PREVALENCE OF NON-COMMUNICABLE DISEASES RISK FACTORS AMONG ADMINISTRATIVE STAFF AT A HIGHER EDUCATION INSTITUTION IN SOUTH AFRICA

Bernard Masvosva

Student Number: 3813932

A mini-thesis submitted in partial fulfilment of the requirements for the degree of Master in Public Health at the School of Public Health,

University of the Western Cape

Supervisor: Prof E C Swart

February 2022

KEY WORDS

University

Employees

Non-communicable diseases

Risk Factors

Cardiovascular disease

Prediction Algorithm

Health survey

Health promotion

Workplace

ABSTRACT

Background: Non-communicable diseases (NCD) continue to rise globally, causing significant morbidity and mortality. Low and medium-income countries (LMIC) such as South Africa are the worst affected because of an existing burden of infectious diseases and general poverty in the population. In South Africa, NCDs were responsible for 57.8% of total deaths in 2017, surpassing group 1 diseases (30.7%) that include tuberculosis and HIV/AIDS. Studies have shown that early detection of NCDs and interventions to reduce NCDs' risk significantly prevent suffering and further loss of lives. Workplace health promotion and healthy university concepts are widely being implemented globally to promote health at workplaces and institutions of higher learning. The study aimed to determine the prevalence of selected non-communicable disease risk factors and to assess the risk of cardiovascular disease among administrative staff at the University of the Western Cape (UWC), South Africa, using secondary data collected in 2011.

Methodology: An analysis of secondary data obtained through descriptive cross-sectional research on administrative staff members at an institution of higher learning. All administrative staff members were invited to a campus health project. Information on NCDs and their risk factors were obtained through interviews using a questionnaire, clinical measurements and a selection of clinical laboratory tests performed on blood samples drawn from each participant. Ten year cardiovascular disease risk was assessed using Framingham laboratory-based algorithm.

Results: A total of seventy-eight employees (63% women, 37% men) with a mean age of 40.7± 10years took part in the survey. There was a high prevalence of modifiable behavioural and biological risk factors among the participants. These were smoking (30.7%), alcohol consumption (65.4%), physical inactivity (43.6%), sedentary behaviour (85.7%), overweight/obesity (83.3%), abnormal WC (73.1%), dyslipidemia (82.9%), hypertension (41.6%), and prehypertension (44.2%). The majority (77.2%) of participants had at least five risk factors for NCDs in one individual. Obesity was associated with gender, WC ($p<0.001$) and BMI ($p=0.04$). Sedentary behaviour was associated with age ($p=0.04$) and marital status of the participant ($p=0.01$). Marital status was associated with dyslipidemia ($p=0.02$). Twelve percent of the participants had a high 10year risk of CVD.

Conclusion: There was a high prevalence of modifiable risk factors for NCDs among administrative staff at the institution of higher learning. Workers at the institution can benefit through workplace health promotion and implementation of healthy university concept to reduce risk to NCD.

DECLARATION

I declare that the thesis "**Prevalence Of Non-Communicable Diseases Risk Factors Among Administrative Staff At A Higher Education Institution In South Africa**" is my work own, has not been submitted for any degree or examination at any other university, and that all the sources I have used or quoted have been indicated in the text and acknowledged in the references section.

Full Name: Bernard Masvosva

Signed : .. …. Date : 25 February 2022

ACKNOWLEDGEMENTS

I am immensely grateful to the Principal Investigator of the campus health project, who was also my supervisor, Professor R, Swart, for allowing me to use secondary data from the survey; for all the mentoring and guidance while writing my thesis. I particularly commend her for her patience and time in sharing her expertise and knowledge with me. I shall forever remain indebted for the experience that I have gained through her during the process of writing this thesis

I also thank the University of the Western Cape library staff, particularly the inter-loan department, for all the help with getting relevant materials and division of postgraduate studies for the coaching assistance rendered during my studies.

My gratitude also goes to my family, parents, wife and children for their patience during my studies as they allowed me to concentrate and provided support.

I dedicate the thesis to my late brother Charles who always encouraged me to work hard.

TABLE OF CONTENTS

List of Tables

List Figures

ABBREVIATIONS AND ACRONYMS

BMI	Body Mass Index
BP	Blood Pressure
BRCA	Breast Cancer Gene
CHOL	Cholesterol
COPD	Chronic Obstructive Pulmonary Disease
CVD	Cardiovascular Disease
DALY	Disability-Adjusted Life Years
DBP	Diastolic Blood Pressure
FIN	Finance
FRS	Framingham Risk Score
FRSLAB	Framingham Laboratory Based Risk Score
FRSNLAB	Framingham Non Laboratory Based Risk Score
GDP	Gross Domestic Product
HDL	High-Density Lipoprotein
HIV	Human Immunodeficiency Virus
AIDS	Acquired Immunodeficiency Syndrome
LDL	Low-Density Lipoprotein
LMIC	Low And Middle-Income Country
MET	Metabolic Equivalent Task
NCD	Non-Communicable Disease
PCE	Pooled Cohort Equations
SADC	Southern African Development Community

SADHS	South Africa Demographic and Health Survey
SANHANES	South African National Health and Nutrition Examination Survey
SBP	Systolic Blood Pressure
SCORE	Systematic Coronary Risk Evaluation
SD	Standard Deviation
T2DM	Type 2 Diabetes Mellitus
TC	Total Cholesterol
TCF7L2	Transcription Factor 7 Like 2
TRIG	Tryglyceride
UNIV	University
UWC	University of the Western Cape
WC	Waist Circumference
WHO	World Health Organisation
WHR	Waist-Hip Ratio
WtHR	Waist-To-Height Ratio
YLL	Years Of Life Lost

CHAPTER ONE

INTRODUCTION AND PROBLEM STATEMENT

1.1. Introduction

South Africa is experiencing a changing pattern of diseases and leading causes of death (Shisana *et al.*, 2013). Since 2010, non-communicable diseases (Group II) have maintained the top position as the leading cause of death in South Africa, surpassing group I diseases (infectious diseases, maternal and perinatal causes and nutritional conditions). In 2017 non-communicable diseases (NCDs) were responsible for 57.8% of the total deaths in South Africa, followed by group I diseases (30.7%) and group III (injuries) (11.5%) (Statistics South Africa, 2018). According to World Health Organisation (2018), adults in low and middle-income countries face almost twice the risk of dying from NCDs as their counterparts in high-income countries. Non-communicable diseases are also the leading cause of death worldwide. In 2016 NCDs were responsible for 71% of all deaths globally. The majority (75%) of the deaths are people aged 30-69 years. Four major NCDs causing most deaths -cardiovascular diseases 44%, cancers 22%, chronic respiratory diseases 9% and diabetes 4% also share four major behavioural risk factors - tobacco use, alcohol abuse, physical inactivity and unhealthy diet (World Health Organization, 2018).

There have been increases in the prevalence of NCDs and their risk factors among South Africans. The prevalence of hypertension has nearly doubled between 1998 and 2016, from 25% to 46% in women and from 23% to 44% among men. While the prevalence of diabetes mellitus was 13% among women and 8% among men, there were very high proportions of pre-diabetes (women 64% and men 66%) (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019). The prevalence of overweight and obesity has also increased significantly, especially among women, from 56% in 1998 to 68% in 2016. In men, body mass index (BMI) prevalence rose by three percentage points to 31% in 2016. Despite the prevalence of tobacco smoking decreasing from 11% in women and 42% in men in 1998 to 8% in women and 37% in men in 2016, South Africa still has a significant number of tobacco smokers (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019). The average age-standardised prevalence of smoking in Sub-Saharan Africa was 11.7% in 2019. South Africa's prevalence of smoking was 22.9%, Botswana 22.3%, Namibia 17.1% and Lesotho 21.7%

(Reitsma *et al.*, 2021). There is also a low intake of fruit and vegetables among South Africans. A national survey in 2012 reported that 42.1% of the study population had inadequate intake of fruit and vegetables (Shisana *et al.*, 2013)

The continued increase of NCDs and their risk factors in low and middle-income countries is linked to many driving factors: globalization, rapid urbanization, environment, culture, and socio-economic factors. Unplanned rapid urbanization has seen many black Africans migrating from rural to urban areas (Puoane *et al.*, 2008). According to Puoane *et al.* (2008), rural to urban migration is accompanied by many changes to lifestyle, dietary habits and physical inactivity. In the city, people adopt a new lifestyle characterized by smoking and alcohol consumption. People change from traditional foods to eating unhealthy foods high in fats, proteins and salt (Puoane *et al.*, 2008). Unavailability and high cost of healthy foods coupled with aggressive marketing of cheap, readily-available unhealthy foods creates an environment where healthy choices are difficult to make. Environmental factors also include safety concerns in some neighbourhoods, which discourages physical activities (Puoane *et al.*, 2008). Globalisation is blamed for exposure to global economies and causing nutritional transitions as populations are exposed to unhealthy foreign foods such as sweetened beverages (Kruger *et al.*, 2005). According to Kruger *et al.* (2005), lack of education and rapid social and economic changes also contribute to NCDs. There are also some cultural beliefs and practices in developing countries that contribute to the rise in NCDs (Kruger *et al.*, 2005). Kruger *et al.* (2005) highlight some views such as associating certain unhealthy foods with wealthy status, women are encouraged to gain weight as it is perceived as attractive, wealthy and losing weight is associated with sickness. Koopman *et al.* (2016) also highlight the ritual practice of fattening young women for marriages. Koopman *et al.* (2016) believe that genes in the population are not compatible with the current affluent environment prevailing in many developing countries, making the population at high risk to NCDs.

Health surveys on employees from different sectors in South Africa have revealed a high prevalence of various risk factors for NCDs. For example, a study on employees at a commercial power plant in South Africa reported a high prevalence of inadequate fruit and vegetable consumption (73%), physical inactivity (64%), increased BMI (76.9%) and high cholesterol (62.2%) (Schouw, Mash & Kolbe-Alexander, 2018). A comparison study of risk factors for NCDs among employees in South Africa and the United Kingdom revealed that South African employees had significantly higher prevalences of risk factors than their United Kingdom counterparts, for example, smoking (20.3% vs 11.8%) and increased BMI (63.3% vs 49.6%) (Milner *et al.*, 2018). Studies have also reported that employees had more than one risk factor for NCDs in one individual. This clustering of risk factors was observed in 42.1% of employees of a financial institution in South Africa (Swanepoel, Strydom and Cockeran, 2015). Another study on employees from 68 companies in South Africa found that the most prevalent risk factors for NCDs were high BMI (62%) and inadequate physical inactivity (67%). Physical inactivity in employees was also found to result in higher occurrence of additional risk factors for NCDs than in those who were considered physically active (Kolbe-Alexander *et al*, 2013).

Several health surveys in Africa and beyond have also reported high levels of various risk factors for NCDs among university staff. A study in Nigeria reported a high prevalence of unhealthy diet (96%) among university staff at an urban community university (Ige, Owoaje & Adebiyi, 2013). Another study in Nigeria reported high prevalences of inadequate fruit and vegetables consumption (94.6%), physical inactivity (77.8%) and hypertension (48.5%) among university staff (Agaba *et al.*, 2017). In a cross-sectional health survey on staff members at a Kenyan university, 33.2% had hypertension, while 60.8% were prehypertensive (Okube & Omandi, 2018). Amin *et al.* (2014) study on Saudi university staff reported inadequate fruit and vegetables consumption (86%), physical inactivity (73%) and clustering of risk factors (57.6% had three or more risk factors for NCDs) among the surveyed sample staff. A study on staff members of a university in Malaysia reported that among the majority of staff of which 80.5% were administrative staff, 80% were overweight and obese (Bo *et al.*, 2018). In South Africa, a study on employees at a tertiary institution found that 43% were at high risk of having cardiovascular diseases, and 56% were classified as prehypertensive (Reddy and Naidoo, 2018). Another study on academic and non-academic workers at a rural university in South Africa reported that 80.8% were overweight and obese (Mushaphi & Madala, 2020). The presence of risk factors for NCDs results in ill-health, which affects the well-being of workers. Employees who had multiple risk factors for NCDs spent more money consulting doctors for different ailments than those who did not have the risk factors (Kolbe-Alexander, Conradie & Lambert, 2013). Boles, Pelletier & Lynch's (2004) study also revealed that having multiple risk factors for NCDs reduced employees' productivity whilst absenteeism from work due to ill-health increased. According to Hancock, Kingo & Raynaud (2011), high and rising prevalence of NCDs and their risk factors threaten the economy due to ill health and reduction in productivity. Both the employers (as a business) and employees are affected by NCDs and their risk factors (Kolbe-Alexander & Lambert, 2013). Many health surveys recommended workplace health promotion programs to curb increasing NCDs and their risk factors among employees.

Workplace health promotion programs are part of a settings-based health promotion approach widely promoted by many international organisations, including the World Health Organisation. A settings approach to health promotion has roots in the Ottawa Charter for health promotion of 1986, which stated that health is a product of where people live, play and love (World Health Organization, 1986). It recognised the influence of environments in shaping the well being of people. Focus on settings was further strengthened by many publications and declarations. Implementation started with healthy cities, hospitals, schools and later universities and other places, including workplaces (Tsouros *et al.*, 1998). According to Dooris *et al.* (2007), implementing a settings approach to health promotion in a whole system would involve policies, environment modification, peer education and impact assessment. An article by Hancock, Kingo & Raynaud (2011) encourages employers to implement workplace health promotion programs as they are beneficial to business by reducing health care costs, reducing absenteeism, improving productivity, and boosting morale and motivating workers. According to Tsouros *et al.* (1998), as a large organisation and significant employer, the university can do a lot to protect and promote staff and students' health by implementing a settings approach to health promotion. Students are at universities for a long time, and they leave as mature citizens who may become leaders in society. The university therefore has a responsibility to influence students' healthy personal and social behaviours. Universities are also influential to their local communities and thus should lead by example in promoting health (Tsouros *et al.*, 1998). Taylor, Saheb & Howse (2019) also view universities as suitable environments for health promotion as leaders, educators and employers in society.

With all efforts geared to tackle NCDs and their risk factors at workplaces, Milner *et al.* (2018) emphasized formulating health promotion programs based on data from the population targeted. However, there is a limitation in information as only a few studies have addressed NCDs and their risk factors among South African employees (including university employees) (Hene *et al.*, 2021). Therefore, this study aimed to assess the prevalence of modifiable risk factors for NCDs and calculated the 10year risk for cardiovascular disease among administrative staff at a tertiary institution in South Africa. The study adds to the body of literature on South African employees' health surveys and calls to implement workplace health promotion programs and healthy university concepts. This would give evidence-based recommendations on workplace health promotion programs to reduce NCDs and their risk factors within the university community.

1.2. Problem Statement

The growing burden of non-communicable diseases and their risk factors continues to rise in South Africa. University employees are equally affected and at-risk as the general population. There are growing calls from various international organisations and the government to apply the settings approach to health promotion in multiple places, including universities, through the healthy university concept. However, a lack of information on the magnitude of NCDs and their risk factors within various employment sectors limits the formulation of effective targeted setting-based health promotion programs. This study explores the extent of NCDs and their risk factors among university administrative employees (logistical constraints prevented inclusion of academic staff in the study (refer to 3.3.1). Findings from this study will provide helpful information to university health promoters and policymakers on health programs or policies that would significantly reduce NCDs and their risk factors among university employees.

1.3. Study Aim and Objectives

The study aimed to determine the prevalence of selected non-communicable disease risk factors and assess the risk of cardiovascular disease among administrative staff at the University of the Western Cape (UWC), South Africa, using secondary data collected in 2011.

The specific objectives were

- To estimate the prevalence of behavioural risk factors to NCDs such as tobacco use, alcohol consumption, and physical inactivity and sedentary behaviours among administrative staff at the UWC.
- To estimate the prevalence of biological risks factors to NCDs, such as hypertension, overweight, obesity, waist circumference, waist-hip ratio, waist-to-height ratio, and dyslipidemia among administrative staff at UWC.
- To assess the association of gender, age, education level, and marital status with risk factors to NCDs in participants

- To assess clustering of NCDs risk factors among the participants (i.e. the number of NCDs risk factors per participant).
- To assess the 10-year risk of cardiovascular disease of participants using different prediction algorithms, namely Framingham laboratory-based risk score (FRSLAB), Framingham non-laboratory based risk score (FRSNLAB), Pooled Cohort Equations algorithm (PCE) for African Americans, Systematic Coronary Risk Evaluation (SCORE)- high and low-cardiovascular risk charts (SCORE-HIGH and SCORE-LOW) and WHO-CVD (World Health Organisation-CVD prediction chart.
- To assess agreement between Framingham laboratory-based risk score and another cardiovascular disease (CVD) prediction algorithms in predicting 10-year CVD risk in participants.

1.4. Outline of the thesis

This thesis is structured into six chapters starting with Chapter 1 above until the sixth chapter, Chapter 6. Chapter 1 is introductory, giving an overview of the problem explored and areas of focus of this thesis. The chapter highlights the problem of NCDs and their risk factors as a global problem and then focuses on South Africa. It then highlights efforts by different sectors of the society to tackle the problem of NCDs and narrows to setting-based health promotion approaches. Finally, the study aim and objectives are at the end of the chapter.

Chapter 2 looks at available literature on risk factors of NCDs grouped into modifiable and non-modifiable factors. The main focus is on Western Cape compared to the rest of the country provinces and South Africa compared to Africa and the rest of the world. The chapter also reviews literature on CVD and methods of assessing risk to CVD.

Chapters 3 outlines the study design, population and sampling approach, data collection including instruments used, data analysis, validity and reliability, and ethical considerations applied in this research.

Chapter 4 present the thesis findings. Results for males and females are compared, and tests of association between variables are also performed. Discussion on the findings is in Chapter 5. This thesis ends with a conclusion and recommendations based on the findings.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

The workplace or work environment has become the focus of health promotion to tackle major public health problems such as non-communicable diseases. The following literature review highlights the increasing burden of NCDs risk factors in South Africa as well as Africa for comparisons, with a focus on modifiable factors. A table at the end of the chapter (Table 2.1) summarises the main findings. The literature review also presents the challenges faced by health practitioners in African countries in choosing and applying algorithms used in predicting the risk of cardiovascular diseases, which are the major cause of NCD death.

2.2. Risk factors for NCDs

A risk factor is a condition or behaviour that increases the chance of having a disease or injury (Priceless South Africa, 2017). Risk factors for NCDs can be classified as modifiable and non-modifiable depending on whether they can be changed or not.

Non-modifiable risk factors

According to Ibekwe (2015), non-modifiable risk factors are attributes of an individual which cannot be changed and are not controlled by the individual, such as age, gender, race, family history, genes and menopause. A study by Phaswana-Mafuya *et al.* (2013) revealed that clustering of NCDs risks factors varied by gender, age and race. Being female, older, coloured or black African was associated with having more risk factors (Phaswana-Mafuya *et al.*, 2013). There are some inherited genes associated with a high risk of diseases. For example, people of Afrikaans descent are at higher risk of CVD due to inherited genes for familial hypercholesterolaemia. Indians are at higher risk of diabetes mellitus than other ethinic groups in South Africa due to insulin resistance. (Puoane *et al.*, 2008). Mutations in genes associated with breast cancer (BRCA-1 and BRCA-2) increase the risk of breast and ovarian cancers in people of Jewish descent (Reid & Emery, 2006). Florez *et al.* (2006) also found that a variant Transcription Factor 7 Like 2 (TCF7L2) gene was associated with an increased risk of diabetes mellitus.

Koopman *et al.* (2016) claim that the increase of NCDs in developing countries is due to gene characteristics of the population that do not favour affluent conditions and therefore puts them at high risk of developing NCDs. Research in China found that women who had menopause at an early age or shorter reproductive years were at higher risk of CVD than those who had menopause late (Yang *et al.*, 2017). According to Reid & Emery (2006), an ideal family history assessment would involve asking about parents, aunts, uncles, siblings and grandparents from both maternal and paternal sides. Detailed family history information can be combined with other personal information relating to behavioural and biological risk factors to assess a person’s risk (Claassen *et al.*, 2010).

Modifiable risk factors

Modifiable risk factors can be adjusted in many ways to reduce the risk of NCDs. Modifiable risk factors to NCDs are further classified into behavioural factors, biological factors and societal factors – a combination of socioeconomic, cultural and environmental factors (Puoane *et al.*, 2008; Budreviciute *et al.*, 2020). According to WHO (2009), eight risk factors for NCDs: tobacco use, alcohol use, high blood pressure, obesity, high cholesterol, high blood glucose, low vegetable intake and physical inactivity are responsible for 61% of cardiovascular deaths. Therefore, this research's scope focused on behavioural and biological (also called metabolic) factors and their association with age, gender, educational level, and marital status.

2.2.1 Behavioural risk factors

Most NCDs share common preventable risk factors, including behavioural factors such as tobacco use, physical inactivity, harmful alcohol consumption, and an unhealthy diet (World Health Organization, 2017). These four preventable behaviours then lead to metabolic changes such as hypertension, obesity, hyperglycemia and hyperlipidemia (World Health Organization, 2010b). However, the analysis of dietary intakes such as fruit and vegetable consumption was not included in this mini-thesis as the information was unavailable.

Tobacco use

Tobacco use was the second leading cause of death, responsible for 8.7% globally (World Health Organization, 2009). In South Africa, tobacco smoking was attributed to 12.4% of all deaths in males and 4.2% of females in 2000 (Groenewald *et al.*, 2007). Estimates by Boachie, Rossouw and Ross,

(2021) attributed 10.1% of all deaths of persons aged between 35 and 74 years to smoking in South Africa in 2016. Smoking causes a variety of NCDs such as cancers (predominantly lung cancer), cardiovascular diseases and respiratory diseases such as chronic obstructive pulmonary disease (COPD) and diabetes (Priceless South Africa., 2017). Users of cigarettes, combustible and smokeless tobacco are at a higher risk of cancer than non-tobacco users. In the United States of America, tobacco use accounts for 16% of all cancer diagnoses (Andreotti *et al.*, 2017). There is evidence that exposure to second-hand tobacco smoke associated with living with smokers increases the risk of lung cancer by 20-30% (U.S. Department of Health and Human Services, 2006). A significant portion of young people reported exposure to secondhand smoking at home (30.4%) and in public places (46.3%) (Warren *et al.*, 2006). According to Reddy *et al.* (2015), ten percent of deaths attributed to tobacco are of non-smokers exposed to environmental tobacco smoke. The majority of deaths in 2000 attributed to tobacco smoking in South Africa were due to cardiovascular diseases followed by COPD and then lung cancers. Nearly half of these deaths occur in persons aged 35 to 64 years (Groenewald *et al.*, 2007).

Studies have shown that smoking prevalence varies significantly according to gender, race and population group (Groenewald *et al.*, 2007; Priceless South Africa., 2017). Reddy *et al.* (2015) reported a 17.6% prevalence of tobacco smoking from the 2012 National Health and Nutrition Survey. In males (29.2%), tobacco smoking was four times higher than females (7.3%). Western Cape (32.9%) had the highest rate of tobacco smoking amongst all the provinces in South Africa. Northern Cape (31.2%) was second, and Northwest province (12.7%) was the lowest. Tobacco smoking prevalence by gender in Western Cape province were 39.6% in men and 26.8% in females (Reddy *et al.*, 2015). According to Reddy *et al.* (2015) prevalence of tobacco also significant differed by racial groups, highest among coloureds (40.1%) and lowest among black Africans (15.1%). Reddy *et al.* (2015) suggest that variation in tobacco smoking by provinces may be due to demographic and sociodemographic factors. The 2016 South Africa national survey reported that males were more likely to smoke than females (37% vs 8%), and smoking rates were higher in urban areas than in rural areas (38.9% vs 31.0% for men). Smoking prevalence in women also decreased with an increase in education level. (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019).

Although there are significant differences in smoking prevalence by gender (Reddy *et al.*, 2013, 2015), a global study on young people in regions including Africa showed that the gender difference in smoking prevalence was narrower among ages of 13 to 15 years (Warren *et al.*, 2006). Warren *et al.* (2006), suggest that this confirms a shifting in the prevalence of smoking by gender, which will impact the burden of disease attributable to tobacco in future generations. Warren *et al.* (2006), also reported that 9.2% of young people in Africa were current smokers, showing that the young are exposed early to smoking. In South Africa, Fagbamigbe *et al.* (2020) also reported that people started smoking at younger ages, as young as nine years, increasing the risk of becoming a regular smoker. Vellios and Van Walbeek (2016), found that living in an urban area and having a parent who smoked increased the chances of initiating smoking while increases in the price of cigarettes (for males only) and better education (including that of parents) discouraged initiation of regular smoking in South Africa. Reddy *et al.(*2013) found lower reductions in smoking prevalence among girls and black learners than other groups. Unchanged prevalence of smoking rates among young girls affects the smoking prevalence ratios of boys and girls, which might be maintained into adult life which is witnessed already in other countries (Reddy *et al.*, 2013)

While there have been notable drops in smoking prevalence since the implementation of various control measures, South Africa still has a high number of smokers (Reddy *et al.*, 2015). According to a report, the average age-standardised smoking prevalence in Sub-Saharan Africa was 11.7% in 2019. South Africa prevalence of smoking was 22.9%, Botswana 22.3%, Namibia 17.1% and Lesotho 21.7% (Reitsma *et al.*, 2021). The prevalence of smoking in the Western Cape remains high, 32.9% in 2012 and 34.8% in 2016 (Reddy *et al.*, 2015; National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019). The cost of smoking in South Africa through health expenditures was equivalent to 1% of South Africa's gross domestic product (GDP) in 2016 (Boachie, Rossouw & Ross, 2021). Boachie, Rossouw & Ross (2021) also argue that the expenses on healthcare cost society more than thrice what the government collects in taxes. An increase in the price of cigarettes due to excise tax caused people to quit smoking while others delayed becoming regular smokers. However, reducing smoking through excise taxing cigarettes is hampered by an influx of illicit cigarettes that evade paying tax (Vellios & Van Walbeek, 2016). Reddy *et al.* (2015), also theorise that excise taxes have a more significant effect on citizens with less money to spend than wealthier ones. Tingum, Mukong & Mdege (2020), encourage effective enforcement of non-pricing legislation and the pricing policy to reduce tobacco use consumption.

There are considerable variations in reports on smoking prevalence among university staff from surveys from different countries. In Nigeria, Agaba *et al.* (2017) reported a smoking prevalence of 2.9%, Ige, Owoaje & Adebiyi (2013) reported 1.9%, and Adejumo *et al.* (2020) reported 11.4%, all from different universities in Nigeria. From Uganda, Amanyire *et al.* (2019) reported 13.5%, Okube & Omandi (2018) in Kenya reported 2.7%, while Amin *et al.* (2014) from Saudi Arabia reported 26.6% prevalence of smoking among university staff. In South Africa, Reddy and Naidoo (2018) reported that 88% of the staff members at a tertiary institution in KwaZulu Natal province did not smoke. Other health surveys on employees from various sectors in South Africa reported a smoking prevalence of 38% in employees from multiple sectors (Kolbe-Alexander, Conradie & Lambert, 2013) and 19.8% among employees in the financial industry (Hene *et al.*, 2021). In the studies that reported smoking prevalence by gender, men were significantly more likely to smoke than women. In some studies, no women reported smoking (Amin *et al.*, 2014; Okube & Omandi, 2018; Adejumo *et al.*, 2020). None of the studies reviewed tested association of smoking prevalence with age, education and marital status. The varying smoking prevalences reported by the studies are due to difference in sociocultural factors within country and geographical location

Physical inactivity

Physical inactivity is another leading behavioural risk factor for NCDs, responsible for 5.5% of worldwide deaths. World Health Organization (WHO) recognises physical inactivity as the fourth leading risk factor for death after high blood pressure, tobacco use and high blood glucose (World Health Organization, 2009). Physical activity can be defined as any skeletal muscle movement that uses more energy than resting metabolic rate. Physical activity can be for occupational (work), sports or household chores. Exercise is a form of physical activity is planned, repeated, and mainly done for development or maintenance (Thivel *et al.*, 2018). Physical activity can be characterized by frequency, intensity and frequency (Thivel *et al.*, 2018). According to Katzmarzyk *et al.* (2020), light physical activity is 1.5 to less than three metabolic equivalent tasks (MET), moderate physical activity is between three and 6 MET, and vigorous physical activity is equal to greater than six MET. WHO recommends at least 150 minutes of moderate-intensity aerobic physical activity per week or vigorous exercise sustained for 75minutes per week for adults of 18-64 years old (World Health Organization, 2010a). Physical inactivity will therefore refer to not meeting recommended physical activity.

While high-level physical activity is associated with decreased all-cause mortality (Katzmarzyk *et al.*, 2020), physical inactivity is associated with CVD and increased all-cause mortality (Kraus *et al.*, 2019). Several NCDs such as type 2 diabetes mellitus (T2DM), coronary artery disease, and strokes caused by lack of physical activity are sometimes called hypokinetic diseases (Botha *et al.*, 2013). Globally physical inactivity was estimated to have caused 7% of T2DM, 10% of breast cancer and colon cancer and 9% of premature death in 2008 (Lee *et al.*, 2012). In South Africa, physical inactivity in 2000 is attributed to have caused 30% ischaemic heart disease, 27% colon cancer, 20% ischaemic stroke, 20% T2DM and 17% of breast cancers (Joubert, Norman & Lambert, *et al.*, 2007)

The prevalence of physical inactivity varies by several factors. Prevalence of physical inactivity was higher in high-income countries (36.8%) than in low-income countries (16.2%) in 2016 due to technological advancement, which make work less physically demanding and high use of private vehicles for transportation in high-income countries (Guthold *et al.*, 2018). In South Africa, physical inactivity has also been caused by urbanization and the factors already mentioned for high-income countries (Joubert, Norman & Lambert, *et al.*, 2007). By gender, physical inactivity is generally higher in women (31.7%) than men (23.4%) globally. According to Guthold *et al.* (2018), girls and women are discouraged from engaging in physical activity due to culture, traditional roles, and lack of support socially and in the community. Guthold *et al*. (2018) reported a physical inactivity prevalence of 21.4% (24.8% in women vs 17.9% in men) in Sub Saharan Africa. Women in South Africa are at high risk of NCDs due to chronic physical inactivity. Physical inactivity increases with age (Joubert, Norman, Lambert, *et al.*, 2007). Mabweazara *et al.* (2019) also found that physical activity varied by gender and geographical location, with males and rural participants having higher physical activity than females and urban areas, respectively. However, in their study, Malambo *et al*. (2016) found that urban participants had higher physical activity than rural areas. Malambo *et al.* (2016) also found that physical activity varied by level of education and marital status. In their study, participants in urban areas who only had secondary level education were more likely to be physically active than those with tertiary schooling. The authors suggest that it could be that those with better education would likely own a car, unlike the less educated. The less educated are also likely to be employed in more physically demanding jobs than the better educated (Malambo *et al.*, 2016). Even though being married was not associated with physical activity in their study, Malambo *et al.* (2016) highlighted different reports on the relationship between marital status and physical activity. According to Malambo *et al.* (2016), most studies have reported less physical activity in the married than the unmarried (for both genders).

Owen *et al.* (2010) found that prolonged sitting periods while watching television, during commuting, or at workplaces had adverse health effects even when the individual is meeting recommended physical activity. Tremblay *et al.* (2017) defined the activity mainly involving sitting or lying down and using minimum energy (lower than 1.5 MET) as sedentary behaviour. The definition of sedentary behaviours excludes sleep (Katzmarzyk *et al.*, 2020). Many studies have linked sedentary behaviours to ill-health, especially to increased risk of NCDs (Jalayondeja *et al.*, 2017; Barker *et al.*, 2018; Katzmarzyk *et al.*, 2019). Barker *et al.* (2018) study found that sedentary behaviours such as watching television for more than 58 minutes per day increased the risk of insulin resistance likelihood of bad eating habits such as consumption of sweets and chocolates. According to Katzmarzyk *et al.* (2020), the effects of sedentary behaviours are more severe in individuals who do not meet recommended physical activity than those who do. Those who have high sedentary behaviours will require more physical activity to reduce the health risk to the level of those who have less sedentary behaviours (Katzmarzyk *et al.*, 2019).

The focus of researchers has now shifted to occupational sedentary behaviours with the appreciation that working is part of adult life (Lin *et al.*, 2015). Occupational sitting has been identified as an independent risk factor of obesity (Choi *et al.*, 2010). Jalayondeya *et al*. (2017), found that office workers were at higher risk of having NCD than field workers due to sedentary behaviours at work. According to Safi *et al.* (2021), sedentary behaviours are increasing due to technology advancements, increased work demands, and policies requiring workers to always sit at their desks. Fountaine, Piacentini and Liguori, (2014) found that university employees spend most (75%) of the time at work seated. Workers who sit for long hours were found to have worse health profiles such as insulin resistance, overweight/ obesity, high waist circumference and increased systolic blood pressure (León-Latre *et al.*, 2014)

Health surveys on university employees have reported a high prevalence of physical inactivity example, Okube & Omandi (2018) reported a prevalence of 90.7% in Kenya, while Agaba *et al.* (2017) reported 77.8% in Nigeria. However, another study in Nigeria reported a lower prevalence of 27.4% (Ige, Owoaje and Adebiyi, 2013). In South Africa, Reddy and Naidoo (2018) reported a 37.6% prevalence of physical inactivity in university staff in KwaZulu Natal, while Kolbe-Alexander, Conradie and Lambert (2013) and Hene *et al.* (2021) both reported a prevalence of 67% physical inactivity in South African employees from different sectors. In Hene *et al*. (2021) study, women had a significantly higher prevalence of physical inactivity than men.

Alcohol abuse

According to Griswold *et al.* (2018), alcohol use is the seventh leading risk factor for age-standardized deaths globally. Health burden due to alcohol abuse is difficult to determine as effects of alcohol occur through three outcomes, intoxication, dependency and direct biochemical effects due to continued consumption over a period of time. Effects of acute intoxication include an accident involving drunken driving, injuries or poisoning. Biochemical effects involve the biological effects of alcohol on organs or tissue (Griswold *et al.*, 2018). Longitudinal studies demonstrated that continuous alcohol consumption is an independent risk factor for stroke. The studies also proved that even light cumulative alcohol consumption increases the risk of stroke (Duan *et al.*, 2019). Their findings agreed with other studies that there is no safe dose of alcohol intake (Griswold *et al.*, 2018; Duan *et al.*, 2019). Although single alcohol consumption did not increase the risk of stroke when taken in small amounts, moderate and heavy intake increased stroke risk (Duan *et al.*, 2019). It is difficult to define the light and moderate amounts. (Rehm *et al.* (2021) also point out that the maximum limit set for most low-risk drinking guidelines are often too high. Jacobs and Steyn (2013) are against encouraging non-drinkers to drink alcohol for health benefits as it can do more harm than good. However, they support spreading the message to heavy alcohol drinkers so that they can moderate their drink for their health (Jacobs and Steyn, 2013). According to Whitfield *et al.* (2013), taking to between two and four drinks per day of alcohol lowers risk of death due to CVD. The authors suggest that this might be to alcohol's effect on known risk factors for CVD such as HDL-cholesterol, insuling resistance and coagulation (Whitfield *et al.*, 2013)

In South Africa, alcohol consumption caused about 7.1% of all deaths in 2000. A significant proportion of deaths attributed to alcohol consumption are due to injuries and cardiovascular events. The burden due to alcohol is topped by 39% interpersonal violence, 18.4% neuropyscharitic conditions and 14.3% road traffic injuries. The risk of alcohol drinking is high among South Africans in formal and informal employment (Burnhams *et al.*, 2014). A 2008 survey revealed that the risk of drinking in men was associated with the 20-54 age group, coloured group, while in women, it was associated with staying in an urban area, being coloured, lower education and high income (Peltzer, Davids & Njuho, 2011). Cigarette smoking was also found to increase the likelihood of alcohol drinking in men and excessive in both men and women (Vellios & van Walbeek, 2018). In the Western Cape province, 44.8% were current alcohol drinkers, 16.3% engaged in binge drinking, and 15% abused drank excessively,

Alcohol abuse leads to an increase in violent crimes, risky sexual behaviour, liver damage, malnutrition, and increased risk of traffic accidents (Jacobs and Steyn, 2013). In addition, there is sufficient evidence that alcohol use is associated with cancers such as oral cavity, liver, colon, oesophagus, breast and pharynx (Parry, Patra & Rehm, 2011). According to evidence risk of cancer increases with an increase in alcohol consumption. Furthermore, alcohol consumption was also confirmed to be positively associated with overall and central obesity in both men and women (Lourenço, Oliveira & Lopes, 2012). In South Africa, alcohol consumption is more common among men than women. More men (28%) than women (5%) engaged in risky alcohol drinking behaviour (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019).

Diet

Dietary risk factors associated with NCDs include excessive sodium intake, saturated fat, transfat and overall high energy intake leading to obesity (World Health Organization, 2017) and low fruits and vegetables. However, this project will not cover dietary intake in analysis, although several studies have reported a low intake of fruits and vegetables among South Africans (Peltzer & Phaswana-Mafuya, 2012; Okop *et al.*, 2019; Vermeulen, 2020). A 2012 national health and nutrition survey in South Africa reported that a quarter (25.6%) of the surveyed sample scored low on the consumption of fruit and vegetables while only 29% achieved a high score (Shisana *et al*., 2013). Low consumption of fruits and vegetables in South Africa is much worse in poorer communities, as revealed by a cross-sectional study involving two rural and urban communities that reported that only 37.8% consumed at least two portions of fruits and vegetables daily (Okop *et al.*, 2019). Another study also reported a low intake of fruits and vegetables among the elderly in South Africa (Peltzer and Phaswana-Mafuya, 2012). The World Health Organization (2003) recommends consuming at least 400g of fruits and vegetables per day to reduce the risk of NCDs. Studies have revealed that adequate consumption of fruits and vegetables reduces the risk of various NCDs, including CVD, as well as death in general (Boeing *et al.*, 2012; Gonzalez *et al.*, 2012; Miedema *et al.*, 2015; Aune *et al.*, 2017; Miller *et al.*, 2017). According to Yu, Malik & Hu (2018), observed benefits of fruit and vegetable consumption may be due to phytochemicals and micronutrients content. Miller *et al.* (2017) suggested that the benefits may also be due to antioxidants and polyphenols, which lower blood pressure and prevent oxidation of lipids, among other things. To derive comprehensive benefits from the multi-components that make up fruits and vegetables, a study by Miedema *et al.* (2015) recommended eating whole foods rather than taking nutritional supplements. The study also provided evidence that high consumption of fruits and vegetables during early adulthood is beneficial to the heart later in life as it prevents events that cause CVDs (Miedema *et al.*, 2015). Several reasons have been given for low consumption of fruits and vegetables. Among the reasons were higher costs (Temple & Steyn, 2011; Vermeulen, 2020), unavailability (Temple & Steyn, 2011), lack of storage facilities (Deloitte Access Economics, 2016) and lack of knowledge about the benefits (Temple

& Steyn, 2011; Peltzer & Phaswana-Mafuya, 2012; Deloitte Access Economics, 2016). Some studies found certain unhealthy habits such as purchasing sugar-sweetened beverages (Okop *et al.*, 2019) and daily tobacco smoking (Peltzer & Phaswana-Mafuya, 2012) to be associated with low intake of fruits and vegetables. The desire to meet energy needs forces people to opt for high-energy foods than fruit and vegetables, which are low in energy but have more nutrients (Temple & Steyn, 2011). Even though healthier foods, including fruits and vegetables, cost more, Temple & Steyn (2011) argue that it is possible to reduce extra costs after carefully selecting foods if the person buying is well informed and motivated.

2.2.2 Biological risk factors

Biological risk factors for non-communicable diseases include high blood pressure, overweight and obesity, raised blood glucose and high total cholesterol (World Health Organization, 2010b; Budreviciute *et al.*, 2020).

High blood pressure

High blood pressure, also known as hypertension, is a major risk for morbidity and mortality worldwide. According to WHO 2004 statistics, hypertension was responsible for 12.8% of deaths globally (World Health Organization, 2009). Hypertension was also a leading risk factor for the burden of diseases for all ages globally in 2019, responsible for 9.3% disability-adjusted life years (GBD 2019 Risk Factors Collaborators, 2020). The pathophysiology of high blood pressure is complex, involving the heart, blood vessels and kidneys. Any malfunction of blood pressure regulation mechanisms results in increased cardiac output and or increased resistance in blood vessels (Camm *et al.*, 2018). Hypertension is diagnosed when systolic blood pressure (SBP) is equal or is more than 140mmHg or diastolic blood pressure (DBP) is equal or is more than 90mmHg (World Health Organization, 2013). Systolic blood pressure (SBP) rises continuously throughout life with differences of between 20-30mmHg from early childhood to late adulthood. Diastolic blood pressure (DBP) increases slightly with age, reaching a peak at around 50years (Camm *et al.*, 2018). Research has identified many risk factors for hypertension such as overweight/ obesity, insufficient intake of fruits and vegetables, diabetis mellitus and physical inactivity (Leung *et al.*, 2019). Acute and chronic stress, high dietary salt intake and low birth weight have also been identified as risk factors for hypertension (Camm *et al.*, 2018). While a family history of hypertension might be an essential factor, researchers query the influence of genetics in the development of hypertension. Mills, Stefanescu & He (2020), argue that there is no evidence of studies that use genetic factors to explain the difference in hypertension prevalence between races and ethnic groups. Ibrahim and Damasceno (2012) also agree that hypertension is more influenced by environmental and lifestyle factors than genetic factors.

Blood pressure is classified based on the level of both SBP and DBP. Optimal BP is defined by SBP of less than 120mmHg and DBP less than 80mmHg, while normal BP is defined by SBP of 120-129mmHg or DBP of 80-84mmHg. SBP of 130-139mmHg or DBP 85-89mmHg defines high normal BP. Hypertension is further graded into grade 1 (mildly elevated), grade 2 (moderately elevated) and grade 3 (severely elevated). Grade 1 hypertension is defined by SBP of 140-159 or DBP of 90-99 mmHg, while grade 2 hypertension is defined by SBP of 160-179 or DBP of 100-109 mmHg. Grade 3 hypertension is when systolic, and diastolic BP exceed 180 and 110 mmHg, respectively. Normal and high normal BP ranges are also known as prehypertension (Williams *et al.*, 2018).

The prevalence of raised blood pressure has significantly decreased in high-income countries whilst rising in low and middle-income countries (LMICs) (Mills *et al.*, 2016). According to Zhou *et al.* (2017), although difficult to explain, the decrease in hypertension prevalence in high income can be attributed to changes in risk factors and scientific advancements in detecting and treating elevated blood. In contrast, the increasing prevalence of hypertension in LMICs such as Sub-Saharan Africa can be due to inadequate fruit and vegetable intake, high dietary salt intake, poor childhood nutrition, low physical activity and rising prevalence of overweight and obesity (Zhou *et al.*, 2017). In addition, the ageing population and unhealthy lifestyles due to urbanization are also drivers of hypertension (Mills *et al.*, 2016). Mills *et al*. (2016) study also observed that hypertension in LMICs affects mainly the middle-aged group while the elderly (over 60years) are primarily the affected in high-income countries. Disease burden in middle-aged groups has a bearing on the economic effects of hypertension as the middle age group consists of the economically most productive population.

According to Camm *et al.* (2018), several studies have shown that the relationship between blood pressure level and cardiovascular events is continuous and independent of other risk factors. For blood pressure in the range of SBP 110-170mmHg and DBP 70-105, a 5mmHg increase in diastolic BP is associated with an increase in the risk of coronary disease of 20% and stroke 35% (Jackson *et al.*, 2005). In South Africa, Norman *et al.* (2007) claim that 50% of stroke, 42% of ischaemic heart disease, 72%

hypertensive disease, and 22% of other cardiovascular diseases in adults were attributable to SBP levels 115mmHg or more. The authors argued that adverse events, even at low blood pressure outside the definition of hypertension, showed a need to intervene through medical treatment to lower blood pressure (Norman *et al.*, 2007). However, Norman *et al.* (2007) suggestions were disapproved by Diallo *et al.* (2021) study, which concluded that the weak relationship between SBP and mortality in South Africa did not justify population-level lowering of SBP to below 140mmHg. Their study also found that the most significant benefits were when the target SBP was 150mmHg (Diallo *et al.*, 2021).

According to Chobanian *et al.* (2004), prehypertension (SBP 120-139/ DBP 80-89mmHg) term was added to identify persons at high risk of developing hypertension if no lifestyle changes are not implemented. The categorization would alert clinicians to offer health education to implement lifestyle changes to delay progression to hypertension (Chobanian *et al.*, 2004). Studies have shown that prehypertension is associated with an increased risk of hypertension and cardiovascular events than optimal blood pressure (Egan and Stevens-Fabry, 2015; Yancu *et al.*, 2018). According to Yancu *et al.* (2018) African Americans (blacks) with prehypertension were likely to experience more cardiovascular disease complications than Caucasians (whites) with prehypertension therefore early diagnosis and interventions are important especially in Africa. A 20mmHg increase in SBP doubles the risk of cardiovascular mortality (Armas Rojas *et al.*, 2021). In South Africa, the prevalence of prehypertension by province ranged between 32.4% and 46.1% in 2012. In the Western Cape province prevalence of prehypertension was 40.2% (Shisana *et al.*, 2013). In 2016, 33.9% of women and 31.6% of men were classified as having prehypertension in the 2016 demographic survey (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019). Studies on university staff around Africa and Asia have reported varying prevalence for prehypertension. A health survey in South Africa, KwaZulu Natal, reported a 56% prevalence of prehypertension in university staff (Reddy & Naidoo, 2018). Okube and Omandi (2018) in Kenya reported a 60.8% prevalence of prehypertension on catholic university staff. Janakiraman *et al.* (2020) reported a prevalence of 39.4% of prehypertension among employees at an Ethiopian university. A study on Malaysian university staff reported a 36.7% prevalence of prehypertension (Bo *et al.*, 2018), while in India, Rathi *et al.* (2018) reported a 20% prevalence. Studies have emphasized the importance of prevention measures through health education and behaviour change communication for prehypertensive individuals.

While the number of people with hypertension is rising, hypertension awareness, treatment and control in LMICs countries remains lower than in high-income countries. Hypertension awareness in high income countries was 67.0% vs 37.9% in low and middle income countries, treatment (58.6% vs 29.0%) and control (28.4% vs 7.7%) (Mills *et al.*, 2016). In South Africa, more than half (58%) of hypertensive study participants were unaware of their hypertension, 33% were taking medication, and only 18% had control of their hypertension. Women and those who reported not adding salt to food at the table were more likely to be aware of their hypertension (Ware *et al.*, 2018). Ibrahim and Damasceno (2012) also reported higher hypertension awareness in women than men. In South Africa, hypertension awareness was 51% in women vs 26% in men (Ibrahim & Damasceno, 2012). In Western Cape province, 13.3% of men and 22.1% of women who were on treatment for hypertension had blood pressure under control (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019). According to WHO (2013), high blood pressure is often undiagnosed in the early stages due to a lack of symptoms. If not controlled, hypertension can cause stroke, heart failure and or renal failure (Sheps *et al.*, 1997).

South Africa has one of the highest prevalences of hypertension in Sub-Saharan Africa. In a study on hypertension, South African sites at 41.6-54.1% had the highest prevalence of hypertension compared to other locations in other countries such as Nairobi, Kenya 25.6% and Navrongo, Ghana 24.5% (Gómez-Olivé *et al.*, 2018). The prevalence of hypertension has nearly doubled between 1998 and 2016, from 25% to 46% in women and from 23% to 44% among men. The difference between the prevalence of self-reported hypertension and prevalence after taking BP readings confirms that a significant portion of South Africans is unaware of their conditions (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019). Kandala *et al.* (2013) study observed a geographical variation in the prevalence of hypertension in South Africa. The authors suggested it could be due to underlying social and environmental factors within provinces that influence individual risk levels.

There is evidence of studies linking elevated blood pressure in childhood to adulthood hypertension. An increase in childhood hypertension will increase the prevalence of hypertension in adults; therefore, measures should be taken to reduce high blood pressure and its risk factors in children and adolescents. A review of 51 studies in Africa revealed that the prevalence of high blood pressure in children ranged from 0.2-24.8% (Noubiap *et al.*, 2017). The study also revealed that childhood high blood pressure was significantly associated with increased BMI. The prevalence of hypertension in obese children was six times higher than children who had normal BMI (Noubiap *et al.*, 2017). A study on rural children in South Africa found that high blood pressure was 0.4% boys and 0.2% in girls aged 7-13years (Goon *et al.*, 2013). A longitudinal study on urban children in South Africa followed subjects from birth in 1990 till they were 18years old. The study found that a third to about half of children who had high blood pressure sometime during the follow-up period had hypertension at the age of 18years. The authors blamed the rise in childhood hypertension the consumption of food high in calories, fats and salt (Kagura *et al.*, 2015)

Western Cape province was amongst the areas with the highest prevalence of hypertension in South Africa. In the 2016 demographic survey, the region recorded the highest hypertension prevalence among men (58.7%) by the province in South Africa, while the prevalence among women was 51.6% (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019). Significant increases in mean SBP and DBP for Western Cape province were reported between 2012 and 2016 surveys. In the 2012 survey, the mean recorded were 131.79mmHg SBP and 71.2mmHg DPB (Shisana *et al.*, 2013) while the 2016 demographic survey reported 134.1mmHg SBP and 85.1mmHg DBP (Shisana *et al.*, 2013; National Department of Health (NDoH), Statistics South Africa (Stats SA) and ICF, 2019). The rise in mean SBP and DBP could be due to uncontrolled and undiagnosed hypertension and the rising prevalence of hypertension. The average prevalence of hypertension reported in 2012 was 9.4%, while in 2016, the average was 55.2% (Shisana *et al.*, 2013; National Department of Health (NDoH), Statistics South Africa (Stats SA) and ICF, 2019) Only 22.1% of women and 13.3% of men who had hypertension had it under control in 2016. Overall, 29.8% of the people in Western Cape province had mildly elevated hypertension, 9.9% had moderately, and 6% had severely elevated hypertension (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019).

Health surveys on employees in South Africa and other studies on university staff in Africa have reported varying prevalence levels of hypertension. Kolbe-alexander, Conradie & Lambert (2013) study on South African employees from 68 worksites found that one-third of employees had hypertension. The authors also found that mean SBP in males was significantly higher than that of females. Joseph-shehu and Ncama (2018) study on university staff in Nigeria reported a prevalence of 33.9%. In their study, hypertension was associated with age, gender, marital status, monthly income, the highest level of education. Married employees were more likely to have hypertension, while women and the highly educated participants were less at risk of having hypertension (Joseph-shehu & Ncama, 2018). Okube & Omandi (2018) study on Kenyan university employees reported hypertension prevalence higher than the national prevalence (33.2% vs 23.8%). However, the prevalence of severe hypertension was lower than the national prevalence (1.3% vs 8%) (Okube & Omandi, 2018).

Overweight and Obesity

Overweight and obesity (mainly defined by BMI >25kg/m^2) are ranked fifth among risk factors for death, responsible for 4.8% of deaths worldwide 2002 (World Health Organization, 2009). Several studies have demonstrated health risks associated with excess weight and fat accumulation (Ehrampoush, Arasteh and Homayounfar, 2017). Obesity has two forms, global and central obesity (Liu *et al.*, 2018). Although BMI is the commonly used indices to define obesity, there are others in use, such as waist circumference (WC), waist-hip ratio (WHR) and waist-to-height ratio (WtHR) (World Health Organization, 2011). While BMI is the only one used to assess global obesity, the others (WC, WHR, WtHR) are used to determine central obesity (Liu *et al.*, 2018). These indices are used to assess the risk of NCDs. Elevated BMI was one of the top five risk factors in terms of death and disability-adjusted life years (DALYs) in 2016 (Stanaway *et al.*, 2018).

In South Africa, elevated BMI causes a significant burden of disease. In 2000, high BMI was attributed to have contributed to 87% of T2DM, 68% of hypertensive disease, 61% of endometrial cancers and 45% of ischaemic stroke (Joubert, Norman, Bradshaw, *et al.*, 2007). Joubert, Norman & Bradshaw, *et al.* (2007) ranked elevated BMI as the fifth risk factor in South Africa based on death and DALYs. The proportion of T2DM, cardiovascular conditions and some cancers attributed to overweight and obesity in South Africa in 2000 were higher than the global estimate, especially in women. The fraction of attributable disease due to overweight and obesity were higher in women than men due to the high prevalence of obesity in South African women.

Jaacks *et al.* (2019) described a pattern of changes in prevalence and subpopulation mostly affected by obesity through epidermiological observation of countries that first experienced obesity and termed the trend - obesity transition. According to Jaacks *et al.* (2019), the first countries to experience obesity have gone through a distinct pattern of predictable stages based on information analysed. Obesity transition has three steps. According to Jaacks *et al.* (2019), South Africa entered the obesity transition in 1975 with several high-income countries. Stage 1 is characterized by a rise in obesity prevalence to 5-20% in women. There will be higher obesity prevalence in women than men and adults than children. Prevalence of obesity in Stage 1 is also positively associated with socioeconomic status and education. That is, the prevalence of obesity is higher in those of higher socioeconomic status and the educated. By 2016 all other countries had entered the obesity transition except for Vietnam (Jaacks *et al.*, 2019).

South Africa entered stage 2 of the transition in 2016 together with countries such as Mexico, Brazil and Russia and many others. Stage 2 is characterized by significant increases in the prevalence of obesity among adults and small increases among children. There is also a reduction in gap obesity prevalence by gender and socioeconomic status. While obesity prevalence may rise to 25-40% in women, in men, it may reach 20%, and in children, it will be close to 10% during stage 2. It is confirmed in South Africa that between 2008 and 2012, the prevalence of obesity in men rose by more considerable proportions than in women. Most middle-income countries are at stage 2 of the transition with varying gaps of obesity between gender and different socioeconomic status. (Jaacks *et al.*, 2019).

The third stage is characterized by a reduction in obesity prevalence between gender and a reversal of positive association with socioeconomic status. The prevalence of obesity will be higher in groups, regions or subpopulations of lower socioeconomic status and lower education. United States of America, Italy, Spain, France, Germany and the United Kingdom entered the third stage by 2016 (Jaacks *et al.*, 2019). According to observation, no country has ever succeeded in reducing obesity. The authors suggest that reductions in the prevalence of obesity have to begin with lowering obesity prevalence in children and adolescents who will grow into adulthood free of obesity (Jaacks *et al.*, 2019).

In South Africa, the burden of obesity is growing unabated. In the Southern African Development Community (SADC) region, South Africa has one of the highest prevalences of overweight and obesity. According to Gona *et al.* (2021), South Africa and Swaziland had the highest prevalence of obesity and overweight in children (2-19yrs) among all SADC countries. Obesity in childhood and adolescence is associated with a higher risk of obesity in adulthood (Simmonds *et al.*, 2016). According to (Puoane, Hughes and Bradley, 2005), contributors to obesity in South Africa include environmental, cultural beliefs, and socioeconomical factors. Globalization has changed the food environment in urban areas. People are forced to shift from a healthy traditional diet to a western diet due to unavailability of traditional food and an almost ubiquitous availability of westernized food stuffs. Urbanization has increased exposure of people to food that is high in salt, unhealthy fats, processed and refined carbohydrates. Cultural beliefs influence women to accept and desire a huge body because of societaly views that associate it with happiness, wealthy and ability of husband in taking care of family. Lack of education, poverty, and unsafe neighborhoods discourage engaging in outdoor physical activities (Puoane, Hughes and Bradley, 2005). The female gender, being married (Goetjes *et al.*, 2021), tertiary education and socioeconomic status (Wagner *et al.*, 2018) are positively associated with increased BMI in South Africa.

In a 2012 national survey, Shisana *et al.* (2013) reported that women in South Africa were significantly more overweight and obese than men (24.8% and 39.2% vs 20.1% and 10.2%). In the Western Cape province mean BMI for men (25.0 kg/m^2) was lower than that of women (28.5 kg/m^2). The prevalence of obesity in women (37.9%) was more than double that of men (16.1%) in Western Cape province. In Western Cape, 48.9% of men had normal BMI, and 26.9% were overweight. Among women, 34.1% had normal BMI, while 24.5% were overweight (Shisana *et al.*, 2013). Obesity defined by other indices WC and WHR were also reported in the survey. In Western Cape province mean WC for men was 84.6cm, 29.8% had WC ≥94cm, and 12.8% had WC ≥102cm. Women's mean WC was 89.0cm, 68.8% had WC ≥ 80cm, and 50.4% had WC ≥ 88cm. Mean WHR was 0.88 for men and 0.87 for women in Western Cape province. Fifty-one percent (51.5%) of women had high WHR while 8.2% of men had abnormal WHR. Obesity indices varied by gender, age, location (urban vs rural), province and race (Shisana *et al.*, 2013).

Many health surveys on university staff around Africa reported a prevalence of obesity above the average for the country in which the university is located (Table 2.1). For example, Agaba *et al.* (2017) reported 26.7% obesity prevalence among university staff in Nigeria, while another study in Nigeria by Adejumo *et al.* (2020) reported obesity prevalence of 31.4% among university staff at a different university. Both studies reported a prevalence of obesity higher than the average 8.9% for Nigeria (*Obesity Rates By Country 2021*, no date). Amanyire *et al.* (2019) reported an obesity prevalence of 28% among university staff against a national average of 5.3% for Uganda. In Kenya, where the national average is 7.1%, Okube & Omandi (2018) reported an obesity prevalence of 36.3% among university staff. The few study examples show that university employees might be at greater risk of obesity than the general population due to their occupation or lifestyles. A few studies reported variations of obesity prevalence by gender, age, education level and marital status of university employees. Agaba *et al.* (2017) reported significant difference of prevalence of obesity by gender (males 10.6% vs females 50.0). Prevalence of obesity was also slightly higher in the married (27.0%) than those not married (25.6%) university staff (Agaba *et al.*, 2017). Amanyire *et al.* (2019) reported a higher prevalence of obesity among younger staff members ≤40years (42.0%) than in those who were over forty years old. The prevalence of obesity among university staff also varied by education. Staff members without a masters degree were less likely to be obese than those with a masters degree (19.5% vs 37.8%) (Amanyire *et al.*, 2019). In South Africa, Reddy & Naidoo (2018) reported an obesity prevalence of 26.6%, similar to the national average of 26.0 reported in the 2016 national demographic survey. The prevalence of obesity varies significantly between and within countries depending on socioeconomic factors that influence lifestyle or modify risk (Jaacks *et al.*, 2019).

Dyslipidemia

Dyslipidemia refers to presence of abnormal levels of any of the components of lipids such as cholesterol, lipoprotein, triglycerides and phospholipids (cut off value are defined in section 3.4.3) (Onyiriuka, Iduoriyekemwen & Sadoh, 2021). Dyslipidemia increases the risk of atherosclerotic cardiovascular diseases. (Talpur *et al.*, 2020; Onyiriuka, Iduoriyekemwen & Sadoh, 2021). It can affect all ages – the elderly and the young (Wakabayashi & Daimon, 2019). According to Vodnala, Rubenfire & Brook (2012) causes of dyslipidemia are grouped into primary and secondary causes. Primary causes of dyslipidemia are due to inherited gene mutations that result in excessive production or failure to remove triglycerides and cholesterol. The secondary causes are due to unhealthy lifestyles such as excessive alcohol intake, smoking, or some medical conditions such as uncontrolled diabetes (Vodnala, Rubenfire & Brook, 2012; Yanai &Yoshida, 2021). Dyslipidemia also occurs together with other risk factors for CVD such as obesity, hypertension and diabetes (Wakabayashi & Daimon, 2019). While many researchers have cautioned on dietary cholesterol intake, linking it to increased risk of CVD, new evidence now disapproves the link (Soliman, 2018). According to Soliman (2018), recent evidence shows that animal sources of cholesterol should be avoided because they contain unhealthy fats which are shown to result in increased levels of LDL-cholesterol, leading to increased risk of CVD.

High serum cholesterol and low-density lipoprotein cholesterol (LDL-cholesterol) were identified as independent risk factors of ischemic stroke in women. All abnormal lipid components were also independently associated with an increased risk of coronary heart disease regardless of gender (Tohidi *et al.*, 2013). The ratio of lipid components such as trigycerirdes to HDL-cholesterol or LDL-cholesterol to HDL-cholesterol are used as predictors for CDV events (Wakabayashi & Daimon, 2019). High cholesterol was the sixth risk factor of death, responsible for 4.5% of deaths globally (World Health Organization, 2009). In a study by Peters *et al.* (2016), the risk of coronary heart disease increased by 20% in women and by 24% in men with every 1-mmol/L increase in total cholesterol. According to WHO (2010), a quarter of adults in low-income countries have raised total cholesterol in their blood. High LDL cholesterol levels and low levels of high-density lipoprotein cholesterol (HDL-cholesterol) were independently associated with coronary atherosclerosis (Pletcher *et al.*, 2010). The prevalence of dyslipidemia is rising in developing countries. Khine & Marais (2016) revealed high prevalence levels of dyslipidemia among the black South African population. The authors suggested that antiretroviral treatment could be one of the contributing factors to the high prevalence of dyslipidemia in South Africa. Other studies have also found high CVD levels in patients on antiretroviral treatment (Yuyun *et al.*, 2020). According to Agongo *et al.* (2019) high prevalence of dyslipidemia in urban areas is linked to physical inactivity, westernized diet and sedentary occupation. The authors also state that lipid profiles vary by ethinicity (Agongo *et al.*, 2019)

In South Africa, the Western Cape province recorded the highest mean serum cholesterol and LDL-cholesterol values in the 2012 national survey. All recorded means values of lipid parameters for Western Cape province were above the national averages. Serum cholesterol in the region was 4.6mmo/l against a national average of 4.22mmol/l, while LDL-cholesterol was 2.75mmol/l vs 2.44mmol/l national average. Mean triglyceride was 1.55mmo/l in the province vs 1.44 average nationally. The mean of HDL cholesterol was 1.31mmol/l in the region, and the national average was at 1.22mmol/l. Within the province, 37% (34.8males vs 39.3% females) had abnormally high cholesterol, 44% (49% in males and 38.8% in female) had abnormal low HDL-cholesterol, 37.9% (32% in men and 43.6% in women) had high LDL-cholesterol, and 28% (32.5% in men vs 20.5% in women) had abnormally high triglyceride levels (Shisana *et al.*, 2013).

Very few studies have reported dyslipidemia in university employees in Africa. Agaba *et al.* (2017) reported a dyslipidaemia prevalence of 51.8% among university employees in Nigeria. (Amin *et al.* (2014) reported a prevalence of 36.6% high cholesterol, 36.1% high triglycerides, 36.8% low HDL-cholesterol and 36.8% high LDL- cholesterol among university staff in Saudi Arabia. In South Africa, Reddy & Naidoo (2018) reported a prevalence of 40% high cholesterol and 48% high triglycerides at a university in KwaZulu Natal. There was variation in cut off points used in the studies, especially on serum cholesterol which varied from 5.0mmol/l to 6.2mmol/l.

High blood glucose and diabetes mellitus

High blood glucose is another important risk factor, third-leading global mortality risk and is responsible for 5.8% of deaths (World Health Organization, 2009). High blood glucose can result from a lack of insulin (diabetes mellitus type 1) or body cells failing to respond to insulin stimulation (diabetes mellitus type 2). Complications of high blood glucose over long periods include CVDs, nerve damage, kidney damage and loss of eyesight due to retinopathy. Globally, diabetes mellitus affects 9.3% of the world's population between the age of 20-79years and is expected to rise to 10.2% by 2030. Among those who 30years and above, diabetes is estimated to have caused 10% of stroke, 12% of renal disease and 14% ischaemia heard disease as well as being responsible for 4.3% of all death in South Africa in 2000 (Norman *et al.*, 2007). The prevalence of diabetes mellitus is higher in high-income countries (8.6-13.3%) than in low-income countries (2.8-6.7%). However, low-income countries have the highest proportion (66.8%) of undiagnosed diabetes worldwide due to limited access to healthcare services (International Diabetes Federation, 2019). The South African Demographic and Health Survey (SADHS) report for Western Cape province was 11.2%, while the national average was 9.5% in women (Shisana *et al.*, 2013). Shisana *et al.* (2013) reported that diabetes varies with age and sex. The South Africa demographic survey of 2016 reported that diabetes prevalence was higher in women with no formal education than in women with other education categories (includes even those who did not complete primary education). A study on university staff with a mean age of 44± 10years in Nigeria reported prevalence of diabetes increased with age while diabetes prevalence was 6.9% in males and 9.7% in females (Agaba *et al.*, 2017)

Table 0.1:Summary of health surveys on university staff across the globe and South African employees from other sectors

REFERENCE	(Agaba *et al.*, 2017)	(Amanyire *et al.*, 2019)	(Amin *et al.*, 2014)	(Janakiraman *et al.*, 2020)	(Reddy and Naidoo, 2018)	(Kolbe-Alexander, Conradie and	(Ige, Owoaje and Adebiyi, 2013)	(Bo *et al.*, 2018)	(Adejumo *et al.*, 2020)	(Okube and Omandi, 2018)	(Rathi *et al.*, 2018)	(Hene *et al.*, 2021)
COUNTRY	Nigeria	Uganda	Saudi Arabia	Ethiopia	South Africa	South Africa	Nigeria	Malaysia	Nigeria	Kenya	India	South Africa
COUNTRY GPD PER CAPITAL	2687.5	843.6	25224.3	640.5	5734.2			9955.2		1336.9	1605.6	
YEAR OF STUDY	2014	2017	2012	2018	2017	2008	N/S	2016	2018	2017	N/S	2016-19
Economic sector	UNIV	UNIV	UNIV	UNIV	UNIV	MIXED	UNIV	UNV	UNIV	UNIV	COLL	FIN
SAMPLE	883	156	691	381	75	2867	525	349	140	301	65	36074
MEAN AGE /YEARS	44	42	24-63	33.5	39.7	35.9	37.4	38.5	41.7	20-60	<40	38.1
SMOKING %	2.9	13.5	26.6		12	38	1.9		11.4	2.7		19.8
ALCOHOL %	24	14.1	0%		68		51			61.1		
LOW FRUIT & VEGETABLES	94.6		86			71	96					89.3
PHYSICAL INACTIVITY %	77.8	61.3	73		37	67	27.4			90.7		77.4
OBESITY %	26.7	28	30.7	13.1	26.6				31.4	36.3	1.6	
COUNTRY AVERAGE OBESITY*	8.9	5.3	35.4	4.5	26.0	26.0	8.9	15.6	8.9	7.1		26.0
OVERWEIGHT %			33	27.1	37.3	62**		80**		47.5	21.9	66.8
ABNORMAL WC %				33.6						78.1		37.4
ABNORMAL WtHR %				51.9								
ABNORMAL WHR %				58.5							15.4	
HYPERTENSION %	48.5	71	22.1	13.9			21.5	20.3	32.9	33.2	7.7	20.3
PREHYPERTENSION				39.4	56			>30	47.1	60.8	20	
DYSLIPIDEMIA %	51.8											
HIGH CHOL %			36.6		40	41		15.5				21.1
HIGH TRIG%			36.1		48			10.6				
LOW HDL CHOL %			36.8					16				
HIGH LDL CHOL %			36.8					16.1				
DIABETES MELLITUS %	8	16	21.5	4.5	1.3		11	12	0		9.2	19.9

***Reference of average obesity for the country (*Obesity Rates By Country 2021*, no date) ** overweight and obesity (high BMI) reported Country GDP/ capita USD (World Bank, no date)**

2.2.3 Clustering of Risk factors for NCDs

A study by Phaswana-Mafuya *et al.* (2013) confirmed that behavioural risk factors NCDs do not exist in isolation but are linked to others. Risk factors for NCDs tend to cluster, whereby an individual will have more than one risk factor. Having multiple risk factors increases the risk of developing NCDs (Phaswana-Mafuya *et al.*, 2013). A study involving three sites in South Africa found that 65% of participants had two or more risk factors per individual. The number of risk factors also significantly differed between the sexes (Wagner *et al.*, 2021). In India, a study on tertiary hospital employees found a high prevalence of overweight and obesity among participants, which the researchers suggested was due to a large portion of the employees being administrative staff who had a sedentary lifestyle (Sharma *et al.*, 2012). South African employees in the financial sector were found to have a high burden of risk factors. Fifty percent (49.6%) of the employees had three to four risk factors, while 19.3% had at least five risk factors for NCDs (Hene *et al.*, 2021). Other studies have also found that clustering of risk factors for NCDs was prevalent among employees (Ketkar *et al.*, 2015; Agaba *et al.*, 2017). According to Peters *et al.* (2018) a combined effect happens when risk factors co-exist in an individual. A single risk factor might not pose much risk when it is alone, but it might have the most significant health threat in the presence of other risk factors. Some of the factors that affect the risk of having cardiovascular disease are blood pressure, total cholesterol, smoking and overweight (Peters *et al.*, 2018). Norman *et al.* (2007) therefore recommended that CVD prevention strategies should assess a combination of risk factors – absolute risk based approach, for them to be effective in reducing the burden of CVD.

2.3. CVD risk and assessment

South Africa has a high and increasing burden of NCDs and their risk factors (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019; Wagner *et al.*, 2021). According to the World Health Organisation, most deaths due to NCDs are caused by cardiovascular diseases (World Health Organization, 2018). Therefore, risk factors for CVD events are also high. Gaziano *et al.* (2013)

estimated high 10-year risk of CVD (>20% on FRSLAB CVD risk algorithm) using 1998 surveillance data to be 18% in the South African population using non-laboratory-based method. Peer *et al.* (2014) study in Cape town involving 1025 black African found that 13% of men and 6.1% of women were at a high 10-year risk of CVD events. Nyirenda (2021) estimated an average 28% high 10-year CVD risk in HIV-positive and HIV-negative study participant. In the study average 10-year, CVD risk was significantly higher in men than in women. Hene *et al.* (2021) found that 10.2% and 4.8% of employees in the financial sector had an intermediate and high risk of CVD, respectively.

Most guidelines used in CVD prevention recommend use of absolute risk approaches as they are more cost effective than the individual risk based approach because they prioritise treatment to those at high risk of CVD while avoiding uncessary treatment of those at low risk (Doust *et al.*, 2012). A research by Black *et al.*, (2021) showed that cardiovascular risk can be reduced significantly by informing patients their risk scores after assessment and then educating them on lifestyles changes to improve the score. CVD risk assessment algorithms are based on the absolute risk approach as they make use of combined risk factors to determine the ultimate risk.

However, according to Wagner *et al.* (2021), the level of CVD risk varies according to the algorithm used and agreement between algorithms is low. Furthermore, most algorithms used to determine ten year CVD risk were developed based on data from developed countries and may not be as accurate for use in developing countries. Therefore, there is a need to validate and calibrate before use in Africa to avoid unnecessary costs or misdiagnosis (Boateng *et al.*, 2018; Wagner *et al.*, 2021). Gaziano *et al.* (2013) compared six laboratory-based CVD risk algorithms to a non-laboratory based risk score. The study included three versions of Framingham risk score, SCORE LOW, SCORE HIGH and CUORE function algorithms. The study found high correlations between the non-laboratory based risk score and laboratory-based scores and recommended using the non-laboratory based algorithms in settings where there are no laboratory facilities. Gaziano *et al*. (2013) assessment of the non-laboratory and laboratory-based algorithms was based on agreement on CVD risk greater than 20% (high) on the FRSLAB algorithm. FRSLAB algorithm agreement with the non-laboratory method was between 89.8-93.9% (Gaziano *et al.*, 2013). Gaziano *et al.* (2013) did not compare the laboratory-based scores against each other. There are many revisions of the risk score algorithms, and many other risk scores now have both laboratory and non-laboratory based methods to estimate CVD risk. A previous version of WHO-CVD (WHO/ISH) was not included in Gaziano *et al.* (2013) study. According to Wagner *et al.* (2021), the WHO-CVD risk algorithm was recently updated in late 2019. However, very few published studies have compared these different algorithms in the African population. A study by Wagner *et al*. (2021) confirmed other researchers' findings that the Framingham algorithms overestimated CVD risk while the WHO CVD risk algorithm identified lesser individuals at higher risk of CVD than the Framingham algorithms. Boateng *et al.* (2018) also found discrepancies in CVD risk assessment between FRSLAB and FRSNLAB and PCE algorithms. The differences could be arising from that Boateng *et al.* (2018) assess the agreement of CVD algorithm in predicted levels from low, intermediate and high-risk score while Gaziano *et al.* (2013) focused on the high-risk group only. This study will include a comparison of the latest WHO-CVD algorithm with the FRSLAB algorithm.

2.4. Conclusion

Lack of evidence-based information on NCDs and their risk factors within specific population subgroups prevents action needed to address the burden of NCDs in that population. In addition, low agreement and discrepancy between CVD risk algorithms affect policy and intervention to avoid the common deadly condition. This study aims to provide insight into the health risks of the university employees, which is crucial for effective advocacy, planning, implementation and evaluation of targeted health programs. The study is also valuable for growing evidence on the performance and comparison of CVD risk assessment algorithms in Africa.

CHAPTER THREE

METHODOLOGY

3.1. Introduction

This chapter will present the research methods used for the study. Research methods are the various planned scientific ways by which a researcher collects samples and or data and analyses it to understand a topic or subject under study better. These include theoretical procedures, experiments and statistical approaches (Gounder, 2012). This chapter will therefore explain how the data was collected, including all the procedures followed. The first section will discuss the study design, study area and setting. Thereafter, sampling procedures, data collection process and research analysis approach followed in this research will be presented. Measurement instruments such as questionnaire and anthropometric measurement, namely weight, height, waist circumference (WC), and Body Mass Index (BMI), will also be discussed. The validity, reliability, trustworthiness and generalizability of the study will be included in this section. The last section deals with ethical issues.

3.2. Study design

The study was based on secondary analyses of underutilized data from a campus health project conducted in 2011, which generated data through descriptive cross-sectional research. The research mainly focused on determining the prevalence of different NCDs risk factors in administrative staff at the University of the Western Cape, South Africa and allowed exploration of multiple risk factors (exposures) and diseases to be investigated simultaneously.

3.3. Population and Sampling

3.3.1 Description of the study population and sampling method

The study population consisted of all (men and women) administrative staff (office workers) working in six faculty offices, student administration, human resources and the finance department at the UWC campus in Bellville South. Administrative staff from the faculty of dentistry were excluded due to logistical reasons as they were located at another site off-campus. Academic staff were excluded from the study due to logistical constraints of finding them compared to administrative staff who are mostly in their offices.

3.3.2 Sampling strategy

Due to a manageable number of the target population (n=150), all administrative staff were considered for the study and therefore approached and invited to participate. No sampling method was applied in selecting participants. All staff members who consented to take part in the study were included.

3.3.3 Sample size

The sample size was calculated using EPIinfo™ version 7.2.4.0, whereby the standard error was set at 0.05 whilst the confidence interval was set at 95%, and the total population size was taken as 150. Assuming a population variance of different risk factors between 5% and 75% based on South Africa national demographic surveys, a sample size of 108 was the highest number obtained (at 50% expected frequency) (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019). However, no sampling was done as all administrative staff members who gave consent were included in the study.

3.4. Data collection

3.4.1 Data collection procedures

Individual appointments were made with each participant at a time that suited them, during which all the measurements were done. All interviews were conducted in English, the official language of the university.

3.4.2 Socio-economic, demographic, and health status data

Information on age, smoking history, exercise patterns, alcohol intake and family history of lifestyle diseases were obtained by interview, using a questionnaire. The questionnaire was developed and tested in a pilot study on administrative staff not included in the main study. All questionnaires were checked for completeness in the field. Questionnaires used for female (Appendix 1) and male (Appendix 2) staff are provided.

3.4.3 Biochemical indicators

A qualified phlebotomist nursing sister drew a 10ml blood sample from the ante-cubital vein using sterile SST (serum separating tube) II Advance vacutainer® tubes and needles. Blood was centrifuged and serum stored at -20°C until analysis. Analysis was done for total cholesterol, triglycerides, low-density lipoproteins (LDL) and high-density lipoproteins (HDL) and markers of glycaemia (HbA1c) using standardized laboratory methodology. Dyslipidemia was diagnosed when a participant has at least one high lipid profile parameter with the cut-offs: total cholesterol ≥ 5.0mmol/l, triglycerides ≥1.7mmol/l, LDL-cholesterol ≥3.0mmol/l or HDL-cholesterol ≤1.2mmol/l (Shisana *et al.*, 2013) (also same as according to laboratory reference ranges).

3.4.4 Anthropometric measurements

Height was measured to the nearest, 0.1 cm without shoes, using a stand-alone stadiometer. Weight was determined to the nearest 0,05 kg, using a calibrated electronic load cell digital scale (A&D precision scale, Capacity 136Kg x 50g). Trained and standardized fieldworkers did weight and height measurements. Scales were calibrated twice a day. An average for both weight and height was used in further calculations after performing measurements twice for each participant. Body mass index (BMI) was calculated for each participant using the formula weight (kg) divided by height squared (m^2). Cut off points were used to interpret BMI whereby less than 18.5 was considered underweight, 18.5 -24.9 as normal weight, 25-.0 - 29.9 as pre-obese or overweight and greater or equal to 30 as obese. Obesity is further classified as class I for BMI of 30.00-34.99kg/m^2, class II when BMI is 35.00-39.99kg/m^2 and class III when BMI is greater than or equal to 40 (World Health Organization, 2000).

Waist circumference (WC) and hip circumference was measured to the nearest 0.1cm using a measuring tape. Two WC and hip circumference measurements were done on every participant, and an average was calculated and used in further data analysis. Waist-hip ratio (WHR) to assess abdominal fat and visceral obesity was calculated by dividing the average of two WC readings by the average of two hip circumference readings. A waist circumference of >94cm for males and >80cm for females defined increased risk for metabolic complication while >102cm for males and >88cm for females defined substantially increased risk for metabolic complication. Waist-hip ratios of ≥90 and ≥0.85 were used as cut off values to define substantially increased risk of metabolic complications in males and females, respectively (World Health Organization, 2011).

Waist to height ratio (WtHR) was also calculated for each participant by dividing average WC by the average height measured. A cut-off point of ≥ 0.5 was used to define increased risk for metabolic complications in both men and women (Baioumi, 2019).

Blood pressure (BP) was measured on the right arm while the participant was sitting, using Omron Digital Blood Pressure Monitor UA-767PC (Saitama, Japan). Two readings 5 minutes apart were taken. A third measurement was taken if the systolic BP differed by more than six mmHg and the diastolic value differed by more than 4 mm Hg for two measurements. An average of accepted two readings was used in the analysis for both systolic and diastolic blood pressure. A participant was classified as having high blood pressure if he/she was taking medication for hypertension or if his/her systolic blood pressure was 140mm/Hg or above or diastolic blood pressure was 90mmHg or above at the time of data collection for the survey (World Health Organization, 2013).

BP was classified according to the European society of cardiology and the European society of hypertension. The classification is the same as that used in the 2016 South Africa demographic and health survey report. Optimal BP is defined by systolic BP of less than 120mmHg and diastolic BP less than 80mmHg, while normal BP is defined by systolic BP of 120-129mmHg or diastolic BP of 80-84mmHg. High normal BP is defined by systolic of 130-139mmHg or diastolic BP 85-89mmHg. BP readings in normal and high normal ranges are also known as prehypertension. Hypertension is further graded into grade 1 (mildly elevated), grade 2 (moderately elevated) and grade 3 (severely elevated). Grade 1 hypertension is defined by systolic 140-159 or diastolic BP 90-99 mmHg, while grade 2 hypertension is defined by systolic 160-179 or diastolic 100-109 mmHg. Grade 3 hypertension is when systolic and diastolic BP exceed 180 and 110 mmHg, respectively (Williams *et al.*, 2018). Participant BP classification was done using the average of two accepted results. In cases where second readings were not available, only single readings were used. If a participant's BP reading fell into different grades based on systolic and diastolic reading, the higher of the two grades was assigned.

3.4.5 Cardiovascular disease risk prediction models

All campus health study participants above 40 years (minimum age requirement for CVD risk assessment) with complete biomedical data, without diabetes, heart problem or history of clinical CVD, were included in the CVD risk prediction assessment. Ten-year risk of CVDs was estimated using six different algorithms, namely, Framingham laboratory-based risk score (FRSLAB) (Klug *et al.*, 2018), Framingham non-laboratory-based risk score (FRSNLAB) (Gaziano *et al.*, 2008), Pooled Cohort Equations (PCE) algorithms for African Americans (*ASCVD Risk Estimator +*, no date), SCORE-high risk charts (SCORE-HIGH), SCORE-low risk charts (SCORE-LOW) (*SCORE Risk Charts*, no date) and the WHO-CVD (The WHO CVD Risk Chart Working Group, 2019). Diabetic patients were excluded from CVD risk assessments because the other models did not include diabetes mellitus status in their prediction equations, except Framingham non-laboratory and WHO-CVD models.

3.5.5.1 Framingham laboratory-based risk score (FRSLAB)

Cornfield and Truett first developed the scoring method in 1967 though it has evolved many times (Boateng *et al.*, 2018). The current FRSLAB algorithm incorporates age, gender, smoking status, systolic blood pressure, total cholesterol, HDL-cholesterol, and whether the person is taking antihypertensive treatment. An excel spreadsheet developed by D'Agostino *et al.* (2008) available on https://framinghamheartstudy.org/files/2017/08/gencardio_lipids.xls was used.

3.5.5.2 Framingham non-laboratory-based risk score (FRSNLAB)

It is a modified version of the Framingham laboratory-based risk score in which total cholesterol is replaced by body mass index in the equation to determine CVD risk. Thus, non-laboratory scoring is more suited and applicable in rural areas where total cholesterol measurement is costly and not readily available (Boateng *et al.*, 2018). An excel spreadsheet developed by D'Agostino *et al.* (2008) also available on https://framinghamheartstudy.org/files/2017/08/gencardio_bmi.xls, was used.

3.5.5.3 Pooled Cohort Equations (PCE) algorithms for African Americans

PCE algorithm provides CVD risk estimates specific to gender and race in African Americans and Whites aged between 40 and 70. The equations are based on age, smoking status, systolic blood pressure, antihypertensive treatment status, diabetes status, total cholesterol and HDL- cholesterol levels (Goff *et al.*, 2014). An excel spreadsheet available at http://static.heart.org/ahamah/risk/Omnibus_Risk_Estimator.xls was used to determine CVD risk for participants. All participants were considered African Americans since no questions about race were asked or captured in the campus health survey data. PCE formula also requires the parameters to be in acceptable ranges. For example, one participant was excluded from CVD risk estimation because of total cholesterol below 3.36mmol/l (130mg/dl).

3.5.5.4 SCORE LOW and SCORE HIGH algorithms

The algorithms are based on analysed data sets from European countries to derive equations for CVD risk prediction. SCORE- LOW algorithm is from data of countries with low risk of CVD, while SCORE-HIGH algorithm is from countries known to have a high-risk population. The algorithms are based on equations that consider age, gender, smoking status, systolic blood pressure and total cholesterol levels. The charts used to derive CVD risk score for participants in the study are available on https://www.escardio.org/static-file/Escardio/Subspecialty/EACPR/Documents/score-charts.pdf

3.5.5.5 WHO CVD Risk Chart Working Group (WHO-CVD) Algorithm

WHO developed the CVD risk prediction charts and the International Society of Hypertension for countries within WHO epidemiological sub-regions and the latest updates are of 2019 (The WHO CVD Risk Chart Working Group, 2019). The charts take into consideration: age, gender, smoking status, systolic blood pressure, total cholesterol levels as well diabetic status of the person to calculate the risk of CVD. For this study, the chart applicable to South Africa is for Southern Sub-Saharan Africa on page 5 of WHO cardiovascular disease risk laboratory-based charts https://www.thelancet.com/cms/10.1016/S2214-109X(19)30318-3/attachment/0bb4f97c-d682-49b9-9d58-a16b58c87155/mmc2.pdf

3.5.5.6 Cardiovascular risk stratification

The absolute cardiovascular risk score for each prediction model was stratified into three levels: low, intermediate and high cardiovascular risk. Cut off values were adopted after consulting various articles as done by others (Selvarajah *et al.*, 2014; Ghorpade *et al.*, 2015; Boateng *et al.*, 2018; Santos Sales & Casotti, 2019; Babatunde *et al.*, 2020). Cut off values used for each model in this study are shown in the table below.

Table 0.1: Cut off values for stratification levels used in each prediction model

Level	Threshold	CVD risk prediction algorithm
Low	<1%	SCORE-LOW, SCORE-HIGH
	<10 %	WHO-CVD, FRSLAB, FRSNLAB, PCE
Intermediate	1-4%	SCORE-LOW, SCORE-HIGH
	10-19.9%	WHO-CVD , FRSLAB, FRSNLAB, PCE
High	≥5%	SCORE-LOW, SCORE-HIGH
	≥20%	WHO-CVD , FRSLAB, FRSNLAB, PCE

.

3.5. Data analysis

Data were analyzed using SPSS® software version 25. Univariate analysis was performed, and parametric data were presented as means and standard deviation (SD). Normal cut-off reference values were used to interpret the levels for each of the biochemical indicators. By default all reported statistics are based on computations using only the available data (non missing cases), thereby eliminating missing cases in our report.

Categorical data were presented as frequencies, proportions and cross-tabulations. Association between various categorical variables were tested using the fisher's exact test (due to cases where the number of variables is less than 5). Mann Whitney U test (data was assumed not normally distributed) was used to compare differences of continuous variables. A value of $p < 0.05$ was considered to be statistically significant.

CVD predictions for each model are presented as proportions for each stratification level (low, intermediate, high). In addition, other prediction models were assessed for agreement with Framingham laboratory-based algorithm using Kappa statistics whereby agreement was rated as poor

(< 0.0), slight (0.01-0.20), fair (0.21-.40), moderate (0.41-0.60), substantial (0.61-0.80) or almost perfect (0.81-0.99) (Viera & Garrett, 2005).

3.6. Data management

Data was stored in Excel on a password protected electronic storage device accessible by the principal investigator of the Campus Health survey. The student was only granted access to an anonymized data set for the selected variables described in the research proposal. The student had no access to personal details and could not link any data set to a specific respondent. The student similarly stored data on a password protected electronic storage device for the duration of data analyses. Thereafter the dataset used by the student was deleted. Similarly, the Principal Investigator will destroy data from the primary study after completing data analysis and writing up or publishing this research.

3.6.1 The role of the student researcher

The student researcher performed all statistical analyses related to the secondary data analyses.

3.7. Validity and Reliability

Threats to internal validity include instrument issues (questionnaire, measurement tools, laboratory machines), order bias and research bias (Mohajan, 2017). To assure internal validity, the following were applied:

3.7.1 Preventing selection bias

Extending an invitation to all the population subjects helped avoid selection bias, and no incentive was offered for participation. Although the researchers tried to prevent selection bias, there were limitations in the efforts as participation in the research depended on volunteerism. Participants decided themselves on whether to be part of the study or not. The researchers, therefore, had low control over the sample. According to Walters (2021), volunteerism results in selection bias because of differences between those who choose to volunteer and non-volunteers. Therefore the volunteer sample rarely represents the population (Gabor, 2007). Gabor (2007) suggests that it might be essential to compare those who volunteer and those who do not, but this was not possible in our study due to various constraints.

3.7.2 Minimizing measurement bias

The interview questionnaire was developed and tested in a pilot study on a similar sample of staff who were not included in the main study. Trained and standardized fieldworkers did the weight and height measurements. Scales were calibrated twice a day. For blood pressure, an average was used from the two readings obtained during measurements.

The laboratory where biochemical indicators were analyzed is a quality accredited (South African National Accreditation System) laboratory. Therefore, the whole system was subjected to periodic rigorous quality checks, thus ensuring the validity of the biological risk factors measurements done in the laboratory.

3.7.3 Researchers knowledge of the environment

Knowledge of environmental events of the researcher also helped in assuring internal validity.

External validity can only be guaranteed for the described populations under investigation. Other research may be needed in other settings to allow generalization to a different population group.

Threats to the reliability of the study include participant error, participant bias, and researcher error and researcher bias. To ensure reliability, face-to-face interviews were conducted in a conducive private office environment to ensure the participants' comfort. Timing of interviews was also crucial, and time conducive to the participant was considered the best time (participants scheduled appointments suited to their schedule). During the interview, the order of the questions was maintained for all participants. A maximum number of interviews per day per interviewer was planned as per the estimated duration of an interview during the pilot testing. Results of other assessments such as biochemical tests were unknown to fieldworkers and eliminated researcher bias.

3.8. Ethical Consideration

The Campus Health project received ethics approval from the Senate Research and Ethics committee (reference 11/5/37). The proposal for this study was submitted to the Humanities and Social Sciences Research Ethics Committee of the University of the Western Cape for approval and ethics clearance (Appendix 3; reference HS20/2/16). Permission to use the secondary data from the Campus Health project was granted by the principal researcher, the supervisor in this thesis project (Appendix 4).

The student had only access to anonymized data in Microsoft Excel. Sound clinical practice principles were applied by the student in the storage of all data.

CHAPTER FOUR

RESULTS

4.1. Introduction

This chapter presents findings from secondary analysis of underutilized data from a campus health project conducted in 2011. The chapter starts with the basic characteristics of participants and their general health conditions. Then, continuous variables are presented with mean, median, standard deviation and interquartile range. Next, a comparison of variables for men and women were performed using an appropriate non-parametric test while proportions were used for ordinal variables, and association with gender, age, educational level and marital status were tested using the fisher's exact test. CVD risk was also calculated using information from the survey for eligible participants using different algorithms. Finally, results of stratified CVD risk are presented, and comparisons of agreement of other prediction algorithms were made with Framingham laboratory-based algorithm. Results are presented under the following subsections:

4.2 Demographic characteristics of participants

4.3 Self-reported family history of NCDs and previously diagnosed health conditions among participants

4.4 Analysis of risk factors for NCDs among participants

4.4.1 Smoking and Alcohol consumption

4.4.2 Physical activity and Sedentary Behaviours

4.4.3 Overweight and Obesity

4.4.4 Waist Circumference

4.4.5 Waist to height ratio

4.4.6 Hypertension

4.4.7 Diabetes

4.4.8 Dyslipidemia

4.4.9 Waist- Hip Circumference

4.4.10 Clustering of risk factors to NCDs

4.5 Risk of cardiovascular disease among participants

4.5.1 Risk of CVD in participants by gender

4.5.2 Comparison of CVD risk in participants predicted by different algorithms

4.6 Conclusion

4.2. Demographic characteristics of participants

A total of seventy-eight administrative staff voluntarily took part in the campus health survey. Participants consisted of more women (62.8%) than men (37.2%). The majority of sampled staff members had completed tertiary education (67.9%) and were married (70.1%). More than half (55.1%) of the participants were above forty years old (Table 4.1), and the mean age of all staff surveyed was 40.7 ± 10.3 years (Table 4.2). There was no significant difference between the mean age of men and women, although the ages of men were more scattered around the mean with a wider standard deviation than that of women (Table 4.2). Only two staff members (2.6%) surveyed were not of South African nationality. There was no sex difference in educational characteristics of surveyed staff members in terms of attaining matric or tertiary education.

Table 0.1: Socio-demographic characteristics of study participants

Socio-demographic aspects	Categories	(n) %
Sex	Male	(29) 37.2
	Female	(49) 62.8
Age	≤ 40 years	(35) 44.9
	> 40 years	(43) 55.1
Education	No Matric	(4) 5.1
	Matric	(21) 26.9
	Tertiary	(53) 67.9
Marital status	Married	(54) 70.1
	Co-habiting	(3) 3.9
	Single	(20) 2.6

Table 0.2: Distribution of selected continuous variables among study participants by gender

Variable	Category	n	Mean	SD	Median	IQR	Man Whitney U test of mean men vs women
Age (years)	Total	78	40.65	10.33	42	18	0.91
	Men	29	41	11.78	42	22	
	Women	49	40.45	9.75	43	17	
BMI	Total	78	30.03	6.67	28.82	7.15	0.47
	Men	29	28.83	3.96	28.04	4.95	
	Women	49	30.74	7.8	30.21	9.12	
Cholesterol (mmol/L)	Total	70	5.18	0.91	5.15	1.4	0.45
	Men	27	5.08	1.08	5	1.7	
	Women	43	5.25	0.8	5.2	1.4	
HBA1c (%)	Total	69	5.4	0.74	5.2	0.4	0.61
	Men	27	5.47	0.99	5.2	0.3	
	Women	42	5.36	0.53	5.3	0.5	
Triglyceride (mmol/L)	Total	70	1.37	0.78	1.1	1	**0.04***
	Men	27	1.52	0.71	1.2	1.1	
	Women	43	1.28	0.81	1	1	
HDL-cholesterol (mmol/L)	Total	70	1.4	0.43	1.3	0.5	**0.001***
	Men	27	1.17	0.23	1.2	0.3	
	Women	43	1.54	0.46	1.5	0.7	
LDL-cholesterol (mmol/L)	Total	70	3.16	0.87	3.2	1.2	0.80
	Men	27	3.21	0.97	3.1	1.2	
	Women	43	3.12	0.81	3.2	1.2	
WC (cm)	Total	78	96.08	14.85	95.95	18.1	0.19
	Men	29	98.6	10.6	98.25	13.5	
	Women	49	94.59	16.79	95	27.5	
Hip Circumference (cm)	Total	78	110.73	13.33	109.9	13.15	0.16
	Men	29	107.18	7.37	108.05	9.8	
	Women	49	112.83	15.53	110	17.28	
Systolic BP (mmHg)	Total	77	131.58	16.75	128.5	19.5	0.52
	Men	29	134.9	19.15	128.5	22.75	
	Women	48	129.58	14.98	128.75	18.25	
Diastolic BP (mmHg)	Total	77	83.94	11.7	84	13	0.11
	Men	29	86.28	10.32	87.5	14.75	
	Women	48	82.52	12.35	83	12	
WtHR	Total	78	0.58	0.88	0.58	0.12	**0.00***
	Men	29	0.56	0.55	0.56	0.9	
	Women	49	0.59	0.1	0.59	0.15	

Note. * p <0 .05

4.3. Self-reported family history of NCDs and previously diagnosed health conditions among participants

The most frequently self-reported family history of NCDs was a history of hypertension (55.1%) followed by diabetes (34.6%). The top three self-reported previously diagnosed medical conditions among participants were hypertension (26.9%), overweight (26.9%), and high cholesterol (23.1%). Conversely, the least self-reported NCDs among participants were diabetes (5%), heart disease (2%) and cancer (1%) (Table 4.3).

Table 0.3: Rate of self-reported personal and parents history of NCDs in study participants

Reported history of NCD	Participants (n) %	Parents (n)%
Diabetes	(4) 5.1	(27) 34.6
Heart Disease	(2) 2.6	(21) 26.9
High Cholesterol	(18) 23.1	(20) 25.6
Hypertension	(21) 26.9	(43) 55.1
Cancer	(1) 1.3	(20) 25.6
Overweight	(21) 26.9	(14) 17.9
Stroke	Not asked	(16) 20.5

4.4. Analysis of risk factors for NCDs among participants.

4.4.1 Smoking and alcohol consumption

Thirty percent (30.7%) of the participants smoked tobacco, including occasional smokers (4%), who smoked less than one cigarette a day. The prevalence of tobacco smoking was higher among men (37.9%) than women (26.5%) (Table 4.4), even though the difference was not statistically significant at alpha 0.05. More than half (53.1%) of women had never smoked, while a fifth had quit smoking. In our study, tobacco smoking was not associated with gender, age, education, or participants' marital status.

The majority (65.4%) of administrative staff members reported that they sometimes take alcohol. Prevalence of tobacco smoking and alcohol consumption were not influenced by gender, age, education level or marital status of participant (Table 4.5)

Table 0.4: Prevalence of ever smoking tobacco among study participants

Status	Total (n) %	Men (n) %	Women (n) %
Current smoker	(21) 26.9	(10) 34.5	(11) 22.4
Occasional smoker	(3) 3.8	(1) 3.4	(2) 4.1
Quit smoking	(18) 23.1	(8) 27.6	(10) 20.4
Never smoked	(36) 46.2	(10) 34.5	(26) 53.1

Table 0.5: Prevalence of modifiable behavioural risk factors and their association with gender, age, education and marital status of study participants.

Variable	Category	Total (n)%	Tobacco smoking (n)%	Alcohol consumption (n)%	Physical inactivity(n)%	Sedentary behaviour (TV viewing)		
						<1hr (n)%	1-3hrs (n)%	>3hrs (n)%
All Participants	All	78	(24) 30.7	(51) 65.4	(34) 43.6	(11) 14.3	(53) 68.8	(13) 16.9
Sex	Male	(29) 37.2	(11) 37.9	(19) 65.5	(12) 41.4	(1) 3.4	(24) 82.8	(4) 13.8
	Female	(49) 62.8	(13) 26.5	(32) 65.3	(22) 44.9	(10) 28.8	(29) 60.4	(9) 18.8
	Fisher's exact		0.32	1.00	0.82	0.07		
Age	≤40 years	(35) 44.9	(12) 34.3	(25) 71.4	(17) 48.6	(4) 11.8	(20) 58.8	(10) 29.4
	>40 Years	(43) 55.1	(12) 27.9	(26) 60.5	(17) 39.5	(7) 16.3	(33) 76.7	(3) 7.0
	Fisher's exact		0.63	0.35	0.49	**0.04**		
Education	No Matric	(4) 5.1	(3) 75.0	(3) 75.0	(2) 50.0	0	(2) 50.0	(2) 50.0
	Matric completed	(21) 26.9	(8) 38.1	(13) 61.9	(9) 42.9	(5) 23.8	(12) 57.1	(4) 19.0
	Tertiary completed	(53) 67.9	(13) 24.6	(35) 66.0	(23) 43.4	(6) 11.5	(39) 75.0	(7) 13.5
	Fisher's exact		0.06	0.92	1.00	0.18		
Marital status	Married	(54 70.1	(18) 33.4	(32) 59.3	(23) 47.6	(8) 15.1	(41) 77.4	(4) 7.5
	Living together	(3) 3.9	(1) 33.3	(2) 66.7	(2) 66.7	0	(1) 33.3	(2) 66.7
	Single	(20) 26.0	(5) 25.0	(17) 85.0	(8) 40.0	(3) 15.0	(10) 50.0	(7) 35.6
	Fisher's exact		0.81	0.10	0.76	**0.01**		

4.4.2 Physical inactivity and sedentary lifestyle

About forty-four percent (43.6%) of the participants did not do any physical exercises, and the majority (85.7%) engaged in sedentary behaviour characterized by sitting and watching television for at least an hour. There was no association between physical inactivity and gender, age, education level or marital status. Sedentary behaviour (watching TV) was associated with the age and marital status of the participant but not with gender and education level. (Table 4.5)

4.4.3 Overweight and obesity

Only 10% of men and 20% of women were of normal BMI. More than half (51%) of the women participants were obese, while 55% of men were overweight (pre-obese) (Table 4.6). Men's mean BMI (28.8 kg/m^2) was lower than women's (30.7 kg/m^2). There was no significant difference between the mean BMI of men and women, even though they fall in different BMI classification categories; men's mean BMI is in the pre-obese while that of women is in the obese class I category. Obesity was associated with gender (p=0.04). Women were significantly more overweight/obese than men. There was no association of BMI with age, level of education and marital status, at an alpha of 0.05 (Table 4.7).

Table 0.6: Percentage of BMI categories among participants by sex, age, education and marital status

Variable	Category	BMI class				
		Normal (n)%	Pre-obese (n)%	Class I (n) %	Class II (n)%	Class III (n)%
All participants	All	(13) 16.7	(30) 38.5	(21) 26.9	(6) 7.7	(8) 10.3
Sex	Male	(3) 10.3	(16) 55.2	(8) 27.6	(2) 6.9	0
	Female	(10) 20.4	(14) 28.6	(13) 26.5	(4) 8.2	(8) 16.3
	Fisher's exact	**0.04**				
Age	≤40 years	(6) 17.1	(16) 45.7	(8) 22.9	(1) 2.9	(4) 11.4
	>40 Years	(7) 16.3	(14) 32.6	(13) 30.2	(5) 11.6	(4) 9.3
	Fisher's exact	0.54				
Education	No Matric	0	(2) 50.0	0	0	(2) 50.0
	Matric completed	(7) 33.3	(9) 42.9	(4) 19.0	(1) 4.8	0
	Tertiary completed	(6) 11.3	(19) 35.8	(17) 32.1	(5) 9.4	(6) 11.3
	Fisher's exact	0.06				
Marital status	Married	(8) 14.8	(19) 35.2	(17) 31.5	(3) 5 .6	(7) 13.0
	Living together	(1) 33.3	(1) 33.3	0	(1) 33.3	0
	Single	(4) 20.0	(10) 50.0	(3) 15.0	(2) 10.0	(1) 5.0
	Fisher's exact	0.36				

Table 0.7: Prevalence of biological risk factors among study participants and their association with sex, age, education and marital status.

Variable	Category	High BMI (n) %	Abnormal WtHR (n)%	T2DM (n)%	Raised TC (n)%	Raised LDL-chol (n)%	High BP (n)%	Low HDL-chol (n)%	Dsylipidemia (n)%	High TRIG (n)%	High WC	Abnormal WHR (n)%
Total (all)	All	(65) 83.3	(67) 85.9	(5) 7.2	(40) 57.1	(41) 58.6	(32) 41.6	(19) 27.1	(58) 82.9	(21) 30.0	(57) 73.1	(44) 56.4
Sex	Male	(26) 89.7	(27) 93.1	(3) 11.1	(14) 51.9	(15) 55.6	(13) 44.8	(10) 37.0	(22) 81.5	(10) 37.0	(21) 72.4	(17) 58.6
	Female	(39) 79.6	(40) 81.6	(2) 4.8	(26) 60.5	(26) 60.5	(19) 39.6	(9) 20.9	(36) 83.7	(11) 25.6	(36) 73.5	(27) 55.1
	Fisher's exact	0.35	0.20	0.37	0.62	0.80	0.81	0.17	1.00	0.42	1.00	0.82
Age	≤40 years	(29) 82.9	(29) 82.9	(1) 3.4	(13) 46.4	(14) 50.0	(12) 35.3	(10) 35.7	(22) 78.6	(6) 21.4	(23) 65.7	(15) 42.9
	>40 Years	(36) 83.7	(38) 88.4	(4) 10.0	(27) 64.3	(27) 64.3	(20) 46.5	(9) 21.4	(36) 85.7	(15) 35.7	(34) 79.1	(29) 67.4
	Fisher's exact	1.00	0.53	0.39	0.15	0.32	0.36	0.27	0.52	0.29	0.21	**0.04**
Education	No Matric	(4) 100	(4) 100	(1) 33.3	(2) 66.7	(2) 66.7	(3) 75.0	0	(3) 100	(2) 66.7	(4) 100	(3) 75.0
	Matric completed	(14) 66.7	(16) 76.2	(1) 5.3	(10) 50.0	(9) 45.0	(6) 28.6	(5) 25.0	(15) 75.0	(4) 20.0	(12) 57.1	(11) 52.4
	Tertiary completed	(47) 88.7	(47) 88.7	(3) 6.4	(28) 59.6	(30) 63.8	(23) 44.2	(14) 29.8	(40) 85.1	(15) 31.9	(41) 77.4	(30) 56.6
	Fisher's exact	0.06	0.34	0.22	0.83	0.31	0.19	0.72	0.52	0.21	0.12	0.73
Marital status	married	(46) 85.2	(47) 87.0	(4) 8.3	(29) 59.2	(32) 65.3	(26) 41.1	(13) 26.5	(44) 89.8	(16) 32.7	(43) 79.6	(34) 63.0
	cohabiting	(2) 66.7	(2) 66.7	0	(2) 66.7	(1) 33.3	0	(2) 66.7	(3) 100	(1) 33.1	(1) 33.3	(1) 33.3
	single	(16) 80.0	(17) 85.0	(1) 5.9	(8) 47.1	(7) 41.2	(6) 31.6	(3) 17.6	(10) 58.8	(3) 17.6	(12) 60.0	(8) 40.0
	Fisher's exact	0.43	0.54	1.00	0.68	0.15	0.18	0.19	**0.02**	0.48	0.06	0.15

4.4.4 Waist circumference (WC)

Mean WC among men of 98.6cm is above the cut of for men WC of 94cm. Thus, the mean WC for men is in the range of abnormal increased metabolic complications. The mean of female participants was 94.6cm and is above the cut for high abnormal (substantially increased metabolic complications) WC of ≥88cm. Women's waist circumference was more scattered from mean and median than men as they had wider standards deviation and interquartile range, respectively (Table 4.2 and Figure 4.1).

While there was no association of abnormal WC with age, education and marital status, there was an association with gender at an alpha of 0.05 (p <0.001) (Table 4.8). In addition, the proportion of women with high abnormal WC was significantly higher than that of men. Over two thirds (69.4%) of women had abnormally high WC compared to 27.6% of men (Table 4.8).

Table 0.8: Percentage of participants who exceed cut off for abnormal and high abnormal waist circumference by sex, age, education and marital status.

Variable	Category	Waist Circumference	
		Abnormal (n)%	High Abnormal (n)%
Total (all)	All participants	(15) 19.2	(42) 53.8
Sex	Male	(13) 44.8	(8) 27.6
	Female	(2) 4.1	(34) 69.4
	Fisher's exact	**<0.001**	
Age	≤40 years	(8) 22.9	(15) 42.9
	>40 Years	(7) 16.3	(27) 62.8
	Fisher's exact	0.23	
Education	No Matric	0	(4) 100
	Matric completed	(3) 14.3	(9) 42.9
	Tertiary completed	(12) 22.6	(29) 54.7
	Fisher's exact	0.22	
Marital status	Married	(10) 18.5	(33) 61.1
	Living together	0	(1) 33.1
	Single	(5) 25.0	(7) 35.0
	Fisher's exact	0.12	

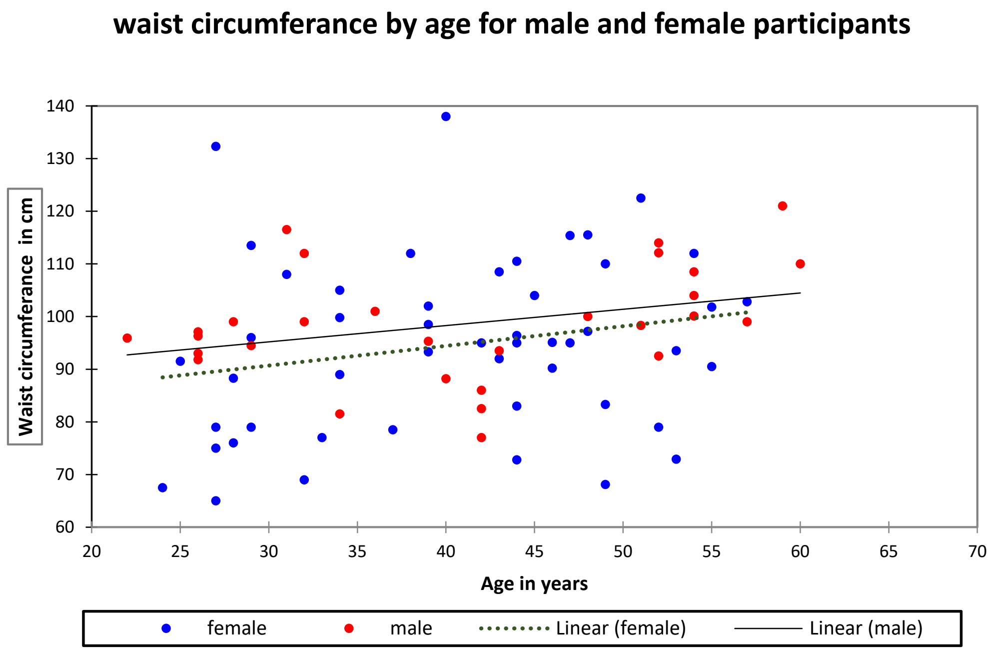


Figure 0.1: Waist circumference by age for male and female participants

4.4.5 Waist to height ratio (WtHR)

The difference between the mean WtHR of men and women was statistically significant at an alpha of 0.05 (Table 4.2). Abnormal WtHR of 0.5 or more was found in 93.1% of men and 81.6% of women. WtHR was not associated with gender, age, education level or marital status of participant (Table 4.7)

4.4.6 Hypertension

A quarter (26.9%) of surveyed administrative staff reported being previously diagnosed with high blood pressure (Table 4.3). Following blood pressure measurements, 41.6% of the participants were hypertensive (Table 4.7). Two-thirds of participants had normal (optimal and prehypertension) readings at the time of taking BP measurements. The normal BP group also includes participants (7.8%) taking medication to control blood pressure and had normal readings at the time of assessment. They constituted 28.5% of the self-reported staff members who self-reported hypertension. Prehypertension was recorded in 44.2% of participants who were not previously diagnosed of having hypertension. The difference between those classified as having hypertension and those previously diagnosed with hypertension (self-reported personal history) shows that some participants were unaware that they were hypertensive. Seventeen percent of men (17.2%) and 15.1% of women had undiagnosed hypertension and were not on treatment. The youngest person among those newly diagnosed with hypertension was twenty-two years old. Prevalence of hypertension was higher in men (44.8%) than in women (39.6%) and among those more than 40years (46.5%) than in the less than 40yrs (35.3%) age group. However, in this study, hypertension was not associated with gender, age, education level, or participants' marital status (Table 4.7).

The mean SBP and DBP of men (134.9 and 86.3 mmHg) were higher than those of women (129.6 and 82.5mmHg), although the difference was not statistically significant at alpha 0.05 (Table 4.2). The mean blood pressure of participants classified as not having hypertension was in the prehypertension category according to SBP but in the optimal range of DBP (Table 4.9). Undiagnosed hypertension participants' mean SBP and DBP were higher than those on treatment (self-reported previously diagnosed BP) (Table 4.8). A quarter of participants (24.7%) had mildly elevated hypertension, while 5.2% had moderate and 3.9% had severe hypertension (Table 4.10).

Table 0.9: Mean of administrative staff grouped according to history of blood hypertension.

Status of Participant	(n) %	Mean SBP ± SD(mmHg)	Mean DBP ±SD (mmHg)
Normal BP (<140 and <90mmHg & no history of BP	(45) 58.4	122.07± 9.82	77.72± 8.57
Undiagnosed hypertension (not on treatment)	(11) 14.3	145.83 ± 13.01	93.58± 8.45
Self reported previous diagnosed (on treatment for hypertension)	(21) 27.3	144.45 ±16.85	92.13 ±10.75

Table 0.10: BP categories among administrative staff by gender.

BP category	All (n)%	Men (n) %	Women (n)%
Optimal (<120/ <80mmHg)	(13)16.9	(4)13.8	(9)18.8
Prehypertension (120-139 / 80-89mmHg)	(38)49.4	(13)44.8	(25)52.1
Grade 1, mildly elevated	(19) 24.7	(8)27.6	(11)22.9
Grade 2, moderately elevated	(4) 5.2	(3)10.3	(1)2.1
Grade 3, severely elevated	(3) 3.9	(1)3.4	(2)4.2

4.4.7 Diabetes

The prevalence of diabetes in the participants was 7.2% (11.1% in men and 4.8 % in women) based on self-reported history of T2DM and glycated haemoglobin results. Most (4/5) of the diabetic participants already knew their condition. Prevalence of diabetes had no association with gender, age, education level and marital status (Table 4.7)

4.4.8 Dyslipidemia

The mean cholesterol of men (5.08mmol/l) was lower than the mean cholesterol of women (5.25mmo/l). The mean LDL cholesterol of men (3.21mmol/l) was higher than the mean LDL cholesterol of women (3.12mmol/l). However, the difference between mean cholesterol and LDL-cholesterol of men and women were not statistically significant. The mean triglycerides of men (1.52mmol/l) were significantly higher than the mean triglycerides of women (1.28mmol/l). The mean HDL cholesterol of women (1.54mmol/l) was significantly higher than the mean HDL cholesterol of men (1.17mmol/l) (Table 4.2).

Dyslipidemia was present in 82.9% of participants and associated with marital status (p=0.02). Further analysis of dyslipidemia in the participants showed that two-thirds of office administrators had at least two abnormal lipid profile parameters (Table 4.11). Thirty-four percent (34%) of administrative staff had undiagnosed high cholesterol as cases increased from 23.1% known cases (Table 4.3) to 57.1% after laboratory tests (Table 4.7). Therefore 34% of the participants were not aware of their condition. Dyslipidemia and prevalence of abnormal lipid profile parameters (cholesterol, triglycerides, HDL-cholesterol and LDL-cholesterol) was not associated with gender, age, education level and marital status of participants (Table 4.11)

Table 0.11 Number of abnormal lipid parameters in participants by gender.

Number of abnormal lipid parameters	Gender		Total
	Male	Female	
	N (%)	(n)%	(n)%
One (1)	(3) 11.1	(9) 20.9	(12) 17.3
Two (2)	(12) 44.4	(19) 44.2	(31) 44.3
Three (3)	(6) 22.2	(7) 16.3	(13) 18.3
Four (4)	(1) 3.7	(1) 2.3	(2) 2.9

4.4.9 Waist –Hip Ratio (WHR)

More than half (56.4) of the administrative staff had abnormal WHR. WHR was significantly associated with age but not with gender, education level, and participants' marital status (Table 4.7). The difference between the mean hip circumference of men and women was not statistically significant (Table 4.2)

4.4.10 Clustering of risk factors to NCDs

Risk factors considered in assessing clustering were tobacco smoking, alcohol consumption, physical inactivity, obesity, abnormal WtHR, dyslipidemia, abnormal waist circumference, abnormal waist-hip ratio, hypertension and diabetes. The highest number of risk factors found in an individual was eight from a possible ten risk factors. According to the assessments, only one woman, constituting 2.3% of women, had no risk factor for NCDs. The most frequent number of risk factors found in an individual was seven in both men and women. More than three-quarters (77.2%) of participants had at least five risk factors per individual (Table 4.12).

Table 0.12: Number of risk factors for NCDs in a participant by gender

Number of Risk factors in a Participant	Gender		Total
	Male	Female	
	N (%)	(n)%	(n)%
No risk factor	0	(1) 2.3	(1) 1.4
One (1)	(0)	(2) 4.7	(2) 2.9
Two (2)	(3)11.1	(2) 4.7	(5) 7.1
Three (3)	(0)	(4) 9.3	(4) 5.7
Four (4)	(3)11.1	(1) 2.3	(4) 5.7
Five (5)	(6)22.2	(7) 16.3	(13) 18.6
Six (6)	(2) 7.4	(9) 20.9	(11)15.7
Seven (7)	(9) 33.3	(11) 25.6	(20) 28.6
Eight (8)	(4) 14.8	(6) 14.0	(10) 14.3

4.5. Risk of cardiovascular disease among participants

Only participants who were at least 40years were eligible for cardiovascular disease risk assessment using prediction algorithms. The prediction models use a combination of some or all of the following inputs: age, gender, race, smoking status, systolic blood pressure, use of antihypertensive medication, BMI, total cholesterol level, HDL-cholesterol, LDL-cholesterol and diabetes status of an individual in determining CVD risk. Charts, formula calculations, or tables developed from population studies to assign a CVD risk score were used. CVD risk score was classified as low, moderate or high based on score and algorithm stratification instructions. Stratified CVD risk for each individual by other algorithms was then compared to the Framingham laboratory algorithm for agreement using Cohen's Kappa statistic coefficient. A total of 41 administrative staff, 26 (63.4%) women and 15 (36.6%) men, with all the parameter data, fit the eligibility criteria for CVD risk assessment. One participant was excluded from the PCE algorithm because of a cholesterol level lower than the minimum required for the formula.

4.5.1 Risk of CVD in participants by gender

Based on Framingham laboratory-based risk score, 76.9% of women were classified as a low risk of cardiovascular disease, with the remainder (23.1%) at intermediate CVD risk. On the other hand, according to Framingham laboratory-based score, a third (33.3%) of men were classified as having a high risk of cardiovascular disease (Table 4.13 and Figure 4.2). Similarly, other CVD risk prediction scores except the WHO-CVD algorithm showed that a small portion of men were the only participants at high CVD risk (Table 4.13 and Figure 4.2).

Table 0.13: Percentage of participants in each CVD risk category by gender using six different algorithms and kappa agreement of prediction algorithm with FRSLAB algorithm

Prediction algorithm	Summary of CVD risk level for all participants				CVD risk level by gender						Agreement with FRSLAB algorithm
					Low		Intermediate		High		
	Total (N)	Low (n)%	Intermed (n)%	High (n)%	Men (n) %	Women (n) %	Men (n) %	Women (n) %	Men (n) %	Women (n) %	kappa
FRSLAB	41	(23) 56.1	(13) 31.7	(5) 12.2	(3) 20.0	(20) 76.9	(7) 46.7	(6) 23.1	(5) 33.3	-	-
FRSNLAB	41	(23) 56.1	(11) 26.8	(7) 17.1	(4) 26.7	(19) 73.1	(4) 26.7	(7) 26.9	(7) 46.7	-	0.747
PCE	40	(32) 80.0	(7) 17.5	(1) 2.5	(7) 50.0	(25) 96.2	(6) 42.9	(1) 3.8	(1) 7.1	-	0.300
SCORE-LOW	41	(20) 48.8	(21) 51.2	0	(2) 13.3	(18) 69.2	(13) 86.7	(8) 30.8		-	0.481
SCORE-HIGH	41	(15) 36.6	(22) 53.7	(4) 9.8	(2) 13.3	(13) 50.0	(9) 60.0	(13) 59.1	(4) 26.7	-	0.642
WHO-CVD	41	(40) 97.6	(1) 2.4	0	(14) 93.3	(26) 100	(1) 6.7	-	-	-	0.013

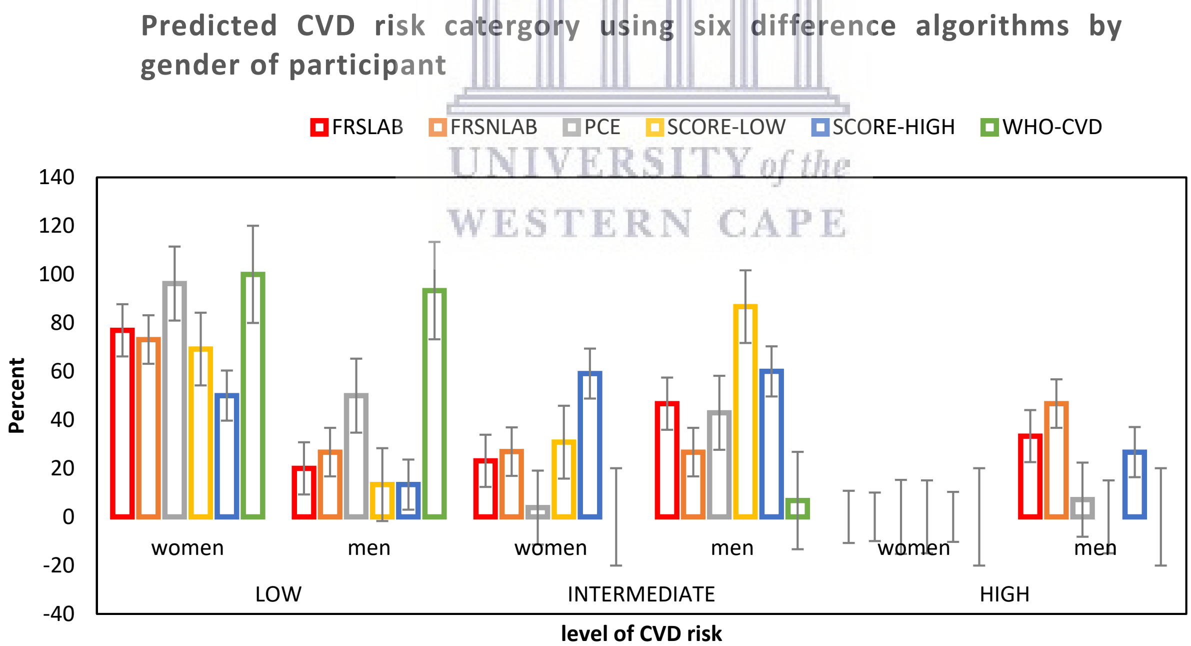


Figure 0.2: Percentage of participants in each CVD risk category by gender using six different algorithms.

4.5.2 Comparison of stratified CVD risk in participants predicted by different algorithms

CVD risk predictions of different algorithms were then compared to the Framingham laboratory-based risk score (FRSLAB), which is more widely used in African countries. Results show that CVD risk predictions by the WHO-CVD algorithm slightly agree with Framingham laboratory-based algorithm predictions. There was substantial agreement in CVD risk predictions by FRSLAB algorithm with the non-laboratory based version, FRSNLAB algorithm and SCORE-HIGH. FRSLAB algorithm also had a moderate and fair agreement with the SCORE-LOW algorithm and PCE algorithm, respectively. (Table 4.13)

4.6. Conclusion

This chapter presented findings of a health survey done on the administrative staff at the University of Western Cape in 2011. The participants comprised more women than men whose age ranges were comparable. Tobacco smoking was more common among men than women. A small fraction of administrative staff had undiagnosed NCD such as hypertension. There was a high prevalence of hypertension among administrative staff. Sedentary behaviour and physical inactivity were common. The majority of participants had dyslipidemia. There was a significant difference between mean triglyceride, HDL-cholesterol and WtHR of male and female office administrators. Gender was associated with obesity, WC ($p<0.001$) and BMI ($p=0.04$). Age was associated with sedentary behaviour ($p=0.04$). Marital status was associated with sedentary behaviour ($p=0.01$) and dyslipidemia ($p=0.02$). Office administrators had multiple risk factors for NCDs per individual. The risk of CVD was generally low among female administrative staff. Twelve percent of participants were at high 10-year CVD risk. Men were at a higher risk of CVD than women. WHO-CVD algorithm prediction for CVD risk among administrative staff had a slight agreement with the FRSLAB algorithm. Substantial agreement between Framingham laboratory and non-laboratory algorithms justifies the use of non-laboratory based algorithms in remote areas where laboratory results may not be immediately available.

CHAPTER FIVE

DISCUSSION

5.1. Introduction

The main findings from the data analysis from the 2011 campus health project survey were that: (i) there was a high prevalence of modifiable behaviour, and biological risk factors for NCDs among participants (ii) majority of administration staff members had multiple risk factors. (iii) the most prevalent risk factor was obesity (both central and global). Other prevalent risk factors included sedentary lifestyle, alcohol consumption, dyslipidemia and hypertension. (iv) a small proportion of surveyed staff members who were all males had a high ten year CVD risk. Finally, (v) there were variations in predicted ten year CVD risk by different algorithms.

The results will be discussed as follows

5.2 Self-reported personal and family history of NCDs
5.3 Tobacco smoking and alcohol consumption
5.4 Physical inactivity and sedentary lifestyle
5.5 Overweight and obesity
5.6 Central obesity (WC, WHR, WtHR)
5.7 Diabetes
5.8 Dyslipidemia
5.9 Hypertension
5.10 Clustering of risk factors
5.11 CVD risk predictions and comparisons
5.12 Strengths and limitations
5.13 Conclusion

5.2. Self-reported personal and family history of NCDs

Overall, self-reported family history of NCDs reported by participants was higher than those of Western Cape province reported by Shisana *et al.* (2013) in a 2012 national survey, for example, hypertension (55.1% vs 38.4%), diabetes (34.6% vs 24.6%) and stroke (20.5% vs 14.1%). Shisana *et al.* (2013) noted that Western Cape province was amongst the regions with a high self-reported family history of NCDs. The notable differences in NCDs' self-reported family history can be due to inaccurate information due to recall bias. A person might not be aware or understand a family member's condition, which affects accuracy. Variation in cultures can also cause inaccurate information from family history, as in some cultures, children will only know more about one side of the maternal or paternal family (Claassen *et al.*, 2010). Even though participants were asked about parents only, results show that a significant portion of participants are at risk of NCDs due to inherited genes and or shared environment and would benefit from further screening for NCDs risk factors.

The top three frequently reported medical conditions among participants were hypertension (26.9%), overweight (26.9%) and high cholesterol (23.1%). Prevalence of self-reported previously diagnosed hypertension and high cholesterol was higher in our study than in the 2012 national survey report Shisana *et al.* (2013), 15.3% and 6.7%, respectively. Shisana *et al.* (2013) noted that the prevalence of self-reported previously diagnosed NCDs increased with age. It might explain the differences as the average reported in the 2012 population survey includes persons aged fifteen years (likely to have no NCDs) who are not eligible for employment (Republic of South Africa, 1997). The notable differences can also be due to other socioeconomic factors such as income which improves health-seeking behaviour among the working class. Those with lower incomes may not go to seek treatment as often as those with higher incomes. Better education influences health-seeking behaviour; thus, an educated person is diagnosed with an NCD condition earlier (Latunji and Akinyemi, 2018). The majority of participants in this study had matric, unlike some of those included in national surveys.

5.3. Tobacco smoking and alcohol consumption.

In this study average smoking prevalence among administrative was 30.7% (men 37.9% vs women 26.5%). There was no association of tobacco smoking with gender, age, education level and marital status of study participants in this survey. The average prevalence of smoking in this survey was higher than the national average for South Africa reported in 2012 (17.6%) (Reddy *et al.*, 2015) and 2016 surveys (22.5%) (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019). Average smoking prevalence in the study was, however, lower than that of Western Cape province for 2012 (32.9%) (Reddy *et al.*, 2015) and 2016 (34.8%) (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019). Prevalence of smoking by gender in this study was slightly lower than those reported for Western Cape province in 2012 for men (37.9% vs 39.6%) but almost similar for women (26.5% vs 26.8%) (Reddy *et al.*, 2015). The findings confirm that there is a high smoking prevalence among university staff who participated in this study. Considering the university's geographic location (within Western Cape province), the results are consistent with high smoking prevalence expected for the the province. According to Reddy *et al.* (2015), Western Cape province had high smoking rates because of a high population of coloured people. Therefore, we assume that there could also be a significant proportion of coloured people within university staff. However, the assumption could not be verified as the questionnaire used in the study did not ask any question about the participant's race. Coloured people are known to have the highest rates of smoking among all the races in South Africa (Reddy *et al.*, 2015; National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019).

In this study, smoking prevalence among administration staff was higher than all reviewed study reports from other African universities. For example, studies in Nigeria reported a prevalence of smoking among university staff of 1.9% to 11.4% (Ige, Owoaje & Adebiyi, 2013; Agaba *et al.*, 2017; Adejumo *et al.*, 2020). A study on university staff in Uganda reported a smoking prevalence of 13.5% (Amanyire *et al.*, 2019). Amin *et al.* (2014) reported a 26.6% smoking prevalence among university staff in Saudi Arabia. The prevalence of smoking in this study was also higher than Hene *et al.* (2021) study report on financial sector employees in South Africa and Reddy & Naidoo (2018) report of university staff in KwaZulu Natal, South Africa. The differences in smoking prevalence can be due to different country prevalences, within-country differences (for studies in the same country), population demographics and socio-cultural practices. For example, a high population of coloured people in Western Cape province contributes to the province to have the highest smoking rates in South Africa (Reddy *et al.*, 2015). Employee proportions by race could not be validated as no question was asked about race in the questionnaire. Although there was no association of smoking with gender in this study, most other studies on university staff showed that smoking was significantly associated with gender (higher in males than females) (Amanyire *et al.*, 2019; Adejumo *et al.*, 2020; Hene *et al.*, 2021). Tobacco smoking increases the risk of developing lung cancer, CVD and COPD (Priceless South Africa., 2017).

The high prevalence of smoking among university employees can cause significant air pollution as most smokers are likely to smoke at workplaces. Smoking within the university campus exposes other workers and students to environmental tobacco smoke (Warren *et al.*, 2006). Passive smoking causes ill health

(Reddy *et al.*, 2015). The university has an obligation to protect and promote the health of those who use the institution. As a leader in higher education, the institution has a role in society by providing leadership and community leaders. High smoking rates among workers within the institution tarnished the image of the university. According to Mujuzi (2010), there are provisions in law through the tobacco product control act, for the university to strictly implement bylaws within the university premises to reduce smoking. Advertisement and sale of tobacco products should be banned within the campus, and smoking can be allowed in only a few spaces that do not expose other university users. The university can work in conjuction with local authority and govenement departments to help reduce smoking within the campus.

Alcohol consumption prevalence for men and women in this survey was 65.4% higher than reported for the province in SA DHS 2016, with 38.1% for women and 53.3% for men. The difference can be due to the lower age range (from 15years) included in the demographic health surveys as the legal age of alcohol consumption is eighteen years (RSA, 2004). Other studies on university staff have observed similar high alcohol consumption prevalence, such as a study in KwaZulu Natal, South Africa, 68% (Reddy and Naidoo, 2018) and in Kenya 61.1% (Okube & Omandi, 2018). Even though risky alcohol consumption was not assessed in this study, it can be assumed that the behaviour is prevalent among South African employees (Burnhams *et al.*, 2014). Some of the factors associated with risky alcohol drinking among men and women highlighted by Peltzer, Davids and Njuho (2011) are likely to be met by participants in this survey and also considering Western Cape population demographic. Being coloured was associated with risk drinking among both men and women. While the 20-54 age group (working class or economically active) was associated with risk drinking among men, urban residence was associated with risky drinking among women. Hence there is a likelihood that a significant portion of the employees may engage in reckless alcohol drinking (Peltzer, Davids & Njuho, 2011).

5.4. Physical inactivity and sedentary behaviours

There was a high prevalence of sedentary behaviour (85.7%) among administrative staff, and 43.6% did not do any form of physical exercise. Several studies have reported a high prevalence of physical inactivity among university staff, such as 90.7% at a Kenyan university (Okube & Omandi, 2018), 77.8% in Nigeria (Agaba *et al.*, 2017) and 58% in India (Rathi *et al.*, 2018). The variation in the prevalence of reported physical inactivity could be due to how research questions are asked in the survey. Rath *et al*. (2018), who reported a lower prevalence, were only asking if a participant does any form of exercise (similar to this study) while the other studies (Okube & Omandi, 2018) determined if a participant was meeting the minimum physical activity requirement as per WHO standard recommendations. Therefore, those who did not meet the minimum level required were categorized as not physically active in that study. If the same question were posed in this survey, the reported physical inactivity of 43 % would have been higher as some participants would not be meeting the minimum physical activity levels even though they were doing some form of exercises.

In contrast to this study findings, a study in South Africa on university staff in KwaZulu Natal reported a high prevalence of physical activity (67%) meeting WHO recommended physical activity levels (Reddy and Naidoo, 2018). The difference with this survey findings could be due to characteristics of the populations as the other university staff seem to *be* more conscious of their health, as shown by the very low smoking prevalence of 12% (Reddy and Naidoo, 2018). According to Reddy and Naidoo (2018), the Western Cape has a high population of coloured people. KwaZulu Natal has a high population of black Africans as it is the home area for most of the Zulu tribe. According to Puoane, Hughes & Bradley (2005), coloured people were the first to experience and adopt a westernized lifestyle before all other races. The difference in experience or adoption of affluent lifestyles explains the high prevalence of NCDs risk factors such as smoking and obesity (Puoane, Hughes & Bradley, 2005). Unsafe neighbourhoods are also a discouragement to physical activity (Puoane, Hughes & Bradley, 2005), especially in the wake of reports of rising gang violence.

The university can provide a safe environment for employees and the community to engage in physical activities in the social or sporting activities. Even though survey analysis did show the association of physical inactivity with gender, many other studies have shown that women are more physically inactive than men (Guthold *et al.*, 2018). Factors associated with physical inactivity in women include culture and tradition and lack of social support (Guthold *et al.*, 2018). The workplace can promote physical activity among women by raising awareness of the health risks physical inactivity poses and breaking cultural barriers through promoting women sporting activities, starting with employees' social clubs and later through supporting women vulnerable groups. The initiative will need multisectoral actions with some sponsoring to the activities. Employees also need to be informed about the dangers of sedentary behaviour at work or home. It is also beneficial for the university to encourage physical activity among its older staff to promote health. They are the more experienced staff valuable to the university core business of imparting knowledge.

5.5. Overweight and obesity

Overweight /Obesity, defined by high BMI, was one of the most common risk factors of NCDs observed among administrative staff surveyed. Only 10% of men and 20% of women were of normal BMI. BMI was associated with participants' gender (p=0.034). Men’s mean BMI was lower than women’s though the difference was insignificant in this study participants. The same observation was also reported in a study in KwaZulu Natal, South Africa (Reddy and Naidoo, 2018). In contrast, a survey on university staff in Nigeria and another in Ethiopia reported significant differences between the mean BMI of men and women (Agaba *et al.*, 2017; Janakiraman *et al.*, 2020). Similarly, a high prevalence of overweight/obesity was also observed on Kenyan university staff where only 15.9% had normal BMI (Okube & Omandi, 2018), while the study in KwaZulu Natal, South Africa, also reported a high prevalence of elevated BMI (63.9%) (Reddy & Naidoo, 2018). However, Janakiraman *et al.*, (2020) reported a low prevalence of overweight/ obesity among university staff, 35.6% in Ethiopia.

The mean BMI of women in this study of 30.7 ±7.8 kg/m^2 was higher than 28.5kg/m^2 reported in the Western Cape province in 2012. Men’s mean BMI of 28.8± 4.0 kg/m^2 was also higher than 25.0 kg/m^2 reported for men in Western Cape in 2012 (Shisana *et al.*, 2013). The difference shows that more women and men in this study had high BMI than in the sample used in the population survey. The prevalence of obesity among this study participants was therefore higher than reported in the national survey. Forty-five percent of women were obese in this survey compared to 37.9% reported for the province. The difference can be due to population characteristics, age, socio-economic status, and demography. Demographic survey samples are of people aged 15years and above, of various socioeconomic levels and from all races. The mean age of study sample was 40.7 ±10years. Participants in this study sample are working-class and are assumed to have a stable and better income than others found in society. It is also possible that UWC employs a high proportion of coloured people because of the high number of coloured people in the province.

Table 2.1 shows a summary of findings from health surveys on university staff from various African countries studies. We have noted in section 4.4.3 that the comparison of reported prevalence of obesity among university staff was higher than the national average for the country. The findings may confirm that university staff are the affluent of the communities in which they work and live. The difference in prevalence reported from across the country demonstrates Jaacks *et al.* (2019) obesity transition model. Countries around the world are at different stages of the obesity transition model. South Africa entered the transition model in 1975, and probably the only African country mentioned to have done so. South Africa is in the second stage and most likely a different level within stage 2. The obesity prevalence reported by various studies on university staff reflects the country's setting within the obesity transition model. We can conclude to what was already alluded to by Jaacks *et al*. (2019) that only Vietnam has not yet entered the obesity stage (where the prevalence of obesity is still less than 5%). Reports that reflect a significant difference in obesity prevalence between males and females are of countries in stage 1. For example, Agaba *et al*. (2017) reported that women obesity was five times higher than men's. The prevalence of overweight/ obesity observed in this study is expected of South Africa and the Western Cape province population. The notable differences of this report with Reddy and Naidoo (2018) are due to differences in population demographics, as highlighted in section 5.4.

The disease burden due to overweight/obesity can be linked to many other risk factors previously mentioned. Elevated BMI has been linked to increased risk of hypertension (Wang *et al.*, 2006) and can be linked to diet, physical inactivity, and their underlying social determinants of health (Puoane, Hughes and Bradley, 2005). Culture plays an essential role as a driving factor in the prevalence of overweight/obesity, especially in women. Perception and views of the society seem to encourage, admire and support it. There is, therefore, no motivation for ladies to lose what is highly regarded in their society. Joubert, Norman & Bradshaw *et al.* (2007) attributed elevated BMI to 87% of T2DM and 68% hypertensive disease, and the proportions of conditions are always higher in women than in men.

5.6. Central obesity (WC, WHR, WtHR)

In this study, both the men's mean WC (98.6cm) and women's mean WC (94.6cm) were higher than the mean WC reported for men (84.6cm) and women (89.0cm) in Western Cape province 2012 survey. Thus, the results show that overally, men and women in this study are at abnormal increased and substantially increased risk of metabolic complications due to central obesity, respectively. Furthermore, the noted difference between the WC means of participants compared to the Western Cape province 2012 survey confirms that the prevalence of obesity was higher among university employees than the survey sample (Shisana *et al.*, 2013).

There was a high prevalence of central obesity as defined by abnormal WC (73.1%), WHR(56.4%) and WtHR (85.9%) among study participants. In addition, high WC in this study was associated with gender. Over two thirds (69.4%) of women had an abnormal WC compared to 27.6% of men. The proportions are higher than those reported for Western Cape province, where 50.4% of women and 12.8% of men had high WC (Shisana *et al.*, 2013). In this study, mean WC for men and women were similar, although other studies on university staff found significant differences between genders (Okube & Omandi, 2018; Reddy & Naidoo, 2018). The scatter diagram of WC versus age shows a positive relationship though the gradient might be small due to scattered values (Figure 4.1). Reddy & Naidoo (2018) also found a positive relationship between WC and age. According to the authors, this might be due to poor lifestyle as people grow old (Reddy & Naidoo, 2018).

The prevalence of high WtHR in men (93.1%) was nearly double the 2016 South African demographic survey report (48.5%) (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019). Mean WtHR for men was significantly higher than the mean of women WtHR. The prevalence of high WtHR in the study was much higher than reported in a survey on university staff in Ethiopia which reported a prevalence of 52.% (Janakiraman *et al.*, 2020). The difference is due to the obesity in study participants compared to 27.1% in the study in Ethiopia. Obesity is attributed to a considerable burden of disease in South Africa which is causing lots of illnesses, especially in women (Joubert, Norman & Bradshaw, *et al.*, 2007)

5.7. Diabetes

In this study, the average prevalence of diabetes mellitus was 7.2%, although by gender, males had 11.1% and females had 4.8%. The prevalence of diabetes was not associated with any of the sociodemographic factors investigated. Only one participant in the study had not previously been diagnosed by a nurse or doctor. Prevalence of diabetes was lower in this survey than in the 2012 South Africa demographic and health survey (SADHS) report for Western Cape province, which was 11.2%, while the national average was 9.5% in women(Shisana *et al.,* 2013). This study could not verify the finding as most of them had matric education and a low prevalence of diabetes in the study. The difference could be due to the small sample size in this study and sample characteristics, especially since all age groups were not well represented. The mean age of participants may explain the observed difference with this study survey. Amanyire *et al.* (2019), in their study in Uganda, reported a higher prevalence of diabetes of 16.7%, which was associated with the age and gender of university staff. However, the reported prevalence in the study might be an exaggeration because the definition of diabetes was based on a high random blood glucose finding which is not the definition of diabetes based on WHO recommendation (World Health Organization, 2006).

5.8. Dyslipidemia

Dyslipidemia was also among the top most prevalent risk factors, found in 82.9% of administrative staff. In this survey, dyslipidemia was significantly associated with marital status ($p = 0.011$). The mean triglyceride of men was considerably higher than that of women (1.52± 0.7 vs 1.28± 0.81mmol/l). Mean HDL-cholesterol of women was significantly higher than that of men (1.54± 0.46 vs 1.17± 0.23mmol/l). There was no significant difference in the mean cholesterol of men and women. More than half (57.1%) of participants had raised cholesterol, while 58.6% had raised LDL cholesterol. Most of the participants also had more than one abnormal lipid profile parameter. A study on university staff in KwaZulu Natal in South Africa observed no significant difference in mean cholesterol (5.18±1.02 vs 5.04±0.77mmol/l) and triglycerides (2.85±1.09 vs 2.28±1.28mmol/l) of men and women (Reddy & Naidoo, 2018). In Nigeria, a study reported dyslipidemia prevalence of 51.8% among university staff. In the same study, males had significantly higher cholesterol (5.22±1.20 vs 4.87±1.07mmol/l) ($p<0.0001$) and HDL-cholesterol (1.57±0.43 vs 1.39±0.41mmol/l) ($p<0.0001$) than females (Agaba *et al.*, 2017). According to Agongo *et al.* (2019) there is inconsistence in reports of lipid levels differences between males and females of African population. There are also other factors that influence lipid levels in males and females such as sleeping hours, smoking, alcohol intake(Agongo *et al.*, 2019)

Another survey on university staff in Malaysia reported a prevalence of 58.3% for dyslipidemia (Bo *et al.*, 2018). The observed differences in reported dyslipidemia could be due to the authors' different cut-off values to determine elevated parameter parameters. For example, Bo *et al.* (2018) used a higher cut off of 6.3mmo/l for cholesterol, while this study used 5.1mmol/l as provided by laboratory reference ranges used. A lower cut off value will help reduce the risk of NCDs as participants will be cautioned earlier and advised to implement lifestyle measures to reduce risk. A third of administrative staff in the survet were unaware that they had elevated cholesterol. According to Janakiraman *et al.* (2020), this could indicate low health-seeking behaviour.

5.9. Hypertension

Twenty-seven percent of the administrative staff were previously diagnosed with hypertension, 14.3% had undiagnosed hypertension, and 44.2% were diagnosed with prehypertension. Following grading of blood pressure measurements, it was found that 24.7% had mildly elevated blood pressure, while 5.2% had moderate and 3.9% had severely elevated blood pressure. There was no association of hypertension with gender, level of education, or marital status in this study, even though the prevalence of hypertension in males (44.8%) was higher than that of females (39.6%). Also, the proportion of those older than 40years who had hypertension (46.5%) was higher than those under 40years who had hypertension (35.3%).

The prevalence of hypertension (41.6%) among administrative staff in this study was much higher than the average for Western Cape province (9.4%) reported in the 2012 survey (Shisana *et al.*, 2013) but lower than the 2016 survey report (55.6%). In this study, men's mean SBP (134.9 vs 131mmHg) vs and DBP (86.3vs 71.2mmHg) were also higher than the average diastolic and systolic mean reported in the 2012 survey. Mean SBP for women (129.6mmHg) was lower than the average SBP (129.6mmHg) reported for Western Cape province; however, women DBP (82.5mmHg) was higher than average for the area. There was no statistically significant difference in the mean systolic and diastolic BP of men and women in this survey. The massive difference in the prevalence of hypertension reported in this study and that of the 2012 national survey report confirms the prevalence of hypertension had been rising in South Africa (National Department of Health (NDoH), Statistics South Africa (Stats SA) & ICF, 2019). According to the SA DHS report for 2016, the prevalence of hypertension rises steadily with age. It is also higher in people without education than those with other forms of education categories. However, the association of hypertension with age and level of education was not detected in this study because of a small sample size that did not have enough numbers for different categories to be compared. High prevalence of hypertension (48.5%) among university staff was also reported in a study in Nigeria where the prevalence rose with age and income (Agaba *et al.*, 2017)

The proportion of persons who had hypertension but had not been previously diagnosed by a nurse or doctor was lower in this study than the SA DHS report of 2016 (14.3% vs 31.5%). The differences could be higher literacy in the study sample than the national survey and participants' age. Janakiraman *et al.* (2020) suggest that undiagnosed hypertension is due to low health-seeking behaviour and is linked to the level of education of an individual. Therefore, due to high literacy or higher level of education achieved by participants in this study, the prevalence of undiagnosed BP is lower. Studies have revealed poor awareness, treatment and control of hypertension in LMICs (Mills *et al.*, 2016). Ibrahim & Damasceno (2012) reported that women had better awareness of hypertension than men, which explain why more men than women have undiagnosed hypertension.

This study findings highlight a high prevalence of prehypertension (44.2%) amongst university staff in this study. Reddy & Naidoo (2018) study in KwaZulu Natal also found a high (56%) prevalence of pre-hypertension among university staff. Similarly, a high prevalence of abnormally high blood pressure among university staff was also observed in a study in Kenya, where only 6% of the participants had optimal BP. The prevalence of hypertension was 33.2%, while 60.8% had prehypertension. The authors suggested that the high prevalence of hypertension was due to the coexistence of other NCDs risk factors such as physical inactivity, alcohol consumption, low consumption of fruits and vegetables and obesity. The study also observed a significant association of high BP with age and alcohol consumption (Okube & Omandi, 2018). According to Rathi *et al.* (2018), preventative measures have to be taken by those diagnosed with prehypertension to reduce progression to hypertension. Therefore, the authors stressed the importance of behaviour change communication and health education to mitigate progression to hypertension by implementing lifestyle changes. Studies have shown that prehypertension increases the risk of hypertension and cardiovascular events than optimal BP (Egan & Stevens-Fabry, 2015; Yancu *et al.*, 2018). There is also evidence that African Americans (blacks) with prehypertension experience more cardiovascular disease complications than Caucasians (whites) with prehypertension (Yancu *et al.*, 2018).

In contrast to this study findings, a study on university staff in Ethiopia found a lower prevalence of hypertension (13.9%), newly diagnosed hypertension (7.6%) and prehypertension (39.4%) (Janakiraman *et al.*, 2020). The majority of staff in the study were younger than in this study. Studies have shown that the prevalence of hypertension increases with age (Agaba *et al.*, 2017)

5.10. Clustering of risk factors

Clustering of risk factors for NCDs was prevalent among administrative staff as three-quarters of them had at least five of the assessed risk factors. This study finding is consistent with other similar studies in Nigeria, where multiple risk factors were observed in one person (Ige, Owoaje & Adebiyi, 2013; Agaba *et al.*, 2017). Having multiple risk factors was also prevalent in South Africa (Wu *et al.*, 2015). In Ige, Owoaje and Adebiyi (2013) study, 30% of participants had multiple risk behaviours. In the study by Agaba *et al*. (2017), the median number of risk factors in an individual was three. Studies that assessed clustering of risk factors did not consider the same number or same risk factors hence the variation and difficulty in comparing the actual number of risk factors per individual. Having multiple risk factors increases the risk of having NCDs (Phaswana-Mafuya *et al.*, 2013). Studies have suggested that interventions that target numerous lifestyles would be more effective than those that target one risk factor. For example, an intervention that targets reducing tobacco smoking might affect other unhealthy behaviours (Morris *et al.*, 2016). According to Gaziano *et al.* (2013), the existence of multiple risk factors in an individual increases the chance of having NCD more than when a risk factor exists alone because of interactions that have an overall synergistic impact.

5.11. CVD risk predictions and comparisons

According to the FRSLAB algorithm, 10-year CVD risk in survey participants were 56.1%, 31.7% and 12.2% for low, intermediate and high, respectively. By gender, the predictions show that all participants at high risk for CVD were only men (33.3%). The results from other algorithms except for WHO-CVD and SCORE-LOW algorithms confirm the finding. There was, however, variations in the 10-year CVD risk prediction by different algorithms. There was a substantial agreement of CVD risk prediction by FRSLAB algorithm with predictions by FRSNLAB and SCORE-HIGH. The poorest/ lowest agreement was with the WHO-CVD algorithm. Compared to the FRSLAB algorithm, the non-laboratory version FRSNLAB algorithm overestimated the 10-year CVD risk in participants by classifying more individuals at high risk of CVD, while the PCE algorithm underestimated the risk. Estimated 10-year CVD risk varies significantly in South Africa depending on population demographics and risk factor profiles and CVD risk algorithm used (Nyirenda, 2021) vs (Peer *et al.*, 2014). Nevertheless, the study survey estimated prediction for CVD in the whole study participants is still within range (by CVD level low, intermediate and high) of reports by Gaziano *et al.* (2013), Peer *et al.* (2014) and Hene *et al.*(2021).

The discrepancy in identifying those at high risk for CVD due to different algorithms was also observed in a study on the Ghanaian population (Boateng *et al.*, 2018). In the survey, the FRSNLAB algorithm identified more people at high risk than the FRSLAB algorithm. The study also found that FRSLAB algorithm predictions were in moderate and low agreement with FRSNLAB and PCE algorithm predictions, respectively (Boateng *et al.*, 2018). Other studies conducted in the United Kingdom and Sub-Saharan African countries also observed that FRSNLAB overestimated CVD risk compared to FRSLAB (Gray *et al.*, 2014; Wagner *et al.*, 2021).

Several other studies have provided evidence that there is variation in 10-year CVD risk prediction due to different algorithms used (Gray *et al.*, 2014; Selvarajah *et al.*, 2014). Selvarajah *et al*. (2014) even suggested using different algorithms for men and women of the same population. This study survey confirms reports of other studies that the FRSLAB algorithm has better agreement with its non-laboratory version FRSNLAB algorithm than with other CVD risk prediction methods (Gaziano *et al.*, 2013; Wagner *et al.*, 2021). In a comparative study, Wagner *et al.* (2021) observed that this was true for any other algorithm. The laboratory and non-laboratory versions of the same algorithm had better agreement than with a different algorithm. Therefore, it follows that, for consistency, any CVD prediction algorithm a country chooses, it should use that algorithm's laboratory and non-laboratory versions to cater to remote areas without laboratory facilities rather than selecting a different algorithm.

CVD risk predictions in this study show a significant association with gender. More men were at higher risk of CVD than women. The results are consistent with the reports of other studies, which found that being male was a predictor of CVD (Nyirenda, 2021; Wagner *et al.*, 2021). In addition, a study in Brazil found out that even at younger ages, men were still at higher risk of CVD than women (Melo *et al.*, 2020). However, Nyirenda (2021) could not find an apparent reason why men were at higher risk of CVD than women. Still, Wagner *et al*. (2021) suggest this could be due to naturally occurring protective hormones such as oestrogen found in women, which delay events that trigger CVDs.

5.12. Strengths and limitations

Limitations

- History of NCDs and risk factors reported by participants (not measured/ observed) may be subject to bias. For example, the medical history of parents may be unknown to the participant or forgotten. In addition, some occasional smokers might, for personal reasons, choose to report that they do not smoke.
- Caution should be taken in generalizing results. The study must be interpreted cautiously since the sample was from one institution with a campus in one province. Sample demographic characteristics will therefore not be representative of national survey or population-based survey. Therefore, the findings cannot be generalized for all South Africans or all university staff.
- The surveyed group might be at higher risk for NCDs due to the white-collar work environment, modernized transportation system, and easy access to fast food compared to other city dwellers.
- Limitations in obtaining a significant sample size might have affected the power of the study in detecting associations or differences of various parameters. Missing laboratory tests data further reduced the study sample size, especially with CVD risk assessment. Some participants were not assessed for laboratory parameters since blood samples were not collected.

Strengths

Regardless of the limitation highlighted, this study adds to the body of knowledge about CVD risk and the use of different algorithms in Africa or South Africa in particular.

The use of validated standardised questionnaires, performing individual interviews, taking anthropometric measurements, and blood tests performed at a quality accredited laboratory in screening for NCD risk factors increases the reliability of this health survey.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

South Africa face an increasing burden of NCDs and their risk associated factors. Considering the university's considerable staff compliment and large student enrollment, the institution is an important setting to promote public health. Implementing health promotion at the institution will improve worker productivity, boost and motivate, and increase staff retention. The university has many roles to play, firstly as a centre for higher learning, a place of innovation and research, a place where adolescents (students) are transformed into adulthood, become employable and responsible citizens, a workplace to many employees and a think-tank resource for partnerships at community and national level.

Therefore, the university must consider all its roles in the various sectors in promoting public health. Following a whole system approach will allow the university to fulfil all the roles. The whole system approach involves policies and providing a supportive environment to promote health and reduce risk to NCDs. The university presents a perfect opportunity for multi-sectoral approaches to NCDs and their risk factors. Workplace health promotions and implementation of healthy university concept is an opportunity to work with the local authority, civil society, non-governmental organizations, government departments, and the international community to mobilize resources needed to promote health for the more significant benefit of all who interact with the institution.

The campus health survey provided a first step towards identifying the most easily implementable measures/ areas of maximum impact in promoting health at the institution. The survey identified the most prevalent risk factor for NCDs and some factors that influence their occurrence.

In summary of the campus health survey findings: there is a high prevalence of modifiable behavioural and biological risk factors for NCDs, which are tobacco smoking (30.7%), alcohol consumption (65.4%), physical inactivity (43.6%), sedentary behaviour (85.7%), hypertension (41.6%), prehypertension (44.2%), overweight/ obesity (83.3%), dyslipidemia (82.9%.). The study also identified some non factors modifiable risk factors such as gender was associated with obesity, age was associated with sedentary behaviours, marital status was associated with sedentary behaviour and dyslipidemia. Overall many study participants had multiple risk factors for NCDs and are therefore at high risk of having CVD and other NCDs.

Comparison with other health surveys on university staff from Africa provided an opportunity to identify other factors that influence the occurrence of risk factors and reflect on the difference in the context of Africa and how the nation is performing in preventing risk factors for NCDs.

6.2. Recommendations

The following recommendations aimed to have the greatest impact to promote health within the institution based on information from the survey

6.2.1 Implement tobacco control act

The campus can be declared a smoke-free zone or provide minimal smoking zones. The university can work with local municipal authorities and health departments to enforce national laws and city laws prohibiting smoking in workplaces and public spaces. A comprehensive ban on sales, advertisement, accepting sponsorship and promoting tobacco products within the campus can be considered. Information about the health risk of smoking should be put up in public spaces around the campus, corridor, billboards, and the library.

6.2.2 Implement alcohol control

University campus bylaws can also be enforced to prevent the sale and consumption of alcoholic drinks within the campus. A comprehensive ban on advertisement, promotion and accepting sponsorship from alcohol-related industry may be implemented.

6.2.3 Promote social sporting activities and access to facilities

In order to promote physical activity, the campus gyms and other sporting facilities should be improved, equipped and maintained. Women and other employees who feel unsafe using gym facilities in their neighborhoods should be encouraged to make use of facilities at the campus. Various trainers and coaches can be hired to facilitate training. Lower access fees than other facilities outside campus can be used to attract enrollment. Security around the facilities and campus should be assured, especially to female users, to make it safe and promote participation and those who want to engage in outdoor physical exercise around campus. Employees should be encouraged to form teams and participate freely. Selected sponsorships can fund teams or provide equipment needs in exchange for marketing exposure for non-alcoholic, non-tobacco products and healthy eating/food.

6.2.4 Promote healthy foods at campus food outlets.

Healthy eating habits can be encouraged by increasing the availability of healthy foods through vending machines and ensuring constant supply of fruits and vegetables at canteens and tuck shops within the university campus. In addition, increase awareness of healthy diet through community radio at the campus. Retail of fast foods or high-energy foods could be banned or at least limited to achieve a positive balance in favour of healthier food outlet options.

6.2.5 Implement and expand annual health survey for staff and students

Staff and students need to be encouraged to regularly screen for NCDs risk factors

6.2.6 Start health education and counselling programs

Individual and group health education and counselling sessions should be initiated. Those who want to quit smoking or alcohol can be assisted through these programs. Group sessions can present opportunities to talk about the cultural issues that increase the risk to NCDs.

REFERENCES

Adejumo, E. N., Adefoluke, J. D., Adejumo, O. A., Enitan, S. S. and Ladipo, O. A. (2020) 'Cardiovascular Risk Factors among Staff of a Private University in South-west Nigeria', *Nigerian Postgraduate Medical Journal* |, 27(2), pp. 127–131. doi: 10.4103/npmj.npmj.

Agaba, E. I., Akanbi, M. O., Agaba, P. A., Ocheke, A. N., Gimba, Z. M., Daniyam, S. and Okeke, E. N. (2017) 'A survey of non-communicable diseases and their risk factors among university employees: a single institutional study', *Cardiovascular Journal of Africa*, 28(6), pp. 377–384. doi: 10.5830/CVJA-2017-021.

Agongo, G., Nonterah, E. A., Debpuur, C., Amenga-Etego, L., Ali, S., Oduro, A., Crowther, N. J. and Ramsay, M. (2019) 'Correction: The burden of dyslipidaemia and factors associated with lipid levels among adults in rural northern Ghana: An AWI-Gen sub-study (PLoS ONE (2019) 13:11 (e0206326) Doi:10.1371/journal.pone.0206326)', *PLoS ONE*, 14(2), pp. 1–21. doi: 10.1371/journal.pone.0213233.

Amanyire, J., Tumwebaze, M., Mugisha, M. K. and Bright, L. W. (2019) 'Prevalence and Risk Factors for Hypertension, Diabetes and Obesity among Lecturers and Support Staff of Bishop Stuart University in Mbarara, Uganda', *Open Journal of Applied Sciences*, 09(03), pp. 126–137. doi: 10.4236/ojapps.2019.93012.

Amin, T. T., Ibrahim, A., Sultan, A., Mostafa, O. A., Darwish, A. and Al-naboli, M. R. (2014) 'Profile of Non-Communicable Disease Risk Factors Among Employees at a Saudi University', 15, pp. 7897–7907.

Andreotti, G., Freedman, N. D., Silverman, D. T., Lerro, C. C., Koutros, S., Hartge, P., Alavanja, M. C., Sandler, D. P. and Freeman, L. B. (2017) 'Tobacco use and cancer risk in the agricultural health study', *Cancer Epidemiology Biomarkers and Prevention*, 26(5), pp. 769–778. doi: 10.1158/1055-9965.EPI-16-0748.

Armas Rojas, N. B., Lacey, B., Soni, M., Charles, S., Carter, J., Varona-Pérez, P., Burrett, J. A., Martínez, M. C., Lorenzo-Vázquez, E., Constantén, S. B., Taylor, H., Sherliker, P., Rigau, J. M. M., Ross, S., Massa, M. S., López, O. J. H., Islam, N., Morales, M. Á. M., Alomá, I. A., Estupiñan, F. A., González, M. D., Muñoz, N. R., Asencio, M. C., Díaz-Diaz, O., Iglesias-Marichal, I., Emberson, J., Peto, R. and Lewington, S. (2021) 'Body-mass index, blood pressure, diabetes and cardiovascular mortality in Cuba: prospective study of 146,556 participants', *BMC Public Health*. BMC Public Health, 21(1), pp. 1–10. doi: 10.1186/s12889-021-10911-9.

ASCVD Risk Estimator + (no date). Available at: http://tools.acc.org/ASCVD-Risk-Estimator-Plus/#!/calculate/estimate/ (Accessed: 18 September 2020).

Aune, D., Giovannucci, E., Boffetta, P., Fadnes, L. T., Keum, N. N., Norat, T., Greenwood, D. C., Riboli, E., Vatten, L. J. and Tonstad, S. (2017) 'Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality-A systematic review and dose-response meta-analysis of prospective studies', *International Journal of Epidemiology*, 46(3), pp. 1029–1056. doi: 10.1093/ije/dyw319.

Babatunde, O. A., Olarewaju, S. O., Adeomi, A. A., Akande, J. O., Bashorun, A., Umeokonkwo, C. D. and Bamidele, J. O. (2020) '10-year risk for cardiovascular diseases using WHO prediction chart: Findings from the civil servants in South-western Nigeria', *BMC Cardiovascular Disorders*. BMC Cardiovascular Disorders, 20(1), pp. 1–10. doi: 10.1186/s12872-020-01438-9.

Baioumi, A. Y. A. A. (2019) 'Comparing Measures of Obesity: Waist Circumference, Waist-Hip, and Waist-Height Ratios', *Nutrition in the Prevention and Treatment of Abdominal Obesity*. Elsevier, pp. 29–40. doi: 10.1016/B978-0-12-816093-0.00003-3.

Barker, A. R., Gracia-Marco, L., Ruiz, J. R., Castillo, M. J., Aparicio-Ugarriza, R., González-Gross, M., Kafatos, A., Androutsos, O., Polito, A., Molnar, D., Widhalm, K. and Moreno, L. A. (2018) 'Physical activity, sedentary time, TV viewing, physical fitness and cardiovascular disease risk in adolescents: The HELENA study', *International Journal of Cardiology*. Elsevier Ireland Ltd, 254, pp. 303–309. doi: 10.1016/j.ijcard.2017.11.080.

Black, J. A., Campbell, J. A., Parker, S., Sharman, J. E., Nelson, M. R., Otahal, P., Hamilton, G. and Marwick, T. H. (2021) 'Absolute risk assessment for guiding cardiovascular risk management in a chest pain clinic', *Medical Journal of Australia*, 214(6), pp. 266–271. doi: 10.5694/mja2.50960.

Bo, M. S., Cheah, W. L., Lwin, S., Moe Nwe, T., Win, T. T. and Aung, M. (2018) 'Understanding the Relationship between Atherogenic Index of Plasma and Cardiovascular Disease Risk Factors among Staff of an University in Malaysia', *Journal of Nutrition and Metabolism*. doi: 10.1155/2018/7027624.

Boachie, M. K., Rossouw, L. and Ross, H. (2021) 'The Economic Cost of Smoking in South Africa, 2016', *Nicotine and Tobacco Research*, 23(2), pp. 286–293. doi: 10.1093/ntr/ntaa162.

Boateng, D., Agyemang, C., Beune, E., Meeks, K., Smeeth, L., Schulze, M. B., Addo, J., de-Graft Aikins, A., Galbete, C., Bahendeka, S., Danquah, I., Agyei-Baffour, P., Owusu-Dabo, E., Mockenhaupt, F. P., Spranger, J., Kengne, A. P., Grobbee, D. E. and Klipstein-Grobusch, K. (2018) 'Cardiovascular disease risk prediction in sub-Saharan African populations — Comparative analysis of risk algorithms in the RODAM study', *International Journal of Cardiology*. The Authors, 254, pp. 310–315. doi: 10.1016/j.ijcard.2017.11.082.

Boeing, H., Bechthold, A., Bub, A., Ellinger, S., Haller, D., Kroke, A., Leschik-Bonnet, E., Müller, M. J., Oberritter, H., Schulze, M., Stehle, P. and Watzl, B. (2012) 'Critical review: Vegetables and fruit in the prevention of chronic diseases', *European Journal of Nutrition*, 51(6), pp. 637–663. doi: 10.1007/s00394-012-0380-y.

Boles, M., Pelletier, B. and Lynch, W. (2004) 'The relationship between health risks and work productivity', *Journal of Occupational and Environmental Medicine*, 46(7), pp. 737–745. doi: 10.1097/01.jom.0000131830.45744.97.

Botha, C., Wright.Hh, Moss, S. and Kolbe-Alexander, T. L. (2013) '"Be active!" Revisiting the South African food-based dietary guideline for activity', *South African Journal of Clinical Nutrition*, 26(3), pp. 18–27.

Budreviciute, A., Damiati, S., Sabir, D. K., Onder, K., Schuller-Goetzburg, P., Plakys, G., Katileviciute, A., Khoja, S. and Kodzius, R. (2020) 'Management and Prevention Strategies for Non-communicable Diseases (NCDs) and Their Risk Factors', *Frontiers in Public Health*, 8(November), pp. 1–11. doi: 10.3389/fpubh.2020.574111.

Burnhams, N. H., Parry, C., Laubscher, R. and London, L. (2014) 'Prevalence and predictors of problematic alcohol use, risky sexual practices and other negative consequences associated with alcohol use among safety and security employees in the Western Cape, South Africa', *Substance Abuse: Treatment, Prevention, and Policy*, 9(1), pp. 1–10. doi: 10.1186/1747-597X-9-14.

Camm, A. J., Lüscher, T. F., Serruys, P. W., Edition, P., Taddei, S., Bruno, R. M., Masi, S. and Solini, A. (2018) 'ESC CardioMed', in *ESC CardioMed*, pp. 1–41. doi: 10.1093/med/9780198784906.001.0001.

Chobanian, A. V., Bakris, G. L., Black, H. R., Green, L. A. and Joseph L. Izzo (2004) *The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure*.

Choi, B., Schnall, Ã. P. L., Yang, H., Dobson, M., Landsbergis, P., Israel, L., Karasek, R. and Baker, D.

(2010) ‘Sedentary Work , Low Physical Job Demand , and Obesity in US Workers’, *AMERICAN JOURNAL OF INDUSTRIAL MEDICINE Sedentary*. doi: 10.1002/ajim.20886.

Claassen, L., Henneman, L., Janssens, A. C. J., Wijdenes-Pijl, M., Qureshi, N., Walter, F. M., Yoon, P. W. and Timmermans, D. R. (2010) ‘Using family history information to promote healthy lifestyles and prevent diseases; A discussion of the evidence’, *BMC Public Health*, 10. doi: 10.1186/1471-2458-10-248.

D’Agostino, R. B., Vasan, R. S., Pencina, M. J., Wolf, P. A., Cobain, M., Massaro, J. M. and Kannel, W. B. (2008) ‘General cardiovascular risk profile for use in primary care: The Framingham heart study’, *Circulation*, 117(6), pp. 743–753. doi: 10.1161/CIRCULATIONAHA.107.699579.

Deloitte Access Economics (2016) *The impact of increasing vegetable consumption on health expenditure*, *Horticulture Innovation Australia*. Available at: https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-increasing-vegetable-consumption-health-expenditure-impact-040716.pdf.

Diallo, A. O., Ali, M. K., Geldsetzer, P., Gower, E. W., Mukama, T., Wagner, R. G., Davies, J., Bijlsma, M. J. and Sudharsanan, N. (2021) ‘Systolic blood pressure and 6-year mortality in South Africa: a country-wide, population-based cohort study’, *The Lancet Healthy Longevity*. The Author(s). Published by Elsevier Ltd. This is an Open Access article under the CC BY-NC-ND 4.0 license, 2(2), pp. e78–e86. doi: 10.1016/S2666-7568(20)30050-7.

Dooris, M., Poland, B., Kolbe, L., De Leeuw, E., McCall, D. S. and Wharf-Higgins, J. (2007) ‘Healthy settings building evidence for the effectiveness of whole system health promotion - Challenges and future directions’, *Global Perspectives on Health Promotion Effectiveness*, (2001), pp. 327–352. doi: 10.1007/978-0-387-70974-1_19.

Doust, J., Sanders, S., Glasziou, P. and Shaw, J. (2012) ‘Prioritising CVD prevention therapy: Absolute risk versus individual risk factors’, *Australian Family Physician*, 41(10), pp. 805–809.

Duan, Y., Wang, A., Wang, Y., Wang, X., Chen, S., Zhao, Q., Li, X., Wu, S. and Yang, L. (2019) ‘Cumulative alcohol consumption and stroke risk in men’, *Journal of Neurology*. Springer Berlin Heidelberg, pp. 2112–2119. doi: 10.1007/s00415-019-09361-6.

Egan, B. M. and Stevens-Fabry, S. (2015) ‘Prehypertension - Prevalence, health risks, and management strategies’, *Nature Reviews Cardiology*. Nature Publishing Group, 12(5), pp. 289–300. doi:

10.1038/nrcardio.2015.17.

Ehrampoush, E., Arasteh, P. and Homayounfar, R. (2017) 'New anthropometric indices or old ones : Which is the better predictor of body fat ?', *Diabetes & Metabolic Syndrome : Clinical Research & Reviews*, 11, pp. 257–263.

Fagbamigbe, A. F., Desai, R., Sewpaul, R., Kandala, N. B., Sekgala, D. and Reddy, P. (2020) 'Age at the onset of tobacco smoking in South Africa: a discrete-time survival analysis of the prognostic factors', *Archives of Public Health*. Archives of Public Health, 78(1), pp. 1–11. doi: 10.1186/s13690-020-00503-1.

Florez, J. C., Jablonski, K. A., Bayley, N., Pollin, T. I., Bakker, P. I. W. de, Alan R. Shuldiner, Knowler, W. C., David M. Nathan and Altshuler, D. (2006) 'TCF7L2 Polymorphisms and Progression to Diabetes in the Diabetes Prevention Program Jose', *New England Journal of Medicine*, 355, pp. 241–250.

Fountaine, C. J., Piacentini, M. and Liguori, G. A. (2014) 'Occupational Sitting and Physical Activity among College Employees', *International Journal of Exercise Science*, 7(4), pp. 295–301. doi: 10.1249/01.mss.0000516937.72055.e2.

Gabor, M. R. (2007) 'Non–Probabilistic Sampling Use in Qualitative Marketing Research. Haphazard Sampling. Volunteer Sampling', *Analele Universităţii din Oradea. Seria Ştiinţe Economice*, XVI(June), pp. 920 – 925.

Gaziano, T. A., Pandya, A., Steyn, K., Levitt, N., Mollentze, W., Joubert, G., Walsh, C. M., Motala, A. A., Kruger, A., Schutte, A. E., Naidoo, D. P., Prakaschandra, D. R. and Laubscher, R. (2013) 'Comparative assessment of absolute cardiovascular disease risk characterization from non-laboratory-based risk assessment in South African populations', *BMC Medicine*, 11(1). doi: 10.1186/1741-7015-11-170.

Gaziano, T. A., Young, C. R., Fitzmaurice, G., Atwood, S. and Michael, J. (2008) 'Laboratory-based versus non-laboratory-based method for assessment of cardiovascular disease risk: the NHANES I Follow-up Study cohort', *Lancet*, 371(9616), pp. 923–931. doi: 10.1016/S0140-6736(08)60418-3.Laboratory-based.

GBD 2019 Risk Factors Collaborators (2020) 'Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019', *The Lancet*, 396(10258), pp. 1223–1249. doi: 10.1016/S0140-6736(20)30752-2.

Ghorpade, A. G., Shrivastava, S. R., Kar, S. S., Sarkar, S., Majgi, S. M. and Roy, G. (2015) 'Estimation of the cardiovascular risk using world health organization/international society of hypertension (WHO/ISH) risk prediction charts in a rural population of South India', *International Journal of Health Policy and Management*. © 2015 by Kerman University of Medical Sciences, 4(8), pp. 531–536. doi: 10.15171/ijhpm.2015.88.

Goetjes, E., Pavlova, M., Hongoro, C. and Groot, W. (2021) 'Socioeconomic inequalities and obesity in south africa—a decomposition analysis', *International Journal of Environmental Research and Public Health*, 18(17). doi: 10.3390/ijerph18179181.

Goff, D. C., Lloyd-Jones, D. M., Bennett, G., Coady, S., D'Agostino, R. B., Gibbons, R., Greenland, P., Lackland, D. T., Levy, D., O'Donnell, C. J., Robinson, J. G., Schwartz, J. S., Shero, S. T., Smith, S. C., Sorlie, P., Stone, N. J. and Wilson, P. W. F. (2014) '2013 ACC/AHA guideline on the assessment of cardiovascular risk: A report of the American college of cardiology/American heart association task force on practice guidelines', *Journal of the American College of Cardiology*, 63(25 PART B), pp. 2935–2959. doi: 10.1016/j.jacc.2013.11.005.

Gómez-Olivé, F. X., Ali, S. A., Made, F., Kyobutungi, C., Micklesfield, L., Alberts, M., Boua, R., Hazelhurst, S., Debpuur, C., Mashinya, F., Dikotope, S., Sorgho, H., Muthuri, S., Soo, C., Mukomana, F., Agongo, G., Wandabwa, C., Afolabi, S., Oduro, A., Tinto, H., Ryan, G., Haregu, T., Wade, A., Kahn, K., Norris, S. A. and Nigel, J. (2018) 'Regional and sex differences in the prevalence and awareness of hypertension across six sites in sub-Saharan Africa: an H3Africa AWI-Gen study', *Global Heart*, 12(2), pp. 81–90. doi: 10.1016/j.gheart.2017.01.007.Regional.

Gona, P. N., Kimokoti, R. W., Gona, C. M., Ballout, S., Rao, S. R., Mapoma, C. C., Lo, J. and Mokdad, A. H. (2021) 'Changes in body mass index, obesity, and overweight in Southern Africa development countries, 1990 to 2019: Findings from the Global Burden of Disease, Injuries, and Risk Factors Study', *Obesity Science and Practice*, 7(5), pp. 509–524. doi: 10.1002/osp4.519.

Gonzalez, C. A., Lujan-Barroso, L., Bueno-De-Mesquita, H. B., Jenab, M., Duell, E. J., Agudo, A., Tjønneland, A., Boutron-Ruault, M. C., Clavel-Chapelon, F., Touillaud, M., Teucher, B., Kaaks, R., Boeing, H., Steffen, A., Trichopoulou, A., Roukos, D., Karapetyan, T., Palli, D., Tagliabue, G., Mattiello, A., Tumino, R., Ricceri, F., Siersema, P. D., Numans, M. E., Peeters, P. P. H., Parr, C. L., Skeie, G., Lund, E., Quirõs, J. R., Sánchez-Cantalejo, E., Navarro, C., Barricarte, A., Dorronsoro, M., Ehrnström, R., Regner, S., Khaw, K. T., Wareham, N., Key, T. J., Crowe, F. L., Blaker, H., Romieu, I. and Riboli, E. (2012) 'Fruit and vegetable intake and the risk of gastric adenocarcinoma: A reanalysis of the european prospective investigation into cancer and nutrition (EPIC-EURGAST) study after a longer follow-up', *International Journal of Cancer*, 131(12), pp. 2910–2919. doi: 10.1002/ijc.27565.

Goon, D., Amusa, L., Mhlongo, D., Khoza, L. and Any-Anwu, F. (2013) 'Elevated blood pressure among rural South African children in Thohoyandou, South Africa', *Iranian Journal of Public Health*, 42(5), pp. 489–496.

Gounder, S. (2012) 'Chapter 3 - Research methodology and research questions', *Research Methodology and Research Method*, (March 2012), pp. 84–193.

Gray, B. J., Bracken, R. M., Turner, D., Morgan, K., Mellalieu, S. D., Thomas, M., Williams, S. P., Williams, M., Rice, S. and Stephens, J. W. (2014) 'Predicted 10-year risk of cardiovascular disease is influenced by the risk equation adopted: A cross-sectional analysis', *British Journal of General Practice*, 64(627), pp. e634–e640. doi: 10.3399/bjgp14X681805.

Griswold, M. G., Fullman, N., Hawley, C., Arian, N., Zimsen, S. R. M., Tymeson, H. D., Venkateswaran, V., Tapp, A. D., Forouzanfar, M. H., Salama, J. S., Abate, K. H., Abate, D., Abay, S. M., Abbafati, C., Abdulkader, R. S., Abebe, Z., Aboyans, V., Gakidou, E., *et al.* (2018) 'Alcohol use and burden for 195 countries and territories, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016', *The Lancet*, 392(10152), pp. 1015–1035. doi: 10.1016/S0140-6736(18)31310-2.

Groenewald, P., Vos, T., Norman, R., Laubscher, R., van Walbeek, C., Saloojee, Y., Sitas, F. and Bradshaw, D. (2007) 'Estimating the burden of disease attributable to smoking in South Africa in 2000', *South African Medical Journal*, 97(8), pp. 674–681. doi: 10.7196/SAMJ.661.

Guthold, R., Stevens, G. A., Riley, L. M. and Bull, F. C. (2018) 'Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants', *The Lancet Global Health*. World Health Organization, 6(10), pp. e1077–e1086. doi: 10.1016/S2214-109X(18)30357-7.

Hancock, C., Kingo, L. and Raynaud, O. (2011) 'The private sector, international development and NCDs', *Globalization and Health*, 7, pp. 1–11. doi: 10.1186/1744-8603-7-23.

Hene, N., Wood, P., Schwellnus, M., Jordaan, E. and Laubscher, R. (2021) 'High prevalence of non-communicable diseases risk factors in 36,074 south african financial sector employees', *Journal of Occupational and Environmental Medicine*, 63(2), pp. 159–165. doi: 10.1097/JOM.0000000000002104.

Ibekwe, R. (2015) ‘Modifiable risk factors of hypertension and socio-demographic profile in Oghara, Delta State; prevalence and correlates’, *Annals of Medical and Health Sciences Research*, 5(1), p. 71. doi: 10.4103/2141-9248.149793.

Ibrahim, M. M. and Damasceno, A. (2012) ‘Hypertension in developing countries’, *The Lancet*. Elsevier Ltd, 380(9841), pp. 611–619. doi: 10.1016/S0140-6736(12)60861-7.

Ige, O., Owoaje, E. and Adebiyi, O. (2013) ‘Non communicable disease and risky behaviour in an urban university community Nigeria’, 13(1), pp. 4–9.

International Diabetes Federation (2019) *IDF Diabetes Atlas 9th Edition*. Brussels. doi: 10.1016/S0140-6736(55)92135-8.

Jaacks, L., Vandevijvere, S., McGowan, C. J., Wallace, C., Imamura, F., Mozaffarian, D., Swinburn, B. and Ezzati, M. (2019) ‘The obesity transition: stages of the global epidemic’, *Lancet Diabetes Endocrinology*, 7(3), pp. 231–240. doi: 10.1530/ey.16.13.15.

Jackson, R., Lawes, C. M. M., Bennett, D. A., Milne, R. J. and Rodgers, A. (2005) ‘Treatment with drugs to lower blood pressure and blood cholesterol based on an individual’s absolute cardiovascular risk’, *Lancet*, 365, pp. 434–441. doi: 10.1056/nejm195410282511803.

Jacobs, L. and Steyn, N. (2013) ‘If you drink alcohol, drink sensibly: Is this guideline still appropriate?’, *Ethnicity and Disease*, 23(1), pp. 110–115.

Jalayondeja, C., Jalayondeja, W., Mekhora, K., Bhuanantanondh, P., Dusadi-Isariyavong, A. and Upiriyasakul, R. (2017) ‘Break in sedentary behavior reduces the risk of noncommunicable diseases and cardiometabolic risk factors among workers in a petroleum company’, *International Journal of Environmental Research and Public Health*, 14(5), pp. 1–9. doi: 10.3390/ijerph14050501.

Janakiraman, B., Abebe, S. M., Chala, M. B. and Demissie, S. F. (2020) ‘Epidemiology of general, central obesity and associated cardio-metabolic risks among university employees, Ethiopia: A cross-sectional study’, *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, 13, pp. 343–353. doi: 10.2147/DMSO.S235981.

Joseph-shehu, E. M. and Ncama, B. P. (2018) ‘Evaluation of health status and its predictor among university staff in Nigeria’, *BMC Cardiovascular Disorders*. BMC Cardiovascular Disorders, 18.

Joubert, J., Norman, R., Bradshaw, D., Goedecke, J. H., Steyn, N. P., Puoane, T., African, S. and Town, C. (2007) 'Estimating the burden of disease attributable to excess body weight in South Africa in 2000', *South African Medical Journal*, 97(8), pp. 683–690.

Joubert, J., Norman, R., Lambert, E. V, Groenewald, P., Schneider, M., Bull, F., Bradshaw, D. and CollaboratingGroup, S. A. C. R. A. (2007) 'Estimating the burden of disease attributable to physical inactivity in South Africa in 2000', *South African Medical Journal*, 97(8), pp. 725–732. doi: 10.7196/SAMJ.661.

Kagura, J., Adair, L. S., Musa, M. G., Pettifor, J. M. and Norris, S. A. (2015) 'Blood pressure tracking in urban black South African children: Birth to twenty cohort', *BMC Pediatrics*. BMC Pediatrics, 15(1), pp. 1–7. doi: 10.1186/s12887-015-0402-z.

Kandala, N. B., Tigbe, W., Manda, S. O. and Stranges, S. (2013) 'Geographic variation of hypertension in sub-Saharan Africa: A case study of South Africa', *American Journal of Hypertension*, 26(3), pp. 382–391. doi: 10.1093/ajh/hps063.

Katzmarzyk, P. T., Powell, K. E., Jakicic, J. M., Troiano, R. P., Piercy, K. and Tennant, B. (2019) 'Sedentary Behavior and Health: Update from the 2018 Physical Activity Guidelines Advisory Committee', *Medicine and Science in Sports and Exercise*, 51(6), pp. 1227–1241. doi: 10.1249/MSS.0000000000001935.

Katzmarzyk, P. T., Ross, R., Blair, S. N. and Després, J. P. (2020) 'Should we target increased physical activity or less sedentary behavior in the battle against cardiovascular disease risk development?', *Atherosclerosis*. Elsevier, 311(March), pp. 107–115. doi: 10.1016/j.atherosclerosis.2020.07.010.

Ketkar, A. R., Veluswamy, S. K., Prabhu, N. and Maiya, A. G. (2015) 'ScienceDirect Screening for noncommunicable disease risk factors at a workplace in India : A physiotherapy initiative in a healthcare', *Hong Kong Physiotherapy Journal*, 33, pp. 3–9.

Khine, A. A. and Marais, A. D. (2016) 'High prevalence of primary dyslipidaemia in black South African patients at a tertiary hospital in northern Gauteng, South Africa', *South African Medical Journal*, 106(7), pp. 724–729. doi: 10.7196/SAMJ.2016.v106i7.10337.

Klug, E., Raal, F. J., Marais, A. D., Smuts, C. M., Schamroth, C., Jankelow, D., Blom, D. J. and Webb, D. A. (2018) 'South African dyslipidaemia guideline consensus statement: 2018 update A joint statement from the South African Heart Association (SA Heart) and the Lipid and Atherosclerosis Society of Southern Africa (LASSA)', *South African medical journal = Suid-Afrikaanse tydskrif vir geneeskunde*, 108(11), pp. 973–1000. doi: 10.7196/SAMJ.2018.v108i11.13383.

Kolbe-Alexander, T. L., Conradie, J. and Lambert, E. V (2013) 'Clustering of risk factors for non-communicable disease and healthcare expenditure in employees with private health insurance presenting for health risk appraisal : a cross-sectional study', *BMC Pediatrics*, 13, p. 1213.

Kolbe-Alexander, T. and Lambert, E. (2013) 'Non-Communicable Disease Prevention and Worksite Health Promotion Programs : A Brief Review', 1(7), pp. 1–8. doi: 10.4172/2329-6879.1000141.

Koopman, J. J. E., Van Bodegom, D., Ziem, J. B. and Westendorp, R. G. J. (2016) 'An emerging epidemic of noncommunicable diseases in developing populations due to a triple evolutionary mismatch', *American Journal of Tropical Medicine and Hygiene*, 94(6), pp. 1189–1192. doi: 10.4269/ajtmh.15-0715.

Kraus, W. E., Powell, K. E., Haskell, W. L., Janz, K. F., Campbell, W. W., Jakicic, J. M., Troiano, R. P., Sprow, K., Torres, A. and Piercy, K. L. (2019) 'Physical Activity, All-Cause and Cardiovascular Mortality, and Cardiovascular Disease', *Medicine and Science in Sports and Exercise*, 51(6), pp. 1270–1281. doi: 10.1249/MSS.0000000000001939.

Kruger, H. S., Puoane, T., Senekal, M. and van der Merwe, M.-T. (2005) 'Obesity in South Africa: challenges for government and health professionals', *Public Health Nutrition*, 8(5), pp. 491–500. doi: 10.1079/phn2005785.

Kshirsagar, A. V., Carpenter, M., Bang, H., Wyatt, S. B. and Colindres, R. E. (2006) 'Blood pressure usually considered normal is associated with an elevated risk of cardiovascular disease', *American Journal of Medicine*, 119(2), pp. 133–141. doi: 10.1016/j.amjmed.2005.08.023.

Latunji, O. O. and Akinyemi, O. O. (2018) 'Factors Influencing Health-Seeking Behaviour Among Civil Servants in Ibadan, Nigeria.', *Annals of Ibadan postgraduate medicine*, 16(1), pp. 52–60. Available at: http://www.ncbi.nlm.nih.gov/pubmed/30254559%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC6143883.

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., Katzmarzyk, P. T., Alkandari, J. R., Andersen, L. B., Bauman, A. E., Brownson, R. C., Bull, F. C., Craig, C. L., Ekelund, U., Goenka, S., Guthold, R., Hallal, P. C., Haskell, W. L., Heath, G. W., Inoue, S., Kahlmeier, S., Kohl, H. W., Lambert, E. V., Leetongin, G., Loos, R. J. F., Marcus, B., Martin, B. W., Owen, N., Parra, D. C., Pratt, M., Ogilvie, D., Reis, R. S., Sallis, J. F., Sarmiento, O. L. and Wells, J. C. (2012) 'Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy', *The Lancet*. Elsevier Ltd, 380(9838), pp. 219–229. doi: 10.1016/S0140-6736(12)61031-9.

León-Latre, M., Moreno-Franco, B., Andrés-Esteban, E. M., Ledesma, M., Laclaustra, M., Alcalde, V., Peñalvo, J. L., Ordovás, J. M. and Casasnovas, J. A. (2014) 'Sedentary Lifestyle and Its Relation to Cardiovascular Risk Factors, Insulin Resistance and Inflammatory Profile', *Revista Española de Cardiología (English Edition)*, 67(6), pp. 449–455. doi: 10.1016/j.rec.2013.10.015.

Leung, A. A., Bushnik, T., Hennessy, D., McAlister, F. A. and Manuel, D. G. (2019) 'Risk factors for hypertension in Canada', *Statistics Canada*, 30(2), pp. 3–13. doi: 10.1016/j.amcp.2021.11.022.

Lin, T., Courtney, T. K., Lombardi, D. A. and Verma, S. K. (2015) 'Association Between Sedentary Work and BMI in a U.S. National Longitudinal Survey', *American Journal of Preventive Medicine*. Elsevier, 49(6), pp. e117–e123. doi: 10.1016/j.amepre.2015.07.024.

Liu, M., Liu, Q., Wen, J., Wang, M., Wu, L., Qu, M., Li, M., Shen, M. and Wu, J. (2018) 'Waist-to-hip ratio is the most relevant obesity index at each phase of insulin secretion among obese patients', *Journal of Diabetes and Its Complications*, 32, pp. 670–676.

Lourenço, S., Oliveira, A. and Lopes, C. (2012) 'The effect of current and lifetime alcohol consumption on overall and central obesity', *European Journal of Clinical Nutrition*, 66(7), pp. 813–818. doi: 10.1038/ejcn.2012.20.

Mabweazara, Z. S., Leach, L. L., Smith, M., Tsolekile, L. and Puoane, T. (2019) 'Ellisras Longitudinal Study 2017: Patterns of physical activity in an urban and rural setting among black South African adults (ELS 23)', *Cardiovascular Journal of Africa*, 30(5), pp. 262–267. doi: 10.5830/CVJA-2019-018.

Malambo, P., Kengne, A. P., Lambert, E. V., De Villiers, A. and Puoane, T. (2016) 'Prevalence and socio-demographic correlates of physical activity levels among South African adults in Cape Town and Mount Frere communities in 2008-2009', *Archives of Public Health*. Archives of Public Health, 74(1), pp. 1–9. doi: 10.1186/s13690-016-0167-3.

Melo, E. S., Antonini, M., Costa, C. R. B., Sorensen, W., Gir, E. and Reis, R. K. (2020) 'Evaluation of cardiovascular risk factors in people living with HIV in São Paulo, Brazil', *Journal of Infection in*

Developing Countries, 14(1), pp. 89–96. doi: 10.3855/jidc.11326.

Miedema, M. D., Petrone, A., Shikany, J. M., Greenland, P., Lewis, C. E., Pletcher, M. J., Gaziano, J. M. and Djousse, L. (2015) ‘Association of fruit and vegetable consumption during early adulthood with the prevalence of coronary artery calcium after 20 years of follow-up’, *Circulation*, 132(21), pp. 1990–1998. doi: 10.1161/CIRCULATIONAHA.114.012562.

Miller, V., Mente, A., Dehghan, M., Rangarajan, S., Zhang, X., Swaminathan, S., Dagenais, G., Gupta, R., Mohan, V., Lear, S., Bangdiwala, S. I., Schutte, A. E., Wentzel-Viljoen, E., Avezum, A., Altuntas, Y., Yusoff, K., Ismail, N., Mapanga, R., *et al.* (2017) ‘Fruit, vegetable, and legume intake, and cardiovascular disease and deaths in 18 countries (PURE): a prospective cohort study’, *The Lancet*, 390(10107), pp. 2037–2049. doi: 10.1016/S0140-6736(17)32253-5.

Mills, K. T., Bundy, J. D., Kelly, T. N., Reed, J., Kearney, P., Reynolds, K., Chen, J. and He, J. (2016) ‘Global Disparities of Hypertension Prevalence and Control: A Systematic Analysis of Population-based Studies from 90 Countries’, *Circulation*, 134(6), pp. 441–450. doi: 10.1161/CIRCULATIONAHA.115.018912.Global.

Mills, K. T., Stefanescu, A. and He, J. (2020) ‘The global epidemiology of hypertension Katherine’, *Physiology & behavior*, 16(4), pp. 223–237. doi: 10.1038/s41581-019-0244-2.The.

Milner, K., da Silva, R., Patel, D. and Salau, S. (2018) ‘How do we measure up? A comparison of lifestyle-related health risk factors among sampled employees in South African and UK companies’, *Global Health Promotion*, 25(1), pp. 73–81. doi: 10.1177/1757975916656346.

Mohajan, H. K. (2017) ‘Two Criteria for Good Measurements in Research: Validity and Reliability’, *Annals of Spiru Haret University. Economic Series*, 17(4), pp. 59–82. doi: 10.26458/1746.

Morris, L. J., D’Este, C., Sargent-Cox, K. and Anstey, K. J. (2016) ‘Concurrent lifestyle risk factors: Clusters and determinants in an Australian sample’, *Preventive Medicine*. Elsevier Inc., 84, pp. 1–5. doi: 10.1016/j.ypmed.2015.12.009.

Mujuzi, J. D. (2010) ‘Smoking in the workplace in South Africa: Law and practice relating to the rights and obligations of employers and employees’, *South African Journal of Bioethics and Law*, 3(2), pp. 79–83.

Mushaphi, L. F. and Madala, S. (2020) ‘The prevalence of non-communicable diseases among academic staff members in rural university, SA’, *Proceedings of the Nutrition Society*, 79(OCE2), p. 2021. doi: 10.1017/s0029665120001743.

National Department of Health (NDoH), Statistics South Africa (Stats SA), S. A. M. R. C. (SAMRC) and ICF (2019) *South Africa Demographic and Health Survey 2016*, *South Africa Demographic and Health Survey 2016*. Pretoria, South Africa, and Rockville, Maryland, USA: NDoH, Stats SA, SAMRC, and ICF.

Norman, R., Thomas. Gaziano, Laubscher, R., Steyn, K., Bradshaw, D., Group, and the S. A. C. R. A. C. and Objectives. (2007) ‘Estimating the burden of disease attributable to high blood pressure in South Africa in 2000’, *South African Medical Journal*, 97(8), pp. 692–698. doi: 10.7196/SAMJ.661.

Noubiap, J. J., Essouma, M., Bigna, J. J., Jingi, A. M., Aminde, L. N. and Nansseu, J. R. (2017) ‘Prevalence of elevated blood pressure in children and adolescents in Africa: a systematic review and meta-analysis’, *The Lancet Public Health*. The Author(s). Published by Elsevier Ltd. This is an Open Access article under the CC BY 4.0 license, 2(8), pp. e375–e386. doi: 10.1016/S2468-2667(17)30123-8.

Nyirenda, M. (2021) ‘Assessment of cardiovascular disease risks using Framingham risk scores (FRS) in HIV-positive and HIV-negative older adults in South Africa’, *Preventive Medicine Reports*. Elsevier Inc., 22, p. 101352. doi: 10.1016/j.pmedr.2021.101352.

Obesity Rates By Country 2021 (no date). Available at: https://worldpopulationreview.com/country-rankings/obesity-rates-by-country (Accessed: 9 November 2021).

Okop, K. J., Ndayi, K., Tsolekile, L., Sanders, D. and Puoane, T. (2019) ‘Low intake of commonly available fruits and vegetables in socio-economically disadvantaged communities of South Africa: Influence of affordability and sugary drinks intake’, *BMC Public Health*. BMC Public Health, 19(1), pp. 1–14. doi: 10.1186/s12889-019-7254-7.

Okube, O. T. and Omandi, F. B. (2018) ‘Assessment of risk factors for the four major non-communicable diseases among the catholic university of eastern Africa staff , Langata campus , Nairobi , Kenya’, *International Journal of Medical Research and Health Research*, 4(10), pp. 22–34.

Onyiriuka, A. N., Iduoriyekemwen, N. J. and Sadoh, W. E. (2021) ‘Prevalence and pattern of dyslipidaemia among Nigerian adolescents living in Benin City: A school-based cross-sectional study’, *Sri Lanka Journal of Child Health*, 50(3), pp. 385–392. doi: 10.4038/sljch.v50i3.9685.

Owen, N., Healy, G. N., Matthews, C. E. and Dunstan, D. W. (2010) 'Too much sitting: The population health science of sedentary behavior', *Exercise and Sport Sciences Reviews*, 38(3), pp. 105–113. doi: 10.1097/JES.0b013e3181e373a2.

Parry, C. D., Patra, J. and Rehm, J. (2011) 'Alcohol consumption and non-communicable diseases: Epidemiology and policy implications', *Addiction*, 106(10), pp. 1718–1724. doi: 10.1111/j.1360-0443.2011.03605.x.

Peer, N., Lombard, C., Steyn, K., Gaziano, T. and Levitt, N. (2014) 'Comparability of total cardiovascular disease risk estimates using laboratory and non-laboratory based assessments in urban-dwelling South Africans: The CRIBSA study', *South African Medical Journal*, 104(10), pp. 691–696. doi: 10.7196/SAMJ.8125.

Peltzer, K., Davids, A. and Njuho, P. (2011) 'Alcohol use and problem drinking in South Africa', *African Journal of Psychiatry*, 1(14), pp. 30–37.

Peltzer, K. and Phaswana-Mafuya, N. (2012) 'Fruit and vegetable intake and associated factors in older adults in South Africa', *Global Health Action*, 5(1), pp. 1–8. doi: 10.3402/gha.v5i0.18668.

Peters, S. A. E., Singhateh, Y., Mackay, D., Huxley, R. R. and Woodward, M. (2016) 'Total cholesterol as a risk factor for coronary heart disease and stroke in women compared with men: A systematic review and meta-analysis', *Atherosclerosis*. Elsevier Ltd, 248, pp. 123–131. doi: 10.1016/j.atherosclerosis.2016.03.016.

Peters, S. A. E., Wang, X., Lam, T. H., Kim, H. C., Ho, S., Ninomiya, T., Knuiman, M., Vaartjes, I., Bots, M. L. and Woodward, M. (2018) 'Clustering of risk factors and the risk of incident cardiovascular disease in Asian and Caucasian populations: Results from the Asia Pacific Cohort Studies Collaboration', *BMJ Open*, 8(3), pp. 1–8. doi: 10.1136/bmjopen-2017-019335.

Phaswana-Mafuya, N., Peltzer, K., Chirinda, W., Musekiwa, A. and Kose, Z. (2013) 'Sociodemographic predictors of multiple non-communicable disease risk factors among older adults in South Africa', *Global Health Action*, 6(1). doi: 10.3402/gha.v6i0.20680.

Pletcher, M. J., Bibbins-Domingo, K., Liu, K., Sidney, S., Lin, F., Vittinghoff, E. and Hulley, S. B. (2010) 'Nonoptimal lipids commonly present in young adults and coronary calcium later in life: The CARDIA (Coronary Artery Risk Development in Young Adults) study', *Annals of Internal Medicine*, 153(3), pp.

137–146. doi: 10.7326/0003-4819-153-3-201008030-00004.

Priceless South Africa. (2017) *Fiscal Policies for Population Health in South Africa*.

Puoane, T., Hughes, G. and Bradley, H. A. (2005) 'Obesity among black South African women', *Journal of Human Ecology*, 13(Special Issue), pp. 91–95. Available at: http://repository.uwc.ac.za/xmlui/handle/10566/243.

Puoane, T., Tsolekile, L., Sanders, D. and Parker, W. (2008) 'Chronic noncommunicable diseases: primary health care: programme areas.', *S Afr Health Review*, pp. 73–87.

Rathi, P., Raghuveer, P., Narendra, V. and Bhargava, M. (2018) 'Prevalence of Non Communicable Diseases and Its Risk Factors among the Non-Teaching Staff of Medical College using WHO STEPS', *Natl J ComunityMedicine 2018*, 9(2), pp. 71–77.

Reddy, P., James, S., Sewpaul, R., Yach, D., Resnicow, K., Sifunda, S., Mthembu, Z. and Mbewu, A. (2013) 'A decade of tobacco control: The South African case of politics, health policy, health promotion and behaviour change', *South African Medical Journal*, 103(11), pp. 835–840. doi: 10.7196/SAMJ.6910.

Reddy, P., Zuma, K., Shisana, O., Jonas, K. and Sewpaul, R. (2015) 'Prevalence of tobacco use among adults in South Africa: Results from the first South African national health and Nutrition Examination Survey', *South African Medical Journal*, 105(8), pp. 648–655. doi: 10.7196/SAMJnew.7932.

Reddy, V. and Naidoo, R. (2018) 'The Lifestyle Habits and Cardiovascular Disease Risk Factor Profiles of Staff Within a Provincial Tertiary Institution in South Africa', *Global Journal of Health Science*, 10(6), p. 102. doi: 10.5539/gjhs.v10n6p102.

Rehm, J., Rovira, P., Llamosas-Falcón, L. and Shield, K. D. (2021) 'Dose–response relationships between levels of alcohol use and risks of mortality or disease, for all people, by age, sex and specific risk factors', *Nutrients*, 13(8). doi: 10.3390/nu13082652.

Reid, G. and Emery, J. (2006) 'Chronic disease prevention in general practice applying the family history', *Australian Family Physician*, 35(11), pp. 879–885.

Reitsma, M. B., Kendrick, P. J., Ababneh, E., Abbafati, C., Abbasi-Kangevari, M., Abdoli, A., Abedi, A., Abhilash, E. S., Abila, D. B., Aboyans, V., Abu-Rmeileh, N. M., Adebayo, O. M., Advani, S. M., Aghaali, M., Ahinkorah, B. O., Ahmad, S., Ahmadi, K., Zuniga, Y. H., *et al.* (2021) 'Spatial, temporal, and demographic patterns in prevalence of smoking tobacco use and attributable disease burden in 204 countries and territories, 1990–2019: a systematic analysis from the Global Burden of Disease Study 2019’, *The Lancet*, 397(10292), pp. 2337–2360. doi: 10.1016/S0140-6736(21)01169-7.

Republic of South Africa (1997) ‘Basic Conditions of Employment Act No. 75, 1997’, *Government Gazette, 5 December 1997*, 390(18491), pp. 1–78. Available at: http://www.nsw.gov.au/sites/default/files/Government_Gazette_2_December.pdf#page=15.

RSA (2004) ‘Liquor Act (59 of 2003)’, *Government Gazette*, 466(26294), pp. 5–40.

Safi, A., Cole, M., Kelly, A. L. and Walker, N. C. (2021) ‘An Evaluation of Physical Activity Levels amongst University Employees’, *Advances in Physical Education*, 11(02), pp. 158–171. doi: 10.4236/ape.2021.112012.

Santos Sales, A. and Casotti, C. A. (2019) ‘Reclassification of the framingham risk score and its agreement with other three calculations’, *Aquichan*, 19(2), pp. 1–10. doi: 10.5294/aqui.2019.19.2.9.

Schouw, D., Mash, B. and Kolbe-Alexander, T. (2018) ‘Risk factors for non-communicable diseases in the workforce at a commercial power plant in South Africa - original research - peer reviewed’, *Occupational Health Southern Africa Africa*, 24(5), pp. 145–152.

SCORE Risk Charts (no date). Available at: https://www.escardio.org/Education/Practice-Tools/CVD-prevention-toolbox/SCORE-Risk-Charts (Accessed: 18 September 2020).

Selvarajah, S., Kaur, G., Haniff, J., Cheong, K. C., Hiong, T. G., Van Der Graaf, Y. and Bots, M. L. (2014) ‘Comparison of the Framingham Risk Score, SCORE and WHO/ISH cardiovascular risk prediction models in an Asian population’, *International Journal of Cardiology*. Elsevier B.V., 176(1), pp. 211–218. doi: 10.1016/j.ijcard.2014.07.066.

Sharma, D., Vatsa, M., Lakshmy, R. and Narang, R. (2012) ‘Original article Study of cardiovascular risk factors among tertiary hospital employees and their families 5’, *Indian Heart Journal*, 64, pp. 356–363.

Sheps, S. G., Black, H. R., Cohen, J. D., Kaplan, N. and Ferdinand, K. C. (1997) ‘The sixth report of the Joint National Committee on the Detection, Evaluation, and Treatment of High Blood Pressure’, *American Journal of Managed Care*, 4(7 SUPPL.). doi: 10.1001/archinte.1997.00440420033005.

Shisana, O., Labadarios, D., Rehle, T., Simbayi, L., K, Z., A, D. and Reddy. P, Parker. W, Hoosain E, Naidoo P, Hongoro C, Mchiza Z, Steyn NP, Dwane N, Makoae M, Maluleke T, Ramlagan S, Zungu N, Evans MG, Jacobs L, Faber M, & S.-1 T. (2013) *South African National Health and Nutrition Examination Survey (SANHANES-1)*. CAPTE TOWN: HSRC PRESS.

Simmonds, M., Llewellyn, A., Owen, C. G. and Woolacott, N. (2016) 'Predicting adult obesity from childhood obesity: A systematic review and meta-analysis', *Obesity Reviews*, 17(2), pp. 95–107. doi: 10.1111/obr.12334.

Soliman, G. A. (2018) 'Dietary cholesterol and the lack of evidence in cardiovascular disease', *Nutrients*, 10(6). doi: 10.3390/nu10060780.

Stanaway, J. D., Afshin, A., Gakidou, E., Lim, S. S., Abate, D., Abate, K. H., Abbafati, C., Abbasi, N., Abbastabar, H., Abd-Allah, F., Abdela, J., Abdelalim, A., Abdollahpour, I., Abdulkader, R. S., Abebe, M., Abebe, Z., Abera, S. F., Murray, C. J. L., *et al.* (2018) 'Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: A systematic analysis for the Global Burden of Disease Stu', *The Lancet*, 392(10159), pp. 1923–1994. doi: 10.1016/S0140-6736(18)32225-6.

Statistics South Africa (2018) *Mortality and causes of death in South Africa, 2016: Findings from death notification*, *Statistics South Africa*. Available at: www.statssa.gov.za,info@statssa.gov.za,Tel+27123108911.

Swanepoel, M., Strydom, G. L. and Cockeran, M. (2015) 'The prevalence and clustering of non-communicable disease risk factors in a South African financial institution: A challenge to corporate management', *African journal for physical, health education, recreation & dance*, 21(4:2), pp. 1469–1488.

Talpur, M. T. H., Katbar, M. T., Shabir, Khalil Ullah, Shabir, Kashif Ullah, Yaqoob, U., Jabeen, S. and Zia, D. (2020) 'Prevalence of dyslipidemia in young adults.', *The Professional Medical Journal*, 27(05), pp. 987–993. doi: 10.29309/tpmj/2020.27.05.4040.

Taylor, P., Saheb, R. and Howse, E. (2019) 'Creating healthier graduates, campuses and communities: Why Australia needs to invest in health promoting universities', *Health Promotion Journal of Australia*, 30(2), pp. 285–289. doi: 10.1002/hpja.175.

Temple, N. J. and Steyn, N. P. (2011) 'The cost of a healthy diet: A South African perspective', *Nutrition*. Elsevier Ltd, 27(5), pp. 505–508. doi: 10.1016/j.nut.2010.09.005.

The WHO CVD Risk Chart Working Group (2019) 'Articles World Health Organization cardiovascular disease risk charts : revised models to estimate risk in 21 global regions', *Lancet Glob Health*, 7, pp. e1332-45. doi: 10.1016/S2214-109X(19)30318-3.

Thivel, D., Tremblay, A., Genin, P. M., Panahi, S., Rivière, D. and Duclos, M. (2018) 'Physical Activity, Inactivity, and Sedentary Behaviors: Definitions and Implications in Occupational Health', *Frontiers in Public Health*, 6(October), pp. 1–5. doi: 10.3389/fpubh.2018.00288.

Tingum, E. N., Mukong, A. K. and Mdege, N. (2020) 'The effects of price and non-price policies on cigarette consumption in South Africa', *Tobacco Induced Diseases*, 18, pp. 1–10. doi: 10.18332/TID/123424.

Tohidi, M., Mohebi, R., Cheraghi, L., Hajsheikholeslami, F., Aref, S., Nouri, S., Azizi, F. and Hadaegh, F. (2013) 'Lipid profile components and incident cerebrovascular events versus coronary heart disease; the result of 9years follow-up in Tehran Lipid and Glucose Study', *Clinical Biochemistry*. The Canadian Society of Clinical Chemists, 46(9), pp. 716–721. doi: 10.1016/j.clinbiochem.2013.03.012.

Travill, A. L., Soeker, F., Overmeyer, D. and Rickers, F. (2019) 'Cardiovascular and metabolic risk factors of shift workers within the automotive industry', *Health SA Gesondheid*, 24, pp. 1–5. doi: 10.4102/hsag.v24i0.1227.

Tremblay, M. S., Aubert, S., Barnes, J. D., Saunders, T. J., Carson, V., Latimer-Cheung, A. E., Chastin, S. F. M., Altenburg, T. M., Chinapaw, M. J. M., Aminian, S., Arundell, L., Hinkley, T., Hnatiuk, J., Atkin, A. J., Belanger, K., Chaput, J. P., Gunnell, K., Wondergem, R., *et al.* (2017) 'Sedentary Behavior Research Network (SBRN) - Terminology Consensus Project process and outcome', *International Journal of Behavioral Nutrition and Physical Activity*. International Journal of Behavioral Nutrition and Physical Activity, 14(1), pp. 1–17. doi: 10.1186/s12966-017-0525-8.

Tsouros, A., Dowding, G., Thompson, J. and Dooris, M. (1998) *Health Promoting Universities. Concept , Experience and Framework for Action*. Copenhagen: World Health Organization.

U.S. Department of Health and Human Services (2006) *The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health*. Atlanta. doi: 10.1016/j.amepre.2007.02.026.

Vellios, N. G. and van Walbeek, C. P. (2018) ‘Self-reported alcohol use and binge drinking in South Africa: Evidence from the national income dynamics study, 2014 - 2015’, *South African Medical Journal*, 108(1), pp. 33–39. doi: 10.7196/SAMJ.2018.v108i1.12615.

Vellios, N. and Van Walbeek, C. (2016) ‘Determinants of regular smoking onset in South Africa using duration analysis’, *BMJ Open*, 6(7), pp. 1–9. doi: 10.1136/bmjopen-2016-011076.

Vermeulen, H. (2020) ‘A balanced food basket approach to monitor food affordability in South Africa’, (February).

Viera, A. J. and Garrett, J. M. (2005) ‘Anthony J. Viera, MD; Joanne M. Garrett, PhD (2005). Understanding interobserver agreement: the kappa statistic. Fam Med 2005;37(5):360-63.’, *Family Medicine*, 37(5), pp. 360–3. Available at: http://www1.cs.columbia.edu/~julia/courses/CS6998/Interrater_agreement.Kappa_statistic.pdf.

Vodnala, D., Rubenfire, M. and Brook, R. D. (2012) ‘Secondary causes of dyslipidemia’, *American Journal of Cardiology*. Elsevier Inc., 110(6), pp. 823–825. doi: 10.1016/j.amjcard.2012.04.062.

Wagner, R. G., Crowther, N. J., Gómez-Olivé, F. X., Kabudula, C., Kahn, K., Mhembere, M., Myakayaka, Z., Tollman, S. and Wade, A. N. (2018) ‘Sociodemographic, socioeconomic, clinical and behavioural predictors of body mass index vary by sex in rural South African adults-findings from the AWI-Gen study’, *Global Health Action*. Taylor & Francis, 11(sup2). doi: 10.1080/16549716.2018.1549436.

Wagner, R. G., Crowther, N. J., Micklesfield, L. K., Boua, P. R., Nonterah, E. A., Mashinya, F., Mohamed, S. F., Asiki, G. and Tollman, S. (2021) ‘Estimating the burden of cardiovascular risk in community dwellers over 40 years old in South Africa , Kenya , Burkina Faso and Ghana’, *BMJ Global Health*, 6, pp. 1–11. doi: 10.1136/bmjgh-2020-003499.

Wakabayashi, I. and Daimon, T. (2019) ‘Comparison of discrimination for cardio-metabolic risk by different cut-off values of the ratio of triglycerides to HDL cholesterol’, *Lipids in Health and Disease*. Lipids in Health and Disease, 18(1), pp. 1–10. doi: 10.1186/s12944-019-1098-0.

Walters, W. H. (2021) ‘Survey design, sampling, and significance testing: Key issues’, *Journal of Academic Librarianship*. Elsevier Inc., 47(3), p. 102344. doi: 10.1016/j.acalib.2021.102344.

Wang, W., Lee, E. T., Fabsitz, R. R., Devereux, R., Best, L., Welty, T. K., Howard, B. V, Wang, W., Lee,

E. T., Fabsitz, R. R., Devereux, R., Best, L., Welty, T. K. and Howard, B. V (2006) 'A Longitudinal Study of Hypertension Risk Factors and', *Journal of the American Society of Hypertension*, 47, pp. 403–409. doi: 10.1161/01.HYP.0000200710.29498.80.

Ware, L. J., Chidumwa, G., Charlton, K., Schutte, A. E. and Kowal, P. (2018) 'Predictors of hypertension awareness, treatment and control in South Africa: results from the WHO-SAGE population survey (Wave 2)', *Journal of Human Hypertension*. Springer US. doi: 10.1038/s41371-018-0125-3.

Warren, C. W., Jones, N. R., Eriksen, M. P. and Asma, S. (2006) 'Patterns of global tobacco use in young people and implications for future chronic disease burden in adults', *Lancet*, 367(9512), pp. 749–753. doi: 10.1016/S0140-6736(06)68192-0.

Whitfield, J. B., Heath, A. C., Madden, P. A. F. and Michele, L. (2013) 'Metabolic and biochemical effects of low-to-moderate alcohol consumption', *Alcoholism Clinical and Experimental Research*, 37(4), pp. 575–586. doi: 10.1111/acer.12015.Metabolic.

Williams et al (2018) '2018 ESC/ESHGuidelines for themanagement ofarterial hypertension', *European Heart Journal*, 39, pp. 3021–3104. doi: 10.1097/HJH.0b013e3281fc975a.

World Bank (no date) *World Development Indicators | DataBank*. Available at: https://databank.worldbank.org/indicator/NY.GDP.PCAP.CD/1ff4a498/Popular-Indicators (Accessed: 3 November 2021).

World Health Organization (1986) 'The Ottawa Charter for Health Promotion', in *First International Conference on Health Promotion, Ottawa, 21 November 1986*, pp. 1–4.

World Health Organization (2000) *OBESITY: PREVENTING AND MANAGING THE GLOBAL EPIDEMIC, World Health Organization, Geneva*. Geneva,. doi: 10.1007/BF00400469.

World Health Organization (2003) *Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases, World Health Organization - Technical Report Series*. doi: 10.1093/ajcn/60.4.644a.

World Health Organization (2006) *Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia : report of a WHO/IDF consultation.*, *WHO/IDF*. doi: 10.1016/S0167-7306(09)60009-0.

World Health Organization (2009) 'Global health risks: mortality and burden of disease attributable to selected major risks.' Available at: http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf.

World Health Organization (2010a) 'Global recommendations on physical activity for health.'

World Health Organization (2010b) 'Global status report on noncommunicable diseases', *World Health Organization*, 53(9), pp. 1689–1699. doi: 10.1017/CBO9781107415324.004.

World Health Organization (2011) *Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation*, *World Health Organization*. Geneva: World Health Organization. doi: 10.1038/ejcn.2009.139.

World Health Organization (2013) *A global brief on Hypertension - World Health Day 2013*, *World Health Organization*. Geneva: World Health Organization. doi: 10.1136/bmj.1.4815.882-a.

World Health Organization (2017) *Noncommunicable Diseases Progress Monitor*. Geneva: World Health Organization.

World Health Organization (2018) *Noncommunicable diseases country profiles 2018*. Geneva. Available at: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases (Accessed: 25 June 2021).

Wu, F., Guo, Y., Chatterji, S., Zheng, Y., Naidoo, N., Jiang, Y., Biritwum, R., Yawson, A., Minicuci, N., Salinas-Rodriguez, A., Manrique-Espinoza, B., Maximova, T., Peltzer, K., Phaswanamafuya, N., Snodgrass, J. J., Thiele, E., Ng, N. and Kowal, P. (2015) 'Common risk factors for chronic non-communicable diseases among older adults in china, ghana, mexico, india, russia and south africa: The study on global AGEing and adult health (SAGE) wave 1', *BMC Public Health*, 15(1), pp. 1–14. doi: 10.1186/s12889-015-1407-0.

Yanai, H. and Yoshida, H. (2021) 'Secondary dyslipidemia: its treatments and association with atherosclerosis', *Global Health & Medicine*, 3(1), pp. 15–23. doi: 10.35772/ghm.2020.01078.

Yancu, C. N., DeBono, A., Lee, A. K., McRae, C. and Witherspoon, D. (2018) 'Prehypertensive Risk among African-American Undergraduates: Do the Extra Pounds Really Matter?', *Journal of Health Disparities Research and Practice*, 11(4), p. 2.

Yang, L., Lin, L., Kartsonaki, C., Guo, Y., Chen, Y., Bian, Z., Xie, K., Jin, D., Li, L., Lv, J. and Chen, Z.

(2017) ‘Menopause characteristics, total reproductive years, and risk of cardiovascular disease among Chinese women’, *Circulation: Cardiovascular Quality and Outcomes*, 10(11), pp. 1–9. doi: 10.1161/CIRCOUTCOMES.117.004235.

Yu, E., Malik, V. S. and Hu, F. B. (2018) ‘Cardiovascular Disease Prevention by Diet Modification: JACC Health Promotion Series’, *Journal of the American College of Cardiology*, 72(8), pp. 914–926. doi: 10.1016/j.jacc.2018.10.019.

Yuyun, M. F., Sliwa, K., Kengne, A. P., Olga, A. and Bukhman, G. (2020) ‘Cardiovascular Diseases in Sub-Saharan Africa Compared to High-Income Countries : An Epidemiological Perspective’, *Global Heart*, 15(1), pp. 1–18.

Zhou, B., Bentham, J., Di Cesare, M., Bixby, H., Danaei, G., Cowan, M. J., Paciorek, C. J., Singh, G., Hajifathalian, K., Bennett, J. E., Taddei, C., Bilano, V., Carrillo-Larco, R. M., Djalalinia, S., Khatibzadeh, S., Lugero, C., Peykari, N., Eggertsen, R., *et al.* (2017) ‘Worldwide trends in blood pressure from 1975 to 2015: a pooled analysis of 1479 population-based measurement studies with 19·1 million participants’, *The Lancet*. The Author(s). Published by Elsevier Ltd. This is an Open Access article under the CC BY license, 389(10064), pp. 37–55. doi: 10.1016/S0140-6736(16)31919-5.

APPENDIX

Appendix 1: Questionnaire for Female Staff

UNIVERSITY OF THE WESTERN CAPE
CAMPUS NUTRITIONAL STATUS AND HEALTH STUDY 2011

STAFF QUESTIONNAIRE:	**FEMALE**

Name of fieldworker: ……………………… **Fieldworker code**: | | | Checked by | | |

CODE NO	**1**	**2**			

INTERVIEW DATE (dd/mm/yy)

D	D	M	M	Y	Y

3.5.5.7 ALL INFORMATION WILL BE TREATED CONFIDENTIALY

1. Sex

Male	1
Female	2

2. Age (in years)

3. In which Faculty / Department are you working?

Specify………………………………………………………………………………………	

4. What is your job title?

Specify……………………………………………………………………………	

5. How long have you been permanently employed at UWC?

Specify in years (if employed <12 months = 0)		

6. What is your highest academic qualification?

Specify………………………………………………………………………………………	

7. Which nationality are you?

South African	1
Other: Specify…………………………………	2

8. Has a doctor/nurse/health professional ever told you that you have any of the following health problems/ diseases/illnesses?

	Yes	No	If Yes, specify age (in years) when diagnosed
Diabetes Mellitus	1	2	
Heart disease: Specify what:………………	1	2	
High blood cholesterol	1	2	
Hypertension/high blood pressure	1	2	
Cancer: Specify type…………	1	2	
Iron deficiency anemia/Low blood iron	1	2	
Allergies/intolerances Specify which…………………………….	1	2	
Overweight/obesity	1	2	

9. Do you suffer from any other health problems/diseases/illnesses, than that previously mentioned?

Yes Specify what………………………………………………………………………………………..	1
No	2

10. Do you take any medications regularly? (more than 3/times a week)

Yes. Specify medications:…………………………………………………………………...	1
No (Go to Q 12)	2

11. For what do you take the medication?

Specify……………………………………………………………………….

12. Has a doctor/nurse/health professional ever told your parents that they have any of the following health problems/ diseases/illnesses?

	Yes	No	Unsure
Diabetes Mellitus/ Blood sugar control problems)	1	2	9
Heart disease: Specify what…………………………………………….	1	2	9
High blood cholesterol	1	2	9
Hypertension/high blood pressure	1	2	9

Stroke	1	2	9
Cancer: Specify type………………………………………………….	1	2	9
Overweight/Obesity	1	2	9

13. Have you ever smoked tobacco products?

(if person has smoked follow up on current smoking and occasional smoking)

Yes, and I am currently still smoking	1
Yes, only occasionally (<1x/day)	2
Yes, but I stopped smoking (Go to Q15)	3
No, have never smoked (Go to Q18)	4

14. Current smokers: What do you smoke and how often?

A. Type		**B. Frequency of use?**			**C. For how long (years) have you been smoking?**
		per day	**per week**	**per month**	
Cigarettes	1				
Pipe	2				
Hookah pipe	3				

15. Ex-smokers: What did you smoke and how often?

A. Type		**B. Frequency of use?**			**For how many years did you smoke?**	**How long ago (years) did you quit?**
		per day	**per week**	**per month**		
Cigarettes	1					
Pipe	2					
Hookah pipe	3					

16. Current smokers: Have you ever considered quitting smoking?

Yes	1
No (Go to Q18)	2

17. Current smokers: How serious do you feel about quitting smoking?

Very serious /have tried numerous times before	1
Serious/have tried a couple of times	2
Not serious. Would like to but have never tried to quit.	3

18. Do you ever drink any alcohol?

Yes	1
No (Go to Q 20)	2

19.

A. Which types of alcoholic beverages do you consume? (you may choose more than one)
B. How often do you drink alcohol?
C. How much do you usually consume at a time?

A. Type of alcoholic beverage		**B. Frequency of use?**			**C. Amount usually consume at a time**
		per day	**per week**	**per month**	
Beer	1				
Wine (white/red)	2				
Brandy/Whiskey	3				
Shooters	4				
Cocktails	5				
Gin/Cane/Vodka	6				
Ciders	7				
Sweet wine/port/sherry	8				
Other: Specify what …………………………..	9				
Other: specify what …………………………..	10				

20. Do you ever exercise (including physical activity of vigorous or moderate intensity that last for longer than 10 minutes at a time)?
(vigorous = breathe much harder; moderate = breathe somewhat harder)

Yes	1
No (Go to Q22)	2

21.
A. What type of exercise do you do?
B. How often do you do exercise?
C. For how long does an exercise session lasts?
(use the last 30 days as reference. If exercise is not done at least once a month, do not record)

A. Type of exercise	**B. Frequency of exercise?**			**Length of exercise session**
	per day	**per week**	**per month**	

22. How many days a week (7 days) do you watch television/movies/series/play electronic games?

Everyday	1
5-6 days	2
3-4 days	3
1-2days	4
Never (Go to Q 24)	5

23. For how many hours, on average, do you watch television/movies/series/play electronic games?

< 1 hour at a time	1
1-3hours at a time	2
Longer than 3hours at a time	3

24. Do you take any vitamin or mineral tablets/herbal medicine or any nutritional supplements?

Yes	1
No (Go to Q 26)	2

25.
A. What is the name of the vitamin/mineral tablet/ nutritional supplement/herbal supplement?
B. How often do you take it?
C. Do you take it with meals? (use the last 30 days as reference. If a supplement has not been taken at least once a month, do not record)

A. Product name/description	**B. Frequency of use?**			**C. Do you take it with meals?**
	/day	**/week**	**/month**	Yes = 1 No = 2 As a meal = 3

26. Do you ever buy food/drinks/snacks on campus?

Yes	1
No, never Specify why not ………………………………………………………………………………. (Go to Q30)	2

27. Complete the following table
A. Specify what food/drinks/snacks you buy on campus
B. Specify where you buy food/drink/snacks on campus
C. Specify how often you buy food/drinks/snacks on campus

A.What	**B. Where**	**C. How often** /day	/week	/month

28. How do you decide what to buy? (Can choose more than one)

Buy what I like	1
Buy because it is nutritious	2
Buy out of habit	3
Buy what my friends buy	4
Buy what I can afford	5
Other Specify…………………………………………………………………	6

29. How much money do you spend on average on food/drink/snacks on campus per week?

R…………………………………………………

30. What food/drink/snacks would you like to be available on campus?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

31. Do you participate in any wellness/health activities/programmes on campus?

Yes Specify which………………………………………………………………………………	1
No	2

32. Wellness/health activities/programmes on campus (circle the Y/N or tick the box)

A. Are you aware of any programmes / activities / campaigns on any of the following?

B. If yes, which of the following have you received/seen/been made aware of during the past 12 months?

C. Would you like to have future campaigns / activities / programmes on these topics?

	Smoking	Fitness	Nutrition	Alcohol/drugs	Weight control	Cancer prevention	Heart disease screening	Personal development	Stress management	Maternity care
A, Awareness	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N
B. Method										
- pamphlets/literature	□	□	□	□	□	□	□	□	□	□
- posters / displays	□	□	□	□	□	□	□	□	□	□
- educational class	□	□	□	□	□	□	□	□	□	□
- health counselling	□	□	□	□	□	□	□	□	□	□
- electronic media	□	□	□	□	□	□	□	□	□	□
- organisation policy	□	□	□	□	□	□	□	□	□	□
C. Future programmes	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N

33. Do you consider yourself to be at optimum health?

Yes Specify why…………………………………………………………………………………… ……………………………………………………………………………………………….	1
No Specify why not…………………………………………………………………………….. ……………………………………………………………………………………………….	2

34. How many times a week (7 days) do usually eat? What do you usually eat and drink – in general terms to establish habitual patterns?

	Number of times	**Food/drink/snack usually eaten**
Breakfast		
In between breakfast and lunch		
Lunch		
In between lunch and supper		
Supper		
After supper		

35. Where do you eat most of the following meals?

	Breakfast	**Lunch**	**Supper**
Buy from a vendor on campus			
In residence dining hall			
I prepare at home, but eat at campus			
At home			
Other Specify……………………………………			

THANK YOU FOR YOUR COOPERATION SO FAR.
THE NEXT SECTION YOU MAY COMPLETE YOURSELF.

PLEASE COMPLETE THE QUESTIONS BELOW TO THE BEST OF YOUR ABILITY. IF YOU ARE UNSURE OF THE QUESTION, YOU MAY ASK THE INTERVIEWER FOR CLARIFICATION. PLEASE REMEMBER THERE ARE NO RIGHT OR WRONG ANSWERS. THIS IS A REFLECTION OF YOUR PERSONAL OPINION.

36. What is your marital status?

Married	1
Living together	2
Unmarried/single	3
Separated / divorced	4
Widowed	5
Other: Specify……………………………………………………………………………….	6

37. Which food(s) do you believe makes one fat?

……………………………………………………………………………………………………….

……………………………………………………………………………………………………….

38. How do you perceive your own weight?

Underweight	1
Normal weight	2
Overweight	3
Obese	4

39. Have you ever tried to lose weight?

Yes Specify why..	1
No (Go to Q 42)	2

40. Have you tried to lose weight in the last 6 months?

Yes Specify why..	1
No	2

41. How did you try to lose weight? (You may choose more than one)

Dietary changes (eat less or eat differently)	1
More exercise	2
Appetite suppressants	3
Use of herbal blends	4
Special diet powders	5
Purging/vomiting	6
Use laxatives	7
Other; specify………………………………………………………………………………….	8

42. What do you consider as healthy food?

……

……

……

43. How would you describe the concept "a healthy lifestyle"?

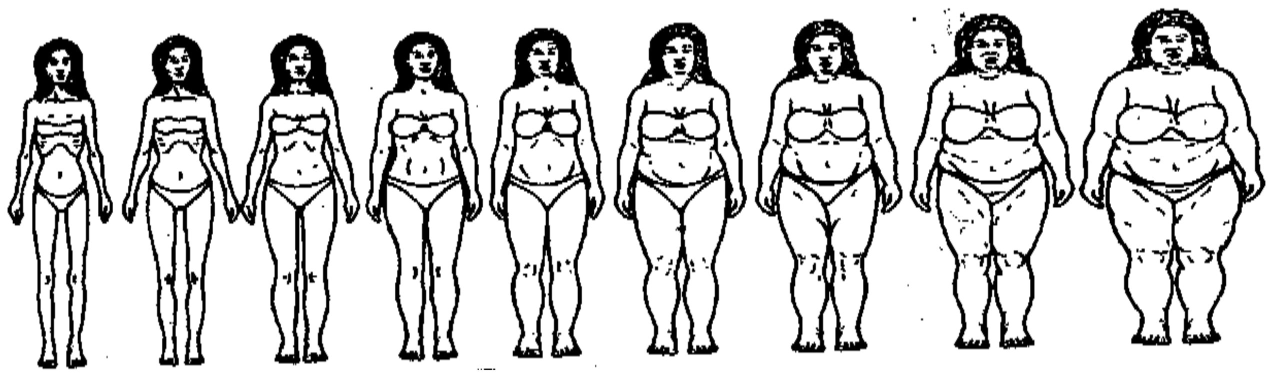
……

………

……

PLEASE VIEW THE PICTURES BELOW

44. Which images below do you think you look like? **(enter only the number of the corresponding picture)**	



1 2 3 4 5 6 7 8 9

45. Which of the images above would you like to look like? **(enter only the number of the corresponding picture)**	

46. Below follows five statements on the food available on campus. Please mark the block (X) that corresponds best with your opinion on the particular statement.

46.1. There is a large variety of food available on campus.

Strongly Disagree 1	*Disagree* 2	*No opinion* 3	*Agree* 4	*Strongly Agree* 5

46.2. The type of food available is appropriate to my dietary preferences.

Strongly Disagree 1	*Disagree* 2	*No opinion* 3	*Agree* 4	*Strongly Agree* 5

46.3. The food available is affordable.

Strongly Disagree 1	*Disagree* 2	*No opinion* 3	*Agree* 4	*Strongly Agree* 5

46.4. The vendors selling food on campus is accessible and near enough for me.

Strongly Disagree 1	*Disagree* 2	*No opinion* 3	*Agree* 4	*Strongly Agree* 5

46.5. Most of the food available on campus is nutritious.

Strongly Disagree 1	*Disagree* 2	*No opinion* 3	*Agree* 4	*Strongly Agree* 5

47. Please read the statements below and circle the response most appropriate to your situation.

47.1 Do you ever run out of money to buy food? (If no, go to Q 47.3)	Yes	No
47.2. If yes, Does it happen 5 or more days in a month?	Yes	No
47.3. Do you ever cut the size of meals or skip any meals because you do not have enough food in the house? (If no, go to Q 47.5)	Yes	No
47.4. If yes, does it happen 5 or more days in a month?	Yes	No
47.5. Do you ever eat less than you should because there is not enough food/money for food? (If no, go to Q 48)	Yes	No
47.6. If yes, does it happen 5 or more days in a month? (Go to Q 48)	Yes	No

If yes to any of the above questions, please answer question 48.
48. If you do not have money for food, where do you find/get food?

Go hungry	1
Ask/visit a friend/neighbour/family	2
Borrow	3
Steal	4
Do casual jobs	5
Other: Specify……………………………………………………………….	6

49. Have you ever been pregnant?

Yes	1
No (Go to end of this page)	2

50. How many times have you been pregnant?

Number of times		

51. How many births have you given?

Number of births		

52. Have you had any miscarriages?

Number of miscarriage (None = 0)	

53. How long ago was your last pregnancy?

Specify in years (if given birth within the last 12 months =<1year)		
Currently pregnant		99

THANK YOU FOR YOUR PARTICIPATION.

PLEASE INDICATE TO THE INTERVIEWER THAT YOU ARE DONE WITH THIS SECTION. WE WILL THEN PROCEED TO DO A COMPLETE DIETARY INTAKE BY ASKING YOU TO RECALL ALL THE FOOD THAT YOU CONSUMED IN THE PAST 24 HOURS.

Appendix 2: Questionnaire for Male Staff

UNIVERSITY OF THE WESTERN CAPE
CAMPUS NUTRITIONAL STATUS AND HEALTH STUDY 2011

STAFF QUESTIONNAIRE: MALE

Name of fieldworker: ……………………… **Fieldworker code**: | | | Checked by | | |

CODE NO	**1**	**1**				**INTERVIEW DATE (dd/mm/yy)**	D	D	M	M	Y	Y

➢ ***ALL INFORMATION WILL BE TREATED CONFIDENTIALY***

1. Sex

Male	1
Female	2

2. Age (in years)

3. In which Faculty / Department are you working?

cSpecify………………………………………………………………………………………

4. What is your job title?

Specify………………………………………………………………………………

5. How long have you been employed at UWC?

Specify in years (if employed <12 months = 0)

6. What is your highest academic qualification?

Specify…………………………………………………………………………………………

7. Which nationality are you?

South African	1
Other: Specify…………………………………	2

8. Has a doctor/nurse/health professional ever told you that you have any of the following health problems/ diseases/illnesses?

	Yes	No	If Yes, specify age (in years) when diagnosed
Diabetes Mellitus	1	2	
Heart disease: Specify what:……………	1	2	
High blood cholesterol	1	2	
Hypertension/high blood pressure	1	2	
Cancer: Specify type…………………….	1	2	
Iron deficiency anemia/Low blood iron	1	2	
Allergies/intolerances Specify which…………………………….	1	2	
Overweight/obesity	1	2	

9. Do you suffer from any other health problems/diseases/illnesses, than that previously mentioned?

Yes Specify what………………………………………………………………………………………..	1
No	2

10. Do you take any medications regularly? (more than 3/times a week)

Yes. Specify medications:…………………………………………………………………………...	1
No (Go to Q 12)	2

11. For what do you take the medication?

Specify…………………………………………………………………….

12. Has a doctor/nurse/health professional ever told your parents that they have any of the following health problems/ diseases/illnesses?

	Yes	No	Unsure
Diabetes Mellitus/ Blood sugar control problems)	1	2	9
Heart disease: Specify what………………………………………….	1	2	9
High blood cholesterol	1	2	9
Hypertension/high blood pressure	1	2	9
Stroke	1	2	9
Cancer: Specify type…………………………………………………….	1	2	9
Overweight/Obesity	1	2	9

13. Have you ever smoked tobacco products?
(if person has smoked follow up on current smoking and occasional smoking)

Yes, and I am currently still smoking	1
Yes, only occasionally (<1x/day)	2
Yes, but I stopped smoking (Go to Q15)	3
No, have never smoked (Go to Q18)	4

14. Current smokers: What do you smoke and how often?

A. Type		**B. Frequency of use?**			**C. For how long (years) have you been smoking?**
		per day	**per week**	**per month**	
Cigarettes	1				
Pipe	2				
Hookah pipe	3				

15. Ex-smokers: What did you smoke and how often?

A. Type		**B. Frequency of use?**			**For how many years did you smoke?**	**How long ago (years) did you quit?**
		per day	**per week**	**per month**		
Cigarettes	1					
Pipe	2					
Hookah pipe	3					

16. Current smokers: Have you ever considered quitting smoking?

Yes	1
No (Go to Q18)	2

17. Current smokers: How serious do you feel about quitting smoking?

Very serious /have tried numerous times before	1
Serious/have tried a couple of times	2
Not serious. Would like to but have never tried to quit.	3

18. Do you ever drink any alcohol?

Yes	1
No (Go to Q 20)	2

19.
A. Which types of alcoholic beverages do you consume? (you may choose more than one)
B. How often do you drink alcohol?
C. How much do you usually consume at a time?

A. Type of alcoholic beverage		**B. Frequency of use?**			**C. Amount usually consume at a time**
		per day	**per week**	**per month**	
Beer	1				
Wine (white/red)	2				
Brandy/Whiskey	3				
Shooters	4				
Cocktails	5				
Gin/Cane/Vodka	6				
Ciders	7				
Sweet wine/port/sherry	8				
Other: Specify what …………………………..	9				
Other: specify what …………………………..	10				

20. Do you ever exercise (including physical activity of vigorous or moderate intensity that last for longer than 10 minutes at a time)?
(vigorous = breathe much harder; moderate = breathe somewhat harder)

Yes	1
No (Go to Q22)	2

21.
A. What type of exercise do you do?
B. How often do you do exercise?
C. For how long does an exercise session lasts?
(use the last 30 days as reference. If exercise is not done at least once a month, do not record)

A. Type of exercise	**B. Frequency of exercise?**			**Length of exercise session**
	per day	**per week**	**per month**	

22. How many days a week (7 days) do you watch television/movies/series/play electronic games?

Everyday	1
5-6 days	2
3-4 days	3
1-2days	4
Never (Go to Q 24)	5

23. For how many hours, on average, do you watch television/movies/series/play electronic games?

< 1 hour at a time	1
1-3hours at a time	2
Longer than 3hours at a time	3

24. Do you take any vitamin or mineral tablets/herbal medicine or any nutritional supplements?

Yes	1
No (Go to Q 26)	2

25.
A. What is the name of the vitamin/mineral tablet/ nutritional supplement/herbal supplement?
B. How often do you take it?
C. Do you take it with meals? (use the last 30 days as reference. If a supplement has not been taken at least once a month, do not record)

A. Product name/description	**B. Frequency of use?**			**C. Do you take it with meals?**
	/day	**/week**	**/month**	Yes = 1 No = 2 As a meal = 3

26. Do you ever buy food/drinks/snacks on campus?

Yes	1
No, never Specify why not ………………………………………………………………………………. (Go to Q30)	2

27. Complete the following table
A. Specify what food/drinks/snacks you buy on campus
B. Specify where you buy food/drink/snacks on campus
C. Specify how often you buy food/drinks/snacks on campus

A.What	**B. Where**	**C. How often** /day	/week	/month

28. How do you decide what to buy? (Can choose more than one)

Buy what I like	1
Buy because it is nutritious	2
Buy out of habit	3
Buy what my friends buy	4
Buy what I can afford	5
Other Specify……………………………………………………………………	6

29. How much money do you spend on average on food/drink/snacks on campus per week?

R……………………………………………….

30. What food/drink/snacks would you like to be available on campus?

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

31. Do you participate in any wellness/health activities/programmes on campus?

Yes Specify which………………………………………………………………………………	1
No	2

32. Wellness/health activities/programmes on campus (circle the Y/N or tick the box)

A. Are you aware of any programmes / activities / campaigns on any of the following?

B. If yes, which of the following have you received/seen/been made aware of during the past 12 months?

C. Would you like to have future campaigns / activities / programmes on these topics?

	Smoking	Fitness	Nutrition	Alcohol/drugs	Weight control	Cancer prevention	Heart disease screening	Personal development	Stress management	Maternity care
A, Awareness	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N
B. Method										
- pamphlets/literature	□	□	□	□	□	□	□	□	□	□
- posters / displays	□	□	□	□	□	□	□	□	□	□
- educational class	□	□	□	□	□	□	□	□	□	□
- health counselling	□	□	□	□	□	□	□	□	□	□
- electronic media	□	□	□	□	□	□	□	□	□	□
- organisation policy	□	□	□	□	□	□	□	□	□	□
C. Future programmes	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N

33. Do you consider yourself to be at optimum health?

Yes Specify why………………………………………………………………………………	1
No Specify why not……………………………………………………………………………..	2

34. How many times a week (7 days) do usually eat? What do you usually eat and drink – in general terms to establish habitual patterns?

	Number of times	**Food/drink/snack usually eaten**
Breakfast		
In between breakfast and lunch		
Lunch		
In between lunch and supper		
Supper		
After supper		

35. Where do you eat most of the following meals?

	Breakfast	**Lunch**	**Supper**
Buy from a vendor on campus			
In residence dining hall			
I prepare at home, but eat at campus			
At home			
Other Specify…………………………………			

THANK YOU FOR YOUR COOPERATION SO FAR.
THE NEXT SECTION YOU MAY COMPLETE YOURSELF.

PLEASE COMPLETE THE QUESTIONS BELOW TO THE BEST OF YOUR ABILITY. IF YOU ARE UNSURE OF THE QUESTION, YOU MAY ASK THE INTERVIEWER FOR CLARIFICATION. PLEASE REMEMBER THERE ARE NO RIGHT OR WRONG ANSWERS. THIS IS A REFLECTION OF YOUR PERSONAL OPINION.

36. What is your marital status?

Married	1
Living together	2
Unmarried/single	3
Separated / divorced	4
Widowed	5
Other: Specify………………………………………………………………………………	6

37. Which food(s) do you believe makes one fat?

……………………………………………………………………………………………………
……………………………………………………………………………………………………

38. How do you perceive your own weight?

Underweight	1
Normal weight	2
Overweight	3
Obese	4

39. Have you ever tried to lose weight?

Yes Specify why..	1
No (Go to Q 42)	2

40. Have you tried to lose weight in the last 6 months?

Yes Specify why..	1
No	2

41. How did you try to lose weight? (You may choose more than one)

Dietary changes (eat less or eat differently)	1
More exercise	2
Appetite suppressants	3
Use of herbal blends	4
Special diet powders	5
Purging/vomiting	6
Use laxatives	7
Other; specify……………………………………………………………………………….	8

42. What do you consider as healthy food?

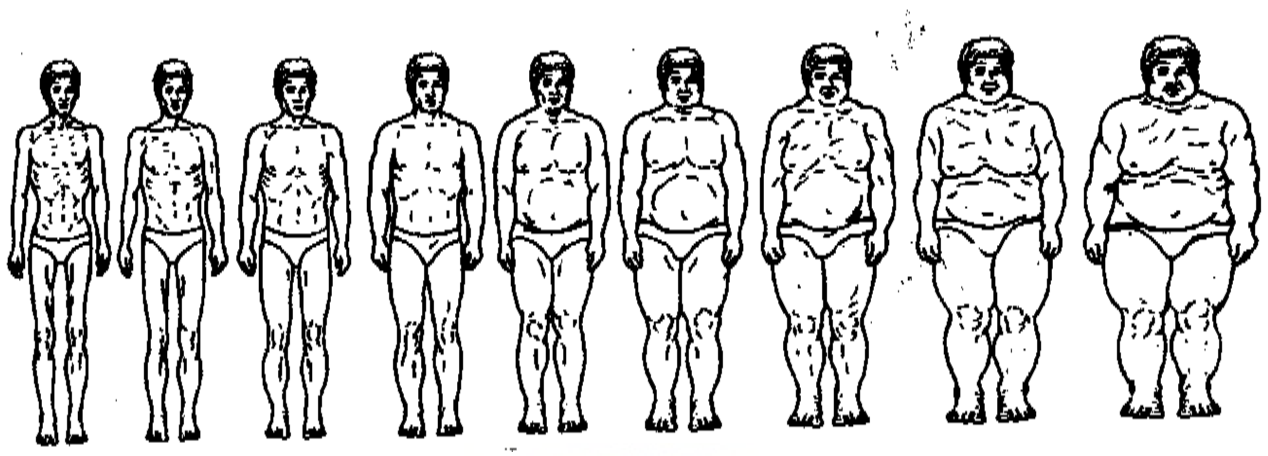
…………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

43. How would you describe the concept "a healthy lifestyle"?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

PLEASE VIEW THE PICTURES BELOW

44. Which images below do you think you look like? **(enter only the number of the corresponding picture)**	



1 2 3 4 5 6 7 8 9

45. Which of the images above would you like to look like? **(enter only the number of the corresponding picture)**	

46. Below follows five statements on the food available on campus. Please mark the block (X) that corresponds best with your opinion on the particular statement.

46.1. There is a large variety of food available on campus.

Strongly Disagree 1	Disagree 2	No opinion 3	Agree 4	Strongly Agree 5

46.2. The type of food available is appropriate to my dietary preferences.

Strongly Disagree 1	Disagree 2	No opinion 3	Agree 4	Strongly Agree 5

46.3. The food available is affordable.

Strongly Disagree 1	Disagree 2	No opinion 3	Agree 4	Strongly Agree 5

46.4. The vendors selling food on campus is accessible and near enough for me.

Strongly Disagree 1	Disagree 2	No opinion 3	Agree 4	Strongly Agree 5

46.5. Most of the food available on campus is nutritious.

Strongly Disagree 1	Disagree 2	No opinion 3	Agree 4	Strongly Agree 5

47. Please read the statements below and circle the response most appropriate to your situation.

47.1 Do you ever run out of money to buy food? (If no, go to Q 47.3)	Yes	No
47.2. If yes, Does it happen 5 or more days in a month?	Yes	No
47.3. Do you ever cut the size of meals or skip any meals because you do not have enough food in the house? (If no, go to Q 47.5)	Yes	No
47.4. If yes, does it happen 5 or more days in a month?	Yes	No
47.5. Do you ever eat less than you should because there is not enough food/money for food? (If no, go to Q 48)	Yes	No
47.6. If yes, does it happen 5 or more days in a month? (Go to Q 48)	Yes	No

If yes to any of the above questions, please answer question 48, otherwise go to the next page.

48. If you do not have money for food, where do you find/get food?

Go hungry	1
Ask/visit a friend/neighbour/family	2
Borrow	3
Steal	4
Do casual jobs	5
Other: Specify……………………………………………………………………………. ………………………………………………………………………………… …………………………………………………………………………………	6

THANK YOU FOR YOUR PARTICIPATION.

PLEASE INDICATE TO THE INTERVIEWER THAT YOU ARE DONE WITH THIS SECTION. WE WILL THEN PROCEED TO DO A COMPLETE DIETARY INTAKE BY ASKING YOU TO RECALL ALL THE FOOD THAT YOU CONSUMED IN THE PAST 24 HOURS.

Appendix 3: Ethical clearance

UNIVERSITY *of the* WESTERN CAPE

60 YEARS *of hope, action & knowledge*

26 May 2020

Mr B Masvosva
School of Public Health
Faculty of Community Health Sciences

Ethics Reference Number:	HS20/2/16
Project Title:	Prevalence of non-communicable disease risk factors among administrative staff at a Higher Education Institution in South Africa.
Approval Period:	25 May 2020 – 25 May 2023

I hereby certify that the Humanities and Social Science Research Ethics Committee of the University of the Western Cape approved the methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report by 30 November each year for the duration of the project.

The permission to conduct the study must be submitted to HSSREC for record keeping purposes.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 4111
Email: research-ethics@uwc.ac.za

NHREC Registration Number: HSSREC-130416-049

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

Appendix 4:

Permission from Principal Investigator to Use Secondary Data from Campus Health Project

UNIVERSITY of the WESTERN CAPE

FACULTY OF COMMUNITY AND HEALTH SCIENCES

DEPARTMENT OF DIETETICS AND NUTRITION

6/10/2019

The Chairperson
Higher Degrees Committee
Faculty of Community and Health Sciences
University of the Western Cape
Robert Sobukwe Road
BELLVILLE
7535

Dear Sir

PERMISSION TO DO SECONDARY DATA ANALYSES ON CAMPUS HEALTH DATA

Mr Bernard Masvosva has been granted permission to use the data generated in the Campus Health project (reference 11/5/37) and which has to date not been reported on, in his mini-thesis. The data is of particular relevance to the expertise of Mr Masvosva, a pathology laboratory technician.

Kind regards

RINA SWART
Supervisor

Private Bag x17, Bellville 7535, South Africa
T: +27 21-9592760 . F: +27 21-9593686
www.uwc.com

A place of quality,
a place to grow, from hope
to action through knowledge