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HEALTH SCIENCES

**PREVALENCE AND RISK FACTORS ASSOCIATED WITH HYPERTENSION AMONG
URBAN COMMUTERS IN NIGERIA, SOUTH AFRICA AND ZIMBABWE**

BY

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A RESEARCH REPORT

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Declaration

I [Hlobile Zanele Nkambule-Bhembe] declare that this research report is my own original, unaided work. It is being submitted for the degree of Master of Science in Epidemiology at the University of Witwatersrand, Johannesburg, South Africa. It has not been submitted before for any degree or examination at any other University or institution.

Signed Hlobile Zanele Nkambule-Bhembe on the 26th day of October 2020 in Mbabane, Kingdom of Eswatini

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ACRONYMNS

AC	Active Commuting
ACC/AHA	American College of Cardiology/ American Heart Association
BP	Blood Pressure
DBP	Diastolic Blood Pressure
CVD	Cardiovascular Disease
GBD	Global Burden of Disease
HIV	Human Immunodeficiency Syndrome
JNC	Joint National Committee
LMICs	Low-Middle-Income Countries
NCD	Noncommunicable Diseases
SBP	Systolic Blood Pressure
SES	Socioeconomic Status
SSA	Sub-Saharan Africa
UMIC	Upper-Middle-Income Countries
WHO	World Health Organisation
WHR	Waist Hip Ratio

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DEDICATION

I dedicate this research work to my husband and three sons. You have been my best cheerleaders.

ABSTRACT

Background: Hypertension is one of the key risk factors for cardiovascular disease that has affected over one billion people worldwide, and continues to kill about nine million people each year (1). Hypertension is a common problem among Sub-Saharan African countries, and comes with serious economic implications due to its underdiagnosis and gravity of complications (2). This study aimed to assess hypertension prevalence and associated risk factors among urban commuters in Nigeria, South Africa and Zimbabwe.

Methods: The study analysed secondary data from the CARFA Study: An Evaluation of Cardiovascular Risk Factors among commuter population in Nigeria, South Africa and Zimbabwe that used face to face structured questionnaires adapted from the WHO STEPwise surveillance approach for NCDs. This approach uses a standardized surveillance tool developed by the World Health Organisation to collect “self-reported” data on NCDs including “demographic and behavioural risk factors,” in addition to physical and biochemical measures. The study sample included all individuals found in each of the selected transit areas who used public transport from 2017 to 2019 in the three countries. Pregnant women and mentally-disabled individuals were excluded from the study.

A sample of 1384 participants who had all the variables of interest were selected from a CARFA total sample of 1425 individuals and included in this study. Data on demographic, socioeconomic, anthropometric and behavioural factors were collected. An average of two blood pressure readings taken with 2-minute intervals after 5-minute rest was used. Individuals that were classified as hypertensive were those with systolic blood pressure (BP) ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg or those taking antihypertensive medication. Data analyses were conducted in STATA 14.

Key characteristics were described through the hierarchical approach by using summary statistics and multivariable logistic regressions to identify key-country specific predictors of hypertension.

Results: In total, the study had 1384 participants, with a mean age of 35.9 years \pm 11.3 years.

Overall, 324 (23.4%) of the participants were hypertensive, whilst 596 (43.1%) were prehypertensive and 464 (33.5%) were normotensive. The highest proportion of hypertensive participants was found in South Africa (28.6%) followed by Zimbabwe (26.7%) and Nigeria with the least hypertensive participants (13%). Results obtained from the hierarchical adjusted multivariable logistic regression models revealed that, overall, being 60 years and older (AOR = 2.10; 95% CI: 1.16 – 3.87), having a family history of hypertension (AOR = 1.41; 95% CI: 1.03 – 1.92), being a current smoker (AOR = 1.34; 95% CI: 1.01 – 1.78), overweight (AOR = 1.68; 95% CI: 1.24 – 2.27), obesity (AOR = 1.54; 95% CI: 1.08 – 2.20), self-reported diabetic status (AOR = 1.62; 95% CI: 1.16 – 2.26) and self-reported hypertensive status (AOR = 1.89; 95% CI: 1.39 – 2.58) were significantly associated with hypertension.

In Nigeria, obesity (AOR = 7.09, 95% CI: 2.84 – 17.70) and self-reported hypertensive status (AOR = 12.13, 95% CI: 4.35 – 33.82) were significantly associated with hypertension. In South Africa, having primary education (AOR = 0.44, 95% CI: 0.21- 0.95) and consuming vegetables three to four times a week (AOR = 1.66, 95% CI: 1.04 – 2.65) was significantly associated with hypertension, whilst in Zimbabwe consuming fruits three to four times a week (AOR = 0.55, 95% CI: 0.32 – 0.94) was the only factor significantly associated with hypertension.

Conclusion: Hypertension prevalence was high in South Africa and Zimbabwe, but relatively low in Nigeria. Risk factors associated with hypertension differed by country. Future research should seek to establish causal pathways through which various risk factors lead to hypertension in different SSA countries. Public health policies and intervention programs should focus on early disease detection and context specific lifestyle modifications to reduce the hypertension burden.

CHAPTER 1

INTRODUCTION

1.1 Background

Hypertension is rapidly emerging as a global health concern, together with other noncommunicable diseases (NCDs) such as cancer, diabetes mellitus, cardiovascular disease among others (3).

Hypertension has affected over one billion people world-wide and continues to kill approximately nine million people per year (1). From 2007 to 2017, the number of deaths from noncommunicable diseases rose by 22.7% representing 7.61 million more deaths worldwide (3).

The results of the Prospective Urban Rural Epidemiology (PURE) study conducted on 142042 individuals aged between 35 and 70 years found that 57840 (40.8%) participants had hypertension, only 26877 (46.5%) of hypertensive participants knew their health status, 23 510 (16.6%) participants were receiving hypertension treatment, and 7634 (13.2%) of the participants had controlled hypertension (which was 32.5% of those receiving treatment)(4).

Low-middle-income countries (LMICs) ranked lowest in terms of hypertension control (10.8%), 19% in high-income countries (HICs) and 15.6% in upper-middle-income countries (UMICs) (4). Poor hypertension control drivers varied between HICs and LMICs. These included social determinants (among others: the structure of human settlements, internal migration of individuals from rural areas, socioeconomic status, political willpower, racial and gender issues); health-related issues (accessibility, availability, infrastructure and quality), medical edification (number of trained medical personnel) as well as patient cooperation and adherence (4). However, the PURE study failed to “unpack the mechanisms” behind the disparities in performance of health-care systems and to explain why some countries perform better than others.

Both developed nations and developing countries need to come up with contextually relevant interventions that are more effective in treating hypertension thus lessening the strain caused by this disease on health-care systems. This is particularly important because, if left uncontrolled, hypertension may cause many other health conditions such a heart attack, heart failure and stroke.

1.2 Problem Statement

Hypertension has become the “leading cause of death” across the globe (5). It is estimated that by the year 2025, LMICs will have about 75% hypertensive individuals (6). Currently, more than 80% of deaths in LMICs, including Sub-Saharan Africa (SSA) are due to chronic diseases, including hypertension (7). The SSA region is undergoing rapid epidemiological transition characterised by rapid urbanization and lifestyle changes which have increased both the incidence and prevalence of NCDs, including hypertension and cardiovascular diseases (CVDs) (8). There is growing evidence of poor awareness, detection and management of hypertension in countries in this region, particularly among the poor and marginalized groups (2,9).

This study focused on hypertension prevalence among commuter populations, a group of individuals who recurrently travel from their residences to work place or place of study or to seek employment. Focusing on commuters offers an opportunity to study a substantial number of individuals of low-and-middle income status on a sovereign environment (10). The Sub-Saharan African region is faced with the highest burden of both communicable and non-communicable diseases compared to any other region, yet it has the weakest health care system in the world (11). Most commuters found in the inner-city taxi ranks come from diverse cultural backgrounds. Thus, although these urban commuters may have access to social amenities including health care services, other factors such as overcrowding and cultural diversity may hinder access to these services. As a result, the key risk factors in this group of people remain unknown.

1.3 Justification

Hypertension is a complex chronic health condition which often leads to the advancement of cardiovascular disease. Several studies have investigated hypertension prevalence in diverse environments including the sub-Saharan region for both urban and rural settings. Numerous studies have investigated the health status of commuters, particularly in developed nations, while very few have been conducted in developing nations (12–21). Notably, no study was found that conducted a comparative analysis of hypertension prevalence and associated risk factors among commuters from different countries in the Sub-Saharan region. Thus, this paper bridges that gap by conducting a comparative analysis of urban commuters from three countries (Nigeria, South Africa and Zimbabwe) in order to inform context-specific interventions.

All three countries have high population densities in inner cities and thus often face high traffic congestion, accidents and high police presence/road blocks particularly during peak hours. All these circumstances, coupled with the poor customer care services rendered by rude rank marshals and drivers are likely to stress commuters, thus increase their risk of developing hypertension. This study will provide insight on the hypertensive status of hard-to-reach urban commuters and associated risk factors in order to inform context-specific public health policies for each of these countries. The main research question for this study was: how prevalent is hypertension among urban commuters in Nigeria, South Africa and Zimbabwe and what are the associated risk factors?

1.4 Research Aim

The main aim of the study was to estimate the prevalence of hypertension among commuter populations in Nigeria, South Africa and Zimbabwe and the associated risk factors.

1.5 Specific Objectives

The specific objectives of this study were to:

- Determine the prevalence rate of hypertension among commuters in Nigeria, South Africa and Zimbabwe;
- Determine the risk factors associated with hypertension among commuters in Nigeria, South Africa and Zimbabwe;
- Compare risk factors associated with hypertension in Nigeria, South Africa and Zimbabwe.

1.6 Literature Review

1.6.1 Hypertension in Low-and Middle-Income Countries

CVD has been classified as the number one reason for mortality and morbidity across the globe (22).

Among NCDs, CVD is the principal reason for mortality and morbidity globally and researchers have claimed that around one-third of all deaths globally are a result of CVD (23). Sarki *et al.*, 2015 found higher hypertension prevalence among the elderly, overweight and obese, non-educated, urban dwellers than rural counterparts, and in males compared to their female counterparts (23).

Whilst various studies show that there is a higher burden of hypertension in LMICs whereby about 30% of all adults in these countries are hypertensive, most of these studies are limited by high risk of selection bias, high levels of heterogeneity and over-reliance on hospital-based studies with very few community-based studies (23,24). However, despite the above limitations, the findings from these studies are still useful in informing hypertension screening and treatment programs in LMICs (23). This study will fill the existing research gap because it does not rely on hospital data but on data from community-based transit stations in the various cities and town from Nigeria, South Africa and Zimbabwe. That said, the results of this study will most likely have selection bias and high heterogeneity.

1.6.2 Hypertension in Sub-Saharan African Populations

The prevalence of hypertension and other related cardiovascular diseases is very high in SSA, yet the actual disease burden is poorly understood (25). A study conducted in four SSA countries in 2017 revealed that the prevalence of hypertension differed in the region; the rate was 15.1% in Nanoro, Burkina Faso, 54.1% in Soweto, South Africa and about 48% of the people suffering from hypertension were mindful of their health conditions (25).

Some of the drivers of hypertension and other NCDs include, “mass migration” of rural-based residents to urban areas and semi-urban areas (2). Such movements coupled with migrants’ changes in diet from low to high salt diet and changes from low to high calorie diets low in potassium were associated with increases in blood pressure and body weight (2,12). Other studies have shown that urbanization often results in a shift from low-fat and vegetable-rich diet to a high-fat and animal-based diet (8). This diet shift is often associated with sedentary lifestyles which results in an increase in obesity, hypertension, CVDs and other NCDs (8). Furthermore, Tibazarwa & Damasceno, 2014 revealed that individuals who migrate from low-salt consumption societies to urban high-salt diets tend to have elevated blood pressures (13).

The Sub-Saharan region is occupied by diverse ethnic groups, cultures and countries of different socioeconomic status. However, most available data and statistics focus on the black groups and the findings show that hypertension increases with increased urbanization. In semi-rural areas, the rising prevalence of hypertension is a result of lifestyle changes associated with civilization and lifestyle modifications which are not in line with the economic conditions of most African states, some of which are severely affected by famine, resource deficiencies and civil conflicts (2,12).

Despite the alarming prevalence of hypertension in SSA, prevention and management measures are often unstructured and suboptimal (7). This is often caused by limited resources, constrained health care systems, lack of effective population level preventive strategies, inefficient drug therapy regimens

and other barriers that hinder adherence to prescribed medication (7,14,25). For instance, in Nigeria, some of the barriers that hamper efficient management of hypertension occur at various levels, including patient, physician and health system levels. Poor knowledge about hypertension, poor adherence to medication, lack of awareness of lifestyle modifications necessary to prevent and manage hypertension, and unrealistic expectations on treatment are some of the additional barriers (15).

1.6.3 Hypertension Prevention and Control

Since hypertension can exist with minimal symptoms, it often exists for prolonged periods of time undetected in many individuals leading to adverse cardiovascular outcomes and underestimation of the disease(13). Effective hypertension prevention and control may be realized through collaborative efforts from all stakeholders which include patients, physicians and the community. A study by Guwatudde *et al.*, 2015 on the burden of hypertension in SSA found that about 50% of hypertensive individuals are unaware of their condition, revealing the high burden and danger of undiagnosed and uncontrolled hypertension facing the region, and indicating the need to increase screening in order to enhance early detection of hypertension and avail adequate resources for treatment (26).

Carey *et al.*, 2018 suggests that the best way to prevent and control hypertension is through streamlined population-based strategies that include policies aimed at increasing consciousness, handling and monitoring of hypertension at individual level as well as policies intended to achieve blood pressure stability in the entire population (16). These policies would work better if there is sufficient use of resources, reliable and optimal adherence to treatment and minimum therapeutic inertia (16). This argument is in line with the Chronic Care Model which emphasizes partnership among patients, service providers and health systems, thus incorporating the multilevel approach for controlling hypertension (17).

SSA is still lagging behind in terms of formulating effective public health policies to deal with hypertension and providing access to quality health care for diagnosis and treatment of hypertension, yet it is hardest hit by the hypertension and NCD scourge (27,28). BeLue, 2017 in the study on the role of family in NCD prevention in SSA highlighted that it is critical for SSA to include the family in primary and secondary prevention strategies for NCDs to enhance existing intervention, expose the whole family to positive NCD management methods and to reinforce better NCD outcomes for the whole family (29).

1.6.4 The Commuter Populations

Commuters are defined as individuals that travel for some distance to and from work on a regular basis (18). Several studies have been conducted around the commuter population mainly to assess the relationship between being an active commuter (that either walks and/or cycles) to and from work and disease prevalence. Kageyama *et al.*, 1998 conducted a study in Tokyo to assess short-term heart rate variability, chronic stress or fatigue on individuals who commuted over longer distances, those who worked long hours, and found that even though shifts in autonomous activities did not directly caused disease, they had potential to induce cardiovascular irregularities that may trigger the onset of heart disease (19).

Very few studies have been conducted on commuter populations in SSA. Studies conducted in South Africa have focused on how acceptable mobile health interventions increase awareness to the risk of diabetes among commuters; “potential barriers to rapid testing for Human Immunodeficiency Virus (HIV) among commuter population in Johannesburg” and the acceptability of home-based rapid testing for HIV infection among inner city commuters in Johannesburg (10,20,21). These studies found that one’s marital status, occupation, educational level, area of employment, residence, distance to the nearest clinic and number of sexual partners were all significantly associated with potential barriers to

HIV testing (20), and that home HIV testing was the preferred alternative to health facility testing among urban-based commuters of the inner city of Johannesburg (21). However, no study has been found that concentrated on a comparative analysis of hypertension prevalence among urban commuters in the SSA.

1.6.5 Active Commuting (AC), Physical Activity and Health

Several studies have reported that active commuting and the use of public transportation increases a population's level of physical activity (18,27,28,30,31). For instance, using public transport often involves interval walking to and from transfer stations and walking to the public transport station at the beginning of the journey or at the end the journey (28). Individuals who spend more time actively commuting (walking and/or cycling), have higher levels of mental wellbeing and overall health (32).

AC is a habit that comes with several health benefits including reducing the risk of obesity, CVDs (such as diabetes, hypertension) and mortality (12,28,33). AC can be used to promote population level physical activity (34). Individuals who use active transport, that is, those who cycle, walk or use public transport together with interval walks to reach their work place, have lower chances of being overweight or obese than those who rely on other means of transport. This reduces their risk of developing noncommunicable diseases (35).

1.6.6 Hypertension Risk Factors

Hypertension is associated with some social determinants (rapid urbanization, resource deficiency, illiteracy, gender issues, politics and racial discernment); socioeconomic factors (housing, education and income); adjustable risk factors (physical inactivity, unhealthy diet, alcohol abuse and smoking); metabolic issues (diabetes, obesity and raised blood lipids), and is closely associated with other cardiovascular diseases such as heart attacks, strokes, heart failure (36).

A majority of cardiovascular diseases are a result of risk factors that can be controlled and modified. Some of the identifiable risk factors include among others, elevated blood pressure, obesity, diabetes mellitus, smoking, physical inactivity, and alcohol abuse (37). According to Mills *et al.*, (2016), in 2010, 31.1 % (1.39 billion people) of all adults had hypertension (38). Hypertension prevalence was lower in HICs (28.5%) compared to LMICs (31.5%) (4). Nevertheless, despite this high hypertension prevalence, hypertension management interventions are relatively low in these LMICs compared to HICs (4).

Research in African states revealed that, despite the fact that over 90% patients with haemorrhagic stroke and over 50% with ischaemic stroke have hypertension, awareness of hypertension is very low, along with prevention, treatment and control measures (39). Very few hypertensive people in LMICs receive blood pressure treatment (40), despite the availability of safe and effective methods to prevent, manage and control high blood pressure (39).

Bovet *et al.*, 2017 observed the following on recommendations for prevention, diagnosis and management of hypertension in SSA: whilst HICs have successfully reduced hypertension through population-based interventions and by making diagnosis and treatment widely available, most developing countries are yet to implement population level policies and strategies focused at individuals with high risk of hypertension (41). Ideally, these strategies should include policies that promote the engagement in regular physical activity; maintaining body mass index < 25kg/m²; limiting alcohol consumption; abstaining from tobacco; reducing salt consumption; maintaining adequate potassium consumption; consuming a balanced diet (such as a diet that includes a variety of high-fibre foods and reduced consumption of foods loaded with saturated fats), among others (41).

According to Shrivastava *et al.*, 2014, the recognized determinants of long-term outcomes of hypertension worldwide include, age and sex, socioeconomic status, race, ethnic differences, genetics,

rural-urban area disparity, urbanization, poor consciousness of hypertension risk factors together with poor compliance to treatment and the presence of comorbidities; stress; obesity; dietary practices and increased consumption of saturated fats; excess sodium consumption; alcohol and tobacco; physical inactivity; absence of regular screening; poor health-care seeking behaviour and access to health systems as well as cultural expectations and values (42).

1.6.6.1 Age and Sex

Chow *et al.*, 2013, in a study on 17 high-middle and low-income countries found that whilst older individuals aged 50 years and above tend to have consistently greater likelihood of developing hypertension, they are more conscious of their health status, access treatment more and have better control of their conditions than the younger individuals (43). Hendriks *et al.*, 2012 studied hypertension in four rural and urban communities in SSA and found that age and BMI were each independently associated with hypertension in all populations considered by the study. Also, there were differences in the effects of ageing and BMI on BP between males and females, whereby increase in age resulted in a steeper increase in blood pressure among women compared to men (44). Christensen *et al.*, 2016 conducted a study in rural Kenya and found that age was positively associated with BP and plasma cholesterol levels, whilst sitting pulse rate was negatively associated with age only among women (45).

In a study by Boo, 2018 more men than women had hypertension and diabetes (46). Also, women had greater awareness of their health status than men, thus more women than men were on treatment and had their health conditions under control (43,46). However, a study by Toprak & Demir, 2012 found that women had 2.74 times more risk of hypertension than men (47). This was in line with the fact that in this study group; obesity was more profound among female participants than male participants in all the age categories under consideration.

Similar findings were shared by Jaddou *et al.*, 2011 in a National survey in Jordan whereby a stratified multiple logistic regression analysis showed that hypertension was associated with increasing age and BMI, having diabetes and the lowest level of education (48). In older individuals, the hypertension risk increased sharply in female participants than males, particularly beyond 50 years of age (48). Sarki *et al.*, 2015 argued that the association between being older and the increased risk of developing hypertension can be “attributed to age-related structural changes” that occur in a person’s blood vessels with age, influencing the vascular lumen to become narrow thus resulting in increases in blood pressure (23).

1.6.6.2 Socioeconomic Status (SES)

Studies conducted on both developing and developed countries show that a higher economic standing is often linked to lower hypertension prevalence, predominantly among women (49,50). Many other studies have found that increases of hypertension prevalence are associated with a lower socioeconomic status in terms of income, occupation and education compared to a higher socioeconomic status (50–53). In a 2005 meta-analysis on hypertension and SES, increased hypertension prevalence among individuals from lowest SES was significant among participants from high income countries particularly among women (54). Also, women are often more interested in maintaining a healthy lifestyle that involves regular exercise and healthy balanced diet than men (54). However, in the same study, an inverse association was observed for combined studies on income and occupational SES in Africa. Findings from research by Sarki *et al.*, 2015 reveal that hypertension is linked with socio-economic disparities in many LMICs and estimates on hypertension prevalence were inversely related to education and income, which are in turn components of socioeconomic status (23). Olack *et al.*, 2015 also found that SES measured by wealth index was positively associated with

hypertension; i.e. the likelihood of developing hypertension was higher among richer participants compared to participants in the middle wealth index (55).

1.6.6.3 Education

Education has been found to be a significant factor in the health status of most individuals (56). In models that were adjusted for age, sex and rural/urban setting, highly educated individuals were more conscious, more likely to treat and manage hypertension in low-income countries (LICs) (43). A systematic review and meta-analysis on prevalence of hypertension in LMICs revealed that participants with no formal education generally had higher hypertension rates compared to participants with primary education (23).

A study by Olack *et al.*, 2015 on risk factors of hypertension among adults aged 35-64 years living in an urban slum in Nairobi, Kenya revealed that overweight, obesity, current smoking, having some level of education, highest wealth index, moderate physical activity, ageing and being a widow were each independently associated with hypertension (55). Guwatudde *et al.*, 2015 in a study on the burden of hypertension in SSA found that population group, older age, higher BMI, higher fasting plasma glucose level, lower educational level and the use of tobacco were factors associated with hypertension (26).

A pooled analysis study by Yang *et al.*, 2019 found that “higher educational levels were significantly associated with lower risk of death from all causes compared with low educational level” (57). The findings were similar among East and South Asia when the comparison was between primary and tertiary education. The East Asians included Chinese, Japanese and Koreans while the South Asians included Indians and Bangladeshis.

In a national survey in Jordan, Jaddou *et al.*, 2011 studied the prevalence, awareness, treatment and control of hypertension as well as associated risk factors, and found that participants with lower educational levels were more likely to have hypertension than participants with higher levels of education (48). This study also found that, generally, highly educated people were: more knowledgeable about health matters as well as hypertension; had greater control of their lives and thus were more likely to implement healthy lifestyle habits such as consuming healthy balanced meals, exercising to maintain healthy body weight than those less educated (48).

1.6.6.4 Income and Occupation

In a study on hypertension and occupation among seniors in USA, it was revealed that after adjusting for education, race, income, drinking and smoking, BMI and a number of comorbidities, white collar professionals, salespersons, private household cleaners and personal service workers were more likely to report hypertensive status among women than their managers. For men, statistically significant occupations were salespersons, personal service workers, mechanics, construction traders, precision production workers and operators (58). The study concluded that generally, pre-retirement occupations were risk factors for hypertension among seniors. Findings by Guwatudde *et al.*, 2015 revealed that hypertension prevalence in Nigeria was highest among health care workers such as nurses, compared to school teachers in South Africa and Tanzania (26).

1.6.7 Obesity

Obesity was found to be positively associated with hypertension (62,63). The ubiquity of obesity and its effects on morbidity continues to increase worldwide, and this has become the most important health problem because obesity substantially exaggerates the risk of a number of chronic diseases such as diabetes mellitus, hypertension, myocardial infarction, stroke, dementia and several cancers and fatty liver (64). Obesity, in particular, excessive visceral fat in the human body often come with many

undesirable alterations of hormones, increases in inflammations and cause endothelial dysfunction (63). These alterations stimulate several other mechanisms that cause high blood pressure and cardiovascular ailment (63).

Systematic review and meta-analysis on hypertension prevalence in LMICs revealed that hypertension was more prevalent amongst overweight and obese individuals compared to those with normal weight in all regions considered (23). Obesity is often a result of an interaction between an individuals' eating habits, physical activity levels and energy expenditure (62). Whilst the increase of the average life expectancy has been a positive achievement in the last two decades, such increases mean that “the adverse metabolic effects of overweight and obesity” will remain for an extended period, thus increasing the risk of many chronic diseases (63). More obesity cases have been observed among less privileged individuals in the Middle East, Australia and China, mainly as a result of dietary practices induced by urbanization and changes in food sources and supply (63).

To reverse the obesity pandemic, individuals are encouraged to limit the intake of energy-rich foods, and consume more fruits, vegetable and legumes, engage in more physical activity, usually estimated at one-hour per day for children and two-and-a-half hours (150 minutes) per week for adults (64). In addition to individual changes, governments need to implement policies and interventions that will motivate behavioural changes (health education and promotions, provision of incentives for healthy living) and enforce regulations, laws and policies aimed at reducing obesity. These laws and regulations may include sugar tax laws, targeting sweetened beverages and the banning of advertisements that promote children's unhealthy eating habits (64). Although some governments have successfully introduced policy-led solutions, they have faced countless challenges. Mainly, food and beverage industries actively lobby against the implementation of such policies. Other barriers to reversing the obesity pandemic include restricted resources, weak coordination, lack of dedicated

agents to monitor long-term progress as well as lack of political will to enforce these laws and regulations (64).

1.6.8 Family History

Numerous studies have found that genes significantly contribute to the development of hypertension and that individuals with a family history (FH) of hypertension have a higher risk of developing this disease (64). Although many studies have found that having FH of hypertension is one of the risk factors for the development of hypertension, very few studies have done a detailed investigation of the impact of other individual elements of FH (65). An investigation by Igarashi *et al.*, 2016 into the effect of individual components of FH and its combinatorial effects revealed that, the odds to develop hypertension for individuals who have had a FH of hypertension for more than one generation were increased by three-fold, compared to individuals with no FH of hypertension. The study also showed that hypertension risk is reduced among individuals who work on modifying other risk factors, even if they have FH of hypertension (65).

1.6.9 Smoking and Excessive Alcohol Consumption

Alcohol consumption can either be toxic or beneficial depending on individual use and management. The World Health Organization reports reveal that global deaths due to alcohol amount to 2.5 million people each year, that amounts to about 4% of all deaths, a figure that is above that of violence, AIDS and tuberculosis (66). Whilst excessive alcohol consumption has been linked to many health and social problems such as seizures, stroke, accidents, violence, moderate alcohol use is beneficial and often reduces one's risk of developing certain chronic diseases including among others diabetes mellitus, heart failure and stroke (66). Thus, effects of alcohol on an individual's health depend upon the quantity and the frequency of consumption.

A study of over 694 000 individuals in the Asia Cohort Consortium, revealed that smoking tobacco increased the risk of dying among Asian adults, and that about 2 million adults above the age of 45 died in 2004 due to tobacco smoking (57). Whilst smoking is often listed as one of the risk factors for hypertension, conflicting results are found for different regions. Systematic review and meta-analysis of countries in Europe, Central Asia, Latin America, Caribbean, Middle East and North African revealed that hypertension prevalence was higher among non-smokers than smokers, whilst for East Asia and Pacific, South Asia and Sub-Saharan regions, the reverse was true (23). In the same study, hypertension prevalence statistics between current drinkers and non-drinkers were comparable for all the other regions except for the Sub-Saharan region whereby hypertension rates for non-drinkers were substantially higher than that of drinkers (23). A study conducted in four villages of India showed that increases in smoking rates often result in increases in the risk of hypertension (67).

A study by Ogunmola *et al.*, 2013 on prevalence of cardiovascular risk factors among adults in rural Ekiti State, Southeast Nigeria, found that even though there was a high prevalence of hypertension, obesity and physical inactivity, the other cardiovascular risk factors such as smoking, alcohol consumption and diabetes were relatively low. Despite that, the researchers concluded that individuals from this community had a high risk of future cardiovascular events (68).

Okpechi *et al.*, 2013 in a study on blood pressure gradients and risk factors in urban and rural populations in Abia State found that the prevalence of hypertension, excessive alcohol consumption, smoking and physical inactivity was higher in males than females while having low income, lack of formal education and the use of 'smokeless tobacco' were more prevalent among rural participants than their urban counterparts (69). Also, in this study, hypertension was significantly associated with age, gender, smokeless tobacco, obesity, annual income and educational level.

1.6.10 Race and Ethnicity

Differences in the prevalence of chronic diseases such as hypertension have been noted by several researchers (70–72). Racial differences occur in the prevalence of hypertension in both pregnant and nonpregnant women (72,73). During their first pregnancy, USA based women’s risk of gestational hypertension varies by race/ethnicity, whereby non-Hispanic black women had an increased risk of experiencing severe disease compared to Hispanic women and women with Asian/Pacific origin (72). Also, findings of a study by Loop *et al.*, 2017 revealed that racial demographic dynamics differed by geographical location in USA and that blacks: smoked more and had a higher prevalence rate of both hypertension and diabetes mellitus (74).

1.6.11 Anti-retroviral Treatment

The universal implementation of antiretroviral therapy has greatly improved the life expectancy of people living with HIV (PLHIV) and communities have seen an increase in the prevalence of an ageing HIV-positive population (75). As a result, the treatment, prevention and management of noncommunicable diseases (NCDs) has become part of HIV care and management (76). Hypertension is the leading risk factor for cardiovascular disease and its prevalence is highest in the African region (77). Thus, this region is now faced with the double burden of both communicable and noncommunicable diseases.

Several studies have investigated the association of different antiretroviral therapy regimens and hypertension in persons living with HIV and AIDS, and have come up with conflicting conclusions on the effects of these regimens on the prevalence of hypertension in HIV-positive individuals. Jerico *et al.*, 2005 studied 710 HIV-infected patients and found that combination antiretroviral therapy had little impact on the prevalence of hypertension (78).

A comparison of patients on highly active antiretroviral therapy (HAART) and those on HAART-naïve in a Cameroon study showed that the prevalence of hypertension was significantly higher among HAART patients compared to those on HAART-naïve (79). Mutemwa *et al.*, 2018 in a study on prevalence, detection, treatment and control in HIV-infected patients attending HIV clinics in South Africa found that contrary to what is found in literature, there were no significant associations between HIV specific characteristics and hypertension prevalence. That led to a conclusion that, hypertension in HIV-positive individuals is mostly driven by the same factors as in the general population (77).

1.6.12 Comorbidities among Patients with Hypertension

In most cases, hypertension tends to coexist along with other cardiovascular diseases (43,80–84). A study conducted in USA in 2010 concluded that the proportion of individuals living with type II diabetes, hyperlipidaemia and hypertension increased with age and BMI (85). Also, hypertension, diabetes mellitus and hyperlipidaemia contribute to the development of coronary heart disease (85). According to Gress *et al.*, 2002, there is shared risk between hypertension and the development of diabetes (86).

Also, Igarashi *et al.*, 2016 discovered that using thiazide diuretics to treat hypertensive adults increased the patient's risk of diabetes, as did beta-blockers (65). In addition, the use of “nonnarcotic analgesics” and low folic acid intake, increased women's risk of developing hypertension (87). A study conducted on 4549 American Indian participants found that ageing, prehypertension, obesity or overweight, consuming alcohol and having macro/microalbuminuria increased a person's risk of developing hypertension (88). Thus, interventions to control, manage and eliminate hypertension should focus on modifying risk factors such as an individuals' blood pressure, weight, plasma glucose level and albuminuria (88).

Hypertension has been identified as one of the greatest contributors to the development of stroke that affects over thirty percent of all adults aged at least 20 years in the USA. Although most hypertensive individuals in the US were conscious of their health status and were accessing treatment, only 50% of them had their blood pressure under control (59). The condition is particularly more common among blacks than whites; higher among women than men and occurs much earlier among blacks than whites (59).

The disproportionate distribution of diseases was noted not only for stroke, but also for the other chronic diseases as well. Chronic diseases in the USA were found to be more prevalent among people with lower education or income, specific races or ethnic backgrounds and in selective geographic locations among other factors (60). For example, the south eastern states have the highest stroke deaths, American Indian tribes have the highest smoking prevalence, particularly those living in the Northern plains, African-Americans have the highest cardiovascular disease death rate and individuals with low education or low income have the highest obesity rate (60).

Guzik & Bushnell, 2017, further argued that a substantial number of stroke cases could be prevented by merely managing the major risk factors which include, hypertension, hyperlipidemia, diabetes mellitus, tobacco use and antithrombotic therapy (59). Boehme *et al.*, 2017 identified both modifiable and nonmodifiable risk factors for stroke. The identified nonmodifiable factors comprised of age, sex, race and ethnicity, while modifiable risk factors included eating habits, sedentary lifestyles, smoking and hypertension.

The most recent additions to the list of risk factors include inflammatory disorders and infection, pollution and cardiac atrial, independent of atrial fibrillation (61). Whilst physical activity is often encouraged in order to reduce one's risk of developing hypertension, the unavailability of standardised

definitions of exercise intensity and variety needed to see effect have made it difficult to come up with definite conclusions on the attributable effects of exercise in the development of stroke and hypertension.

On another note, the Mediterranean diet which comprises of increased intake of micro and macronutrients; increased consumption of fruits, vegetables, leguminous plants and olive oil; decreased salt intake; low saturated fats, simple sugars and dairy intake; preferential intake fish and poultry; reduced consumption of red meat is recommended for good health of the cardiovascular system (61). However, no study was found that directly considered the link between hypertension prevalence, diet and physical inactivity in SSA.

1.7 Conceptual Framework of the Study

This study focuses on the prevalence and risk factors associated with hypertension among commuters. The study was based on a theory by Palaniappan *et al.*, 2010 that stated that both modifiable and nonmodifiable risk factors can influence the prevalence of hypertension, as well as other intermediate conditions and comorbidities (89). For instance, hypertension prevalence may be attributed to modifiable risk factors: smoking, excessive consumption of alcohol, sedentary lifestyle and poor diet, whilst in some cases, the prevalence may be attributed to non-modifiable risk factors: age, sex, race, genetics and disease family history.

Also, socio-economic status (SES) and the prevalence of comorbidities such as diabetes, dyslipidaemia and other intermediate conditions, such as obesity, high low-density cholesterol and low high-density cholesterol are often considered one of the fundamental determinants of health (89). Other less prominent risk factors include the use of anti-retroviral treatments which may interact with intermediate conditions to aggravate the risk of hypertension, coronary heart disease and stroke.

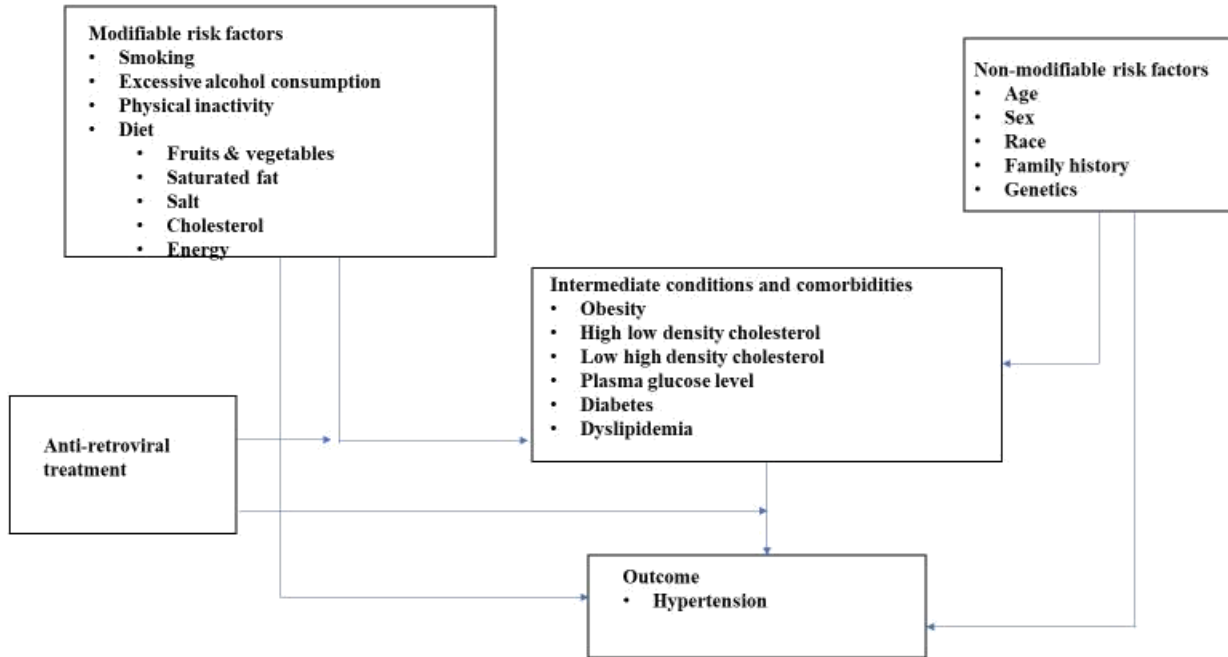


Figure 1. Adapted conceptual framework for the study

Source: Adapted from Palaniappan *et al.*, 2010 (89).

CHAPTER 2

METHODS

2.1 Introduction

This chapter describes the methods used to collect and analyse data, the variables of interest and the study sites, study settings and the target population. Sampling as well as data management methods are also described.

2.2 Primary Study and Data Collection

The primary study was cross-sectional in design and data were obtained from the CARFA study on cardiovascular risk factors among commuters in three cities in Zimbabwe, nine cities and towns in Nigeria and three cities in South Africa. The primary hypothesis for the study was that the cardiovascular risk factors among commuters are different from that of non-commuters. A semi-structured WHO STEPS-wise questionnaire was used to collect demographic and socio-economic variables as well as behavioural measurements (90). Height, weight, hip and waist and blood pressure measurements were also collected.

Blood pressure measurements were obtained using digital sphygmomanometer (Omron Digital Blood Pressure Monitor HEN-712C). Three readings were taken within a 5-minute interval. Height measurements were obtained using a tape measure on a smooth surface at a 90⁰ angle to the floor after removing participant's shoes. Hip circumference and waist circumference were measured around the most prominent part of the hip and abdomen respectively. Weight in kilograms was measured using digital scales with maximum capacity of 150kg on a smooth horizontal surface.

2.3 Study Sites

The study was conducted among urban commuters found in the busiest mini-bus taxi hubs that serve as transfer stations for commuters traveling to and from nearby settlements and villages as well as starting points for city residents.

2.4 Study Design

This study used secondary data obtained from the CARFA study on cardiovascular risk factors in Africa using a WHO STEPwise approach. This approach is a standardized surveillance tool developed by the World Health Organisation to collect “self-reported” data on NCDs including “demographic and behavioural risk factors” along with physical and biochemical measures. This approach has been used by many countries in their quest to strengthen NCD surveillance systems and improve policies meant to fight NCDs (90).

2.5 Study Population

The target population included all individuals found in each of the selected transit areas in Nigeria, South Africa and Zimbabwe who used public transport to and from places of work or those who travelled in search of employment from 2017 to 2019. The public transport spaces selected as venues for the study were the busiest mini-bus taxi hubs in each of the selected countries. The mini-bus taxi system in these countries is utilised mainly by individuals of lower socioeconomic status since it is considered as the most reasonably priced mode of transport in the cities and surrounding townships (10,20,21).

2.6 Sampling

Convenience samples of 1425 participants were selected from the public transport spaces selected for the study, 514 from South Africa; 439 from Nigeria and 472 from Zimbabwe. Since the study was conducted in crowded public transport ranks, large populations of eligible individuals were within reach, and only those that were willing and available to participate were selected to be part of the study. This way, data was collected quickly and in the most economic manner. For this study, a sample of 1384 participants who had all the variables of interest were selected for inclusion in this study. Pregnant women, mentally disabled individuals and those who did not give consent were excluded from the study.

2.7 Data Management

Data for the study were collected and entered into Excel spreadsheets. Data entries were checked for duplications and errors, validated and then imported into Stata where most of the statistical analysis was performed.

2.8 Data Analysis

All statistical analysis was performed using Stata version 14. **For univariate analysis:** Demographic, socioeconomic and behavioural characteristics were summarized as means and standard deviation for continuous variables and proportions/percentages for categorical variables. **For bivariate analysis,** the chi-square test was used to compare the prevalence of hypertension and other risk factors. These variables included age-group, sex, marital status, level of education, occupation, smoking and alcohol status, consumption of fruit, vegetable and carbonated soft drinks, and exercise status.

Bivariate logistic regression models were constructed to assess the influence of individual risk factors on hypertension. **For multivariate analysis:** hierarchical logistic regression models were used to find significant determinants of hypertension. The variables were grouped into: non-modifiable, modifiable and intermediate conditions and comorbidities as shown in figure 1 and classified as follows:

Non-modifiable factors: age-group (< 40, 40-49, 50-59, & > 60 years); sex (male, female); family history of disease (diabetes, hypertension, stroke and other).

Non-modifiable factors: marital status (single, married, separated/divorced/widowed); education (no formal education, primary education, secondary education, diploma, first degree or better); occupation (self-employed, public service, private sector worker, other); income (< R500, R501 – R2,000, R2,001-R4,000, > R4,000), smoking status (ever smoked and current smoker); alcohol consumption (ever drank alcohol, current alcohol user); fruit consumption (2 or less times, 2-4 times, 5 or more times); vegetable consumption (2 or less times, 2-4 times, 5 or more times); consumption of carbonated soft drinks (2 or less times, 2-4 times, 5 or more times); physical activity (< 150 and \geq 150 mins/week).

Intermediate conditions and comorbidities: self-reported comorbidities (diabetes, hypertension, stroke and other); BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m^2) and classified as (normal if $< 25.0 \text{ kg}/\text{m}^2$, overweight if between 25.0 and 29.9 kg/m^2 and obese if $\geq 30 \text{ kg}/\text{m}^2$).

The investigation of hypertension risk factors was done in stages. The first stage involved investigating each of the risk factors independently (bivariate analysis) and later the factors were studied using hierarchical multivariable logistic regression models. For the bivariate analysis, variables with p-values less than or equal to 0.20 were selected for inclusion in the multivariable model.

In building each of the logistic regression models, variables were added to the model in blocks as determined by the conceptual framework involving factors associated with hypertension. Figure 2 shows the order in which the variable blocks were added to the model. In building the logistic regression models, both the analyses and presentation of results were done in phases. The first phase involved analysing the overall effects of non-modifiable risk factors only as model 1.

The non-modifiable risk factors were presented in the first block and remained there for factor adjustment of the other variables. The second phase involved adding the block for modifiable risk factors and the effect of these factors was assessed in the presence of significant non-modifiable risk factors (using p -values ≤ 0.05) (Model 2). The third phase involved adding the block of intermediate conditions and comorbidities and again the effects of these factors were assessed in conjunction with the confounding effects of the modifiable and non-modifiable risk factors (Model 3) (Figure 3).

To assess the strength and direction of association, crude odds ratios and adjusted odds ratios along with the respective 95% confidence intervals (CI) were constructed. Since SES was assessed using three indicators namely: education, income and occupation; after checking for multicollinearity, interaction effects between these variables were performed whereby logistic regression models were constructed with the main effects for the variables of interest as well as interaction effects of the two variables.

The outcome variable: was hypertension status. A participant was classified hypertensive if systolic blood pressure (SBP) ≥ 140 mmHg; diastolic blood pressure (DBP) ≥ 90 mmHg; or reported using antihypertension medication; pre-hypertension if SBP was between 120-139.9mmHg or DBP between 80-89.9 mmHg (6,41) and normal if SBP < 120 mmHg or DBP < 80 mmHg.

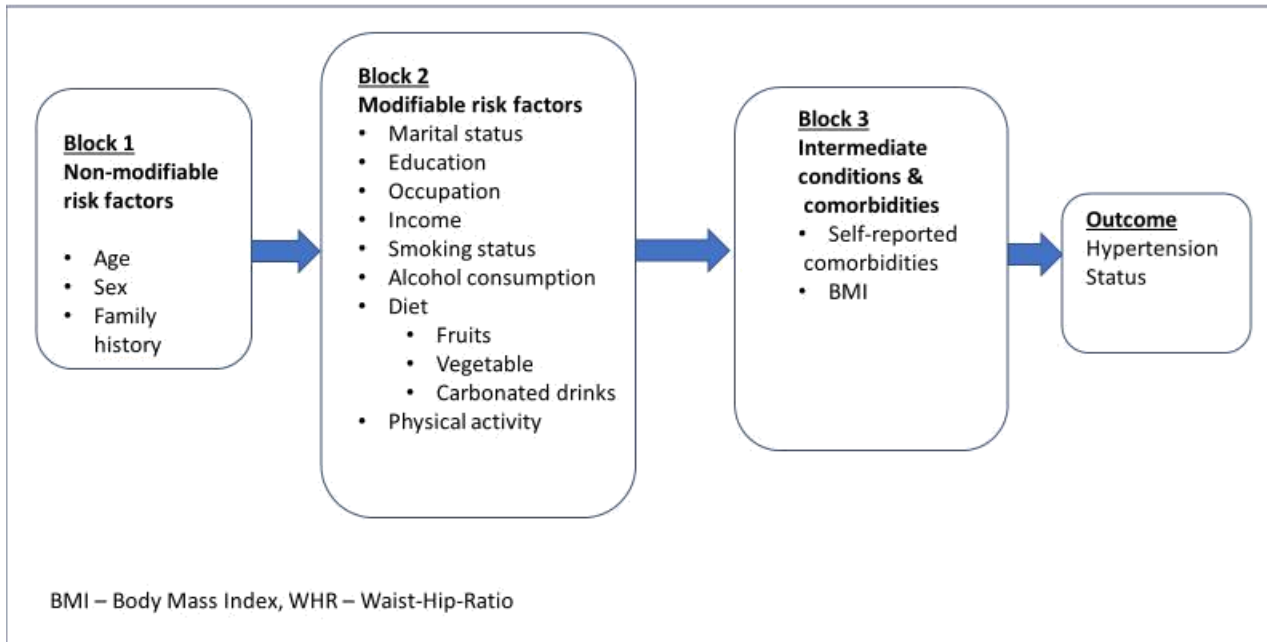


Figure 2. Hierarchical presentation of variables included in the logistic regression models



Figure 3/ Conceptual framework for risk factors for NCDs adapted from Victora et al., 1997.

2.9 Ethical Considerations

Primary study: Ethics approval for the three studies was obtained in Nigeria under protocol number ERC/2016/08/21/38B. Participants gave written consent before taking part in the study’s activities.

Participants were assured of the confidentiality of their responses and that only project team members

had access to identifying information. Also, participants were clearly told that they had the right to choose to participate or not, and that they would not be discriminated for not participating in the study. An ethics clearance was obtained from the Human Research Ethics Committee (Medical) of the University of Witwatersrand for Ethics approval, the Ethics clearance certificate number: M1911129.

Data anonymity, storage form and privacy issues: No participant information was linked to unique identifier and no third party was allowed to have access to the data.

CHAPTER 3

RESULTS

3.1 Introduction

This chapter presents the results of statistical analyses obtained when investigating the prevalence of hypertension among urban commuters in Nigeria, South Africa and Zimbabwe and the associated risk factors. This chapter presents the participants by hypertension status, socio-demographic and behavioural characteristics (dietary behaviour, family history and comorbidities). The chapter also presents results of the logistic regression models that identified the risk factors that were significantly associated with hypertension overall and in each of the three countries (Nigeria, South Africa and Zimbabwe).

3.2 Socio-Demographic Characteristics of Participants

About 69% of the 1384 participants of the study were aged between 15 and 39 years, 53 % were female, 62% were single, about 26% either had no formal education or had less than secondary education, 93% were Christian and 31 % were self-employed (Appendix 2A). This table also shows the different characteristics of the participants by country. In Nigeria, there were more female participants (62%) than their male counterparts, whilst in South Africa and Zimbabwe the numbers were relatively equal. Also, in Nigeria, most of the participants were married (67%) whilst in South Africa and Zimbabwe a majority of the participant were single 78% and 77% respectively. Nigeria had more self-employed participants (44%).

3.3 Behavioural Characteristics of Participants

Appendix 2B presents other behavioural characteristics of the participants. This table shows that about 65% of the participants never smoked, 29% were current smokers, 49% had consumed alcohol at some point in their lives and 36% were current consumers of alcoholic beverages. In addition, about 41% of the participants had jobs that involved physical activity and about 56% of the participants exercised for about 150 minutes or more per week.

However, it is possible that participants were not very truthful when reporting exercise, smoking and alcohol consumption behaviours, especially if society frowned upon individuals who lived sedentary lifestyles, smoked and consumed alcohol, thus leading to social desirability bias. When asked about hours they slept per night, about 73% of the participants indicated that they slept at least 6 hours a day and the two most popular modes of transportation to work or the workshop were walking and using car. Further classification of participants by BMI status showed that about 62% of the participants were either overweight or obese (Appendix 2B).

Country to country analysis revealed that Nigeria had the lowest proportions of participants who were either current smokers or smoked at some point in their lives, and a similar pattern was observed for alcohol consumption. When participants were analysed by sleeping behaviour, more Nigerian commuters slept less than 6 hours per night (39.1%; $p = 0.8$) compared to their counterparts in South Africa (22.7%; $p = 0.952$) and Zimbabwe (21.8%; $p = 0.911$), and the largest proportion of overweight or obese participants was found among South African commuters (91%) (Appendix 2B and Table 2).

3.4 Diet, Family History and Prevalence of Comorbidities

Appendix 2C describes the participants by dietary behaviour, family history and comorbidities. This table revealed that a majority of the participants ate fruits and vegetables and drank carbonated soft drinks at least once a week (95%, 92% and 94.5% respectively). However, very few participants ate fruits and vegetables everyday across the three countries. When asked about their parent(s) disease history, 45% of the participants indicated that they had a family history of other diseases other than the NCDs (diabetes, hypertension or stroke) under study, and 49% reported to be afflicted by other diseases themselves. A breakdown by country revealed that fruit and vegetable consumption behaviours were relatively similar across the three countries (Appendix 2C).

3.5 Prevalence of Hypertension

3.5.1 All participants

Of the total of 1384 participants, 324 (23.4%) were hypertensive whilst 76.6% were either prehypertensive or non-hypertensive ($p < 0.001$) (Table 1). An analysis of hypertension prevalence by selected socio-demographic characteristics revealed that hypertension prevalence increased with age and was highest among participants aged 60 years and above (35.9%, $p = 0.164$), among males (24.5%; $p = 0.026$), single people (25.9%; $p < 0.001$) and participants with no formal education (30.6%; $p < 0.001$).

Figure 1 indicates that the highest proportion of hypertensive participants was found in South Africa (28.6%), followed by Zimbabwe (26.7%) and then Nigeria with the least number of hypertensive participants (13%). This graph also indicates that Nigeria had the highest proportion of normotensive individuals (56.2%) whilst South Africa and Zimbabwe had the highest proportion of prehypertensive participants (49.2% and 46.8% respectively).

Table 2 revealed that hypertension prevalence was dependent on current alcohol status ($\chi^2 = 16.97$; $p < 0.001$), current smoking status ($\chi^2 = 31.72$; $p < 0.001$), family disease history ($\chi^2 = 43.46$; $p < 0.001$)

and self-reported comorbidities ($\chi^2 = 79.32$; $p < 0.001$). However, country-specific analyses produced different results for the three countries.

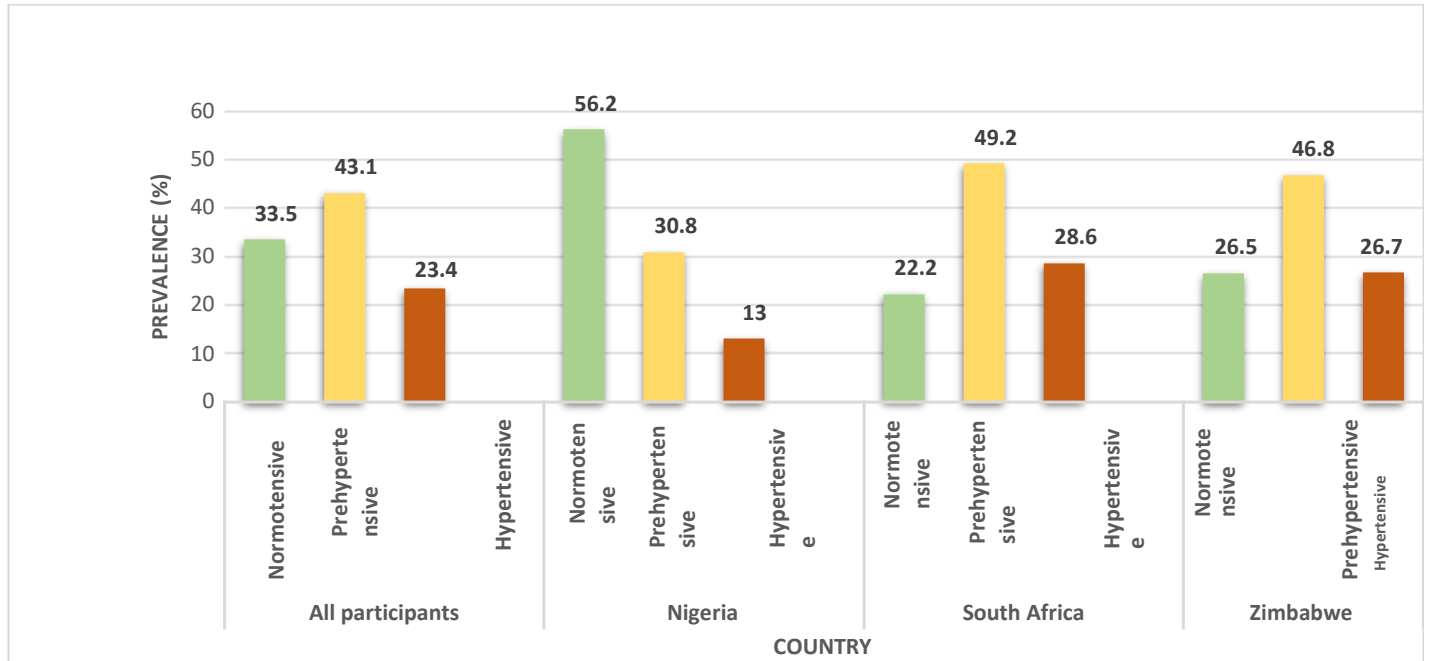


Figure 4. Hypertension status of participants by country

NB: There were significant differences in prevalence across the countries with $\chi^2 = 135.31$ ($p < 0.001$).

3.5.2 Hypertension Prevalence in Nigeria, South Africa and Zimbabwe

Hypertension prevalence in Nigeria depended on age ($\chi^2 = 65.3619$; $p < 0.001$), sex ($\chi^2 = 10.2396$; $p = 0.006$), and marital status ($\chi^2 = 17.4456$; $p = 0.002$). Prevalence was found to increase with age and was highest among participants of 60 years and above (33.3%, $p < 0.001$), males (14.4%, $p = 0.006$) and separated, divorced and widowed participants (29.6%, $p = 0.002$) than the married and single counterparts (Table 1). Table 1 further shows that hypertension prevalence in South Africa was independent of age, sex, marital status, education and occupation and dependent on education ($\chi^2 = 18.7297$; $p = 0.016$) and occupation ($\chi^2 = 13.8203$; $p = 0.032$).

Table 2 revealed that hypertension prevalence in Nigeria depended on current smoking behaviour ($\chi^2 = 11.11$; $p = 0.004$), current alcohol consumption ($\chi^2 = 6.57$; $p = 0.037$), family history of disease ($\chi^2 = 22.80$; $p = 0.001$) and self-reported comorbidities ($\chi^2 = 89.15$; $p < 0.001$) (Table 2). However, in South Africa and Zimbabwe, hypertension prevalence was independent of all the factors considered (Table 2).

Table 3 classified participants by hypertension status, BMI, diet and physical activity. This table revealed that for the collective analysis of participants; hypertension prevalence varied significantly by BMI status ($\chi^2 = 51.27$; $p < 0.001$) and consumption of carbonated soft drinks ($\chi^2 = 13.96$; $p = 0.001$). In Nigeria there were significant differences in hypertension status across three classes of BMI ($\chi^2 = 59.77$; $p < 0.001$). In South Africa hypertension prevalence was higher among individuals who consumed vegetables three to four times a week than in those who consumed them 2 or less times a week ($\chi^2 = 10.07$; $p = 0.039$), while in Zimbabwe the hypertension status was independent of BMI, diet and physical activity.

A study by Ekwunife *et al.*, 2010 on prevalence, awareness, treatment and control of hypertension in a Nigerian population revealed that hypertension was a serious public health problem in that country. In Nsukka, a city located in South East Nigeria, hypertension prevalence was 21.1% in a sample of 756 adults aged 18 years and above and the rate was higher in men compared to women. Among the hypertensive individuals, only 23.7% males and 17.5% females were on anti-hypertension treatment and only 5% and 17.5% respectively of the hypertensive males and females had controlled hypertension (92). These results show that there was poor detection, treatment and control of hypertension in this part of Nigeria.

A study by Irazola *et al.*, 2016 on hypertension prevalence, awareness, treatment and control for rural and urban adults revealed that the overall hypertension prevalence in selected LMICs was 52.2%

(95%CI: 50.1-54.8%) among men and women aged 35 to 74 years (93). Another study conducted in SSA by Gomez-Olive *et al.*, 2017 showed that the prevalence rate of hypertension among adults 40-60 years of age in this region was over 40% and increased with age in both males and females (25). Mutowo *et al.*, 2015 in a meta-analysis to quantify the hypertension burden in Zimbabwe among adults over 18 years found that the overall pooled prevalence of hypertension was 30% (95% CI: 19-42%) from April 1980 to December 2013. This study also reported that urban areas had higher prevalence of hypertension than the rural counterparts (94).

Table 1. Prevalence of Hypertension by selected socio-demographic characteristics

Variable	All participants			Nigeria			South Africa			Zimbabwe		
	Normal 464 (33.5%)	Prehypertensive 596 (43.1%)	Hypertensive 324 (23.4%)	Normal 226 (56.2%)	Prehypertensive 124 (30.8%)	Hypertensive 52 (13.0%)	Normal 113 (22.2%)	Prehypertensive 251 (49.2 %)	Hypertensive 146 (28.6%)	Normal 125 (26.5%)	Prehypertensive 221 (46.8%)	Hypertensive 126 (26.7%)
Age (years)	$\chi^2 = 9.1723 (0.164)$			$\chi^2 = 65.3619 (< 0.001)$			$\chi^2 = 3.3727 (0.761)$			$\chi^2 = 3.6537 (0.723)$		
< 40	336 (35.4)	404 (42.4)	212 (22.3)	163 (72.2)	51 (22.6)	12 (5.3)	81 (22.1)	183 (50.0)	102 (27.9)	92 (25.6)	170 (47.2)	98 (27.2)
40 – 49	79 (30.6)	117 (45.4)	62 (24.0)	35 (38.9)	40 (44.4)	15 (16.7)	24 (24.2)	44 (44.4)	31 (31.3)	20 (29.0)	33 (47.8)	16 (23.2)
50 – 59	34 (30.9)	49 (44.6)	27 (24.6)	16 (36.4)	17 (38.6)	11 (25.0)	8 (21.6)	19 (51.4)	10 (27.0)	10 (34.5)	13 (44.8)	6 (20.7)
60 and above	15 (23.4)	26 (40.6)	23 (35.9)	12 (28.6)	16 (38.1)	14 (33.3)	0 (0.0)	5 (62.5)	3 (37.5)	3 (21.4)	5 (35.7)	6 (42.9)
Sex	$\chi^2 = 7.2704 (0.026)$			$\chi^2 = 10.2396 (0.006)$			$\chi^2 = 0.9761 (0.614)$			$\chi^2 = 0.7932 (0.673)$		
Male	194 (29.9)	296 (45.6)	159 (24.5)	71 (46.4)	60 (39.2)	22 (14.4)	59 (22.8)	122 (47.1)	78 (30.1)	64 (27.0)	114 (48.1)	59 (24.9)
Female	270 (36.7)	300 (40.8)	165 (22.5)	155 (62.3)	64 (25.7)	30 (12.1)	54 (21.5)	129 (51.4)	68 (27.1)	61 (26.0)	107 (45.5)	67 (28.5)
Marital Status	$\chi^2 = 23.6180 (< 0.001)$			$\chi^2 = 17.4456 (0.002)$			$\chi^2 = 5.5640 (0.234)$			$\chi^2 = 4.0020 (0.406)$		
Single	248 (28.9)	387 (45.2)	222 (25.9)	66 (68.8)	25 (26.0)	5 (5.2)	88 (22.0)	190 (47.5)	122 (30.5)	94 (26.0)	172 (47.7)	95 (26.3)
Married	199 (41.5)	190 (39.7)	90 (18.8)	147 (54.7)	87 (32.3)	35 (13.0)	24 (23.1)	56 (53.9)	24 (23.1)	28 (26.4)	47 (44.3)	31 (29.3)
Sep./ Div./Wid.	17 (37.0)	19 (41.3)	10 (21.7)	13 (37.1)	12 (34.3)	10 (29.6)	1 (16.7)	5 (83.3)	0 (0.0)	3 (60.0)	2 (40.0)	0 (0.0)
Education	$\chi^2 = 32.8107 (< 0.001)$			$\chi^2 = 19.8399 (0.0811)$			$\chi^2 = 6.6766 (0.572)$			$\chi^2 = 18.7297 (0.016)$		
No formal educ	37 (25.7)	63 (43.8)	44 (30.6)	12 (44.4)	7 (25.9)	8 (29.6)	13 (21.3)	29 (47.5)	19 (31.2)	12 (21.4)	27 (48.2)	17 (30.4)
Primary	54 (24.1)	117 (52.2)	53 (23.7)	21 (50.0)	11 (26.2)	10 (23.8)	22 (22.5)	57 (58.2)	19 (19.4)	11 (13.1)	49 (58.3)	24 (28.6)
Secondary	108 (38.3)	102 (36.2)	72 (25.5)	48 (57.1)	24 (28.6)	12 (14.3)	24 (24.2)	44 (44.4)	31 (31.3)	36 (36.4)	34 (34.3)	29 (29.3)
Diploma	150 (32.8)	199 (43.5)	108 (23.6)	56 (66.7)	21 (25.0)	7 (8.3)	39 (20.4)	94 (49.2)	58 (30.4)	55 (30.2)	84 (46.2)	43 (23.6)
≥ First degree	115 (41.8)	114 (41.5)	46 (16.7)	89 (54.6)	60 (36.8)	14 (8.6)	15 (24.6)	27 (44.3)	19 (31.1)	11 (21.6)	27 (52.9)	13 (25.5)
Occupation	$\chi^2 = 14.6152 (0.023)$			$\chi^2 = 10.4152 (0.108)$			$\chi^2 = 7.9854 (0.239)$			$\chi^2 = 13.8203 (0.032)$		
Self-employed	149 (35.0)	183 (43.0)	94 (22.1)	90 (50.9)	59 (33.3)	28 (15.8)	33 (25.4)	62 (48.0)	35 (26.9)	26 (21.9)	62 (52.1)	31 (26.1)
Public Servant	119 (38.0)	120 (38.3)	74 (23.6)	58 (54.7)	33 (31.1)	15 (14.2)	26 (24.3)	43 (40.2)	38 (35.5)	35 (35.0)	44 (44.0)	21 (21.0)
Private-Sector	123 (34.9)	155 (44.0)	74 (21.0)	55 (68.8)	21 (26.3)	4 (5.0)	29 (21.0)	69 (50.0)	40 (29.0)	39 (29.1)	65 (48.5)	30 (22.4)
Other	73 (25.2)	137 (47.2)	80 (27.6)	23 (63.9)	10 (27.8)	3 (8.3)	25 (18.5)	77 (57.0)	33 (24.4)	25 (21.0)	50 (42.0)	44 (37.0)

Data are categorical, presented as proportions (percentages)
Chi-square test

consume alcohol												
Yes	204 (44.0)	299 (50.2)	174 (53.7)	92 (40.7)	69 (55.6)	31 (59.6)	48 (42.5)	125 (49.8)	79 (54.1)	64 (51.2)	105 (47.5)	64 (50.8)
No	260 (56.0)	297 (49.8)	150 (46.3)	134 (59.3)	55 (44.4)	21 (40.4)	65 (57.5)	126 (50.2)	67 (45.9)	61 (48.8)	116 (52.5)	62 (49.2)

Table 2. Prevalence of hypertension by selected behavioural characteristics, family history and comorbidities

Variable	All participants			Nigeria			South Africa			Zimbabwe		
	Normal 464 (33.5%)	Prehypertensive 596 (43.1%)	Hypertensive 324 (23.4%)	Normal 226 (56.2%)	Prehypertensive 124 (30.8%)	Hypertensive 52 (13.0%)	Normal 113 (22.2%)	Prehypertensive 251 (49.2%)	Hypertensive 146 (28.6%)	Normal 125 (26.5%)	Prehypertensive 221 (46.8%)	Hypertensive 126 (26.7%)
Ever smoked	$\chi^2 = 28.4143 (< 0.001)$			$\chi^2 = 6.9663 (0.031)$			$\chi^2 = 2.2869 (0.319)$			$\chi^2 = 0.2346 (0.889)$		
Yes	204 (44.0)	299 (50.2)	174 (53.7)	18 (39.1)	18 (39.1)	10 (21.7)	45 (19.2)	120 (51.5)	70 (29.8)	55 (27.2)	92 (45.5)	55 (27.2)
No	260 (56.0)	297 (49.8)	150 (46.3)	208 (58.2)	106 (29.8)	150 (54.1)	68 (24.0)	131 (50.6)	72 (57.1)	70 (25.9)	129 (47.8)	71 (26.3)
Currently smoke	$\chi^2 = 31.7186 (< 0.001)$			$\chi^2 = 11.1128 (0.004)$			$\chi^2 = 1.9903 (0.370)$			$\chi^2 = 0.1536 (0.926)$		
Yes	91 (22.8)	189 (47.4)	119 (29.8)	4 (23.5)	7 (41.2)	6 (35.3)	39 (19.4)	99 (49.3)	63 (31.3)	48 (26.5)	83 (45.9)	50 (27.6)
No	373 (37.9)	407 (41.4)	204 (20.7)	222 (57.8)	117 (30.5)	45 (11.7)	74 (24.0)	152 (49.2)	83 (26.9)	77 (26.5)	138 (47.4)	76 (26.1)
Ever consumed alcohol	$\chi^2 = 7.8965 (0.019)$			$\chi^2 = 10.5242 (0.005)$			$\chi^2 = 3.4777 (0.176)$			$\chi^2 = 0.5751 (0.750)$		
Yes	212 (30.1)	299 (42.3)	174 (25.7)	92 (47.9)	69 (35.9)	31 (16.2)	48 (19.0)	125 (49.6)	79 (31.4)	64 (27.5)	105 (45.0)	64 (27.5)
No	260 (36.8)	297 (42.0)	150 (21.2)	134 (63.8)	55 (26.2)	21 (10.0)	65 (25.2)	71 (28.8)	46 (36.5)	61 (25.5)	116 (48.5)	62 (25.9)
Currently consumed alcohol	$\chi^2 = 16.9725 (p < 0.001)$			$\chi^2 = 6.5673 (p = 0.037)$			$\chi^2 = 5.0373 (p = 0.081)$			$\chi^2 = 0.8009 (p = 0.670)$		
Yes	134 (27.1)	232 (44.9)	139 (38.1)	30 (46.7)	37 (34.6)	60 (23.0)	35 (37.4)	55 (50.3)	33 (26.2)	49 (26.2)	84 (44.9)	54 (28.9)
No	168 (37.0)	373 (42.1)	185 (20.9)	174 (59.6)	86 (29.4)	32 (11.0)	78 (25.2)	150 (48.5)	81 (26.2)	76 (26.7)	137 (48.1)	72 (25.2)
Hours of sleep per night	$\chi^2 = 6.1561 (p = 0.188)$			$\chi^2 = 1.6465 (p = 0.800)$			$\chi^2 = 0.6938 (p = 0.952)$			$\chi^2 = 0.9940 (p = 0.911)$		
< 6 hours	30 (6.8)	155 (41.8)	20 (2.9)	84 (53.8)	53 (34.0)	5 (2.0)	28 (24.1)	46 (46.6)	3 (2.4)	26 (25.2)	48 (46.6)	29 (28.2)
6-8 hours	212 (34.9)	262 (41.3)	140 (22.8)	112 (52.1)	57 (29.1)	104 (47.1)	48 (24.0)	99 (49.1)	48 (38.1)	52 (25.7)	99 (49.0)	51 (25.3)
> 8 hours	143 (28.8)	178 (44.3)	162 (25.8)	29 (6.2)	13 (27.7)	5 (10.6)	37 (20.8)	91 (51.1)	50 (28.1)	47 (28.1)	74 (44.3)	46 (27.5)
Family history reported sickness	$\chi^2 = 43.4644 (p < 0.001)$			$\chi^2 = 22.8005 (p = 0.001)$			$\chi^2 = 5.1644 (p = 0.523)$			$\chi^2 = 3.5967 (p = 0.731)$		
Diabetes	76 (26.4)	131 (45.5)	81 (28.1)	15 (41.7)	16 (44.4)	5 (13.9)	25 (20.3)	60 (46.5)	43 (33.3)	35 (28.5)	55 (44.7)	33 (26.8)
Hypertension	88 (24.9)	168 (47.5)	98 (27.7)	21 (36.2)	23 (39.7)	14 (24.1)	32 (20.5)	82 (52.6)	42 (26.9)	35 (25.0)	63 (45.0)	42 (30.0)
Stroke	30 (56.6)	14 (26.4)	9 (17.0)	20 (69.0)	5 (17.2)	4 (13.8)	5 (41.7)	5 (41.7)	2 (16.7)	5 (41.7)	4 (33.3)	3 (25.0)
Other	69 (26.1)	271 (40.8)	132 (19.9)	161 (63.4)	68 (27.1)	25 (9.8)	50 (23.5)	104 (48.8)	59 (27.7)	50 (25.4)	99 (50.3)	48 (24.4)
Self-reported sicknesses	$\chi^2 = 79.3232 (p < 0.001)$			$\chi^2 = 89.1537 (p < 0.001)$			$\chi^2 = 5.4020 (p = 0.493)$			$\chi^2 = 7.4114 (p = 0.284)$		
Diabetes	21 (9.3)	128 (46.2)	80 (28.9)	2 (20.0)	5 (50.0)	7 (2.8)	33 (25.7)	46 (48.9)	2 (1.6)	34 (26.6)	55 (43.0)	39 (30.5)
Hypertension	31 (6.1)	296 (50.2)	205 (32.8)	24 (9.8)	24 (48.0)	15 (30.0)	24 (16.0)	98 (52.1)	47 (37.3)	33 (24.4)	64 (47.4)	38 (28.2)
Stroke	7 (2.2)	12 (3.1)	9 (3.2)	9 (81.8)	1 (9.1)	1 (9.1)	5 (35.7)	7 (50.0)	2 (14.3)	7 (53.8)	4 (30.8)	2 (15.4)
Other	50 (42.0)	296 (40.1)	132 (17.9)	208 (63.2)	97 (29.5)	24 (7.3)	51 (23.9)	101 (47.4)	61 (28.6)	51 (26.0)	98 (50.0)	47 (24.0)

Data are categorized as reported as proportions (percentages) for categorical variables and presented as means (standard deviations) for continuous variables. BMI = Body mass index.

Table 3. Prevalence of hypertension by BMI, diet and physical activity

Variable	All participants			Nigeria			South Africa			Zimbabwe		
	Normal 464 (33.5%)	Prehypertensive 596 (43.1%)	Hypertensive 324 (23.4%)	Normal 226 (56.2%)	Prehypertensive 124 (30.8%)	Hypertensive 52 (13.0%)	Normal 113 (22.2%)	Prehypertensive 251 (49.2 %)	Hypertensive 146 (28.6%)	Normal 125 (26.5%)	Prehypertensive 221 (46.8%)	Hypertensive 126 (26.7%)
BMI category	$\chi^2 = 51.2673 (p < 0.001)$			$\chi^2 = 59.7654 (p < 0.001)$			$\chi^2 = 4.7560 (p = 0.313)$			$\chi^2 = 1.0480 (p = 0.902)$		
Normal weight	236 (44.5)	204 (38.5)	90 (17.0)	148 (70.5)	51 (24.3)	11 (5.2)	11 (23.9)	26 (56.5)	9 (19.6)	77 (28.1)	127 (46.4)	70 (25.6)
Overweight	154 (27.8)	249 (45.0)	151 (27.2)	57 (48.3)	45 (38.1)	16 (13.6)	75 (21.7)	162 (46.8)	109 (31.5)	22 (24.4)	42 (46.7)	26 (28.9)
Obese	74 (24.7)	143 (47.7)	83 (27.7)	21 (28.4)	28 (37.8)	25 (33.8)	27 (22.9)	63 (53.4)	28 (23.7)	26 (24.0)	52 (48.2)	30 (27.8)
Fruit consumption	$\chi^2 = 4.0429 (p = 0.400)$			$\chi^2 = 4.9657 (p = 0.291)$			$\chi^2 = 1.6550 (p = 0.799)$			$\chi^2 = 5.3042 (p = 0.257)$		
2 or less times	151 (31.9)	208 (44.0)	114 (24.1)	67 (54.5)	43 (35.0)	13 (10.6)	37 (20.9)	91 (51.4)	49 (27.7)	46 (26.9)	73 (42.7)	52 (30.4)
3 - 4 times	156 (35.3)	196 (44.3)	90 (20.4)	88 (39.8)	41 (33.6)	15 (30.6)	32 (20.4)	79 (50.3)	46 (29.3)	36 (25.5)	76 (53.9)	29 (20.6)
5 or more times	147 (32.5)	188 (41.6)	117 (25.9)	65 (52.8)	37 (30.1)	21 (17.1)	44 (25.0)	81 (46.0)	51 (29.0)	43 (28.1)	72 (45.0)	45 (28.1)
Vegetable consumption	$\chi^2 = 7.3923 (p = 0.117)$			$\chi^2 = 9.2339 (p = 0.056)$			$\chi^2 = 10.0737 (p = 0.039)$			$\chi^2 = 4.4267 (p = 0.351)$		
2 or less times	204 (33.1)	283 (45.9)	129 (20.9)	93 (53.4)	64 (36.8)	17 (9.8)	46 (20.1)	122 (53.3)	61 (26.6)	65 (30.5)	97 (45.5)	51 (24.0)
3 - 4 times	147 (35.9)	158 (38.6)	104 (25.4)	89 (59.7)	40 (26.9)	20 (13.4)	27 (19.9)	58 (42.7)	51 (37.5)	31 (25.0)	60 (48.4)	33 (26.6)
5 or more times	111 (31.4)	152 (42.9)	91 (25.7)	42 (56.7)	17 (23.6)	15 (20.8)	40 (27.6)	71 (49.0)	34 (23.5)	29 (21.5)	64 (47.4)	42 (31.1)
Consumption of carbonated drinks	$\chi^2 = 13.9587 (p = 0.001)$			$\chi^2 = 1.0949 (p = 0.578)$			$\chi^2 = 1.3102 (p = 0.519)$			$\chi^2 = 0.4805 (p = 0.786)$		
2 or less times	317 (30.7)	456 (44.2)	258 (25.0)	115 (58.7)	57 (29.1)	24 (12.2)	98 (22.6)	209 (48.2)	127 (29.3)	104 (25.9)	190 (47.4)	107 (26.7)
3 - 4 times	142 (41.2)	139 (40.3)	64 (18.5)	106 (53.5)	66 (33.3)	26 (13.1)	15 (19.7)	42 (55.3)	19 (25.0)	21 (29.6)	31 (43.7)	19 (26.8)
Physical activity per week	$\chi^2 = 0.2241 (p = 0.894)$			$\chi^2 = 2.5854 (p = 0.275)$			$\chi^2 = 0.4524 (p = 0.798)$			$\chi^2 = 1.6110 (p = 0.447)$		
< 150 min/ week	219 (35.6)	278 (45.1)	119 (19.3)	121 (64.4)	60 (31.9)	7 (3.7)	48 (21.2)	114 (50.4)	684 (28.3)	50 (24.8)	104 (51.5)	48 (23.8)
≥150 mins/week	245 (31.9)	318 (41.4)	205 (26.7)	105 (49.1)	64 (29.9)	45 (21.0)	65 (22.9)	137 (48.2)	82 (28.9)	75 (27.8)	117 (43.3)	78 (28.9)

Data are categorical, presented as proportions (percentages)
Chi-square test
BMI-Body mass index

3.6 Risk Factors for Hypertension

3.6.1 Overall Analysis

In the bivariate analysis, the collective analysis of hypertension prevalence by non-modifiable risk factors across the three countries revealed that being 60 years and older (OR = 1.96; 95% CI: 1.50 - 3.34) and having family history of diabetes (OR = 1.58; 95% CI: 1.15 - 2.17) and hypertension (OR = 1.54; 95% CI: 1.14 - 2.08) had significant association with hypertension (Appendix 2D). That is, the odds of being hypertensive increased with age and that being 60 years and above increased the odds of hypertension by 96% compared to participants aged less than 40 years. Also, having a FH of diabetes and hypertension increased the likelihood of developing hypertension by 58% and 54% respectively, compared to participants who had a FH of other diseases.

Appendix 2E reveals that being married (OR = 0.66; 95% CI: 0.50 – 0.87), having a Bachelor's degree or better (OR = 0.46; 95% CI: 0.28 – 0.73), being a current smoker (OR = 1.63; 95% CI: 1.25 – 2.12), current drinker (OR = 1.48; 95% CI: 1.15 – 1.91) and consuming carbonated drinks for 3 to 4 times a week (OR = 0.68; 95% CI: 0.50 – 0.93) were each independently associated with hypertension. Whilst having a marriage partner, tertiary education was protective, smoking and consuming alcohol increased the odds of hypertension. Having a marital partner was associated with a 34% reduction in the odds of hypertension than being single.

Also, having some form of education reduced the likelihood of developing hypertension compared to not having any formal education. Possessing a first degree or better reduced the odds of hypertension by 54% compared to not having any formal education. Being a current alcohol consumer and smoker increased the likelihood of hypertension by 48% and 63% respectively compared to individuals who did not currently drink alcohol and smoke. One surprising finding was that consuming more carbonated drinks was

protective. The findings revealed that consuming carbonated soft drinks 3 to 4 times a week was significantly associated with 32% reduced odds of hypertension than participants who drank them 2 or less times. This could be a proxy for low socioeconomic status.

Furthermore, being overweight or obese was significantly associated with hypertension and the odds of hypertension increased with increases in BMI index. On one hand, the odds of hypertension increased by 68% for every unit increase in BMI; whilst for obese individuals, the odds of hypertension increased by 54% for every unit increase in BMI (Table 4). The odds of hypertension among those reported to be diabetic increased by 43% compared to those who reported other comorbidities (Appendix 2F). In addition, the results showed that being overweight and obese was associated with 83% and 87% increases in the odds of hypertension than participants with normal weight.

After hierarchical adjustments of the logistic regression model, being 60 years and older (AOR = 2.10; 95% CI: 1.16 – 3.87), having a FH of hypertension (AOR = 1.41; 95% CI: 1.03 – 1.92), being a current smoker (AOR = 1.34; 95% CI: 1.01 – 1.78), overweight (AOR = 1.68; 95% CI: 1.24 – 2.27) and obese (AOR = 1.54; 95% CI: 1.08 – 2.20) and having a self-reported disease: diabetes (AOR = 1.62; 95% CI: 1.16 – 2.26) and hypertension (AOR = 1.89; 95% CI: 1.39 – 2.58) remained in the model, presenting statistically significant effects on the hypertension status. However, effects of other variables, namely marital status, education, smoking, consumption of alcohol and carbonated soft drinks became insignificant after the hierarchical adjustment (Table 4).

After the adjustments, being 60 years and above significantly increased the odds of hypertension by 110% compared to participants below 40 years; having a FH of hypertension increased the odds by 41%, while being a current tobacco smoker increased odds by 34%. Overweight and obese participants had 68% and 54% greater odds of hypertension than normal weight participants. The odds of hypertension in participants with diabetes and hypertension comorbidities increased by 62% and 89% respectively compared to those with other diseases.

Table 4. Factors associated with hypertension among urban commuters in Nigeria, South Africa and Zimbabwe

Block 1: Non-modifiable risk factors	Model 1: Block 1			
	OR crude	OR adjusted	95% CI	p-value
Age				
< 40	1	1		
40–49	1.10	1.08	[0.77, 1.50]	0.655
50–59	1.14	1.09	[0.68, 1.74]	0.725
60 and above	1.96	1.95	[1.13, 3.37]	0.016
Family history				
Diabetes	1.58	1.60	[1.16, 2.21]	0.004
Hypertension	1.54	1.56	[1.15, 2.10]	0.004
Stroke	0.82	0.80	[0.38, 1.68]	0.549
Other & No Family history of disease	1		1	
Block 2: Modifiable risk factors	Model 2: Block 1 & 2			
Age				
< 40		1		
40–49		1.21	[0.85, 1.72]	0.291
50–59		1.27	[0.76, 2.13]	0.364
60 and above		2.13	[1.06, 4.27]	0.033
Family history				
Diabetes		1.45	[1.03, 2.03]	0.032
Hypertension		1.43	[1.04, 1.98]	0.029
Stroke		0.95	[0.42, 2.12]	0.892
Other		1		
Marital status				
Single	1	1		
Married	0.66	0.75	[0.54, 1.03]	0.077
Separated, Divorced, Widowed	0.79	0.34	[0.11, 1.03]	0.056
Currently smoke				
No	1	1		
Yes	1.63	1.92	[1.00, 3.71]	0.051
Block 3: Intermediate conditions & comorbidities	Model 3: Block 1,2 & 3			
Age				
< 40		1		
40–49		1.10	[0.78, 1.54]	0.601
50–59		1.12	[0.68, 1.82]	0.661
60 and above		2.10	[1.16, 3.81]	0.015
Family history				
Diabetes		1.37	[0.98, 1.91]	0.062
Hypertension		1.41	[1.03, 1.92]	0.030
Stroke		0.95	[0.43, 2.11]	0.896
Other		1		
Currently smoke				
No		1		
Yes		1.34	[1.01, 1.78]	0.039
BMI				
Normal weight	1	1		
Overweight	1.83	1.68	[1.24, 2.27]	0.001
Obese	1.87	1.54	[1.08, 2.20]	0.016
Self-reported comorbidities				
Other	1	1		
Diabetes	1.43	1.62	[1.16, 2.26]	0.005
Hypertension		1.89	[1.39, 2.58]	< 0.001
Stroke		0.73	[0.27, 1.92]	0.518

3.6.2 Hypertension Risk Factors in Nigeria

Country-specific bivariate analysis of hypertension prevalence revealed that, of the three non-modifiable factors considered (age, sex and family history of disease), age, particularly being 60 years and older (OR = 8.92; 95% CI: 3.75 – 21.19) and family history of hypertension (OR = 2.91; 95% CI: 1.41 – 6.04) were significantly

associated with hypertension (Appendix 2D). The odds of hypertension increased with age. Also, the odds of hypertension among participants with a FH of hypertension was 54% percent higher than that of participants without a FH of the disease.

When Nigerian participants were analysed by modifiable risk factors: marital status, particularly having a marital partner (OR = 2.72; 95% CI: 1.03 – 7.17) and being separated/divorced/widowed (OR = 7.28; 95% CI: 2.27 – 23.25), holding a diploma, first degree or better (OR = 0.22; 95% CI: 0.08 – 0.60), private-sector employment (OR = 0.28; 95% CI: 0.09 – 0.83), currently smoking (OR = 4.11; 95% CI: 1.44 – 11.65), currently drinking alcohol (OR = 1.87; 95% CI: 1.02 – 3.43) and consuming vegetable more than four times a week (OR = 2.35; 95% CI: 1.10 – 5.00) were significantly associated with hypertension (Appendix 2E). It is worth noting that one's marital status could be a marker for age.

This table revealed that, having a marriage partner or being separated/divorced/widowed increased the likelihood of developing hypertension than being single, whilst having higher education (diploma or better) was protective compared to having no formal education. However, this could also be a marker for age. Also, being a private sector employee was found to be protective than being self-employed (Appendix 2E). Current tobacco smokers and those who consumed alcohol had higher odds of hypertension than those who did not engage in any of those habits. Being a current smoker increased the likelihood of developing hypertension by as much as 311% compared to non-smokers, whilst being a current alcohol consumer increased the odds of hypertension by 87% . One surprising finding was that the odds of hypertension were higher among participants who consumed vegetables more than four times per week than those who ate vegetables two or less times. This could be a proxy for age, income or something else. This finding contradicts the notion that diets that are rich in fruits and vegetables are associated with reduced risk of hypertension and other chronic diseases.

Further bivariate analysis of Nigerian participants by prevalence of intermediate health conditions and comorbidities revealed that those who reported having diabetes (OR = 5.45; 95% CI: 1.32 – 22.42) and hypertension (OR = 14.71; 95% CI: 7.01 – 30.88), overweight (OR = 2.84; 95% CI: 1.27 – 6.34) and obese (OR = 9.23; 95% CI: 4.25 – 20.03) were more likely to have hypertension. Specifically, the odds of hypertension among those who reported having diabetes was 5.45 times the odds of hypertension among

those who did not have diabetes. The odds of hypertension among those who reported having the disease was 14.71 times more the odds of the disease among those who did not report having the disease.

The hierarchically adjusted logistic regression model for the Nigerian participants showed that obesity (AOR = 7.09; 95% CI: 2.84 – 17.70) and self-reported hypertension (AOR = 12.13; 95% CI: 4.35 – 33.82) remained significantly associated with hypertension even after adjustment, whilst the other variables, namely age, marital status, education, occupation, smoking and alcohol consumption became insignificant after the adjustment (Table 5).

Table 5. Factors associated with hypertension among Nigerian urban commuters

Block 1: Non-modifiable risk factors	Model 1: Block 1			
	OR crude	OR adjusted	95% CI	p-value
Age				
< 40	1	1		
40–49	3.57	2.69	[1.15, 6.28]	0.022
50–59	5.94	5.08	[1.99, 12.96]	0.001
60 and above	8.92	7.34	3.02, 17.85]	< 0.001
Family history				
Diabetes	1.48	1.43	[0.49, 4.19]	0.515
Hypertension	2.91	2.44	[1.13, 5.27]	0.023
Stroke	1.47	1.54	[0.47, 5.08]	0.474
Other	1	1		
Block 3: Intermediate conditions & comorbidities				
Age				
< 40		1		
40–49		1.23	[0.47, 3.26]	0.674
50–59		2.80	[0.96, 8.16]	0.059
60 and above		1.86	[0.60, 5.82]	0.283
BMI				
Normal weight	1	1		
Overweight	2.84	1.90	[0.74, 4.84]	0.180
Obese	9.23	7.09	[2.84, 17.70]	< 0.001
Self-reported comorbidities				
Diabetes	5.45	4.39	[0.79, 24.37]	0.090
Hypertension	14.71	12.13	[4.35, 33.82]	< 0.001
Stroke	1.27	2.35	[0.22, 25.03]	0.480
Other	1	1		

3.6.3 Hypertension Risk Factors in South Africa

Results of bivariate analysis of South African data produce a totally different picture to that observed with the collective analysis which showed that various factors were associated with hypertension. The analysis made in South Africa revealed that none of the non-modifiable factors, intermediate conditions and comorbidities were associated with hypertension (Appendix 2D and 2F). Among the modifiable factors, only vegetable

consumption (particularly consuming vegetables, three to four times a week) was significantly associated with hypertension (Appendix 2E). However, it was surprising that consuming vegetables 3 to 4 times was associated with 65% increase in the odds of having hypertension than those who consumed vegetables two or less times.

The results of the hierarchically adjusted logistic regression model for South African participants were slightly different from the result obtained in the bivariate analysis. Education that was previously marginally significant in the bivariate model became significant after hierarchical adjustment for age, family history and BMI, whilst vegetable consumption remained significant even after the adjustment (Table 6). The final model for South Africa revealed that having primary education (AOR = 0.44; 95% CI: 0.21– 0.95) reduced the odds of having hypertension by 56% compared to those that did not have formal education. Also, consuming vegetables 3 to 4 times a week (AOR = 1.66; 95% CI: 1.04 – 2.65) was associated with a 66% increase in the odds of hypertension compared to those who ate 2 or less vegetable portions.

Table 6. Factors associated with hypertension among South African urban commuters

Block 1: Non-modifiable risk factors	Model 1: Block 1			
	OR crude	OR adjusted	95% CI	p-value
Age				
< 40	1	1		
40–49	1.18	1.20	[0.74, 1.95]	0.468
50–59	0.96	0.92	[0.43, 1.98]	0.835
60 and above	1.55	1.42	[0.33, 6.12]	0.637
Family history				
Other	1			
Diabetes	1.31	1.31	[0.81, 2.11]	0.266
Hypertension	0.96	0.97	[0.61, 1.54]	0.896
Stroke	0.52	0.51	[0.11, 2.37]	0.385
Block 2: Modifiable risk factors	Model 2: Block 1 & 2			
Age				
< 40		1		
40–49		1.22	[0.74, 20.3]	0.431
50–59		0.91	[0.41, 1.99]	0.805
60 and above		1.80	[0.39, 8.23]	0.448
Family history				
Other		1		
Diabetes		1.39	[0.85, 2.28]	0.192
Hypertension		0.99	[0.61, 1.59]	0.952
Stroke		0.58	[0.12, 2.85]	0.500
Education				
No formal education	1	1		
Primary	0.53	0.43	[0.20, 0.94]	0.034
Secondary	1.01	0.83	[0.40, 1.75]	0.626
Diploma	0.96	0.70	[0.35, 1.43]	0.332
First degree +	1.00	0.81	[0.35, 1.86]	0.613
Vegetable consumption				
Up to 2 times	1	1		
3–4 times	1.65	1.57	[0.97, 2.54]	0.067
More than 4 times	0.84	0.84	[0.51, 1.40]	0.508
Block 3: Intermediate conditions & comorbidities	Model 3: Block 1, 2 & 3			
Age				
< 40		1		
40–49		1.26	[0.76, 2.09]	0.364
50–59		0.89	[0.41, 1.94]	0.770
60 and above		1.48	[0.33, 6.71]	0.610
Family history				
Other		1		
Diabetes		1.35	[0.83, 2.21]	0.233
Hypertension		0.97	[0.60, 1.57]	0.892
Stroke		0.54	[0.11, 2.62]	0.443
Education				
No formal education		1		
Primary		0.44	[0.21, 0.95]	0.037
Secondary		0.93	[0.46, 1.89]	0.843
Diploma		0.89	[0.47, 1.70]	0.729
First degree +		0.86	[0.39, 1.90]	0.708
Vegetable consumption				
Up to 2 times		1		
3–4 times		1.66	[1.04, 2.65]	0.034
More than 4 times		0.79	[0.48, 1.30]	0.353
BMI				
Normal weight	1	1		
Overweight	1.89	1.81	[0.82, 3.96]	0.141
Obese	1.28	1.13	[0.47, 2.69]	0.782

3.6.4 Hypertension Risk Factors in Zimbabwe

Results from the bivariate analysis for Zimbabwe data were similar to results obtained from South Africa's data, whereby none of the non-modifiable factors, intermediate conditions and comorbidities were associated with hypertension (Appendix 2D and 2F). Among the modifiable factors, only fruit consumption (OR = 0.59; 95% CI: 0.35 – 1.00) was marginally significant associated with hypertension as well as being a student, retiree and unemployed (OR = 1.66; 95% CI: 0.96 – 2.90) (Appendix E).

The hierarchically adjusted logistic regression model for the Zimbabwean participants revealed that consuming fruits 3 to 4 times a week (AOR = 0.55; 95% CI: 0.32 – 0.94) was associated with 45% reduced odds of hypertension compared to consuming fruits two or less times per week. The other factors that were previously marginally significant, lost their significance after adjusting for age and family history of disease (Table 7).

Table 7. Factors associated with hypertension among Zimbabwe urban commuters

Block 1: Non-modifiable risk factors	Model 1: Block 1			
	OR crude	OR adjusted	95% CI	p-value
Age				
< 40	1	1		
40–49	0.81	0.84	[0.46, 1.54]	0.571
50–59	0.70	0.70	[0.28, 1.78]	0.454
60 and above	2.01	2.03	[0.68, 6.05]	0.203
Sex				
Male	1	1		
Female	1.20	1.21	[0.80, 1.83]	0.356
Family history				
Diabetes	1.14	1.14	[0.70, 1.92]	0.617
Hypertension	1.33	1.33	[0.82, 2.17]	0.253
Stroke	1.03	1.02	[0.26, 3.97]	0.981
Other	1	1		
Block 2: Modifiable risk factors				
Age				
< 40		1		
40–49		0.74	[0.40, 1.39]	0.350
50–59		0.69	[0.27, 1.79]	0.449
60 and above		1.97	[0.64, 6.00]	0.235
Family history				
Other		1		
Diabetes		1.10	[0.65, 1.88]	0.714
Hypertension		1.43	[0.87, 2.37]	0.160
Stroke		1.25	[0.31, 4.96]	0.756
Fruit consumption				
Up to 2 times	1	1		
3-4 times	0.59	0.55	[0.32, 0.94]	0.029
More than 4 times	0.90	0.88	[0.54, 1.43]	0.597

CHAPTER 4

DISCUSSION

4.1 Introduction

This chapter discusses the main findings of the study with regards to the research aim, existing literature to explore relevance, significance and meaning of the findings. Strengths and limitations of the study including the study design are considered and suggestions for future research are presented. This chapter concludes with recommendations for public health policy makers and researchers.

4.2 Main Findings

This study showed that the overall prevalence of hypertension in the three countries under study was 23.4%. The highest level of hypertension occurred in South Africa (28.6%), followed by Zimbabwe (26.7%) and the lowest prevalence in Nigeria (13%). These prevalence rates were all lower than the prevalence rate found by Gomez-Olive *et al.* 2017 for SSA, whereby prevalence was found to be 33.3% (25). The Gomez-Olive study was conducted to assess hypertension prevalence, awareness and control among adults 40 to 60 years of age in rural and urban settings on 6 sites located in West, East and Southern Africa namely: Burkina Faso (Nanoro), Ghana (Navrongo), Kenya (Nairobi) and South Africa (Agincourt, Dikgale, Soweto) found that South Africa's hypertension prevalence was comparable to that obtained by Woodiwiss *et al.*, 2019 in the South African May Measurement Month (MMM) blood pressure screening exercise which found hypertension prevalence to be 24.5% (95).

The prevalence of hypertension in Nigeria reported by Okubadejo *et al.*, 2019 in a study of eight densely-populated Lagos urban areas was 55% based on ACC/AHA (2017) guideline and 27.5% when based on the JNC7 (2003) guidelines respectively (96). Hypertension prevalence of 26.7% in Zimbabwe was above that of 14.4 % found by Gonde *et al.*, 2019 in a study conducted in Hatcliffe, Harare (97).

Further analysis of hypertension prevalence indicated that age, FH of both diabetes and hypertension were significantly associated with hypertension. In this study, more hypertensive individuals were found among participants aged 60 years and above.

Hypertension was significantly associated with marital status (being married), high education (first degree or better), earning high income, being a current smoker, alcohol consumption, having DM, overweight and obesity. There were country-to country variations in both the prevalence and the risk factors associated with hypertension. These variations could be attributed to the different socioeconomic environments, public transport settings, infrastructure and political environments prevalent in each of these three countries under study.

Overall analysis of all the participants revealed that the odds of hypertension increased with age and that being 60 years and above significantly increased the likelihood of developing hypertension by 96%. This finding was consistent with findings by other scholars including (23,46,55,98–100) that reported that the likelihood of hypertension increased with advancing age. This finding could be attributed to the fact that, as a person ages, there are “age-related structural changes” that happen in a person’s blood vessels that narrow the vascular lumen thus resulting in increases in blood pressure (23). Also, as the population ages, there is a very high chance that many of the previously prehypertensive individuals progress to full hypertension if appropriate measures are not taken to reverse the situation. In addition, it has been proven that treatment becomes more difficult among elderly than younger patients. With age, it becomes harder to change lifestyle habits and to adopt a healthier lifestyle that involves vigorous exercises (100). This implies that adopting healthier lifestyle habits in the early stages of life may assist in delaying the development as well the progression of hypertension and related issues.

Min *et al.*, 2010 found that the odds of diabetes and hypertension increased by 7% for every unit increase in age across the age groups considered (101). Furthermore, a study conducted in Kenya found that hypertension prevalence was lower in females than males aged 35-44 years. However, after 44 years, this trend reversed, and prevalence became higher among females than males (55). This could be attributed to menopause, women are hemodynamically younger than men of the same age, thus making them less vulnerable to hypertension. However, after menopause, women experience hormonal changes and tend to gain more weight thus making them more vulnerable to blood pressure increases (102).

Hypertension is generally known to be a disease that runs in the family (46). In this study, the findings revealed that having a family history of diabetes and hypertension increased the odds of having hypertension. This was in line with findings from Turkey which showed an OR of 2.23 for participants with family history of hypertension (47). In Beijing, more participants with FH of hypertension were hypertensive than those without family history (103).

In Korea, having a parental history of CVD increased the likelihood of developing hypertension and diabetes (46). Similarly, Igarashi *et al.*, 2016 also found that the odds of hypertension in individuals with a family history of hypertension in both parents, in addition to one or more grandparents and at least one sibling was 2.41 compared to those without any family history (65). Furthermore, findings of the study displayed that FH enhanced the other hypertension risk factors, and interacted with BMI, smoking, physical activity, fasting plasma glucose (FPG), haemoglobin A1c, uric acid (UA) and triglyceride (TG) (65). In addition, a study by Qui *et al.*, 2003 showed that individuals with parental history of type 2 diabetes had double the risk of preeclampsia (99). Individuals with a parental history of both diabetes and hypertension, had a 3-fold higher risk of preeclampsia than those whose parents were neither hypertensive nor diabetic (104).

The study's finding that having a marital partner is protective was in line with findings by Triantafyllou *et al.*, 2010 which indicated that having a marital partner was associated with 54% lower odds of developing hypertension than being single (105). In Israel, Abu-Saad *et al.* (2014) found that single participants had higher odds of uncontrolled hypertension than married participants (106). However, the magnitude and the direction of

the effect of marital status on hypertension differed in different studies and populations (107–109). In many societies, having a marital partner is an important factor for one's health, behaviour, financial stability, social standing, and psychological welfare (106,110).

Furthermore, in some countries, widows face many challenges that increase their vulnerability to hypertension compared to their married individuals. A study in Burkina Faso found that the risk of hypertension among widowed participants was twice the risk of hypertension in married counterparts of the same age (55). However, findings from a study on Korean adults found that unmarried participants had lesser odds of developing both hypertension and diabetes (101). This was similar to findings from Limpopo, South Africa which found hypertension prevalence to be significantly lower among single participants compared to married counterparts (99).

This study further found that individuals having tertiary education had significantly lower odds of hypertension than individuals in other educational brackets. These results were similar to results obtained in South Africa (99) and India (111), whereby educational attainment was inversely related with hypertension. Also, studies from Pakistan (100) and Nepal (112) showed that individuals with lower literacy levels were more vulnerable to developing hypertension compared to those more literate. Similar conclusions were reached in Nepal (113), North West Tanzania (36) and Afghanistan (114). Chow *et al.*, 2013 further concluded that higher education was associated with greater awareness and treatment of hypertension, particularly in low income countries (43).

The results of this study revealed that having tertiary education and earning relatively high family income was protective. This is one of the indicators that an individual's educational and economic status enhances the person's likelihood to engage in health - enhancing activities (115). Higher education was found to lead to reduced risk of all-cause mortality compared to having primary or lower education (57). Furthermore, in Nigeria, a study on patient-related barriers to the control of hypertension found that a patient's level of education had a positive effect in the control of blood pressure (BP). Ideally, hypertension patients have to be educated on hypertension including the causes, duration of treatment, lifestyle modification needed to manage hypertension, the importance of medical adherence as well as adhering to regular check-ups. This is intended

to ensure that patients comply and adhere to treatment instructions and to minimise the chances of discontinuing treatment prematurely (15).

A study conducted in Western Cape, South Africa revealed that lower education was associated with poor BP control but did not find a significant relationship between hypertension and education (116). In most cases, low education is accompanied by low income, and this sometimes hinders individuals from accessing medication, including hypertension medication. Findings from LMICs suggest that hypertension may be associated with socioeconomic status (SES) (23). The prevalence of hypertension in these countries was inversely proportional to educational attainment. Similar sentiments were shared by Mubarik *et al.*, 2019 who found that individuals with lower SES tend to have a lower literacy rate and are more vulnerable to hypertension compared to those with higher SES (100).

This study also found that earning higher income was protective and significantly associated with hypertension. The odds of hypertension were lower among participants with high income than those with low income. These findings were in line with findings by Tropak & Demir, 2012 which revealed that individuals from low income households were more prone to developing hypertension and that individuals from these low-income families were more inclined to eating more energy dense foods that made them feel full but, in the process, cause them to gain weight (47). Also, Ghosh & Kumar, 2019 found that hypertension disproportionately affected more economically disadvantaged individuals in India's developed states of Punjab, Haryana, Jammu & Kashmir (111). A similar pattern was observed in rural Kerala & Mizoram (105).

In this study, smoking and alcohol consumption increased the odds of hypertension by 63% and 48% respectively. Similar results were observed in Nepal (87,100) and in Japan (65). Also, a systematic review and meta-analysis of LMICs revealed that, in Asians regions, smokers were more likely to develop hypertension than non-smokers. However, in the other regions, the odds of hypertension were higher among non-smokers than smokers (23). The researchers speculated that these findings were a result of reporting errors whereby smokers were captured as non-smokers and vice versa. Sarki *et al.*, 2015 noted that the increased risk of hypertension among non-smokers and non-drinkers could be a result of their engagement in other harmful behaviours that make them more susceptible to developing hypertension (23). Biino *et al.*,

2013 in a study on environmental and genetic contribution to hypertension also found smoking to be inversely associated with hypertension (117).

Many epidemiological studies have found that alcohol consumption increases a person's risk of developing hypertension (98,112,118). However, a study on hypertension in SSA involving cross-sectional studies from Nigeria, Kenya, Tanzania and Namibia found no association between alcohol consumption and hypertension (44). Diabetes was another risk factor that was significantly associated with hypertension. The Thailand National Health Examination Survey, Cycle III (NHES-III), found that diabetic patients had an increased risk of developing hypertension than non-diabetic patients (100). Similar findings were also found in Nepal (112) and Jordan (48). However, Ware *et al.*, 2018, found that patients with both hypertension and diabetes mellitus tended to have better control and adherence to BP medication (116).

Lastly, obesity was significantly associated with hypertension compared to normal weight. This was in line with findings from Kenya (55), Nepal (98), Ethiopia (118), Japan (65) and from LMICs (23). The mechanisms that link obesity to hypertension are still under investigation (62,64,119). Whilst in earlier research studies linked the association between obesity and hypertension to haemodynamic factors, latest studies have revealed that the link between obesity and hypertension is more complicated and not yet fully understood (120).

The development of hypertension in obese individuals has further been attributed to interactions between dietary, genetic, epigenetic and environmental factors (64,121,122). "Visceral adipocyte dysfunction leads directly to renal, cardiac and vascular dysfunction, via an impaired immune or inflammatory response, and by affecting neuroimmune interactions that alter SNS signalling. Cardiac and/or renal abnormalities can lead to vascular dysfunction and vice versa. Obesity-related hypertension is associated with structural and functional changes in the kidney, heart and vasculature. Hyperuricaemia might also affect adipocyte function and vascular remodelling and cause renal abnormalities" (121).

4.3 Strength and Limitations of the Study

The major strength of the study lies in the use of a validated STEPwise questionnaire which is a WHO standardized tool for NCDs, thus gives results comparable to other studies that used a similar tool. In all three countries, the studies were carried out in urban areas in order to find risk factors for hypertension. The following limitations need to be considered. Ideally, blood pressure assessment should be done using an average of two or more consecutive readings taken on different occasions.

However, in this study, there was no record of the participant's previous blood pressure reading, and all readings were taken on the same day, one after the other with a 5-minute interval. Because of that, this study cannot eliminate the "white-coat effect" or masked hypertension. More importantly, nothing indicates that the researchers managed to find a quiet space in a taxi rank to ensure that a good BP reading could be taken. Also, there were no follow-ups of the participants.

In addition, the cross-sectional study design used to collect data, captured a 'snapshot' of the outcome and characteristics associated with it at a specific point in time, hence we cannot use it to analyse behaviour over a longer period of time. As a result, no causal relationship between hypertension and any of the risk factors could be established, and findings cannot be generalised (123). Moreover, the scope of the study did not include collecting urine, blood and other biochemical measurements, to assess participants' blood glucose, total cholesterol, triglycerides, HDL and LDL, that provide more insight on the health conditions and overall well-being of the study's participants.

Also, the study relied heavily on self-reporting of non-modifiable and modifiable risk factors, such as age, disease history, family income, smoking, alcohol consumption, physical activity and diet, thus it was not free from recall and social desirability biases. The study did not differentiate between emergency commuters, those looking for employment and those employed. Lastly, due to the use of convenience sampling, the study population may not be representative of all the urban commuters in the three countries (Nigeria, South Africa and Zimbabwe), or the wider population.

4.4 Conclusion

Hypertension prevalence was high in South Africa and Zimbabwe, but relatively low in Nigeria. The risk factors associated with hypertension differed by country. In Nigeria, obesity significantly increased commuters' chances of developing hypertension; in South Africa, having some formal education had a protective effect, while in Zimbabwe fruit consumption was protective towards developing hypertension. Thus, in all three countries, hypertension was associated with dietary behaviours and obesity. Therefore, public health policies and intervention programs should focus on early disease detection and lifestyle modifications aimed at improving urban dietary patterns, reducing weight and the burden of disease.

It is worth noting that urban groups of individuals potentially have better access to antihypertensive medication. However, constraints such as low socioeconomic status resulting from low education, low income may result in poor diets; whilst in high-income groups (obesity, sedentary lifestyles, smoking and alcohol consumption) may increase their risk of developing hypertension. As a result, there is need for more frequent screening campaigns strategically placed in the busiest urban public spaces to strengthen hypertension diagnosis.

Also, campaigns to promote healthy eating, physical activity should be conducted regularly in the populations as primary prevention strategies. Hypertension now requires more intense and all-embracing interventions for early diagnosis of asymptomatic hypertension cases. SSA region can build on the successes achieved in the fight against infectious diseases to extend it to include rigorous fight against hypertension and other non-communicable diseases.

4.5 Implications for Public Health Policy and Recommendations for Future Research

This study provided some baseline estimates of hypertension prevalence among urban commuters along with associated risk factors. Thus, these findings may be used to develop directed public health policies, especially, policies on how to encourage individuals to increase physical activity and eat better, to reduce weight, morbidity and mortality. Also, this study focused on urban commuters only, excluding rural commuters, thus leaving room for future studies to focus on rural commuters and a comparative analysis of rural-urban commuter groups. Furthermore, the study did not consider hypertension prevalence by the different ethnic groups, thus future studies can extend the analysis to consider hypertension prevalence and associated risk factors by ethnicity.

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APPENDICES

APPENDIX 1: PLAGIARISM DECLARATION



PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I HLOBSILE ZANELE NKAMBULE-BHEMBE (Student number: 2259481) am a student registered for the degree of MASTER OF SCIENCE IN EPIDEMIOLOGY in the academic year 2020.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.
- I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document.

Signature: 

Date: 26/10/2020

APPENDIX 2A: Sociodemographic characteristics of study participants

Characteristic	All participants N=1384 (100.0%)	Nigeria n=402 (29.0%)	South Africa n=510 (36.9%)	Zimbabwe n=472 (34.1%)
Age (years)				
< 40	952 (68.8%)	226 (56.2%)	366 (71.8%)	360 (76.3%)
40–49	258 (18.6%)	90 (22.4%)	99 (19.4%)	69 (14.6%)
50–59	110 (7.9%)	44 (10.9%)	37 (7.3%)	29 (6.1%)
60–69	49 (3.5%)	27 (6.7%)	8 (1.5%)	14 (3.0%)
70 and above	15 (1.1%)	15 (3.8%)	0 (0.0%)	0 (0.0%)
Mean ± SD	35.91 ± 11.30			
Min	15			
Max	85			
Sex				
Male	649 (46.9%)	153 (38.1%)	259 (50.8%)	237 (50.2%)
Female	735 (53.1%)	249 (61.9%)	251 (49.2%)	235 (49.8%)
Marital Status				
Single	857 (62.0%)	96 (24.0%)	400 (78.4%)	361 (76.5%)
Married	479 (34.6%)	269 (67.3%)	104 (20.4%)	106 (22.5%)
Separated /Divorced	23 (1.7%)	17 (4.3%)	3 (0.6%)	3 (0.6%)
Widowed	23 (1.7%)	18 (4.5%)	3 (0.6%)	2 (0.4%)
Education				
No formal education	144 (10.4%)	27 (6.7%)	61 (11.9%)	56 (11.9%)
Primary	224 (16.2%)	42 (10.5%)	98 (19.2%)	84 (17.8%)
Secondary	282 (20.4%)	84 (21.0%)	99 (19.4%)	99 (21.0%)
Diploma	457 (33.1%)	84 (21.0%)	191 (37.5%)	182 (38.5%)
First Degree	173 (12.5%)	117 (29.3%)	30 (5.9%)	26 (5.5%)
MSc and PhD	96 (7.0%)	40 (10.0%)	31 (6.1%)	25 (5.3%)
Other	6 (0.4%)	6 (1.5%)	0 (0.0%)	0 (0.0%)
Religion				
Christianity	1281 (92.7%)	299 (74.9%)	510 (100.0%)	472 (100.0%)
Islam	99 (7.2%)	99 (24.8)	0 (0.0%)	0 (0.0%)
Other	1 (0.1%)	1 (0.3%)	0 (0.0%)	0 (0.0%)
Occupation				
Self-employed	426 (30.8%)	177 (44.4%)	130 (25.5%)	119 (25.2%)
Public Servant	313 (22.7%)	106 (26.6%)	107 (21.0%)	100 (21.2%)
Private Sector Worker	352 (25.5%)	80 (20.0%)	138 (27.0%)	134 (28.4%)
Unemployed	273 (19.8%)	23 (5.8%)	133 (26.1%)	117 (24.8%)
Other (Student, Retired)	17 (1.2%)	13 (3.3%)	2 (0.4%)	2 (0.4%)
Monthly Income				
No income	39 (2.9%)	39 (11.0%)	0 (0.0%)	0 (0.0%)
< R500	510 (38.2%)	30 (8.4%)	130 (25.5%)	350 (74.1%)
R501 – R2,000	317 (23.7%)	138 (38.9%)	65 (12.8%)	114 (24.2%)
R2,001 – R4,000	317 (23.7%)	49 (13.8%)	260 (51.0%)	8 (1.7%)
R4,001 - R8,000	76 (5.7%)	51 (14.4%)	25 (4.9%)	0 (0.0%)
R8,001 - R12,000	35 (2.6%)	23 (6.5%)	12 (2.4%)	0 (0.0%)
R12,001- R16,000	33 (2.5%)	15 (4.2%)	18 (3.5%)	0 (0.0%)
>R16,000	10 (0.7%)	10 (2.8%)	0 (0.0%)	0 (0.0%)

APPENDIX 2B: Distribution of participants by selected behavioural characteristics and BMI

Variable	All participants n=1384 (100.0%)	Nigeria n=402 (29.0%)	South Africa n=510 (36.9%)	Zimbabwe n=472 (34.1%)
Ever smoked tobacco				
Yes	483 (34.9%)	46 (11.4%)	235 (46.1%)	202 (42.8%)
No	901 (65.1%)	356 (88.6%)	275 (53.9%)	270 (57.2%)
Currently smoke				
Yes	399 (28.9%)	17 (4.2%)	201 (39.4%)	181 (38.4%)
No	984 (71.1%)	384 (95.8%)	309 (60.6%)	291 (61.6%)
Ever consumed alcohol				
Yes	677 (48.9%)	192 (47.8%)	252 (49.4%)	233 (49.4%)
No	707 (51.1%)	210 (52.2%)	258 (50.6%)	239 (50.6%)
Currently consume alcohol				
Yes	495 (35.8%)	107 (26.8%)	201 (39.4%)	187 (39.6%)
No	886 (64.2%)	292 (73.2%)	309 (60.6%)	285 (60.4%)
Does your work involve physical activity				
Yes	552 (40.7%)	131 (35.1%)	219 (42.9%)	202 (42.8%)
No	803 (59.3%)	242 (64.9%)	291 (57.1%)	270 (57.2%)
Physical activity per week				
<150 min/ week	616 (44.5%)	188 (46.8%)	226 (44.3%)	202 (42.8%)
≥150 mins/week	768 (55.5%)	214 (53.2%)	284 (55.7%)	270 (57.2%)
Hours of sleep/night				
≤ 6 hours	375 (27.2%)	156 (39.1%)	116 (22.7%)	103 (21.8%)
6-8 hours	614 (44.4%)	196 (49.1%)	216 (42.4%)	202 (42.8%)
>8 hours	392 (28.4%)	47 (11.8%)	178 (34.9%)	167 (35.4%)
Mode of transport to work /workshop				
No work	21 (1.5%)	21 (5.4%)	0 (0.0%)	0 (0.0%)
Motorcycle	190 (13.9%)	104 (26.7%)	45 (8.8%)	41 (8.7%)
Car	513 (37.4%)	144 (36.9%)	192 (37.6%)	177 (37.5%)
Bicycle	60 (4.4%)	41 (10.5%)	10 (2.0%)	9 (1.9%)
Trek /Walk	443 (32.3%)	79 (20.3%)	188 (36.9%)	176 (37.3%)
Other	145 (10.6%)	1 (0.3%)	75 (14.7%)	69 (14.6%)
BMI category				
Underweight	30 (2.2%)	30 (7.5%)	0 (0.0%)	0 (0.0%)
Normal weight	500 (36.1%)	180 (44.8%)	46 (9.0%)	274 (58.0%)
Overweight	554 (40.0%)	118 (29.4%)	346 (67.8%)	90 (19.1%)
Obese	300 (21.7%)	74 (18.4%)	118 (23.2%)	108 (22.9%)

APPENDIX 2C: Distribution of participants by diet, family history and comorbidities

Variable	All participants N=1,384 (100.0%)	Nigeria n=402 (29.0%)	South Africa n=510 (36.9%)	Zimbabwe n=472 (34.1%)
Fruit consumption				
Never eat fruits	4 (0.3%)	4 (1.0%)	0 (0.0%)	0 (0.0%)
1 – 2 times	467 (34.0%)	119 (30.3%)	177 (34.7%)	171 (36.2%)
3-4 times	442 (32.1%)	144 (36.6%)	157 (30.8%)	141 (29.9%)
5-6 times	452 (32.4%)	116 (29.5%)	176 (34.5%)	160 (33.9%)
Every day	7 (0.5%)	8 (2.0%)	0 (0.0%)	0 (0.0%)
Occasionally	2 (0.2%)	2 (0.5%)	0 (0.0%)	0 (0.0%)
Vegetable consumption				
Never eat vegetables	2 (0.2%)	2 (0.5%)	0 (0.0%)	0 (0.0%)
1 – 2 times	608 (44.1%)	166 (41.8%)	229 (44.9%)	213 (45.1%)
3-4 times	409 (29.7%)	149 (37.5%)	136 (26.7%)	136 (28.6%)
5-6 times	352 (25.5%)	72 (18.1%)	145 (28.4%)	145 (30.7%)
Every day	2 (0.2%)	2 (0.5%)	0 (0.0%)	0 (0.0%)
Occasionally	6 (0.4%)	6 (1.5%)	0 (0.0%)	0 (0.0%)
Consumption of carbonated drinks				
Never consume drinks	76 (5.5%)	26 (6.4%)	25 (4.9%)	26 (5.5%)
1 – 2 times	955 (69.4%)	171 (43.4%)	409 (80.2%)	375 (79.5%)
3-4 times	345 (25.1%)	198 (50.2%)	76 (14.9%)	71 (15.0%)
Family history				
None	55 (4.1%)	55 (14.6%)	0 (0.0%)	0 (0.0%)
Diabetes	288 (21.2%)	36 (9.6%)	129 (25.3%)	123 (26.1%)
Hypertension	354 (26.1%)	58 (15.4%)	156 (30.6%)	140 (29.7%)
Stroke	53 (3.9%)	29 (7.7%)	12 (2.3%)	12 (2.5%)
Other	609 (44.8%)	199 (52.8%)	213 (41.8%)	197 (41.7%)
Self-reported diseases				
None	64 (4.7%)	64 (16.4%)	0 (0.0%)	0 (0.0%)
Diabetes	277 (20.2%)	10 (2.6%)	139 (27.3%)	128 (27.1%)
Hypertension	320 (23.3%)	41 (10.5%)	144 (28.2%)	135 (28.6%)
Stroke	38 (2.8%)	11 (2.8%)	14 (2.8%)	13 (2.8%)
Other	674 (49.1%)	265 (67.8%)	213 (41.8%)	196 (41.5%)

APPENDIX 2D: Distribution of participants by age, sex and family history of disease

Variable	All Participants			Nigeria			South Africa			Zimbabwe		
	OR crude	95% CI	P-values	OR crude	95% CI	P-values	OR crude	95% CI	P-values	OR crude	95% CI	P-values
Non-modifiable risk factors												
Age (years)												
< 40	1			1			1			1		
40–49	1.10	[0.80, 1.53]	0.549	3.57	[1.60, 7.96]	0.002	1.18	[0.73, 1.91]	0.501	0.81	[0.44, 1.48]	0.488
50–59	1.14	[0.72, 1.80]	0.588	5.94	[2.43, 14.57]	< 0.001	0.96	[0.45, 2.05]	0.913	0.70	[0.28, 1.76]	0.447
60 and above	1.96	[1.50, 3.34]	0.013	8.92	[3.75, 21.19]	< 0.001	1.55	[0.36, 6.62]	0.552	2.01	[0.68, 5.93]	0.208
Sex												
Male	1			1			1			1		
Female	0.89	[0.69, 1.14]	0.352	0.82	[0.45, 1.47]	0.499	0.86	[0.58, 1.26]	0.434	1.20	[0.80, 1.80]	0.390
Family history of disease												
Diabetes	1.58	[1.15, 2.17]	0.005	1.48	[0.53, 4.14]	0.458	1.31	[0.81, 2.10]	0.270	1.14	[0.68, 1.90]	0.622
Hypertension	1.54	[1.14, 2.08]	0.005	2.91	[1.41, 6.04]	0.004	0.96	[0.60, 1.53]	0.869	1.33	[0.82, 2.16]	0.250
Stroke	0.82	[0.39, 1.73]	0.610	1.47	[0.47, 4.55]	0.509	0.52	[0.11, 2.45]	0.410	1.03	[0.27, 3.98]	0.960
Other	1			1			1			1		

APPENDIX 2E: Distribution of participants by education, marital status, occupation, income, smoking and alcohol consumption, diet, physical activity and sleeping pattern

Variable	All participants			Nigeria			South Africa			Zimbabwe		
	OR crude	95% CI	P-values	OR crude	95% CI	P-values	OR crude	95% CI	P-values	OR crude	95% CI	P-values
Modifiable risk factors												
Marital Status												
Single	1			1			1			1		
Married	0.66	[0.50, 0.87]	0.003	2.72	[1.03, 7.17]	0.043	0.68	[0.41, 1.13]	0.139	1.16	[0.72, 1.87]	0.550
Separated, Divorced, Widowed	0.79	[0.39, 1.63]	0.530	7.28	[2.27, 23.25]	0.001						
Education												
No formal education	1			1			1			1		
Primary	0.70	[0.44, 1.13]	0.144	0.74	[0.25, 2.21]	0.592	0.53	[0.25, 1.11]	0.093	0.92	[0.44, 1.92]	0.820
Secondary	0.78	[0.50, 1.22]	0.271	0.40	[0.14, 1.11]	0.077	1.01	[0.51, 2.01]	0.982	0.95	[0.46, 1.94]	0.889
Diploma	0.70	[0.46, 1.07]	0.097	0.22	[0.07, 0.67]	0.008	0.96	[0.52, 1.80]	0.908	0.71	[0.37, 1.38]	0.312
≥ First degree	0.46	[0.28, 0.73]	0.001	0.22	[0.08, 0.60]	0.003	1	[0.46, 2.15]	0.999	0.78	[0.34, 1.83]	0.576
Occupation												
Self-employed	1			1			1			1		
Public Servant	1.09	[0.77, 1.55]	0.613	0.88	[0.44, 1.73]	0.705	1.49	[0.86, 2.60]	0.155	0.75	[0.40, 1.42]	0.382

Private-Sector	0.94	[0.67, 1.33]	0.725	0.28	[0.09, 0.83]	0.021	1.11	[0.65, 1.89]	0.707	0.82	[0.46, 1.46]	0.497
Other (Unemployed., students, retired)	1.35	[0.95, 1.90]	0.091	0.48	[0.14, 1.69]	0.254	0.88	[0.51, 1.52]	0.644	1.66	[0.96, 2.90]	0.071
Monthly Income												
< R500	1			1			1			1		
R501 – R2000	0.72	[0.51, 1.01]	0.055	1.48	[0.55, 3.93]	0.436	1.08	[0.55, 2.15]	0.815	0.77	[0.47, 1.27]	0.303
R2001 – R4000	1.25	[0.92, 1.71]	0.154	1.19	[0.34, 4.16]	0.781	1.46	[0.91, 2.35]	0.118	1.56	[0.37, 6.67]	0.545
> R4000	0.59	[0.37, 0.95]	0.030	1.45	[0.52, 4.07]	0.482	0.95	[0.45, 1.98]	0.887			
Ever smoked												
No	1			1			1			1		
Yes	1.46	[1.13, 1.87]	0.004	2.08	[0.96, 4.49]	0.063	1.11	[0.76, 1.63]	0.592	1.05	[0.69, 1.58]	0.821
Currently smoke												
No	1			1			1			1		
Yes	1.63	[1.25, 2.12]	<0.001	4.11	[1.44, 11.65]	0.008	1.24	[0.84, 1.84]	0.274	1.08	[0.71, 1.64]	0.719
Ever consumed alcohol												
No	1			1			1			1		
Yes	1.28	[1.00, 1.65]	0.049	1.73	[0.96, 3.13]	0.069	1.30	[0.89, 1.91]	0.179	1.08	[0.72, 1.63]	0.708
Currently consume alcohol												
No	1			1			1			1		
Yes	1.48	[1.15, 1.91]	0.003	1.87	[1.02, 3.43]	0.044	1.35	[0.91, 1.99]	0.135	1.20	[0.79, 1.82]	0.386
Fruit consumption												
2 or less times	1			1			1			1		
3 - 4 times	0.81	[0.59, 1.10]	0.175	1.00	[0.46, 2.20]	0.996	1.08	[0.67, 1.74]	0.744	0.59	[0.35, 1.00]	0.050
5 or more times	1.08	[0.80, 1.45]	0.624	1.77	[0.84, 3.72]	0.130	1.07	[0.67, 1.69]	0.787	0.90	[0.58, 1.44]	0.648
Vegetable consumption												
2 or less times	1			1			1			1		
3 - 4 times	1.29	[0.96, 1.73]	0.094	1.43	[0.72, 2.84]	0.306	1.65	[1.04, 2.60]	0.030	1.15	[0.69, 1.91]	0.585
More than 4 times	1.31	[0.96, 1.78]	0.088	2.35	[1.10, 5.00]	0.027	0.84	[0.52, 1.37]	0.490	1.43	[0.89, 2.32]	0.142
Consumption of carbonated drinks												
2 or less times	1			1			1			1		
3 - 4 times	0.68	[0.50, 0.93]	0.014	1.08	[0.60, 1.96]	0.792	0.81	[0.46, 1.41]	0.449	1.00	[0.57, 1.78]	0.989
Physical activity												
< 150 mins/ week	1			1			1			1		
≥ 150 mins/ week	1.06	[0.82, 1.36]	0.669	1.38	[0.77, 2.49]	0.284	0.92	[0.63, 1.35]	0.671	1.00	[0.67, 1.51]	0.990
Hours of sleep per night												
< 6 hours	1			1			1			1		
6 – 8 hours	1.06	[0.77, 1.44]	0.733	1.15	[0.61, 2.16]	0.659	0.97	[0.59, 1.60]	0.907	0.86	[0.51, 1.47]	0.585
> 8 hours	1.24	[0.89, 1.73]	0.206	0.86	[0.30, 2.44]	0.774	0.94	[0.56, 1.58]	0.821	0.97	[0.56, 1.68]	0.913

APPENDIX 2F: Distribution of participants by BMI, intermediate conditions and comorbidities

Variable	All participants			Nigeria			South Africa			Zimbabwe		
	OR crude	95% CI	P-values	OR crude	95% CI	P-values	OR crude	95% CI	P-values	OR crude	95% CI	P-values
Intermediate conditions and comorbidities												
Self-reported diseases												
Diabetes	1.43	[1.07, 1.93]	0.017	5.45	[1.32, 22.42]	0.019	0.94	[0.58, 1.51]	0.791	1.39	[0.84, 2.89]	0.197
Hypertension				14.71	[7.01, 30.88]	< 0.001	1.13	[0.71, 1.80]	0.596	1.24	[0.75, 2.04]	0.394
Stroke				1.27	[0.16, 10.35]	0.823	0.42	[0.09, 1.91]	0.259	0.58	[0.12, 2.69]	0.484
Other	1			1	1		1	1		1	1	
BMI category												
Normal weight	1			1			1			1		
Overweight	1.83	[1.36, 2.46]	< 0.001	2.84	[1.27, 6.34]	0.011	1.89	[0.88, 4.05]	0.102	1.18	[0.70, 2.01]	0.533
Obese	1.87	[1.33, 2.63]	< 0.001	9.23	[4.25, 20.03]	< 0.001	1.28	[0.55, 2.97]	0.567	1.12	[0.70, 1.85]	0.655

APPENDIX 3: ETHICS CLEARANCE CERTIFICATE

UNIVERSITY OF THE
WITWATERSRAND
JOHANNESBURG



R14/49 Ms H Nkambule-Bhembe

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL) CLEARANCE CERTIFICATE NO. M191129

NAME: Ms H Nkambule-Bhembe
(Principal Investigator)
DEPARTMENT: School of Public Health
Division of Epidemiology and Biostatistics
Medical School
University

PROJECT TITLE: Prevalence and risk factors associated with hypertension among urban commuters in Nigeria, South Africa and Zimbabwe

DATE CONSIDERED: 2019/11/29

DECISION: Approved unconditionally

CONDITIONS:

SUPERVISOR: Dr J Kagura

APPROVED BY: 
Dr CB Penny, Chairperson, HREC (Medical)

DATE OF APPROVAL: 2020/02/17

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and ONE COPY returned to the Research Office Secretary on the 3rd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to submit details to the Committee. I **agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **November** and will therefore reports and re-certification will be due early in the month of **November** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).


Principal Investigator Signature

25/02/2020
Date

APPENDIX 4: QUESTIONNAIRE ON “CARDIOVASCULAR RISK FACTORS IN AFRICA: A WHO STEPS-wise APPROACH”

QUESTIONNAIRE ON “CARDIOVASCULAR RISK FACTORS IN AFRICA: A WHO STEPS-wise APPROACH”

Dear respondent, the aim of this study is to determine the “cardiovascular risk factors of people of African descent using a WHO STEPS-wise approach”. Names are not required in connection with any information on this questionnaire. Participants are free to withdraw at any time without any penalization.

Statement of person giving consent: I have read the description of this study or it has been explained to me. I understand that my participation is voluntary. I know about the purpose and benefits of the research study to judge that I want to take part in it. I understand that I may freely stop being part of this study at any time.

Date: **Signature:** **Name of Town/Location:** **Questionnaire Number:**

Kindly answer the questions appropriately and with all sincerity. All information will be treated with confidentiality.

SECTION A (SOCIO-DEMOGRAPHIC DATA)

1. Age: _____
2. Gender: Male Female
3. Marital Status: Single Married Separated Divorced Widowed
4. Religion: Christianity Islam Others: pls specify _____
5. Tribe: _____
6. Nationality: Nigerian South African South Sudanese Others: pls specify _____
7. Level of education: No formal education Primary Secondary Diploma
First Degree MSc PhD Others: pls specify _____
8. Occupation: Artisan Trader/Small Business Public Servant Private Sector Worker
Teacher Unemployed Others: pls specify _____
9. Monthly income (in rand): < R500 501 - R1000 R1001 - R2000 R2001 - R4000
R4001 - R8000 R8001 - R12000 R12001 - R16000 R16001 - R20000 > R20000

SECTION B (BEHAVIOURAL MEASUREMENTS)

10	Have you ever smoked any tobacco product such as cigarettes, cigars, pipes, snuff etc	Yes <input type="checkbox"/>	No <input type="checkbox"/>	If yes, how long (years)? _____ Which type? _____ Age at first consumption: _____ When you stopped: _____ Why? _____
11	Do you currently smoke any tobacco product? <i>(estimate in the past 3 months)</i>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	If yes, which type? _____ How often? _____ How many wraps/sticks per day/week? _____
12	During the past one month, on how many days did someone in your home or work place smoke when you were present?			Daily <input type="checkbox"/> 4 days <input type="checkbox"/> 3 days <input type="checkbox"/> 2 days <input type="checkbox"/> 1 day <input type="checkbox"/> Others: _____
13	Have you ever consumed an alcoholic drink e.g. beer, wine, spirit etc	Yes <input type="checkbox"/>	No <input type="checkbox"/>	If yes, how long (years)? _____ Which type? _____ Age at first consumption: _____ When you stopped: _____ Why? _____
14	Do you currently consume an alcoholic drink e.g. beer, wine, spirit etc	Yes <input type="checkbox"/>	No <input type="checkbox"/>	If yes, which type? _____ How often? _____

<i>(estimate in the past 3 months)</i>			How many sachets/bottles per day/week? _____
--	--	--	--

15. During the past 30 days, how many times did you take at least one alcoholic drink? _____
16. How often do you eat fruits? Every day Weekly Once in a while
 When I have the money to buy it When someone buys for me Others: pls specify _____
17. Make a list of the types of fruits you eat regularly _____
18. Are there times you take fruit as a complete meal? Yes No
19. If yes, how often? _____
20. How often do you eat vegetables? Every day Weekly Once in a while
 When I have the money to buy it When someone buys for me Others: pls specify _____
21. Make a list of the types of vegetables you eat regularly _____
22. Are there times you take fruit as a complete meal? Yes No
23. If yes, how often? _____
24. In the last 3 days, insert the food you ate below in the corresponding spaces (**Day of interview is not inclusive**)

	MORNING	AFTERNOON	EVENING	NIGHT (AFTER 9PM)
DAY 1 MEAL				
DAY 2 MEAL				
DAY 3 MEAL				

25. How many times do you eat a day (i.e. breakfast, lunch, dinner etc)? _____
26. How often do you eat snacks e.g. sandwich, meat pie, chips, doughnut, biscuits, ice cream? _____
27. How often do you drink carbonated soft drink? Daily Weekly Occasionally Others: _____
28. On average, how many meals per week do you eat that were not prepared in your home? _____
29. When do you eat your largest meal? Breakfast Lunch Dinner Others: _____
30. Does your work involve physical exercise that causes increases in breathing? Yes No
31. In a week, on how many days do you deliberately do physical exercises? _____
32. How much time do you spend on the average doing physical exercises on a typical day? _____
33. In what type (s) of exercise do you participate? _____
34. How many minutes or hours do you usually spend sitting on a typical day? _____
35. How do you get to your work place or workshop? Motorcycle Car Bicycle Trek Others: _____
36. If you have to trek/walk, estimate how many minutes per day this take: _____
37. Does your parent (s) have: Diabetes Hypertension Stroke Others: _____
38. Do you have: Diabetes Hypertension Stroke Others: _____
39. How many hours do you sleep at night? < 2 hours 2 – 4 hours 4 – 6 hours 6 – 8 hours > 8 hours

SECTION C (PHYSICAL PARAMETERS)

Weight (kg)	Height (m)	Body Mass Index (kg/m ²):	Systolic BP (mmHg): [TWO READINGS]	Diastolic BP (mmHg): [TWO READINGS]	Waist Circumference (cm):	Hip Circumference (cm):	Waist-Hip Ratio:

APPENDIX 5: TURNITIN REPORT

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Signed 

Dr J Kagura

Date 2/11/2020

