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Prevalence and determinants of comorbidity amongst hypertensive adults (20+ years) in South Africa

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Prevalence and Determinants of Comorbidity amongst hypertensive adults (20+ years) in South Africa



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A RESEARCH REPORT SUBMITTED TO THE SCHOOLS OF PUBLIC HEALTH AND SOCIAL SCIENCES, UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ARTS IN THE DEMOGRAPHY AND POPULATION STUDIES.

MARCH, 2020

DECLARATION

I, **OgoneWarona Motlogeloa** hereby declare that this research report is my original work. This research work is being submitted for the degree of Masters in Health Demography at the University of the Witwatersrand, Johannesburg. To the best of my knowledge, this work has not been submitted for any degree or examination or to any other university.



16th Day of March 2020

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LIST OF ABREVIATIONS

GIS: Geographical Information Systems

NCD: Non-communicable Disease

WHO: World Health Organisation

HTN: Hypertension

CVD: Cardiovascular Disease

HBP: High Blood Pressure

NHI: National Health Insurance

PHC: Primary Health Care

NDP: National Development Plan

SAGHS: South African General Household Survey

LIST OF DEFINITIONS

HYPERTENSION/ HBP: A condition in which the force of the blood against the artery walls is too high. Usually hypertension is defined as a blood pressure above 140/90, and is considered severe if the pressure is above 180/120.

COMORBIDITY: Comorbidity is defined as the co-occurance of more than one disorder in the same individual.

GIS: A geographic information system is a conceptualized framework that provides the ability to capture and analyze spatial and geographic data.

Abstract

Introduction; Comorbidity has several definitions based on different conceptualisations of a single core concept: the presence of more than one distinct condition in an individual. The prevalence of comorbidity is high, as the vast majority of the South African population on average have between two and three co-existing conditions. Comorbidity is associated with a decline in many health outcomes and increases in mortality and the use of health care resources. Hypertension is one of the leading causes of mortality, with an estimated 1.2 billion sufferers globally. South Africa has the highest Hypertension prevalence in Southern Africa. In the year 2017, an estimated 42% to 54% of people were suffering from Hypertension in South Africa and this figure is expected to increase. With this in mind, this study looked at the four most prevalent comorbidities in South Africa and the areas in which their prevalence is highest.

DATA & METHODS: Data were drawn from the 2017 General Household Survey. The analysis compromised of a total of three phases: the first stage, descriptive statistics were used to show the overall distribution of the four most prevalent comorbidities amongst hypertensive adults, ArcGIS was used to perform a GIS analysis to visualize the prevalence of comorbidities of hypertension across South Africa and lastly, a multinomial regression model was used to finally examine the socioeconomic factors associated with comorbidities amongst hypertensive adults. The data were analyzed using STATA software version 14. All model diagnostics showed that the model fits reasonably for the data. The interpretation of results was made using relative risk ratios (RRRs), and 95% confidence intervals.

RESULTS: Diabetes and Hypertension had the highest prevalence rate with 21% of Hypertensive adults suffering from both chronic illnesses. The second was Hypertension and Hyperlipidemia (5.63%), followed by Hypertension and Heart Attacks (3.77%) and lastly

Hypertension and HIV/AIDS (2.92%). For all four comorbidities, Females had an overall higher rate than their male counterparts as their relative risk increases by a factor of 2.2.

CONCLUSION & RECOMMENDATIONS: Comorbidity and multimorbidity have been shown to be associated with adverse health outcomes, such as poor quality of life, disability, psychological problems, and increased mortality. They also associated with increased frequency of health-service use involving emergency hospital admission, adverse drug events, poly-pharmacy, duplicate testing, and poor care coordination. A large proportion of women and individuals from the Black/African racial group experience several comorbidities, highlighting the need to address the chronic non-communicable disease epidemic in South Africa and to co-ordinate multidisciplinary primary-, secondary- and tertiary-level care in the country's complex healthcare system for a better outcome.

Keywords: Hypertension, Comorbidity

CHAPTER ONE

INTRODUCTION

1.1. Background

Comorbidity is defined as the co-occurance of more than one disorder in the same individual. (Valderas et al., 2009). The predominance of comorbidity is high in South Africa, as most by far of the South African populace on normal have somewhere in the range of two and three coinciding conditions (Coovadia et al., 2009). Comorbidity is related to a decrease in numerous wellbeing results and increments in mortality and the utilization of health care resources.

Hypertension is a condition in which the force of the blood against the artery walls is too high. Usually hypertension is defined as a blood pressure above 140/90, and is considered severe if the pressure is above 180/120. Hypertension is one of the main causes of mortality, with an expected 1.2 billion sufferers all around the world (WHO, 2016). South Africa has the most noteworthy Hypertension prevalence in Southern Africa (Seedat &Rayner, 2011). In the year 2017, an expected 42% to 54% of individuals were experiencing Hypertension in South Africa and this figure is relied upon to expand (Stats SA, 2017). In South Africa Diabetes, Hyperlipidemia, Angina, Depression, and Anxiety are a portion of the comorbidities related to hypertensive individuals the levels and/or rates of these comorbidities differ across the board and factors that contribute to occurrence differ. (Grimsrud et al., 2009; Van der Spuy et al., 2018;Mutyambizi et al., 2017). The commonness of these comorbidities fluctuates across provinces, racial profiles, and gender depending on certain factors such as educational attainment (Van der Spuy et al., 2018).

The health care system, which offers various types of services for an expected populace of more than 58 million individuals, consists of the private and public sectors. Essentially, South Africa's public health care system contains five layers, in particular: primary health care in the form of clinics, district hospitals, local clinics, tertiary/scholarly hospitals; and central/scholastic hospitals (Young, 2016). This structure was created to address financially savvy health care for all residents, on an appropriate level, and to guarantee better health for all. The majority of the population access health services through government-run and funded public clinics and hospitals. The public health services are divided into primary, secondary and tertiary through health facilities that are located in, and managed by, the provincial departments of health (Young, 2016).

South Africa is committed to the overall well-being of its citizens; and other nationals living in the country with fair access to better health care services (Booysen, 2003). This right to health is profoundly established in post-politically-sanctioned racial segregation South Africa's constitution, which determines that 'everybody has the right to have access to health care services, including reproductive health care services (South Africa Constitution, 1996). In this manner, everybody has access to both public and private health care services.

However, access to private health care relies to a great extent upon a person's capacity to pay: people can either decide to pay out-of-pocket or buy private insurance so as to be treated at private medical clinics and Hospitals (Naledi, Barron &Schneider, 2011). Public Health Care offers for the most part free types of assistance and cares to all residents, including pharmaceuticals, wheelchairs and supports, and home care visits, among others. Be that as it may, public health care is regularly portrayed by issues, for example, long holding up times,

rushed appointments, old facilities, poor disease control and prevention practices, and low quality of care, when contrasted with private health care services (Burger & Christian, 2018).

Physical access to such help is additionally an issue. Rural or Nonmetropolitan occupants frequently experience obstructions to healthcare that limit their capacity to get the care and consideration they need (Harris et al., 2011). In order for rural residents to have sufficient access, necessary and appropriate healthcare services must be accessible and reachable in a convenient way. Even when an adequate supply of healthcare services exists in the community, there are other factors to consider in terms of healthcare access (Hartley, Quam & Lurie, 1994). This study thus serves to increase knowledge on critical factors that predict hypertensive comorbidity among South African population across geographical locations.

1.2. Statement of the Problem

Statistics South Africa discharged their yearly Mortality and Causes of Death report, it broke down the 456, 612 deaths recorded in 2016 (Statistic SA, 2017). This is a diminishing from the past measure of deaths experienced in 2015 yet at the same time a significant region of concern. The top common causes of death in South Africa were Tuberculosis which brought about a sum of 29,513 deaths (Statistic SA, 2017). Heart ailments and cerebrovascular illnesses represented 5.1% of all-out deaths separately, HIV represented 4.8% of total deaths, Hypertensive Diseases represent 4.4% of all deaths and non-natural causes for death represented 11.2% of all total deaths in South Africa (Statistic South Africa, 2017).

Cardiovascular diseases account for the majority of NCD deaths, or 17.9 million individuals every year, trailed by cancers (9.0 million), respiratory illnesses (3.9million), and diabetes (1.6 million) (WHO, 2016). As indicated by WHO (2008), the overall non-communicable disease

age-standardized death rates for all ages in low-and medium – income nations were 756 for every 100,000 for males and 565 for every 100,000 for females. Age-standardized male NCD death rates for all ages were most noteworthy in the African districts for males (844 for every 100,000) and for females (724 for each 100,000).

Studies have indicated that hypertension is one of the most important risk factors for cardiovascular disease and has a high prevalence in South Africa and other low- and middle-income countries (Jongen et al., 2019). However, awareness of hypertension has been reported to be low. Health programs can increase awareness of hypertension and its causes, but hinge on the knowledge and perception of the targeted community. Despite the high prevalence of hypertension in South Africa, both awareness and control are low among hypertensive individuals, with figures ranging between 19.0–56.0% and 4.0–33.0%, respectively (Palafox et al., 2016;Peltzer &Phaswana-Mafuya, 2013; Ataklte et al.,2015). Be that as it may, spatial mapping of these patterns in South Africa is constrained and even less is done on hypertension comorbidities among adults aged 20 and above.

Health Care in South Africa varies from basic primary health care to highly specialized, hi-tech health services available to both the public and private sectors (Harris et al., 2011). However, the public sector is under tremendous strain as it is being stretched thin since it is entrusted with delivering varying services that include treatment for both non-communicable and communicable disease. Taking into consideration that the state just contributes 40% of all expenditure towards health as a whole, while the public health sector needs to cater to 80% of the population (Harris et al., 2011). South Africa experiences huge discrepancies, particularly in the health sector geographical location is one factor that aids in exacerbating these discrepancies (Hartley, Quam & Lurie, 1994).

With this in mind, the purpose of this study is to look closely at hypertensive adults and to determine the four most prevalent comorbidities they are suffering from. Using GIS location as a tool. This study will determine the exact areas that are most affected and will allow for target relief solutions to be employed. In addition, the study will also assess the demographic and socio-economic factors that are contributing to hypertension in adults.

1.3. Justification

Adults of working age are vital for the advancement of each country as a result of their critical commitment to the financial development of the nation (Stats SA, 2018). Poor health status among adults, however, results in a diminished labour capacity leaving little room for economic growth and gross domestic product expansion that a low to a middle-income country such as South Africa so desperately needs (Stats SA, 2018). Subsequently, a geographical health-based investigation of adults in South Africa especially comparable to comorbidities in hypertensive adults has been to a great extent disregarded.

The overall health and wellbeing of the population are communicated in the National Health Act, 2003. The goals of this Act are regulate national health and to provide uniformity with respect to health services across the nation. This focuses on establishing a national health system that encompasses public and private providers of health services and providers of health services and provides in an equitable manner the population of the Republic with the best possible health services that available resources can provide (National Health Act, 2003).

Findings from this study are expected to inform policy interventions aimed at addressing a crucial social determinant of health and contribute towards achieving the Sustainable Development Goal 3. Achieving this goal would imply that by 2030, South Africa would have been able to improve the mental health and well-being of all persons in the country (SA SDG

Hub, 2018). Specifically, findings from the study are expected to contribute significantly towards the achievement of the South Africa Policy on Quality in Health Care such that South Africa would be able to reduce the underlying causes of injury, illness, and disability through preventive and health promotion activities.

1.4. Research Questions

The main research question reads as follows:

What are the geographical distributions and socio-demographic characteristics associated with hypertension comorbidities amongst adults (20+ years) in South Africa?

Sub-Questions:

1. What are the levels and geographical distributions of hypertensive comorbidities amongst adults (20+ years) in South Africa?
2. What are the demographic and socioeconomic factors associated to hypertension comorbidities in adults (20+ years) in South Africa?

1.5. Research Objectives

The main research objective is to determine the geographical distributions and socio-demographic characteristics associated with hypertension comorbidities amongst adults (20+ years) in South Africa

Sub- Objectives

1) To determine the levels and geographical distributions of hypertensive comorbidities amongst adults in South Africa.

2) To determine the demographic and socioeconomic factors associated to hypertension comorbidities in adults in South Africa.

CHAPTER 2

LITERATURE REVIEW

This chapter presents the review of relevant literature and the theoretical framework that underpins this study. Relevant literature related to the study were collected through Google search engine, JSTOR, Google Scholar, Research Gate, PubMed and reports. Access to some of the articles was secured through the University of the Witwatersrand's Library. Keywords and mesh terms for literature search included: hypertension, comorbidity, risk factors & geographical location. Studies were included if they spoke to hypertension comorbidities globally and nationally, Social Determinants of Health with an emphasis on geographical locations and socio-demographic factors.

In an attempt to better engage with previous literature this section will be divided into two sections each covering varying topics: 1) Hypertension and Hypertension comorbidities and 2) Health and Geographical Location.

2.1. Hypertension & Hypertension Comorbidities

Hypertension (HTN), is one of the most common medical disorders, is associated with an increased incidence of all-cause and cardiovascular disease (CVD) mortality. Hypertension (High Blood Pressure, HBP) is defined as a systolic blood pressure≥140 mmHg and/or a diastolic blood pressure ≥90 mm Hg (Roger et al., 2012).

As indicated by WHO, hypertension is a significant risk factor for cardiovascular disease (CVD, excluding congenital CVD) just as renal impedance, impairment, peripheral vascular disease, and visual impairment. HTN is evaluated to cause 7.5 million deaths overall every year, about 12.8% of the total deaths (Mendis, Puska, &Norrving, 2011). In the same report, WHO estimates the prevalence of hypertension in high-income countries as 35% for both genders, while in low, lower-middle and upper-middle-income countries the prevalence is roughly 40%.

Sub-Saharan Africa (SSA) is one of the regions in the world with striking socioeconomic and demographic diversities. It is well known that many populations from this region are undergoing a rapid epidemiologic and demographic transition (Mathers & Loncar, 2006). Specifically, these countries in Sub-Saharan Africa with a particular reference to South Africa in this case are facing a high burden of infectious disease, multiple disease burdens with an unfinished agenda of malnutrition, and as of recent an emerging burden of non-communicable diseases. Hypertension and stroke are already common among adults in SSA (Steyn et al., 2005;Connor, Modi & Warlow, 2009). Addo, Smeeth & Leon (2007) noted that hypertension is already of public health importance in SSA, particularly in urban areas, with evidence of considerable underdiagnoses and lack of strategies to prevent, detect, and treat hypertension effectively in this region. Furthermore, in South Africa, the prevalence of people with HBP was estimated to be 11% for men and 14% for women, based on the 1995 South African Hypertension Society cut-points (≥160/95 mm Hg), and 21% for both genders based on current World Health Organization cut-points (≥140/90 mm Hg) (Seedat & Rayner, 2011). The same data suggest that only 55% of females and 29% of males who had hypertension were aware of their condition. However, in that study, there was no examination of geographic variation in hypertension prevalence and potential risk factors, either at the individual or province level. In

addition, from more recent cross-sectional studies in South Africa and other countries in the region, it is estimated that the true prevalence of hypertension could be up to 25% in rural areas and as high as 40% in urban areas (Maseko et al, 2010).

Hypertension has several risk factors as per the University of California San Francisco (2019) there are ten significant risk factors related with hypertension. These risk factors can be considered to fall under the classification of diet and lifestyle choices. Structural determinants comprise the economic, societal, political and geographical context in which a person is born and lives, which dictates one's socioeconomic position. One's socioeconomic position then sets the stage for the intermediary determinants (material circumstances, behavioral and/or biological factors, psychosocial circumstances, and the health system itself) and the likelihood of exposure to health-compromising conditions. Illnesses caused by poor living conditions can then circle back to the structural determinants. Poor living conditions would then be able to hover back to the auxiliary determinants. Studies have demonstrated that there is a connection between psychological wellbeing and hypertension (Grimsrud et al., 2009). In general, 16.7% announced a past clinical finding of hypertension, and 8.1% and 4.9% were found to have year anxiety or depression, respectively in adjusted analyses, hypertension diagnosis was associated with 12-month anxiety disorders [Odds ratio (OR) = 1.55, 95% Confidence interval (CI) = 1.10–2.18]. While being diagnosed with both hypertension and another chronic physical condition were associated with 12-month anxiety disorders (Grimsrud et al., 2009).

Hypertension is believed to be a severe threat to human beings' health due to its association with many comorbidities, it subsequently increases the number of challenges a patient face (Parekh & Barton, 2012). Comorbidity is the occurrence of more than one illness or condition at the same time (WHO, 2003). Several studies conducted in South Africa have suggested that

there are several conditions associated with Hypertension. One study conducted suggested that growing evidence suggests high levels of comorbidity between hypertension and mental illness This study examined the association between hypertension and depression and anxiety in South Africa. Data come from a nationally-representative survey of adults (n = 4351). The Composite International Diagnostic Interview was used to measure DSM-IV mental disorders during the previous 12-months. Overall, 16.7% reported a previous medical diagnosis of hypertension, and 8.1% and 4.9% were found to have a 12month anxiety or depressive disorder, respectively. In adjusted analyses, hypertension diagnosis was associated with 12month anxiety disorders [Odds ratio (OR) = 1.55, 95% Confidence interval (CI) = 1.10–2.18] but not 12-month depressive disorders or 12-month comorbid anxiety-depression (Grimsrud et al., 2009).

A subsequent report was led and takes a look at information from the 2012 South African National Health and Nutrition Examination Survey; a nationally delegate cross-sectional household survey. This investigation utilized multinomial logistic regression models to analyse the relationship between diabetes cardiovascular disease comorbidity and several predictors including race, obesity level of income and socio-economic status. As indicated by information taken from the study, 5% of South Africans aged 15 and above had self-reported diabetes in 2011–2012. Among those with self-reported diabetes, 73% had in any event one addition cardiovascular chronic illness (Mutyambizi et al., 2017).

2.2. Health and Geographical Location

Globally, researchers and policymakers have long sought not only to improve overall population health and reduce disability, ill-health and burden of disease, but also to eliminate and/or reduce health differentials, based on socioeconomic status, race, geography and ethnicity, amongst others (Whitehead, 2007, Arcaya &Subramanian, 2015;Hu et al., 2016).

Despite considerable attention on socio-economic related health inequalities, striking contrasts in health still persist within and among nations, today. Socio-economic related differences within countries are often substantial especially in developing African countries (WHO, 2008;Braveman & Tarimo, 2002).

It is critical to contextualise this and make note of the way that preceding 1994, South Africa's health system was partitioned along racial lines - one framework was exceptionally resourced and profited the white minority, while the other was deliberately under-resourced and was for the for the black majority (Republic of South Africa Department of Health, 2011; Coovadia, et al., 2009). Eminently, the health system was exceptionally portrayed by racial segregation and systemic fragmentation, with 14 separate health departments. Health services were focused on the hospital sector, primary health care services were underdeveloped while health services were systematically underfunded among the black population group (Coovadia et al, 2009).

Post-1994, the South African health system has formed developed into a two-tiered system that is unified and more coordinated. The National Health plan, created by the African National Congress (ANC) in 1994, charted a new path way for a more progressively sound and codified health system framework (ANC, 1994). PHC was made the foundation of health policy, with the introduction of free medical treatment for pregnant women and children younger than 6 years in 1994 and 1996, and ensuing augmentation to all clients. 14 fragmented health departments were also consolidated into one national and nine provincial health departments. Driven by the need to review discriminations and inequities, the health system is being changed, through various recorded changes, approaches and projects (including the on-going implementation of the national health insurance (NHI) scheme) into an integrated and comprehensive health care system (Chopra et al., 2009).

Currently, the health care system, which provides services for an estimated population of over 58 million people, comprises the public and private sectors respectively. Communicable diseases as of more recently place a large strain on the Department of Health in South Africa. This burden of disease is closely associated with the vast socioeconomic inequalities that characterize the country, known as one of the most unequal in the world, even as the government fights against socio-economic inequalities and social injustice and in all facets of life (Bhorat & Van der Westhuizen, 2010). Thus, addressing social determinants of health has been a cornerstone in PHC, its re-engineering strategy, and the NDP (Naledi, Barron & Schnieder, 2011).

This study places a lot of emphasis on geography more especially Geographical Location. Geography is often thought of as the interpretation and generation of maps that describe the physical world. Geography is far more than that, but the physical description of boundaries has a great deal to do with how we view communities and how we construct society (Giddens, 1984). The physical aspects of a community are normally characterized by boundaries that may have been developed for a specific public purpose, but that often creates gradients that separate one population group from another. This can be obvious in zoning rules or in the creation of jurisdictions that have different systems of social support. Areas can also become different through social and economic processes that create regions or communities whose boundaries are essentially invisible.

Geography plays a pivotal role in accessing health care and to whom health care services are easiest available too. Access to health care services in rural versus urban areas has been explored by health services researchers for decades. Rural residents are, on average, poorer,

older, and, for those under age 65, less likely to be insured than persons living in urban areas (American College of Physicians, 1995; Hartley et al., 1994; Braden &Beauregard, 1994; Schur & Franco, 1999). Rural Americans also report more chronic conditions and describe themselves in poorer health than urban residents. Further, injury-related mortality and the number of days of restricted activity are higher in nonmetropolitan areas. The degree to which lower levels of access affect health outcomes and utilization for rural persons is at issue, however, given the conclusions drawn by MedPAC in its *Report to Congress* (MedPAC, 2001). It is easy to challenge its flat assertion that an access gap does not exist. The analysis did not always include controls for health status, and the risk adjustment for prior use may have made the analyses inaccurate. The access study also did not differentiate between underserved and adequately served communities and did not reveal whether there was an independent rural or travel effect for the measures of access. But most importantly, the sample was drawn with the assumption that rural places compose a homogenous sample stratum. While the wide variation in access in urban systems is accepted and comparisons within and between metropolitan areas are usual in national surveys, this is not feasible for rural places given the current construction of these surveys (Schur et al., 1998). This is the same for South Africa.

Overall Hypertension has been looked at in South Africa and the same thing can be said for Hypertension Comorbidities. However, there has been a huge failure of looking at the overall prevalence of comorbidity in a geographical context. Many studies zone into a specific area in a bid to establish a relationship between two varying illnesses but never the entire country. They also fail to employ any GIS methodology and stick to pure statistical methods as many solely focus on sociodemographic factors.

2.3. Theoretical Framework

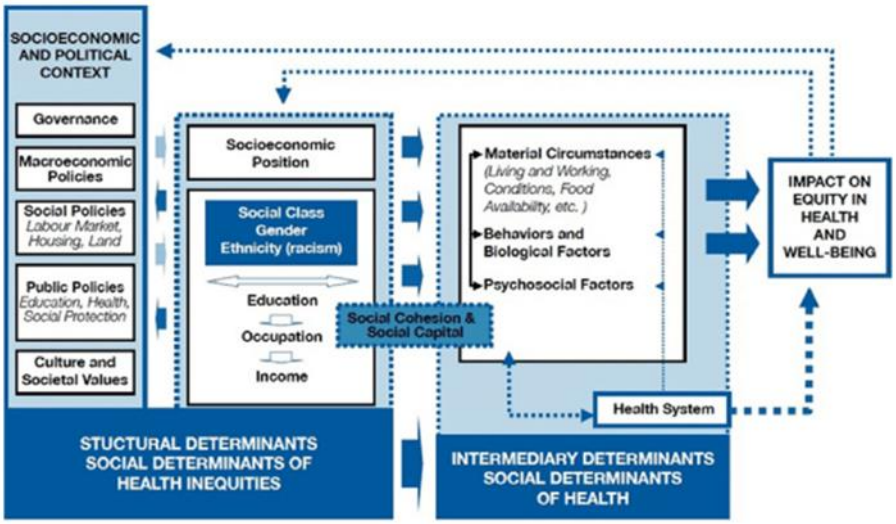


Figure 2.1: Social Determinants of Health Framework (WHO,2007)

The theoretical framework used in this study is the *Social Determinants of Health.* The social determinants of health are the conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of power, resources and money at global, national and local levels. The social determinants of health are mostly responsible for health inequities, these are the unfair and avoidable differences in health status seen not only between countries but within a country too.

The framework is divided into structural and intermediary determinants. The structural determinants comprise the societal, economic, and political context in which a person is born

and lives, which dictates one's socioeconomic position. One's socioeconomic position then sets the stage for the intermediary determinants (psychosocial circumstances, behavioural and/or biological factors, material circumstances and the health system itself) and the likelihood of exposure to health-compromising conditions. Illnesses caused by poor living conditions can then circle back to the structural determinants if, for example, a person experiences a loss of employment or income, thereby lowering his or her socioeconomic status. Bridging the structural and intermediary determinants are concepts of social capital and social cohesion. The commissioners who developed the framework acknowledged that the inclusion of these concepts risked depoliticizing approaches to public health and the social determinants of health. However, they opted to include this bridge because they also believed that states could be in a position to promote equity through cooperative relationships between citizens and institutions by developing systems that would facilitate such connections. The final box to the far right of the figure shows the impacts of structural and intermediary determinants on equity in health and well-being and how those impacts can feedback to the structural determinants, having a positive, negative, or neutral influence on future generations. This theory tries to understand health from a holistic point of view. Health is not a concept that exists in isolation but has other factors acting on it.

2.4. Conceptual Framework

The conceptual framework for this study was guided by the reviewed literature as well as the social determinants of health theory. As mentioned before the social determinants of health theory looks at the condition in which people are born, grow, live, work and which racial group they belong too affects their overall wellbeing. These circumstances are shaped by the distribution of money, power, and resources at global, national and local levels.

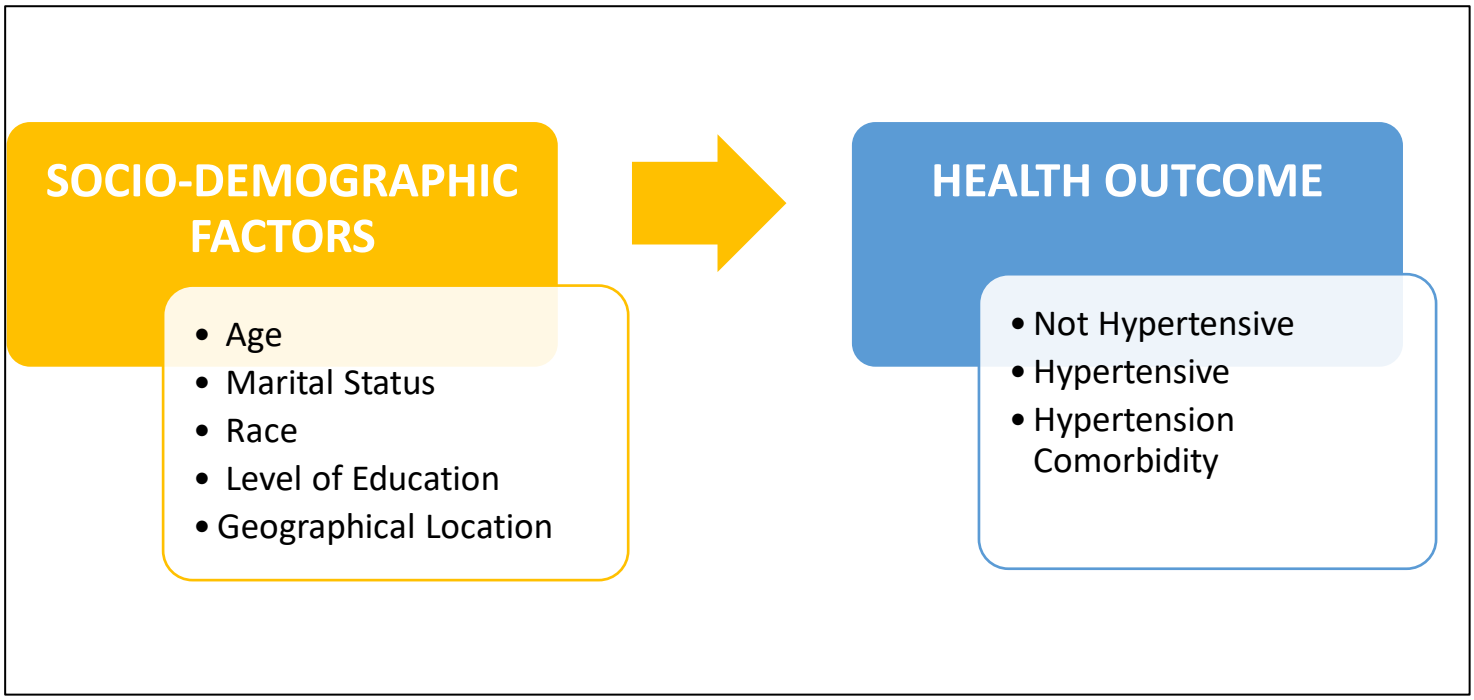


Figure 2. 2: Conceptual Framework of the study showing the relationship between Socio-Demographic Factors and Health Outcomes, adopted from the Social Determinants of Health Framework (WHO, 2010).

The conceptual framework above illustrates that the socio-demographic factors such as Age, Marital Status, Race, Level of Education & Geographical Location subsequently directly affects one's health outcome in this case if they do not have hypertension if they only have hypertension or suffer from both hypertension and another illness simultaneously. This framework enables the risk factors to be determined. For examples one's level of educational attainment, Geographical Location and Marital Status plays a huge role on one's lifestyle and lifestyle choices. This is especially so because studies have shown that hypertension is closely related to one's life style. Age is also a risk factor as Hypertension is often related to those who are above a certain age.

2.5. Hypothesis

Based on the frameworks above, the following hypotheses were tested:

H0: There is no significant association between socio-demographic factors and Hypertension Comorbidities.

H1: There is a significant association between socio-demographic factors and Hypertension Comorbidities**.**

CHAPTER THREE

METHODOLOGY

3.1. Introduction

This chapter presents the description of the study area and the sources of data. Also presented in this chapter are details of data collection procedures, sampling design technique, sample size, variables definition, data analysis procedures as well as the study limitations and the ethical procedure taken before undergoing this study.

3.2. Study Design and Data Source

This study is a quantitative study and utilised data that was collected at one point in time, therefore it is a cross-sectional study design. It was conducted in South Africa using General Household Survey (SAGHS) 2017 dataset. The questionnaire for the SAGHS was designed to cover the following broad areas: education, health and social development, housing, household access to services and facilities, food security and agriculture (Stats SA, 2018). This was administered in all provinces in South Africa.

The data was obtained from the SAGH for the year 2017. This dataset was suitable for the study as it contained information on population demographic and socio-economic characteristics including health. This dataset was downloaded via the Statistics South Africa Website. It was weighted in order to cater to the content of the study and the coverage area simultaneously.

3.3. Description of Study Area

This study is focused solely on South Africa. South Africa is situated in the bottommost part of Africa. Its neighbouring countries are Botswana, Lesotho, Mozambique, Namibia, Swaziland, and Zimbabwe. The country is divided into nine (9) provinces which vary by size, from Northern Cape province which covers nearly 30% of the country's land area, to Gauteng province, which takes up a mere 1.5%. The 2011 national population Census estimated the country's population to be 51,770,560 while the current mid-year population of the country is estimated at 55, 91 million (Stats SA, 2016).



Figure 3.3: Map of South Africa showing its nine provinces (Norval & Wright, 2017)

South Africa has an interesting and politically turbulent past characterised by racial discrimination prior to and in 1994 when the country was declared as a democratic nation (Hoogeveen & Berk, 2005). Since 1994, South Africa has enjoyed a peaceful and prosperous

economic and political era (Hoogeveen & Berk, 2005). At the same time, it has positioned itself as one of the economic hubs of Africa. However, despite the progress made and stability achieved, South Africa remains plagued by inequality with regards to education, employment and to an extent health services much like the rest of Africa (Hoogeveen & Berk, 2005).

South Africa is a great study area to examine as the prevalence of overall comorbidity in the country is high, as the vast majority of the South African population on average have between two and three co-existing conditions (Coovadia et al., 2009).. Comorbidity is associated with a decline in many health outcomes and increases in mortality and use of health care resources. Hypertension is one of the leading causes of mortality, with an estimated 1.2 billion sufferers globally (Coovadia et al., 2009).South Africa has the highest Hypertension prevalence in Southern Africa (Valderas et al., 2009). In the year 2017, an estimated 42% to 54% of people were suffering from Hypertension in South Africa and this figure is expected to increase (Stats SA, 2017).

3.5. Sampling Design

The data was obtained from the South African General Household survey. A multi-stage design was used in this survey, which is based on a stratified design with probability proportional to size selection of primary sampling units (PSUs) at the first stage and sampling of dwelling units (DUs) with systematic sampling at the second stage (Stats SA, 2018). After allocating the sample to the provinces, the sample was further stratified by geography (primary stratification), and by population attributes using Census data (secondary stratification) (Stats SA, 2018).

Survey officers employed and trained by Stats SA visited all the sampled dwelling units in each of the nine provinces (Stats SA, 2018). During the first phase of the survey, sampled dwelling units were visited and informed about the coming survey as part of the publicity campaign. The actual interviews took place four weeks later. More than 20 000 households (including multiple

households) were successfully interviewed during face-to-face interviews (Stats SA, 2018). Two hundred and thirty-three enumerators (233) and 62 provincial and district coordinators participated in the survey across all nine provinces (Stats SA, 2018). An additional 27 quality assurors were responsible for monitoring and ensuring questionnaire quality (Stats SA, 2018). National refresher training took place over a period of two days. The national trainers then trained provincial trainers for two days at provincial level (Stats SA, 2018).

3.6. Study Population & Sample Size

The study population consisted of 4,171,798 adults who were suffering from Hypertension during the 2017 General Household Survey.

3.7. Study Variable Definition & Measurement

3.7.1. Definition of Dependent Variable

The broader definition of the dependent variable is health outcome status. This study places prominence on the phenomenon of comorbidities amongst adults that suffer from both hypertension and another illness. Hence, for the purpose of this report the dependent variable can be defined as hypertension comorbidity. This variable is categorical in nature and includes two categories the one being Hypertension only whilst the other is Hypertension Comorbidity. Under Hypertension Comorbidity the following four options exist: 1) Hypertension and Diabetes 2) Hypertension and Hyperlipidemia 3) Hypertension and Heart Attack and 4) Hypertension and HIV /AIDS. These four comorbidities mentioned above were found to be the most prevalent in the year 2017 according to the SAGHS. In order to create each of the four comorbidities the variables were combined and labeled comorbidity 1, comorbidity 2, comorbidity 3 and comorbidity 4 on Stata. All four of these comorbidities where then combined to form the variable hypertension comorbidity. For the purpose of the hypertension variable

the data set was cleaned leaving only those who are above the age of 20 and hypertensive to be examined.

Table 3.1: Definition and Categorization of Outcome Variable.

DEPENDENT VARIABLES	**VARIABLE DEFINITION**	**STUDY MEASUREMENT**
Health Outcome	The individual suffers from hypertension or suffers from both hypertension and another illness.	Hypertension (0) Hypertension Comorbidity (1)

3.7.2. Definition of Independent Variables

All the independent variables for this report can be seen as socio-demographic in nature. The first variable is Educational Attainment it has three categories (1) No education & Primary Education, (2) Secondary Education and (3) Tertiary Education.

Marital Status was another variable that was utilised it was categorised as follows: Legally Married (1), Living together like husband and wife (2), Divorced (3), Separated, but still legally married (4), Widowed (5), Single, but have been living together with partner (6), Single and have never been married before (7).

Race and has four categories (1) Black, (2) Coloured, (3) Indian/Asian and (4) White. It is categorical in nature.

The fourth independent variable is Age and it is continuous in nature. In the description given below it will presented using the following 6 age groups: 20-29, 30-39,40-49,50-59,60-69, 70+ .

The final independent variable is categorical in nature and it looks at the concept of gender it's either a respondent is male (1) or female (2).

It is important to note that geographical location will only be used for the geospatial analysis (GIS methodology) and will not be included in the regression model.

Table 3.2: Definition and Categorization of Independent variables.

CONTROL VARIABLES	**DEFINITION**	**STUDY MEASUREMENT**
Educational Attainment	Highest level of education attained by respondents	No education & Primary (1) Secondary (2) Tertiary (3)
Marital Status	Married or single	Legally Married (1) Living together like husband and wife (2) Divorced (3) Separated, but still legally married (4) Widowed (5) Single, but have been living together with partner (6)

		Single and have never been married before (7)
Race	To which racial group does the individual belong too.	Black (1) Asian/Indian (2) Colored (3) White (4)
Age	How old the respondent is	20-29 (1) 30-39 (2) 40-49 (3) 50-59 (4) 60-69 (5) 70+ (6)
Geographical Location	The nine South African Provinces.	• Western Cape • Eastern Cape • Northern Cape • Free State • Kwazulu Natal • North West • Gauteng • Mpumalanga • Limpopo

3.8. Data Management

Data for this study was managed and analysed using two various software packages. Stata software version 14 was used to run all the statistical analysis whilst ArcMap was employed to run the GIS analysis. All missing values and 'don't knows' were excluded from the analysis (Stata Corporation, USA).

3.9 Method of Analysis

In order to investigate the association between hypertension comorbidities and socio-demographic factors in adults in South Africa, the analysis was conducted in three stages using Stata 14 and ArcMap:

1. Descriptive Statistics
2. GIS methodology
3. Multinomial Regression

All data was cleaned to ensure that the focus was only on adults aged 20 and above and weighted accordingly to adjust for differences in probability of selection and non-response between cases in the sample. The sections that follow give a detailed, comprehensive explanation of how each objective was achieved how the model was derived and how all of the results will be interpreted and lastly how multicollinearity will be checked.

3.9.1. *Achieving the main objective*

To achieve the main objective of this study, descriptive statistics will be used to determine the measure of frequency. This will be in the form of counts and frequencies. The overall prevalence of the Hypertension Comorbidity was displayed on a table. This information was given in both frequencies and percentage distributions to understand how the population was

affected as a whole. It is important to note that this report only looks at the four most prevalent comorbidities.

To get a better understanding of the Sociodemographic factors associated with these comorbidities a bivariate analysis will be conducted looking at age andsex respectively. This information will be represented on a table.

3.9.2 Achieving sub-objective one

To achieve the second objective GIS methodology was employed. This methodology utalises a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. The findings are often displayed in the form of a map. For this section ArcMap was used, this is the software that was used to create the map that was able to determine areas that have a high prevalence rate of adults suffering from Hypertension and Diabetes, Hypertension and Hyperlipidaemia, Hypertension and Heart Attacks and lastly Hypertension and HIV. A hot spot analysis was conducted. The Hot Spot Analysis tool calculates the Getis-Ord Gi* statistic for each feature in a dataset. The resultant z-scores and p-values tell you where features with either high or low values cluster spatially. This tool works by looking at each feature within the context of neighbouring features. A feature with a high value is interesting but may not be a statistically significant hot spot. To be a statistically significant hot spot, a feature will have a high value and be surrounded by other features with high values as well. The local sum for a feature and its neighbours is compared proportionally to the sum of all features; when the local sum is very different from the expected local sum, and when that difference is too large to be the result of random chance, a statistically significant z-score results.

The Getis-Ord local statistics is given as:

$$G\frac{*}{i} = \frac{\sum_{j=1}^{n} wi,jxj - \bar{X}\sum_{j=1}^{n} wi,j}{s\sqrt{\frac{\left[\sum_{j=1}^{n} w_{i,j}^{2} - \left(\sum_{j=1}^{n} wi,j\right)\right]}{n-1}}}$$

Where xj is the attribute value for feature$j$, wi,j is the spatial weight between feature i and j , n is equal to the total number of features and:

$$\bar{X} = \frac{\sum_{j=1}^{n} xj}{n}$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x\frac{2}{j}}{n} - (\bar{X}^{2})}$$

The $G\frac{*}{i}$ statistic is a z-score so no further calculations are required.

Source: ArcGIS, 2019

For the purpose of this report, due to the nature of the SAGHS data, the variables available and the level at which geographical data is distributed a hot spot (refer to formula above) is not possible. In a bid to give a better overview of the areas across South Africa that have the highest prevalence rates of Hypertension Comorbidity a dot density map was given instead. A **dot** distribution map, or dot density map, is a map type that uses a dot symbol to show the presence of a feature or a phenomenon. Dot maps rely on a visual scatter to show spatial pattern.It will also be able to demonstrate the cold and hot spots across South Africa thus the overall guiding principal remains the same. It looked at all the non-metropolitan areas in South Africa. It is important to note that that this map focuses solely on overall prevalence throughout South Africa. Each Comorbidity will be represented by a different colour dot therefore symbology played a vital role. Each dot on the maps roughly represent 400 people.

3.9.3. Achieving sub-objective two

To achieve the final sub-objective which was to determine the demographic and socio-economic factors contributing to hypertension comorbidities amongst adults in South Africa amultinomial logistic regression will be used. Multinomial Logistic regression is a regression approach that is conducted when a dependent variable is nominal and has more than two categories that have no natural ordering. It is used to predict the probabilities of the different outcomes of the dependent variable. The categories of the dependent variable must be mutually exclusive and exhaustive which suggests that each category has to be completely independent and cannot belong to another group. The results obtained from this model were interpreted using Relative Risk Ratios (RRR). RRR>1 indicating a higher risk, RRR<1 indicating a lower risk and RRR=1 indicating no risk difference. The level of significance was set at 0.05, and a confidence interval (CI) of 95% was used. Data and variables were weighted on Stata to correct for survey design sampling errors and to ensure that the sample reflects truly, the population from which it was drawn.

The results obtained from the regression are depicted in a table. The formula for the model is depicted below:

Multinomial Logistic Regression

We can model probability of each outcome as:

$$P_{ij} = \frac{e \sum_{i=1}^{K} \alpha + \beta_{kj} X_{kji}}{\sum_{j=1}^{J} e \sum_{i=1}^{K} \alpha + \beta_{kj} X_{kji}}$$

Where:

I=cases,

j= categories

k = independent variables

Coefficients sum to zero

Source: Kwak & Clayton-Matthews, 2002

The Multinomial Logistic Regression Model was the most suitable model because it assumes that the dependent variable consists of various categories that are not ordinal in nature.

3.10. Test for Multicollinearity

The test for multicollinearity examines the level of collinearity among the study variables. This could be done using a correlation matrix, variance inflation factor (VIF) or test for tolerance. A very high correlation coefficient above (0.80) between study variables as well as a tolerance value above 0.1 and VIF value of 10 or more may be an indication of multicollinearity. The results for the variance inflation factor (VIF) can be found in the Appendix.

3.11. Ethical Issues

This study used secondary data obtained from the 2017 South African General Household Survey. Ethical permission to make use of this data was granted by Statistics SA through their website: statssa.gov.za. No personal information or name of the respondents was identified in the dataset. Therefore, anonymity and confidentiality of the study interviewees was guaranteed. The ethics waiver form was downloaded from Sakai under the resource tab. This form was filled in on the electronic version and printed out to be signed by Professor Nicole De Wet-Billings. Once completed this signed document was then uploaded onto Sakai together with

my 10-page proposal. These documents were submitted to faculty and once approved a School Ethics Protocol Number was received. The Ethics Protocol number for this study is: WDEMG2019/07/04.

3.12. Study Limitations

The first limitation of this study is that hypertensive comorbidities are self-reported and thus self-reported data is often subject to biases resulting in a number of issues pertaining to accuracy and validity. Secondly, this study focused a lot on geography a limitation with this is the level at which data is available in some cases no enumeration area is available and only provincial data is available for use this limits the level at which GIS analysis can be conducted.

Thirdly, the level of health literacy plays a crucial role as many respondents may not be aware that they are suffering from more than on condition or diseases at once and may not be able to identify which illness appeared before the other.

Lastly, due to the cross-sectional data of the SAGHS used in this study, results of this study should be interpreted as mere associations and not as causations. This is especially because the study cannot completely determine the temporal sequence of events especially regarding which illness came first.

CHAPTER FOUR

RESULTS

The main research objective was to determine the four most prevalent comorbidities in hypotensive adults in South Africa with respect to their geographical location. The two sub-objectives were to determine the levels and geographical distributions of hypertensive comorbidities amongst adults in South Africa and to determine the demographic and socio-economic factors contributing to hypertension comorbidities in adults in South Africa. This chapter is dedicated to representing the research findings.

4.1. Prevalence of Hypertension Comorbidity in South Africa

Table 4.1: Seven most prevalent Comorbidities amongst adults who suffer from Hypertension.

RANK	DISEASE (N)		FREQUENCY DISTRIBUTION	PERCENTAGE DISTRIBUTION (%)
1	Diabetes	Yes	866, 981	21.00
		No	3,261,183	79.00
2	Hyperlipidemia	Yes	232,584	5.63
		No	3,895,581	94.37
3	Heart Attack	Yes	155,479	3.77
		No	3,972,685	96.23
4	HIV & AIDS	Yes	120,680	2.92
		No	4,007,485	97.08

The table above shows the four most prevalent hypertensive comorbidities amongst adults aged 20 and above in South Africa for the year 2017. The most prevalent hypertensive comorbidity is Diabetes followed by High Cholesterol, Heart Attacks, HIV & AIDS, Strokes, Depression and lastly Cancer. This research report will focus on the four most prevalent comorbidities. 21% of adults suffer from both Hypertension and Diabetes simultaneously whilst 5.68% of adults suffer from both Hypertension and Hyperlipidemia simultaneously. 3.77% of adults have suffered a Heart Attack whilst being diagnosed with Hypertension and 2.98% of adults are both HIV+ and Hypertensive.

4.2. Descriptive Profile of Hypertension Comorbidity in Adults in South Africa.

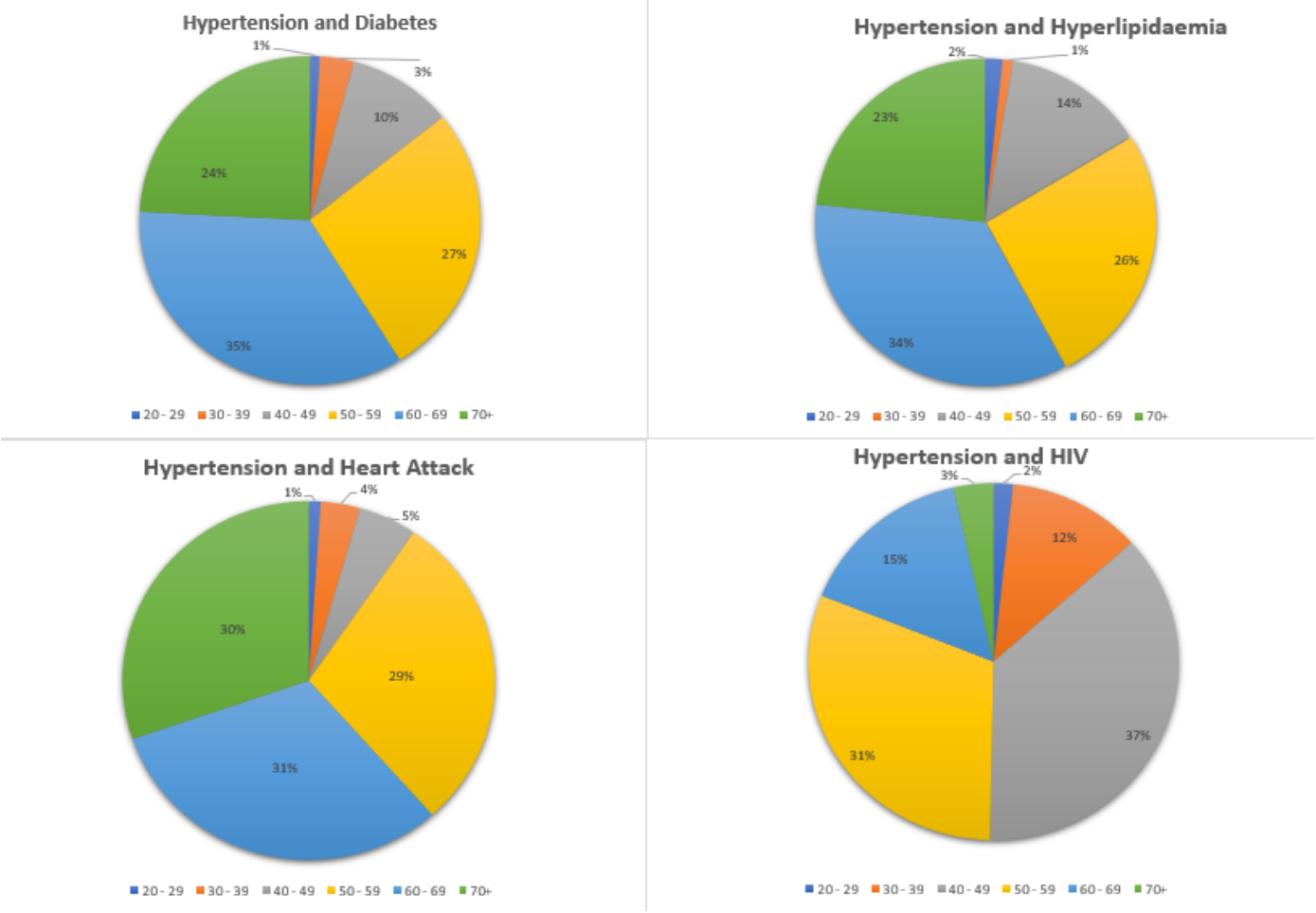


Figure 4.4: Cross Tabulations of Hypertension Comorbidities and Age.

Figure 4.1 depicts a series of bar graphs that look at age and the four most prevalent comorbidities. There is a total of six age groups: 1) 20-29-year olds, 2) 30 – 39-year olds, 3) 40 -49-year olds, 4) 50 -59-year olds, 5) 60 – 69-year olds and 6) 70+ year olds. The results vary across the four comorbidities respectively.

Hypertension and Diabetes: The large majority of adults who suffer from both Hypertension and Diabetes fall with the 60 -69 age group with 35%. This is followed by those in the 50 – 59 age group (27%) and then the 70+ age group (24%). 10% of those suffering with this

comorbidity are between the age of 40 – 49 whilst those that fall within the 30 -39 age group make up 3% and those between the ages of 20 and 29 make up a mere 1%.

Hypertension and Hyperlipidemia: 34% of adults who suffer with this comorbidity are between the ages of 60 and 69, whilst 26% of these adults are between the ages of 50 – 59. Those in the 70+ age group account for 23% of the adult sufferers. 14% of these adult sufferers are between the ages of 40 and 49. 2% are between the ages of 20 and 29, and those that are between the ages of 30 and 39 years of age account for only 1%.

Hypertension and Heart Attack: 31% of adult sufferers are between the ages of 60 and 69, whilst 30% are 70+ years of age. 29% of these adult sufferers are between the ages of 50 – 59, 5% are 40 – 49 years old. 4% are between the ages of 30 and 39 and only 1% of sufferers are between the ages of 20 – 29.

Hypertension and HIV/AIDS: The vast majority of adult sufferers are between the ages of 40 – 49 (37%). This is followed by those in the 50 – 59 age group (31%) and the 60 – 69-year-old age group (15%) respectively. 12% of these sufferers are between the ages of 30 and 39, 3% are 70+ years of age and 2% are between the ages of 20 and 29.

Table 4.2: Descriptive Profile of adults (20+ years) suffering with Hypertension Comorbidities in South Africa (SAGHS, 2017)

Socio-Demographic Characteristics	Hypertension and Diabetes		Hypertension and Hyperlipidemia		Hypertension and Heart Attack		Hypertension and HIV/AIDS	
	n	%	n	%	n	%	n	%
Sex								
Male	296,985	33.98	109,989	46.78	53,533	34.14	34,065	28.23
Female	576,994	66.02	125,153	53.22	103,268	65.86	86,614	71.77
Race								
Black	505,402	69.02	25,101	12.18	77,888	51.87	112,324	93.56
Coloured	105,947	14.47	60,143	29.19	29,550	19.67	3,903	3.25
Indian/Asian	35,938	4.9	12,845	6.23	10,938	7.28	406	0.33
Whites	84,867	11.59	107,937	52.39	31,781	21.16	3,412	2.84
Marital Status								
Legally Married	362,478	49.5	122,131	59.28	68,008	45.29	32,058	26.7

Cohabitation	30,026	4.1	3,053	1.48	9,273	6.17	24,788	20.64
Divorced	25,620	3.5	19,740	9.58	4,844	3.22	5,339	4.44
Separated	10,299	1.4	964	0.47	1,151	0.76	2635	2.19
Widowed	223,009	30.45	37,298	18.1	48,640	32.39	18,070	15.05
Single, but have been living together.	9,427	1.28	1,828	0.89	2,963	1.97	11,084	9.23
Single, and have never been married.	71,326	9.74	21,011	10.19	15,277	10.17	26,071	21.71
Educational Attainment								
Primary Education or Less	323,746	44.22	27,299	13.25	62,190	41.41	62,463	52.03
Secondary Education	375,729	51.31	151,646	73.6	83,423	55.55	54,785	45.63
Tertiary Education	32,680	4.46	27,082	13.14	4,543	3.02	2,798	2.33

The table above speaks to the descriptive profile of the adults (20+ years) suffering with hypertension comorbidities. The table focuses on four variables: 1) Sex, 2) Race, 3) Marital Status and 4) Educational Attainment.

Sex: For all four comorbidities respectively, females have a higher frequency and percentage distribution compared to their male counterparts. For Hypertension and Diabetes 33.98% [N=296,985] of sufferers are male whilst 66.02% are female [N= 576,994]. For the second comorbidity of Hypertension and Hyperlipidemia 46.78% are male [N= 109,989] and 53.22% are female [N=125,153]. For those who have suffered a heart attack and hypertension 34.14% are males [N= 53,53] and 66.86% are females [N= 103,268]. For the final comorbidity, Hypertension and HIV/AIDS only 28.23% of sufferers are males [N=34,065] whilst 71.77% are females [N= 86,614].

Educational Attainment: This variable has three categories: Primary education or less, secondary education ad tertiary education. 51.31% of individuals who have hypertension and diabetes have a secondary education [N= 375,729], 44.22% [N= 323,746] have a primary education or less and 4.46% [N= 32, 680] have a tertiary education. 73.6 of individuals who have hypertension and hyperlipidemia have a secondary education [N= 151,646], 13.25% [N= 27,299] have a primary education or less and 13.14% [N= 27,082] have a tertiary education. 55.55% of individuals who have hypertension and experienced a heart attack have a secondary education [N=83,423], 41.41% [N= 62,190] have a primary education or less and 3.02% [N= 4,543] have a tertiary education. 52.03% of individuals who have hypertension and HIV/AIDS have a primary education or less [N= 62,463], 45.63% [N= 54,785] have a primary education or less and 2.33% [N= 2,798] have a tertiary education.

Marital Status: There are a total of seven categories for the variable marital status. For those suffering from hypertension and diabetes 49.5% of them are legally married, 4.1% of them are Cohabitating, 3.5% are divorced, and 1.4% are separated. 30.45% are widowed, 1.28% are single and have been living together and 9.74% are single and never been married before. Those suffering from hypertension and hyperlipidemia have varying results. 59.28% of sufferers are legally married, 1.48% are cohabitating, 9.58% are divorced 0.47% are separated, 18.1% are widowed, 0.89% are single but living together and 10.19% are single and have never been married.

45.29% of individuals who have had a heart attack and are hypertensive are legally married. 6.17% are cohabitating, 3.22% are divorced, 0.76% are separated, 32.39% are widowed, 1.97% are single and living together and 10.17% are single and are yet to have been married. 26.7% of people with hypertension and HIV/AIDS are legally married and 20.64% are cohabitating. 4.44% are divorced whilst 2.19% are separated and 15.05% are widowed. 9.23% are single, but have been living together and 21.71% are single, and have never been married.

Race: Based on the findings for the hypertension and Diabetes comorbidity, black people account for 69.02% [N=505,402], coloured people account for 14.47% [N=105,947], the Indian/Asian community account for 4.9% [N=35,938] and white people account for 11.59% [N=84,867]. White people account for 52.39% [N=107,937] for those suffering from hypertension and hyperlipidemia. Indian/Asian people count for 6.23% [N=12,845], coloured people count for 29.19% [N=60,143] and black people account for 12.18% [N=25,101]. For those suffering with heart attacks and hypertension, 51.87% [N=77,888] are black, 19.67% [N=29,550] are coloured, whilst 7.28% [N=10,938] are Indian/Asian and 21.16% are white [N=31,781]. 93.56% [N=112,324] of people who have hypertension and HIV/AIDS are black, 3.25% [N=3,903] are coloured, 0.33% [N=406] are Indian/Asian and 2.84% [N=3,412] are white people.

4.3. Prevalence of Comorbidity amongst Hypertensive adults across South African provinces (ArcMap, 2019).

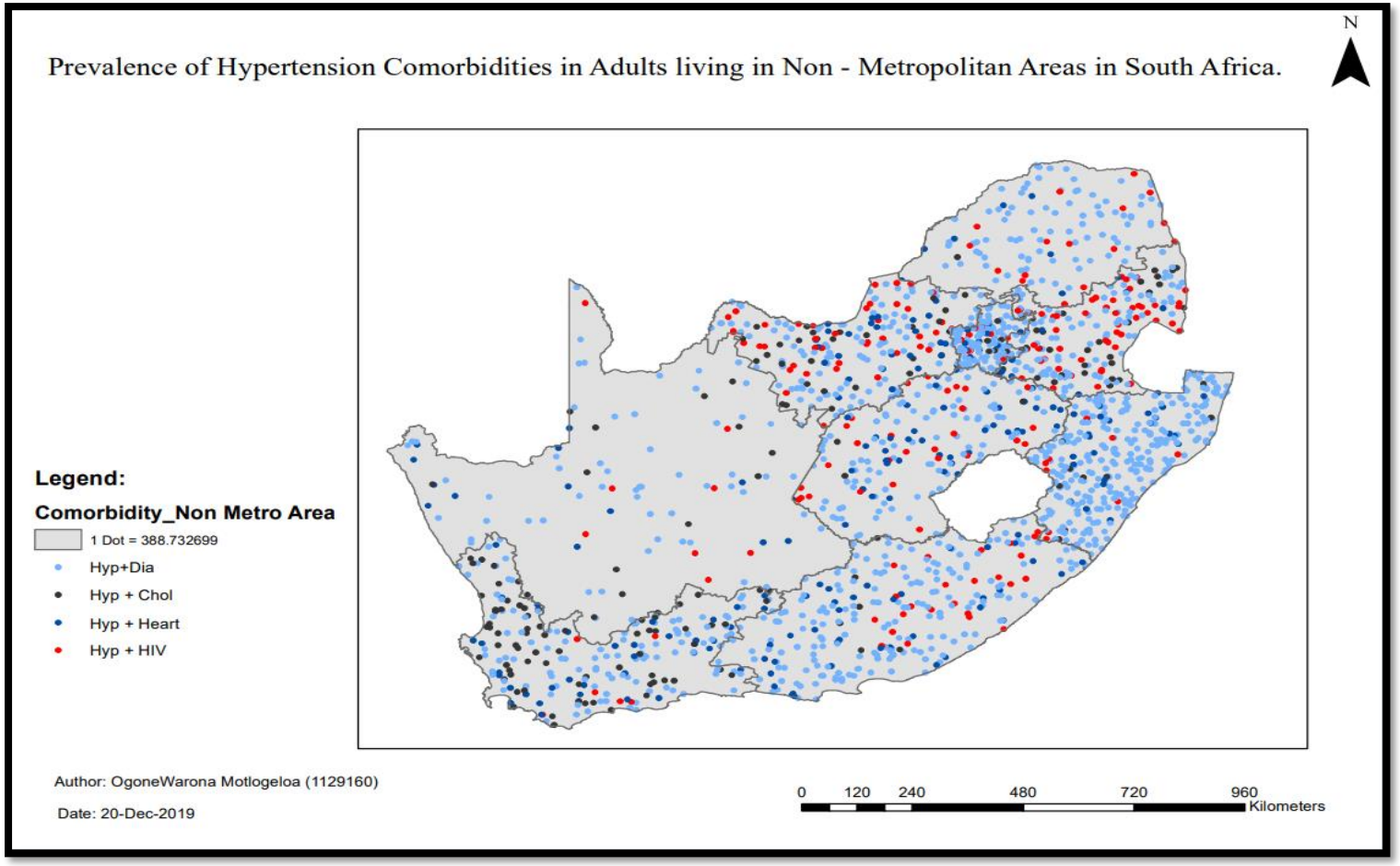


Figure 4.5: Distribution of Comorbidity Hypertensive Adults across South Africa (Motlogeloa, 2019)

The above map depicts the geographical distribution of the four most prevalent Hypertension Comorbidities. Due to the nature of the map Symbology played an important role in ensuring that each comorbidity is represented fairly. The light blue dots represent Hypertension and Diabetes. These are spread out throughout the entire interior of South Africa however, cluster around the entire province of KwaZulu Natal and Gauteng respectively. The Eastern Cape, Western Cape, South -Western region of Mpumalanga and North West respectively have a high prevalence of Hypertension + Diabetes Comorbidity too.

Hypertension and Hyperlipidaemia is found predominantly located throughout the entire interior of the Western Cape Province. This comorbidity also affects those based in the central parts of Gauteng, the North – Eastern, Southern and South – Western parts of Mpumalanga. It can also be seen to have a strong presence throughout North-West province and is scattered throughout the province of the Northern Cape.

Hypertension and Heart Attacks are located predominantly along the Eastern parts of South Africa in the Western Cape, Eastern Cape and KwaZulu Natal. Free State also has a somewhat high prevalence of this comorbidity.

The last comorbidity is Hypertension and HIV/AIDS. It is represented by the red dots. There is a strong prevalence of this comorbidity throughout the province of Mpumalanga and North West. It is slightly dispersed throughout the province of Limpopo, KwaZulu Natal, Free State and the North – Eastern parts of the Eastern Cape. This comorbidity has the lowest presence in the provinces of Northern and Western Cape respectively.

4.4. Association between Hypertension Comorbidities and Selected Socio-Demographic factors

Table 4.3: Multinomial Regression Model showing the association between Hypertension Comorbidities and Selected Socio-Demographic factors.

Comorbidity Outcome	**RRR**	**P>l z l**	**[95% Conf. Interval]**	
Hypertension	(Base Outcome)			
Hypertension and Diabetes				
*** Age**	2.20	0	2.081547	2.335489
Sex				
Male	RC			
* Female	1.72	0	1.4999799	1.989519

Marital Status				
Legally Married	RC			
* Cohabitation	0.49	0	0.3570804	0.6617811
Divorced	0.78	0.147	0.5551701	1.091592
Separated	0.69	0.167	0.402876	1.170754
* Widowed	0.78	0.003	0.6579278	0.9153407
* Single, but have been living together.	0.41	0.001	0.228238	0.7030402
* Single, and have never been married.	0.04	0	0.3342007	0.5120438
Educational Attainment				
Primary Education	RC			
Secondary Education	1.08	0.331	0.9281018	1.248098

* Tertiary Education	0.67	0.019	0.4828222	0.9381531
Racial Group				
Black/African	RC			
* Coloured	1.39	0	1.155735	1.675871
Indian/Asian	1.28	0.153	0.9120634	1.799039
*White	0.63	0	0.4894382	0.8029699
Hypertension and Hyperlipidemia				
*** Age**	2.12	0	1.885524	2.374215
Gender				
Male	RC			
Female	0.97	0.849	0.7407479	1.280056

Marital Status				
Legally Married	RC			
* Cohabitation	0.28	0.013	0.102321	0.768242
* Divorced	1.80	0.017	1.108305	2.911716
Separated	0.97	0.962	0.2329529	4.002924
Widowed	0.95	0.777	0.6456442	1.386949
Single, but have been living together.	0.99	0.995	0.3097	3.202521
Single, and have never been married.	0.78	0.283	0.4921281	1.229826
Educational Attainment				
Primary Education	RC			
* Secondary Education	1.74	0.007	1.164162	2.59043

Tertiary Education	1.29	0.385	0.7280408	2.275131
Racial Group				
Black/African	RC			
* Coloured	14.91	0	10.02531	22.16423
* Indian/Asian	8.73	0	4.623549	16.48798
* White	13.49	0	8.782092	20.73671
Hypertension and Heart Attack				
*** Age**	2.41	0	2.116951	2.73773
Gender				
Male	RC			
* Female	1.54	0.006	1.13027	2.08603

Marital Status				
Legally Married	RC			
Cohabitation	1.03	0.928	0.574369	1.8376
Divorced	0.69	0.382	0.2985712	1.58912
Separated	0.65	0.549	0.1579127	2.66622
Widowed	1.13	0.498	0.7943071	1.60564
Single, but have been living together.	1.38	0.458	0.5923589	3.19911
* Single, and have never been married.	0.60	0.039	0.37001	0.97459
Educational Attainment				
Primary Education	RC			
Secondary Education	1.21	0.241	0.8779519	1.67665

Tertiary Education	0.59	0.176	0.2702016	1.270239
Racial Group				
Black/African	RC			
* Coloured	2.53	0	1.769936	3.604206
* Indian/Asian	2.62	0.002	1.416069	4.84162
White	1.37	0.174	0.8687303	2.171655
Hypertension and HIV/AIDS				
*** Age**	1.32	0	1.16825	1.497109
Sex				
Male	RC			
* Female	2.26	0	1.611967	3.164206

Marital Status				
Legally Married	RC			
* Cohabitation	2.58	0	1.635051	4.064052
Divorced	2.05	0.064	0.9584846	4.403673
Separated	2.27	0.086	0.8902159	5.777313
Widowed	0.90	0.686	0.5549519	1.47311
* Single, but have been living together.	3.94	0	2.22104	6.971911
Single, and have never been married.	0.95	0.823	0.6089601	1.483601
Educational Attainment				
Primary Education	RC			
* Secondary Education	0.37	0	0.2566102	0.5205056

* Tertiary Education	0.23	0.005	0.081486	0.6393412
Racial Group				
Black/African	RC			
* Coloured	0.41	0.013	0.1997979	0.8299597
Indian/Asian	0.59693	0.472	0.1463378	2.434951
* White	0.2956835	0.042	0.0913938	0.9566158

An adjusted Multinomial Logistic Regression was run to determine the most statistically significant variables. In the table above these were all denoted with a "*". For the purpose of this report only those variables that have been identified as statistically significant will be spoken on and interpreted accordingly.

Hypertension and Diabetes: Based on what can be seen in the table above the risk of having Hypertension and Diabetes simultaneously increases with age. The risk of having the comorbidity versus only having hypertension increases by a factor of 2.20 for every one-unit increase in age, when other covariates are held constant [CI: 2.081547 – 2.335489].

The variable sex was found to be statistically significant based on the P value [0] and 95% Confidence Interval [CI: 1.4999799-1.989519]. The relative risk of having a comorbidity of hypertension and diabetes versus having only hypertension increases by a factor of 1.73 among female adults in relation to male adults, when other covariates are held constant. Focusing on the predictor variable of Marital Status, the reference category for this variable is legally married. The relative risk of having hypertension and diabetes versus having only hypertension decreases by a factor of 0.49 among adults who are cohabiting in relation to adults who are legally married, when other covariates are held constant. [CI: 0.3570804 – 0.6617811]. The relative risk of having hypertension and diabetes versus having hypertension only decreased by a factor of 0.78 among adults who are legally married vs being widowed, when other covariates are held constant[CI: 0.66-0.92]. The relative risk of having hypertension and diabetes vs hypertension only decreased by a factor of 0.41 among adults that are Single, but living together in relation to those who are legally married [CI: 0.23-0.70] and the relative risk of having hypertension and diabetes versus having only hypertension decreased by a factor of 0.04 among adults who are single, and never been married compared to those who are legally married [CI: 0.33-0.51].

Educational attainment has three categories it's either an individual has a primary education, secondary education or a tertiary education. The reference category for this variable is primary education. Based on the results the relative risk of having Hypertension and Diabetes vs hypertension only decreased by a factor of 1.08 for those with a tertiary education [CI: 0.33-0.51].

The reference category for race is Black. The relative risk of an individual from the coloured community being both hypertensive and diabetic vs just being hypertensive increases by a factor of 1.39 compared to adults in the Black community, keeping all other covariates constant [CI: 1.16 – 1.68]. Whilst the relative risk of an individual from the white community having the comorbidity vs just having hypertenison decreases by a factor of 0.63 compared to an adult from the black community keeping all other covariates constant [CI: 0.49-0.80].

Hypertension and Hyperlipidemia: The second comorbidity is Hypertension and Hyperlipidemia. The relative risk of having Hypertension and Hyperlipidemia simultaneously versus just having hypertension increases with age. The relative risk of having the comorbidity increases by a factor of 2.12 for every one-unit increase in age if all other covariates remain constant [CI: 189 – 2.37].

Focusing on the predictor variable of Marital Status, the reference category for this variable is legally married. The relative risk of adults having this comorbidity compared to just having hypertension decreases by a factor of 0.2.8 for adults that are cohabitating versus those that are legally married, keeping all other covariate constant [CI: 0.10 – 0.77]. The same can be said for the other marital statuses except for divorced individuals it increases by a factor of 1.80 [CI: 1.11 – 2.91].

Educational attainment has three categories its either an individual has a primary education, secondary education or a tertiary education. The reference category for this variable is primary education. Based on the results the relative risk of having Hypertension and Hyperlipidemia and having just Hypertension increases by a factor of 1.74 for those adults who have acquired secondary education versus those who have primary education, when other covariates are held constant [CI: 1.16 – 2.59].

The relative risk of an individual from the coloured community having both hypertension and hyperlipidemia vs just hypertension increases by a factor of 14.91 in comparison to an individual in the Black community, when other covariates are kept constant[CI: 10.03 – 22.16]. Whilst the relative risk of an individual from the Indian/Asian community having the comorbidity vs just having hypertension increased by a factor of 8.73 compared to those from the Black community, this is when all other covariates remain constant [CI: 4.62 – 16.49]. Lastly the relative risk of an individual from the white community having the comorbidity vs just having hypertension increases by a factor of 13. 49 compared to those in the black community, when all other covariates remain constant [CI: 8.78 – 20.74].

Hypertension and Heart Attack: This section will focus on individuals that have suffered a heart attack and are also hypertensive. The relative risk of having Hypertension and a Heart attack simultaneously versus just having hypertension increases with age. The risk of having the comorbidity increases by a factor of 2.41 for every one-unit increase in age [CI: 2.12 – 2.74].

The Reference Category forSex is males. The relative risk of a female having both hypertension and a heart attack vs having just hypertension increases by a factor of 1.54 compared to males if all other covariates remain constant [CI: 1.13 – 2.09].

Focusing on the predictor variable of Marital Status, the reference category for this variable is legally married. The relative risk of individuals who are legally married having the comorbidity versus just hypertension decreases by a factor of 0.60 compared to those legally married once all other covariates remained constant [CI: 0.37 – 0.97].

The relative risk of an individual from the coloured community being both hypertensive and having a heart attack vs just having hypertension increased by a factor of 2.53 compared to an individual from a black community, keeping all other covariates constant [CI: 1.77 – 3.60]. Whilst the relative risk of an individual from the Indian/Asian community having the comorbidity vs having just hypertension increasd by a factor of 2.62 compared to those in the black community, keeping all other covariates constant [CI: 1.42 – 4.84].

Hypertension and HIV/AIDS: This section will focus on individuals that have Hypertension and HIV & AIDS. The relative risk of having Hypertension + HIV AIDS versus just having hypertension increases with age. The risk of having the comorbidity compared to just having hypertension increases by a factor of 1.32 for every one-unit increase in age [CI: 1.17 – 1.50].

The relative risk of a female having both hypertension and HIV/AIDS vs just having hypertension increases by a factor of 2.26 compared to males, keeping all other covariates constant [CI: 1.61-3.16].

The relative risk of an individual from the coloured community being both hypertensive and HIV/AIDS vs being just hypertensive decreases by a factor of 0.41compared to one from a black community, keeping all other covariates constant [CI: 0.20 – 0.83]. The relative risk of an individual from the white community having the comorbidity vs just hypertension decreased by a

factor of 0.30 compared to an individual from the black community, when other covariates are held constant [CI: 0.09 – 0.96].

Based on the results obtained above the relative risk of having the comorbidity versus just having hypertension decreases by a factor of 0.37 [CI: 0.26 – 0.52] for those with a secondary education compared to those with a primary education whilst it decreases by a factor of 0.23 for those with a tertiary education compared to those with a primary education, when other covariates are held constsnt [CI: 0.08 – 0.64].

Focusing on the predictor variable of Marital Status, the reference category for this variable is legally married. The relative risk of individuals who are legally married having the comorbidity vs just being hypertensive increases by a factor of 3.94 for those who are single and living together, holding other covariates constnt [CI: 2.22 -6.97]. The relative risk of individuals who are legally married having the comorbidity vs just hypertension increases by a factor of 2.58 compared to those who are cohabitating, given that all other covariates remain constant [CI: 1.64 – 4.06].

Chapter Five:

DISCUSSION

5.1. Introduction

This study addressed the main research objective, which was to determine the four most prevalent hypertension comorbidities in adults in South Africa concerning their geographical location. The

sub-objectives were to determine the levels and geographical distributions of hypertensive comorbidities amongst adults in South Africa and to determine the demographic and socio-economic factors contributing to hypertension comorbidities in adults in South Africa. The purpose of this chapter is therefore to present the results of this study. In presenting this discussion, the various findings from this study are unified and integrated within the context of what is known about the topic globally.

5.2. Discussion of Results

The results of the study indicate that the most prevalent comorbidity throughout the South African population is Hypertension and Diabetes. Hypertension and Diabetes often overlap (Cheung & Li, 2012). This phenomenon does not only occur in South Africa but globally too. Dating back as early as the year 2004 hypertension had occurred in approximately 30% of patients with type 1 diabetes and 50% to 80% of patients with type 2 diabetes in the United States (Landsberg & Molitch, 2004). In the Hong Kong Cardiovascular Risk Factor Prevalence Study, only 56% of people with hypertension had normal glucose tolerance whilst only 42% of people with diabetes had normal blood pressure and (Cheung, 2010). This could suggest that there is a serious link between the two conditions.

The study findings have made it clear that females are at a higher risk of suffering from all four comorbidities respectively in comparison to their male counterparts. At a younger age, high blood pressure (BP) is more often present in men than in women, but this reverses gradually after the age of 50 (Yanes & Reckelhoff, 2011). Elevated sympathetic nerve activity in older women may be

an important contributor to the increased prevalence of hypertension after the menopause (Barne et al., 2014).

Black Africans were the reference category in the regression model and their relative risk for all three hypertensive disorder were less than all other racial groups excluding hypertension and HIV/AIDS. However, literature often refutes the idea that Black people are in better health than other racial groups. There are huge disparities between race and health (Whitfield et al., 2002). Disadvantages in health exist for many groups when compared to Whites. Asians on many accounts are found to have more positive health profiles than Black people but are not without disadvantages in comparison with Whites (Whitfield et al., 2002). The literature on health disparities has documented Black and White differences in major causes of death such as hypertension, diabetes, fatal stroke, and heart disease.

In 2005 the Institute of Medicine in America released a report documenting several reasons as to why there is so much inequality regarding the health of Whites and Blacks respectively (Bridges, 2019). This report argued that the poverty in which black people disproportionately live cannot account for the fact that black people are sicker and have shorter life spans than their white complements (Bridges, 2019).

There is a concrete, inferior care that physicians give their black patients. Black persons are less likely than white persons to be given appropriate cardiac care, to receive kidney dialysis or transplants, and to receive the best treatments for stroke, cancer, or AIDS (Bridges, 2019).

Bringing this concept back home to South Africa, the same can be said. A decomposition study was conducted and whites and blacks with similar socio-economical characteristics had different health. Unsurprisingly, we find a strong indirect racial effect in favour of whites (Charasse-Pouele & Fournier, 2006). The results of this study subsequently stressed the need not only to open

sophisticated health care access to black people in the country but also to provide them with the economic opportunity to use it (Charasse-Pouele & Fournier, 2006). This concept is closely linked to geography.

Geography and health are intrinsically linked (Dummer, 2008). Where people are born, live, study and work directly affect and influence their health experience: the air they breathe, the food they eat, the viruses they are exposed to and the health services they have access to (Dummer, 2008). The social, built and natural environments affect people's health and well-being in ways that are directly relevant to health policies.

Spatial location (the geographic context of places and connectedness between places) plays a pivotal role in shaping environmental risks as well as many other health effects (Tunstall, Shaw & Dorling, 2004). Based on what is depicted on the first map it is clear to note that non-metropolitan areas have a much higher hypertension comorbidity rate than those situated in metropolitan areas. The light blue dots represent Hypertension and Diabetes. These are spread out throughout the entire interior of South Africa however, cluster around the entire province of KwaZulu Natal and Gauteng respectively. The Eastern Cape, Western Cape, South -Western region of Mpumalanga and North West respectively have a high prevalence of Hypertension + Diabetes Comorbidity too. Hypertension and Hyperlipidaemia is found predominantly located throughout the entire interior of the Western Cape Province. Hypertension and Heart Attacks are located predominantly along the Eastern parts of South Africa in the Western Cape, Eastern Cape and KwaZulu Natal. Hypertension and HIV/AIDS strong prevalence throughout the province of Mpumalanga and North West.

Marital status was found to have been a significant predictor of all the hypertensive comorbidities. A study explored the relationship between marital status and hypertension among women and men in Ghana. Drawing on data from the 2014 Ghana Demographic and Health Survey (GDHS) descriptive statistics and binary logistic regression models were used to analyse the link between marital status and hypertension (Tuoyire & Ayetey, 2018). About 13% of women aged 15–49 and 15% of men aged 15–59 were found to be hypertensive. After controlling for lifestyle and socio-demographic covariates, the logistic regression models showed significantly higher odds of hypertension for married (OR=2.14, 95% CI=1.30–3.53), cohabiting (OR=1.94, 95% CI=1.16–3.23) and previously married (OR=2.23, 95% CI=1.29–3.84) women (Tuoyire & Ayetey, 2018), . In contrast, no significant association was found between any of the marital status cohorts and hypertension for men (Tuoyire & Ayetey, 2018). The health of populations can be measured along many dimensions by indicators that reflect mortality, morbidity, overall well-being, lifestyle behaviours, and other health-related risk factors (Eberhardt & Pamuk, 2004). Indeed, differences exist between those areas that are considered to be metropolitan and those that are not, some adverse health measures are highest in metropolitan areas such as homicide (Eberhardt et al., 2001). However, for the most part, a lot of health measures show a huge health disadvantage in non-metropolitan areas (Eberhardt & Pamuk, 2004). Therefore, it is safe to say that non-metropolitan and metropolitan health patterns are not always monotonic.

The results of this study indicated that as one gets older, they are at a higher risk of being more susceptible to having either one of the four hypertension comorbidities. This can be explained by the lack of physical inactivity older persons post their economically active period, as in South Africa, the retirement age occurs between the age group 60-65 years (Department of Social

Development, 2005). It would seem as though there will always be a linear pattern towards the increase in age and non-communicable diseases as a result of the deterioration of older person health (Rarau et al., 2019). Thus, less physical activity as a result of age will attract the chances of diseases among the population in South Africa (Neupane, Prakash, & Doku, 2016).

This study also found that those that have attained any form of tertiary education are less likely to suffer from hypertension comorbidity. This is because concepts of education and health are developed and linked. Basic educational expertise and skills, including fundamental knowledge, reasoning ability, emotional self-regulation, and interactional abilities, are critical components of health. Moreover, education is a fundamental social determinant of health (Hahn & Truman, 2015)

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The study set out to determine the prevalence of comorbidity among adults in South Africa that suffer from Hypertension. Highlighting the need to address the chronic non-communicable disease epidemic in South Africa and to co-ordinate multidisciplinary primary-, secondary- and tertiary-level care in the country's complex healthcare system for a better outcome.

Comorbidity and multimorbidity are associated with adverse health outcomes, such as poor quality of life, disability, psychological problems and increased mortality (Valderas et al., 2009 As such South Africa's medical care system is particularly ill-prepared to deal with patients with comorbidity and multimorbidity (*Coovadia* et al., *2009*). These issues are especially relevant in certain clinical settings, such as general practice and services caring for the aging population.

South Africa needs to place more prominence on health about geographical location. Health Geography recognizes the importance of context, setting and spatial scale in determining health outcomes.

These are the issues that need urgent attention in South Africa, given its aging population and the Policies the country as a whole has agreed to adhere too. There is a strong need for partnerships among health specialists and geographers that can help sustain innovative approaches to solving complex problems and ultimately reduce inequality.

Throughout this study, it was clear to note that there is a lack of uniformity with regards to not only health care provision in South Africa but overall health throughout the population affecting some people more than others. This study employed GIS methodology and was able to definitively identify the most troubled areas in the country. Moving forward such methodology needs to be employed before the launch of health programs as it identifies geographical areas that are most affected.

6.2 Policy and Future Research Recommendations

6.2.1. Policy Recommendation

The issue at hand is the fact that comorbidities are increasing rapidly across the whole of South Africa and it is putting a huge strain on the country's health care services. Geospatial analysis is a good tool that needs to be used more often in the field of public health. All policies need to be

backed up by empirical evidence as well as exact location. The rationale behind this policy recommendation stems from the fact that need to be distributed to the areas that need it the most. It is important to know exactly which village in rural Eastern Cape needs certain health care facilities. By doing this less fund get embezzled.

6.2.2. Future Research Recommendations

This study looked closely at the association between Socio-Demographic Factors and Hypertension Comorbidities. However, because hypertension is a disease that is closely related to lifestyle and behavioral choices. These may include exercise, calories eaten, stress, and/ or smoking and drinking patterns. Future research should take such factors into consideration to essentially determine the extent to which behaviour plays of one's health. There could be a possibility that genetics plays a huge role too so it would be interesting to see.

Secondly this study looked at comorbidities but did not look at what sickness came first. Did the Diabetes cause the Hypertension or was it vice versa? Future Research should look into such a study.

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APPENDIX

APPENDIX A – TEST FOR MULTICOLLINEARITY

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Variable	VIF	1/VIF
Age_group	1.26	0.790899
Q12aMARST	1.19	0.838594
Q15HIEDU	1.09	0.918206
Race	1.06	0.942731
Gender	1.01	0.989891
Mean VIF	1.12	

APPENDIX B - LITERATURE REVIEW MATRIX

Title	Author & Year	Data Source	Study Description	Method	Findings	Gaps
Inequities in access to health care in South Africa.	Harris, B; Goudge, J; Ataguba, J.E; McIntyre, D; Nxumalo, N; Jikwana, S & Chersich, M. (2011)	In 2008, a household survey was conducted in South Africa, with households selected using multi-stage sampling, detailed elsewhere and in this edition.	Cross – Sectional	To detect differences among categorical variables we used the Rao–Scott F statistic to determine P-values. Given the large sample size, virtually all associations were significant. Using principal	The health decision-maker declined participation or was ineligible in 238 households (5 per cent), 223 of which were substituted. The 4668 households sampled contained 21 159 individuals. Four-fifths were	Although we enquired about preventative and related non-curative services, responses were restricted largely to curative care. Further, methodologically, temporal relationships

		The team selected five randomly-chosen households within 960 enumerator areas. Within each household, we administered the questionnaire to an adult responsible for household health decisions.		component analysis, we developed a composite index of socio-economic status based on variables including access to water and sanitation, housing characteristics, and age and gender of household heads, which are strongly related	black Africans, almost half had only primary schooling or less, and 39.9 per cent inhabited rural areas (Table 1). A quarter were employed, a similar proportion unemployed, and the remainder either pensioners	cannot be established between variables within cross-sectional surveys.

				to socio-economic status in South Africa.	(8.3 per cent), or children and students (44.3 per cent). Median per capita expenditure (for everything, including, but not restricted to, health services) was US$26.7/month (IQR ¼$13.3–$53.3; $1 ¼R7.5), with 28.9 per cent spending below $15/month.	

					Conversely, 5.4 per cent spent $250/month or more. Most did not have health insurance (88.4 per cent).	
South African hypertension practice guideline 2014	Seedat, Y.K & Rayner, B.L. (2011).	Southern African Hypertension Society (SAHS).	Clinical Studies.	Applicable HTN and CVD treatment and prevention guidelines were reviewed as well as HTN trials reporting clinical	Extensive data from many randomised, controlled trials have shown the benefit of treating hypertension (HTN). The target	The article needed to look at countries separately and compare the relevant results to determine which country in

				end-points, including those with individuals with important co-morbidities such as diabetes mellitus and chronic kidney disease.	blood pressure (BP) for antihypertensive management is systolic < 140 mmHg and diastolic < 90 mmHg, with minimal or no drug side effects. Lower targets are no longer recommended. The reduction of BP in the elderly should be achieved	Southern Africa is most at risk.

					gradually over one month. Co-existent cardiovascular (CV) risk factors should also Lifestyle modification and patient education are cornerstones of management. The major indications, precautions and contra-indications are listed for each antihypertensive drug	

					recommended. Drug therapy for the patient with uncomplicated HTN is either mono- or combination therapy with a low-dose diuretic, calcium channel blocker (CCB) and an ACE inhibitor (ACEI) or angiotensin receptor blocker (ARB).	

					Combination therapy should be considered *ab initio* if the BP is ≥ 160/100 mmHg. In black patients, either a diuretic and/or a CCB is recommended initially because the response rate is better compared to an ACEI. In resistant hypertension, add an alpha-blocker,	

					spironolactone, vasodilator or β-blocker. be controlled.	
Defining comorbidity: implications for understanding health and health services.	Valderas, J.M; Starfield, B; Sibbald, B; Salisbury, C & Roland, M. (2009).	A PubMed search in MEDLINE was conducted and this is where the vast majority of the data came from.	This article was investigatory in nature. It sought out to properly define the concept of comorbidity.	Literature on available definitions of the concept of comorbidity were searched. Given the lack of specificity for standard search strategies a PubMed search in	In this article, we review definitions of comorbidity and their relationship to related constructs. We show that the value of a given construct lies in its ability to explain a particular	More research into patients' perspectives on the ways in which multiple conditions affect their health, well-being, and clinical care is needed to complement the professional

				MEDLINE, including solely the Medical Subject Heading term "comorbidity" retrieved more than 25,000 records in the last 10 years	phenomenon of interest within the domains of (1) clinical care, (2) epidemiology, or (3) health services planning and financing. Mechanisms that may underlie the coexistence of 2 or more conditions in a patient (direct causation, associated risk factors,	perspective adopted here and ensure that care is truly patient centered

					heterogeneity, independence) are examined, and the implications for clinical care considered. We conclude that the more precise use of constructs, as proposed in this article, would lead to improved research into the phenomenon of ill health in clinical care,	

					epidemiology, and health services.	
Urban and rural differences in health insurance and access to care.	Hartley, D.L., L.Quam, & N.Lurie. (1994)	Data were collected from a telephone survey of 10,310 randomly selected households in Minnesota.	Cross -Sectional Study.	Sub-samples of 400 group-insured, individually insured, intermittently insured, and uninsured people, were asked about access to health care. Those with group or individual insurance were also asked about	Rural areas had a higher proportion of uninsured and individually insured respondents than urban areas. Among those who purchased insurance through an employer, rural residents had fewer covered benefits than urban	Attempts to expand access to health care need to consider how the current structure of employment-based insurance creates inequities for individuals in rural areas as well as the burdens this structure may place on rural providers.

				the costs and characteristics of their insurance policies.	residents (5.1 vs 5.7, P < 0.01) and were more likely to have a deductible (80% versus 40%, P < 0.01). In spite of this, rural uninsured residents were more likely to have a regular source of care than urban residents (69% versus 51%, P < 0.01), and	

					were less likely to have delayed care when they thought it was necessary (21% versus 32%, P<0.01). These differences were confirmed by multivariate analysis. Rural residents with group insurance have higher out-of-pocket costs and fewer benefits.	

					Uninsured rural residents may have better access to health care than their urban counterparts.	

APPENDIX C – TURN IT IN REPORT

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ORIGINALITY REPORT

6%	3%	2%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	equityhealthj.biomedcentral.com Internet Source	1%
2	www.nap.edu Internet Source	1%
3	Submitted to University of South Africa Student Paper	1%
4	Submitted to University of Leeds Student Paper	1%
5	Submitted to Universidad Privada Boliviana Student Paper	1%
6	Kandala, N.-B., W. Tigbe, S. O. Manda, and S. Stranges. "Geographic Variation of Hypertension in Sub-Saharan Africa: A Case Study of South Africa", American Journal of Hypertension, 2013. Publication	1%