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SCREENING FOR CARDIOMETABOLIC RISK FACTORS AMONG COMMERCIAL DRIVERS IN BUFFALO CITY METROPOLITAN MUNICIPALITY, EASTERN CAPE, SOUTH AFRICA

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BY

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Supervisor: Prof DT Goon
Co-Supervisor: Dr OV Adeniyi

May, 2018

DECLARATION

I, the undersigned, declared that this thesis entitled ‘‘Screening for cardio-metabolic risk factors among commercial drivers in Buffalo City Metropolitan Municipality, Eastern Cape, South Africa’’ submitted to the University of Fort Hare for the degree of Magister Curationis in the Faculty of Health Sciences, and the work contained herein is my original work with the exemptions of citations and that this work has not been submitted to any other University in partial or entirely for the award of any degree.

Name: **Aanuoluwa Odunayo Adedokun**

Signature: ……………………………..

Date: …………………………………..

DECLARATION ON PLAGIARISM

I, Aanuoluwa Odunayo Adedokun, student number: **201613824** hereby declare that I am fully aware of the University of Fort Hare's Policy on plagiarism and I have taken every precaution to comply with the regulations.

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CERTIFICATION

This thesis entitled ‘‘Screening for cardio-metabolic risk factors among commercial drivers in Buffalo City Metropolitan Municipality, Eastern Cape, South Africa’’ meets the regulation governing the award of the degree of Magister curationis of the University of Fort Hare, and is approved for its contribution to the scientific knowledge and literary presentation.

……………………………………….   …………………………

Prof. DT Goon   Date

Supervisor

DEDICATION

I dedicate this research study to the Almighty God, my source of inspiration, who has been my rock and thus far helped me. May his name be praised.

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LIST OF ACRONYMS

ADA:	American Diabetes Association
AHA:	American Heart Association
ATP:	Adult Treatment Panel
AO:	Abdominal Obesity
BCMM:	Buffalo City Metropolitan Municipality
BMI:	Body Mass Index
BP:	Blood Pressure
CDC:	Centre for Disease Control
CMRFs:	Cardio-metabolic Risk Factors
CVDs:	Cardiovascular Diseases
DALYs:	Disability-Adjusted Life-Years
DM:	Diabetes Mellitus
ELDISTA:	East London District Taxi Association
ELTA:	East London Taxi Association
FBG:	Fasting Blood Glucose
GBD:	Global Burden of Diseases
HDL:	High Density Lipoprotein
HICs:	High Income Countries
HIV/AIDS:	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
HTN:	Hypertension
IDF:	International Diabetes Foundation
JNC:	Joint National Council
LMICs:	Lower-middle-income countries
SANTACO:	South Africa National Taxi Council
SDGs:	Sustainable Development Goals
MELTA:	Mdanstane East London Taxi Association
META:	Mdanstane Taxi Association
METs:	Metabolic Syndrome
MVA:	Motor Vehicle Accidents

NC:	Neck Circumference
NCDs:	Non-communicable diseases
NCEP:	National Cholesterol Education Programme
OGTT:	Oral Glucose Tolerance Test
RTA:	Road Traffic Accident
SA:	South Africa
SADHS:	South Africa Demographic Health Survey
SPSS:	Statistical Package of Social Sciences
SSA:	Sub-Sahara Africa
US:	United State
WC:	Waist Circumference
WHO:	World Health Organization
WHR:	Waist-Hip-Ratio
WHtR:	Waist-to-Height Ratio
YLL:	Years of life Lost
ZAR:	South African Rand

ABSTRACT

Cardio-metabolic risk factors are the aggregates of conditions that increase the susceptibility of developing cardio-metabolic diseases such as cardiovascular diseases (CVD) and diabetes. This includes insulin resistance, obesity, hyperglyceamia, dyslipoproteinemia, hyperinsulinemia and hypertension. This condition are worsen by smoking and physical inactivity as they mostly are not easily detected

This was a cross-sectional survey of 403 commercial taxi drivers at ten different taxi ranks in BCMM. The study utilized a convenient sampling technique for the participants of the study. The WHO STEPwise approach was used for data collection. The WHO STEPwise questionnaire was used for a face-to-face interview. Socio-demographic (sex, age, marital status, driving experience, income) and behavioural characteristics (smoking, alcohol consumption, consumption of sweet drinks, physical activity, and dietary intake) of participants were obtained. Also, objective reports concerning anthropometric measurements (weight, height, waist and hip circumference), blood pressure and biochemical measurement that is the blood glucose measurement. All anthropometric measurements were taken following a standard procedure using a Lufkin non-extensible flexible anthropometric tape (W606PM), Rosscraft, Canada and a SECA weighing scale and stadiometer (Hamburg, Germany). Blood pressure was checked also in accordance with standard protocols using a Medic+ Digital Blood Pressure Monitor Model 1219 (Hamburg, Germany). A validated ACCU-CHEK glucose monitoring apparatus (Mannheim, Germany) was used for blood glucose measurement.

Overweight and obesity was defined as a body mass index (BMI) of 25.0 kg/m^2 –29.9 kg/m^2 and$\geq$ 30 kg/m^2, respectively. Pre-hypertension was defined according JNC-8 criteria a systolic blood pressure of 120- 139 mmHg and diastolic of BP 80-89 mmHg while hypertension was defined as an average of two systolic BP $\geq$140mmHg and/or diastolic BP of $\geq$90mmHg or a history of hypertension or anti hypertensive medication use. Diabetes status was determined using the fasting blood glucose (FBG) test and defined as a FBG $\geq$ 7.0mmol/L or self-reports of history or current diabetes medication use (treatment), while pre-diabetes was defined as a FBG of 5.6-6.9mmol/L. Awareness of diabetes was defined as self-reported history of diabetes among the people with diabetes. Metabolic syndrome status was determined according to the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria

Descriptive statistics (frequency, percentages, mean and standard deviation) were used for categorical variables. Inferential statistics (Bivariate and multivariate analysis) were used to determine the prevalence and determinants of obesity, hypertension and diabetes and their 95% confidence interval (95%). A p-value of < 0.05 was considered statistically significant. Pairwise correlations and Kappa statistics were used to assess the relationship and agreement among makers of abdominal obesity. Statistical Package for Social Sciences (SPSS) was used for data analysis.

The mean age of the participants was 43.3 (SD±12.5) years. The prevalence of overweight and obesity was 34.0% and 38.0%, respectively. Age, marital status, period of driving, not-smoking, hypertension and diabetes were significantly associated with obesity. In logistic regression analysis, after adjusting for confounding factors, only age (OR 1.6, CI 1.0-2.7), hypertension (OR 3.6, CI 2.3-5.7) and non-smoking (OR 2.0, CI 1.3-3.1) were the independent and significant determinants of obesity. The prevalence rates of abdominal obesity by waist circumference (WC), waist-hip-ratio (WHR), waist-to-height ratio (WHtR) and neck circumference (NC) were 61.5%, 67.5%, 80.1% and 65.3%, respectively. A strong correlations exists between WHR and WC (>0.64); and WHtR and WC (>0.62). There exists a good agreement between WC and WHR. Also, a moderate agreement exists between WC and WHtR, WC and NC, WHR and WHtR, and WHtR and NC. The prevalence of above normal body composition for participants with hypertension was 71.0%, 65.9%, 63.2% and 66.5% by WC, WHR, WHtR and NC, respectively. For diabetes, the prevalence was 20.6%, 19.4%, 17.0% and 18.6% by WC, WHR, WHtR and NC, respectively. Waist circumference was a stronger predictor of hypertension and diabetics, with odds ratio of 3.7 (95 % CI: 2.3-6.1 and 3.1 (95 % CI: 1.6-6.0), compared to NC, with odds ratio of 1.7 (95 % CI: 1.1-2.8).

The prevalence of pre-hypertension was 33.7% and hypertension was 57.0%. Age, marital status, level of education, period of driving, obesity, alcohol, sweet drinks consumption and diabetes were significantly associated with hypertension. After adjusting for confounders, age >35 years ($P=0.004$), obesity and alcohol use ($P<0.001$), period of driving >5years ($p=0.028$) and diabetes ($P=0.003$) were significant predictors of hypertension.

Prevalence of pre-diabetes and diabetes was 17% and 16%, respectively. Of those who were diabetic (n=63), the majority were aware of their diabetes status (n=43) and were on treatment (n=30). Age, marital status, level of education, period of driving, obesity, sweet drinks consumption, physical activities and hypertension were significantly associated with diabetes. Only age >35 (AOR= 3.6, CI 1.2-11.1), ever married (AOR= 3.3, CI 1.5-7.0) and hypertension (AOR= 3.4, CI 1.7-6.8) were the independent predictors of diabetes after adjusting for confounders.

The prevalence of metabolic syndrome was 22%. Age, marital status, level of education, physical inactivity and period of driving were significantly associated with metabolic syndrome. After adjusting for confounders, only age above 35 years (Adjusted Odd Ratio [AOR] =3.8, CI=1.4-9.5), ever married (AOR=3.0, CI=1.6-5.3) and period of driving above five years (AOR= 2.4, CI=1.2-4.7) were the significant and independent predictors of metabolic syndrome.

About 30% of the participants were daily smokers, 37% consume alcohol regularly and only 18% were physically active, while 82% were physically inactive.

In conclusion, there was a high prevalence of obesity, hypertension and diabetes among the commercial drivers in this setting, which is associated with unhealthy lifestyles (smoking, excessive alcohol consumption, physical inactivity). Interventions aimed at promoting cardiovascular health of commercial drivers such as health education and workplace screening, should prioritize weight reduction, healthy eating and physical activity in this population.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Non-communicable diseases (NCDs) are diseases of long duration with slow progression and which do not resolve themselves spontaneously, also known as chronic diseases (World Health Organization, 2011c). There are five major NCDs with the first four being the major cause of morbidity and mortality. These are cardiovascular diseases (hypertension, stroke, coronary heart disease, congestive heart failure), cancer, chronic respiratory diseases (asthma, chronic obstructive pulmonary diseases, respiratory allergies), diabetes and mental illness (Bloom et al., 2011:8). Non-communicable diseases account for 70% of global mortality yearly among people within the ages of 30 and 69 years; and more than 80% of this mortality occurs in low and middle income countries (LMICs) (World Health Organization, 2011e; World Health Organization, 2017c).

The global epidemic of non-communicable diseases over the past few decades is concerning (Terzic & Waldman, 2011:225), as it accounts for seven in every 10 global deaths; and the WHO estimates a 17% increase in the burden of non-communicable diseases (World Health Organization, 2013a). Apparently, NCDs also account for and increase the disability-adjusted life-years (DALYs) rate (Naghavi & Forouzanfar, 2013:s95). Nations are faced with the burden of diseases, which non-communicable diseases are a part of, and which have become a surging burden, thus placing it as one of the items on the 2030 agenda for sustainable development goals (SDGs). The SDG stipulates as one of its objectives, to reduce by one third premature mortality from non-communicable diseases (United Nations Development Programme, 2017:2). Non communicable diseases account for the majority of global deaths, when compared with injuries, communicable diseases, maternal, perinatal and nutritional health conditions (Hunter & Reddy 2013:1336). It is projected that increases in NCDs will account for almost three-quarters of all deaths worldwide by 2020 (World Health Organization, 2017b). According to the (United Nations Development Programme, 2013) report, non-communicable disease accounts for 60% of the world‘s recorded mortality. The burden of NCDs poses direct and indirect costs on individuals, households and governments, especially in low and middle-income countries

(Kankeu et al., 2013). In recent times, non-communicable diseases have been investigated by WHO, the World Bank and UNDP (World Health Organization, 2014e; World Bank, 2011; United Nations Development Programme, 2013). This signals the health, economic and social implications of NCDs (Reubi et al., 2016:184; Stuckler, 2008:291; Miranda et al., 2008). These diseases have been tagged or identified as health and economically threatening, which has become a source of concern to health and economic organizations, as well as governments. For instance, in some parts of the developing countries, the annual cost effect of chronic disease management ranges from US$ 3 billion to US$ 72 billion. Notably, NCDs often bring about co-morbidities that make cost estimations and projections impossible. Hence, it becomes an economic burden when budgets cannot be planned accurately (Bloom et al., 2011:11).

Non communicable diseases are the largest health burden facing developing countries (Islam et al., 2014:82). About eighty percent of deaths due to NCDs occur in low-and middle-income countries (LMICs) (World Health Organization, 2011b; World Health Organization, 2011a); and this is concurrent with the burden of infectious diseases, such as the Human Acquired Immunodeficiency Syndrome (HIV/AIDS), malaria and tuberculosis among many others (Islam et al., 2014:84; Remais et al., 2013:223). In the past, NCDs were regarded as diseases of the rich countries, but this has surprisingly, recently become a significant disease in even the poor countries(World Health Organization, 2017b). NCDs have been disproportionately more prevalent in LMICs than in the high income countries (HICs), due to delays in implementing preventative measures and the inherently weak health systems prevailing in these countries (Samb et al., 2010). The World Health Organization (2014d), reported that 28% of NCDs occur in high income countries as compared with the 48% rate in LMICs occurring among adults. It accounted for 80% of DALYs attributable to non-communicable diseases in 2012 in LMICs. Conversely, the situation is better and seems under control in HICs (World Health Organization, 2014a). In Sub-Saharan Africa (SSA), the high and increasing risk factors of non-communicable diseases are attributed to epidemiological and nutritional transition (Dalal et al., 2011:894; McAloon et al., 2016:262). In 2010, non-communicable diseases caused over two million mortalities (Lim et al., 2012; Naghavi et al., 2013:s95). Low middle income countries exhibit vulnerability to NCDs, in the sense that the majority of the activities and risk factors in these countries promote NCDs, ranging from urbanization to lifestyle behaviours (Remais et al., 2013:222; Nyirenda, 2016:158; Allen et al., 2017:e285; Allender et al., 2010:300). To combat the burden of NCDs, a multi-sectoral approach is crucial. It is imperative to use the model applied by HICs to reduce the accelerated rise of non-communicable diseases in LMICs, and more specifically, in sub Saharan Africa, with the ever-rising statistics of NCDs. The health system cannot solely solve the problem of NCDs (Juma et al., 2016; Stuckler, 2008), as a multi-dimensional approach is needed.

South Africa is faced with the quadruple burden of diseases as a developing nation, and non-communicable diseases are predominantly on the increase (Hofman, 2014:647; Pillay-van Wyk et al., 2016:e642; Mayosi et al., 2009:935). In South Africa (SA), with 27% probability of death between the ages of 30-70 years, NCDs account for 43% of total mortality (World Health Organization, 2014e). South Africa is one of the SSA countries with high age-standardized death rates (ASDRs), due to a higher NCDs rates in LMICs than those in high income countries (Abegunde et al., 2007:1930). About 38.9% of deaths in 2010 were associated with non-communicable diseases with ASDRs of 287, 114, 58, and 52 per 100 000 for the following: CVDs, cancers, chronic respiratory diseases and diabetes mellitus (DM) respectively (Nojilana et al., 2016a:477). Although a decrease was observed in the rate, it is yet to meet the recommended and estimated 2% decrease success rate of NCDs annually, while fluctuations were also observed (Nojilana et al., 2016b:437). The majority of the premature deaths are targeted towards the age range of 30 -70 years of age; coupled with the burden of HIV/AIDS mortality (Pillay-van Wyk et al., 2017:168). The challenge of the NCDs burden has been identified in South Africa, but appropriate policies, health services, human resources, surveillance and screening, information and of course finances are insufficient to combat NCDs in the country (Bradshaw et al., 2011).

Cardio-metabolic risk factors account for the global burden of diseases (GBD) and mortality (Danaei et al., 2014). Some of these non-communicable diseases are the end result of the aggregates of cardio-metabolic risk factors. Among factors driving non communicable diseases are population ageing, urbanization, lifestyle, socio-economic changes all of which fuel NCD risk factors and increases the disease burden, especially in developing countries (Dalal et al., 2011:886), which could be particularly applicable to South Africa. In resolving the global burden of NCDs, Kroll et al. (2015:1253), states that surveillance is one important tool for early detection and diagnosis of NCDs for better prevention and control, wherein interventions can be made. Supporting this, Ebrahim et al. (2013) maintained that constant research, and repeating studies for comparison, could discern what needs to be known about resolving the challenge of NCDs. This is one of the strategies used in HICs. Tackling NCDs should be focused on the diseases and on implementing relevant interventions.

Commercial drivers are a high-risk population for cardio-metabolic diseases (CMDs) and health problems. Of course, several studies have proven that the prevalence of predisposing factors is high among commercial drivers. Commercial drivers in South Africa are independent owners or hired drivers of motor vehicles for commercial purpose. The driving profession has a great impact in the transportation industry and is of great benefit to the public and their safety (Sangaleti et al., 2014). As such, there is a need to pay attention to drivers' health. The commercial taxi drivers are involved in many routine activities that impact on their health. For instance, their lengthy working hours on the road, unpredicted schedules, physical inactivity and a scarce option for a healthy diet results in overweight and obesity (Lim & Chia, 2015: 9; Rosso et al., 2015: 212; Thiese et al., 2015: 662). Commercial drivers often engage in the consumption of unhealthy, readily available food items. With the habit of eating away from home; they eat less fruits and vegetables and more heavy, stomach-filling meals (Nagler et al., 2013: 6; Lakshman et al., 2014). Commercial drivers fall far short of the WHO recommended daily amount of physical activity, namely moderate intensity activity of 150 minutes per week and vigorous intensity activity of 75minutes per week (World Health Organisation, 2016), as they sit behind the wheel all through the day. Hence, the existence of non-communicable disease cannot be ruled out among them. Chapman and Naweed (2015), opined that, chronic diseases such as diabetes and cardiovascular diseases are associated with unhealthy lifestyle, and are considered a burden to individuals, communities and the larger society with serious undesirable effects on the transportation industry. As such, it is advisable that commercial drivers should be in a good state of health to function optimally, prevent disability and be productive (Sangaleti et al., 2014).

1.2 STATEMENT OF THE PROBLEM

Cardio-metabolic risk factors are conditions which significantly enhance the possibilities of developing non-communicable diseases (NCD) for example cardiovascular disease and diabetes mellitus. Non-communicable diseases (NCDs) account for about 29% of deaths and 11%

because of CVDs in South Africa (WHO 2011). More than two thirds of Africans with diabetes remain undiagnosed (International Diabetes Federation, 2015:68). Predominantly, commercial taxi drivers are male, and many are under the age of fifty years, and without health insurance. These are attributes that are often associated with poor health practices. Circumstances common to commercial taxi drivers contribute to their risk profile: drivers routinely work long hours with frequent shift changes and irregular time for meals and relaxation, and thus they are subject to high stress levels, due to uncertain income and traffic congestion. They are at a relatively high-risk for violence and homicide, and are exposed to toxic materials and exhaust fumes on a regular basis. Probably because commercial taxi drivers are a relatively autonomous and hard to-reach group, there is a gap in knowledge about their health.

Despite the increase in the overall number of commercial taxi drivers and the importance of the taxi industry as a source of employment in South Africa, research has hardly been conducted on the risk factors for the cardio metabolic health of commercial taxi drivers in South Africa. Existing studies focus on HIV/AIDS, violence, sexual behaviour, musculoskeletal system disorders and stress. By contrast, the cardio metabolic risk profiling of taxi drivers has been studied in recent years in Brazil(Sangaleti et al., 2014), Hong Kong (Siu et al., 2012), Australia (Abu Dabrh et al., 2014), Korea(Shin et al., 2013), Iran (Saberi et al., 2011; Izadi et al., 2013), Nigeria (Tobin et al., 2013; Olusegun & Ikeoluwapo, 2016; Erhiano et al., 2015) and India (Satheesh & Veena, 2013; Lakshman et al., 2014a; Borle & Jadhao, 2015)

Given that commercial taxi drivers occupy an important role in the transport industry; this contributes to the growth of the economy by the nature of the services they provide. Their health should not be downplayed, but rather profiled for proper planning. Anecdotally, commercial taxi drivers in South Africa exhibit poor lifestyle health behaviours, in terms of sedentarism, excessive alcohol consumption, smoking and other risky health behaviours. However, unlike other population groups in South Africa, their physical and biomarker risks regarding health assessment have not been as well documented in South Africa as elsewhere. As such, understanding the magnitude of the problem is necessary to inform health policy-makers to take appropriate intervention strategies in designing health programmes tailored to the needs of this special population. This study could form a benchmark for future research on this global health problem; as information on cardio metabolic risk factors among South African commercial taxi drivers is lacking. Therefore, the present study will examine the prevalence and correlates of cardio metabolic risk factors among commercial taxi drivers in the Buffalo city metropolitan municipality (BCMM)

1.3 AIM AND OBJECTIVES

The overall aim of the study is to examine the prevalence and correlates of CMRFs among commercial taxi drivers in the Buffalo city metropolitan municipality area, Eastern Cape Province, to inform public health policy concerning the preventative measures for the associated risk factors among commercial drivers.

The specific objectives of the study are to:

- Determine the prevalence and risk factors of overweight and obesity among commercial drivers in BCMM.
- Determine the prevalence and risk factors of hypertension and pre-hypertension among commercial drivers in BCMM.
- Determine the prevalence and risk factors of diabetes Mellitus type 2 and pre-diabetes among commercial drivers in BCMM.
- Assess age, duration of driving, educational level, socio-economic differences in CMRFs risk factors and prevalence rates among commercial drivers in BCMM; and
- Examine the association of CMRFs risk factors with lifestyle characteristics (smoking, alcohol consumption, physical activity, dietary intake) among commercial drivers in the East London metropolitan area.

1.4 RESEARCH QUESTIONS

- What are the prevalence and risk factors of overweight and obesity among commercial drivers in BCMM?
- What are the prevalence and risk factors of hypertension and pre-hypertension among commercial drivers in BCMM?
- What are the prevalence and risk factors of type 2 diabetes mellitus and pre-diabetes among commercial drivers in BCMM?

- Would age, duration of driving, educational level, and other socio-economic variables predict the risk of CMRFs among commercial taxi drivers in BCMM?
- Would smoking, alcohol consumption, physical activity, and dietary intake have any significant effect on the risk of developing CMRFs among commercial drivers in BCMM?

1.5 SIGNIFICANCE OF THE STUDY

Continuous surveillance of the prevalence of NCDs as well as their associated risk factors is the first step in curbing their increase. As recommended by the World Health Organization (WHO), surveillance is vital in the formulation of public health policy and the implementation of prevention strategies for non-communicable diseases (World Health Organization, 2003b). The findings of the study will be instrumental in the development of public health policies tailored to the prevention of cardio-metabolic diseases among this seemingly, neglected population. In addition, findings from this study will assist in identifying individuals at risk, and this is essential in the planning and implementation of cost-effective prevention programmes. Besides, the findings will create awareness of the health conditions of commercial drivers in BCMM, South Africa, which will be useful in health surveillance of the group.

1.6 SCOPE OR DELIMITATION OF THE STUDY

The focus of the study will be the commercial taxi drivers under the South Africa National Taxi Council (SANTACO), in Buffalo City Metropolitan Municipality, above the age of 20 years. The NCDs of interest are cardiovascular diseases and diabetes. The independent variables of interest include social and demographic characteristics of the drivers. The dependent variables of interest are cardio-metabolic risk factors namely; hypertension, diabetes, overweight and obesity, alcohol use, smoking, physical inactivity and metabolic syndrome.

1.7 THEORETICAL FRAMEWORK

1.7.1 The Health Promotion Model

The Health Promotion Model (HPM) proposed by Pender (1982; revised, 1996) was designed to be a complementary counterpart to models of health protection. This defines health as a positive dynamic state rather than simply the absence of disease. Health promotion is directed at increasing a patient's level of well-being. The health promotion model describes the multidimensional nature of persons as they interact within their environment in pursuit of health

The model has three components;

Individual characteristics and experiences: this describes prior related behaviour, the frequency of the same or similar health behaviours in the past and personal factors (biological, psychological, socio-cultural); general characteristics of the individual that influence health behaviour such as age, personality structure, race, ethnicity, and socioeconomic status.

Behaviour-Specific Cognitions and Affect: this describes the perceived benefits of action, perceived barriers to action, perceived self-efficacy, activity-related effects, interpersonal influences (family, peers, and providers), and situational influences (options, demand characteristics, aesthetics), commitment to a plan of action and immediate competing demands and preferences.

Behavioural Outcome and Health Promoting Behaviour: the desired behavioural end-point or outcome of health decision-making and preparation for action (Pender, 2011)

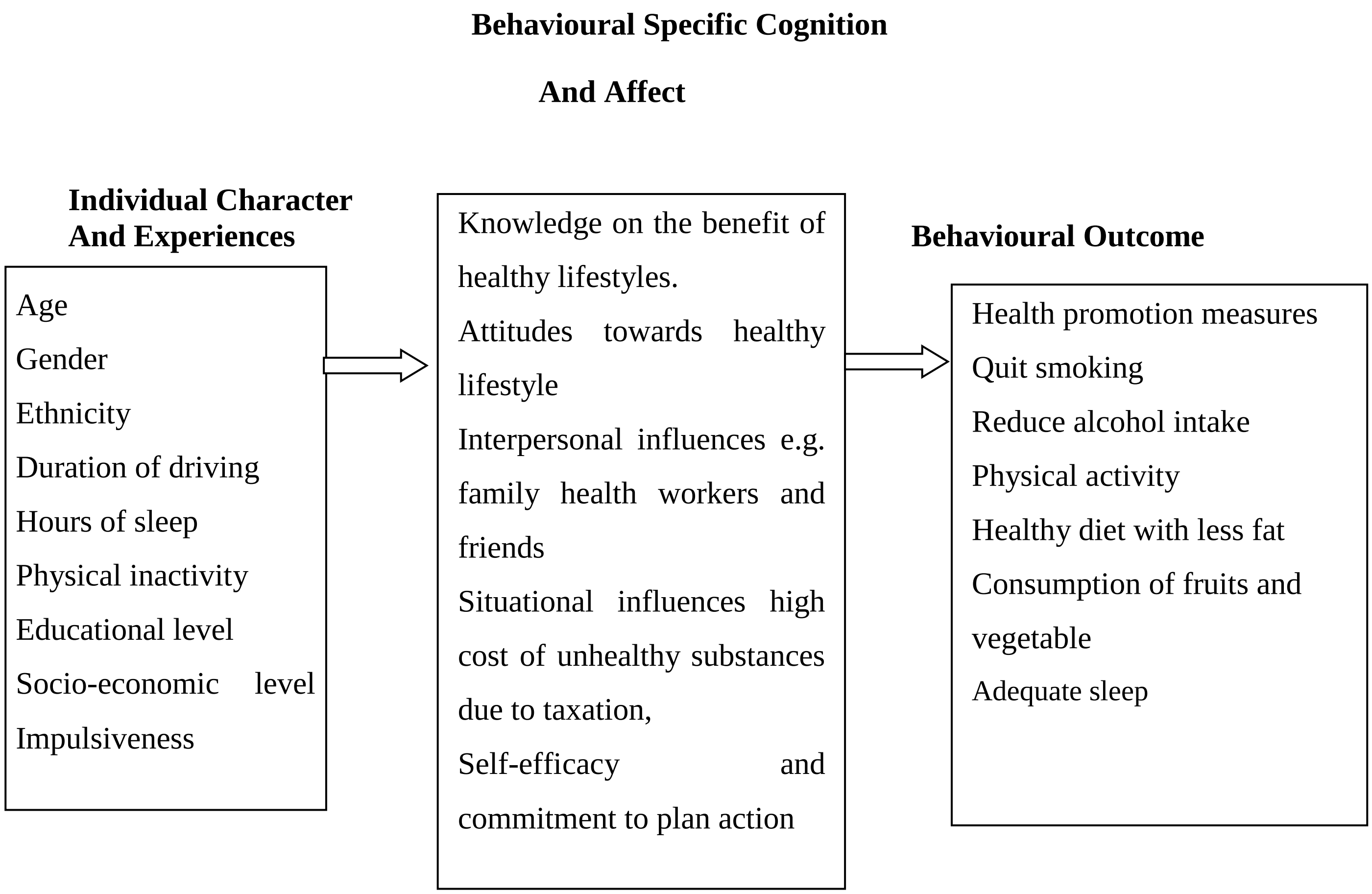


Figure 1.1: Extract from Pender Health Promotion Model

1.7.2 Application of the model to the study

Some characteristic behaviours and experiences constantly have an effect on an individual's health. This could either promote or demote their health status. Having self-knowledge and knowing the advantages of healthy living influences action positively, while perceived barriers such as (affordability of alcohol and cigarette and expensive healthy meal) block action towards a healthy lifestyle among individuals. Influences from health workers, family and friends via; health education, health screening, family support and personal observation of healthy behaviour motivates the individual towards adherence to actions for living healthily. Situational influences such as increased cost of unhealthy substances, and affordability of healthy and health initiatives for different categories of people will also bring greater interest in individuals towards health-promoting behaviours with beneficial outcomes.

1.8 DEFINITION OF KEY OPERATIONAL TERMS

The following terms are defined as used in this study:

Cardio-metabolic diseases: These are a group of cardiovascular and metabolic diseases.

Cardio-metabolic risk factors: These are predisposing factors which cluster together to increase the chances of developing type 2 diabetes mellitus or cardiovascular diseases.

Commercial driver: This is a person licensed and permitted by the Department of Transport, under a registered association, to convey passengers or property for commercial purposes and for profit.

Determinants: They are factors that predispose a disease condition.

Non-communicable diseases: They are non-infectious, chronic diseases that progress slowly.

Metabolic syndrome: Is the clustering of three or more cardio-metabolic risk factors.

Obesity: Is the excessive accumulation of total or central body fat.

Prevalence: The generality of a disease condition. It is a statistical concept referring to the number of cases of a disease that are present in a population at a given time, that is the total number of individuals in a population who have a disease or health condition at a specific period, usually expressed as a percentage of the population.

Screening: Is a way of checking the vital signs of diseases before they become symptomatic. Also, it is checking the probability of a person having an abnormal health condition which has not been diagnosed yet.

1.9 CHAPTER OUTLINE

Chapter one includes the background to the study, the problem statement, aim, objectives, research questions, significance of the study, theoretical frame work and the definition of operational terms. It also includes the outline of the study.

Chapter two focuses on the literature review. This chapter discusses the definition of cardio-metabolic risk factors, cardiovascular diseases and diabetes mellitus.It also describes the global burden and prevalence of cardio-metabolic disease in South Africa, particularly among drivers.

Chapter three describes the research methodology that is used in this study. This includes the study design used, the population settings, sampling and sampling size, the research instruments, validity and reliability of the instrument, ethical consideration and the pilot study. The description of the data collection process, anthropometric, blood pressure and blood glucose measurements, administration of the questionnaire and the definition of the risk factors is discussed. Lastly, data analysis is described.

Chapter four presents the results of the study and the discussion.

In chapter five, the summary of the study, its findings, limitations and strengths of the study is described. Finally, conclusions, recommendations and suggestions for further studies are made.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter provides a relevant literature review on cardio-metabolic risk factors and diseases, as well as the underlying factors for its prevalence, particularly regarding commercial drivers.

2.2 OVERVIEW OF THE SOUTH AFRICAN TRANSPORT INDUSTRY AND DRIVING

The transport industry, regardless of the role definition (individual, associations, company), plays an important and notable role in the public. The industry empowers people through job creation and economic improvement. It also serves as a major source of mobility, and is accessible to all levels of socio-economic status. The motivating reason of being in a taxi driving job for some drivers varies from lack of education to an inability to get desired employment (Bawa & Srivastav, 2013; Facey, 2003:255). The Minibus taxi drivers in South Africa are a group of private or individual owners of vehicles used for public transit. This group is responsible to the Department of Transport, although the driving business is not directly run by the transport industry in South Africa, there is a working relationship between the department and the drivers' association that often runs the driving business. The efficiency of the transport association brings about economic and social benefits for the country (Rodrigue & Notteboom, 2017). Transportation is an important aspect of an individual's social life, as transport services are needed to provide mobility of goods and humans, which creates completeness of an individual's daily activities. A country with no form of mobility remains static because, economic growth, local, national, and the international network and business will be hindered. According to the South Africa National Taxi Council (SANTACO), about five million people are being transported daily. This comprises approximately 70% of the workforce in the country (Oxford, 2013). This portrays the social and economic importance of the transport industry for the public and the government (Rodrigue et al., 2017). Thus, the taxi drivers' health should be prioritised.

Commercial drivers are a group of people who convey passengers from one place to another. Being a taxi driver requires no formal education. However, proper skill in driving is required through testing to obtain a driving license (Federal Motor Carrier Safety Association (FMCSA), 2017) and guidance (Mayhew & Simpson, 2002:ii7). The nature of the work of commercial taxi drivers is characterized by irregular sleep patterns, prolonged sitting behind the wheel, irregular eating habits, a lack of physical exercise and other dangerous lifestyle behaviours (Yang et al., 2014).

Bawa et al.'s (2013) study among taxi drivers in Mumbai, India, revealed that the majority of the taxi drivers were from lower socioeconomic status groups, working over eight hours every day; and 89% of those had one or more morbidities. Facey (2003:256), describes commercial driving as precarious work, which predisposes the drivers to a lot of economic uncertainty, stress and unhealthy behaviours that promote disease. Because of the stress and hazards of the job, drivers exhibit workplace absenteeism due to health-related issues (Brunoro et al., 2015:329). Furthermore, the educational standard of most commercial drivers is low (Ozoh et al., 2014), thus affecting their health literacy in terms of promotion of healthy habits (van der Heide et al., 2013).

The workplace burden is expanding with world population growth. The commercial drivers' workplace environment is not conducive for promoting healthy living. Hannerz and Tüchsen (2001), reported in their study that professional drivers, compared with other men have greater risk of developing diseases that affect all the systems and organs of the body. Commercial drivers also have a higher risk of having chronic and infectious diseases, due to their exposure to various forms of diseases and illnesses (Hirata et al., 2012; Aslam. et al., 2015:863). Driving is a stressful activity (Brunoro et al., 2015: 331); due to the shifting nature of the job, and hours spent behind the wheel. Road traffic accidents (forty six percent) were a major cause for the rise in mortality due to injuries in the period from 1990 to 2010. Other contributory factors were non-communicable diseases such as hypertension, diabetes mellitus (DM) and obesity (Lozano et al., 2012:2096).

2.3 CARDIO-METABOLIC RISK FACTORS

The inception of cardio-metabolic risk screening arose from the first Framingham Heart Study in 1948, which was undertaken to identify individuals at risk of cardio-metabolic diseases (Mahmood et al., 2014). Cardio-metabolic risk factors (CMRFs) are multiple factors (type 2 diabetes mellitus, hypertension) that complicates into cardiovascular diseases and metabolic disease process. These factors combine greatly towards bringing about cardiovascular diseases and type 2 diabetes mellitus. They encompass the traditional (hypertension, dyslipidemia, etc.) as well as the emerging risk factors such as abdominal obesity (Leiter et al., 2011:e1; Chatterjee et al., 2012:389). Cardio-metabolic risk factors are clusters of various factors such as tobacco use, hypertension (HTN), dyslipidemia, low physical activity, high fasting plasma glucose level and high body mass index (BMI) (Leiter et al., 2011:e1; Brunzell et al., 2008:811). These were the cause of about 67% of cardiovascular diseases and diabetes mortality worldwide in 2010 (Danaei et al., 2014:634). Cardio-metabolic risk factors (CMRFs) strengthen the chances of cardiovascular illnesses and death (Leiter et al., 2011). Cardio-metabolic risk factors are interwoven, such that developing one of the risk factors increases the risk of developing another. Identifying cardio-metabolic risk factors in clinical practice for preventing and managing non-communicable disease is essential.

Cardio-metabolic risk factors can be classified into modifiable and non-modifiable risk factors, which should be screened for and treated promptly. Physical inactivity or smoking together with one or more risk factors increases cardio-metabolic risk (Wang, 2015). The non-modifiable risk factors include age, race and ethnicity, gender, and family history; while modifiable risk factors include obesity, inflammation, hypertension (Chiang et al., 2013:735), smoking, physical inactivity, unhealthy diet, insulin resistance, dyslipidemia and hyperglycemia (Wang, 2015). High blood pressure, obesity, high glucose level and cholesterol are the four leading metabolic risk factors, which further result in complications (Danaei et al., 2014:636).

2.4 CARDIO-METABOLIC DISEASES

Cardio-metabolic diseases in this study are referred to as cardiovascular diseases and diabetes mellitus.

2.4.1 DIABETES MELLITUS

Diabetes Mellitus is a progressive metabolic disorder and also an endocrine disorder whereby there is impairment of the pancreatic beta cell function, causing a deficiency in insulin secretion and insulin resistance also causing hyperglycemia (Ozougwu et al., 2013:46). Diabetes is a chronic metabolic or endocrine disorder characterized by a raised sugar level, evidenced by polyphagia, polydipsia and polyuria (World Health Organization, 2016a:11). This often occurs in the beta cell of the islet of langerhan or pancreatic cell. It is basically a metabolic disorder that occurs as a result of insulin action, insulin secretion or both (World Health Organization, 2016a:11). Pathogenetically, diabetes mellitus occurs as a result of insulin action and reactions that is, the inability of the pancreas to produce sufficient adequate insulin or when there is no response to the insulin produced (International Diabetes Federation, 2015:12). It can also be described as difficulty in the metabolism of glucose or carbohydrates.

Pre-diabetes describes a state of uncertainty, and a precursor to the development of type 2 diabetes mellitus. It characterized a condition in which blood glucose levels are higher than the optimal level, but not enough to be classified as type 2 diabetes mellitus (International Diabetes Federation, 2015:26). Buysschaert and Bergman (2011:290), opined that pre-diabetes is better diagnosed and managed as a disease entity rather than as a stage of type 2 diabetes mellitus, to better treatment and prevent deterioration to type 2 diabetes. The authors further stated that developing diabetes from the pre-diabetes stage could be within a short period of time or a longer period. Colberg et al. (2016: 2065), defines glucose intolerance as an intermediate stage, characterized by hyperglycemia, but at a level lower than what qualifies for the diagnosis of diabetes. Pre diabetes predisposes a person to type 2 diabetes mellitus; which is a risk factor (Buysschaert et al., 2011:294). It also increases the chances of developing cardiovascular diseases (Colberg et al., 2016:2065). It presents with the opportunity to take preventive measures against type 2 diabetes mellitus, if there is awareness about the condition.

Diabetes mellitus increases the risk of diseases and co-morbidities such as metabolic syndrome, obesity, HIV and sickle cell diseases resulting in serious micro vascular and macro vascular complications (Kengne et al., 2013:982). Diabetes increases blood pressure. This occurs as a result of these processes decreasing the blood vessels' ability to stretch, increasing the amount of fluid in the body and changing the way the body manages insulin (Barhum, 2017). Managing diabetes mellitus requires a multidisciplinary approach which has not been put in place yet, especially in Africa, by means of this approach, the current increased prevalence of diabetes can be reduced, or the burden combated.

2.4.1.1 The burden of diabetes mellitus

Diabetes is a major global public health issue. The United States of America (USA) is ranked as the leading country with the highest prevalence of diabetes among the developed nations, with about twelve to fourteen percent of the USA adults live with DM (Menke et al., 2015). There were 242 million increases in the number of individuals affected with diabetes from 1980 to 2014 (Roglic, 2016). A global projection of the prevalence of diabetes was a 54% increase from 2010 to 2030 (Shaw et al., 2010:10), while Guariguata et al. (2014:144) study, predicted an increase in diabetes from 382 million in 2013 to 592 million in 2035, highlighting a major increase in low and middle income countries (LMICs). Poorly controlled diabetes or uncontrolled diabetes complications is the basic cause of mortality, when compared with well-treated diabetes (Bhutani & Bhutani, 2014). In 2012, about 1.5million and 2.2 million premature deaths from diabetes and pre-diabetes were recorded (Roglic, 2016). The persistent increase of diabetes in developing countries can disturb the economic growth of a country due to its economic burden on the individual, the health care systems and the country at large (International Diabetes Federation, 2015:58).

2.4.1.3 Type 2 Diabetes Mellitus in Sub-Saharan Africa

Type 2 Diabetes Mellitus is the major form of diagnosed diabetes (Wu et al., 2014:1185), previously perceived as a disease of predominantly rich nations. It is now growing rapidly in developing nations (Gill, 2014:249). Baleta and Mitchell (2014: 687), projected that in 2030, type 2 DM will affect 49.7 million persons in Sub-Saharan Africa (SSA). This is gradually becoming the case, though there are variations in the prevalence of Type 2 Diabetes Mellitus (T2DM) in Africa. The prevalence of diabetes in SSA ranges from as low as 2.7% to 28.2% in 2012 (Erasmus et al., 2012: 842). An estimated 14.2 million adults have diabetes in Africa and more than two thirds of the people in Africa are undiagnosed or are unaware of their blood glucose levels (International Diabetes Federation, 2015:70). Diabetes is now common not only among the urban communities, but also in the rural areas in Africa (International Diabetes Federation, 2015:78). The burden of non-communicable diseases has been quite a challenge posing a threat to health in Africa. According to IDF (2015:48), one in 11 adults was affected by diabetes in 2015, and one in 10 adults will be affected by 2040. This implies that 415 million of the world's population of adults were affected, and these will increase to 642 million by 2040. Mortality attributable to diabetes in Africa is about a million (Peer et al., 2013:6). Annually, in SSA, US$67.03 billion, or US$8836 is expended on each individual with diabetes (Hall et al., 2011:569). Some of the challenges in battling the increasing prevalence of diabetes are ignorance, poverty and the huge economic cost of managing DM (Buowari, 2013:135).

2.4.1.3 Diabetes mellitus in South Africa

Diabetes mellitus affects two in 10 adults in South Africa (Shisana et al., 2013:94). In Sub-Saharan African countries, South Africa is one of the countries with a high prevalence of diabetes. It was estimated that, in 2013, 8.3% of the population were living with diabetes (Guariguata et al., 2014:139). Also, according to (International Diabetes Federation, 2015) 2.3 million persons have diabetes in South Africa (SA), and this figure is expected to increase by 2035 (International Diabetes Federation, 2017). According to (Guariguata et al., 2014:139), the national prevalence of diabetes in South Africa is 8.3%, with an expected increase to 9.9% by 2035, thus projecting South Africa as the country with the second highest prevalence with diabetes in Africa. Bertram et al. (2013:208), indicated in their study that there was an increase of diabetes from 5.5% in 2000 to 9% in 2009. Also, there are about 2 million cases of diabetes in South Africa with about 55% undiagnosed cases. It has accounted for 78,900 years of life lost due to disability (YLD), attributable to diabetes, while the majority of the YLD (64%) was due to DM alone (Bertram et al., 2013: 206). There is a low awareness rate and an increased prevalence of diabetes in South Africa. Among different population studies, the report of the DM rate among coloured groups in the Western Cape was 28.2%, in which over half of the people were not aware of the disease condition (Erasmus et al., 2012: 842) unlike black South Africans in Cape Town which showed a prevalence rate of 13.1% with 57.9% awareness rate (Peer et al., 2012). The disease condition is also predominant in the Eastern Cape Province of the country

(Owolabi et al., 2016). Diabetes mellitus is one of the leading causes of morbidity and mortality in South Africa (Pillay-van Wyk et al., 2017:168).

2.4.1.4 The burden of diabetes mellitus among commercial drivers

Occupational activities of commercial drivers do have an impact on public road users that is other private drivers, pedestrians and perhaps roadside sellers. By the nature of their occupation, they are prone to a high-risk of diabetes mellitus, among other different cardio-metabolic risk factors. A recent study in the United Kingdom, reported that 43% of commercial drivers had type 2 DM or pre-diabetes (Varela-Mato et al., 2017). Siu et al. (2012:62), reported in their study that 8.1% had undiagnosed DM and a 10% prevalence of diabetes among drivers in Hong Kong. In Nigeria, Odeyinka &Ajayi (2017) reported that 3.4% of drivers had type 2 diabetes mellitus. In Iran, 6.3%, 9.1% and 7.0% (Tofangchiha et al., 2014; Saberi et al., 2011:8; Izadi et al., 2013:23) of the drivers had type 2 DM. Also, in Brazil, 16.4%, 11.0%, and 2.8% (Sangaleti et al., 2014:1063; Reis et al., 2017:485; Hirata et al., 2012) were reported to have diabetes mellitus. Likewise, in China, 8.8% of them were diagnosed with type 2 diabetes mellitus (Yang et al., 2014). Commercial drivers in developing countries such as Iran and Brazil (Tofangchiha et al., 2014; Reis et al., 2017) and developed countries like Hong Kong (Siu et al., 2012) presented with different prevalence values of diabetes. Prevalence rate varies, based on the type of vehicle and perhaps the length of trips being made. Tofangchiha et al. (2014), in their three-year cross-sectional study reported that commercial drivers have poorly controlled diabetes mellitus.

Risk factors associated with the high prevalence of diabetes among commercial drivers were found to be obesity, high blood pressure, hyperlipidemia, age, a family history of DM and a family history of CVD (Siu et al., 2012:65; Izadi et al., 2013; Sangaleti et al., 2014:1069). Being married, a history of hypertension, high waist circumference and blood pressure also increases risk of developing pre-diabetes (Siu et al., 2012:63).

Also specific to diabetes, in a similar way as hypertension, unhealthy behaviour and job-related behaviour accounts for causes of diseases among commercial drivers (Krueger et al., 2007). These factors are: long working hours; unstable schedules, often conflicting with circadian rhythms; poor locations for sleep; limited exercise; prolonged sitting; an unhealthy diet; traffic and delivery schedule-related stress, and environmental stressors like noise, heat, cold, and lack of ventilation (Krueger et al., 2007; Knipling, 2015). While there are studies on the prevalence, awareness, treatment and determinants of diabetes and pre-diabetes among commercial taxi drivers in other countries, such information is lacking in South Africa.

2.4.2 CARDIOVASCULAR DISEASES

Cardiovascular diseases (CVDs) are a group of heart and blood vessel diseases, which occur as a result of plaque formed in the arterial walls, hence causing narrowing of the arterial wall passages, making blood flow to the circulatory system difficult (American Heart Association, 2017). CVDs can also be described as various diseases of the circulatory system and congenital CVDs as well (Lloyd-Jones et al., 2010a:e55) that include hypertension, cerebrovascular disease (stroke), coronary artery disease (heart attacks), peripheral artery disease, rheumatic heart disease, congenital disease and heart failure (World Health Organization, 2017a). Cardiovascular diseases can also be defined as a health related issue due to a deviation from cardiovascular health (Lloyd-Jones et al., 2010b:586). Ischemic heart disease and stroke are the commonest form of CVDs.

Cardiovascular diseases are one of the major public health problems in the world. They are the major cause of disability, morbidity and mortality among the NCDs worldwide (Lim et al., 2012; Mendis et al., 2011). Cardiovascular diseases are the cause of 31% of all death globally, killing about 17.3 million people per year; and they are the number one global cause of death in the developing and the non-developed countries (World Health Organization [WHO], 2016; International Alliance for Responsible Drinking [IARD], 2016). Cardiovascular diseases are attributable to one in every four deaths (Lozano et al., 2012:2096). Although these cardiovascular diseases are preventable, they contribute to disabilities and death globally. It is was reported as causing 393.8 million (14.4%) of total global DALYs lost in 2012 (McAloon et al., 2016:257), and years of life lost (YLL) (World Health Organization, 2014a). According to WHO in 2012, CVDs were the major cause of mortality comprising about 17.6 million persons globally (World Health Organization, 2014b).

Cardiovascular diseases have also grown and thus have become an economic burden. According to Lloyd-Jones et al. (2010a:e48), in the United States in 2010, an estimated US$ 503.2 billion was expended on CVD directly and indirectly, and in Europe the annual economic cost is €192 billion (Allender et al., 2008). This represents the cost burden in the developed countries.

In recent times, developing countries or low-and middle-income countries (LMICs) are faced with the challenge of CVDs of non-communicable diseases (Sarki et al., 2015:7). Cardiovascular diseases were the cause of 31% of deaths globally in 2015 and 37% of deaths in low-and middle-income countries (World Health Organization, 2017a). It also accounted for three quarters of deaths in these countries, favouring an increasing burden of CVDs in LMICs (Roth et al., 2015b; Roth et al., 2015a). Kwan et al. (2016:2565), stated that cardiovascular diseases predominate in the poorest billion of the poorest countries in the world. LMICs are suffering a great deal from the burden of CVDs, that have been reported to be subsiding in HICs or developing countries, with substantial difference in the age standardized rate of CVDs in LMICs, compared to HICs (Celermajer et al., 2012:1208). Stroke and ischemic heart disease are the leading causes of DALYs, due to CVDs (Forouzanfar et al., 2017:172).

Sub-Saharan Africa is saddled with the public health burden of CVDs, although, there is sparse surveillance data to depict the real burden of CVDs in SSA. Cardiovascular diseases account for 8.8% of all deaths, and 3.5% of DALYs in Sub-Saharan Africa (Moran et al., 2013:3). Unlike other parts of the world, younger age groups are mostly affected (Moran et al., 2013:3), which was previously, unobtainable (Peltzer & Phaswana-Mafuya, 2013:68). Cardiovascular diseases, after HIV/AIDS is the leading cause of death in South Africa (Msemburi et al., 2014; Norman et al., 2007a). CVDs in South Africa has the highest age-standardised death rates (ASDRs) and stroke, which is the leading CVD and mortality affecting the country (Nojilana et al., 2016a), accounts for 215 daily deaths in South Africa (Byrne et al., 2016).

2.4.1 Risk factors for cardiovascular diseases

There are various factors of CVDs which are also categorized as modifiable and non-modifiable risk factors. They are but not limited to modifiable (tobacco smoking, alcohol abuse, obesity, lack of physical activity, dietary habits, elevated blood pressure, type 2 diabetes, dyslipidemias and non-modifiable age, gender, ethnicity, family history of CVDs (Reiner et al., 2011:1773; McAloon et al., 2016:259; Chatterjee et al., 2012:389). It has been postulated that a family history of CVDs will increase the risk of developing cardiovascular diseases (Imes & Lewis, 2014:117; Cohen et al., 2014:1215); and lack of exercise is attributable to the development of different types of chronic disease (Booth et al., 2012:1149; Reddigan et al., 2011:1429), and obesity (Patel et al., 2016:71). There are different scoring tools that are utilised to estimate the risk of CVDs in people namely the Framingham and the Systematic Coronary Risk Evaluation SCORE projects (D’Agostino et al., 2008; D'Agostino Sr et al., 2001; Conroy et al., 2003). Blood pressure, total cholesterol, high density lipoprotein (HDL) cholesterol, smoking, age and blood pressure medications are the assessment variables incorporated in the Framingham risk scoring (Wilson et al., 1998; Grundy et al., 1999) which aids the evaluation of cardiovascular risk in individuals.

2.4.2 Cardiovascular diseases among commercial drivers

Studies have shown that commercial drivers are more likely to have CVDs risks, and the CVD risk increases the likelihood of road accidents occurring (Fatigue Alcohol. N.T.S. Board editor, 1990; Ronna et al., 2016:32). As such, it is a public health issue as pedestrians and other road users are affected by it. Ronna et al. (2016), in their study in the United States, reported an average of 8.9% on the Framingham scoring-based risk of CVDs among drivers, with more than one third of the drivers (38.9%) having CVD risk of ≥ 9%. Clustering of CVD risk among drivers in various settings, ranging from 16.4% to 72.6% (Sangaleti et al., 2014; Hirata et al., 2012; Mansur et al., 2015; Shin et al., 2013). In Sweden, drivers, had about twice the odds of developing myocardial infarction (Bigert et al., 2003:333). Robinson and Burnett (2005), found that CVDs like IHD, acute myocardial infarction (AMI), and other forms of heart diseases were major causes of death among drivers in the USA. Studies conducted in India, reported that cardiovascular diseases were part of the health complaint of drivers, while coronary artery diseases (CAD) and ischemia accounted for most of motor vehicle accidents (MVA) (Yesurajan & Indra, 2017; Koppad et al., 2012). Even in the midst of the burden of CVDs among drivers, interventions tailored towards reduction of the burden were not effective, due to occupational demand and the nature of the job (Ronna et al., 2016;33).

Basically, commercial drivers in the process of their occupational activities go through physiological processes and stresses, which increase their chances of developing cardiovascular diseases (Belkić K et al., 1998; Biglari et al., 2016). This strongly increases the risk of cardiovascular diseases (Hirata et al., 2012). Furthermore, the lifestyle activities and exhibition of a modifiable risk factor common among commercial drivers in their workplace promotes risk factor clustering, which increases CVD development (Blumenthal et al., 2002; Hirata et al., 2012). CVDs such as coronary heart disease have the potential to incapacitate drivers while driving, thereby causing road traffic accidents and sudden death (Blumenthal et al., 2002:14).

Psychosocial and work stress predisposes a person to cardiovascular diseases (Chandola et al., 2008:644; Chandola et al., 2006). The work of the drivers is by nature stressful. For example, irregular schedules, traffic stress due to congestion, financial instability, lack of social support, and job-passenger responsibility among others, are the risk factors for the development of CVDs among commercial drivers. The aforementioned factors increases the mechanism of stress progression to the development of various CVDs as stressors promote development of CVDs (Kivimäki & Kawachi, 2015; Apantaku-Onayemi et al., 2012; Antoun et al., 2017; Biglari et al., 2016). Other related risk factors are constant exposure to noise, thermal exposure and air and environmental pollution (Belkic et al., 1992; Kristensen, 1989a; Kristensen, 1989b). Shown in Figure 2.1, is the interrelation of work, personal and environmental factors cascading to risk factors, with health and driver outcomes (Crizzle et al., 2017).

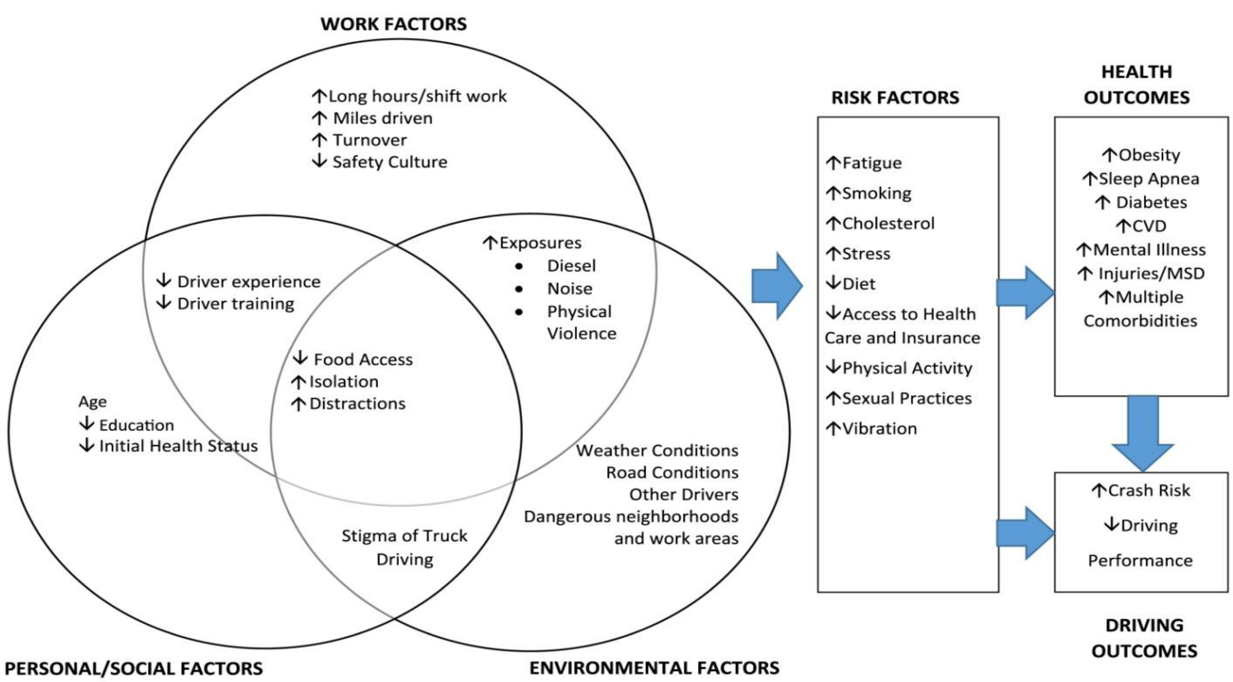


Figure 2.1: Interplay of Work, Personal and Environmental Factors on Health and Driver Outcomes. (Crizzle et al., 2017)

2.5 CARDIO-METABOLIC RISK FACTORS

2.5.1 OVERWEIGHT AND OBESITY

Overweight and obesity also referred to as adiposity, could be defined simply as the accumulation of extra or excess fat in the body, leading to excess body weight (Del Parigi, 2010). Excess weight is dangerous to health (World Health Organization, 2011d). The American Heart Foundation (2014), defined obesity as the accumulation of body fat in the waist region, which increases the risk of disease.

Obesity is a global health problem, occurring in both high income and low and middle-income countries (Ford et al., 2017; Borrell & Samuel, 2014; Ng et al., 2014a:771; World Health Organization, 2003a:vi). In 2014, 39% and 13% of the world's population were overweight and obese, respectively (World Health Organization, 2016b). South Africa is one of the countries with a high prevalence of obesity (Shukla et al., 2014). In a Demographic and Health Survey conducted in 1998, 29.2% of men and 56.6% of women were overweight or obese (Puoane et al., 2002:1041) and the National Department of Health (NDoH) et al. (2017) reported a 68% and 31% increase in the prevalence of overweight or obesity among women and men, respectively.

Obesity is linked with the development non-communicable diseases (Amarya et al., 2014); diabetes (Eckel et al., 2011), cardiovascular diseases (CVD), cancer (Basen-Engquist & Chang, 2011), renal problems (Silva Junior et al., 2017) and dyslipidaemia (Klop et al., 2013). The burden of obesity is largely driven by nutritional transition (Popkin et al., 2012:7) and urbanization (Ford et al., 2017:149; Malik et al., 2013:14), attributed to consummation of processed, fasts foods, in neglect of traditional food rich in fibre with low caloric and rich nutritional content; and lack of physical activity (World Health Organization, 2016b; Scott et al., 2012:11; Balakumara et al., 2016:603; Ford et al., 2017;149). Over the years, efforts being made to curb the rising menace of obesity seem to have been futile obviously by the increasing reports of obesity especially in countries with low or middle socio-demographic index (Afshin et al., 2017:13). Generally, overweight and obesity is greatly increasing among every individual both children and adults, however, females tend to be more obese than males among adults (Ali & Crowther, 2009:83; Afshin et al., 2017;16).

Commercial drivers are particularly at increased risk of obesity because of the high rate of unhealthy lifestyle behaviour and dietary practices (Sieber et al., 2014:623; Hirata et al., 2012). Also, prolonged exposure to work-related stress has been identified as another contributing factor to the obesity burden found among commercial drivers (Pop et al., 2015:31). Obesity among commercial drivers is associated with several co-morbidities, musculoskeletal problems, sleep apnea, increased risk of accidents, accident or disease related injuries and mortality (Marcinkiewicz & Szosland, 2010:177; Hirata et al., 2012; Anderson et al., 2012; Zhu et al., 2006:737; Abu Dabrh et al., 2014; Thiese et al., 2015:662; Mozafari et al., 2015:432; Rice & Zhu, 2013). Although obesity has been extensively studied, much of the research has focused on other population groups. Contrastingly, obesity among commercial drivers has been reported in several countries (Udayar et al., 2015; Montazerifar et al., 2016; Elshatarat & Burgel, 2016; Thiese et al., 2015; Sieber et al., 2014).

Commercial drivers do exhibit a high rate of obesity, even when compared with their colleagues in the same working environment. In a Pakistan study, commercial drivers and conductors (who are known to more active) both exhibited a high rate of obesity prevalence however; commercial drivers had a higher body mass index 65.5% compared to 32.4% among conductors. Correlating obesity with waist circumference the prevalence of obesity was higher among commercial drivers (43.7%) than the conductors (18.9%). Likewise, for waist to hip ratio (WHR>1) which was 18.8% and 2.0% among commercial drivers and conductors respectively (Aslam M. et al., 2015:861). Similarly, Joshi et al. (2013) reported a relatively high prevalence of overweight, obesity and central obesity among commercial drivers (43.3%, 22.2%, 23.8%) as compared with conductors (28.1%, 16.25,18.1%) in Belgaum, India. Crizzle et al. (2017) also reviewed that most drivers are obese. These are expressive of the burden of obesity and its complications among commercial drivers, even though these are in countries reported to have high rates of obesity as compared to global prevalence (Ng et al., 2014a: 772). However, overweight and obesity, not a rare problem in the general population of South Africa, is never reported regarding commercial drivers.

2.5.1.1 Measures of Obesity

Body mass index (BMI) is commonly used to define total obesity in clinical practice, academic research, and public health perspective (Wu et al., 2014:100). BMI is not an accurate measure of obesity, especially relating to fat distribution (Burkhauser & Cawley, 2008; Pi-Sunyer, 2013). Notwithstanding the disadvantages of BMI in distinguishing between fat mass and fat-free mass, it has been widely used to screen for health risks in populations because it is inexpensive, non-invasive and suitable for large-scale surveys (Goon et al., 2017:578). However, scholars proposed different measurements for obesity based on the region of the body where the fat is accumulated; which BMI could not measure. Hence studies began to incorporate the measures such as neck circumference (Aswathappa et al., 2014; Aswathappa et al., 2013), waist circumference (Pouliot et al., 1994), waist to hip ratio, and waist to height (Ashwell et al., 2012; Ashwell & Gibson, 2016; Ashwell & Gibson, 2014).

Waist circumference a measure of central obesity cut off point was established by international Diabetes Foundation, IDF as ≥94 cm and ≥80 cm for Africans, though waist circumference according to NCEP-ATP III gave a larger cut-off, regardless of ethnicity being ≥120 cm for men and ≥88cm. Neck circumference was also added as a parameter for measurement of obesity. This is a very simple method of determining obesity. These measures of abdominal obesity are better predictors of cardio-metabolic risk factors (Ware et al., 2014:900; Liang et al., 2013:e145). Some other sophisticated measures of obesity are underwater weighing for body composition, magnetic resonance imaging (MRI), computerized tomography (CT), dual-energy x-ray absorptiometry (DEXA), bioelectric impedance analysis (BIA) and air displacement plethysmography (ADP) for anatomical distribution. Prospective dietary records, a measure of energy consumed and energy can also be measured (WHO, 2000:7).

2.5.1.2 The global prevalence of obesity

According to the World Health Organization (2017d), in 2016, more than 1.9 billion adults were overweight and obese, out of which over 650 million were obese. Recently, more than one in two adults are obese, contrary to the one in five that was reported in 2015 by the Organisation for Economic Co-operation and Development (OECD) countries (Organisation for Economic Co-operation and Development, 2017). The prevalence of obesity varies between countries and regions within countries. Quite a lot of countries are suffering from the problem of obesity with a global estimation of over 300 million people suffering from obesity, (World Health Organization, 2017). In the GBD 2015 study, a global estimate of over 107 million children and about 604 million adults were reported as obese (Afshin et al., 2017:13). Countries with the highest rate of adult obesity were the United States and China (Afshin et al., 2017:19; Finucane, 2011). In 2015, it also accounted for the mortality of four million (Afshin et al., 2017:22).

2.5.1.3 Obesity in Low and Middle Income Countries

Overweight and obesity have been concentrated in developing countries, mostly among underprivileged persons, urban areas and in females. This condition is not increasing without diseases being attributable to it (Ellulu et al., 2014). Ellulu et al. (2014), reported that 44% of diabetes mellitus is attributable to obesity in these countries. Its prevalence in LMICs where it was increasing was estimated to be 36.9% in men and 38% in women. Obesity is increasing and spreading its roots throughout the world (Ford et al., 2017:146). Countries such as India, Nepal and Bangladesh, which were previously battling with the problem of under-nutrition, are now experiencing a dramatic increase in the prevalence of obesity. Obesity is also increasing in Sub-Saharan African countries (Ajayi et al., 2016). In SSA, overweight and obesity is prevalent throughout the five regions, and increasing. According to Agyemang et al. (2015) the five countries with the highest prevalence of obesity in SSA are the Seychelles (64 %), Mauritius (44.8 %), Cameroon (43.9 %), Botswana (41.6 %), and South Africa (41 %). While some parts like Uganda, Zambia and a part of Nigeria have a relatively low prevalence of obesity (Kengne et al., 2013:981), However the number of countries with high prevalence rate surpasses those with low prevalence, it was predicted that increased BMI in Africa and South Asia will later outrun the prevalence of those in the developed countries (Bhurosy & Jeewon, 2014)

There are quite a lot of factors that increase the body mass index in Africa. (Agyemang et al. (2015); Kruger et al. (2007:493), spelt out the risk factors for obesity as socio-demographic status (the female gender often has higher rates of obesity than the male gender). Marital status also increases the likelihood of being obese, especially among the parous female. Also, socioeconomic status applies (Alaba & Chola, 2014:3400), whereby wealth increases the rate of obesity in some parts, whereas by contrast, in some parts, the poor had greater prevalence of obesity. Education accounts for increase obesity rate among persons with a low level of education. Furthermore, body perception increases body weight, and this is dependent on individual cultures, some cultures perceiving being overweight as a sign of beauty and wealth, while seeing normal stature as a sign of being unhealthy. Lifestyle factors contribute immensely to the increasing burden of overweight and obesity. The habits of smoking, high alcohol consumption, low physical activity level, and unhealthy food consumption lacking adequate nutrients and vitamins; all have a positive association towards being overweight or obese. Another factor is a lack of sleep, a lack of rest and unhealthy eating patterns such as consumption of heavy meals or low nutrient meals (Chaput et al., 2011:1294).

2.5.1.4 Obesity in South Africa

Obesity is the sixth risk factor for the global burden of disease and mortality and the third risk factor in Southern Africa (Lim et al., 2012). South Africa is one of the countries with a high prevalence of obesity (Shukla et al., 2014). Also in Sub-Saharan Africa, SA has the highest prevalence of obesity with 42% prevalence rate among women (Ng et al., 2014a; Peer et al., 2014a). In the Demographic and Health Survey conducted in 1998, 29.2% men and 56.6% women were overweight or obese (Puoane et al., 2002) and the National Department of Health (NDoH) et al. (2017) reported a 68% and 31% increase in the prevalence of overweight or obesity among women and men, respectively. With the high prevalence of obesity already recorded in south Africa, prevalence continued to increase (Cois & Day, 2015:46; Shisana., 2013:135). Prevalence of obesity by race was found to be higher among the black population than among other races in south Africa (Kruger et al., 2007). This is pronounced among black women and among white men (National Department of Health (NDoH) et al., 2017). Population-based studies have shown that obesity is a significant health problem in South Africa evident by its reported prevalence. In the Eastern Cape Province there is a total prevalence of 70.0%; overweight (24.0%) and obesity (46.0%) was reported (Owolabi et al., 2017a). In the Free State, (Prinsloo et al., 2011), reported 76.3% overweight and obesity

The trend towards a high calorie diet and physical inactivity among South Africans is the cause of the burden of obesity in the country (Kruger et al., 2007:493). These have resulted in the neglect of traditionally healthy diets towards the adoption of processed, unhealthy, readily available foods and beverages with high calorie levels and less nutritional content combined with a lack of physical activity (World Health Organization, 2016b; Scott et al., 2012; Balakumara et al., 2016; Ford et al., 2017). Socio-economic circumstances after the post-apartheid transition (1994) have changed drastically and rapidly, and with it, the living conditions of the South African population. These changes included nutrition and physical activity which are the leading predictors of obesity in the country (Cois et al., 2015:46). Obesity has increased dramatically over the last decade in the South African population.

2.5.2 HYPERTENSION

Hypertension is one of the major risks for CVDs as it relates to all cardiovascular diseases. This becomes a risk as soon as blood pressure exceeds normal blood pressure levels (Forouzanfar et al., 2017). Hypertension is a leading modifiable risk factor for cardiovascular diseases and an independent risk factor for morbidity and mortality; which often go unnoticed as a result of its asymptomatic nature (Echouffo-Tcheugui et al., 2015:751; Roth et al., 2015b; Tibazarwa & Damasceno, 2014:530). It is also the leading risk factor for the Global Burden of Diseases (GBD) and a 7.0% cause of global disability-adjusted life year (DALYS) (Lim et al., 2012:2224); accounting for 9 million annual deaths in the world (Lim et al., 2012). Globally, there is an increasing prevalence of hypertension, even in economically disadvantaged countries (Van de Vijver et al., 2013). In 2000, the global estimate of people with hypertension was 972 million (26.4%), with majority 639 million from developing countries (Kearney et al., 2005). In 2015, about 900 million adults were diagnosed with high blood pressure (Huffman & Lloyd-Jones, 2017).

Hypertension is the one established causal factor for CVDs (Kaplan et al., 2010; Giles, 2006; Giles et al., 2009:611), especially high systolic blood pressure (Mourad, 2008). It is associated with all other cardio-metabolic risk factors like obesity, dyslipidemia (Neves et al., 2013). Hypertension also has a relationship with diabetes as they share a common mechanism and risk factors with diabetes, however the link is not clear, but it is paramount to treat the disease conditions simultaneously (Cheung & Li, 2012:163; Wise, 2015; Dokken, 2008). There is almost a 60% risk of developing diabetes among individuals with hypertension (Wise, 2015). It could also worsen diabetes condition in already-diagnosed persons. As such, there was a controversy about the targeted control normal blood pressure level for individuals with diabetes which is <130/80mmHg (Bangalore et al., 2011:2806). However, according to the statement by the American Society for Hypertension (ASH) and the International society of Hypertension (ISH), this guideline has not been proved to be beneficial (Weber et al., 2014:15). (Prospective Studies Collaboration, 2009) reported that, hypertension is one of the factors that accounted for a strong correlation of high body mass index with ischaemic heart disease.

2.5.2.1 Hypertension in Low and Middle Income Countries

Until recent times hypertension was regarded as a disease of the affluent countries in the world (Cappuccio & Miller, 2016:300). There is an increasing prevalence of hypertension in LMICs, ranging from 19.2%-54.9% in selected LMICs (Irazola et al., 2016:54; Sarki et al., 2015). Most of the morbidity and mortality in LMICs is related to hypertension. The majority of individuals with hypertension in LMICs remain undiagnosed and poorly controlled, probably as a result of the non-availability of health awareness programmes, particularly in rural settings (Lemogoum, 2014:555; Dewhurst & Walker, 2016:221).

Ataklte et al. (2014:291), reported a pooled prevalence of hypertension ranging from 7% to 56% in Sub-Saharan African countries. Not considering the risk and consequences of this disease there was a low level of awareness, treatment and control levels especially in SSA (Ataklte et al., 2014:295). Also, an estimated prevalence of hypertension was reported to be 125.5 million people are expected to be diagnosed with hypertension by 2025 (Ogah & Rayner, 2013). The prevalence of hypertension in SSA is projected to increase to 216.8 million cases by 2030 (Adeloye & Basquill, 2014).

2.5.2.2 Hypertension in Sub-Sahara Africa

In SSA, high blood pressure increases yearly, affecting most countries. Although the rise in hypertension differs from country to country, based on location, occupation and urbanization (Guwatudde et al., 2015:1215). This also reflects the level of awareness or diagnosis in the population. People often do not realise their blood pressure status early enough because of the asymptomatic nature of hypertension (Bell et al., 2015). Hypertension related disease among the SSA population includes ischaemic heart diseases, stroke and heart failure, chronic kidney diseases (CKD), vascular dementia (Echouffo-Tcheugui et al., 2015; Owolabi et al., 2015; Adeloye, 2014; Mensah, 2008). The increasing prevalence of hypertension and its complications in SSA, has been attributed to the individual's carelessness and negligence (Kayima et al., 2013:60), the urbanization and population growth in Africa (World Health Organization, 2013b), and ageing (Dewhurst et al. 2016:221). An extreme rate of unawareness and undiagnosed hypertension aggravates the risk of various cardiovascular diseases which are life threatening, like myocardial infarction, renal failure, stroke; among many others (Guwatudde et al., 2015:1215; Ogah et al., 2013).

2.5.2.3 The Burden of Hypertension in South Africa

South Africa is not exempted from the growing burden of hypertension and its complications (Hasumi & Jacobsen, 2012). It is the leading risk of strokes and heart attacks (Norman et al., 2007b). More than 6.2 million South Africans are hypertensive with about 53 men and 78 women dying daily from the effects of hypertension; with a high likelihood of a future increase as the population ages (Rayner, 2013). Hypertension in South Africa is reportedly increasing. Prevalence increased dramatically from the 1998 South Africa Demographic Health Survey (SADHS), 21% to 77.3% in 2008 (Steyn et al., 2001; Peltzer et al., 2013). Moreover, hypertension within the country continues to increase even in the rural areas (Ntuli et al., 2015). In a study conducted among low to middle income countries, South Africa had the highest prevalence of hypertension which was 54.9% (Irazola et al., 2016:53), with variations across provinces and regions. In the Eastern Cape Province, there were documented research records of 46% pre-hypertension and hypertension levels (Nkeh-Chungag et al., 2015:908) and 49.2% (Owolabi et al., 2017d) among adults. Lamentably, while the prevalence of hypertension keeps increasing, the awareness level is low (Rayner, 2010). Several factors are responsible for this; such as epidemiological transitioning, resulting from ageing and urbanization (Ngo et al., 2014:841), unhealthy dietary practices, sedentary lifestyles, stressful activities (Jiang et al., 2016:2396; Hall et al., 2015), and obesity (Jiang et al., 2016:2396), education, and family history, especially in South Africa (Steyn et al., 2008). Hence, there is an increase burden of hypertension in SA with varying factors.

2.5.2.4 Hypertension among commercial drivers

Several studies have reported a high prevalence of hypertension among commercial drivers (Nasri & Moazenzadeh, 2006; Kurosaka et al., 2000; Nayak et al., 2014). Nayak et al. (2014;121), found a prevalence rate of hypertension among drivers was 46% compared to the non-driver workers which was 18%; Shin et al. (2013:37)'s study reported that 53.3% commercial drivers were diagnosed with high blood pressure while two separate groups, group A and B had a prevalence of 17.6% and 19.7% respectively in Korea. There are few or scarcely documented prevalence rates of hypertension among commercial drivers in Africa, with evidence of high prevalence ranging from a 9%-33.5% prevalence rate of hypertension in Nigeria (Tobin et al., 2013; Erhiano et al., 2015; Olusegun et al., 2016) and even higher among some drivers in different parts of the world. Also, among drivers, hypertension is one of the risk factors for cardiovascular disease (Hirata et al., 2012). Their study reported that over one third of the participants have hypertension. In India, 41.9% and 41.3% of commercial drivers were diagnosed with pre-hypertension and hypertension respectively, coupled with a low awareness rate, treatment and control (Lakshman et al., 2014). Reports of an exceptionally high prevalence of hypertension were also documented among commercial drivers in Hong Kong, Taiwan and Korea which were to be 57%, 56% and 53.3 % respectively (Siu et al., 2012:60; Wang & Lin, 2001:262; Shin et al., 2013;37). Commercial drivers in both developing and non-developing countries have a high prevalence of hypertension (Wang et al., 2001; Sangaleti et al., 2014:1066). Prevalence in other studies was ere16% and 14.2% (Satheesh et al., 2013; Udayar et al., 2015) in India and 42.9% and 16.4% in Iran (Saberi et al., 2011; Izadi et al., 2013).

Supporting large numbers of family members, and diets especially meals at restaurants with high levels of fats and salts, were factors that increased the risk of hypertension (Lakshman et al., 2014). Also, age, smoking, family history, total and abdominal obesity, lipid disorders and duration of driving, in terms of experience or years all contribute to the odds of being hypertensive (Olusegun et al., 2016; Tobin et al., 2013). Although several studies have been conducted on the prevalence of hypertension in the general population in South Africa, and among commercial taxi drivers in other countries, scant information exist on hypertension among commercial drivers in South Africa.

2.5.3 SMOKING

Smoking is a social health problem among adults. Smoking is one of the leading causes of diseases and mortality (World Health Organization, 2008) and it is also increased from being the third risk factor to the second leading cause of the global disease burden (Lim et al., 2012;2224; Forouzanfar et al., 2015). Globally, in 2012 and 2015, there were substantial decreases in the prevalence rate of smoking from the reported 1990 prevalence rates, yet the numbers of daily smokers increases daily (Ng et al., 2014b:168; Reitsma et al., 2017:1901). However, the decrease prevalence is not homogenous that is it is not evenly reported.

Smoking contributes to diseases and deaths. A lot of diseases are caused or aggravated due to smoking such as tuberculosis, cancers and CVDs (Ezzati & Riboli 2013). According to Forouzanfar et al. (2015:2299), death attributed to smoking increased to 5.8 million in 2013. Global mortality due to tobacco this may increase to 10 million deaths by 2030 with an increase in the rate of tobacco use as estimated by (World Health Organization, 1999b). Also, according to the World Health Organization (2008) report, 5.4 million people die per annum as a result of tobacco use which is projected to increase by 2030 to 8 million deaths per year especially in developing countries. Smoking accounted for 11.5% of global deaths, the majority of these deaths occurred in USA, China, Russia and India. It was ranked the fifth leading risk factor by DALYs (Reitsma et al., 2017:1885). Globally there have been reports of uneven decreased prevalence of smoking across countries whereas countries such as Congo, Azerbaijan for men and Kuwait and Timor-Leste for women still recorded annual increases of smoking prevalence (Reitsma et al., 2017).

In Sub-Saharan Africa, Southern Africa has the highest smoking rate (Van de Vijver et al., 2013). Smoking in South Africa is more prominent in the urban areas than the rural areas (Van de Vijver et al., 2013). 81.4% of smokers observed signs of the negative health impact of smoking (Reddy et al., 2015) In South Africa, a large percent of the population use tobacco, more common among males than females (Reddy et al., 2015). It could also be recalled that smoking accounted for 8%-9% of deaths and 3.7%-4.3% DALYs in 2000 (Groenewald et al., 2007). While action has been employed to curtail the habit and prevalence of smoking, majority of South Africans have adopted the cheap alternative to manufactured cigarette termed ‘roll-your-own' cigarettes, which ironically, of its own accord is increasing the prevalence of smoking (Ayo-Yusuf & Olutola, 2013). Also, the prevalence of smoking was reported to be 20.8% while the majority presented themselves as daily smokers (Shisana et al., 2013:96), while Reddy et al. (2015) reported a 17.6% prevalence of men smoking in their study with a four times higher rate of smoking among men than in women, a likelihood that has increased from the previous three times higher rate among men than women. The implication is that prevalence may decrease but the number of smokers is increasing.

The Western Cape (32.9%), the Northern Cape (31.2%) and the Free State (27.4%) were the provinces with a higher prevalence of smoking. Notwithstanding that, the exposure rate to smoking is high in the Eastern Cape Province, amidst the high prevalence rate.(Owolabi et al., 2017e) reported 15% current smokers among adults with 39.5% secondary smoking rate. Among higher learners in the Eastern Cape 26% were smokers (Awotedu et al., 2006). This presents the burden and an increased probability of dire consequences of smoking among active and passive smokers.

2.5.3.1 Smoking as a cardio-metabolic risk factor

The use of tobacco shortens the life of the user. Studies have it that smokers die young on average of 8 to 10 years younger than others, as smoking, as a risk factor that causes mortality due to cardiovascular diseases and diabetes (Chang, 2012:401). According to the 2014 Surgeon General's Report on smoking and health, smoking causes cardiovascular disease in such a way that the cells lining the blood vessels become inflamed and swollen, narrowing down the blood vessels. This is caused by the chemicals (tar and nicotine) in cigarette smoke. The action plan of a 30% relative reduction has been proposed by the WHO to combat the indiscriminate use of tobacco (World Health Assembly WHA, 2013:22).

Smoking is a risk factor for CVD and diabetes mellitus that is associated with insulin resistance, inflammation and dyslipideamia. This increases the risk of diabetes and its complications (Chang, 2012:399). Although the way that smoking leads to diabetes is not quite understood, it does have a harmful effect causing an increased risk of diabetes and complicates the disease. It also aggravates glucose homeostasis (Chang, 2012:399). Further reporting that smoking increases the rate of stroke, especially in individuals with diabetes. In like manner, it increases blood pressure (Talukder et al., 2011:H391). The effect of smoking increases as the number of cigarettes increases per day. Smoking increases body fat distribution which can also predisposes the metabolic syndrome (Chiolero et al., 2008:805; Matsushita et al., 2011:649).

Cho et al. (2009), in their prospective study described smoking as an independent factor for the development of diabetes. Relatively, smoking increase the person's susceptibility to developing T2DM (Maddatu et al., 2017). Quitting smoking also increases the risk of developing Type 2 diabetes mellitus.This is related to the weight gain experienced after the cessation of smoking (Maddatu et al., 2017:102). The severity of diabetes development is based on how heavily an individual smokes. Also, increased insulin resistance and inflammation links smoking with the development of diabetes (Chang, 2012; Chiolero et al., 2008:806) The effect of nicotine is the major factor linking with other social factors, which causes the development of diabetes mellitus. It acts on insulin secretion and action, to develop DM (Xie et al., 2009:784; Bergman et al., 2012:3165).

Smoking cessation initiates the development of obesity over a certain period, which with lifestyle modification, can possibly reduce diabetes (de Munter et al., 2015). However, many find it difficult to quit smoking. Heavy smoking has been found to increase abdominal obesity, evidenced by increased waist circumference (Morris et al., 2015). Among individuals with previous type 2 diabetes mellitus, smoking was found to be associated with more abdominal obesity in current smokers than in non-smokers and also in heavy smokers than in light smokers (Yun et al., 2012:319). The nicotine found in the cigarettes acts as an appetite suppressant. Therefore, it can be deduced that smoking increases the occurrence of more abdominal obesity than total obesity.

2.5.4 ALCOHOL

Alcohol is also a social and medical problem. It increases the chances of disease and aggravates existing health problems (World Health Organization, 2014c). It affects both the young and adults in developing countries, causing about 2.5 million annual deaths and diseases like cancer, cardiovascular diseases, liver cirrhosis and injuries (National Council on Alcoholism and Drug

Dependence, 2011). Alcohol was quoted as the sixth major risk factor for global burden of diseases in 2013, and it accounted for about 2.8million global deaths (Forouzanfar et al., 2015). Alcohol consumption serves as a component cause for various chronic diseases and resultant deterioration.

South Africa holds the leading rank for alcohol use in Africa (Peer, 2009). Alcohol intake is a social aspect of various economic groups in South Africa. It is a source of pleasure and recreation. South Africans have an acceptable abstinence level, however the percentage of alcohol consumers who have an indiscriminate drinking habit is increasing (Peltzer et al., 2011; Peer et al., 2014b; Peltzer & Ramlagan, 2009). South Africa is considered a hard-drinking country (World Health Organization, 2014c; Owolabi et al., 2017c; Owolabi et al., 2017e). The enormous burden of alcohol use goes with financial implication in South Africa (Matzopoulos et al., 2014; Seggie, 2012). Alcohol use is a major cause of CVD and CVD related mortality (Zatu et al., 2016). In South Africa, alcohol use and tobacco smoking are among the leading risk factors and are attributable to DALYs (Norman et al., 2007a). South Africa is also experiencing a rise in the burden of road traffic crashes and this has been highlighted as impeding socio-economic development in the country and also impacts on the wellbeing of the populace (Wheel 24, 2017; Taylor, 2016).

Alcohol consumption has both social and health consequences for individuals whereby relatives and the public partakes of it. Alcohol use has been reported as one of the risk factors of communicable diseases (infectious diseases) (Rehm et al., 2010; Samokhvalov et al., 2010b), non-communicable diseases (Parry et al., 2011) and injuries (Zhao et al., 2015; Cherpitel et al., 2015). Excessive alcohol use could also be a cause of respiratory depression and death (Agarwal, 2002). Although moderate alcohol intake was reported to have some cardiovascular health benefits (O'Keefe et al., 2007), the majority consume it excessively. Nonetheless, the negative implications of alcohol use override its benefits.

2.5.4.1 Prevalence of substance use (alcohol and smoking) among commercial drivers

Probably because of stress and other factors, commercial drivers indulge in substance abuse (alcohol and smoking). The prevalence of substance abuse (alcohol and smoking) is high among commercial drivers, with variations in its level and effects in different countries. The self-reported prevalence rates of smoking among commercial drivers in Nigeria were as follows 32%, 25.8% and 39.4% (Ozoh et al., 2014; Adekoya et al., 2011:870; Fasasi et al., 2014); Brazil (29%) (Sangaleti et al., 2014:1063), Colombia (20.3%) (Useche et al., 2017); while Bangladesh drivers had an exceptionally high prevalence rate of 93% (Goon & Bipasha, 2014b). Likewise, the prevalence of alcohol use in Nigeria is high (93.7%) (Akpan &Ikorok (2014), and 84.5% (Bello et al., 2011). In Colombia, 27.9% of the commercial drivers reported using alcohol (Useche et al., 2017) while 66.8% use alcohol in Brazil (Sangaleti et al., 2014). Abiona et al. (2006), further analysed the pattern of alcohol consumption in their study as heavy drinkers, moderate drinkers and mild or occasional drinkers (47%, 15.3% and 37.7%) respectively out of a total prevalence rate of 67.2% alcohol users.

Bello et al. (2011); Akpan et al. (2014), stated that young age, environment (such as the use by family and friends), sale of alcohol around the workplace, and years of driving, influence the use of alcohol and probably other substances. In an attempt to reduce or minimise the involved job strain, stress and frustrations, some of the commercial drivers resorted to using psychoactive drugs such as alcohol and cigarettes (Makanjuola et al., 2014; Abiona et al., 2006; Useche et al., 2017). There is an anticipated benefit of smoking being the relief of stress, and keeping alert and awake for several hours at a time. Unknown to these drivers, the use of such psychoactive substances impair their driving performance, their problem solving skills as well as their sense of judgement in the face of an unexpected incident, thus contributing to crashes (Adekoya et al., 2011; Zhao et al., 2014a)**.** The use of alcohol and other psychoactive substances has also been implicated as a driving force for the increasing burden of road traffic crashes. Although the literature is replete with studies on the prevalence and pattern of psychoactive substance use among drivers in Africa; Nigeria (Makanjuola et al., 2014; Adekoya et al., 2011; Bello et al., 2011), Iran (Heydari et al., 2016); Ghana (Asiamah et al., 2002), There are hardly any studies on South African commercial taxi drivers, which is surprising when one considers the high prevalence of alcohol, cigarettes and other substance abuse in South Africa.

2.5.5 PHYSICAL INACTIVITY

Physical inactivity is simply a lack of exercise or being insufficiently physically active. It can also be defined as the inability to meet required physical activity recommendations (O'Donovan et al., 2010:574). Physical activity is an exercise or bodily movement produced by skeletal muscles that requires energy expenditure. Physical inactivity globally (Lim et al., 2012) is the fourth highest risk factor leading to chronic diseases and mortality. According to the WHO guideline healthy adults should have at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate and vigorous-intensity activity (World Health Organization, 2010). In addition, adults with disease conditions who have rightly met the standard physical activity recommendation may also increase to 300 min or more of moderate-intensity aerobic activity each week, or 150 min or more of vigorous-intensity aerobic activity each week, or equivalent combinations of moderate and vigorous-intensity aerobic activities, which may be applicable to adults with an increased risk of cardiovascular disease or type 2 diabetes (O'Donovan et al., 2010:575).

2.5.5.1 Burden of physical inactivity

The rising physical inactivity levels worldwide have the dangerous implication of increasing non- communicable disease among the general population (World Health Organization, 2010). Guthold et al. (2008), found a prevalence range of physical inactivity among countries to be from 1.6% to 51.7% in 2007. According to Dumith et al. (2011:26), crude prevalence of physical inactivity was 21.4% which implies that one in five adults are physically inactive. Hallal et al. (2012), indicated that 31.1% of the world population groups are physically inactive. Physical inactivity is less prevalent in the developing countries and more prevalent in developed country and among the affluent (Dumith et al., 2011:25). Also, there is a disparity in the prevalence within the developed countries as opposed to developing countries. For instance, prevalence of physical inactivity is was 27.5% in Africa, 43.3% in America, 43.2% in theEastern Mediterranean, 34.8% in Europe 33.7% in theWestern Pacific while it is was low in southern Asia (17%) (Hallal et al., 2012:248). Physical inactivity caused approximately cause 27% diabetes and 30% ischemic heart disease burden (World Health Organization, 2010). Physical inactivity has an adverse effect on health; it increases and worsens the occurrence of NCDSs. Lee et al. (2012:225), highlighted that physical inactivity accounts for 6%-10% of the disease burden for coronary heart disease, diabetes, cancers and 9% of premature death globally, while it also decreases quality of life. (Lee et al., 2012). About 3.2million death per year 2.8% of DALYs was recorded in 2010 as a result of physical inactivity (World Health Organisation, 2017; Lim et al., 2012:2235). It was observed that women are more physically inactive than men (Guthold et al., 2008:488; Hallal et al., 2012:247). A targeted 10% reduction by 2025 has been planned by WHO (World Health Organisation, 2017), this could avert 533000 deaths while 25% reduction could avert over 1.3 million deaths (Lee et al., 2012). This suggests that physical activity is an essential part of healthy living. Hence, it has a contributory role in the prevention and management of non-communicable diseases and the mortality attributable to them (Durstine et al., 2013). It is an act that boosts cardiovascular health which in turn, reduces the chances of developing cardiovascular disease. Physical activity is evident in lowering the risk of cardiovascular diseases by 20-30%, especially leisure time physical activities (Li & Siegrist, 2012). Agarwal (2012:543), affirms that it is the most convenient, the cheapest and the best protective way of life against disease. Physical inactivity also relates to the cost burden of chronic diseases, as one of the cogent modifiable risk factors (Pratt et al., 2014), its direct and indirect cost estimate was $67.5 billion globally (University of Sydney, 2016).

2.5.5.2 Developing countries and physical inactivity

In developing countries, the burden of physical inactivity is also increasing which contributes to the high rate of obesity and diseases (Bhurosy et al., 2014). Advances in technology and devices have reduced the amount of labour and total energy expended in implementing the activities of daily living. The result is reduction in activity levels (Hallal et al., 2012:247). Xu et al. (2014), reported in their study that in China an increase in the mortality rate attributed to the increased physical inactivity rate in the country. There was a 27.5% prevalence of physical inactivity in Africa (Hallal et al., 2012). In Africa, physical activity is also the fourth leading risk factor in the region (Lim et al., 2012:15). There are various factors leading to the increased rate of inactivity in developing countries. Koyanagi et al. (2017), highlighted some of the factors such as the female gender, marital status, high level of education, wealth, sometimes unemployment, and some health conditions such as respiratory diseases and visual impairment.

South Africans have been found to have a high rate of physical inactivity, which is ranked as the ninth risk factor for diseases and the twelfth risk factor for DALYs (Joubert et al., 2007) with a 44.7% physical inactivity rate (Guthold et al., 2008). According to the South African National Health and Nutrition Examination Survey (SANHANES), 27.9% men and 45.2% of women are physically inactive (Shisana et al., 2013b:131).South Africa has one of the highest rates of physical inactivity in the African region (Guthold et al., 2008:489). In the Study of Global Ageing and Adult Health (SAGE) 2008, 55.0% of the participants reported no vigorous or moderated physical activity at work, 89.1% reported no vigorous or moderated physical activity during leisure and 57.5% did not walk or cycle, indicating a limited enthusiasm of people for physical activity (Peltzer & Phaswana-Mafuya, 2012). In the 2000 estimation of the burden of diseases by Joubert et al. (2007), physical inactivity in the country was associated with 30% of ischaemic heart disease, 27% of colon cancer, 22% of ischaemic stroke, 20% of type 2 diabetes, and 17% of breast cancer. It also accounted for deaths. With the resulting burden and complications due to insufficient physical activity, it is also exhibited among the younger age group (Mokabane et al., 2014; McVeigh & Meiring, 2014).

2.5.5.3 Physical inactivity among commercial drivers

Commercial drivers also present with high rates of physical inactivity; driving is a sedentary job (Varela-Mato et al., 2017). During work days, which comprises most hours and days of the week commercial drivers spend 97% of their daily time seated or being sedentary (Varela-Mato et al., 2016). In a study in Brazil, the drivers presented with 72.8% physical inactivity rate (Sangaleti et al., 2014:1063). Also in Brazil, comparing drivers with postmen, Sena et al. (2008), found that 80.8% (55.8% of the total are sedentary, 25.0% insufficiently). In Nigeria, 44.6% of commercial drivers reported being physically inactive (Odeyinka & Ajayi, 2017).Commercial drivers often show a reluctant attitude towards physical activity. Those with off breaks do not engage in any physical activity, while drivers generally perform less than the recommended physical activity level (Turner & Reed, 2011). Although physical activity enhances driving performance and safety, mostly, it is not practiced (Marmeleira et al., 2009).

2.5.5.4 Physical inactivity as a cardio-metabolic risk factor

Physical inactivity is a predisposing factor for accumulation of body fat or weight gain. In a prospective study, Ekelund et al. (2011:832), suggested physical activity as an intervention for reducing central and total obesity, as insufficient physical activity predicts obesity among those with normal weight and increases weight gain more among overweight and obese individuals. Being physically active is protective of cardio-metabolic health by lowering the body mass index (Braun et al., 2016). Knight (2012), maintained that physical inactivity increases the risk of coronary heart and cerebrovascular diseases, type 2 diabetes mellitus, and hypertension. Hunter et al. (2013:1336), pointed at physical inactivity as one of the four common risk factors for some NCDs. In a randomized control trial Flynn et al. (2009:1457) found that being physically active improves health management among patients with heart failure. Physical activity is effective in the primary and secondary prevention of cardiovascular diseases that is; it could prevent the likelihood of developing CVDs or it could slow down the progress of diseases (Alves et al., 2016;Hamer et al., 2012) similarly, moderate to vigorous activity lowers the risk of myocardial infarction unlike low or no physical activity level or strenuous jobs which does not have any significance with lowering the condition (Held et al., 2012:463).

In a prospective study by Hjerkind et al., (2017), a decrease in physical activity level increases the rate of obesity, which was significantly correlated with an increase in diabetes mellitus. In Al Tunaiji et al. (2014)'s systematic review, diabetes also was attributable to physical inactivity. Active exercise improves insulin action; this preventing the development of diabetes mellitus (Colberg et al., 2016:2066).

2.5.5 METABOLIC SYNDROME

Metabolic syndrome (METs) can be referred to as insulin resistance syndromes or syndrome X. It is defined as the clustering of three or more of these components, abdominal or central obesity, atherogenic dyslipidemia, high blood pressure, insulin resistance with or without glucose intolerance, pro-inflammatory state and pro-thrombic states, which are the major predictors of diabetes and cardiovascular diseases (Grundy et al., 2004; Beilby, 2004; Zubair et al., 2014; Wiley & Carrington, 2016; O'Neill & O'Driscoll, 2015). The complexity of the metabolic syndrome is due to two major strong linking factors; obesity and insulin resistance. Developing these two conditions can lead to diabetes, hypertension, dyslipidemia, or microalbuminuria (Zubair et al., 2014).

2.5.6.1 Diagnostic criteria for metabolic syndrome

There were controversies in the diagnostic criteria of metabolic syndromes, based on different organizations, namely: World Health Organization (WHO), National Heart Lung Blood Institute/American Heart Association (NHLBI/AHA) and the International Diabetes Federation (IDF). The World Health Organization (1999a:33), defined the metabolic syndrome which was then opened for modification; as the presence of glucose intolerance, impaired glucose tolerance or diabetes mellitus and or insulin resistance with other two components. According to the IDF criteria, the metabolic syndrome is diagnosed as central obesity (≥ 94cm for men and ≥ 80cm for women) and any two components of METs. The National Cholesterol Education Program's Adult Treatment Panel III (ATP III) defined its criteria for diagnosing metabolic syndrome as the presence of any three or more of the risk factors (Grundy et al., 2004:435). However, a consensus was reached as to the common diagnostic criteria for metabolic syndrome as the clustering of any three of these, without prioritizing any one component (Alberti et al., 2009:1641). This is referred to as Joint Interim Statement (JIS) criteria. The different diagnostic criteria are indicated in Table 2.1

Table 2.1: Diagnostic criteria for metabolic syndrome

Components	WHO	NCEP-ATPIII	IDF	JIS
Blood pressure	≥ 140/90 mmHg or HTN treatment	≥ 130/85 mmHg	≥ 130/85 mmHg or HTN treatment	≥ 130/85 mmHg or HTN treatment
Anthropometrics	WHR male > 0.9 female > 0.85 and/or BMI > 30 kg/m^2	WC (cm) male≥ 102 female > 88	WC (cm) male≥ 94 female > 80	WC (cm) male≥ 94 female > 80
Glucose	*Diabetes Mellitus,IGT or Insulin Resistance	FBG > 110 mg/dL	FBG ≥ 100 mg/dL or DM history	FBG ≥ 100 mg/dL
Triglyceride	*> 150 mg/dL	≥ 150 mg/dL	≥ 150 mg/dL	≥ 150 mg/dL
Low HDL cholesterol (mg/dL)	male < 35 female < 39	male < 40 female < 50	male < 40 female < 50	male < 40 female < 50
MET s Criterion	DM, IGT or Insulin Resistance +2 other components	3 or more components	WC plus 2 components	3 or more components

Impaired Glucose Tolerance (IGT) or Diabetes Mellitus (DM), HTN- Hypertension, Waist to Hip Ratio (WHT) Waist Circumference (WC), Body Mass Index (BMI), Metabolic syndrome (METs). * Glucose or triglycerides can be used interchangeably

2.5.6.2 Prevalence of metabolic syndrome in South Africa

There is an increase in the prevalence and burden of METs in developing countries, especially in Africa (Misra & Khurana, 2008; Okafor, 2012; Batsis et al., 2007). This is increasing alongside the high prevalence of obesity. Notably, obesity and diabetes mellitus which has a strong bond with metabolic syndrome has become a burden in the developed countries, increasing their prospects of increases (Ellulu et al., 2014; Buowari, 2013:133). In South Africa, studies conducted across various population settings have shown a high prevalence of METs, ranging from 21.8% to as high as 55.4% (Erasmus et al., 2012; Owolabi et al., 2017b; Peer et al., 2015a; Motala et al., 2011). Several factors associated with the increasing burden of METs include age, gender, income, unemployment (Owolabi et al., 2017b; Peer et al., 2015a; Kaduka et al., 2012; Hajian-Tilaki et al., 2014), obesity, physical inactivity and other unhealthy lifestyle behaviours such as harmful alcohol use and smoking, which is linked to urbanization and globalisation (Peer et al., 2015b; Zhao et al., 2014b; Xi et al., 2013; Hajian-Tilaki et al., 2014).

2.5.6.3 Prevalence of metabolic syndrome among commercial drivers

Metabolic syndrome among commercial taxi drivers is a significant public health concern, considering its effect on the health of drivers and the entire public. Commercial drivers have a high prospect of developing the metabolic syndrome. For instance, Sieber et al. (2014) found 62% of commercial drivers reported having two or more risk factors such as Hypertension, obesity, smoking, high cholesterol, physical inactivity, six or fewer hours of sleep daily. In a systematic review among commercial truck drivers, it was found that drivers have a high prevalence of risk factors of the metabolic syndrome which fell within the range of a 19–74% prevalence of abdominal obesity, overweight and obesity (23–53%) and (15–70%) respectively, hypertension (5–48%) dyslipidemia (7–46%) and prevalence of diabetes (1–22%) (Erin Mabry et al., 2016:413). The most prominent risk factor of METs among commercial drivers is abdominal obesity, one of the strongest risk factors of the metabolic syndrome (Erin Mabry et al., 2016:420).

Metabolic syndrome is prevalent among commercial drivers country-wide .However, such studies among commercial drivers are scarce in Africa. Among countries that have recorded the prevalence of metabolic syndrome are Iran, USA, Hong Kong, Taiwan, Brazil and Korea. As documented in Iranian studies there is a high prevalence of the metabolic syndrome among commercial drivers. Ebrahimi et al. (2016), reported using three different criteria according to ATP III, IDF, and AHA, the prevalence rate of metabolic syndrome among the drivers was 26.1%, 35.2% and 31.6% respectively. Mohebbi et al. (2010:37), who presented 32.4% commercial drivers with metabolic syndrome using ATP III criteria, indicated that overtime driving increases the odds of drivers developing metabolic syndrome. Also using ATP III, about thirty-six percent of commercial drivers were reported to have metabolic syndrome in Iran with abdominal obesity being the highest prevalence risk of METs (Saberi et al., 2011). In a larger population study using IDF criteria, Mohebbi et al. (2012) also reported a crude prevalence rate of 30.5% and an age adjusted rate of 32.4%. The prevalence rate of metabolic syndrome differs is based on different regions within a region. However, a high prevalence of the metabolic syndrome among commercial drivers in the country was ascertained, with no wide margins. Apparently, metabolic syndrome is high among commercial drivers in both the LMICs and in the HICs. Studies reported a prevalence rate of metabolic syndrome in Taiwan as 43.1% (Chen et al., 2013), Hong Kong, 26.8% (Siu et al., 2012:62), UK, 34% (Varela-Mato et al., 2017), South Korea, 49.9% (Shin et al., 2013) and 29.9% in USA (BC Legal News, 2017) for HICs. In LMICs, Cavagioni et al. (2008), reported that 24% of commercial drivers in Brazil have metabolic syndrome, also, there is a reported prevalence in Iran.

The lifestyle pattern of commercial drivers is typically characterised by risk factors such as irregular sleeping patterns and hours, a sedentary lifestyle, unhealthy dietary practices as well as physical and mental stress. These put commercial drivers at a high-risk of cardio-metabolic disorders and METs. Some of the associated risk factors for METs among commercial drivers according to the literature were said to be obesity, smoking, age, diabetes, hypertension, driving experience and duration (Mansur et al., 2015; Saberi et al., 2011; Mohebbi et al., 2012). Abdominal obesity which is the most prioritized component of METs has also been shown to be high among commercial drivers (Shin et al., 2013; Sena et al., 2008; Montazerifar et al., 2016) and is the most common risk factor for METs (Erin Mabry et al., 2016; Mohebbi et al., 2012). Conversely, high triglyceride and low HDL-C levels were found to be the prominent risk factors for METs among commercial drivers (Saberi et al., 2011). Apart from an increased risk for chronic diseases, METs has also been documented as associated with sleep apnea; one of the leading causes of road crashes (Mansur et al., 2015). However, while several studies on METs are conducted among various population groups in South Africa (Kruger & Nell, 2017; Saloojee et al., 2016; Owolabi et al., 2017b; Motala et al., 2011; Muluvhu et al., 2014; De Lucia Rolfe et al., 2015; Peer et al., 2015a), where none exist on commercial drivers; an economically important sub-group, providing a fundamental role in the transport industry by virtue of the services they provide. Seemingly, their physical biomarkers for health risk assessment have not been documented in South Africa as elsewhere.

In summary, the burden of cardio-metabolic risk factors persist and keeps on increasing across various regions. Drivers in particular are at great risk as a result of the nature of their occupation, yet with limited time to access healthcare. A high prevalence of cardio-metabolic risk factors is found among commercial drivers. This poses significant threat on their health as well as that of the entire population, considering the significant role they play in the society.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter provides a perspective of the design and methodologies used for the study. This section describes the research setting, research design, population, sampling of the study. Also, the research instruments, validity and reliability, pilot study, data collection procedure, ethical considerations and analysis.

3.2 DESIGN OF THE STUDY

A cross-sectional study, quantitative, descriptive research approach was adopted to screen for cardio-metabolic risk factors among commercial drivers in Buffalo City Metropolitan Municipality (BCMM), East London, South Africa.

3.3 SETTING OF THE STUDY

This was a cross-sectional study involving 403 commercial taxi drivers selected across different taxi ranks in BCMM, Eastern Cape Province of South Africa. Buffalo City Metropolitan Municipality is one of the eight districts in the Eastern Cape Province. It is made up of some towns in the Eastern Cape which include East London, Bisho, King Williams Town and Mdanstane and it is largely populated (85.2%) by Black South Africans. The transport industry makes up 12% of its economic sector (Main, 2017). A taxi industry is the most readily available mode of transportation for the public, covering both short and long distance trips, through urban, rural and intercity journeys. The taxi rank is the station where taxis collect and drop passengers. It is situated at strategic centres, close to shops, offices and institutions in the city which are easily accessible to all.

The taxi industry is a critical pillar of the South African public transport sector. Currently, the taxi industry is the most available mode of transport to the largest number of transport ‘customers’ across a variety of income and need segments. As such, taxis carry 65% of the 2.5 billion annual passenger trips in the urban environment and serve as the base-load public transport carrier, both during peak and off-peak transport times. Presently, the taxi fleet consists of approximately 130 000 vehicles operating with legal transport permits. Approximately 95 000 are used for short and medium distance trips in the urban environment, and the remainder for rural and inter-city transport.

The five taxi associations (MELTA, ELTA, META, ELDISTA and UNCEDO) operating under the umbrella of SANTACO in BCMM were considered for the study at ten conveniently selected taxi ranks. The ten taxi ranks were Gillwell taxi rank, Shoprite taxi rank, Mdanstane local taxi rank, Highway mdanstane, Ok taxi rank, old boxers' taxi rank, Vincent taxi rank, St. Johns taxi rank, Rhino taxi rank and Quigney taxi rank which are all in BCMM.

3.4 TARGET POPULATION

The target population for the study was minibus taxi drivers from the age of 20 years and older operating at the taxi ranks in Buffalo City Metropolitan Municipalities, East London and Mdanstane.

3.4.1 Inclusion Criteria

Participants were included in the study if they were commercial drivers, 20 years and above; a member of a recognized taxi association; worked for at least six months and had fasted eight hours prior to the day of data collection.

3.4.2 Exclusion Criteria

Participants were excluded from the study if they had less than six months experience as minibus taxi driver, if they were on any drugs that could cause weight gain e.g anti-retroviral, if ill or disabled in such a way that obtaining anthropometric measurements was difficult.

3.5 SAMPLE AND SAMPLING TECHNIQUE

A convenience sample of 403 drivers were included in the study. Numbers of registered vehicles were used to determine the number of minibus taxi drivers. According to the statistics retrieved from Eastern Cape Department of Transport, the numbers of registered commercial vehicles in East London, operating under East London district Taxi Association (ELDISTA) are 315 and

East London Taxi Association (ELTA) are 765, while the numbers of vehicle registered for Mdanstane includes, Mdantsane East London Districts Taxi Association (MELTA) are 1514, Mdantsane East London Taxi association (META) 288 and Mdantsane UNCEDO service Taxi Association (UNCEDO) are 677; these totals up to 3,559 vehicles, making the numbers of vehicle drivers in East London and Mdantsane. The sample size for this study was based on the estimated number of drivers in the district. The estimated number of commercial taxi drivers was approximately 4000 (Eastern Cape Department of Transport).The appropriate sample size was determined using the Creative Research Systems sample size calculator (Creative Research Systems, 2015) at a confidence level of 95%. The required sample size was 351 participants. However, 403 drivers recruited from ten conveniently selected taxi ranks across the district were included in the study. All commercial taxi drivers who were available, willing and met the inclusion criteria were recruited into the study. This study was conducted in March-April, 2017.

3.6 DATA COLLECTION INSTRUMENT

An extract of the World Health Organisation STEPwise approach questionnaire was used for collecting demographic and socio-behavioural data (WHO, 2011b: 15)(ANNEXURE 1). It is the recommended framework by the World Health Organization for risk factors and non-communicable diseases surveillance for its member countries. It has been used by various countries in all the regions of the world (WHO, 2015i). The questionnaire was adapted to suit the local context.

The WHOSTEPwise instrument is made up of three models (Core, Expanded and Optional) and the three steps are:

Step 1: This involves self-reported information. Close ended questions were asked in order to obtain information on socio-demographic data such as lifestyle behaviours, dietary pattern, smoking, alcohol use, physical activities and fruits and vegetable consumption.

Step 2: This comprises objective reports obtained through physical and anthropometric measurements which were weight, height, hip circumference, waist circumference and blood pressure measurements. Derived measurements of obesity and abdominal obesity were calculated from the anthropometric measurements, these are body mass index, waist-to-hip ratio and waist-height-ratio.

Step 3: The third step involved objective information obtained through biochemical measure which is the fasting blood glucose.

3.7 VALIDITY AND RELIABILITY

The WHO STEPs tool used in the study is a validated and reliable research instrument used in different regions and countries (Virgin Island Ministry of Health and Social Development, 2010; Asgari, Mirzazadeh & Heidarian 2007; Riley, Guthold, Cowan, Savin, Bhatti, Armstrong, & Bonita, 2016), prepared to suit various settings.

3.7.1 Selection and Training of Research Assistants

The study involved ten research assistants. The research assistants were qualified nurses and students in health care related fields who were currently in the tertiary institutions and who could speak either Xhosa or Afrikaans. They were enlightened about the study and trained by the researcher and the supervisor (Prof DT Goon), a medical doctor and other experts in the field. The training was organised for the individual research assistant understanding of the questionnaires and enabling of accurate anthropometric, blood pressure and blood glucose measurements. Each person was allocated to a specific role to enhance consistency of the measurement and prevent role conflict. The research assistants were trained to work as a team.

3.7.2 Pilot Study

A pilot study was conducted prior to the main data collection. This was done in order to test the tool for logistical, administrative and measurement procedures on 20 commercial minibus drivers who were not a part of the main study. The pilot study also determined the effectiveness of the research assistants and the suitability of the instrument in the research settings. To validate the questions to meet the purpose of the study, it was reviewed and adjusted based on relevant suggestions and contributions. The reliability of the tool had already been established in various studies and at different settings (Virgin Island Ministry of Health and Social Development, 2010; Asgari, Mirzazadeh & Heidarian 2007; Riley, Guthold, Cowan, Savin, Bhatti, Armstrong, & Bonita, 2016). No significant changes was made to the questionnaire.

3.8 DATA COLLECTION PROCEDURE

3.8.1 Procedure for Anthropometric Measurements

Anthropometric measurements were taken according to the International Society for the Advancement of Kinanthropometry recommendations (Marfell-Jones et al., 2006). The procedure was explained to the participant before measurement.

3.8.1.1 Body weight

Body weight was measured in light clothes to the nearest 0.01kg in the standing position using a SECS Scale (without shoes) (Marfell-Jones et al., 2006).

3.8.1.2 Body height

Height was measured using a standard standiometer while the subject stands with no shoes. Subject will be asked to put both hands by the sides, feet closed to each other and looking straight ahead. Measurement will be taken to the nearest centimeters (without shoes) (Marfell-Jones et al., 2006)..

3.8.1.3 Waist circumference

Waist circumference was measured just between the lowest ribs above the iliac crest according to standardized techniques. Participants were asked to stand erect in a relaxed position with both feet together on a flat surface. Circumferences were measured with a non-elastic tape to the nearest 0.1 cm, in a standing position. One layer of light clothing was used for the measurement. The participant will be relaxed, and the measurements were taken at the end of a normal expiration. Two consecutive measurements were recorded to the nearest tenth of a centimeter; the average of the two measures was used to determine waist circumference for analysis.

3.8.1.4 Hip circumference

Hip measurement was taken at the greatest circumference at the level of greater trochanters (the widest portion of the hip) on both sides. Measurements were made to the nearest 0.1 cm. The participant stood with feet close together, arms at the side and body weight evenly distributed, with light clothing.

3.8.1.5 Neck circumference (NC)

Neck measurement was taken at the midway of the neck, between mid-cervical spine and mid anterior neck. For men with a laryngeal prominence (Adam's apple), measurement was taken just below the prominence. Participant was asked to look straight, with the subjects standing upright with shoulders down, but not hunched. While taking this reading care was taken not to involve the shoulder/neck muscles (trapezius) in the measurement and subjects with any thyroid disorder. Non-stretchable plastic tape was used to take readings. It is a marker of upper body subcutaneous adipose tissue distribution.

3.8.2 Blood pressure measurement

Blood pressure was measured in accordance with standard protocols(Seedat et al., 2014)with a Medic+ Digital Blood Pressure Monitor. Hypertension was defined according to JNC-8 criteria as the average of two systolic blood pressure of $\geq$ 140mmHg and diastolic of $\geq$ 90mmHg or history of hypertension (Bell et al., 2015).

3.8.3 Blood Glucose tests

Fasting blood glucose of each participant was measured with a validated ACCU-CHEK glucose monitoring apparatus in fasting state. Readings were taken to the nearest 0.1mmol/l. Fasting blood glucose of each participant was measured with a validated ACCU-CHEK glucose monitoring apparatus in fasting state.

3.8.4 Derived Measurements

3.8.4.1 Body mass index (BMI)

This was calculated by dividing a person’s weight in kilograms by the square of their height in meters (m^2). It was used to measure overweight and total obesity.

3.8.4.2 Waist-to-Hip ratio (WHR)

This was calculated by dividing the waist circumference by the hip circumference. It was used to measure abdominal fat distribution.

3.8.4.3 Waist-to-height ratio (WHtR)

This was calculated by dividing waist circumference by height. It measures central obesity.

3.8.5 Definition of Risk Factors

3.8.5.1 General obesity

This was defined using Body mass index [BMI], a measure of excess weight; this was used to determine overweight and obesity. Overweight and generalized obesity was defined as BMI of 25.0kg/m^2 – 29.9kg/m while, obesity was defined as BMI of ≥30kg/m^2 (CDC, 2016).

3.8.5.2 Abdominal obesity

Abdominal obesity was defined using four anthropometric indices as follows:

i. Waist circumference (WC): WC of ≥ 94 cm for men and WC ≥80 cm for women (World Health Organization, 2011f).
ii. Waist-to-hip ratio (WHR): WHR of ≥0.90 for men and ≥0.85 for women (World Health Organization, 2008a).
iii. Waist-to-height ratio (WHtR): WHtR of >0.5 will be used to define central obesity (Ashwell et al., 2016).
iv. Neck circumference (NC): NC of >38cm for males and >34cm for females (Aswathappa et al., 2014b).

3.8.5.3 Pre-hypertension and hypertension

Pre-hypertension was defined as systolic blood pressure of 120-139 mmHg and diastolic blood pressure of 80-89 mmHg. Hypertension was defined as the elevation of arterial pressure more than the classified stipulated figures (Giles et al., 2009:611) and this is classified using the updated 2014 eighth Joint national Committee (*JNC-8*) as follows:

Hypertension: systolic blood pressure ≥ 140mmHg and diastolic ≥ 90mmHg or a history of hypertension or anti hypertensive medication use (Bell et al., 2015:4).

3.8.5.4 Pre Diabetes and Diabetes

Pre diabetes was defined as fasting blood glucose between (100 mg/dl to 125 mg/dl) or (5.6mmol/L to 6.9mmol/L)

Diabetes mellitus (DM) was diagnosed if the fasting blood glucose is ≥ 126mg/dl or 7.0mmol/L (American Diabetes Association, 2014).

3.8.5.5 Physical inactivity:

This was define as lack of exercise (Al Tunaiji et al., 2014) i.e. not meeting up to the recommended WHO physical activity of adults aged 18–64 years, of 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity (WHO, 2016).

3.8.5.6 Metabolic syndrome

Metabolic syndrome was defined as having at least three of the following metabolic abnormalities according to the modified National Cholesterol Education's Adult Treatment Panel III (NCEP-ATP III): elevated fasting blood sugar ≥ 100 mg/dl (5.6mmol/l), high blood pressure: systolic blood pressure ≥ 130mmHg, diastolic blood pressure ≥ 85 mmHg or on current treatment for high blood pressure, waist circumference: ≥94 cm in men and ≥ 88 cm in women, elevated triglycerides ≥ 150mg/dl (1.7mmol/l), low HDL; <40 mg/dl (1.03mmol/l) in men and <50mg/dl (1.3mmol/l) in women (Grundy et al., 2005;Grundy et al., 2004).

3.9 ETHICAL CONSIDERATIONS

The research proposal was submitted to the University of Fort Hare Ethics Committee for ethical approval (ANNEXURE 2). Permission was sought from the Eastern Cape Provincial Department of Health (ANNEXURE 3), Department of Transport, the association of commercial drivers in BCMM and at each taxi rank. The participants were informed about the purpose of the research study and to consent voluntarily with the understanding of the research, they were also informed about withdrawal from the study whenever they wish without penalty. An informed consent form was issued for non-verbal consent and verbal consent was obtained before the commencement of data collection. Participants were assured of a minimum level of inconvenience and confidentiality; participant's privacy was respected and protected.

3.10 DATA ANALYSIS

Data were captured on measurement form, checked for completeness and accuracy in terms of demographic information and measurements. Data were analysed using a combination of descriptive and inferential statistics. Descriptive statistics (frequency percentages, mean and standard deviation) were used for categorical variables. Inferential statistics (bivariate and multivariate logistic regression) were used to identify the significant associated risk factors of obesity, hypertension, diabetes metabolic syndrome and their 95% confidence interval (95% CI). The logistic regression was also adjusted for confounding factors to determine which of the demographic variables (sex, age, level of education, marital status, income, driving history) and behavioural lifestyle variables (smoking, alcohol consumption, physical inactivity, dietary intake) independently and significantly predict the risk of developing CMRFs in the participants.

The proportions of participants who were abdominally obese were calculated using four indices. Association and agreements among anthropometric indices were examined using pairwise correlations and kappa statistics, respectively. Discordances between the indices were analysed using cross-tabulations.

A p-value of < 0.05 was considered statistically significant. All statistical analyses were performed with the Statistical Package for Social Sciences (SPSS) version 22.0 for windows (SPSS Inc., Chicago, IL, USA).

CHAPTER FOUR

RESULT AND DISCUSSION

This chapter presents the results of the study and a discussion of the results. The results are presented in tables, charts and figures.

4.1 DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS

A total of 403 participants were included in the analysis. Larger percentages of the participants were males (98.8%). The mean age of participants was 43.3 (±12.5), age range from 20 to 74 years. The majority of the participants were black (93.3%), had at least grade 8 level of education (73.7%), married (47.1%) and single (45.5%) (Table 4.1) and the majority (47.1%) of the participants have been driving for more than 10 years (Table 4.1.1)

Table 4.1: Demographic characteristics of the participants

Variables	Frequency (n)	Percentage (%)
Sex		
Male	398	98.8
Female	5	1.2
Age (years)		
20 to 30	72	17.9
31-40	103	25.6
41-50	105	26.1
Above 50	123	30.5
Level of education		
No formal education	15	3.7
Grade 1-7	59	14.6
Grade 8-12	297	73.7
Tertiary	32	7.9
Race		
Black	376	93.3
Coloured	27	6.7
Marital Status		
Married	190	47.1
Separated	8	2.0
Divorced	16	4.0
Widowed	6	1.5
Single	183	45.4
Duration of driving		
<2 years	30	7.4
2-5 years	103	25.6
6-10 years	80	19.9
> 10 years	190	47.1

Table 4.2: Characteristics of study population

Variables	Median (Standard deviation) n=403
Age	43.3 (12.5)
Days spent driving in a week	6.4 (0.7)
Minutes spent driving in a typical day	10.8 (2.9)
Hours of sleep in a typical day	7.2 (1.6)
Monthly earning	3650.1 (2503.7)

4.2 BEHAVIOURAL MEASUREMENTS OF PARTICIPANTS

This aspect describes the behavioural characteristics of the respondents. Behavioural characteristics include tobacco use, alcohol consumption as well as fruit and vegetable consumption.

4.2.1 Prevalence of tobacco use

As shown in the Table 4.3, 45% of the participants have a prior history of smoking, while 30% are current smokers , 29% of the participants (97% of current smokers) smoke daily taking on average 9.2 (SD ± 6.0) sticks of tobacco product. The mean age when participants started smoking was 18 (SD ± 4.7) years. Daily smokers took on average 9.2 (SD ± 6.0) sticks. Ninety seven percent of current smokers use manufactured cigarette and hand rolled cigaretteusers comprised (2.2%), while the average stick per day was 5.9 (SD ± 3.0) sticks.

The mean age of smoking initiation was 18 (SD ± 4.7) years. About 20.0% (79) participants had stopped smoking more than 8 years ago. The average number of age when participants had quit smoking was 15.0 (± 9.2) years.

Table 4.3: Smoking and alcohol consumption

Questions	Yes n (%)	No n (%)
Have you ever consumed tobacco products	199 (49)	204 (51)
Do you currently smoke?	121 (30)	282 (70)
Do you smoke daily?	117 (97)	4 (3.0)
Have you ever consumed alcohol?	242 (60)	161 (40)
Have you consumed alcohol in the past 12 months?	165 (41)	238 (59)
Have you consumed alcohol in the past 30 days?	149 (37)	254 (63)

n= Number; %= Percentage

4.2.2 Prevalence of alcohol consumption

Table 4.3 shows the previous history of participants (60%) that has ever consumed alcohol. Forty one percent of the participants have consumed alcohol in the past 12 months with 72.5% frequency of 1-2 days in a week (figure 4.1). The prevalence of alcohol consumption among the participants was 37% those who have consumed alcohol within the past thirty days, with an average bottle of 10 (±9.3) bottles per week ranging from 1-50 bottles.

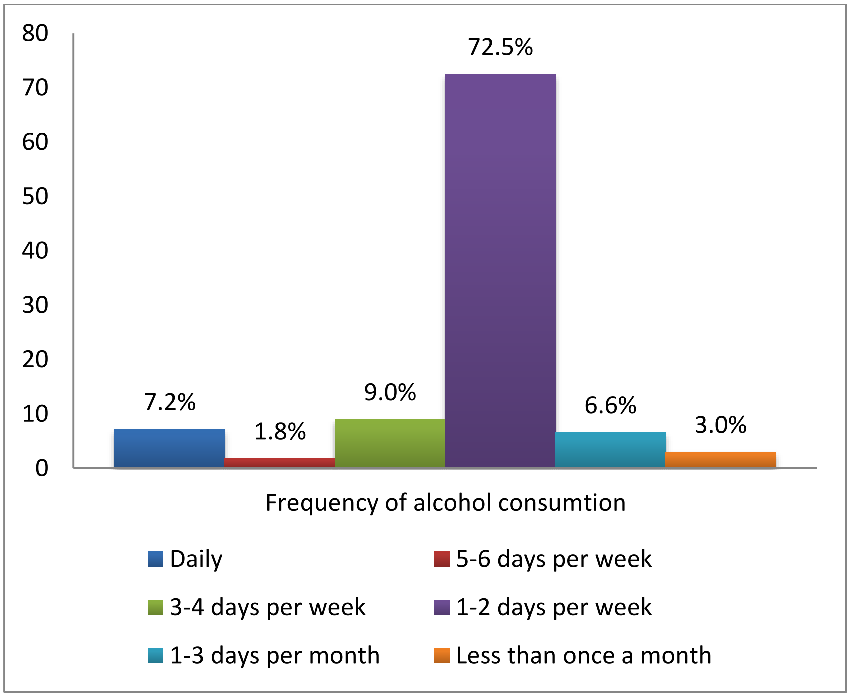


Figure 4.1: Frequency of alcohol consumption

4.2.3 Binge drinking

Figure 4.2 shows the prevalence of participants who binge drink (consumption of four or more drinks for women and five or more drinksfor men at one sitting). Ninety-six participants (24%) indulged in binge drinking.

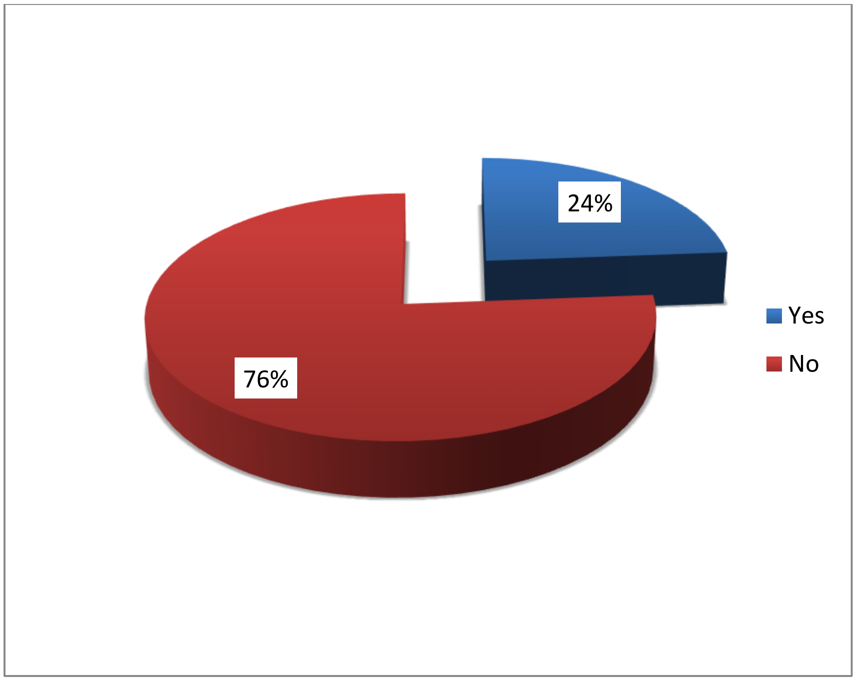


Figure 4.2: Prevalence of binge drinking

4.2.4 Dietary pattern

Table 4.4 shows that, majority of the participants (33.7%) reported that they often eat breakfast at home, (31.5%) of the participant do not eat breakfast at home, while (17.9%) and (16.9%) sometimes or rarely ate breakfast at home, respectively. About 52.9% of the participants often buy food from vendors, while 32.3% reported that they do sometimes buy food from vendors. Forty-four percent of the participants sometimes buy food from the fast food outlets and 13.2% often patronized the fast food. Most of the participants reported taking fried food (41.9%), while 36.0% do so often. Most of the participants (67.0%) often take sweet drinks.

Table 4.4: Dietary pattern

Variables	Never n (%)	Rarely n (%)	Sometimes n (%)	Often n (%)
How often do you eat breakfast at home?	127 (31.5)	68 (16.9)	72 (17.9)	136 (33.7)
How often do you buy food from the vendors?	23 (5.7)	37 (9.2)	130 (32.3)	213 (52.9)
How often do you buy fast food?	30 (7.4)	142 (35.2)	178 (44.2)	53 (13.2)
How often do you eat fried food?	16 (4.0)	73 (18.1)	145 (36.0)	169 (41.9)
How often do you take sweet drinks?	17 (4.2)	33 (8.2)	83 (20.6)	270 (67.0)

n= Number; %= Percentage

4.2.5 Fruit and vegetable consumption

As shown in the Table 4.5, 49.9% and 48.4% eats vegetables and fruits, respectively for 6-7 days in a week. Only a few of the participants do not eat fruit and vegetables (Table 4.5).

Table 4.5: Fruit and vegetable consumption

Questions	Number of days			
	0 n (%)	1-3 n (%)	4-5 n (%)	6-7 n (%)
How many times do you eat vegetables in a week?	5 (1.2)	118 (29.3)	79 (19.6)	201 (49.9)
How many times do you eat fruit in a week?	3 (0.7)	113 (28.1)	92 (23.8)	195 (48.4)

n= Number; %= Percentage

4.2.6 Physical activity participation

As indicated in Figure 4.3, the participation of participants in physical activity was low. The Majority (82%) of the participants were physically inactive.

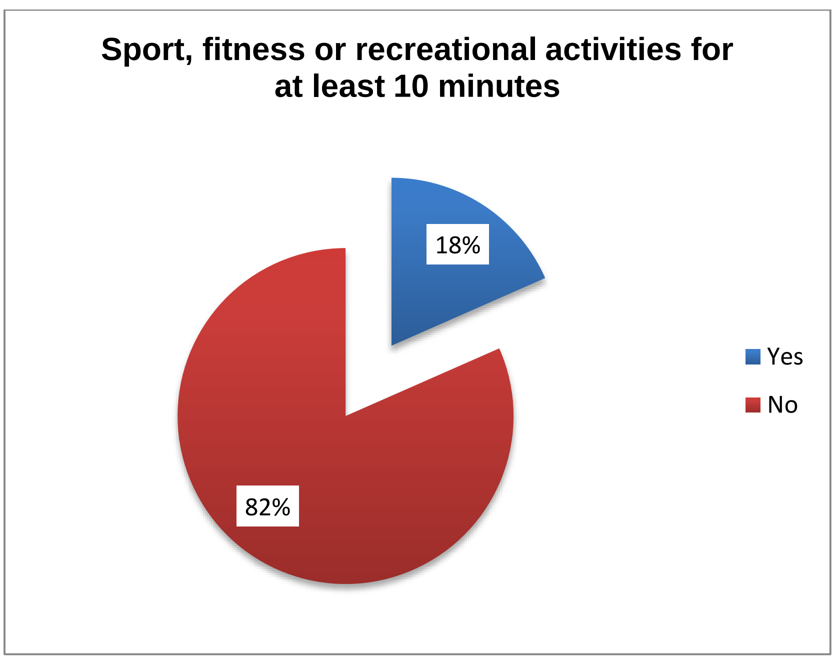


Figure 4.3: Physical activity participation

4.3 HISTORY TAKING

4.3.1 Blood Pressure

The majority of the participants (62.2%) have checked their blood pressure once and 21.1% have been diagnosed with high blood pressure while 11.7% reported being on treatment for blood pressure. (Table 4.6).

Table 4.6: History of raised blood pressure

Variables	Yes n (%)	No n (%)
Have you ever had your BP measured?	250(62.2)	153(38.0)
Have you ever been diagnosed of BP?	85(21.1)	318(78.9)
Have you been told in the past 12 months that you raised BP?	63(15.6)	340(84.4)
In the past weeks, have you taken any drugs for raised BP prescribed by a doctor or other health worker?	47(11.7)	356(88.3)
Have you ever seen a traditional healer for a raised blood pressure or hypertension?	4(1.0)	399(99.0)
Are currently taking any herbal or traditional remedy for your raised blood pressure?	4(1.0)	399(99.0)

n= Number; %= Percentage

4.3.2 Blood sugar

Less than half of the participants (43.9%) have ever checked their blood sugar level, 11.0% had ever been diagnosed with high blood sugar and 7.4%were on medication for treatment; and 4.0% were using insulin for treatment (Table 4.7).

Table 4.7: History of raised blood sugar

Variables	Yes n (%)	No n (%)
Have you ever had your blood sugar measured?	177(43.9)	226(56.1)
Have you ever been diagnosed of raised blood sugar?	43(10.7)	360(89.3)
Have you been told in the past 12 months that you have a raised blood sugar?	33(8.2)	370(91.8)
In the past weeks, have you taken any drugs for raised blood sugar prescribed by a doctor or other health worker?	30(7.4)	373(92.6)
Are you currently taking insulin for diabetes prescribed by a health worker?	16(4.0)	387(96.0)
Have you ever seen a traditional healer for a raised blood sugar?	3(0.7)	400(99.3)
Are currently taking any herbal or traditional remedy for your raised blood sugar?	2(0.5)	401(99.5)

n= Number; %= Percentage

4.3.3 Lifestyle advice

About fourteen percent of the participants were told to reduce salt and fat in their diet, 11.9% and 10.7% had been told to lose weight or maintain a healthy body weight and to exercise, respectively (Table 4.8).

Table 4.8: Lifestyle advice

During the past 3 years, has a health worker advised you to the following:	Yes n (%)	No n (%)
Quit using tobacco or don't start?	33 (8.2)	370 (91.8)
Reduce salt in your diet?	56 (13.9)	347 (86.1)
Eat at least 5 servings of fruits and vegetables daily?	65 (16.1)	338 (83.9)
Reduce fat in your diet?	56 (13.9)	347 (86.1)
Start or do more physical activity?	43 (10.7)	360 (89.3)
Maintain a healthy body weight or lose weight	48 (11.9)	355 (88.1)

n= Number; %= Percentage

4.4 OVERWEIGHT AND OBESITY

4.4.1 Prevalence of overweight and obesity

As shown in Figure 4.4, the prevalence of overweight and obesity among the participants was 34% and 37%, respectively. Less than one third (27%) of the participants had normal weight. About 20% of participants had class 1 obesity 12% had class 2 obesity (BMI 35-39.99 kg/m), while 5% had class 3 obesity (BMI ≥40 kg/m).

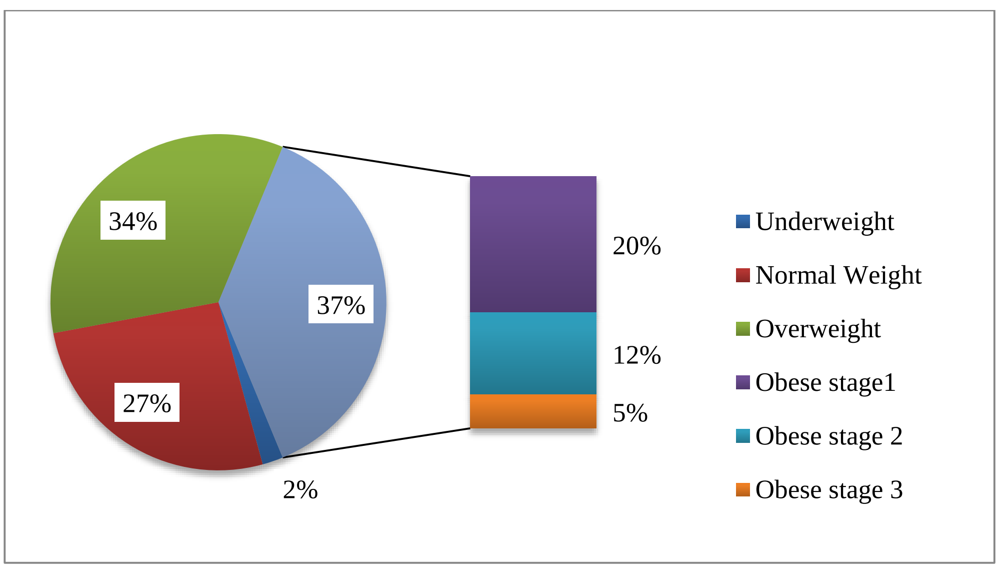


Figure 4.4: Prevalence of obesity

4.4.2 Obesity and associated risk factors

Table 4.9 shows the association between obesity, demographic factors, behavioural and cardiovascular risk factors. Age, marital status, period of driving, hypertension and diabetes were significantly associated with obesity. The prevalence of obesity increased from age 35years, reaching peak at age 66years (60.0%). Participants who do not smoke (44.6%), never took sweetened beverages (64.7%) and those who had been driving for more than five years (42.6%) had a higher prevalence of obesity compared to smokers (30.2%), those who often drink sweetened beverages (34.8%) and those driving for less than five years (27.1%). Obesity was found to be higher among participants who had hypertension (50.0%) and diabetes (49.2%) compared to those who do not, 21.1% and 35.3%, respectively.

Table 4.9: Bivariate analysis showing factors associated with obesity

Variables	Obese n (%)	Not Obese n (%)	p-value
Age(years)			
25 and below	2 (6.1)	31(93.9)	
26-35	30(31.9)	64(68.1)	
36-45	39(37.5)	65(62.5)	
46-55	48(50.0)	48(50.0)	
56-65	26(39.4)	40(60.6)	
66 and above	6(60.0)	4(40.0)	0.000
Marital status			
Married	83(43.7)	107(56.3)	0.000
Separated	2(25.0)	6(75.0)	
Divorced	6(37.5)	10(62.5)	
Widow	2(33.3)	4(33.7)	
Single	58(31.7)	125(68.3)	
Level of education			
No formal school	7(46.7)	8(53.3)	0.286
Grade 1-7	26(44.1)	33(55.9)	
Grade 8-12	110(37.0)	187(63.0)	
Tertiary	8(25.0)	24(75.0)	
Income			
2000 and below	63(37.5)	105(62.5)	0.537
Above 2000	88(37.5)	147(62.6)	
Race			
Black	140(37.2)	236(62.8)	0.432
Coloured	11(40.7)	16(59.3)	
Period of driving			
5 years and below	36(27.1)	97(72.9)	0.002
Above 5years	115(42.6)	155(57.4)	
Did you ever smoke any tobacco product			
Yes	60(30.2)	139(69.8)	
No	91(44.6)	113(55.4)	0.002
Have you ever consumed alcohol			
Yes	89(37.1)	151(62.9)	
No	62(38.0)	101(62.0)	0.464
How often do you take sweet drinks			
Never	11(64.7)	6(35.3)	0.043
Rarely	10(30.3)	23(69.7)	
Sometimes	36(43.4)	47(56.6)	
Often	94(34.8)	176(65.2)	
Do you do any sports, fitness or recreational activities, for at least 10minutes?			
Yes	22(29.7)	52(70.3)	
No	129(39.2)	200(60.8)	0.081
Hypertension			
Yes	114 (50.0)	114 (50.0)	0.000
No	37 (21.1)	138 (78.9)	
Diabetics			
Yes	31 (49.2)	32 (50.8)	0.026
No	120 (35.3)	220 (64.7)	

n= Number; %= Percentage

4.4.3 Binary logistic regression showing determinants of obesity

In the logistic regression model analysis, after adjusting for confounders, only age, hypertension and not smoking were significant and independent predictors of obesity. Participants who were above 35 years old and those who do not smoke were twice more likely to be obese than those with an age lower than 35 years and smoking. Hypertensive participants were four times more likely to be obese than those were not (Table 4.10).

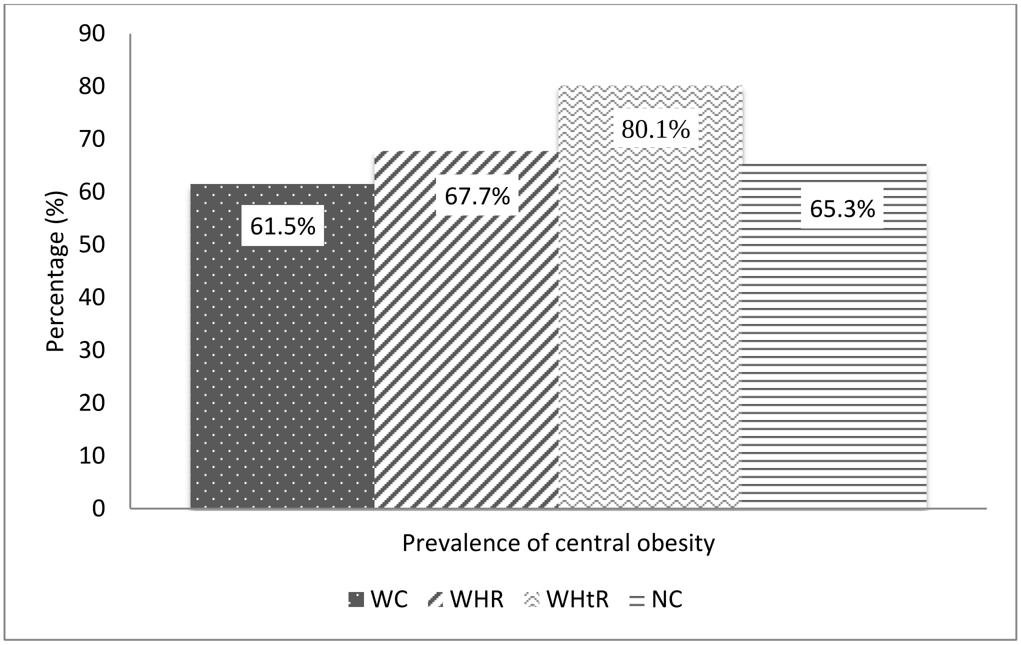
Table 4.10: Binary logistic regression showing determinants of obesity

Variables	Beta	Wald	Odd Ratio (CI)	p-value
Non-Smokers	0.70	9.76	2.0 (1.3-3.1)	0.002
Smokers (reference)				
Age above 35	0.50	3.84	1.6 (1.0-2.7)	0.05
35 years and below (reference)				
Hypertensive	1.28	28.95	3.6 (2.3-5.7)	<0.001
Not hypertensive (reference)				

CI= Confidence interval

4.4.4 Prevalence of abdominal obesity using four anthropometric indices

The highest prevalence rate of AO was observed in the waist-to-height ratio (WHtR) index (80.1%). The prevalence rates by WC, WHR and NC were 61.5%, 67.5% and 65.3%, respectively (Figure 4.5).



WC=Waist circumference; WHR= Waist-to-hip ratio; WHtR=Waist-to-height ratio; NC =Neck circumference
Figure 4.5: Prevalence of abdominal obesity using four anthropometric markers

4.4.5 Correlations among anthropometric markers of cardio-metabolic diseases

There exists a positive correlation among the four anthropometric markers of cardio-metabolic conditions. The strongest correlations were between WHR and WC (>0.64); and WHTR and WC (>0.62). The weakest correlation was between NC and WHR (>0.35), and NC generally had lower correlation with the other anthropometric indices (Table 4.11).

There exists a good agreement between WC and WHR. Also, a moderate agreement exists between WC and WHtR, WC and NC, WHR and WHtR, and WHtR and NC. However, there was fair agreement between WHR and NC (Table 4.12).

Table 4.11: Correlations among anthropometric markers of cardio-metabolic diseases

	WHTR	WHR	NC	WC
WHTR	1	.595**	.440**	.628**
WHR	.595**	1	.355**	.644**
NC	.440**	.355**	1	.516**
WC	.628**	.644**	.516**	1

**. Correlation is significant at the 0.01 level (2-tailed)' WC=Waist circumference; WHR=Waist-to-hip ratio; WHtR=Waist-to-height ratio; NC=Neck circumference

Table 4.12: Cohen's Kappa measure of agreement among anthropometric markers for classifying obesity

Variables	Central obesity n (%)	Cohen's kappa coefficient	Strength of agreement
WC-WHR	227(91.5)	(*k=0.64*)	Good
WC-WHtR	248 (100.0)	(*k=0.57*)	Moderate
WC-NC	210 (84.7)	(*k=0.51*)	Moderate
WHR-WHtR	263 (96.7)	(*k=0.56*)	Moderate
WHR-NC	210 (76.9)	(*k=0.35*)	Fair
WHtR-NC	244 (75.5)	(*k=0.41*)	Moderate

WC=Waist circumference; WHR=Waist-to-hip ratio; WHtR=Waist-to-height ratio; NC=Neck circumference; n= Number; %= Percentage

4.4.6 Abdominal obesity and cardio-metabolic risk factors

The analysis of the relationships between each of the four anthropometric indices with hypertension and diabetes (Table 4.13) indicates that the prevalence of above normal body composition for participants with hypertension were 71.0%, 65.9%, 63.2% and 66.5% by WC, WHR, WHtR and NC, respectively. However, lower prevalence of above normal body composition for participants with diabetes were observed as 20.6%, 19.4%, 17.0% and 18.6% by WC, WHR, WHtR and NC, respectively.

Table 4.13: Association between abdominal obesity and cardio-metabolic risk factors

Anthropometric indices	Diabetes n (%)	p-value	Hypertension n (%)	p-value
Waist circumference				
Normal	12(7.7)	<0.001	52(33.5)	<0.001
Obese	51(20.6)		176(71.0)	
Waist-to-hip ratio				
Normal	10(7.7)	0.001	48(36.9)	<0.001
Obese	53(19.4)		180(65.9)	
Waist-to-height ratio				

Normal	8(10.1)	0.086	24(30.4)	<0.001
Obese	55(17.0)		204(63.2)	
Neck circumference				
Normal	14(10.0)	0.015	53(37.9)	<0.001
Obese	49(18.6)		175(66.5)	

n= Number; %= Percentage

4.4.7 Logistic regression showing predictors of cardio-metabolic risk factors

After adjustment for age and sex, WC was a stronger predictor of hypertension and diabetes, with odds ratio of 3.7 (95 % CI: 2.3-6.1 and 3.1 (95 % CI: 1.6-6.0), compared to NC, with odds ratio of 1.7 (95 % CI: 1.1-2.8) (Table 4.14).

Table 4.14: Logistic regression showing predictors of cardio-metabolic risk factors

	Hypertension			Diabetics		
Variables	Wald	OR(95%CI)	p-value	Wald	OR(95%CI)	p-value
WC >94cm for men or >80cm for women	28.168	3.7 (2.3-6.1)	<0.001	11.035	3.1(1.6-6.0)	0.001
Reference)		1				
NC >38cm for men or >34 for women	4.599	1.7 (1.1-2.8)	0.032			
Reference		1				

WC=Waist circumference; NC=Neck circumference

4.5 PRE-HYPERTENSION AND HYPERTENSION

4.5.1 Prevalence of pre-hypertension and hypertension

As shown in Figure 4.6, systolic blood pressure (SBP) was classified into normal, pre-hypertension and hypertension. Forty seven percent of the participants had systolic blood pressure (≥ 140mmHg) while 44% of the participants had systolic pre hypertension of (SBP= 120-139mmHg).

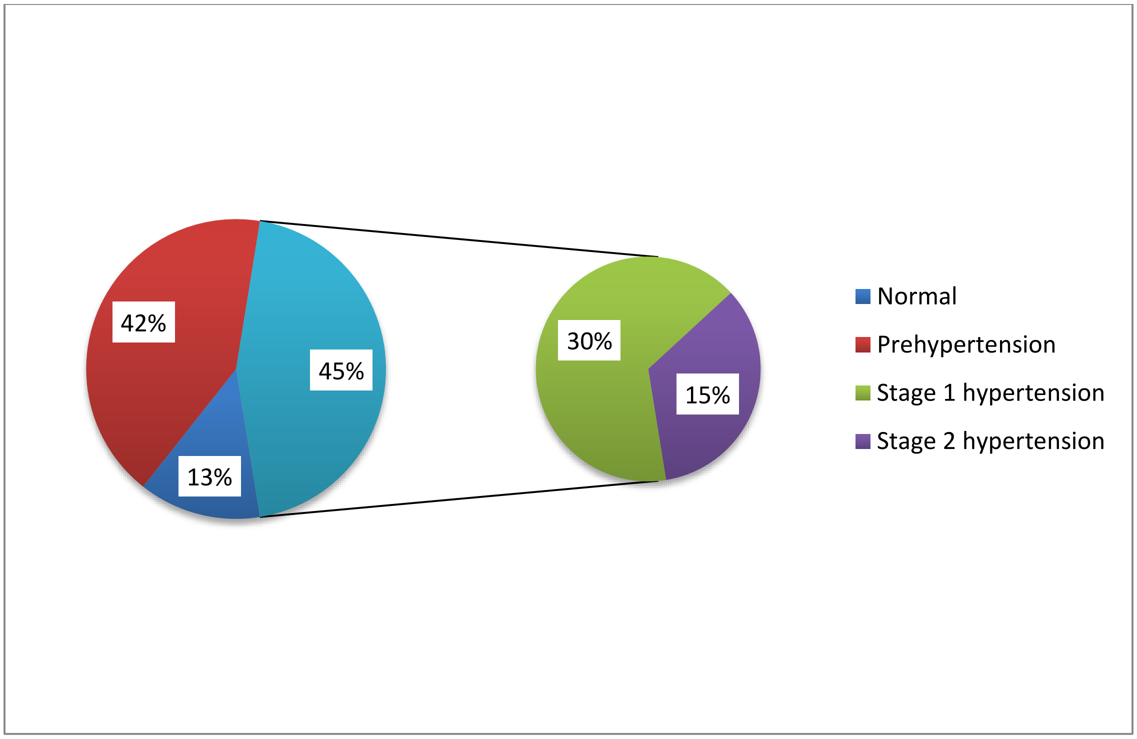


Figure 4.6: Prevalence of systolic pre-hypertension and hypertension.

The prevalence of diastolic pre-hypertension (DBP= 80-89mmHg) was found to be (29%) while diastolic hypertension (DBP ≥90mmHg) is (43%) among the participants (Figure 4.7).

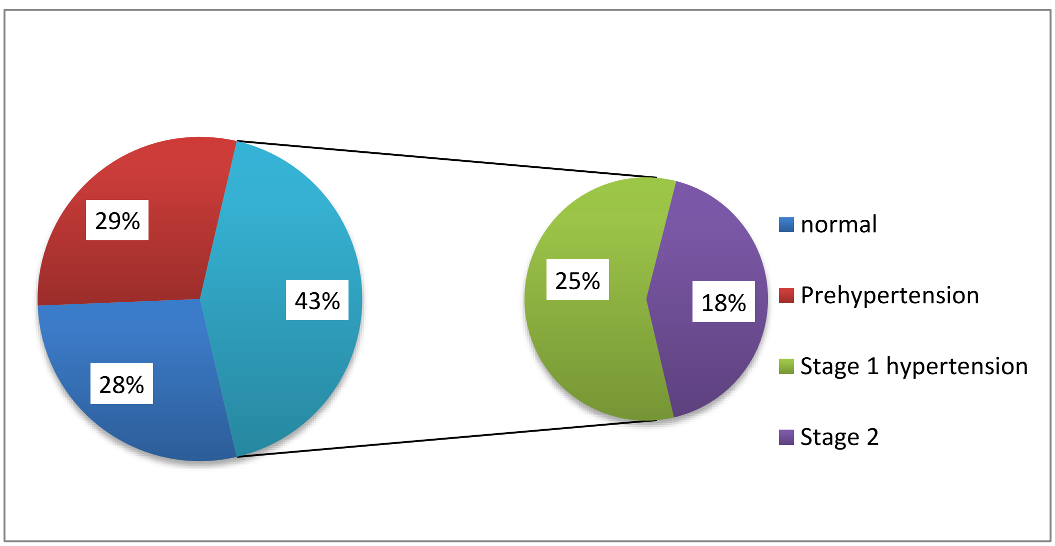


Figure 4.7: Prevalence of diastolic pre-hypertension and hypertension

More than half of the participants (57%) had hypertension with the blood pressure of (SBP ≥ 140) and, or (DBP ≥90) with the history of hypertension and current use of anti-hypertensive medication (Figure 4.8). About 34% of the participants had pre-hypertension (Figure 4.9).

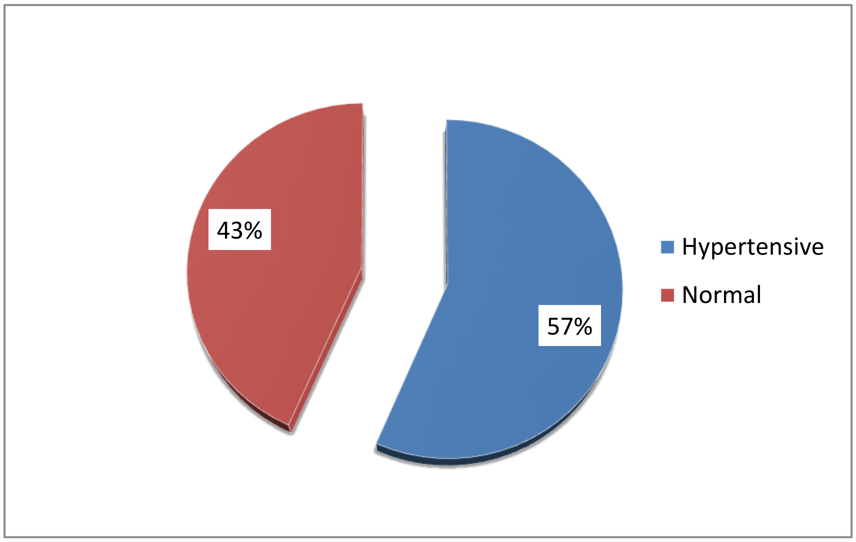


Figure 4.8: Prevalence of hypertension

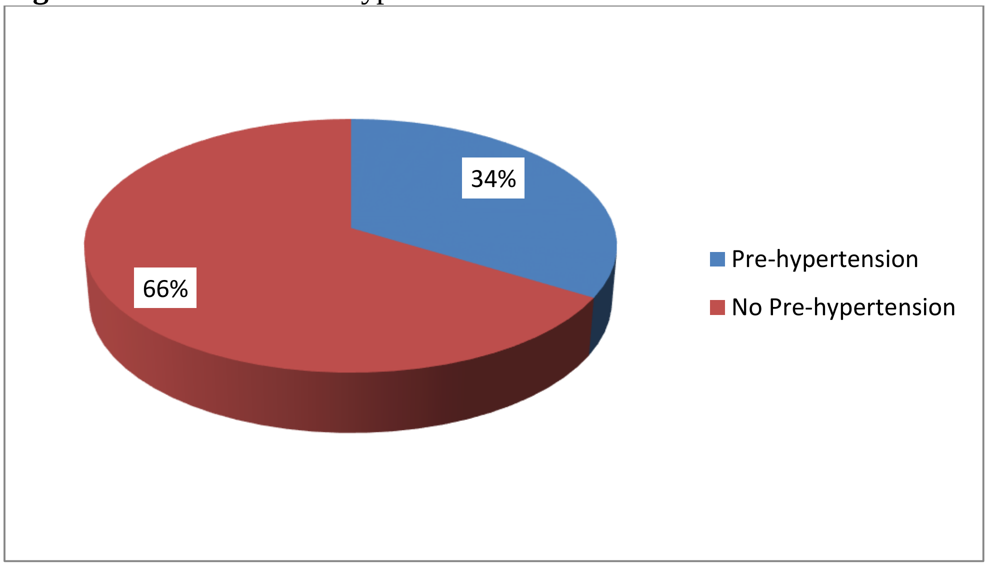


Figure 4.9: Prevalence of pre-hypertension

4.5.2 Hypertension and associated risk factors

As shown in Table 4.15, in the bivariate analysis, age (p=<0.001), marital status (p= 0.002), level of education (p=0.003), duration of driving (p=<0.001), obesity (p=<0.001), alcohol use (p=<0.001), consumption of sweet drinks (p =<0.006), diabetes (p=<0.001), and abdominal obesity (p=<0.001) were significantly associated with the prevalence of hypertension. In the logistic regression, after adjusting for confounding variables, only age, duration of driving, alcohol use, obesity and diabetes were the significant and independent predictors of hypertension (Table 4.15).

Table 4.15: Bivariate analysis showing determinants of hypertension

Variables	HTN n (%)	No HTN n (%)	RR	CI	p-value
Age (years)					
>35	179 (64.9)	97 (35.1)	2.9	1.9-4.5	<0.001
≤ 35	49 (38.6)	78 (61.4)			
Marital status					
Ever married	140(63.6)	80(36.4)	1.9	1.2-2.8	0.002
Never married	88(48.1)	95(51.9)			
Level of education					
No formal school	12(80.0)	3(20)			0.003
Grade 1-7	44(74.6)	15(25.4)			
Grade 8-12	155(52.2)	142(47.8)			
Tertiary	17(53.1)	15(46.9)			
Income					
2000 and below	99(58.9)	69(41.1)	1.2	0.8-1.8	0.420
Above 2000	129(54.9)	106(45.1)			
Race					
Black	212(56.4)	164(43.6)	0.9	0.4-2.0	0.771
Coloured	16(59.3)	11(40.7)			
Period of driving					
5 years and below	56(42.1)	77(57.9)	2.4	1.6-3.7	<0.001
Above 5years	172(63.7)	98(36.3)			
Smoking					
Yes	115(57.8)	84(42.2)	0.9	0.6-1.3	0.627
No	113(55.4)	91(44.6)			
Obesity					
Obese	114(75.5)	37(24.5)	3.7	2.4-5.8	<0.001
Not obese	114(45.2)	138(54.8)			
Diabetes					
Yes	52 (82.5)	11 (17.5)	4.4	2.2-8.7	<0.001
No	176 (51.8)	164 (48.2)			
Abdominal obesity					
Yes	176 (71.0)	72(29.0)	0.2	0.1-0.3	<0.001
No	52(33.5)	103(66.5)			
Have you ever consumed any alcoholic drink					
Yes	153(63.7)	87(36.3)	2.1	1.4-3.1	<0.001
No	75(46.0)	88(54.0)			
How often do you take sweet drinks					
Never	16(94.1)	1(5.9)			0.006
Rarely	22(66.7)	11(33.3)			

Sometimes	46(55.4)	37(44.6)	
Often	144(53.3)	126(46.7)	

n= Number; %= Percentage

4.5.3 Binary logistic regression showing determinants of hypertension

As illustrated in Table 4.16, the logistic regression, after adjusting for confounders, only age (above 35 years) (AOR= 2.2, CI=1.3-3.7), period of driving (above 5 years) (AOR=1.8, CI=1.1-2.7), alcohol use (AOR=2.8, CI=1.7-4.4), obesity (AOR=3.4, CI= 2.1-5.4) and diabetes (AOR= 3.1, CI=1.5 -6.4) were significant and independent predictors of hypertension.

Participants aged above 35 years were 2.2 times more likely to develop hypertension compared with participants who are 35 years old and below. Participants with period of driving above 5 years are 1.8 times more likely to be hypertensive than other participants with a period of driving of 5 years and below. The odds of being hypertensive were 2.8 times higher among alcohol users than in non alcohol users. Participants with diabetes had three times the likelihood of developing hypertension than participants who were not.

Table 4.16: Binary logistic regression showing predictors of hypertension

Variables	Beta	Wald	Odd Ratio (CI)	p-value
Obesity				
Obese	1.212	24.649	3.4(2.1-5.4)	<0.001
Non-obese (reference)				
Age (years)				
> 35	0.775	8.490	2.2(1.3-3.7)	0.004
≤ 35 (reference)				
Diabetes				
Diabetes	1.121	8.995	3.1(1.5-6.4)	0.003
Non-diabetic (reference)				
Duration of driving				
> 5 years	0.561	4.853	1.8(1.1-2.7)	0.028
≤ 5 years (reference)				
Alcohol use				
Alcohol users	1.022	18.417	2.8(1.7-4.4)	<0.001
Non-alcohol users(reference)				

4.5.4 Pre-hypertension, hypertension and cardiovascular risk factors

The prevalence of hypertension was high among participant with a body mass index of more than normal, which increases with an increase in the body mass index. There were significant associations between abdominal obesity and hypertension regardless of what parameter was used for abdominal obesity. Diabetes mellitus was also significant with hypertension. While abdominal obesity has a significant association with pre-hypertension, obesity and waist to height ratio abdominal obesity were not significant with pre hypertension.

Prevalence of hypertension was high among obese participants (76.8%) and that of pre-hypertension was higher among participants with normal weight (44.3%) and overweight participants (39.1%). Among the participants with abdominal obesity, the prevalence of hypertension in participants with a high waist circumference was (71.0%) high. Likewise, the prevalence of pre-hypertension was high among participants with high waist circumference (46.5%). Participants with high waist to hip ratio and high neck circumference had a high prevalence of hypertension (65.9%) and (66.5%) respectively, compared to the high prevalence of pre-hypertension among people with normal waist to hip ratio and normal neck circumference (45.5%) and (44.3%) respectively. There was high prevalence of hypertension in participants with high waist to height circumference (63.2%) which is not significant for pre-hypertension. Majority (82.5%) of participants with diabetes had high prevalence of hypertension and participants that are not diabetic on the other hand had high prevalence of pre hypertension (37.4%). (Table 4.17)

Table 4.17: Pre-hypertension, hypertension and predictors of obesity

Variables	Hypertension n (%)	RR(CI)	P-value	Pre-hypertension n (%)	RR(CI)	P-value
BMI categories						
Underweight	2(25.0)		<0.001	2(25.0)		0.003
Normal	38(35.8)			47(44.3)		
Overweight	74(53.6)			54(39.1)		
Obese class 1	63(76.8)			16(19.5)		
Obese class 2	37(75.5)			11(22.4)		
0bese class 3	14(70.0)			6(30.0)		
Waist circumference						
Abdominal obesity	176(71.0)	0.2(0.1-0.3)	<0.001	72(46.5)	2.5(1.6-3.8)	<0.001
Normal	52(33.5)			64(25.8)		
Waist-to- hip ratio						
Abdominal obesity	180(65.9)	0.3(0.2-0.5)	<0.001	77(28.2)	2.1(1.4-3.3)	0.001
Normal	48(36.9)			59(45.5)		
Waist to height ratio						
Abdominal obesity	204(63.2)	0.3(0.2-0.4)	<0.001	102(31.6)	1.6(0.9-2.7)	0.054
Normal	24(30.4)			34(43.0)		
Neck circumference						
Abdominal obesity	175(66.5)	0.3(0.2-0.4)	<0.001	74(28.1)	2.0(1.3-3.1)	0.001
Normal	53(37.5)			62(44.3)		
Diabetes						
Present	52 (82.5)	4.4(2.2-8.7)	<0.001	9(14.3)	0.2(0.1-0.6)	<0.001
Not present	176 (51.8)			127 (37.4)		

4.6 PRE-DIABETES AND DIABETES

4.6.1 Prevalence of pre-diabetes and diabetes

As shown in Figure 4.10, the prevalence of pre-diabetes and diabetes was 17% and 16%, respectively. Of those who were diagnosed as diabetic (n=63), 43(68%) were aware of their diabetes status and 30 were already on treatment.

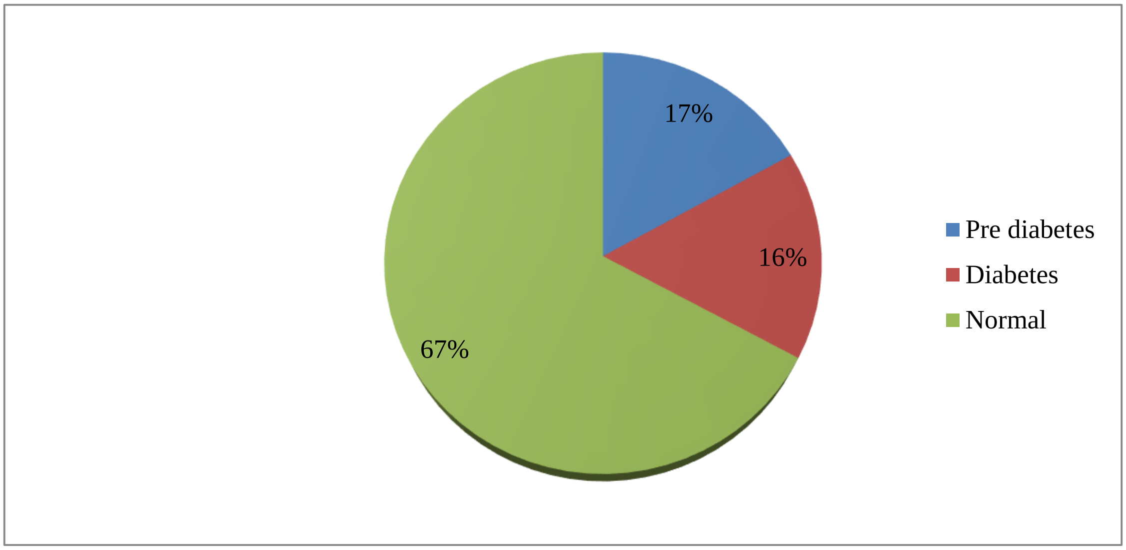


Figure 4.10: Prevalence of pre-diabetes and diabetes

4.6.2 Associated risk factors with diabetes

Age, marital status, level of education, period of driving, obesity, physical activity and hypertension were significantly associated with diabetes mellitus. The prevalence of diabetes was higher among participants aged above 35 years (21.4%) compared to participants aged 35 years and below. The participants who were ever married (24.1%), with no formal education (40.0%) and a minimum level of education (grade 1-7) (32.2%) had a higher prevalence of diabetes compared to never married participants and those with a higher level of education. Also, there was a high prevalence of diabetes among participants who were obese (20.5%) and hypertensive (23%). Prevalence of diabetes among physically inactive participants (17.3%) was double the prevalence found among the physically active (Table 4.18).

Table 4.18: Factors associated with diabetes mellitus

Variables	Diabetes n (%)	Non-diabetes n (%)	OR (CI)	p-value
Age (years)				
Above 35	59 (21.4)	217 (78.6)	8.4 (3.0-23.6)	<0.001
35 years and below	4 (3.1)	123 (96.9)		
Marital status				
Ever married	53 (24.1)	167 (75.9)	5.5 (2.7-11.2)	<0.001
Never married	10 (5.5)	173 (94.5)		
Level of education				
No formal school	6 (40.0)	9 (60.0)		<0.001
Grade 1-7	19 (32.2)	40 (67.8)		
Grade 8-12	35 (11.8)	262 (88.2)		
Tertiary	3 (9.4)	29 (90.6)		
Income				
2000 and below	32 (19.0)	136 (81.0)	1.5 (0.9-2.7)	0.110
Above 2000	31 (13.2)	204 (86.8)		
Race				
Black	58 (15.4)	318 (84.6)	0.8 (0.3-2.2)	0.669
Coloured	5 (18.5)	22 (81.5)		
Period of driving				
Above 5years	50 (18.5)	220 (81.5)	2.1 (1.1-4.0)	0.023
5 years and below	13 (9.8)	120 (90.2)		
Smoking				
Yes	31 (15.6)	168 (84.4)	1.0 (0.6-1.7)	0.976
No	32 (15.7)	172 (84.3)		
Obesity				
Obese	31 (20.5)	120 (79.5)	1.8 (1.0-3.1)	0.036
Not obese	32 (12.7)	220 (87.3)		
Have you ever consumed any alcohol				
Yes	41 (17.1)	199 (82.9)	1.3 (0.8-2.3)	0.331
No	22 (13.5)	141 (86.5)		
How often do you take sweet drinks				
Never	6 (35.3)	11 (64.7)		0.006
Rarely	10 (30.3)	23 (69.7)		
Sometimes	9 (10.8)	74 (89.2)		
Often	38 (14.1)	232 (85.9)		
Do you do any sports, fitness or recreational activities				
Yes	6 (8.1)	68 (91.9)	0.4 (0.2-1.0)	0.049
No	57 (17.3)	272 (82.7)		
Hypertension				
Yes	52 (22.8)	176 (77.2)	4.4 (2.2-8.7)	<0.001
No	11 (6.3)	164 (93.7)		

4.6.3 Binary Logistic regression showing determinants of diabetes

In the logistic regression, after adjusting for cofounders, only age, ever married and hypertension were the significant and independent predictors of diabetes. Participants aged above 35 years were about four times more likely to develop diabetes (AOR=3.6, CI=1.2-11.1) than participants aged 35 and below. Participants who were married were three times more likely to develop diabetes (AOR=3.3, CI=1.5-7.0) and hypertensive participants had thrice the likelihood of developing diabetes (AOR= 3.4, CI=1.7-6.8) (Table 4.19).

Table 4.19: Binary logistic regression showing determinants of diabetes

Variables	Beta	Wald	Odd Ratio (CI)	p-value
Age				
Age above 35	1.292	5.196	3.6 (1.2-11.1)	0.023
≤ 35 years (reference)				
Marital status				
Ever married	1.181	9.212	3.3 (1.5-7.0)	0.002
Never married (reference)				
Hypertension status				
Hypertensive	1.210	11.275	3.4 (1.7-6.8)	0.001
Non-hypertensive (reference)				

4.7 PREVALENCE OF METABOLIC SYNDROME

The prevalence of metabolic syndrome among the study participants was 22% (Figure 4.11).

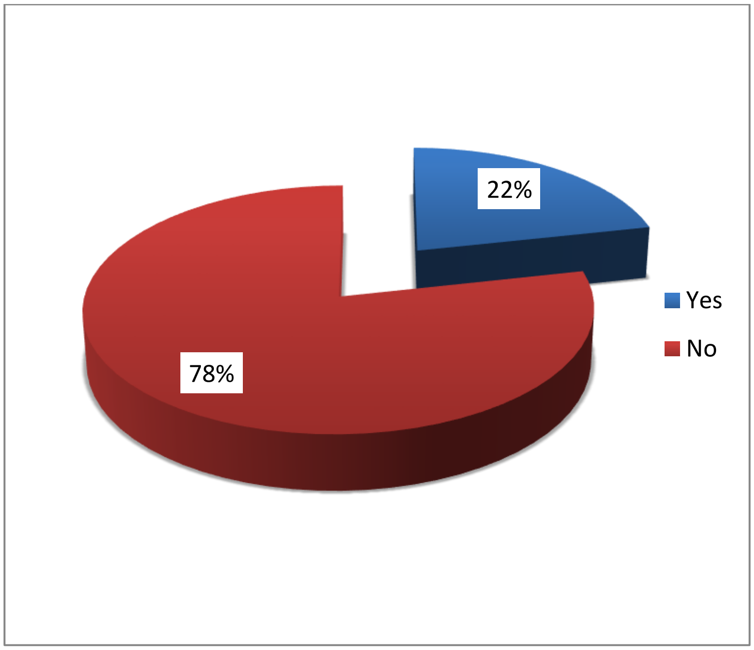


Figure 4.11: Prevalence of metabolic syndrome

4.7.1 Associated risk factors for metabolic syndrome

Age (p=<0.001), marital status (p=<0.001), level of education (p=0.001), period of driving (p<0.001), were the significant socio-demographic factors associated with metabolic syndrome (METs). The prevalence of metabolic syndrome was higher among participants who were above 35 years of age (29.3%). Consumption of sweet drinks (p=0.031) and physical inactivity (p=0.013) were the significant behavioural factors associated with METs. Participants with the minimum level of education (grade 1-7) had a higher prevalence of METs (40.7%), compared with well-educated participants (12.5%). The Prevalence of metabolic syndrome was higher among participants with periods of driving above 5 years (27.8%) compared to participants with periods of driving of 5 years and below (9.0%). There was a high prevalence of METs amongst married participants (32.3%) and amongst participants who did not engage in physical activities (Table 4.20).

Table 4.20: Factors associated with metabolic syndrome

Variables	Metabolic syndrome (%)	No Metabolic syndrome (%)	p-value
Age (years)			
Above 35	81(29.3)	195(70.7)	<0.001
35 years and below	6(4.7)	121(95.3)	
Marital status			
Ever married	71(32.3)	149(67.7)	<0.001
Never married	16(8.7)	167(91.3)	
Level of education			
No formal school	5(33.3)	10(66.7)	
Grade 1-7	24(40.7)	35(59.3)	0.001
Grade 8-12	54(18.2)	243(81.8)	
Tertiary	4(12.5)	28(87.5)	
Race			
Black	81(21.5)	295(78.5)	0.934
Coloured	6(22.2)	21(77.8)	
Period of driving			
Above 5years	75(27.8)	195(72.2)	<0.001
5 years and below	12(9.0)	121(91.0)	
Smoking			
Yes	54(22.5)	186(77.5)	0.589
No	33(20.2)	130(79.8)	
Have you ever consumed alcohol			
Yes	54(22.5)	186(77.5)	0.623
No	33(20.2)	130(79.8)	
How often do you take sweet drinks			
Never	8(47.1)	9(52.9)	0.031
Rarely	10(30.3)	23(69.7)	
Sometimes	16(19.3)	67(80.7)	
Often	53(19.6)	217(80.4)	
Do you do any sports, fitness or recreational activities			
Yes	8(10.8)	66(89.2)	0.013
No	79(24)	250(76.0)	

4.7.2 Binary logistic regression showing the determinants of metabolic syndrome

In the logistic regression, only age (>35 years), being married and having been a commercial driver for more than 5 years were the independent predictors of METs, after adjusting for confounding factors. Participants aged above 35years were 3.8 times more likely to have metabolic syndrome than participants aged 35years and below. Ever married participants were thrice more likely to have metabolic syndrome than the never married participants. Participants with above 5 years of driving had 2.4 times the likelihood of having metabolic syndrome than participants with a driving period of less than 5 years (Table 4.21).

Table 4.21: Binary logistic regression showing determinants of metabolic syndrome

Variables	Beta	Wald	Odd Ratio (CI)	p-value
Age above 35	1.322	7.724	3.8(1.4-9.5)	0.005
35 years and below (reference)				
Ever married above 35 years	1.081	11.282	3.0(1.6-5.3)	0.001
Never married (reference)				
Period of driving >5 years	0.864	5.988	2.4(1.2-4.7)	0.014
Period of driving of ≤5 (reference)				

4.8 DISCUSSION

4.8.1 Overweight and obesity

This study sought to determine the prevalence and associated factors of obesity among commercial drivers in Buffalo City Metropolitan Municipality, South Africa. The prevalence of overweight and obesity in this study is 34% and 37%, respectively. The prevalence of obesity found in this study is similar to previous reports from Romania and India (Pop et al., 2015; Udayar et al., 2015) and higher than the reported prevalence among commercial drivers in Iran (Sieber et al., 2014; Montazerifar et al., 2016; Mohebbi et al., 2012; Izadi et al., 2013), Brazil (Reis et al., 2017; Hirata et al., 2012), United State (Elshatarat et al., 2016), Italy (Rosso et al., 2015; Rosso et al., 2016), Poland (Marcinkiewicz et al., 2010) and Nigeria (Olusegun et al., 2016; Isara & Aigbokhaode, 2017) which ranged from 14.3% - 29.9% and less than 53.3% reported in the study by(Thiese et al., 2015) in the United State of America. Also the prevalence of overweight found in this study is similar to that found in some studies in the USA, India, Iran and Nigeria (Udayar et al., 2015; Montazerifar et al., 2016;Thiese et al., 2015; Olusegun et al., 2016) (Table 4.22).

Table 4.22: Prevalence of overweight and obesity among drivers in previous studies

Country	Design/Sample size	Mean age (years)	Overweight prevalence	Prevalence of obesity	Author
Iran	Cross-sectional: 1100	41.8±10.7	37.9%	14.3%	(Montazerifar et al., 2016)
Italy	Cross-sectional:497	43±9.3	44.8%	16.8%	(Rosso et al., 2015)
Poland	Cross-sectional	39	45.3%	17.9%	(Marcinkiewicz et al., 2010)
Brazil	Retrospective observational: 659	41± 6.9	55.6%	19.6%	(Hirata et al., 2012)
Iran	Cross-sectional: 12,138	37.8±10.1	44.8%	20.8%	(Mohebbi et al., 2012)
Iran	Cross-sectional: 1903	41.55±10.53	41.4%	21.3%	(Izadi et al., 2013)
Italy	Cross-sectional: 335	42.7 ±9.7	45%	21.4%	(Rosso et al., 2016)
Iran	Cross-sectional: 429	36.6 ±10.7	41.0%	23.0%	(Saberi et al., 2011)
United State	Cross-sectional: 130	45 ±10.75	43.8%	24.7%	(Elshatarat et al., 2016)
Nigeria	Cross-sectional: 389	39.0±10.0	35.8%	25.7%	(Olusegun et al., 2016)
Brazil	Cross-sectional: 155	--	52.3%	27.0%	(Reis et al., 2017)
Nigeria	Cross-sectional: 214	45 ±10.0	-	29.9%	(Isara et al., 2017)
India	Cross-sectional: 204	41.38±10.45	36.2%	34.8%	(Udayar et al., 2015)
Romania	Cross-sectional: 84	44.4±7	50.0%	38.09%	(Pop et al., 2015)
United States of America	88,246	46 ±10.4	31.0%	53.3%	(Thiese et al., 2015)
***South Africa**	**Cross-sectional: 403**	**43.3±12.5**	**34.0%**	**37.0%**	**Present study**

With the exception of the USA, the prevalence of obesity among commercial drivers in South Africa compared with the other drivers, in different countries and Nigeria as an African country, is high. Also, studies examining the prevalence of obesity in the general population in the Eastern Cape Province of South Africa reported a high prevalence of obesity: 60.2% (Adeniyi et al., 2015), 38% (Otang-Mbeng et al., 2017) and 46% (Owolabi et al., 2017a). Obesity is affected by factors including individual genetic composition, sex, geographical location and socio-economic status. The high obesity prevalence found among participants in this study could be related to some of the lifestyle behaviours, which increased the risk for developing obesity and overweight; such as lengthy working hours on the road, unpredictable schedules, physical inactivity and a scant opportunity for a healthy diet (Lim et al., 2015). Also, the number of years, low educational level and the hours spent driving are risk factors for obesity (Rosso et al., 2015; Rosso et al., 2016). The long hours of driving without adequate sleep is another factor that should be considered in understanding the prevalence of obesity among the drivers in this study. It has been demonstrated that people who did not get much sleep had a 20% higher likelihood of being overweight and a 57% greater odds of being obese (Jean-Louis et al., 2014).

In this study, it was shown that the commercial drivers work under stressful conditions and with inadequate hours of sleep (6.2±1.6) per day. Besides, they smoke cigarettes (30%), drink alcohol daily (72.4%), binge drink (24%) and rarely participate in physical activity. These lifestyle behaviours could lead to obesity, and the high prevalence of obesity found among the drivers, is as expected and a public health concern. Obesity is a major factor for cardiovascular diseases and is associated with less participation in work activities, an increase in absenteeism and a loss of productivity, with a consequent increase in the use of resources (Udayar et al., 2015). Obese individuals often avoid wearing seat belts while driving because of the discomfort and localized pressure (Burton et al., 1998; Hamilton et al., 2007) are at higher risk of death when involved in car accidents, compared with normal-weight individuals. Studies have also shown that individuals with BMI >32kg/m^2 frequently complain of daytime sleepiness, an obvious danger during driving (Hamilton et al., 2007; Frank et al., 2004). As such, given the deleterious health implications of obesity, it is necessary to implement preventative interventions in this sub-population. Potential interventions for taxi drivers, to have the greatest impact, should be multi-level, addressing individual risk (that is, the screening and prevention, counselling, linkages to primary care, and management of obesity) (Gany et al., 2016).

Age (>35 years) was found to be associated with obesity among the study participants. This is congruent with the findings among Iranian (Montazerifar et al., 2016) and Mexican drivers (Aguilar-Zinser et al., 2007), but in contrast to the findings among Italian drivers (Rosso et al., 2015). The higher prevalence of obesity associated with ageing could be as a result of increased energy intake, less energy expenditure or a combination of both, due to insufficient physical activity (Amarya et al., 2014). Another possible reason for the higher prevalence of obesity found among those above the age of thirty five is the documented increase in fat mass in the body, with an accompanying decrease in fat-free mass, which occurs between the ages of 30-70years (Villareal et al., 2005; Amarya et al., 2014; Barzilai et al., 2012).

There was a significant association between non-smoking and obesity. This is congruent with the study by (Reis et al., 2017) among long distance truck drivers in Brazil, where non-smoking was significantly associated with obesity. In contrast, smoking was not associated with obesity among Italian drivers(Rosso et al., 2015). Smoking has been found to reduce body weight, although it is associated with an increase in central obesity (Canoy et al., 2005; Stokes & Preston, 2016; Dare et al., 2015; Liu et al., 2010; Cawley et al., 2004). The weight loss effects of smoking is as a result of the increase in energy expenditure (EE) due to the effect of nicotine in tobacco (Hofstetter et al., 1986), which suppresses appetite for food (Chiolero et al., 2008). This suppression of appetite leads to less consumption of food and consequently, less weight. Nonetheless, the overall effect of smoking on health is detrimental.

Participants with hypertension in this study have about four times the risk of being obese compared to those without hypertension. It is established that overweight and obesity induce the development of hypertension and hypertension also increases body weight (Julius et al., 2000; Narkiewicz, 2006), describing the obesity and hypertension relationship as vice versa. The use of certain anti-hypertensive drugs such as beta blocker has been linked to obesity development (Sharma et al., 2001; Pischon & Sharma, 2001). This could be a plausible reason for the higher odds for obesity among hypertensive patients. Finally, obesity is a predisposing factor for hypertension as a result of its role in the development of endothelial dysfunction and systematic inflammation (Guh et al., 2009). Thus, the higher prevalence of obesity among the hypertensive drivers is not surprising.

4.8.1.1 Abdominal obesity

This is the first study to examine the prevalence of AO based on four contrasting anthropometric indices (WC, WHR, WHtR and NC) among commercial taxi drivers in South Africa. Consistent with other studies (Haregu et al., 2016;Ashwell et al., 2012), there were variations in the prevalence rates among the four anthropometric indices. The prevalence of AO was based on WC, WHR, WHtR and NC was 61.5%, 67.7%, 80.1% and 65.3%, respectively. Irrespective of the type of anthropometric indicator, the proportion of AO was high, with discordant results. Even among the general population in South Africa, the prevalence of AO has been reported as being high (Motala et al., 2011; Matsha et al., 2013; Peer et al., 2015a; Goon et al., 2014a; De Lucia Rolfe et al., 2015). Among the four anthropometric indices, the WHtR records the highest prevalence rate of AO. The WHtR is a newly introduced anthropometric index, which is a more useful clinical screening tool than WC, with a cut-off value of 0.5 applicable to both children and adults worldwide. This anthropometric index was postulated by Ashwell et al. (2014),with a message "keep your waist circumference to less than half your height."

Notably, the working environment of the South African commercial taxi drivers, usually called 'Taxi Rank', are characterized by a rhythm of life, which is faster, noisier and the drivers suffer from greater life and work stress. It is postulated that stress reactions are associated with the development of abdominal obesity (Bjorntorp, 2001). Also, the participants in this study smoke (30%) and drink alcohol daily (72.4%) and binge drink (24%). As reported in other studies (Laitinen et al., 2004;Riserus & Ingelsson, 2007), abdominal obesity is more frequent among people who smoke and drink alcohol. Additionally, sleep is an important lifestyle indicator impacting on health. Other studies have found an association between shorter sleeping time and the risk of AO (Lopez-Sobaler et al., 2016; Sperry et al., 2015). The mean sleeping time of the drivers in this present study was 6.2±1.6 hours per day. These working health dynamics could explain why the commercial taxi drivers in this present study had higher proportions of AO. Ergonomically, the AO of the drivers may impact on some aspects of their ergonomics in terms of the sitting position versus the positioning of the wheel steering and, possibly the seatbelt. The seat conformation (width and depth) would assume an android or gynoid fat distribution (Capodaglio et al., 2010). Research has shown that obese individuals often avoid wearing seat belts whilst driving because of the discomfort and localized pressure (Burton et al., 1998;

Hamilton et al., 2007) and are at higher risk of death when involved in car accidents, compared to normal-weight individuals. As such, it is postulated that the design of vehicles should take this data into consideration (Rodacki et al., 2005; Moreno et al., 2006). Studies have demonstrated that individuals with BMI>32 frequently complain of daytime sleepiness, an obvious danger during driving (Hamilton et al., 2007; Frank et al., 2004). Research is needed to elucidate the impact of AO on the seat position ergonomics of drivers in South Africa.

Like other anthropometric indicators, other studies have explored the utility of NC as a simple and valuable screening tool for identifying individuals with overweight and obesity (Ben-Noun et al., 2012; Lou et al., 2012; Yan et al., 2014; Preis et al., 2010; Stable et al., 2013). Of course, the NC has shown to be strongly associated with classic obese markers such as BMI and WC; and is correlated with cardiometabolic risk factors: blood pressure, fasting plasma glucose levels and triglyceride levels (Yan et al., 2014).

The present study found that, among the four indices, WHR and WC (r=0.644) and WHTR WC (r=0.628) are strongly correlated. Previous studies have reported a strong correlation with WHR and WC (Guan et al., 2016; Haregu et al., 2016); and in WHTR with WC (Lam et al., 2015; Haregu et al., 2016; Guan et al., 2016; Kim et al., 2017; Krakauer & Krakauer, 2016). The high correlations between WC and WHTR could be explained in the context of 'measuring' obesity in an individual. WC is an absolute measure of waist, while WHTR is a relative measure, suggesting that the two measurements are strongly related to each other (Haregu et al., 2016). Thus, adjusting for WC for height would have little correction effect on WHTR.

The present study showed that WC was the best predictor of hypertension (OR (95 % CI); 3.7 (2.3-6.1)) and diabetes (OR (95 % CI); 3.1(1.6-6.0) in the population. Previous studies (Pouliot et al., 1994; Krakauer et al., 2016; Haregu et al., 2016; Wei et al., 1997; Dobbelsteyn et al., 2001) have reported the superiority of WC over other anthropometric indicators in detecting cardiometabolic risk factors. Clinically, the WC has been recommended as a diagnostic screening tool for both children (Schroder et al., 2014; Goon, 2013) and adults (Nagao et al., 2013; Kim et al., 2017; Siren et al., 2012). This anthropometric index is easy to measure, and requires only a simple tape.

4.8.2 Pre-hypertension and hypertension

Undiagnosed and uncontrolled hypertension contributes significantly to the burden of cardiovascular diseases and its complications. It is also an independent risk factor for morbidity and mortality (Kayima et al., 2013). We found an alarmingly high prevalence of hypertension among commercial taxi drivers in this study. To the best knowledge of the authors, no study has been conducted on hypertension among commercial taxi drivers in South Africa. Thus, the findings of this study can only be comparable to studies conducted elsewhere. The prevalence of hypertension found in this study is higher than the reported prevalence of hypertension among commercial taxi drivers across Africa (Erhiano et al., 2015; Tobin et al., 2013; Olusegun et al., 2016) and several developing countries (Satheesh et al., 2013; Lakshman et al., 2014; Nayak et al., 2014; Wang et al., 2001; Saberi et al., 2011; Siu et al., 2012; Izadi et al., 2013; Shin et al., 2013) which ranged from 9.0% to 46%. The prevalence recorded in this study is only comparable with the study among commercial drivers in two developed countries; Hong Kong and Taiwan, 57% and 56%, respectively (Table 4.23). Also, the prevalence found among the sample in this present study is higher than the reported prevalence (49.2%) among the general population in the same district (Owolabi et al., 2017d). The finding in this study affirms the assumed higher risk for hypertension among commercial taxi drivers. A thorough comparison of prevalence across various studies might be difficult because of variation in study settings and methodology. However, the findings of this study mirror the notion of an epidemiological transition and the increasing hypertension burden currently sweeping across developing countries, and commercial driversespecially are particularly at a higher risk given their unhealthy lifestyle behaviour, in terms of sedentarism, excessive alcohol consumption, smoking and other illicit health behaviours. Also, the high prevalence of pre-hypertension found among this group is a cause for concern. Pre-hypertension indicates a high-risk for hypertension (Wang et al., 2015; Xu et al., 2016), thus, there is a possibility of a future increase in hypertension burden if appropriate interventions are not implemented. There is an urgent need to promote health awareness, frequent health screening and implementation of effective interventions targeting hypertension among this neglected group, as their health is very crucial to the society at large.

Table 4.23: Prevalence hypertension among South African commercial taxi drivers compared with the literature

Country	Design/ Sample size	Mean age	Percentage	Author
Abuja, Nigeria	Cross- sectional; 389	39.0 ±10.0	9.0%	(Olusegun et al., 2016)
Chittoor, India	Cross-sectional; 204	41.38 ±10.45	14.21%	(Udayar et al., 2015)
Bangalore, India	Cross- sectional; 500	-	16.0%	(Satheesh et al., 2013)
Iran	Cross-sectional;1903	41.55 ±10.43	16.4%	(Izadi et al., 2013)
South-south, Nigeria	Cross-sectional; 112	37.49 ±9.3	21.4%	(Tobin et al., 2013)
Sokoto, Nigeria	Cross-sectional; 213	47.48 ±10.18	33.5%	(Erhiano et al., 2015)
India	Cross-sectional; 587	46.9 ±6.69	34.8%	(Borle et al., 2015)
Brazil	Retrospective observational; 659	41.7 ±6.9	38.2%	(Hirata et al., 2012)
South India	Cross- sectional;179	36.5 ±8.4	41.3%	(Lakshman et al., 2014a)
Iran	Cross- sectional; 429	36.6 ±10.7	42.9%	(Saberi et al., 2011)
South Brazil	Cross-sectional; 250	41.9 ±10.0	45.2%	(Sangaleti et al., 2014)
India	Cross-sectional comparative; 50	-	46.0%	(Nayak et al., 2014)
Korea	433	-	53.3%	(Shin et al., 2013)
Hong Kong	3376	50.9 ±7.6	57.0%	(Siu et al., 2012)
Taiwan	Cross-sectional; 1761	-	56.0%	(Wang et al., 2001)
South Africa	**Cross-sectional; 403**	**43.3 ±12.5**	**57.0%**	**Present study (2017).**

Age, duration of driving, alcohol use, abdominal obesity and diabetes were significant predictors of hypertension among the study participants. This corroborates several studies (Satheesh et al., 2013; Tobin et al., 2013; Lakshman et al., 2014; Udayar et al., 2015). Consistent with other studies (Lakshman et al., 2014; Peltzer et al., 2013; Satheesh et al., 2013), a higher prevalence of hypertension was found among participants older than 35 years compared to those below 35 years. Age is an independent risk factor for cardiovascular disorders, especially hypertension(Mcdonald et al., 2009). Ageing is often accompanied by changes in the body systems, including the cardiovascular system and degeneration of cells (Suastika et al., 2012) which increases susceptibility to cardiovascular disorders, including hypertension (Mcdonald et al., 2009). This might also be the plausible reason for the higher prevalence found among drivers with a longer duration of driving as they constitute those in the higher age group.

Additionally, both generalized and abdominal obesity and diabetes were found to be independently associated with hypertension in the study setting. This is similar to other studies (Erhiano et al., 2015; Olusegun et al., 2016). The association between hypertension and obesity has long been established (Chiang et al., 1969). Obesity increases the risk of developing hypertension(Borrell et al., 2014) due to the activation of the sympathetic nervous system, renin-angiotensin system, and sodium retention among other abnormalities (Jiang et al., 2016; Re, 2009). Obesity, particularly abdominal obesity exerts a deleterious health effect on the development of insulin resistance and glucose metabolism (Pinto & Beltrán-Sánchez, 2015), which predisposes one to diabetes, later, hypertension and ultimately, cardiovascular diseases (World Heart Federation, 2016). Also, hypertension and diabetes share a similar metabolic pathways and risk factors such as genetics, physical inactivity, dyslipidemia, insulin resistance and obesity. These factors collectively contribute to the development of arterial stiffness, which promotes the development of hypertension(Cheung & Li, 2012b;DeMarco et al., 2014).Thus, the associative link between obesity, diabetes and hypertension among the study participants is expected. This calls for joint intervention programmes targeting all the cardio-metabolic risk factors among commercial taxi drivers in the study setting.

Finally, alcohol usage was significantly associated with hypertension among the study participants. This finding agrees with Udayar et al. (2015) study, but contrast with other studies (Satheesh et al., 2013; Tobin et al., 2013). Although, controversies exist regarding the impact of alcohol on health, and while moderate alcohol drinking has been shown to improve cardiovascular function, especially among younger age groups, heavy consumption (more than three at a sitting) impacts negatively on cardiovascular health, especially hypertension and atrial fibrillation (Pisa et al., 2010; Samokhvalov et al., 2010a). Heavy alcohol consumption increases blood pressure(Husain et al., 2014; Sheps, 2015). Thus, the high prevalence of hypertension found in this study is not surprising. Anecdotally, most commercial motor drivers in South Africa consume excessive alcohol, smoke and indulge in illicit health behaviours, which tend to compromise their health status; and South Africa is reported to be a hard-drinking country (Morojele & Ramsoomar, 2016). Most of the factors contributing to the high burden of hypertension among commercial taxi drivers are modifiable, and that "prevention is better than cure", intervention strategies are needed to safeguard the health of this special population.

4.8.3 Prevalence and risk factors for diabetes

The present study determined the prevalence, awareness, treatment and determinants of diabetes and pre-diabetes among commercial taxi drivers in BCMM, South Africa. To the best knowledge of the researcher, this is the first study reporting the prevalence of diabetes and pre-diabetes among commercial taxi drivers in South Africa. Thus, this study can only be compared to studies conducted among commercial taxi drivers outside South Africa. Diabetes mellitus has become a global public health challenge not limited to the high income countries but has extended to the majority of the low and middle income countries (Zhang et al., 2010) where the prevalence rate is growing to a peak and projections increasing (World Health Organization, 2012). Diabetes mellitus is a metabolic disorder that poses a significant threat to the life of drivers, passengers and other road users.

The findings of this study revealed an overall prevalence of 16% and 17% for diabetes and pre-diabetes, respectively. The prevalence of diabetes in this study is higher than studies carried out among drivers in countries like Hong Kong, Iran and Brazil; although, Sangaleti et al. (2014) reported a similar finding (16.4%) among commercial taxi drivers in South Brazil (Table 5). Comparison with commercial drivers in other countries may not give an accurate picture or might be overemphasizing the burden of diabetes in this study. However, when compared to studies conducted among the general population of South Africa, the prevalence rate found in this study is more than the 8.3% overall prevalence of diabetes in South Africa (Guariguata et al., 2014). With the incessant projection of an increase in the prevalence of diabetes, coupled with the high prevalence of pre-diabetes found among the study participants, there is a need for prompt interventions to curb this growing menace, especially among this high-risk population group.

Table 4.24: Prevalence of diabetes among South African commercial taxi drivers compared with reports of other studies

Country	Design	Mean age	Percentage	Author
Iran	Cross-sectional: 1137	47.7 ±28.7	6.3%	(Tofangchiha et al., 2014)
Iran	Cross-sectional: 1903	41.55 ±10.53	9.1%	(Izadi et al., 2013)
Hong Kong	3376	50.9 ±7.6	8.1%	(Siu et al., 2012)
Iran	Cross-sectional: 429	36.6 ±10.7	7.0%	(Saberi et al., 2011)
Brazil	Retrospective observational: 659	41.7 ±6.9	2.8%	(Hirata et al., 2012)
Brazil	155	_	11.0%	(Reis et al., 2017)
Brazil	Cross-sectional: 250	41.9 ±10.0	16.4%	(Sangaleti et al., 2014)
South Africa	**Cross-sectional:403**	**43.3 ± 12.5**	**16%**	**Present study**

With regard to awareness and treatment of diabetes among participants with diabetes, 68% (n=43) of them were aware of their diabetes status and of these, the majority, 30 (70%) reported being on treatment. This is similar to Sangaleti et al. (2014), who reported an awareness rate of 63% among drivers in Brazil. The diabetes awareness and treatment rate among the study participants is commendable. However, further actions should be taken by district health managers to ensure that the burden of undiagnosed diabetes is drastically reduced among this cohort. Also, as practiced in developed nations(Thiese et al., 2015), which was also practiced in Iran (Izadi et al., 2013)and Brazil (Hirata et al., 2012), the adoption of a mandatory medical fitness test for commercial driving among drivers living with diabetes in South Africa could assist in improving awareness, treatment and control. This will also ensure the safety of the commercial drivers, passengers and other road users.

The independent predictors of diabetes according to this study were older age, being ever married and hypertension. Ageing increases susceptibility to diabetes (Gunasekaran & Gannon, 2011). This finding is similar to that of other studies conducted among drivers in Iran (Izadi et al., 2013) and Hong Kong (Siu et al., 2012). Obesity is a common predisposing factor for diabetes and the link between increasing age and diabetes could be as a result of both generalized and central obesity found among the older adults, as a result of reduction in physical activity levels (Amati et al., 2009a).This is evidenced by the significant association found between physical inactivity and diabetes in this study. Also, ageing has been reported to be associated with a higher incidence of insulin resistance, inflammation and impaired insulin secretion precipitated by impairment in the functioning and proliferative capacity of the islet cells with a resultant development of diabetes (Maedler et al., 2006b; Amati et al., 2009a; Kirkman et al., 2012). Thus, the American Diabetes Association (American Diabetes Association, 2013), specified the need for regular diabetes screening among older adults. This is also a call for action for district health managers to regularly organize screening programmes for diabetes among commercial taxi drivers, especially, the older ones in order to reduce the burden associated with diabetes and its complications.

A higher prevalence of diabetes was also found among the married, obese and physically inactive commercial taxi drivers. This is similar to the findings of (Owolabi et al., 2016) among adults in BCMM, South Africa. The association between diabetes and marriage is unclear. It could be due to the influence of other clusters of modifiable and non-modifiable risk factors among the study participants (Leong et al., 2014). Also, it might be that married participants have better and regular access to staple foods like maize meal coupled with regular snacking and unhealthy diets commonly eaten at various taxi ranks. Additionally, most of the commercial taxi drivers usually sit for long hours (sedentarism) without engaging in any physical activity. They work in a stressful environment and with less hours of sleep (6.37±1.6) (Razmpa et al., 2011). These lifestyle behaviours could lead to obesity and the development of diabetes (Marks & Landaira, 2015; Al-Quwaidhi et al., 2013).

Surprisingly, a higher prevalence of diabetes was found among participants who reported not taking sweet beverages. This is contrary to several studies which purported the harmful effects of sweet beverages and their negative effect on type 2 diabetes (Hu, 2013; Vartanian et al., 2007; Imamura et al., 2015). Although, we cannot specifically state that the consumption of sweet drinks does not have a negative effect on diabetes development, the higher prevalence found among those who reported not consuming them could be due to other underlying factors. They might have stopped consuming such drinks after the diagnosis of diabetes or they might have other underlying conditions that predispose them towards diabetes.

Finally, hypertension was found to be associated with diabetes among the study participants. This is not surprising. Several studies have also reported similar association among drivers across various countries such as Iran (Izadi et al., 2013), Poland (Marcinkiewicz et al., 2010) and Hong Kong (Siu et al., 2012). This association is often linked to the similar metabolic pathways between both conditions, as well as their shared risk factors, which range from genetics, behavioural, metabolic, and demographic factors to physiological factors (Landsberg & Molitch, 2004; Cheung et al., 2012; Tekola-Ayele et al., 2013).

Education also has a significant association with diabetes mellitus shown by its impact in the increase of diabetes mellitus in this study. Education plays a vital role in being informed health wise; it supports health literacy, as a low level of education often results in low health literacy or health illiteracy (van der Heide et al., 2013). A higher level of education with resultant health literacy gives individuals a conscious understanding of proper dietary modification, healthy living and behaviours and a need to assess health care facilities for health consultation, with the knowledge of what results are from a deviation from wellness (Zimmerman et al., 2015; Smith et al., 2011). This is consistent with the literature, (Sacerdote et al., 2012; Agardh et al., 2011; Flor & Campos, 2017; Shang et al., 2013) which has previously been documented in the study area (Owolabi et al., 2016). Type 2 diabetes was more prevalent among participants with a low level of education and this could contribute to poor prognosis of the disease(Berkman et al., 2011), unlike individuals with a high level of education (van de Sande et al., 2007). Not furthering the education of the participants in this study could have contributed to an increase prevalence of type 2 diabetes mellitus among this group of commercial drivers. Mostly, this is linked with low socio-economic status and income, which could influence their everyday life, making them susceptible to developing type 2 diabetes mellitus. Also, low level of education could be a contributory factor to the high odds among the confounders of diabetes in this study.

Being obese increases the prevalence of type 2 diabetes mellitus in this study. Obesity individually, is a proximate factor of non-communicable diseases that is it serves as a driver of chronic diseases. Obesity specifically increases the mechanism and substances that could aid the development of diabetes in an individual who is obese, compared with a person of normal weight. Due to obesity it becomes so easy for the beta cells to dysfunction and the body becomes insensitive to insulin action (Al-Goblan et al., 2014), which will eventually results in to type 2 diabetes mellitus. This finding is in accordance with several study findings in South Africa reporting strong correlation between obesity and diabetes (Owolabi et al., 2016; Matsebula & Ranchhod, 2016; Kruger et al., 2007). It could also be noted that, often, physical inactivity goes with obesity and traditionally, physical inactivity predisposes to different diseases, which is one of the outcomes of this study's findings. The prevalence of diabetes was greater and more significantly correlated with reports of participants being physically inactive. This may be related to the rate at which sedentarism as a result of lifestyle and the nature of the job of commercial drivers leads to obesity (Choi et al., 2010). Physical inactivity in this study can also be linked to the long period of driving among commercial drivers that could have consumed most of their time thus precluding physical activity. Having a constant routine of sitting behind the wheel for 5 years or more, without engaging in some sort of active physical activity as recommended can pose a serious health threat.

4.8.4 Prevalence and risk for metabolic syndrome

This is the first study in South Africa to determine the prevalence of metabolic syndrome among South African commercial taxi drivers. The prevalence of metabolic syndrome in this study is 22%. The finding in this study is close to the reported findings of 24% among Brazilian (Cavagioni et al., 2008) and 26.8% among Hong Kong drivers (Siu et al., 2012). However, the prevalence rate in this study is lower than that of the USA having 29% (BC Legal News, 2017), Korea 49.9% (Shin et al., 2013), Taiwan 43.1% (Chen et al., 2013) and Iran (26.1%-35.9%)

(Mohebbi et al., 2012; Mohebbi et al., 2010; Ebrahimi et al., 2016; Saberi et al., 2011) (Table 4.25). The absence of lipid disorders in defining criteria for METs in this study, might have underestimated the prevalence among study participants. Notwithstanding, the observed prevalence of metabolic syndrome among the taxi drivers in this study is high and could be ascribed to the working conditions and the unhealthy lifestyle behaviours (sedentarism, unhealthy dietary practices, smoking, excessive alcohol consumption), as well as work-related stress (Apantaku-Onayemi et al., 2012; Siedlecka, 2006; Chen et al., 2013; Ebrahimi et al., 2016; Mohebbi et al., 2010).With the nutritional transition in South Africa, there have been reports of high abdominal obesity (Peer et al., 2015b; Motala et al., 2011) which is a predisposing factor for metabolic syndrome. Also, a constant source of income when having a job (Peer et al., 2015a) whereby there is money to feed and probably overfeed, this can increase the development of metabolic syndrome.

Table 4.25: Prevalence of metabolic syndrome among drivers in past studies

Country	Method	Mean age	Prevalence	Author
USA	115/262	-	29%	(BC Legal News, 2017)
Iran	Cross-sectional: 1018	42.17 ± 10.65	26.1% ATP III, IDF 35.2%, 31.6% AHA.	(Ebrahimi et al., 2016)
Iran	Cross-sectional: 429	36.6 ± 10.7	35.9%	(Saberi et al., 2011)
Hong Kong	3376	50.9 ±7.6	26.8%	(Siu et al., 2012)
Iran	12,138	37.8 ±10.1	30.5%	(Mohebbi et al., 2012)
Taiwan	421	46.5 ± 9.4	43.1%	(Chen et al., 2013)
Brazil	Cross-sectional: 258	37.5 ± 10.1	24%	(Cavagioni et al., 2008)
Iran	Cross-sectional: 626	38.8± 10.07	32.4%	(Mohebbi et al., 2010)
Korea	Cross-sectional: 443		49.9%	(Shin et al., 2013)
South Africa	Cross-sectional: 403		22%	Present study

Generally, there has been an increase in the prevalence of metabolic syndrome in developing countries (Misra et al., 2008) and South Africa is no exemption. Several studies have reported high prevalence of metabolic syndrome in South Africa, ranging from 21.8% to 62% (Peer et al., 2015a; Owolabi et al., 2017b; Motala et al., 2011; Erasmus et al., 2012; Prakaschandra & Naidoo, 2016) and its prevalence is high when compared with other African countries (Hoebel et al., 2012; Motala et al., 2011). This mirrors the epidemiological, nutritional and socio-economic transition taking place across developing countries (Kabudula et al., 2017) and in South Africa.

A low level of education was associated with a higher prevalence of METs. This finding is similar to the finding of Owolabi et al. (2017) among South African adults, as well as the finding of Hajian-Tilaki et al. (2014) among Iranians. There is a documented resultant increase in knowledge, associated with education. Also, it is speculated that the more educated an individual is, the more knowledgeable they are about their health, and the more receptive they become to information obtained regarding their health (Cutler & Lleras-Muney, 2010; Deaton et al., 2006). Whether this mirrors the situation of the drivers in this present study is debatable. It could be inferred that such increased knowledge resulting from increased levels of education, which, in turn, might have influenced the health behaviours of the more educated drivers, and perhaps, reduced their vulnerability to cardio-metabolic risk.

Older participants and those with a period of driving for more than five years, had a higher prevalence of METs. Ageing is an established risk factor for cardio-metabolic health compromise (Okafor, 2012). All the components of METs have been linked with increasing age (Amati et al., 2009b; Owolabi et al., 2016; Kirkman et al., 2012). Less physical activity, increased food consumption, reduction in lean body mass and an increase in body fat and visceral adiposity found among the older adults resulted in an increased predisposition to obesity, which is also a predisposing factor to other cardio-metabolic risk factors (Yamamoto et al., 2011; Amati et al., 2009b). In addition, ageing is accompanied by a decline in islet cells functioning as well as changes in the cardiovascular system, which brings about the development of diabetes and hypertension, respectively (Rankin & Kushner, 2009; Maedler et al., 2006a). Thus, the higher prevalence of METs among the older adults is not surprising. This might also be the underlying reason behind the higher prevalence found among those with longer periods of driving. Aside from this, an accumulation of work-related stress, unhealthy diet and inactivity among the drivers with longer duration of driving could also contribute to the higher odds for METs (Chandola et al., 2006; Apantaku-Onayemi et al., 2012; Siedlecka, 2006).

There was a three-fold increase in metabolic syndrome among married participants in this study. There is no clear-cut explanation regarding the association between marriage and METs. Although some authors documented similar higher odds for METs among married individuals (Bhanushali et al., 2013; Owolabi et al., 2017b), Hosseinpour-Niazi et al. (2014), reported no significant association between marriage and METs. Troxel et al. (2005), on the other hand, identified marital quality as the link between marriage and METs. In addition, higher prevalence of the various components of METs, often seen among married individuals, might also be responsible for this finding. Even age might be an underlying factor, as most married people are usually older than the singles. Also, an improper change in eating patterns of married individuals could consequently increase the chances of developing obesity. This could subsequently, with the presence of other associated factors, lead to METs.

Finally, the consumption of sweet beverages and physical inactivity were the behavioural factors associated with METs in this study population. This was anticipated as unhealthy beverages and physical inactivity are leading causes of obesity, a predisposing factor to other components of METs. This finding is similar to that found among Taiwanese drivers by Chen et al. (2013).

4.8.5 Prevalence of alcohol, smoking and physical inactivity

This was an on-site screening among commercial taxi drivers in Buffalo City Metropolitan Municipality, South Africa, to assess the prevalence of unhealthy lifestyle behaviours such as alcohol use, smoking and physical inactivity. These factors all contribute to the development of non-communicable diseases, as well as road traffic crashes and injuries, which constitute a significant health and socio-economic threat.

4.8.5.1 Smoking

In this study, 30% of the commercial drivers were current smokers with majority smoking daily. The prevalence in this study is similar to the reported prevalence among drivers in Nigeria (32%) (Ozoh et al., 2014) and Brazil (29%) (Sangaleti et al., 2014). It is however slightly higher than that observed among drivers in Colombia (20.3%) (Useche et al., 2017) and some other parts of Nigeria (25.8%) (Adekoya et al., 2011). Some authors documented a higher prevalence than the one observed in the study, a prevalence ranging from 39.4% in Nigeria (Fasasi et al., 2014) to as high as 93% among Bangladesh drivers (Goon et al., 2014b). The prevalence of smoking among this study's participants is however higher than the reported national prevalence of 17.6% (Reddy et al., 2015). Likewise, (Owolabi et al., 2017e) in their study on the general populace in this same setting reported a prevalence as low as 15% among adults in this setting. These all establish the fact that commercial taxi drivers participate in the illicit use of harmful psychoactive substances like cigarettes more than the general population. Most likely, commercial taxi drivers smoke cigarettes in a bid to ease the stress involved in their work, to relax, be active or keep their weight in check (Okpataku, 2015; Usman & Ipinmoye, 2016). This, however, is disastrous both for drivers and for the populace at large. Also, other factors such as male dominance of the occupation (Reddy et al., 2015), urban location (Vellios & van Walbeek, 2016), low literacy level (Goon et al., 2014b; Owolabi et al., 2017e), might also have contributed to the high prevalence of smoking observed. There is a need for sensitisation among this group by the Department of Health in collaboration with the Department of Transport with regards to the harmful effects of cigarette smoking. Also, there is a need for the better enforcement of existing laws regarding cigarette smoking.

4.8.5.2 Alcohol

A high prevalence (37%) of alcohol use was found among the commercial drivers in this study. Several studies (Useche et al., 2017; Abiona et al., 2006; Akpan et al., 2014; Adekoya et al., 2011; Sangaleti et al., 2014) have also documented a high prevalence of harmful alcohol use among commercial drivers. Thus, the finding in this study is not shocking. The prevalence found among the commercial taxi drivers is higher than the reported national prevalence in South Africa (Peltzer et al., 2011). Commercial taxi drivers in this setting, do not just drink, they binge drink. Generally in this setting, a high prevalence of binge drinking has been reported (Owolabi et al., 2017c). The high prevalence of binge drinking among commercial drivers is not surprising and is concerning, given the fact that drinking while driving is associated with injuries and deaths related to road traffic crashes. The existing policies on alcohol use, as well as the legislation that applies to the commercial drivers need to be revisited, re-evaluated and reinforced. As it is, it does not seem that these drivers are aware of the existing policies and legislation regarding drunk driving and this should be corrected to protect the lives of drivers and the passengers that they carry.

4.8.5.3 Physical inactivity

Another lifestyle risk factor assessed among this group is physical inactivity. Physical inactivity contributes to non-communicable diseases and road traffic injuries by stimulating obesity. The majority (82%) of the study participants were inactive. This prevalence is twice the prevalence recorded among the general South African population (46%) (Peer, 2013). Several other studies have also highlighted the huge burden of physical inactivity among commercial drivers (Sangaleti et al., 2014; Hirata et al., 2012; Varela-Mato et al., 2017; Varela-Mato et al., 2016; Sena et al., 2008). These scholars related this high burden of physical inactivity to the nature of the work of commercial drivers, which entails long hours of sitting, while driving, and even when not driving. Physical activities promote cardio-metabolic health and reduce the incidence of cardio-metabolic diseases (Kolbe-Alexander et al., 2013; Wilmot et al., 2012; Puhkala et al., 2015). Also, obese drivers might not be able to assume a comfortable position while driving and this might increase the chance of getting involved in road crashes. There is therefore a need to encourage the drivers to engage in physical activities. Thus, proper health education and awareness creation programmes are required for this group, in this regard.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

INTRODUCTION

A summary of the study, the conclusion, the study's limitations and strengths and recommendations will be presented in this chapter.

5.1 SUMMARY

Cardio-metabolic risk factors have been researched in South Africa, in the Eastern Cape Province of the country, in Buffalo City Metropolitan Municipality (BCMM); but there are no studies on the cardio-metabolic risk profile of commercial drivers in the Eastern Cape Province of the Country. The main aim of the study was to determine the prevalence and correlates of cardio-metabolic risk factors (CMRFs) among minibus taxi drivers in Buffalo City Metropolitan Municipality, East London, South Africa. Cardio-metabolic risk factors are basically factors that raise the individual's susceptibility to cardiovascular diseases and diabetes mellitus.

The specific aims of the study were to:

i. Determine the prevalence and risk factors of overweight and obesity among commercial drivers in BCMM;
ii. Determine the prevalence and risk factors of hypertension and pre-hypertension among commercial drivers in BCMM;
iii. Determine the prevalence and risk factors of type 2 diabetes mellitus and pre-diabetes among commercial drivers in BCMM;
iv. Assess age, duration of driving, educational level, socio-economic differences in CMRFs, risk factors and prevalence rates among commercial drivers in BCMM; and,
v. Examine the association of CMRFs risk factors with lifestyle characteristics (smoking, alcohol consumption, physical activity, dietary intake) among commercial drivers in BCMM.

The research questions for the study were:

i. What is the prevalence and risk factors of overweight and obesity among commercial drivers in BCMM?
ii. What is the prevalence and what are the risk factors of hypertension and pre-hypertension among commercial drivers in BCMM?
iii. What is the prevalence and what are the risk factors of type 2 diabetes Mellitus and pre-diabetes among commercial drivers in BCMM?
iv. Would age, duration of driving, educational level, and other socio-economic variables predict the risk of CMRFs among commercial drivers in BCMM?
v. Would smoking, alcohol consumption, physical activity, and dietary intake have any significant effect on the risk of developing CMRFs, among commercial drivers in BCMM?

The study was a cross-sectional, quantitative survey among commercial drivers registered in the existing taxi associations in ten selected taxi ranks in BCMM. The study used a convenient sample technique for the study participants. A sample size of 403 commercial drivers participated in the study with completed questionnaires. The WHO STEPwise questionnaire (World Health Organization, 2003) was used for data collection. The WHO questionnaire involves self-reported information socio demographic (sex, age, level of education, race, education, marital status, income and work experience) and lifestyle behavioural risk factors (smoking, alcohol consumption, physical inactivity, dietary intake).

The second aspect of the instrument focused on objective reports concerning anthropometric measurements which include weight, height, waist circumference, hip circumference, neck circumference and blood pressure. The third aspect involved objective information obtained through biochemical measures. This comprised the fasting blood glucose level. The WHO STEPS recommended instrument has been validated through several studies which used the same standardised questions and protocol in different regions and countries (Virgin Island ministry of Health and Social Development, 2010: Fereshteh et al., 2007; Kingsley, 2003; WHO, 2015).

The study involved ten research assistants. The research assistants were qualified nurses and students in health-care-related fields. Training was organized for the research assistants to facilitate competency in all aspect of the study (questionnaire administration, anthropometric, blood pressure and blood glucose measurements). During training, each person was allocated to a specific aspect of measure for consistency. There were team leaders for each unit who coordinated the activities of the units.

Due explanations about the aim, nature and the procedures of the study were given to the participants before data collection. Information on the demographics, behavioural characteristics and dietary patterns (fruit and vegetable consumption) was obtained from the participants through the questionnaire administration. The body mass index, waist to hip ratio and waist height ratio were derived from the anthropometric measurements.

Data were analysed using a combination of descriptive and inferential statistics. Descriptive statistics (frequency percentages, mean and standard deviation) were used for categorical variables. Inferential statistics (bivariate and multivariate logistic regression) were used to identify the significant associated risk factors of obesity, hypertension, diabetes metabolic syndrome and their ninety five percent confidence interval (95% CI). The logistic regression was also adjusted for confounding factors, to determine which of the demographic variables (sex, age, level of education, marital status, income, driving history) and behavioural lifestyle variables (smoking, alcohol consumption, physical inactivity, dietary intake) independently and significantly predicted the risk of developing CMRFs in the participants. A p-value of < 0.05 was considered statistically significant. All statistical analyses were performed with the Statistical Package for Social Sciences (SPSS) version 22.0 for Windows (SPSS Inc., Chicago, IL, USA).

Major Findings

The major findings of the study were:

i. A high prevalence of overweight (34%) and obesity (37%) exists among the participants.
ii. Age, marital status, period of driving, smoking, sweet drinks consumption, hypertension and diabetes were significantly associated with overweight and obesity among the study participants. However, after adjusting for confounding variables, only age, smoking and hypertension were independent predictors of obesity among the study participants.

iii. There was a high prevalence of pre-hypertension (34%) and hypertension (43%) among the study participants.
iv. Age, marital status, level of education, period of driving, alcohol, sweet drinks consumption, obesity and diabetes were significantly associated with hypertension. However after adjusting for confounders, only age, obesity, diabetes, alcohol and period of driving were independent predictors of hypertension among the study participants.
v. There was a high prevalence of hypertension among participants with a lower education (below grade 8), participants who were obese and those who reported not to take sweet drinks.
vi. There was a high prevalence of diabetes (16%) and pre-diabetes (17%) among the study participants
vii. Awareness of among participants with diabetes was 63% and 43% were on treatment.
viii. Age, marital status, level of education, period of driving, sweet drinks consumption, obesity physical activities and hypertension were significantly associated with diabetes. However after adjusting for confounders, only age, being married and hypertension were independent predictors of diabetes among the study participants.
ix. The prevalence of diabetes was high among participants with level of education below grade 8.
x. There was a high prevalence (22%) of metabolic syndrome among the participants.
xi. Age, marital status, level of education, period of driving, sweet drinks consumption and physical activities were significantly associated with metabolic syndrome. However after adjusting for confounders, only age, being married and period of driving were independent predictors of metabolic syndrome among the study participants.
xii. There was a high prevalence (82%) of physical inactivity among the study participants
xiii. The prevalence of smoking among the participants was 30% among which 97% are daily smokers
xiv. There was a high prevalence (37%) of alcohol consumption among participants
xv. Prevalence of participants that binge drink was 24%

5.2 LIMITATIONS

The limitations to the study should also be noted. First, this was a cross-sectional study. Therefore, causal associations cannot be ascertained, but can only be interpreted as hypothetical causal relations as this did not allow for a causal relationship between the risk factors and (obesity, hypertension and diabetes). Also, the present study involved commercial drivers operating in 'Taxi ranks' in BCCM, Eastern Cape Province and, therefore, may not necessarily represent the entire group of commercial drivers in South Africa. Diagnosis of diabetes among the participants without previous history was based on a single fasting blood glucose test. Additional tests such as glycosylated haemoglobin or oral glucose tolerance test could have validated the diagnosis of diabetes in the study.

Additionally, standard criteria of METs include abdominal obesity, hypertension, hypertriglyceridemia, low HDL-cholesterol level, and hyperglycemia (Kassi et al., 2011); however, this study assessed only three criteria. Thus firstly, there is a possibility of underestimating the prevalence of METs among the commercial drivers. The participants self-report of information may be inaccurately reported due to social desirability (for example reporting being physically active or eating fruits and vegetables), or embarrassment (for example under-reporting alcohol use) (Elshatarat et al., 2016). Second, the questionnaire was self-reported; as such some recall bias cannot be overruled. Third, there was no gold standard to compare all indices. Finally, some of the abdominal obesity cut-off points were developed for different population groups and may not necessarily suit the population in this study.

5.3 STRENGTHS

This study is the first survey conducted to screen for CMRFs among commercial taxi drivers in South Africa. Besides, it is a unique study, because it provides important baseline information about the significant correlates of CMRFs among commercial taxi drivers. Additionally, multiple BP readings were obtained; and all the measurements were done in the field. Measurements were done according to standard protocols. Participants with abnormal BP and glucose levels were advised regarding appropriate medical care. Given the paucity of data on the clustering of these cardio-metabolic risk factors among commercial drivers in BCMM, this study provides a snapshot of the metabolic health of this neglected group in health biomarkers assessment compared to the general population in South Africa. It also serves as comparable baseline data for health intervention among this unique population. Research assistants were properly trained to ensure the quality of data collection. Height, weight and waist and hip circumferences were measured, not self-reported, which is a more accurate assessment procedure that adds strengths to the data. Also, to the best of the researcher's knowledge, no study exists on the prevalence and predictors of abdominal obesity among taxi drivers in South Africa.

5.4 CONCLUSION

The prevalence report of overweight and obesity, pre-hypertension and hypertension and pre-diabetes and diabetes among commercial taxi drivers in BCMM is alarmingly high. This implies that the commercial taxi drivers are more predisposed to cardiovascular and metabolic diseases; this is worrisome, as it may have a dangerous effect on their health and thus may affect the safety of the public who travel with them and share the same road network with them.

The study shows that age, marital status, period of driving, smoking, sweet drinks consumption, hypertension and diabetes are significantly associated with overweight and obesity among the participants. Also, there was a high prevalence of abdominal obesity.

Age, marital status, period of driving, level of education, period of driving, obesity, alcohol, sweet drinks consumption and diabetes is significantly associated with hypertension

Also, there are significant associations between age, marital status, level of education, period of driving, sweet drinks consumption, physical activities, obesity and hypertension among the study participants.

The findings reveal that there is a high rate of physical inactivity, smoking and alcohol consumption prevalence.

5.5 RECOMMENDATIONS

According to the findings of this study, the following recommendations are made:

i. There is a need for continual awareness creation and screening for cardiovascular risk factors among commercial drivers across the country. Effective interventions targeted at the reduction of modifiable lifestyle behaviours should be implemented among this high-risk group.

ii. There is an urgent need for interventions tailored towards weight reduction among this important, but neglected population group. This may possibly assist in the reduction of non-communicable diseases, crashes and injuries related to obesity among commercial drivers.

iii. There is a need to further encourage and organize opportunistic screening for diabetes among this cohort to further reduce the burden of undiagnosed diabetes.

iv. Efforts should be made to promote participation in physical activities among commercial drivers in this study, using workplace health education to raise the awareness of its health benefits and the health and social hazards of smoking and alcohol intake

v. Age is one important associated factor of all the cardio-metabolic risk factors screened for in this study; hence commercial drivers should be encouraged to have constant health check-ups as they age and as their period of driving increases.

vi. On-site health education should focus on healthy behaviours and living at different taxi ranks in collaboration with the department of health.

vii. Future studies examining total or abdominal obesity in this special population group should endeavour to include cardiovascular risk variables such as total cholesterol, triglycerides, and fasting blood glucose. This will aid understanding of the relationship of obesity with physiological variables often associated with increased metabolic risk, among South African commercial taxi drivers.

viii. Studies on cardio-metabolic risk factors among commercial drivers in various settings and provinces in the country are also recommended, and should be regularly updated on the health profile of commercial drivers in South Africa.

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Step 1 Demographic Information

CORE: Demographic Information		
Question	**Response**	**Code**
Sex (*Record Male / Female as observed)*	Male 1 Female 2	C1
What is your date of birth? *Don't Know 77 77 7777*	└─┴─┘ └─┴─┘ └─┴─┴─┴─┘ *If known, Go to C3* dd mm year	C2

EXPANDED: Demographic Information		
What is the **highest level of education** you have completed?	No formal schooling 1 Grade 1-7 2 Grade 8-12 3 Tertiary 4 Refused 88	C3
What is your *racial group*	Black 1 Coloured 2 White 3 Refused 88	C4
What is your **marital status**?	married 1 Separated 2 Divorced 3 Widowed 4 Single 5 Refused 88	C5
How long have you been working as a mini bus taxi driver	Less than 2years 1 2-5 years 2 6-10 years 3 > 10 years 4 Refused 88	C6
How many days do you drive in a typical week?	Number of days └─┴─┘ days	C7
How much time do you spend driving on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	C8
How many hours of sleep do you get on a typical day	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	C9
How much do you earn in a month (RAND)	Per Month └─┴─┴─┴─┴─┴─┴─┘ *Go to T1*	C10a
	Refused 88	C10b

Step 1 Behavioural Measurements

CORE: Tobacco Use

Now I am going to ask you some questions about tobacco use.

Question	Response	Code
In the past, did you **ever smoke** any tobacco products? *(USE SHOWCARD)*	Yes 1 No 2 *If No, go to A1*	T1
Do you **currently** smoke any **tobacco** products, such as cigarettes, cigars or pipes?	Yes 1 *If Yes, go to T4* No 2 *If No, go to T3*	T2
When did you quit smoking	└─┴─┘ Years └─┴─┘ Months	T3
Do you currently smoke tobacco products **daily**?	Yes 1 No 2	T4
How old were you when you **first started** smoking?	Age (years) Don't know 77 └─┴─┘ *If Known, go to T7a*	T5
Do you remember how long ago it was? *(RECORD ONLY 1, NOT ALL 3)* *Don't know 77*	In Years └─┴─┘ *If Known, go to T7a*	T6a
	OR in Months └─┴─┘ *If Known, go to T7a*	T6b
	OR in Weeks └─┴─┘	T6c
On average, **how many** of the following products do you smoke **each day?** *(IF LESS THAN DAILY, RECORD WEEKLY)* *(RECORD FOR EACH TYPE, USE SHOWCARD)* *Don't Know 7777*	DAILY↓ WEEKLY↓	
	Manufactured cigarettes └─┴─┴─┴─┘ └─┴─┴─┴─┘	T7a
	Hand-rolled cigarettes └─┴─┴─┴─┘ └─┴─┴─┴─┘	T7b
	Pipes full of tobacco └─┴─┴─┴─┘ └─┴─┴─┴─┘	T7c
	snuff └─┴─┴─┴─┘ └─┴─┴─┴─┘	T7d
	Other └─┴─┴─┴─┘ └─┴─┴─┴─┘ *If Other, go to T7other*	T7e
	Other (please specify): └─┴─┴─┴─┴─┴─┘	T7other

CORE: Alcohol Consumption

The next questions ask about the consumption of alcohol.

Question	Response	Code
Have you **ever** consumed any alcohol such as beer, wine, spirits or *[add other local examples]*? *(USE SHOWCARD OR SHOW EXAMPLES)*	Yes 1 No 2 *If No, go to B1*	A1
Have you consumed any alcohol within the **past 12 months**?	Yes 1 *If Yes, go to A3* No 2 *If No, go to B1*	A2

During the past 12 months, **how frequently** have you had at least one **standard alcoholic drink**? *(READ RESPONSES, USE SHOWCARD)*	Daily 1 5-6 days per week 2 3-4 days per week 3 1-2 days per week 4 1-3 days per month 5 Less than once a month 6	A3
Have you consumed any alcohol within the **past 30 days**?	Yes 1 No 2 *If No, go to B1*	A4
During the past 30 days, on how many **occasions** did you have at least one standard alcoholic drink?	Number Don't know 77	A5
During the past 30 days, when you drank alcohol, how many **standard drinks on average** did you have during one drinking occasion? *(USE SHOWCARD)*	Number Don't know 77	A6
During the past 30 days, what was the **largest number** of standard drinks you had on a single occasion, counting all types of alcoholic drinks together?	Largest number Don't Know 77	A7
During the past 30 days, how many times did you have **five or more** standard drinks in a single drinking occasion?	Number of times Don't Know 77	A8

CORE: Diet

The next questions ask about the foods you usually eat. I have a nutrition card here that shows you some examples of local food. As you answer these questions please think of a typical week in the last year. How often do you do the following

Question	Response				Code
FOOD	NEVER	RARELY	SOMETIMES	OFTEN	D1
Take breakfast in your house					a
Buy food from vendors?					b
you buy fast foods (KFC, Steers)					c
Eat fried food					d
Do you take sweet drinks (Twist)					e

How many times do you eat vegetables	Number Don't know 77 Week Month	D2
How many times do you eat fruits	Number Don't know 77 Week Month	D3

CORE: Physical Activity; Recreational activities		
The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness and recreational activities (leisure) *[Insert relevant terms]*.		
Do you do any sports, fitness or recreational *(leisure)* activities that cause large increases in breathing or heart rate like *[running or football]* for at least 10 minutes continuously? *[INSERT EXAMPLES] (USE SHOWCARD)*	Yes 1 No 2 *If No, go to H 1*	P1
In a typical week, on how many days do you do sports, fitness or recreational *(leisure)* activities?	Number of days └─┘	P2
How much time do you spend doing sports, fitness or recreational activities on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	P3 (a-b)

CORE: History of Raised Blood Pressure

Question	Response	Code
Have you ever had your blood pressure measured by a doctor or other health worker?	Yes 1 No 2 *If No, go to H6*	H1
Have you ever been told by a doctor or other health worker that you have raised blood pressure or hypertension?	Yes 1 No 2 *If No, go to H6*	H2a
Have you been told in the past 12 months?	Yes 1 No 2	H2b
In the past two weeks, have you taken any drugs (medication) for raised blood pressure prescribed by a doctor or other health worker?	Yes 1 No 2	H3
Have you ever seen a traditional healer for raised blood pressure or hypertension?	Yes 1 No 2	H4
Are you currently taking any herbal or traditional remedy for your raised blood pressure?	Yes 1 No 2	H5

CORE: History of Diabetes

Question	Response	Code
Have you ever had your blood sugar measured by a doctor or other health worker?	Yes 1 No 2 *If No, go to H12a*	H6
Have you ever been told by a doctor or other health worker that you have raised blood sugar or diabetes?	Yes 1 No 2 *If No, go to H12a*	H7a
Have you been told in the past 12 months?	Yes 1 No 2	H7b
In the past two weeks, have you taken any drugs (medication) for diabetes prescribed by a doctor or other health worker?	Yes 1 No 2	H8
Are you currently taking insulin for diabetes prescribed by a doctor or other health worker?	Yes 1 No 2	H9

Have you ever seen a traditional healer for diabetes or raised blood sugar?	Yes 1 No 2	H10
Are you currently taking any herbal or traditional remedy for your diabetes?	Yes 1 No 2	H11

CORE: Lifestyle Advice		
Questions	**Response**	**Code**
During the past three years, has a doctor or other health worker advised you to do any of the following? *(RECORD FOR EACH)*		
Quit using tobacco or don't start	Yes 1 No 2	H12a
Reduce salt in your diet	Yes 1 No 2	H12b
Eat at least five servings of fruit and/or vegetables each day	Yes 1 No 2	H12c
Reduce fat in your diet	Yes 1 No 2	H12d
Start or do more physical activity	Yes 1 No 2	H12e
Maintain a healthy body weight or lose weight	Yes 1 *If C1=1 go to M1* No 2 *If C1=1 go to M1*	H12f

Step 2 Physical Measurements

CORE: Blood Pressure		
Cuff size used	Small 1 Medium 2 Large 3	M1
Reading 1	Systolic (mmHg) └─┴─┴─┘	M2a
	Diastolic (mmHg) └─┴─┴─┘	M2b
Reading 2	Systolic (mmHg) └─┴─┴─┘	M3a
	Diastolic (mmHg) └─┴─┴─┘	M3b
Reading 3	Systolic (mmHg) └─┴─┴─┘	M4a
	Diastolic (mmHg) └─┴─┴─┘	M4b
During the past two weeks, have you been treated for raised blood pressure with drugs (medication) prescribed by a doctor or other health worker?	Yes 1 No 2	M5
CORE: Height and Weight		
Question	**Response**	**Code**
Height	in Centimetres (cm) └─┴─┴─┘.└─┘	M6
Weight	in Kilograms (kg) └─┴─┴─┘.└─┘	M7
CORE: Waist		
Waist circumference	in Centimetres (cm) └─┴─┴─┘.└─┘	M8
CORE: Neck		
Neck circumference	in Centimetres (cm) └─┴─┴─┘.└─┘	M9

EXPANDED: Hip Circumference and Heart Rate		
Hip circumference	in Centimeters (cm) └─┴─┴─┘.└─┘	M10
Heart Rate		
Reading 1	Beats per minute └─┴─┴─┘	M11a
Reading 2	Beats per minute └─┴─┴─┘	M12b
Reading 3	Beats per minute └─┴─┴─┘	M13c

Step 3 Biochemical Measurements

CORE: Blood Glucose		
Question	**Response**	**Code**
During the past 12 hours have you had anything to eat or drink, other than water?	Yes 1 No 2	B1
Random blood glucose *[CHOOSE ACCORDINGLY: MMOL/L OR MG/DL]*	mmol/l └─┴─┘.└─┴─┘ mg/dl └─┴─┴─┘.└─┘	B2
Today, have you taken insulin or other drugs (medication) that have been prescribed by a doctor or other health worker for raised blood glucose?	Yes 1 No 2	B3

University of Fort Hare
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ETHICAL CLEARANCE CERTIFICATE
REC-270710-028-RA Level 01

Certificate Reference Number:	GOO121SADE01
Project title:	**Screening for cardio-metabolic risk factors among Minibus taxi drivers in East London, South Africa.**
Nature of Project:	Masters in Health Science
Principal Researcher:	Aanouluwa Adedokun
Supervisor:	Prof D.T Goon
Co-supervisor:	N/A

On behalf of the University of Fort Hare's Research Ethics Committee (UREC) I hereby give ethical approval in respect of the undertakings contained in the above-mentioned project and research instrument(s). Should any other instruments be used, these require separate authorization. The Researcher may therefore commence with the research as from the date of this certificate, using the reference number indicated above.

Please note that the UREC must be informed immediately of

- Any material change in the conditions or undertakings mentioned in the document
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research

The Principal Researcher must report to the UREC in the prescribed format, where applicable, annually, and at the end of the project, in respect of ethical compliance.

Special conditions: Research that includes children as per the official regulations of the act must take the following into account:

Note: The UREC is aware of the provisions of s71 of the National Health Act 61 of 2003 and that matters pertaining to obtaining the Minister's consent are under discussion and remain unresolved. Nonetheless, as was decided at a meeting between the National Health Research Ethics Committee and stakeholders on 6 June 2013, university ethics committees may continue to grant ethical clearance for research involving children without the Minister's consent, provided that the prescripts of the previous rules have been met. This certificate is granted in terms of this agreement.

The UREC retains the right to

- Withdraw or amend this Ethical Clearance Certificate if
  - Any unethical principal or practices are revealed or suspected
  - Relevant information has been withheld or misrepresented
  - Regulatory changes of whatsoever nature so require
  - The conditions contained in the Certificate have not been adhered to

- Request access to any information or data at any time during the course or after completion of the project.

- In addition to the need to comply with the highest level of ethical conduct principle investigators must report back annually as an evaluation and monitoring mechanism on the progress being made by the research. Such a report must be sent to the Dean of Research's office

The Ethics Committee wished you well in your research.

Yours sincerely

Professor Wilson Akpan
Acting Dean of Research

02 November 2016

Eastern Cape Department of Health

Enquir1es:	Madoda Xokwe	Tel No:	040 608 0830
Date:	18 November 2016	Fax No:	043 642 1409
e-mail address:	madoda.xokwe@echealth.gov.za		

Dear Ms. A. Adedokum

Re: Screening For Cardio-Metabolic Risk Factors among Minibus Taxi Drivers in East London, South Africa. (EC_2016RP29_402)

The Department of Health would like to inform you that your application for conducting a research on the abovementioned topic has been approved based on the following conditions:

1. During your study, you will follow the submitted protocol with ethical approval and can only deviate from it after having a written approval from the Department of Health in writing.
2. You are advised to ensure, observe and respect the rights and culture of your research participants and maintain confidentiality of their identities and shall remove or not collect any information which can be used to link the participants.
3. The Department of Health expects you to provide a progress on your study every 3 months (from date you received this letter) in writing.
4. At the end of your study, you will be expected to send a full written report with your findings and implementable recommendations to the Epidemiological Research & Surveillance Management. You may be invited to the department to come and present your research findings with your implementable recommendations.
5. Your results on the Eastern Cape will not be presented anywhere unless you have shared them with the Department of Health as indicated above.

Your compliance in this regard will be highly appreciated.

SECRETARIAT: EASTERN CAPE HEALTH RESEARCH COMMITTEE

PGDP EASTERN CAPE 2004 - 2014 PROVINCIAL GROWTH AND DEVELOPMENT PLAN

Ikamva eliqaqambileyo!

University of Fort Hare
Together in Excellence

Ethics Research Confidentiality and Informed Consent Form

SCREENING FOR CARDIOMETABOLIC RISK FACTORS AMONG COMMERCIAL DRIVERS IN BUFFALO CITY METROPOLITAN MUNICIPALITY, EASTERN CAPE, SOUTH AFRICA.

PRINCIPAL INVESTIGATOR: Miss A.O. ADEDOKUN (BNSc RN, RM)
SUPERVISOR: Prof D.T GOON (Department of Nursing Science, University of Fort Hare, East London).

Dear Research Participant,
You are invited to participate in a research study that forms part of my formal Master's in Nursing Science (M cur) degree programme. This information Leaflet will help you to decide whether you will like to participate before you agree to take part unless you are completely satisfied with all aspect of the study.

WHAT IS THE STUDY ALL ABOUT?
Cardio-metabolic risk factors are clusters of various factors that lead to cardiovascular diseases (CVD) and type 2 diabetes mellitus (Leiter, et al., 2011:e1), and cause of about 67% cardiovascular diseases and diabetes mortality worldwide in 2010 (Danaei, et al., 2014:634). Cardiovascular diseases are the leading cause of 31% of all death globally, killing about 17.3 million per year; and the number one global cause of death in the developing and the non-developed countries (World Health Organization [WHO], 2016; International Alliance for Responsible Drinking [IARD], 2016:1). Non-communicable diseases (NCDs) account for about 29% of deaths and 11% as a result of CVD in South Africa (WHO 2011). Cardio-metabolic risk factors are classified into non-modifiable risk factors include age, race and ethnicity, gender, and family history; and modifiable risk factors include obesity, inflammation, hypertension, smoking,

physical inactivity, unhealthy diet, insulin resistance, dyslipidemia and hyperglycaemia (Wang, 2015).

Driving profession has a great impact in the transportation industry and of great benefit to the public and their safety (Sangaleti, et al., 2014). Lim and Chia (2015:92), submitted that some of the routine activities of vehicle drivers that precipitate obesity and overweight are their lengthy working hours on the road, unpredicted schedules, physical inactivity and a rare option for healthy diet. Anecdotally, commercial drivers in South Africa exhibits poor lifestyle health behaviour, in terms of sedentarism, excessive alcohol consumption, smoking and other illicit health behaviours. However, unlike other population groups in South Africa, their physical and biomarker risks health assessment have not been documented in South Africa as elsewhere.
Therefore, the present study will examine the correlates of developing cardio metabolic abnormalities minibus taxi drivers in East London metropolitan.

WHAT WILL YOU BE REQUIRED TO DO IN THIS STUDY?

If you decide to take part in this study, you will be required to do the following:

- Sign this informed consent;
- Complete a World Health Organization STEPwise questionnaire which comprise of demographic information (Age, Education, Race, marital status and work) behavioural life style (Tobacco use, smoking, alcohol consumption and diet) and physical activity involvement;
- Complete the questionnaire in a designated conducive place to be provided by the chairperson of each taxi rank. This should take 30 minutes to be completed;
- Sit for ten minutes before blood pressure is being measured three times;
- Have your weight, height, waist, hip and neck circumferences measured;

ARE THERE CONDITIONS THAT MAY EXCLUDE YOU FROM THE STUDY?

You will not be eligible to participate in this study if you have less than three months experience as a commercial driver.

WHAT ARE THE RISKS INVOLVED IN THE STUDY OR CAN ANY OF THE STUDY PROCEDURES RESULT IN PERSONAL DISCOMFORT OR INCONVENIENCE?

Questionnaire: The study and procedure involves no foreseeable physical discomfort or inconvenience for you or to your family. Due to the personal nature of the questions, you may experience some emotional discomforts.

Blood pressure: The procedure will not be painful as it is not invasive and will not involve any discomfort.
Anthropometric Measurements: The procedure will not be painful as it is not invasive and will not involve any discomfort.

WHAT ARE THE POTENTIAL BENEFITS OF PARTICIPATING IN THIS STUDY?

The benefits of participating in this study are:

- You will make contribution towards broadening of academic knowledge and understanding towards cardio-metabolic risk factors among commercial drivers in Buffalo city metropolitan municipality, South Africa.
- You will receive personal information concerning your cardio-metabolic health status and individuals at risk of cardio-metabolic co-morbidities.
- It can direct efforts and reform in the prevention and management of cardio-metabolic risk factors among drivers.
- The data may also proof useful in epidemiological studies that correlate behavioural lifestyles with cardio-metabolic risk factors among drivers.
- The findings will create awareness of the health conditions of commercial drivers in Buffalo city metropolitan municipality, South Africa.

WILL YOU RECEIVE ANY FINANCIAL COMPENSATION OR INCENTIVE FOR PARTICIPATING IN THE STUDY
Please, note that you will not be paid for participating in the study.

WHAT ARE YOUR RIGHTS AS A PARTICIPANT IN THIS STUDY?

Your participation in this study is entirely voluntary. You have the right to withdraw at any stage without any penalty or future disadvantage whatsoever. You don't have to provide reason for such decision. You may also be asked to withdraw from the study if you do not adhere to the study protocol.

HOW WILL CONFIDENTIALITY AND ANONIMOTY BE ENSURED IN THE STUDY?

Confidentiality of data will be maintained such that your identity will only be known to the researcher. I will remove or mask all identifying data on transcriptions and final report documents e.g thesis and journal articles. Thus your identity will not be revealed during or after the study, even when the study is use in any format.

IS THE RESEARCHER QUALIFIED TO CARRY OUT THE STUDY?

The researcher is a qualified, registered nurse and midwife who has previously completed similar research studies. Also, she has received training in Nursing Science from the University of Fort Hare, South Africa.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

Yes. The University of Fort Hare Research Ethics Committee (UREC) have approved the formal study proposal. All parts of the study will be conducted according to international accepted ethical principles.

WHO CAN YOU CONTACT FOR ADDITIONAL INFORMATION REGARDING THE STUDY?

The principal investigator, Miss A.O. Adedokun, can be contacted on her cellular phone at 0737357980. The supervisor, Prof D.T. Goon, can be contacted during office hours at Tel (043)704-7368. Should you have any question regarding the ethical aspects of the study, you can contact the Dean of research, University of Fort Hare, Prof Gideon De Wets, during office hours at Tel (043)704-7512.

DECLARATION: CONFLICT OF INTEREST

There is no conflict of interest that may influence the study procedures, data collection, data analysis and publication of results.

A FINAL WORD

Your co-operation and participation in the study will be greatly appreciated. Please sign the underneath informed consent if you agree to partake in the study.

INFORMED CONSENT

I hereby agree to participate in research regarding Screening for cardio-metabolic risk factors among commercial drivers in Buffalo City Metropolitan Municipality, Eastern Cape, South Africa. I understand that I am participating freely and without being forced in any way to do so. I also understand that I can stop this interview at any point should I not want to continue and that this decision will not in any way affect me negatively.

I understand that this is a research project whose purpose is not necessarily to benefit me personally.

I have received the telephone number of a person to contact should I need to speak about any issues which may arise in this interview.

I understand that this consent form will not be linked to the questionnaire, and that my answers will remain confidential.

I understand that if at all possible, feedback will be given to my community on the results of the completed research.

……………………………..
Signature of participant **Date**:…………………..

I hereby agree to the tape recording of my participation in the study

……………………………..
Signature of participant **Date**:…………………..

THESIS OUTPUTS

PUBLISHED ARTICLE

1. **Adedokun, A.O.,** Goon, D.T., Owolabi, E.O., Adeniyi, O.V. & Ajayi, A.I (2017). Driving to better health: Screening for hypertension and associated factors among commercial taxi drivers in Buffalo City Metropolitan Municipality, South Africa. *The Open Public Health Journal*, 10: 303-312.

SUBMITTED MANUSCRIPTS

1. **Adedokun, A.O.,** Goon, D.T. & Adeniyi, O.V. (2017). Driving towards better health: A cross-sectional study of the prevalence and correlates of obesity among commercial drivers. *BMC Population and Health Nutrition.*

2. **Adedokun, A.O.,** Goon, D.T. & Adeniyi, O.V. (2017). Anthropometrically determined abdominal obesity among South African commercial taxi drivers using four contrasting criteria. *South African Medical Journal*

3. **Adedokun, A.O.,** Goon, D.T. & Adeniyi, O.V. (2017). Driving towards better health: A cross-sectional survey of prevalence, awareness, treatment and determinants of diabetes mellitus type 2 among commercial taxi drivers in East London, South Africa. *South African Journal of Family Practice*

4. **Adedokun, A.O.,** Goon, D.T. & Adeniyi, O.V. (2017). Metabolic syndrome and associated factors among commercial taxi drivers in BMMC, South Africa. *International Journal of Occupational and Environmental Health*

5. **Adedokun, A.O.,** Goon, D.T. & Adeniyi, O.V. (2017). On-site evaluation of smoking, alcohol consumption and physical inactivity among commercial taxi drivers in Buffalo City Metropolitan Municipality, South Africa. *Online Journal of Health and Allied Sciences,*

CONFERENCE PRESENTATIONS

1. **Adedokun, A.O.,** Goon, D.T. & Adeniyi, O.V. (2017). Metabolic syndrome and associated factors among commercial taxi drivers in BMMC, South Africa. University of Fort Hare, Postgraduate Conference, 26th October, 2017.

2. **Adedokun, A.O.,** Goon, D.T. & Adeniyi, O.V. (2017). Driving towards better health: A cross-sectional survey of prevalence, awareness, treatment and determinants of diabetes mellitus type 2 among commercial taxi drivers in East London, South Africa. International Conference for Physical Life and Health Sciences, 28th November-1st December 2017 (Accepted for oral presentation).