of diabetes, was categorised as follows, 1 = overweight/obese and smoked and 2 = overweight/obese and did not smoke.

Nutritional intake focused on quantifying the mean intake and standard deviation of the macronutrients, namely, carbohydrates (i.e., total carbohydrates and added sugars), proteins and fats (i.e., mono-unsaturated and polyunsaturated fats). The consumption of a diet high in calories, saturated fat, refined carbohydrates and added sugar is not only a risk factor of diabetes, but also of obesity (Steyn *et al*., 2016). Nutritional intake, as a risk factor of obesity, was assessed using DRIs with which to compare the mean nutritional intakes of participants.

3.6.6. Determining the Risk Factors of Diabetes and Obesity Related to Dietary Intake Practices

Data on nutrient intake was summarised as means and standard deviations. The data was then compared with the dietary reference intakes (DRIs) to assess dietary adequacy. DRIs refer to a set of reference values used to plan and assess nutrient intakes of healthy people (Institute of Medicine Food and Nutrition Board, 1998). Nutritional intake data was analysed using the Food Finder (version 3, 2002) computer software programme, developed by the South African Medical Research Council (SAMRC). An analysis of various food groups, i.e., cereals and grains, vegetables, fruit, beans, soya, seeds and nuts, milk and milk products, meat and meat products, sugar and sugar products and alcoholic beverages was done to assess dietary intake practices associated with the increased risk of diabetes and obesity. The consumption of a diet high in calories, saturated fats, added sugars and low in fruit, vegetables and nuts increases the risk for developing diabetes and obesity (Bhupathiraju & Frank, 2017).

3.7. Statistical Data Analysis

PURE data was captured on the IBM SPSS (version 25) statistical programme and MS Excel (version 2010). Discrepancies and errors in the data were checked and cleaned by an appointed statistician. Both datasets were then imported into the STATA (version 14) (Stata Corporation, College Station, TX, USA) statistical programme for secondary data analysis.

The results on the sociodemographic variables and the prevalence of diabetes and obesity were analysed using descriptive statistics. There was some missing participant values for each of the variables analysed, hence, there were differences in the total number of participants for each variable. Categorical variables were depicted in the form of frequencies (percentages), and grouped as follows:

- Age (1 = 35 - 45 years, 2 = 46 - 55 years, 3 ≥ 56 years)
- Gender (1 = female, 2 = male)
- Level of education (1 = primary education or none, 2 = secondary education or higher)
- Marital status (1= single, 2 = married or living with a partner, 3 = widowed/ separated/ divorced)
- Employment status (1= unemployed, 2 = employed)
- Family history (1 = no family history of diabetes , 2 = positive family history of diabetes)
- Smoking (1 = smoked, 2 = did not smoke).
- Diabetes diagnosis (1 = not diagnosed with diabetes, 2 = diagnosed with diabetes or on prescribed diabetic medication.

- BMI categories were classified as (1 = underweight , 2 = normal weight, 3 = overweight, 4 = class 1 obesity, 5 = class 2 obesity, 6 = class 3 obesity)

Correlation refers to a statistical method used to measure the relationship between two or more continuous variables (Mukaka, 2012). However, it should be noted that correlation is not causation, as there is always the possibility that a third variable may have influenced the results (Aggarwal & Ranganathan, 2016). Pearson's correlation analysis was used to determine the relationship between dietary intake and diabetes, as well as between dietary intake and obesity.

A multivariate binary logistic regression model was also generated. The analysis defined dietary intake practices for the prediction of obesity and diabetes in the current study. A confidence interval of 95% was used, and a significance level of $p < 0.05$ was considered statistically significant.

3.8. Ethics Considerations

The study was submitted to the University of the Western Cape's Senate Biomedical Research Ethics Committee (BMREC) for approval and ethics clearance. Written explicit permission to conduct the study was requested from the International Steering Committee of the PURE study and the local principal investigator in South Africa. The principal investigator was informed that the participants' information would be kept confidential and private at all times, including the publication of research articles and reports. The data was kept as encrypted files on computer, and will be deleted upon completion of the study.

CHAPTER FOUR

RESULTS

4.1. Introduction

The aim of this chapter is to interpret and describe the results of the study. The chapter starts by describing the sociodemographic characteristics of the participants, followed by a description of the prevalence of diabetes and obesity, a description of the risk factors of diabetes and obesity, a description of the relationship between the risk factors of diabetes, specifically related to dietary intake practices, and the prevalence of diabetes, and a description of the relationship between the risk factors of obesity, specifically related to dietary intake practices, and the prevalence of obesity.

4.2. Sociodemographic Characteristics

Table 4.1 indicates the sociodemographic characteristics of the participants. The majority of the participants in the study were female (70.9%), with relatively similar proportions of females coming from both urban (70.5%) and rural (71.4%) areas. A total of 37.8% of the participants were in the age group 35 to 45 years, with a higher proportion coming from urban (40.2%) than rural (35.3%) areas. A total of 30.5% of the participants were between the ages of 46 to 55 years, with a slightly higher proportion of participants in rural (31.2%) than urban (29.9%) areas. A total of 31.7% of the participants were 56 years and older with a higher proportion of participants in rural (33.5%) than urban (30%) areas. The majority (65.6%) of participants had either a primary education or no formal education at all, which was more apparent in the urban (77.0%) than rural (54.6%) participants.

A relatively sizeable proportion of participants in the study were single (40.3%), with more urban participants being single (50.0%) than rural participants (30.4%). More rural participants were either married or living with a partner (46.6%), compared to urban participants (35.9%). Few participants were widowed, separated or divorced (18.5%), with more of them in the rural (23.0%) compared to the urban (14.1%) area. A total of 21.8% of the female participants were employed, with a higher proportion of participants being in

urban (25.9%) than rural (17.6%) areas. A total of 25.6% of male participants were employed, with a relatively higher proportion being in urban (29.6%) than rural (20.4%) areas.

Table 4.1. Participants' sociodemographic characteristics.

Variable	Urban		Rural		Total	
Gender	n	%	n	%	n	%
Females	727	70.45	764	71.40	1491	70.93
Males	305	29.55	306	28.60	611	29.07
Total	1032	100.00	1070	100.00	2102	100.00
Age Group						
35-45 years	412	40.20	353	35.3	765	37.78
46-55 years	306	29.85	312	31.20	618	30.52
≥56 years	307	29.95	335	33.50	642	31.70
Total	1025	100.00	1000	100.00	2025	100.00
Education						
Primary education or no formal education	795	77.03	584	54.58	1379	65.60
Secondary education and higher	237	22.97	486	45.42	723	34.40
Total	1032	100.00	1070	100.00	2102	100.00
Marital status						
Single	512	49.95	304	30.40	816	40.29
Married or living with the partner	368	35.91	466	46.60	834	41.19
Widowed, separated or divorced	145	14.14	230	23.00	375	18.52
Total	1025	100.00	1000	100.00	2025	100.00
Employment Status						
Employed females	158	25.99	105	17.56	263	21.81
Unemployed females	450	74.01	493	82.44	943	78.19
Total	608	100.00	598	100.00	1206	100.00
Employed males	78	29.55	41	20.40	119	25.60
Unemployed males	186	70.45	160	79.60	346	74.40
Total	264	100.00	201	100.00	465	100.00

4.3. Prevalence of Diabetes

An analysis of results in Table 4.2 illustrates that a minority (9.7%) of the participants were diabetic with a higher proportion in urban (12.0%) than rural (7.3%) areas.

Table 4.2. Proportion of participants diagnosed with diabetes.

Diagnosed with Diabetes	Urban		Rural		Total	
	n	%	n	%	n	%
No	830	88.02	894	92.74	1724	90.40
Yes	113	11.98	70	7.26	183	9.66
Total	943	100.00	964	100.00	1907	100.00

Table 4.3 shows that there were more female (10.6%) than male (6.7%) participants diagnosed with diabetes.

Table 4.3. Proportion of participants diagnosed with diabetes according to gender.

Diagnosed with diabetes	Female		Male		Total	
	n	%	n	%	n	%
Yes	149	10.63	34	6.73	183	9.60
No	1253	89.37	471	93.27	1724	90.40
Total	1402	100.00	505	100.00	1907	100.00

4.4. Prevalence of Obesity

Table 4.4 indicates that 48.6% of the participants were obese with a higher proportion in urban (57.2%) than rural (43.0%) areas.

Table 4.4. Proportion of participants with obesity.

Diagnosed with obesity	Urban		Rural		Total	
	n	%	n	%	n	%
Yes	270	57.20	313	43.00	583	48.58
No	202	42.80	415	57.00	617	51.42
Total	472	100.00	728	100.00	1200	100.00

Table 4.5 indicates that the proportion of obesity among all three age groups was fairly similar, i.e., 33.8%, 33.0% and 33.2% in the age categories 35 to 45 years, 46 to 55 years, and 56 years and older, respectively.

Table 4.5. Proportion of participants with obesity according to age category.

Age Category	Diagnosed with obesity					
	Yes		No		Total	
	n	%	n	%	n	%
35-45 years	191	32.76	215	34.84	406	33.83
46-55 years	198	33.96	198	32.09	396	33.00
≥56 years	194	33.28	204	33.06	398	33.17
Total	583	100.00	617	100.00	1200	100.00

Table 4.6 shows that there were more females (57.8%) with obesity than males (17.8%).

Table 4.6. Proportion of participants with obesity according to gender.

Participants with obesity	Females		Males		Total	
	n	%	n	%	n	%
No	390	42.20	227	82.25	617	51.42
Yes	534	57.80	49	17.75	583	48.58
Total	924	100.00	276	100.00	1200	100.00

Figure 4.1 indicates that there was a slight difference in the proportion of underweight participants in the urban (3.6%) and rural (2.9%) areas. The proportion of participants with normal weight was higher in the rural (28.4%) than urban (21.2 %) areas. There were slightly more participants who were overweight in the rural (25.7%) than urban (18%) areas. The proportion of participants who were in class 1 obesity was similar in the rural (20.5%) and urban (19.9%) areas. The proportion of participants with class 2 obesity was higher in the urban (17.2%) than rural (12.4%) areas. The proportion of participants with class 3 obesity was substantially higher in the urban (20.1%) than rural (10.2%) areas. Therefore, the overall prevalence of obesity among the participants was 48.6%, with 57% in the urban area compared to 43% in the rural area.

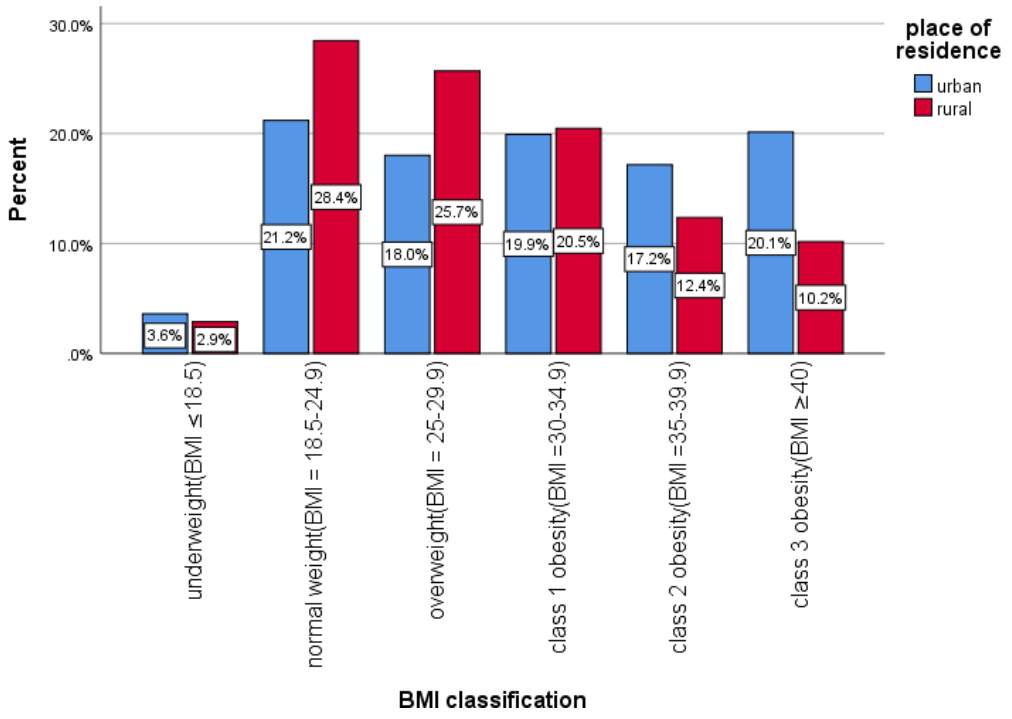


Figure 4.1. Classification of participants according to BMI in urban and rural areas.

4.5. Risk Factors of Diabetes

Table 4.7 depicts that a total of 17.5% of the participants diagnosed with diabetes were in the age category of 35 to 45 years with more participants in urban (23%) than rural (8.6%) areas. The proportion of participants diagnosed with diabetes in the age category of 46 to 55 years was 30.6%, with a marginal difference in the proportion of urban (31.0%) and rural (30.0%) participants. The majority (51.9%) of the participants diagnosed with diabetes were in the age category of 56 years and older with a higher proportion of participants in rural (61.4%) than urban (46%) areas. Therefore, there is an increasing prevalence of diabetes with age.

The majority (76.9%) of participants had no family history of diabetes from their paternal side, while 4.7% had a paternal family history of diabetes, and 18.3% indicated an unknown history. The rural area had a marginally higher proportion (6.6%) of participants with a paternal family history of diabetes compared to urban (2.8%) participants.

The majority (74%) of participants had no family history of diabetes from their maternal side, while 11.9% had a maternal family history of diabetes, and 14.1% indicated an unknown history. The rural area had a higher proportion (14.7%) of participants with a maternal family history of diabetes compared to urban (9.1%) participants.

The majority (85%) of the participants diagnosed with diabetes were either overweight (BMI = 25.0 - 29.9 kg/m²) or obese (BMI ≥ 30 kg/m²), with more participants in the urban (45.8%) than rural (39.2%) areas.

A minority (22.7%) of participants in both rural and urban areas smoked, with the proportion of smokers slightly higher in the urban (24.0%) than rural (21.5%) areas. A much higher proportion of males (46.4%) smoked compared to females (14.2%). The proportion of females who smoked was slightly higher in the urban (7.6%) than rural (6.6%) areas. The proportion of males who smoked was similar in urban (23.4%) and rural (23.0%) areas. A total of 20.5% of the participants diagnosed with diabetes also smoked, with a slightly higher proportion in the urban (11.1%) than rural (9.4%) areas.

Table 4.7. Risk factors of diabetes.

Risk factor	Urban		Rural		Total	
Age and diagnosis of diabetes	n	%	n	%	n	%
35-45 years	26	23.00	6	8.57	32	17.49
46-55 years	35	30.97	21	30.00	56	30.60
≥ 56 years	52	46.02	43	61.43	95	51.91
Total	113	100.00	70	100.00	183	100.00
Family history of diabetes (paternal)						
Yes	25	2.78	60	6.61	85	4.71
No	720	80.18	669	73.68	1389	76.91
Unknown	153	17.04	179	19.71	332	18.38
Total	898	100.00	908	100.00	1806	100.00
Family history of diabetes (maternal)						
Yes	81	9.05	133	14.73	214	11.90
No	702	78.44	629	69.66	133	74.03
Unknown	112	12.51	141	15.61	253	14.07
Total	895	100.00	903	100.00	1798	100.00
Diabetic and overweight/obese						
Diabetic and overweight/obese	55	45.83	47	39.17	102	85
Diabetic and not overweight/obese	8	6.67	10	8.33	18	15
Total	63	52.50	57	47.50	120	100.00
Smoking						
Yes	221	24.00	205	21.51	426	22.73
No	700	76.00	748	78.49	1448	77.27
Total	921	100.00	953	100.00	1874	100.00
Gender and smoking						
Females smoking	105	7.62	91	6.60	196	14.22
Females not smoking	552	40.06	630	45.72	1182	85.78
Total	657	47.68	721	52.32	1378	100.00
Males smoking	116	23.39	114	22.98	230	46.37
Males not smoking	148	29.84	118	23.79	266	56.63
Total	264	53.23	232	46.77	496	100.00
Diabetic and smoked						
Diabetic and smoked	20	11.10	17	9.44	37	20.56
Diabetic and did not smoke	90	50.00	53	29.44	143	79.44
Total	100	61.10	70	38.88	180	100.00

4.6. Risk Factors of Obesity

The proportion of obesity was similar among all age groups. The proportion of participants diagnosed with obesity was 33.57%, 32.75% and 33.68% among the age-groups 35 to 45 years, 46 to 55 years, and 56 years and older, respectively.

As indicated in Table 4.8 below, the majority (81.6%) of the participants who were overweight or obese were female, with a substantially higher proportion in the urban (49.3%) than rural (32.4%) areas. A minority (35.9%) of the participants who were overweight or obese were male, with a higher proportion in the urban (20.1%) than rural (15.8%) areas. The proportion of participants who smoked and were also overweight was 16.0% with a similar proportion in rural (8.2%) and urban (7.8%) areas.

Table 4.8. Risk factors of obesity.

Risk factor	Urban		Rural		Total	
Age and overweight/obese	n	%	n	%	n	%
35-45 years	129	36.34	158	31.60	287	33.57
46-55 years	113	31.83	167	33.40	280	32.75
≥56 years	113	31.83	175	35.00	288	33.68
Total	355	100.00	500	100	855	100.00
Age and not overweight/obese						
35-45 years	47	40.17	72	15.21	119	34.49
46-55 years	44	37.60	72	39.13	116	33.62
≥56 years	26	22.22	84	45.65	110	31.88
Total	117	100.00	228	100.00	345	100.00
Gender and overweight/obese						
Females overweight/obese	305	32.38	464	49.25	769	81.63
Females not overweight/obese	56	5.94	117	12.43	173	18.37
Total	361	38.32	581	61.67	942	100.00
Males overweight/obese	56	20.20	44	15.83	100	35.97
Males not overweight/obese	63	22.66	115	41.37	178	64.03
Total	119	42.80	159	57.20	278	100.00
Overweight/obese and smoked						
Overweight/obese and smoked	67	7.77	71	8.23	138	16.01
Overweight/obese and did not smoke	287	33.29	437	50.69	724	83.99
Total	354	41.06	508	58.92	862	100.00

4.7. Risk Factors of Diabetes and Obesity Related to Dietary Intake Practices

Figure 4.2 shows the consumption of cereals and grains in rural and urban participants. An excess consumption of refined cereals and grains that are high in fat and added sugar is a risk factor of developing diabetes and obesity (Steyn *et al*., 2016). Mahewu maize meal as a drink was the beverage most consumed among the participants with a higher consumption in rural (mean = 286.6 g) than urban (mean = 203.0 g) participants. This was followed by cooked porridge made from maize meal, oats, etc., with a higher consumption in rural (mean = 213.3 g) than urban (mean = 169.8 g) participants. Participants in the rural area consumed more bread, bread rolls and "vetkoek" (fat cakes) (mean = 111.5 g) than urban (mean = 106.1 g) participants. Participants in the rural area also consumed more samp, rice, macaroni and other staple starchy foods (mean = 89.8 g) compared to urban (mean = 82.1 g) participants. The least consumed food items were biscuits, sweets and rusks among both rural (mean = 10.6 g) and urban (mean = 10.7 g) participants.

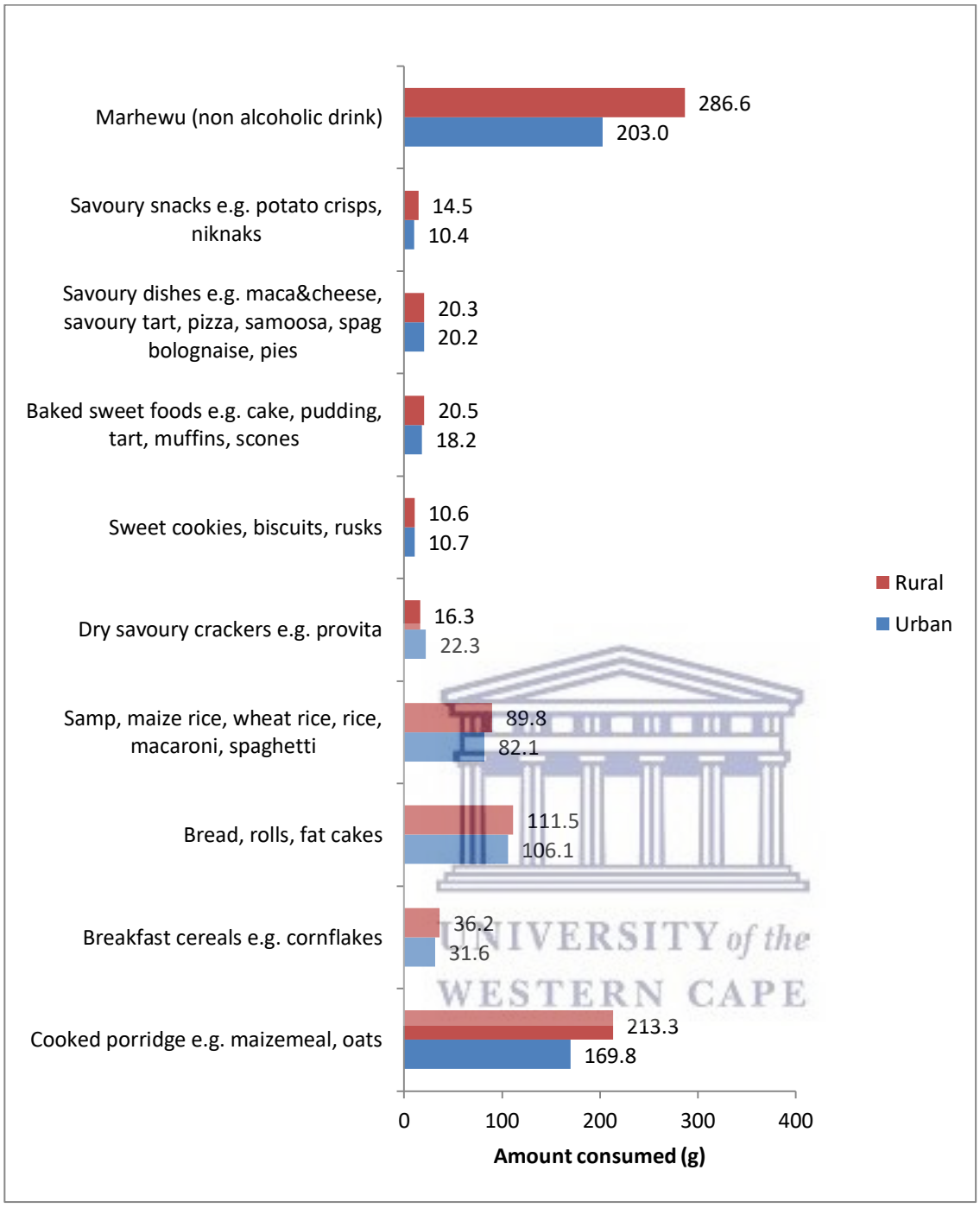


Figure 4.2. Consumption of cereals and grains in rural and urban participants.

Figure 4.3 shows the consumption of vegetables in rural and urban participants. Starchy vegetables, such as potatoes, were consumed more in the rural (mean = 94.7 g) than urban (mean = 68.0 g) participants. Green leafy vegetables, such as spinach, cabbage and others also had a higher intake in the rural (mean =50.4 g) than urban (mean = 42.9 g) participants. Red and yellow vegetables, such as carrots, beetroot and others were consumed more in rural (mean = 43.1 g) than urban (mean = 41.0 g) participants. The least consumed vegetables were mixed vegetables, green beans or peas in both rural (mean = 12.7 g) and urban (mean = 8.8 g) participants.

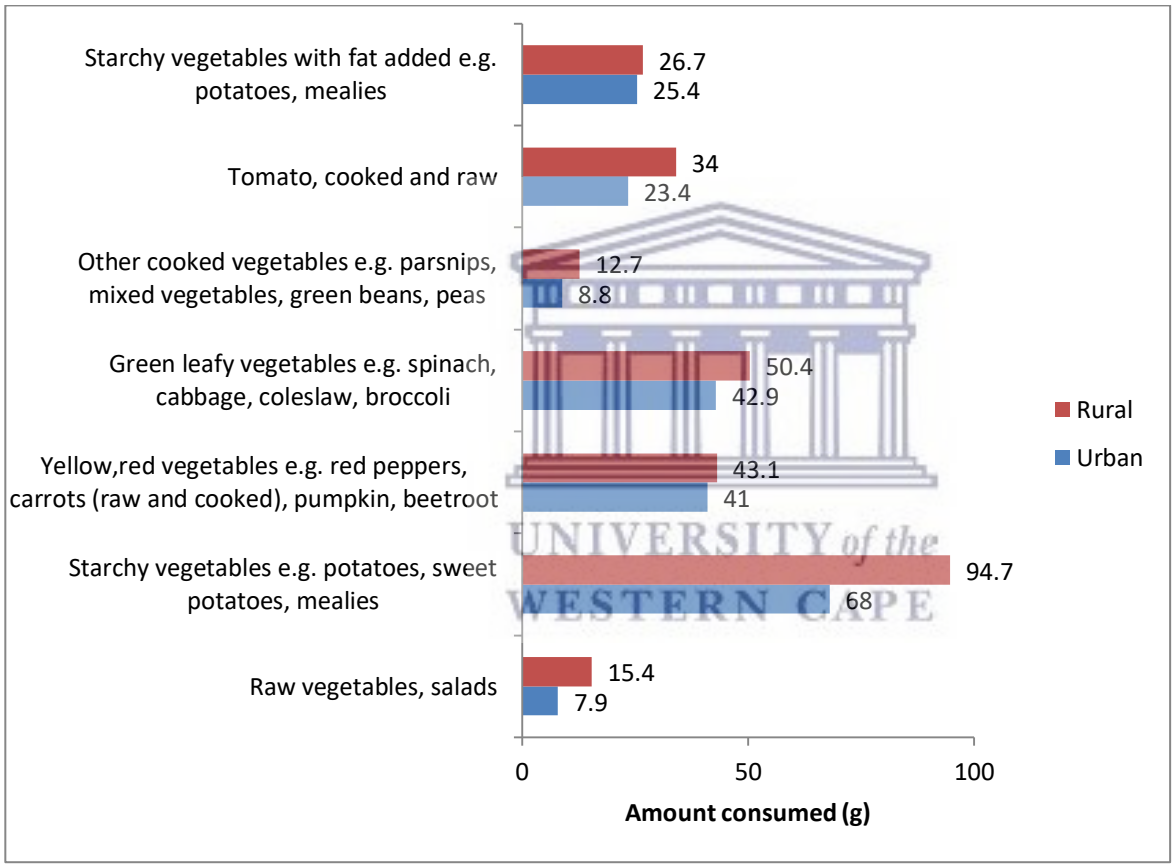


Figure 4.3. Consumption of vegetables in rural and urban participants.

Figure 4.4 depicts consumption of fruit in rural and urban participants. White-flesh fruits, such as apples, were consumed the most in both rural (mean = 108.5 g) and urban (men = 86.9 g) participants, followed by coloured (yellow/orange) fruits, such as oranges (mean = 84.2 g in rural and 68.3 g in urban participants), then fruit juice (mean = 56.6 g in rural and 53.7 g in urban participants). Canned fruit with added sugar was less popular (mean = 17.7 g in rural and 18.3 g in urban participants), while dried fruit was the least consumed in rural (mean = 9.9 g) and urban (3.0 g) participants.

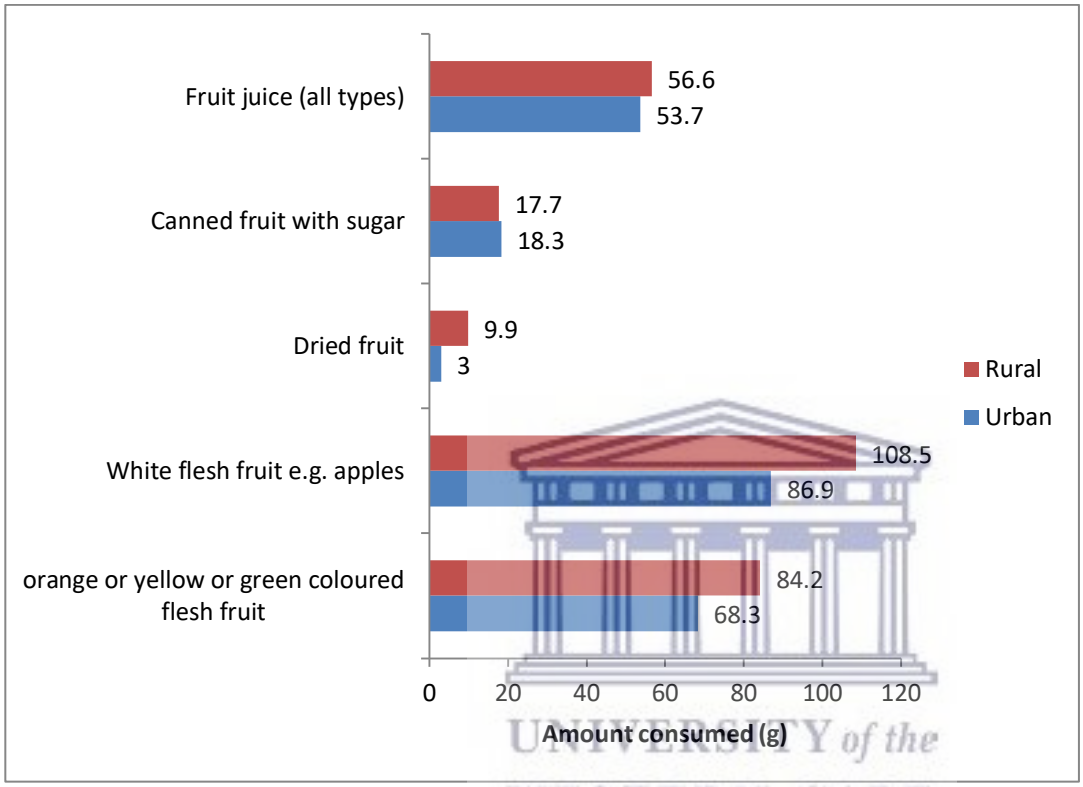


Figure 4.4. Consumption of fruit in rural and urban participants.

Figure 4.5 depicts the consumption of beans, soya and nuts in rural and urban participants. Soya bean products were the most popular, in terms of consumption, in rural (mean = 46.5 g) and urban (mean = 39.9 g) participants, followed by mixed dishes containing beans, with similar mean consumption values in rural (mean = 42.5 g) and urban (mean = 42.6 g) participants. Beans, such as sugar beans, baked beans and other related foods were less popular in rural (mean = 24.3 g) and urban (mean = 21.0 g) participants. Nuts were the least popular in both rural (mean = 6.8 g) and urban (mean = 4.7 g) participants.

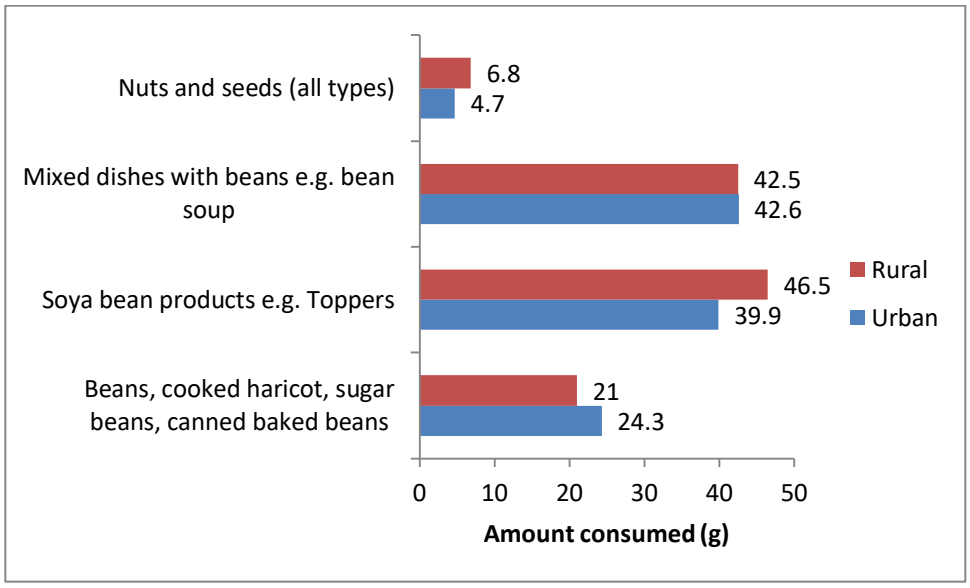


Figure 4.5. Consumption of beans, soya, nuts and seeds in rural and urban participants.

Figure 4.6 shows the consumption of milk and milk products in rural and urban participants. Full cream milk was consumed the most in both rural (mean = 74.0 g) and urban (mean = 72.0 g) participants, followed by low fat milk (mean = 61.2 g in rural participants and mean = 68.3 g in urban participants). Skim milk was mostly consumed by urban (mean = 69.7 g) than rural (mean = 16.7 g) participants. There was a marginal difference in the consumption of maas (sour milk) in rural (mean = 36.9 g) than urban (mean = 34.3 g) participants. Processed cheese was the least consumed in both rural (mean = 5.0 g) and urban (mean = 3.9 g) participants.

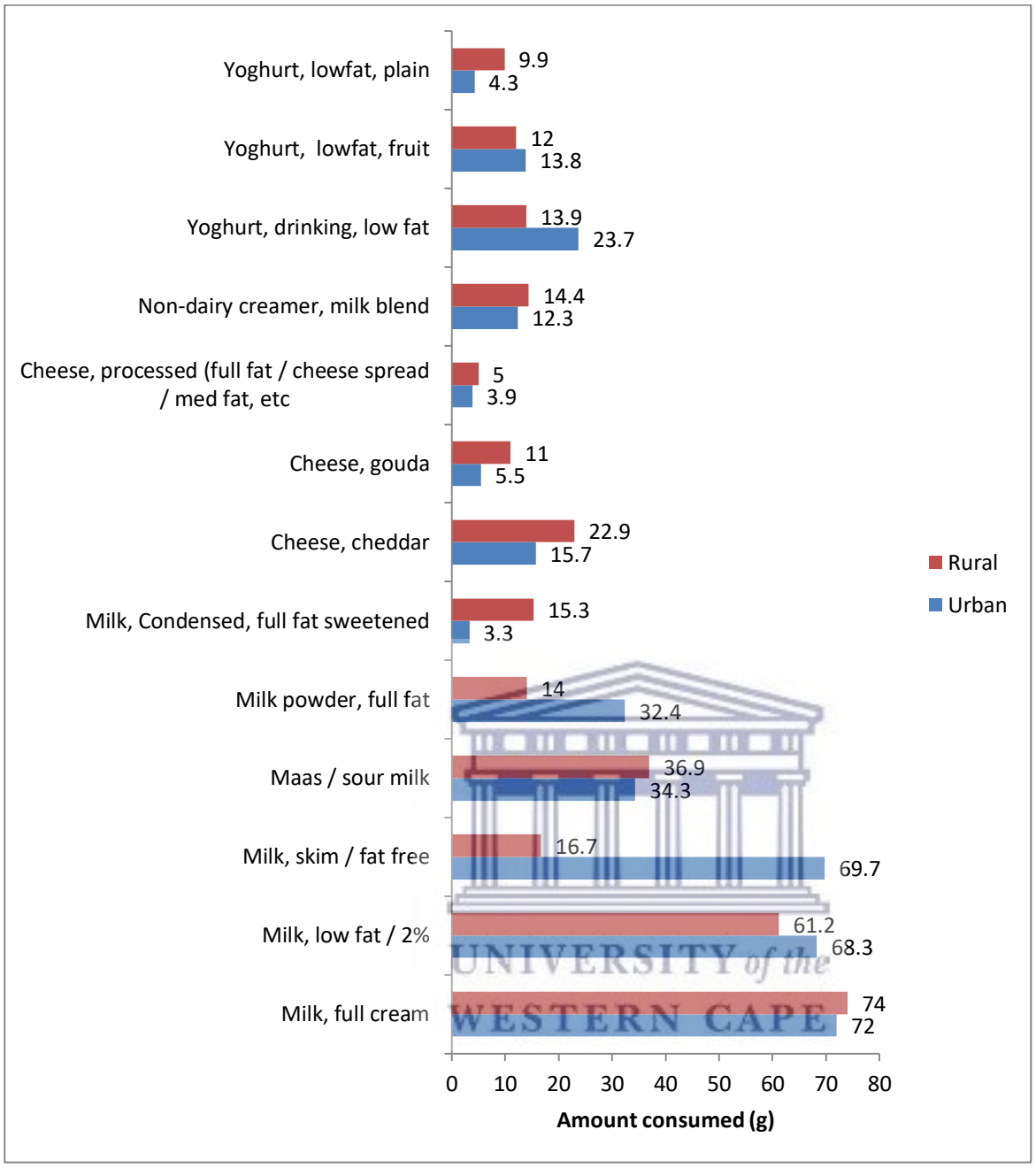


Figure 4.6. Consumption of milk and milk products in rural and urban participants.

Figure 4.7 shows the consumption of meat and meat products in rural and urban participants. Chicken, Kentucky Fried Chicken, Nandos and other poultry meats were consumed the most, with a higher mean intake in the urban (mean = 45.9 g) than rural (mean = 40.6 g) participants. The second most consumed meats were processed meats, such as "boerewors", corned meat, viennas, ham and others, with similar mean intakes of 28.7 g and 27.7 g in rural and urban participants, respectively. The mean consumption of mutton was similar in rural (mean = 23.1 g) and urban (mean = 24.1 g) participants. Beef stew was the least consumed, with similar mean intake in rural (mean = 11.7 g) and urban (11.6 g) participants.

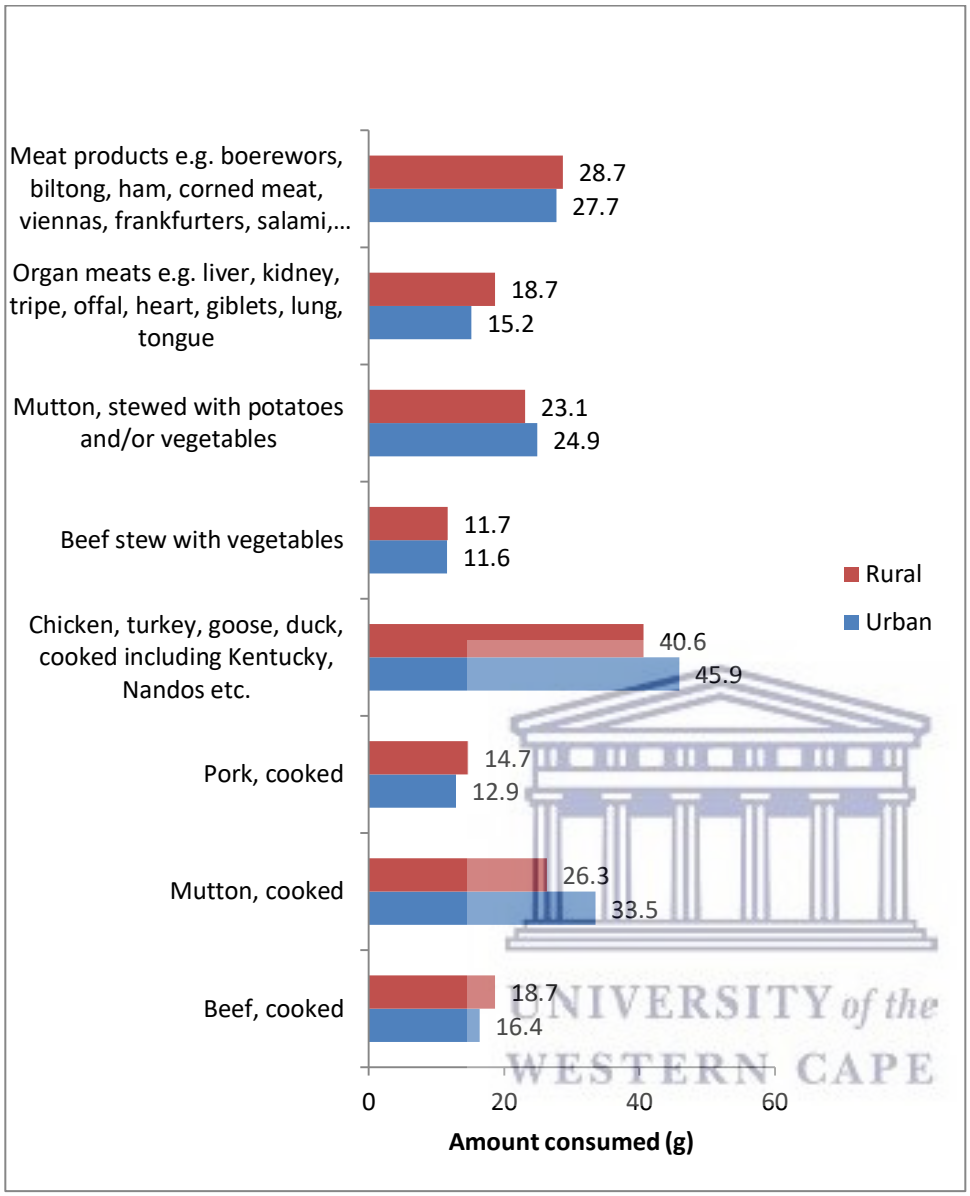


Figure 4.7. Consumption of meat and meat products in rural and urban participants.

Figure 4.8 shows the consumption of fish and fish products in rural and urban participants. Canned fish, such as pilchards, was the fish product consumed the most in rural (mean = 29.2 g) and urban (mean = 21.3 g) areas, followed by low fat fish with a mean intake of 17.4 g and 13.6 g in rural and urban participants, respectively. Rural (mean = 14.7 g) participants consumed more fish products, such as fish cakes, fish fingers and others than urban (mean = 11.3 g) participants. Fish paste was the least consumed, with a higher intake in rural (mean = 7.3 g) than urban (mean = 4.2 g) participants.

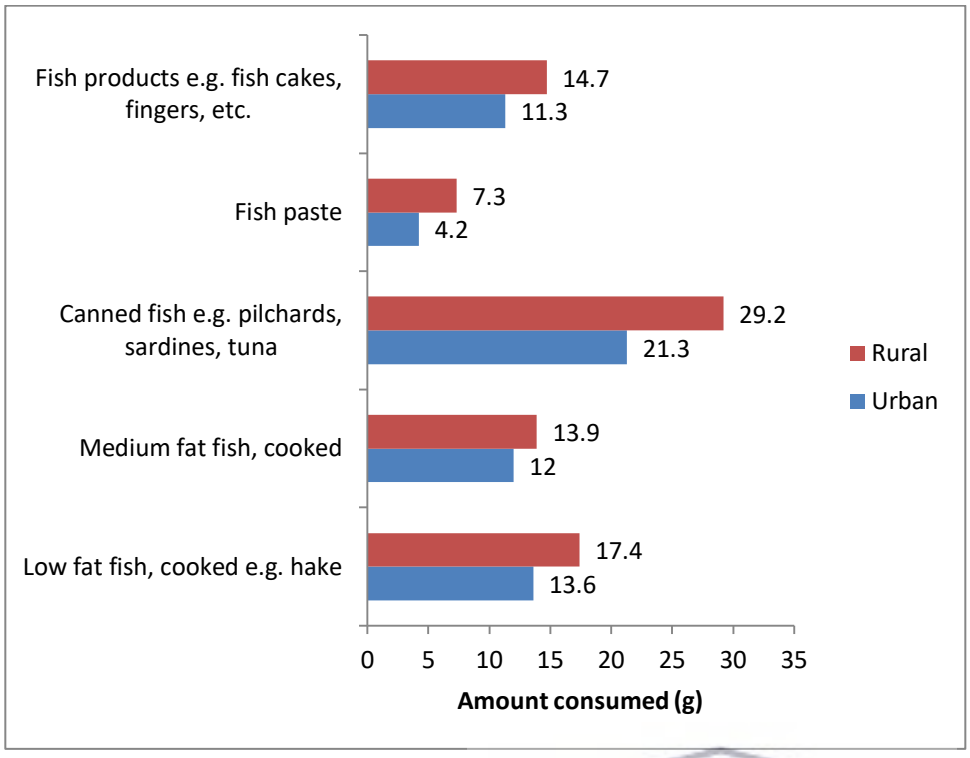


Figure 4.8. Consumption of fish and fish products in rural and urban participants.

Figure 4.9 depicts the consumption of sugar and sugar products in rural and urban participants. Coffee and tea were widely consumed, with urban (mean = 444.9 g) participants having a higher intake than rural (mean = 328.6 g) participants. Low calorie (ready to mix) drinks were the second most popular food, with a higher mean intake in rural (mean = 137.7 g) than in urban (mean = 89.0 g) participants. Rural (mean = 76.4 g) participants consumed more carbonated drinks than urban (mean = 61.3 g) participants. The mean sugar intake was higher in rural (mean = 35.1 g) than urban (mean = 26.3 g) participants.

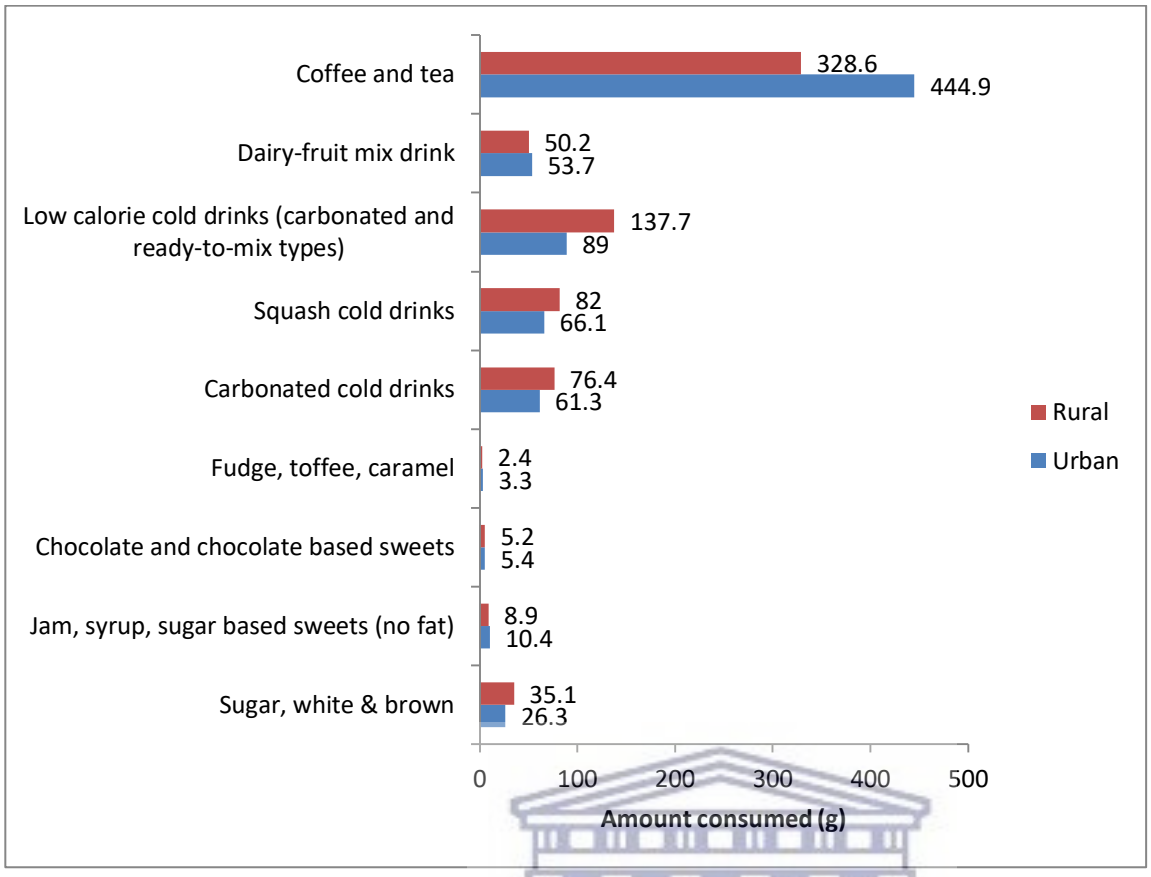


Figure 4.9. Consumption of sugar and sugar products in rural and urban participants.

Figure 4.10 shows consumption of alcoholic beverages in rural and urban participants. The most consumed alcoholic beverages were commercial and home-made beers, with the highest intake in rural (mean = 116.3 g) than urban (mean = 65.9 g) participants, followed by red and white wine, with mean intakes of 33.7 g and 41.1 g in urban and rural participants respectively. The least consumed alcoholic beverages were spirits, such as gin, brandy, whiskey and others, with a higher mean intake in rural (mean = 26.4 g) than ~~in~~ urban (mean = 17.8 g) participants

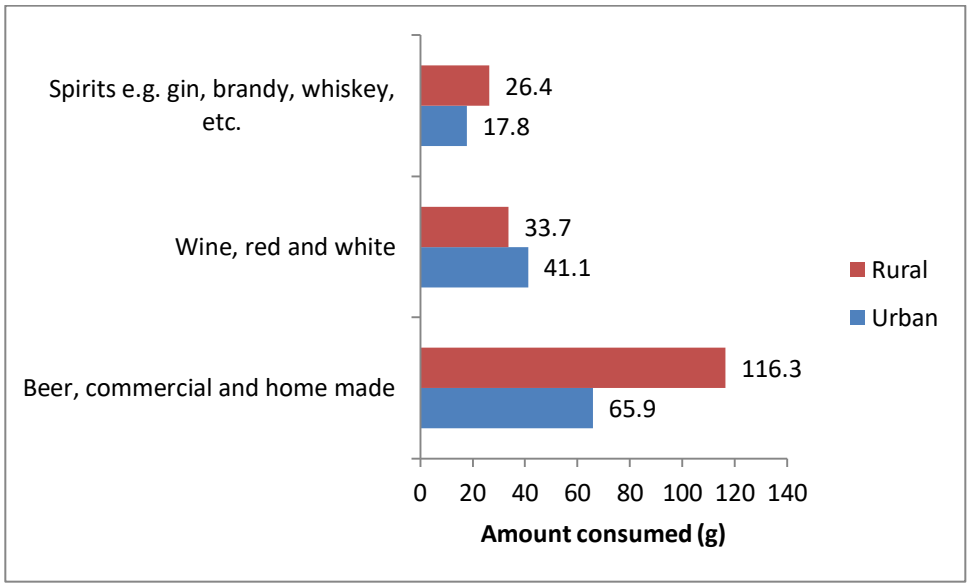


Figure 4.10. Consumption of alcoholic beverages in rural and urban participants.

Nutrient intake data was summarised as means and standard deviations. The data was compared with the dietary reference intakes (DRIs) of 18 to 70 year-olds to assess adequacy. Table 4.9 shows that the mean energy intake of the participants was lower than the DRIs (8824.1 kJ for women and 10083.4 kJ for men) in urban (5751.0 kJ) and rural (6659.3 kJ) areas. The participants mostly consumed foods high in carbohydrates, with the participants consuming more in the rural (mean = 225.3 g) than urban (mean = 195.3 g) areas. The total daily carbohydrate intake of the participants was higher than the DRIs of 130.0 g per day.

The second most frequently consumed macronutrient was protein, with no difference between urban (mean = 54.7 g) and rural (mean = 54.0 g) areas. The mean protein intake was within the DRI (46.0 g for females and 56.0 g for males), even though there were participants consuming less than 30.0 g of protein per day.

The least consumed macronutrient was fat, with a marginally higher intake in the urban (mean = 43.3 g) than rural (39.9 g) participants but these were within the required percentage of the total energy intake for fat. The participants in the urban area had 28.5% of their energy intake from fat, while those in the rural area had 22.6% from fat. The participants in the rural area consumed a diet high in added sugars (mean = 40.6 g) than those in the urban area (mean = 35.8 g). However, the percentage energy intake from the consumption of added sugar was less than 25.0%.

The fibre intake of the participants in the rural area was higher (mean = 21.5 g), compared to the urban area (mean = 18.8 g), but both were lower than the DRI range (30-38 g for males, 21-25 g for females). The intake of saturated fats was low (<10% of the total energy intake) in both urban (mean = 12.3 g) and rural (mean = 10.9 g) areas, while the intake of polyunsaturated fats was within the stipulated DRI (5-10% of the total

energy) in urban (mean = 10.8 g) and rural (mean = 9.3 g) areas. The dietary intake of monounsaturated fats was above the DRI (0.6 to 1.2% of total energy) in both urban (mean = 14.8 g) and rural (mean = 13.1 g) areas. The cholesterol intake of the participants was higher in the urban (mean = 240.7 mg) than rural (mean = 224.2 mg) areas.

Table 4.9. Nutrient intake in rural and urban participants compared to the dietary reference intakes.

	Urban			Rural			DRIs (18-70 years)
Variable	n	Mean	SD	n	Mean	SD	
Energy (kJ)	968	5751.04	2481.84	1070	6659.32	3253.70	♀ 8824.06 EER ♂ 10083.44 EER
Total carbohydrates (g)	968	195.32 (57.06 %)	67.00	1070	225.25 (56.82 %)	78.54	130 g/day
Total proteins (g)	968	54.70 (15.98 %)	23.12	1070	54.00 (13.60 %)	21.68	♂ 56g/day ♀ 46 g/day
Total fats (g)	968	43.34 (28.5 %)	22.17	1070	39.86 (22.62%)	21.42	20-35% of total energy intake
Added Sugar (g)	968	35.79 (10.00 %)	23.24	1070	40.57 (9.74%)	26.66	<25% of total energy intake
Fibre (g)	968	18.77	6.97	1070	21.48	7.97	♂30-38 g/day ♀21-25 g/day
Saturated fats (g)	968	12.35 (8.11 %)	7.13	1070	10.96 (6.22%)	6.57	Keep as low as possible
Polyunsaturated fats (g)	968	10.78 (7.00 %)	6.53	1070	9.30 (5.27%)	5.99	5-10% of total energy intake
Monounsaturated fats (g)	968	14.83 (9.70%)	8.17	1070	13.14 (7.60%)	7.54	0.6- 1.2 % of total energy intake
Cholesterol (mg)	968	240.71	186.27	1070	224.24	189.72	Keep as low as possible

Key: ♀ = Female; ♂ = Male; EER = Energy efficiency ratio

4.8. Relationship between the Prevalence of Diabetes and the Risk Factors of Diabetes Specifically Related to Dietary Intake Practices

Nine food categories or groups were computed, as per the food frequency questionnaire (FFQ) (i.e., cereals and grains; vegetables; fruit; beans, soya, nuts and seeds; milk and milk products; sugar and sugar products; alcoholic beverages; meat and meat products; and fish and fish products). Table 4.10 indicates that there was no statistically significant correlation between the consumption of any of the nine food groups and diabetes.

Table 4.10. Correlation between the consumption of different food groups and diabetes.

Food group	Diabetes
Vegetables	-0.0631
Fruit	-0.1168
Beans, soya, nuts and seeds	0.0545
Milk and milk products	0.0486
Meat and meat products	0.0382
Fish and fish products	0.0300
Sugar and sugar products	0.0088
Alcoholic beverages	0.1134
Cereals and grains	0.1033

Table 4.11 depicts that meat and fish significantly affected diabetes .The consumption of meat and meat products was 7 times more likely to affect diabetes risk (OR = 7.1; $p < 0.05$). In contrast, the consumption of fish and fish products decreased the likelihood of diabetes by 90% (OR = 0.10; $p < 0.05$). The consumption of all the other foods [i.e., fruit (OR = 0.58; $p > 0.05$), beans, soya, nuts and seeds (OR =1.04; $p > 0.05$), milk and milk products (OR = 4.07; $p > 0.05$), sugar and sugar products (OR = 0.81; $p > 0.05$), alcoholic beverages (OR = 0.21; $p > 0.05$) and cereals and grains (OR = 4.10; $p > 0.05$)] did not affect diabetes risk.

Table 4.11. Multivariate regression analysis between dietary intake and diabetes.

Food group	Odds Ratio	SE	z	p > z	[95% CI]	
Vegetables	1.39	0.95	0.48	0.631	0.365	5.283
Fruit	0.58	0.43	-0.73	0.466	0.135	2.503
Beans, soya, nuts and seeds	1.04	0.77	0.06	0.956	0.243	4.460
Milk and milk products	4.07	3.80	1.5	0.133	0.653	25.407
Meat and meat products	7.06	6.71	2.06	0.040	1.096	45.447
Fish and fish products	0.10	0.11	-2.13	0.033	0.012	0.836
Sugar and sugar products	0.81	0.65	-0.26	0.794	0.166	3.949
Alcoholic beverages	0.21	0.18	-1.84	0.066	0.041	1.108
Cereals and grains	4.10	4.58	1.27	0.205	0.461	36.498

Table 4.12 indicates that the consumption of polyunsaturated fats decreased the likelihood of obesity by 25% in rural (OR = 0.75; $p < 0.05$), but not urban (OR = 1.00; $p > 0.05$) participants, which was the only statistically significant result. In the urban area, carbohydrates (OR = 1.41; $p > 0.05$), fats (OR = 1.73; $p > 0.05$) and added sugar (OR = 1.49; $p > 0.05$) were 1.41, 1.73 and 1.49 times associated with diabetes, respectively, but the results were not statistically significant. Similarly, The consumption of protein (OR = 1.08; $p > 0.05$) and polyunsaturated fats (OR = 0.99; $p > 0.05$) did not have an effect on diabetes. In the rural area, carbohydrates (OR = 1.60; $p > 0.05$), protein (OR = 1.53; $p > 0.05$), fats (OR = 2.85; $p > 0.05$) , fibre

(OR = 2.14; p > 0.05) and added sugar (OR = 1.61; p > 0.05) were 1.60, 1.53, 2.85, 2.14 and 1.61 times more likely to have an effect on obesity, respectively, but the results were not statistically significant. Similarly, the consumption of saturated fats did not have a statistically significant effect on diabetes risk.

Table 4.12. Multivariate regression between nutrient intake and diabetes.

	Urban				Rural			
Nutrient	OR	p > z	[95% CI]		OR	p > z	[95% CI]	
Total carbohydrates	1.412	0.178	0.85	2.33	1.600	0.506	0.40	6.45
Total protein	1.081	0.817	0.54	2.20	1.530	0.644	0.25	9.21
Total fat	1.728	0.365	0.53	5.64	2.850	0.496	0.14	58.21
Saturated fats	0.551	0.272	0.19	1.60	0.760	0.854	0.04	14.02
Total fibre	1.144	0.626	0.67	1.97	2.140	0.334	0.46	10.04
Added sugar	1.399	0.236	0.80	2.44	1.610	0.487	0.42	6.18
Polyunsaturated fats	0.988	0.691	0.93	1.05	0.750	0.010	0.60	0.93

4.9. Relationship Between the Prevalence of Obesity and the Risk Factors of Obesity Specifically Related to Dietary Intake Practices

Table 4.13 shows that none of the nine food groups had a statistically significant correlation with obesity.

Table 4.13. Correlation between the consumption of different food groups and obesity.

Food group	Obesity
Vegetables	0.0726
Fruit	0.0335
Beans, soya, nuts and seeds	-0.0778
Milk and milk products	0.0348
Meat and meat products	0.0218
Fish and fish products	0.0271
Sugar and sugar products	0.0512
Alcoholic beverages	-0.0342
Cereals and grains	-0.0233

Table 4.14 shows that consumption of cereals and grains decreased the likelihood of obesity by 89% in urban (OR = 0.11; p < 0.05), but not rural (OR = 0.49; p > 0.05) participants, which was the only statistically significant result. Vegetables (OR = 0.78; p > 0.05), beans, soya, nuts and seeds (OR = 0.77; p > 0.05), (OR = 0.78; p > 0.05), fish and fish products (OR = 0.82; p > 0.05) and sugar and sugar products (OR = 0.43; p > 0.05) did not have an effect on obesity in urban participants. Even though the consumption of meat and meat

products (OR = 1.83; p > 0.05) in the urban area was 1.8 times associated with obesity, the results were not statistically significant. Similarly, the consumption of milk and milk products (OR = 2.04; p > 0.05) in the urban area was twice more likely to be associated with obesity, however, the results were not statistically significant.

In the rural area, vegetables (OR = 0.68; p > 0.05), fruit (OR = 1.30; p > 0.05), beans, soya, nuts and seeds (OR = 0.46; p > 0.05) milk and milk products (OR = 1.96; p > 0.05), meat and meat products (OR = 1.45; p > 0.05), fish and fish products (OR = 0.81; p > 0.05) and sugar and sugar products (OR = 2.29; p > 0.05) did not have an effect on obesity. Even though milk products were 1.9 times associated with obesity, the results were not statistically significant, as was the case for sugar and sugar products which was 2.29 times more likely to have an effect on obesity, but was also not significant.

Table 4.14. Multivariate regression analysis between dietary intake and obesity.

	Urban				Rural			
Food group	OR	p > z	[95% CI]		OR	p > z	[95% CI]	
Cereals and grains	0.111	0.007	0.02	0.54	1.486	0.410	0.58	3.81
Vegetables	0.781	0.708	0.21	2.85	0.678	0.424	0.26	1.76
Fruit	1.019	0.976	0.29	3.53	1.301	0.582	0.51	3.32
Beans, soya, nuts and seeds	0.779	0.699	0.22	2.75	0.463	0.149	0.16	1.32
Milk and milk products	2.038	0.308	0.52	8.02	1.956	0.190	0.72	5.33
Meat and meat products	1.832	0.404	0.44	7.61	1.447	0.515	0.48	4.40
Fish and fish products	0.815	0.816	0.14	4.60	0.805	0.681	0.29	2.26
Sugar and sugar products	0.425	0.243	0.10	1.79	2.290	0.175	0.69	7.59

Table 4.15 shows that none of the seven nutrient groups had a statistically significant relationship with obesity. The only nutrient that had a tendency to be statistically significant was dietary fibre intake. In the rural area, dietary fibre intake was 1.5 times associated with obesity, but the result was not statistically significant (OR = 1.47; p = 0.05).

In the urban area, carbohydrates food group (OR = 1.52; p > 0.05) was 1.5 times more likely to have an effect on obesity, but the result was not statistically significant. Proteins (OR = 1.37; p > 0.05) and fats (OR = 1.30; p > 0.05) were 1.4 and 1.3 times to have an effect on obesity, respectively, but the results were not statistically significant. Saturated fats (OR = 1.06; p > 0.05) and added sugars (OR = 1.03; p > 0.05) seemed to have a slight effect on obesity, but the results were not statistically significant. The consumption of total fibre (OR = 0.79; p > 0.05) and polyunsaturated fats (OR = 0.96; p > 0.05) did not have an effect on obesity.

In the rural area, the consumption of carbohydrates (OR = 1.13; p > 0.05) and fats (OR = 1.69; p > 0.05) were 1.1 and 1.7 times associated with obesity, respectively, however, the results were not statistically significant. In the rural area, the consumption of proteins (OR = 0.63; p > 0.05) was not associated with obesity. Similarly, saturated fats (OR = 0.95; p > 0.05) did not have an effect on obesity. The consumption of polyunsaturated fats (OR = 1.01; p > 0.05) and added sugars (OR = 1.05; p > 0.05) had a very slight effect on obesity, but the results were not statistically significant.

Table 4.15. Multivariate regression analysis between nutrient intake and obesity.

	Urban				Rural			
Nutrient	OR	p > z	[95% CI]		OR	p > z	[95% CI]	
Total carbohydrates	1.520	0.065	0.97	2.38	1.130	0.450	0.82	1.57
Total proteins	1.370	0.330	0.73	2.57	0.630	0.060	0.39	1.02
Total fats	1.300	0.596	0.49	3.40	1.690	0.150	0.83	3.40
Saturated fats	1.060	0.901	0.44	2.57	0.950	0.880	0.53	1.73
Total fibre	0.790	0.330	0.49	1.27	1.470	0.050	0.99	2.16
Added sugar	1.030	0.911	0.64	1.64	1.050	0.770	0.75	1.47
Polyunsaturated fats	0.960	0.131	0.91	1.01	1.010	0.610	0.97	1.05

CHAPTER 5

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

This chapter discusses the key results emanating from chapter four, and presents comparisons with the results of other researchers. The conclusion and recommendations for future studies are also presented.

5.2. Prevalence of Diabetes

A report released by the South African Medical Research Council (2017) states that the prevalence of diabetes has increased (in men) from 3.4% in 1980 to 8.5% in 2014. The prevalence of diabetes has also increased steadily in women from 4.15% in 1980 to 8.9% in 2014 (SAMRC, 2017). The report showed that more females were diagnosed with diabetes than males. In the current study, 9.6% of the participants were diagnosed with diabetes. The current study also shows that the majority of participants diagnosed with diabetes were female, whereas a minority were male. In the context of black South African females, the higher proportion diagnosed with diabetes in the current study is alarming, and supports the evidence of a higher prevalence of obesity and metabolic syndrome among black South African females (Gradidge & Crowther, 2017).

Mbanya *et al*. (2010) found that gender had little effect on the development of diabetes globally, with no recognisable trend currently present in SSA. Basically, both males and females are at a risk of developing diabetes with advancing age, due to the age-related increases in blood glucose levels (Jung & Choi, 2017). Globally, the diabetes prevalence for adult men and women is similar, although, in men above the age of 60 years and in older women, it is slightly higher (Wild, 2004). In the current study, the proportion of participants diagnosed with diabetes was higher in the urban area compared to the rural area. A study by Peer *et al*. (2012) also showed a high diabetes prevalence of 13.1% among urban dwellers.

Contrary to the findings of these studies, a study by Chiwanga *et al*. (2016) in Uganda and Tanzania showed a higher prevalence of diabetes in rural Ugandan residents (16.1%) compared to peri-urban Ugandan residents (7.6%) and urban Tanzanian residents (8.3%).

5.3. Prevalence of Obesity

WHO declared obesity as a chronic disease (van de Merwe & Pepper, 2006). Obesity is an epidemic in both adults and children, and the number of people with morbid obesity is becoming larger than the overweight population (Lavie et al., 2014). The South African Medical Research Council report stated that the proportion of South Africans with obesity and overweightness has increased to 69.3% (SAMRC, 2014).

In the current study, 48.6% of the participants were categorised as obese. The proportion of participants who were obese was higher in urban than rural areas. This finding is expected, as urbanisation is associated with obesity, due to poor dietary intake practices adopted by individuals when moved from rural to urban areas, which are characterised by high fat, sugar and salt intake (Pretorius & Sliwa, 2011). In addition, with urbanisation, physical activity declines, because of sedentary employment that is further reinforced by living in confined spaces and being more exposed to violent crimes in the cities, which keeps people indoors and inactive (Stern *et al.*, 2010).

5.4. Risk Factors of Diabetes and obesity

In the study, the total number of participants diagnosed with diabetes was 9.6%. A total of 17.5 % of the participants diagnosed with diabetes were in the age category 35 to 45 years, with more participants in the urban than rural areas. The proportion of participants diagnosed with diabetes in the age category 46 to 55 years was 30.6%, with similar proportions in both urban and rural participants. The majority of the participants diagnosed with diabetes were in the age category 56 years and older. Therefore, the current study showed an increasing prevalence of diabetes with age. The National Population Health Survey (NPHS) showed that the likelihood of contracting diabetes increased by 9 % per year with age (Choi & Shi, 2001). The International Diabetes Federation (IDF) estimated that most people develop diabetes between the ages of 40 – 59 years, but by 2030, the highest prevalence will be in the oldest age-group of 60 – 79 years (Mbanya *et al*., 2010).

It is estimated that 70% of the world's population diagnosed with diabetes is found in developing countries and aged from 45 to 64 years (Wu & Tanaka, 2014). In Africa, type 2 diabetes mostly affects the working class, aged 40 to 60 years (Pheiffer *et al*., 2018). However, Al-Saeed *et al*. (2016) argue that type 2 diabetes is no longer a condition of the elderly but a disease of youth who, in recent years, are increasingly being diagnosed with diabetes. The participants in the current study showed a family history of diabetes from the

paternal and maternal sides. A family history of diabetes is a key risk factor for type 2 diabetes, as it is associated with a range of genetic abnormalities, which is especially alarming in the presence of multiple risk factors, such as obesity and physical inactivity (Tsenkova, Karlamangla & Ryff, 2016). Studies conducted in Sudan and in rural South Africa reported family history as an independent risk factor for developing type 2 diabetes, but the association was not significant in participants from rural South Africa (Mbanya *et al*., 2010). However, another study conducted amongst blacks in South Africa identified family history as one of the significant independent risk factors for developing diabetes (Motala *et al.*, 2008).

WHO estimated that overweightness and obesity account for about 44% of diabetic cases (Leitner *et al.,* 2017). In the current study, 85% of the participants diagnosed with diabetes were overweight or obese, with a higher proportion of participants in urban than rural areas. The first South African National Health and Nutrition Examination Survey (SANHANES) showed that a higher percentage of males (29.2%) than females (7.3%) smoked (Reddy, Zuma, Shisana, Kim & Sewpaul, 2015). In the current study, a minority of the participants smoked, with the majority of smokers being men. The results from a meta-analysis showed that smokers were 45% more likely to develop diabetes compared to non-smokers (Hu, 2011). In the current study, 21% of the participants who smoked were also diagnosed with diabetes. Smoking is closely linked to diabetes-associated complications, including heart disease, peripheral vascular disease and lower extremity amputations (Choi & Shi, 2001). In this study, the proportion of obesity was similar among all age groups.

Globally, the prevalence of obesity is increasing across all ages, with the highest proportion seen among adults (Frasca *et al*., 2017). However, a study by Cois and Day (2015) showed that a younger age was associated with being overweight and obese in South Africa. In the current study, the proportion of participants who were obese and smoked was 16%. A study in Dutch women showed that smoking was associated with a lower body mass index, but an increased waist circumference, while discontinuation of smoking was associated with weight gain (Wild & Byrne, 2006). Central obesity in smokers could be a result of increased cortisol levels, due to stimulation of the sympathetic nervous system, while in women, smoking has anti-oestrogenic effects (Hu, 2011). However, Dare *et al*. (2015) assert that studies that looked at the association between smoking and obesity have produced conflicting results, even though their study showed that participants who smoked heavily or who quit smoking were more likely to be obese.

Obesity among South African black women is increasing exponentially in recent years, despite most black African women being sufficiently active, according to the guidelines for achieving the recommended dose of exercise, i.e., equal or more than 150 minutes of moderate-intensity activity per week (Gradidge, 2017). In the present study, the majority of participants who were overweight or obese were female. Gradidge and

Crowther (2017) also reported an increasing prevalence of obesity and metabolic syndrome among black African women which is cause for concern.

In this study, the majority of female participants were unemployed compared to male participants. Studies have shown an inverse relationship between socio-economic status and BMI (Mizuta, Fujiwara & Ojima, 2016) in low and medium income countries (Nienaber-Rousseau *et al*., 2017). Spires *et al*. (2016) argue that communities that cannot afford to buy healthy food have poor dietary intake, and are at higher risk of diet-related diseases. They concluded that unhealthy food environments promote poor dietary practices, which is seen in communities with low-income and low socio-economic status (Spires *et al*., 2016). The development of obesity is associated with the inaccessibility of affordable healthy foods, which leads to the consumption of unhealthy fast foods, high in fats and sugars (Stern *et al*., 2010). Even though low socioeconomic status is associated with higher BMI, some studies showed that in South Africa the affluent were more likely to have a higher BMI than their poorer counterparts (Nienaber-Rousseau *et al*., 2017).

There is evidence that links level of education with health outcomes, because of the association between socioeconomic status and level of health literacy, which is also linked to behaviour change (Cohen *et al*., 2013). In the current study, the majority of participants had either a primary education or no education at all, which was more apparent in the urban than rural participants. A study showed an inverse relationship between various fat indicators (subcutaneous fat, general obesity, and central obesity) and participants who were the least educated (Anyanwu *et al*., 2010). Another study found a negative relationship between educational status and overweightness or obesity among women, which varied according to marital status (Murakami, Ohkubo & Hashimoto, 2017).

5.5. Risk Factors of Diabetes and Obesity Related to Dietary Intake Practices

In South Africa, the political transition, since the start of the democratic era has been accompanied by a rise in NCDs in both rural and urban areas (Mayosi *et al*., 2009). Diet and nutrition play a central role in the development of NCDs, such as diabetes and some cancers (Steyn *et al*., 2016). In South Africa, it is estimated that 47-53% of black communities are experiencing profound poverty, leading to poor dietary intake practices (Govender, Pillay, Siwela, Modi & Mabhaudhi, 2017).

The consumption of a high calorie diet and physical inactivity are the main risk factors for developing diabetes and obesity (Leitner *et al*., 2017). Poor dietary intake is characterised by a diet high in calories, saturated fat, and refined carbohydrates and sugars (Steyn *et al*., 2016). In the current study, the mean intake of energy was lower than the DRIs in both urban and rural areas. Even though the mean intake of

carbohydrates was more than the DRI of 130 g per day in both urban and rural areas, the total energy consumption from carbohydrates was less than 65% in both urban and rural areas. The results also show that carbohydrates were the most commonly consumed macronutrient among urban and rural participants. Poor communities depend heavily on social grants in order to survive and, therefore, consume mostly cheaper carbohydrate-rich staple foods (Devereux & Waidler, 2017). A review by Govender *et al*. (2017) indicates that in rural areas, the dietary intake is high in refined, simple carbohydrates and low in fruit and vegetables (complex carbohydrates). The harmful effects of high carbohydrate diets over prolonged periods of time have been well-documented (Siri-tarino, Sun, Hu & Krauss, 2010). High carbohydrate diets result in high levels of both triglycerides and low density lipoprotein (LDL) cholesterol that contribute to obesity (Siri-tarino, Sun, Hu & Krauss, 2010; Buyken, Mitchell, Ceriello & Brand-Miller, 2010).

The present study showed that protein intake in both rural and urban areas was mostly from milk, soya, beans and chicken, including Kentucky Fried chicken, Nandos and other poultry meats. In this study, the consumption of meat and meat products was significantly associated with the prevalence of diabetes even though the mean protein intake in urban and rural participants was within the DRI. In a study by Barnard, Levin and Trapp (2014), meat consumption was associated with diabetes risk. Dietary patterns that include excess protein intake from animal sources has been associated with the risk of developing type 2 diabetes (Tian *et al*., 2017). In the current study, the participants consumed mostly chicken, turkey and takeaway fried chicken, such as Kentucky fried chicken, followed by processed meats and mutton. The consumption of high fatty meat, such as processed meats, is associated with diet-related NCDs, such as diabetes (Van Dam, Willett, Rimm, Stampfer & Hu, 2002).

In the current study, consumption of fish and fish products decreased the likelihood of diabetes by 90%. Consuming a diet high in white and oily fish is associated with reduced risk of type 2 diabetes (Patel *et al*., 2009). In contrast , the daily or weekly consumption of fish was associated with diabetes (Agrawal, Millett, Subramanian & Ebrahim, 2014). Even though the consumption of fish is associated with greater chances of consuming omega 3 fatty acids, which have a protective effect on cardiovascular health, the association between the consumption of fish and diabetes remains uncertain (Xun & He, 2012).

The consumption of a high fat diet, especially saturated fats, is associated with insulin resistance and diabetes (Riserus, Walter & Hu, 2009). In this study, the participants' total intake from fat was within the required range of 20% to 35% of the total energy intake per day, even though fat intake in the urban area was slightly higher compared to the rural area. Saturated fat intake was within the recommended range in urban and rural participants. These results are supported by another study which found a positive correlation between urbanisation and total fat intake (Steyn *et al*., 2016). Urbanisation exposes poor people to an unfavourable

environment that leads to poor food choices comprising of cheap fast foods that are high in saturated fat, added sugar, salt and refined carbohydrates (Stern *et al*, 2010).

In this study, added sugar intake was below the DRIs for both urban and rural areas. The results of the current study are in contrast to the PURE study, which showed that sugar intake of rural dwellers increased rapidly in a five year study period (Vorster *et al*., 2014). A study by Steyn *et al*. (2016) on dietary intake of black South Africans in Cape Town also showed an increase in sugar intake. The inclusion of added sugars as part of the diet has been associated with the increased risk of developing obesity, diabetes and various cardiovascular diseases (Rippe & Angelopoulos, 2016).

The results of a review of dietary surveys in South Africa showed that dietary fibre intake of South Africans was low in both urban and rural areas (Mchiza *et al*., 2015). In the present study, the fibre intake of participants in the urban area was lower than the DRIs, but was within the DRIs range for participants in the rural area .The participants in both urban and rural areas consumed mostly starchy vegetables rather than green leafy vegetables and fruit. The lower intake of dietary fibre in urban areas could be attributed to the inaccessibility to affordable healthy foods in poor communities, such as vegetables and fruit, which leads to the consumption of unhealthy fast foods, high in fats and sugars and low in fibre (Stern *et al*., 2010). In a study by Robaina and Martin (2013), food-secure participants were twice as likely to consume fruit, vegetables and other fibre-rich foods than participants who were food-insecure. The consumption of adequate amounts of fruit and green leafy vegetables is associated with a reduced risk of developing diabetes (Li, Fan, Zhang, Hou, & Tang, 2014).

5.6. Relationship between the Prevalence of Diabetes and the Risk Factors of Diabetes Related to Dietary Intake Practices

In this study, dietary intake practices, including the consumption of cereals and grains, vegetables, fruit, beans, soya, nuts and seeds, milk and milk products, sugar and sugar products, alcoholic beverages did not have an effect on the prevalence of diabetes, except meat and meat products, and fish and fish products. In a study by Banard *et al*. (2014), meat consumption was associated with diabetes risk. In the current study, the consumption of meat and meat products was significantly associated with the prevalence of diabetes. The participants in the current study consumed mostly chicken, turkey and takeaway fried chicken, such as Kentucky fried chicken. The results of a meta-analysis comparing the consumption of all meats and processed meats indicated a 17% and 21% increased risk, respectively, for the development of type 2 diabetes (van Dam, 2002). The results of a cohort study showed that the consumption of three or more portions of meat,

especially processed meats, was associated with an increased risk of developing type 2 diabetes (Mari-Sanchis *et al*., 2016).

The consumption of lean fish is associated with a reduced risk of diabetes, although there was no effect observed for the consumption of fatty fish, fish products, cod liver oil, total fish and fish oil supplements (Rylander, Sandanger, Engeset & Lund, 2014). In the current study, the consumption of fish and fish products decreased the likelihood of diabetes by 90%. Contrary to the results of the current study, the results of a meta-analysis did not show an inverse relationship between the consumption of fish and the incidence of diabetes (Xun & He, 2012).

5.7. Relationship between the Prevalence of Obesity and the Risk Factors of Obesity Related to Dietary Intake Practices

In the current study, none of the nine food groups (cereals and grains, vegetables, fruit, beans, soya, nuts and seeds, milk and milk products, sugar and sugar products, alcoholic beverages, meat and meat products, and fish and fish products) were associated with obesity. The results showed that carbohydrates were the most commonly consumed macronutrient among participants in urban areas. The mean intake of carbohydrates was more than the DRI of 130 g per day. However, in this study, a high carbohydrate diet was not associated with obesity. These results are supported by a systematic review and meta-analysis which showed that consuming a high-carbohydrate diet was not linked to an increased risk of obesity (Sartorius *et al*., 2018).

5.8. Strengths of the Study

A strength of the study was the random and cluster methods used for participant recruitment. The sample size was large enough to achieve a statistical power required to detect statistical differences observed in the study. The dietary intake practices associated with diabetes and obesity included a comprehensive variety of food groups. According to the researcher's best knowledge, no single study was conducted in the rural Eastern Cape on dietary intake practices associated with diabetes and obesity.

5.9. Limitations of the Study

Even though strategies to ensure rigour of the study were applied, limitations of the study included the fact that there was no control over self-reported data by participants, which included information such on medical and diet history. This could have resulted in recall bias, due to over- and/or under-reporting of information by

participants. As this study employed a cross-sectional design, a causal relationship with the risk factors could not be ascertained. The participants were recruited from mainly Xhosa-speaking people in Langa township, Cape Town, and Mt Frere, Eastern Cape. Therefore, the generalizability of the results may be limited, since the participants included in the study were not representative of all black South Africans.

5.10. Conclusion

The prevalence of diabetes was higher among urban than rural participants. The proportion of participants who were obese was higher in the urban than rural areas. Diabetes and obesity were more prevalent among black African females than males in both urban and rural areas. The consumption of meat was significantly associated with the prevalence of diabetes in males and females in both urban and rural settings, which is cause for concern. The consumption of fish and fish products was a positive dietary intake practice that decreased the likelihood of diabetes by 90%. Because the prevalence of diabetes and obesity is continuing to increase exponentially among black South Africans, especially black African females of low socioeconomic status, urgent attention is drawn to the need for effective and timeous health promotion and educational interventions to address this pandemic which, if left unabated, is an indictment against our public healthcare institutions.

5.11. Recommendations

In the current study, it was established that the consumption of vegetables and fruit was very low, while the consumption of carbohydrates, especially highly refined and processed sugars, was high. The results from the current study will be useful in informing public health policies and future interventions aimed at health promotion, such as nutrition educational programmes to prevent and control diabetes and obesity in similar rural and urban settings of South Africa.

Diabetes and obesity are continuing to increase exponentially in South Africa, as in other parts of the world (SAMRC, 2017). This calls for prioritisation of health promotion programmes aimed at preventing NCDs and promoting health. In planning health promotion programmes, it is particularly important to include prevention strategies targeted specifically at black African women of low socioeconomic status, because various NCD reports, including the current study, indicate that more black African females are predisposed to developing diabetes and obesity in South Africa.

The results of the current study have implications for public policy, such as the Health for All policies across all state departments, which strive to improve population health and equity. Intersectoral collaboration cannot be over-emphasised, as the success of health promotion programmes depends on addressing the social determinants of health. For example, the Department of Agriculture needs to be involved in guiding communities on how to grow and access healthy food. Other departments, such as Education, Social Development, Cooperative Governance and Traditional Affairs, Human Settlement, Justice and Police need to work collaboratively and cooperatively with the Department of Health in preventing and promoting equitable and sustainable public health for all that is aligned with the WHO sustainable development goals.

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APPENDIX A: ADULT QUESTIONNAIRE

PURE/South Africa

We are very grateful to you for your participation in this study. All information given by you will be held in strict confidence, and will be used for the purpose of this study only after removing any personal identifying information.

Adult Questionnaire

INSTRUCTIONS

Please answer EACH question by marking an X in ONE BOX on each line: (unless otherwise instructed)

OR

By writing number(s) in the spaces provided:

OR

By specifying the answer on the line(s) provided

Adult Questionnaire

Subject Initials- F= first letter of first name
M= first letter of middle name
L= first letter of last name

3. National I.D#

If not applicable please mark the N/A box

Ethnicity Codes

01 - South Asian (India, Sri Lanka, Pakistan, Bangladesh)

02 - Chinese (China, Hong Kong, Taiwan)

03 - Japanese

04 - Malays

05 - Other Asian (Korea, Malaysia, Papua New Guinea, Thailand, Philippines, Indonesia, Nepal,Vietnam, Cambodia, Laos, Myanmar/Burma, Bhutan, Singapore)

06 - Persian

07 - Arab

08 - Black African

09 - Coloured African (Subsaharan African only)

10 - European

11 - Native North/South American or Australian Aborigine

12 - Latin American (Latino)

13 - Bantu/Semi Bantu

14 - Hemitic/Semi Hemitic

15 - Nilotic/Hausa

16 - Pygmie

17 - Swahili

18 - Other (any other ethnoracial group not listed above)

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Today's date: year month day

1. Name: Given name Surname

2. Not applicable in South Africa

3. National identity # or equivalent: N/A ☐

4. DOB: year month day OR **Age** yrs

5. Sex: ☐ Female ☐ Male

6. Marital status: (check one only)

☐ Never married ☐ Currently married ☐ Common law/Living with partner
☐ Widowed ☐ Separated ☐ Divorced

7. Ethnicity: ☐☐ → (Please refer to facing page for codes)

8. Caste/Tribe: _____

9. What level of formal education have you completed? (check highest level only):

☐ None
☐ Primary
☐ Secondary/highschool/higher secondary
☐ Trade School
☐ College/University
☐ Unknown

Adult Questionnaire

11. Occupation

Group 1: Legislators, senior officials and managers

Legislators and senior officials
Corporate managers
General managers
Businessman

Group 2: Professionals

Physical, mathematical and engineering science professionals
Life science and health professionals
Teaching professionals
Other professionals

Group 3: Technicians and associate professionals

Physical, mathematical and engineering-science associate professionals/technicians
Life science and health associate professionals/technicians
Teaching associate professionals/technicians
Other associate professionals/technicians

Group 4: Clerks

Clerks
Customer service clerks

Group 5: Service workers and shop and market sales workers

Personal and protective services workers
Models, salespersons and demonstrators

Group 6: Skilled agricultural and fishery workers

Market-oriented skilled agricultural and fishery workers
Subsistence agricultural and fishery workers

Group 7: Craft and related trade workers

Extraction and building trade workers
Metal, machinery and related trades workers
Precision, handicraft, printing and related trades workers
Other craft and related trades workers

Group 8: Plant and machine operators and assemblers

Stationary plant and related operators
Machine operators and assemblers
Drivers and mobile plant operators

Group 9: Elementary occupations

Sales and services elementary occupations
Agricultural, fishery and related labourers
Labourers in mining, construction, manufacturing and transport

Group 10: Armed forces

Armed forces

Group 11: Homemaker

Housewife/Husbehusband

Subject ID

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☐☐	☐☐☐	☐☐☐	☐☐

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10. Not applicable in South Africa

11a) Not applicable in South Africa

b) Please indicate which group best describes your main occupation.
(Please refer to facing page for definitions of groups and instruction manual for detailed definitions)

☐ Group 1 ☐ Group 2 ☐ Group 3 ☐ Group 4 ☐ Group 5
☐ Group 6 ☐ Group 7 ☐ Group 8 ☐ Group 9 ☐ Group 10 ☐ Group 11

c) Not applicable in South Africa

d) What is your main source of income? _____

If occupation is group 11 (homemaker) go to question 13

12. Are you currently employed?

☐ No → **(answer 12a - 12b)** ☐ Yes → Go to #13

a) Are you retired/stopped work from your primary occupation due to old age? ☐ No ☐ Yes

b) Have you stopped working due to illness? ☐ No ☐ Yes

Subject ID

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13. CURRENT DISABILITY:

		No	Yes
a)	Do you have any problems using your fingers to grasp or handle?	☐	☐
b)	Do you have any trouble walking about?	☐	☐
c)	Do you have any trouble bending down and picking up an object from the floor?	☐	☐
d)	Do you require a walking stick cane/walker to move about?	☐	☐
e)	Do you have any trouble reading or seeing the individual grains of rice/corn on your plate? (with glasses worn)	☐	☐
f)	Do you have trouble seeing a person from across the room? (12 feet/3.5 meters) (with glasses worn)	☐	☐
g)	Do you have trouble speaking and being understood?	☐	☐
h)	Do you have any trouble hearing what is said in a normal conversation?	☐	☐

Subject Medical History

14. Have you experienced any of the following in the last six months?

		No	Yes			No	Yes
a)	Chest pain or tightness with usual activity	☐	☐	i)	Vomiting	☐	☐
If Yes, →	does the pain spread to the back, neck or inner border of arm	☐	☐	j)	Loss of appetite	☐	☐
b)	Breathlessness with usual activity	☐	☐	k)	Painful or bleeding teeth/gums	☐	☐
c)	Cough for at least 2 weeks	☐	☐	l)	Jaundice	☐	☐
d)	Any sputum while coughing	☐	☐	m)	Burning while passing urine	☐	☐
e)	Blood in sputum	☐	☐	n)	Swelling of feet	☐	☐
f)	Wheezing or whistling in the chest	☐	☐	o)	Swelling of face	☐	☐
g)	Early morning cough with chest tightness	☐	☐	p)	Blood in urine	☐	☐
h)	Loose stools/diarrhea for at least 3 days	☐	☐	q)	Involuntary weight loss of > 3kg	☐	☐

15. Not applicable in South Africa

16a) Do you use glasses/spectacles/contact lenses at present? No ☐ Yes ☐

b) Do you use a hearing aid? No ☐ Yes ☐

Adult Questionnaire

Cancer Sites

1= Mouth
2= Esophagus
3= Stomach
4= Small intestine
5= Large intestine including rectum
6= Pancreas
7= Liver
8= Lung
9= Breast
10= Cervical/uterine/ovarian
11= Prostate
12= Head and neck
13= Other, specify

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

17. Have you ever been diagnosed with any of the following?(check all that apply)

	No	Yes	#of yrs since diagnosis
a) Diabetes	☐	☐	☐☐
b) Hypertension/ high blood pressure	☐	☐	☐☐
c) Stroke	☐	☐	☐☐
d) Angina/heart attack/ Coronary artery disease	☐	☐	☐☐
e) Heart failure	☐	☐	☐☐
f) Other heart disease	☐	☐	☐☐
g) Hepatitis/Jaundice	☐	☐	☐☐
h) Cancer	☐	☐	☐☐

Please refer to facing page for cancer sites → ☐☐ site

other, specify _____

	No	Yes	#of yrs since diagnosis
i) COPD	☐	☐	☐☐
j) Asthma	☐	☐	☐☐
k) Tuberculosis	☐	☐	☐☐
l) Malaria	☐	☐	☐☐
n) HIV/AIDS Not answered ☐	☐	☐	☐☐

18. Have you been taking any medications regularly (ie. at least once per week) in the last month? ☐ No → **go to 19** ☐ Yes

a) If yes, for what conditions:

	No	Yes
Blood pressure	☐	☐
Cholesterol lowering drugs	☐	☐
Stroke	☐	☐
Diabetes	☐	☐
Asthma	☐	☐
Others	☐	☐ → If Yes, specify _____
Unknown	☐	☐

Subject ID

☐☐ ☐☐☐ ☐☐☐ ☐☐

Centre # *Community#* *Household #* *Subject #*

Subject Initials ☐☐☐

F M L

18b) List all the medications you are <u>currently</u> consuming at least once a week for the last month?

i) _____ ii) _____

iii) _____ iv) _____

v) _____ vi) _____

vii) _____ viii) _____

<u>Men go to question #23</u>

<u>For Women Only (Questions 19 - 22)</u>

19. Are you currently pregnant ? ☐ No ☐ Yes → **Go to #21**

20. Do you still have periods? ☐ No → **(answer 20a)** ☐ Yes → **Go to #21**

a) How many years since you stopped menstruating? ☐☐ years

21. Have you ever used an oral/ injectable contraceptive? ☐ No ☐ Yes

22a) How many live children have you given birth to? ☐☐ Boys ☐☐ Girls

b) Did you breast feed any of your children? ☐ No ☐ Yes

23. Do you wear a helmet when riding a moped/motorcycle?

a) As a driver ☐ No ☐ Yes ☐ Not applicable

a) As a passenger ☐ No ☐ Yes ☐ Not applicable

24. Do you wear a seatbelt when riding in a car/jeep?

a) As a driver ☐ No ☐ Yes ☐ Not applicable

a) As a passenger ☐ No ☐ Yes ☐ Not applicable

Adult Questionnaire

25. Accidents and Injuries

Location of Injury
1= Factory/industrial place
2= Office
3= Agriculture field/farm
4= Home
5= Road
6= Sport/game e.g. track, court, field, etc.
7= Public building
8= Mine/quarry
9= Construction site e.g. building, road-works, etc.
10 = Other

Type of Injury
1= Burns
2= Scalds
3= Fractures
4= Muscle and ligament sprains/tears
5= Cuts and lacerations
6= Bruises and abrasions
7= Suffocation
8= Head injury (where person did not lose consciousness)
9= Head injury (where person lost consciousness for some time)

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

25. During the past 12 months, have you had any injuries that were serious enough to limit your normal activities? (check all that apply)

☐ No → **Go to #26** ☐ Yes → **(answer 25a - 25s)**

If yes, please provide details:

Cause of injury

Please refer to facing page for Location and Type Codes

			Location	Type	Absence from work or usual activities (Days)
a)	Motor vechicle accident (as a passenger)	☐ No ☐ Yes →			
b)	Motor vehicle accident (as a pedestrian)	☐ No ☐ Yes →			
c)	Struck by an object	☐ No ☐ Yes →			
d)	Explosion	☐ No ☐ Yes →			
e)	Natural/environmental factors (gales/cyclones/lightning, etc.)	☐ No ☐ Yes →			
f)	Suffocation	☐ No ☐ Yes →			
g)	Poisoning	☐ No ☐ Yes →			
h)	Snake/scorpion bite	☐ No ☐ Yes →			
i)	Fall	☐ No ☐ Yes →			
j)	Fire/flames, resultant fumes	☐ No ☐ Yes →			
k)	Physical assault (gun, kidnapping, etc.)/violent crime	☐ No ☐ Yes →			
l)	Domestic violence (beaten by a family member)	☐ No ☐ Yes →			
m)	Drowning/submersion	☐ No ☐ Yes →			
n)	Hot or corrosive liquids/floods/substances	☐ No ☐ Yes →			
o)	Crush injuries (boulders, building materials, etc.)	☐ No ☐ Yes →			
p)	Accident caused by machinery	☐ No ☐ Yes →			
q)	Attempted suicide	☐ No ☐ Yes →			
r)	Armed conflict	☐ No ☐ Yes →			
s)	Other(specify) _____	☐ No ☐ Yes →			

Adult Questionnaire

Location of Fractures

1= Hip/pelvis
2= Thigh
3= Leg
4= Forearm
5= Wrist
6= Hand/finger
7= Vertebrae (back)
8= Other

Fractures: In situations where subjects are in a cast and cannot differentiate between ligament tear or fracture, include as fracture only if doctor confirmed it as a broken bone

27c) Tobacco: Regular use is defined as consuming at least one tobacco product per day.

Duration of use:

For those that have consumed tobacco for <1 year, please enter "0"

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Subject Initials F M L

26. Have you ever fractured a bone? ☐ No (go to #25) ☐ Yes (if yes, answer a),b) and c)

a) Number of fractures

b) Years since last fracture (yrs)

c) Bone (s) broken in the most recent fracture(if more than 3, list most severe sites) (location) If other, specify

Please refer to facing page for fracture locations

Tobacco

27. Which best describes your history of tobacco use?

a) ☐ Formerly used tobacco products ☐ Currently use tobacco products ☐ **Never used tobacco products** → **Go to #28**

b) At what age did you start? yrs

c) Have you ever regularly used any of the following tobacco products? (check all that apply)

	Average amount/day	Duration (years)	**Past users only** When Stopped (years ago)	If less than 1 yr (months ago)
(i) Cigarettes (all kinds)	number			
(ii) Beedies	number			
(iii) Cigars	number			
(iv) Pipes	number			
(v) Sheesha/water pipe Hookah	# of times			
(vi) Chewing tobacco	# of times			
(vii) Snuff	# of times			
(x) Dagga				
(xi) Other _____ *Specify*				

Subject ID

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☐☐	☐☐☐	☐☐☐	☐☐

Subject Initials ☐☐☐ (F M L)

Question 28 to be answered by non-smokers and former smokers only

28. During the past 12 months, have you been regularly (at least once per week) exposed to other people's tobacco smoke?
("Exposed" is defined as a minimum of 5 consecutive minutes, during which you inhale other people's smoke.)

☐ No ⟶ **Go to #29** ☐ Yes ⟶ Please answer questions **28a**

a) Over the past 12 months, what has been your typical exposure to other peoples smoke?
("Exposed" is defined as a minimum of 5 consecutive minutes, during which you inhale other peoples smoke)

Select ONE only

☐ 1-2 times/week ☐ 3-6 times/week ☐ at least once a day ☐ 2-3 times/day ☐ 4 or more times/day

29. Not applicable in South Africa

30c) Alcoholic Beverage: Regular use is defined as at least once a month.

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30. Which best describes your history of alcohol use?

a) ☐ Formerly used alcohol products ☐ Currently use alcohol products ☐ **Never used alcohol products** → **Go to #31**

b) At what age did you start? ☐☐ yrs

c) What forms of alcohol have you regularly used? (check all that apply)

Form of Alcohol	Approx. size of one "drink"	Frequency: Daily	Weekly	Monthly	Average # of drinks	Duration (years)	Past users only When Stopped (years ago)
(i) Spirits(rum,whisky, gin,vodka etc)	30ml	☐	☐	☐	☐☐	☐☐	☐☐
(ii) Wine	125ml	☐	☐	☐	☐☐	☐☐	☐☐
(vi) Beer	375ml	☐	☐	☐	☐☐	☐☐	☐☐
(vii) Country liquor/arrack/ sugar cane spirit	30ml	☐	☐	☐	☐☐	☐☐	☐☐

d) **At least once a month, do you consume >5 alcoholic drinks/day?** ☐ No → **Go to #31** ☐ Yes

If yes,(i,ii)

i) How many times per month do you consume >5 alcoholic drinks in a day? ☐☐

ii) What is the average number of drinks that you consume each time? ☐☐

31 a) During your longest or nocturnal sleep period, what time do you normally go to bed? ☐☐:☐☐ (00:00-23:59)

b) During your longest or nocturnal sleep period, what time do you normally wake up? ☐☐:☐☐ (00:00-23:59)

c) Do you usually take naps/siestas? ☐ No ☐ Yes *Total nap duration* → ☐☐☐ mins

35. **Civic organization**: are defined as non-profit, voluntary organization societies, self help groups and clubs.

Religious organization: are defined as different types of formal and informal groups set up on a religious basis.

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32. Are you a member of any of the following:

			How often do you participate in the activities of this group? Per Month	OR	Per Year
(i) Self help group, Co-operative, Social club, Sports club,	☐ No	☐ Yes →	☐☐		☐☐
(ii) Religious Group (e.g: church group, etc.)	☐ No	☐ Yes →	☐☐		☐☐
(iii) Other _____ *Specify*	☐ No	☐ Yes →	☐☐		☐☐

33. Please answer the following: (choose only one option for each)

	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
(i) People are generally honest and want to help others.	☐	☐	☐	☐
(ii) If I do nice things for someone, I can anticipate that they will respect me and treat me just as well as I treat them.	☐	☐	☐	☐

34a) The television, radio, newspaper or magazine advertisements help me decide to buy the type of: (choose only one option for each)

					Not Applicable
(i) Cooking oil	☐	☐	☐	☐	☐
(ii) Flour	☐	☐	☐	☐	☐
(iii) Rice/ Maize meal	☐	☐	☐	☐	☐

b) The television, radio, newspaper or magazine advertisements influence whether I buy: (choose only one option for each)

(i) Soft drinks	☐	☐	☐	☐	☐
(ii) Snacks	☐	☐	☐	☐	☐
(iii) Cigarettes	☐	☐	☐	☐	☐
(iv) Alcohol	☐	☐	☐	☐	☐

35. In a difficult situation, whose help can you count on from?(Please see facing page for definitions)

(i) Civic organizations: specify _____

☐ none ☐ little ☐ moderate/average ☐ a great deal

(ii) Religious organizations: specify _____

☐ none ☐ little ☐ moderate/average ☐ a great deal

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36. Have you experienced any of the following events during the last 12 months?

	No response	No	Yes	
(i) Loss of job	☐	☐	☐	
(ii) Retirement	☐	☐	☐	
(iii) Loss of crop/business failure	☐	☐	☐	
(iv) Household break in	☐	☐	☐	
(v) Marital separation/divorce	☐	☐	☐	
(vi) Other major intra-family conflict	☐	☐	☐	→ Please specify _____
(vii) Major personal injury or illness	☐	☐	☐	
(viii) Violence	☐	☐	☐	
(ix) Armed conflict/war	☐	☐	☐	
(x) Death of a spouse	☐	☐	☐	
(xi) Death/major illness of another close family member	☐	☐	☐	
(xii) Other major stress	☐	☐	☐	→ Please specify _____
(xiii) Wedding of family member	☐	☐	☐	
(xiv) New job	☐	☐	☐	
(xv) Birth in the family	☐	☐	☐	
(xvi) Seperation from family	☐	☐	☐	
(xvii) Unavailability of food/ food insecurity	☐	☐	☐	

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37. Please answer the following: (Choose only one option for each)

For the following question, stress is defined as feeling irritable or filled with anxiety, or as having sleeping difficulties as a result of conditions at work or at home.

	No response	Never Experienced Stress	Some Period of Stress	Several Periods of Stress	Permanent Stress
a) How often have you felt stress at work in the last 12 months? (Mark here if not applicable: i.e. no longer working ☐)	☐	☐	☐	☐	☐
b) How often have you felt stress at home in the last 12 months?	☐	☐	☐	☐	☐

38. What level of financial stress have you felt in the last 12 months?

☐ No response ☐ Little/none ☐ Moderate ☐ High/severe

39. During the past twelve months, was there ever a time when you felt sad, blue, or depressed for two weeks or more in a row?

☐ No ☐ Yes → **If yes, during those times, did you:**

	No response	No	Yes
a) Lose interest in most things like hobbies, work or activities that usually give you pleasure?	☐	☐	☐
b) Feel tired or low on energy?	☐	☐	☐
c) Gain or lose weight?	☐	☐	☐
d) Have more trouble falling asleep than you usually do?	☐	☐	☐
e) Have more trouble concentrating than usual?	☐	☐	☐
f) Think a lot about death (either your own, someone else's, or death in general)	☐	☐	☐
g) Feel down on yourself, no good or worthless?	☐	☐	☐

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☐☐	☐☐☐	☐☐☐	☐☐

Subject Initials ☐☐☐ (F M L)

40. Please answer the following: (Choose only one option for each)

	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
a) I can do most of my regular shopping (food, household necessities, etc.) at stores within easy walking distance (less than 15 minutes) of my home.	☐	☐	☐	☐
b) Walking or bicycling in my neighbourhood is difficult because of the speed and/or amount of traffic.	☐	☐	☐	☐
c) My neighbourhood is generally free from pollution (litter, air pollution and noise pollution).	☐	☐	☐	☐
d) My neighbourhood streets are well lit at night.	☐	☐	☐	☐
e) I can see other people when I am walking in my neighbourhood.	☐	☐	☐	☐
f) I can speak to other people when I am walking in my neighbourhood.	☐	☐	☐	☐
g) There is a high crime rate in my neighbourhood.	☐	☐	☐	☐
h) There is a problem with unattended dogs in my neighbourhood.	☐	☐	☐	☐

Subject ID

Centre #	Community#	Household #	Subject #
☐☐	☐☐☐	☐☐☐	☐☐

Subject Initials ☐☐☐ (F M L)

40a) Please answer the following: (Please check all that apply)

i) Has your household been a victim of the following crime(s) in the last 12 months?

	No	Yes
1. Armed robbery	☐	☐
2. Violent attacks	☐	☐
3. Murder	☐	☐
4. Vehicle hijacking	☐	☐
5. House breaking	☐	☐
6. Theft	☐	☐
7. Rape	☐	☐
8. Women abuse eg. (beat,swear-words,sexual) please specify _____	☐	☐
9. Child abuse eg. (burn,swear-words,rejection) please specify _____	☐	☐
10. Child sexual abuse	☐	☐
11. Other, please specify _____	☐	☐

ii) Do you think that crime in your area has increased in the past 5 years? ☐ No ☐ Yes

if yes, which of the following crime(s)?

- ☐ Armed robbery
- ☐ Violent attacks
- ☐ Murder
- ☐ Vehicle hijacking
- ☐ House breaking
- ☐ Theft
- ☐ Rape
- ☐ Women abuse
- ☐ Child abuse
- ☐ Child sexual abuse
- ☐ Other, please specify _____

Subject ID

Centre #	Community#	Household #	Subject #
☐☐	☐☐☐	☐☐☐	☐☐

Subject Initials ☐☐☐ (F M L)

40b) Questions on HIV:

i) Do you know people who have HIV/AIDS? ☐ No ☐ Yes

if yes, which of these people: (please mark all that apply)

- ☐ Your children
- ☐ Your grandchildren
- ☐ Your spouse
- ☐ Your family members
- ☐ Your friends
- ☐ People in the community

ii) What would you consider the mean age of the people who are ill/have died of HIV/AIDS?

- ☐ Younger than 10 years
- ☐ Between 11-20 years
- ☐ Between 21-30 years
- ☐ Between 31-40 years
- ☐ Between 41-50 years
- ☐ Over 50 years

iii) If someone in your household is HIV positive, who is the primary caregiver?

- ☐ Spouse
- ☐ Parents
- ☐ Family member
- ☐ Child.children
- ☐ Friends
- ☐ Volunteer

40c) Do you care for any orphans in your family? ☐ No ☐ Yes

Adult Questionnaire

42b) Health History:

Cancer Sites

1= Mouth
2= Esophagus
3= Stomach
4= Small intestine
5= Large intestine including rectum
6= Pancreas
7= Liver
8= Lung
9= Breast
10= Cervical/uterine/ovarian
11= Prostate
12= Head and neck
13= Other, specify

Subject ID

Centre #	Community#	Household #	Subject #
☐☐	☐☐☐	☐☐☐	☐☐

Subject Initials ☐☐☐ (F M L)

41. How long would it take you to get from your house to the nearest facility if you walked?

	Minutes	Don't know		Minutes	Don't know
i) grocery/convenience store	☐☐☐	☐	iv) video store	☐☐☐	☐
ii) bank	☐☐☐	☐	v) non-fast food restaurant	☐☐☐	☐
iii) post office	☐☐☐	☐	vi) fast food restaurant	☐☐☐	☐

42a) Total number of siblings ☐☐

b) Health History: Complete for all parents and siblings, alive or dead

	Father			Mother			Siblings			# of siblings with the condition
	Unknown	No	Yes	Unknown	No	Yes	Unknown	No	Yes	If yes →
Diabetes	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐☐
Coronary Heart Disease	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐☐
High Blood Pressure	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐☐
Stroke	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐☐
Cancer (Please refer to facing page for cancer sites)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐☐
if Yes, indicate site	☐☐			☐☐			☐☐			
	Other, Specify			Other, Specify			Other, Specify			

Adult Questionnaire

If subject refuses to provide any of the measures, enter a value of "0" into each of the boxes for that question

For more detailed instructions please refer to the instruction manual

Subject ID

Centre # | Community# | Household # | Subject #

Subject Initials F M L

43. Physical Measurements

Sitting a) Right arm blood pressure

#1 Systolic Diastolic mmHg

#2 Systolic Diastolic mmHg

b) Heart Rate

#1 beats/min

#2 beats/min

c) Waist

#1 . cm → ☐ minimal/no clothing ☐ full clothing

#2 . cm

d) Weight . kg → ☐ minimal/no clothing ☐ full clothing

e) Hip

#1 . cm → ☐ minimal/no clothing ☐ full clothing

#2 . cm

f) Height . cm (without shoes)

44a) Circumference of mid upper right arm: . cm

b) Circumference of right calf: . cm

c) Head Circumference: . cm

Subject ID

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47. Grip Strength (Maximal contraction):

a) Non-dominant hand:	#1	kg.	b) Dominant hand:	#1	kg.
	#2	kg.		#2	kg.
	#3	kg.		#3	kg.

Adult Questionnaire

If subject refuses to provide any of the measures, enter a value of "0" into each of the boxes for that question

For more detailed instructions please refer to the instruction manual

48. Spirometry:

American Thoracic Society criteria for acceptable spirograms:
Spirograms are acceptable if they are free from:

1. Cough during exhalation
2. Early termination or cut-off
3. Variable effort
4. Leaks
5. Obstructed mouth piece

Subject ID

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☐☐	☐☐☐	☐☐☐	☐☐

Subject Initials ☐☐☐ (F M L)

48. Spirometry:

a) FEV1 (Litre): **#1** ☐.☐☐ **#2** ☐.☐☐ **#3** ☐.☐☐

b) Does FEV1 obtained meet ATS criteria?

☐ No → (answer (i) to (iii) ☐ Yes → Go to **c)**

Reasons for not meeting the ATS criteria: (check all that apply)

i) Cough ☐

ii) Values not within 0.2L of each other ☐

iii) Less than 3 values ☐

c) FVC (Litre): **#1** ☐.☐☐ **#2** ☐.☐☐ **#3** ☐.☐☐

d) Does FVC obtained meet ATS criteria?

☐ No → (answer (i) to (iii) ☐ Yes → Go to **e)**

Reasons for not meeting the ATS criteria: (check all that apply)

i) Cough ☐

ii) Values not within 0.2L of each other ☐

iii) Less than 3 values ☐

e) PEFR (Litre/min): **#1** ☐☐☐ **#2** ☐☐☐ **#3** ☐☐☐

f) Does PEFR obtained meet ATS criteria?

☐ No → (answer (i) to (ii) ☐ Yes → Go to **Q#47**

Reasons for not meeting the ATS criteria: (check all that apply)

i) Cough ☐

ii) Less than 3 values ☐

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49. Not applicable in South Africa

50. ECG obtained? No → **Go to #51** Yes

a) 2 0 _ _ _ _ _ _ (year / month / day) → Place ECG :File Label Here

b) **Please print ECG label #:**

51 a) Blood sample obtained? No → **Go to #52** Yes

b) Fasting sample Non-fasting sample

c) 2 0 _ _ _ _ _ _ (year / month / day) **Time** _ _ : _ _ (00:00-23:59) → **Hours since any food/beverage consumed (excluding water)**

d) **Please print Blood label #:** Place Blood label here

52 a) Urine sample obtained? No → **Go to #53** Yes

b) Fasting sample Non-fasting sample

c) **Please print Urine label #:** Place Urine label here

53. Name of Interviewer: *(please print)* _____ (First Initial) _____ (Last Name) **Interviewer Code:**

APPENDIX B: FOOD FREQUENCY QUESTIONNAIRE

PURE/South Africa

Quantitative Food Frequency Questionnaire

Introduction:

Thank you for giving up your time to participate in this study. I hope you are enjoying it so far. Here we want to find out what people living in this area eat and drink. This information is important to know as it will tell us if people are eating enough and if they are healthy.

Please think carefully about the food and drink you have consumed during the past four weeks. I will now go through a list of foods and drinks with you and I would like you to tell me:

- if you eat the food

- how the food is prepared?

- how much of the food you eat at a time?

- how many times a day you eat it and if you do not eat it every day, how many times a week or a month you eat it?

To help you to describe the amount of a food you eat, I will show you pictures of different amounts of the food. Please say which picture is the closest to the amount you eat, or if it is smaller, between sizes or bigger than the pictures.

THERE ARE NO RIGHT OR WRONG ANSWERS.

EVERYTHING YOU TELL ME IS CONFIDENTIAL. ONLY YOUR SUBJECT NUMBER APPEARS ON THE FORM.

IS THERE ANYTHING YOU WANT TO ASK NOW?

ARE YOU WILLING TO GO ON WITH THE QUESTIONS?

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INSTRUCTION:

Check the appropriate box. Fill in the amount and times eaten in the appropriate columns.

I shall now ask you about the type and the amount of food you have been eating in the last few months. Please tell if you eat the food, how much you eat and how often you eat it. We shall start with maize meal porridge.

1. Do you eat maize meal porridge? ☐ No ☐ Yes

If yes, what type do you have at home now?

☐ Brand name(specify) _____

☐ Don't know

☐ Grind self

If brand name given, do you usually use this brand? ☐ No ☐ Yes ☐ Don't know

2. Where do you get your maize-meal from? (May answer more than one)

☐ Shop ☐ Employer ☐ Harvest and grind self ☐ Other _____ (specify) ☐ Don't know

Food	**Description**	**Amount**	**Per day**	**Per week**	**Per month**	**Seldom/ Never**
3. Maize-meal porridge	Stiff (pap)	_____	☐	☐	☐	☐
4. Maize-meal porridge	Soft (slappap)	_____	☐	☐	☐	☐
5. Maize-meal porridge	Crumbly (phutu)	_____	☐	☐	☐	☐
6. Ting		_____	☐	☐	☐	☐
7. Mabella Coarse fine rice	Stiff	_____	☐	☐	☐	☐
8. Mabella	Soft	_____	☐	☐	☐	☐
9. Oats		_____	☐	☐	☐	☐

Subject ID

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Food	**Description**	**Amount**	**Per day**	**Per week**	**Per month**	**Seldom/ Never**
10. Breakfast cereals	**Brand names of cereals at home now: (5)**					
	_____	_____	☐	☐	☐	☐
	_____	_____	☐	☐	☐	☐
	_____	_____	☐	☐	☐	☐
	_____	_____	☐	☐	☐	☐
	☐ **Don't know**	_____	☐	☐	☐	☐

11. Do you pour milk on your porridge or cereal? ☐ No ☐ Yes

If yes, what type of milk (whole fresh, sour, 1%, fat free, milk blend? _____

Instruction: Show subject examples.

If yes, how much milk?		_____	☐	☐	☐	☐
12. Do you pour sugar on your porridge/cereal/mabella?		☐ No	☐ Yes			
If yes, how much sugar?		_____	☐	☐	☐	☐
13. Samp	Bought	_____	☐	☐	☐	☐
14. Samp	Self ground	_____	☐	☐	☐	☐
15. Samp and beans		_____	☐	☐	☐	☐

16. Are the amount of samp and beans the same as in the picture? ☐ No ☐ Yes

If no, do you use more beans than the picture of less? ☐ More ☐ Less

Subject ID

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Food	Description	Amount	Per day	Per week	Per month	Seldom/ Never
17. Rice	White	_____	☐	☐	☐	☐
	Brown	_____	☐	☐	☐	☐
	Maize rice	_____	☐	☐	☐	☐
18. Pasta	Macaroni	_____	☐	☐	☐	☐
	Spaghetti	_____	☐	☐	☐	☐
	Other: _____ (Specify)	_____	☐	☐	☐	☐

You are being very helpful. Can I now ask you about meat?

Chicken, meat, fish

19. Chicken	Boiled	_____	☐	☐	☐	☐
	Fried in batter/ crumbs (not coated)	_____	☐	☐	☐	☐
	Roasted/grilled	_____	☐	☐	☐	☐

20. Do you eat chicken skin? ☐ Always ☐ Sometimes ☐ Never

21. Chicken bones stew		_____	☐	☐	☐	☐
22. Chicken feet		_____	☐	☐	☐	☐
23. Chicken offal		_____	☐	☐	☐	☐

How do you like meat?

24. With fat		_____	☐	☐	☐	☐
25. Fat trimmed		_____	☐	☐	☐	☐

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Food	Description	Amount	Per day	Per week	Per month	Seldom/ Never
26. Red meat	Fried	_____	☐	☐	☐	☐
	Stewed	_____	☐	☐	☐	☐
	Mince with tomato and onion	_____	☐	☐	☐	☐
27. Beef offal	Intestines: boiled, nothing added	_____	☐	☐	☐	☐
	Stewed with vegetables	_____	☐	☐	☐	☐
	Liver	_____	☐	☐	☐	☐
	Kidney	_____	☐	☐	☐	☐
	Other: _____ (specify)	_____	☐	☐	☐	☐

28. What vegetables are usually put into meat stews? _____

29. Wors/sausage	Fried	_____	☐	☐	☐	☐
30. Bacon		_____	☐	☐	☐	☐
31. Cold meats	Polony	_____	☐	☐	☐	☐
	Ham	_____	☐	☐	☐	☐
	Viennas	_____	☐	☐	☐	☐
	Other: _____ (specify)	_____	☐	☐	☐	☐

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Food	Description	Amount	Per day	Per week	Per month	Seldom/ Never
32. Canned meat	Bully beef		☐	☐	☐	☐
	Other: _____ (specify)		☐	☐	☐	☐
33. Meat pie	Bought		☐	☐	☐	☐
34. Hamburger	Bought		☐	☐	☐	☐
35. Dried beans/ peas/lentils (10)	Soup		☐	☐	☐	☐
	Salad		☐	☐	☐	☐
36. Soya products eg. Toppers						
	Brand names of cereals at home now: (5)					
	_____		☐	☐	☐	☐
	_____		☐	☐	☐	☐
	_____		☐	☐	☐	☐
	_____		☐	☐	☐	☐
	☐ **Don't know**		☐	☐	☐	☐
	Show examples					
37. Pilchards in tomato/chili/brine	Whole		☐	☐	☐	☐
	Mashed with fried onion		☐	☐	☐	☐

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Food	Description	Amount	Per day	Per week	Per month	Seldom/ Never
38. Fried fish	With batter/ crumbs	_____	☐	☐	☐	☐
	Without batter/ crumbs	_____	☐	☐	☐	☐
39. Other canned fish	Tuna	_____	☐	☐	☐	☐
	Pickled fish	_____	☐	☐	☐	☐
	Other: _____ (specify)	_____	☐	☐	☐	☐
40. Fish cakes	Fried	_____	☐	☐	☐	☐
41. Eggs	Boiled/poached	_____	☐	☐	☐	☐
	Scrambled	_____	☐	☐	☐	☐
	Fried	_____	☐	☐	☐	☐

We now come to vegetables and fruit.

How do you cook cabbage?

42. Cabbage	Boiled, nothing added	_____	☐	☐	☐	☐
	Boiled with potato and onion and fat	_____	☐	☐	☐	☐
	Fried, nothing added	_____	☐	☐	☐	☐
	Boiled, then fried with potato and onion	_____	☐	☐	☐	☐
	Other: _____ (specify)	_____	☐	☐	☐	☐
	Don't know	_____	☐	☐	☐	☐

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Food	Description	Amount	Per day	Per week	Per month	Seldom/ Never
How do you cook spinach?						
43. Spinach/morogo/ other green leafy	Boiled, nothing added	_____	☐	☐	☐	☐
	Boiled fat added	_____	☐	☐	☐	☐
	Boiled with onion/ tomato and fat	_____	☐	☐	☐	☐
	- onion, tomato & potato	_____	☐	☐	☐	☐
	- with peanuts	_____	☐	☐	☐	☐
	Other: _____ (specify)	_____	☐	☐	☐	☐
	Don't know	_____	☐	☐	☐	☐
44. Tomato and onion 'gravy'	Homemade with fat	_____	☐	☐	☐	☐
	Homemade without fat	_____	☐	☐	☐	☐
	Canned	_____	☐	☐	☐	☐
How do you cook pumpkin?						
45. Pumpkin	In fat & sugar	_____	☐	☐	☐	☐
	Boiled, little sugar and fat	_____	☐	☐	☐	☐
	Other: _____ (specify)	_____	☐	☐	☐	☐
	Don't know	_____	☐	☐	☐	☐

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Food	Description	Amount	Per day	Per week	Per month	Seldom/ Never
How do you cook carrots?						
46. Carrots	Boiled, sugar and fat	_____	☐	☐	☐	☐
	With potato and onion	_____	☐	☐	☐	☐
	Raw, salad	_____	☐	☐	☐	☐
	Chakalaka	_____	☐	☐	☐	☐
	Other: _____ (specify)	_____	☐	☐	☐	☐
	Don't know	_____	☐	☐	☐	☐
How do you eat mealies?						
47. Mealies/Sweet corn	On cob	_____	☐	☐	☐	☐
	Off cob, creamed sweet corn	_____	☐	☐	☐	☐
	Off cob, whole kernel	_____	☐	☐	☐	☐
48. Beetroot salad	Homemade	_____	☐	☐	☐	☐
	Bought	_____	☐	☐	☐	☐

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Food	Description	Amount	Per day	Per week	Per month	Seldom/ Never
How do you cook potatoes?						
49. Potatoes	Boiled/baked with skin					
	Boiled/baked without skin					
	Mashed					
	Roasted					
	French fries					
	Salad					
	Other: _____ (specify)					
How do you cook sweet potatoes?						
50. Sweet Potatoes	Boiled/baked with skin					
	Boiled/baked without skin					
	Mashed					
	Other: _____ (specify)					
	Don't know					
51. Salad vegetables	Raw tomato					
	Lettuce					
	Cucumber					
52. Other salad vegetables	_____ (specify)					
	_____ (specify)					

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Fruit

53. Do you like fruit? ☐ No ☐ Yes

Food	Description	Amount	Per day	Per week	Per month	Seldom/ Never
54. Apples/pears	Fresh	_____	☐	☐	☐	☐
	Canned pears	_____	☐	☐	☐	☐
55. Bananas		_____	☐	☐	☐	☐
56. Oranges/ naartjie		_____	☐	☐	☐	☐
57. Grapes		_____	☐	☐	☐	☐
58. Peaches	Fresh	_____	☐	☐	☐	☐
	Canned	_____	☐	☐	☐	☐
59. Apricots	Fresh	_____	☐	☐	☐	☐
	Canned	_____	☐	☐	☐	☐
60. Mangoes	Fresh	_____	☐	☐	☐	☐
61. Guavas	Fresh	_____	☐	☐	☐	☐
	Canned	_____	☐	☐	☐	☐

62. If subject eats canned fruit: Do you have custard with canned fruit? ☐ No ☐ Yes

63. Custard	Homemade Ultramel	_____	☐	☐	☐	☐
64. Wild fruit/ berries	(specify type)	_____	☐	☐	☐	☐
65. Dried fruit	(specify type)	_____	☐	☐	☐	☐
66. Other fruit	(specify type)	_____	☐	☐	☐	☐

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|---|---|---|
| *F* | *M* | *L* |

Bread and bread spreads

Food	**Description**	**Amount**	**Per day**	**Per week**	**Per month**	**Seldom/ Never**
67. Bread/bread rolls	White	_____	☐	☐	☐	☐
	Brown	_____	☐	☐	☐	☐
	Whole wheat	_____	☐	☐	☐	☐

68. Do you spread anything on the bread? ☐ Always ☐ Sometimes ☐ Never

69. Margerine: What brand do you have at home now? _____		_____	☐	☐	☐	☐
	Don't know	_____	☐	☐	☐	☐
	Show examples					
70. Peanut butter		_____	☐	☐	☐	☐
71. Jam/syrup/ honey		_____	☐	☐	☐	☐
72. Marmite/Fray Bentos		_____	☐	☐	☐	☐
73. Fish/meat paste		_____	☐	☐	☐	☐
74. Cheese	**Type:** _____	_____	☐	☐	☐	☐
75. Achaar		_____	☐	☐	☐	☐
76. Other spreads	_____ (specify)	_____	☐	☐	☐	☐
77. Dumpling		_____	☐	☐	☐	☐
78. Vetkoek		_____	☐	☐	☐	☐

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Food	**Description**	**Amount**	**Per day**	**Per week**	**Per month**	**Seldom/ Never**
79. Provita, crackers, etc			☐	☐	☐	☐
80. Mayonnaise/ salad dressing	_____ Number of spoons		☐	☐	☐	☐
	_____ Number in family		☐	☐	☐	☐
Drinks						
81. Tea			☐	☐	☐	☐
82. Coffee			☐	☐	☐	☐
83. Sugar/cup tea or coffee			☐	☐	☐	☐
What type of milk do you use in tea and coffee?						
84. Milk/cup tea or coffee	Fresh/long life whole		☐	☐	☐	☐
	Fresh/long life 2%		☐	☐	☐	☐
	Fresh/long life fat free		☐	☐	☐	☐
Whole milk powder	Brand:		☐	☐	☐	☐
Skimmed milk powder	Brand:		☐	☐	☐	☐
Milk blend	Brand:		☐	☐	☐	☐
Whitener	Brand:		☐	☐	☐	☐
85. Condensed milk			☐	☐	☐	☐
86. Evaporated milk			☐	☐	☐	☐
87. None			☐	☐	☐	☐

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What type of milk do you drink as such?

Food	Description	Amount	Per day	Per week	Per month	Seldom/ Never
88. Milk as such	Fresh/long life whole		☐	☐	☐	☐
	Sour/Maas		☐	☐	☐	☐
89. Milk drinks Brand	Nestle		☐	☐	☐	☐
	Milo		☐	☐	☐	☐
	Flavored milk		☐	☐	☐	☐
	Other		☐	☐	☐	☐
90. Yoghurt	Drinking yoghurt		☐	☐	☐	☐
	Thick yoghurt		☐	☐	☐	☐
91. Squash	SweetO		☐	☐	☐	☐
	SixO		☐	☐	☐	☐
	Oros/Lecol with sugar		☐	☐	☐	☐
	artificial sweetner		☐	☐	☐	☐
	Kool-Aid		☐	☐	☐	☐
	Other		☐	☐	☐	☐
92. Fruit juice	Fresh/Liquifruit/ Ceres		☐	☐	☐	☐
	Tropica		☐	☐	☐	☐

Show examples

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Food	**Description**	**Amount**	**Per day**	**Per week**	**Per month**	**Seldom/ Never**
93. Fizzy drinks Coke,Fanta	Sweetened	_____	☐	☐	☐	☐
	Diet	_____	☐	☐	☐	☐
94. Mageu/Motogo		_____	☐	☐	☐	☐
95. Home brew		_____	☐	☐	☐	☐
96. Tlokwe		_____	☐	☐	☐	☐
97. Beer		_____	☐	☐	☐	☐
98. Spirits		_____	☐	☐	☐	☐
99. Wine red		_____	☐	☐	☐	☐
100. Wine white		_____	☐	☐	☐	☐
101. Other, specify: _____		_____	☐	☐	☐	☐
Snacks and Sweets:						
102. Potato crisps		_____	☐	☐	☐	☐
103. Peanuts	Raw	_____	☐	☐	☐	☐
	Roasted	_____	☐	☐	☐	☐
104. Cheese curls: Niknaks etc.		_____	☐	☐	☐	☐
105. Raisins		_____	☐	☐	☐	☐
106. Peanuts and raisins		_____	☐	☐	☐	☐
107. Chocolates	_____ (specify)	_____	☐	☐	☐	☐

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Food	**Description**	**Amount**	**Per day**	**Per week**	**Per month**	**Seldom/ Never**
108. Candies	Sugus,gums, hard sweets		☐	☐	☐	☐
109. Sweets	Toffees, fudge, caramels		☐	☐	☐	☐
110. Biscuits, Type: _____			☐	☐	☐	☐
111. Cakes, Type: _____ **and tarts**			☐	☐	☐	☐
112. Scones			☐	☐	☐	☐
113. Rusks			☐	☐	☐	☐
114. Savouries	Sausage rolls		☐	☐	☐	☐
	Samoosas		☐	☐	☐	☐
	Biscuits eg. bacon kips		☐	☐	☐	☐
	Other, specify: _____		☐	☐	☐	☐
115. Jelly			☐	☐	☐	☐
116. Baked pudding			☐	☐	☐	☐
117. Instant pudding			☐	☐	☐	☐
118. Icecream			☐	☐	☐	☐
119. Sorbet			☐	☐	☐	☐
120. Other, specify: _____			☐	☐	☐	☐

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Sauces/Gravies/Condiments

Food	Description	Amount	Per day	Per week	Per month	Seldom/ Never
121. Tomato sauce/ worchester sauce			☐	☐	☐	☐
122. Chutney			☐	☐	☐	☐
123. Pickles			☐	☐	☐	☐
124. Packet soups			☐	☐	☐	☐
125. Others, specify:			☐	☐	☐	☐

Wid birds, Animals or Insects (hunted in rural areas or on farms)

126. Wild fruit			☐	☐	☐	☐

Miscellaneous: Please mention any other foods used more than once/two weeks which we have not talked about:

127.			☐	☐	☐	☐
128.			☐	☐	☐	☐
129.			☐	☐	☐	☐
130.			☐	☐	☐	☐

Salt Use:

131. What type of salt do you use? _____

The next few questions are to find out if you use salt, where you use it and how much you use.

132. Do you add salt to food while it is being cooked? ☐ Always ☐ Sometimes ☐ Never ☐ Don't know

133. Do you add salt to your food after it has been cooked? ☐ Always ☐ Sometimes ☐ Never

134. Do you like salty foods eg. salted peanuts, crisps? ☐ Always ☐ Sometimes ☐ Never

Subject ID

Centre #	*Community #*	*Household #*	*Subject #*

Subject Initials | | | |
F M L

Do you use any of the following:

	Name of product	Amount/day
135. Vitamins/vitamins and minerals		
136. Tonics		
137. Health foods		
138. Body building preparations		
139. Dietary fibre supplement		
140. Other _____ (specify)		

Thank you for your cooperation and patience

Good-bye