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THE PREVALENCE AND PREDICTORS OF HIV-HYPERTENSION COMORBIDITY AMONG YOUTH LIVING WITH HIV IN SOUTH AFRICA, 2010- 2016.

BY

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THIS RESEARCH IS SUBMITTED IN PARTIAL FULFILMENT OF MASTERS OF ARTS IN HEALTH DEMOGRAPHY AT UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG.

SUPERVISOR: DR NICOLE DE WET

15MARCH2018

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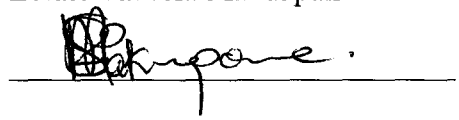
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DECLARATION

I, **Lerato Patricia Makuapane**, do hereby declare that this research paper is my own original work and has not been submitted before for any other degree or examination in any other university. Also be notified that the use of references herein, are dully quoted and acknowledged. Therefore, this is now submitted for the degree of Masters of Arts in Health Demography at the University of the Witwatersrand, Johannesburg.

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Signature: 

Date: 15th day of March, 2018

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ABBREVIATIONS AND ACRONYMS

AIDS	Acquired ImmunoDeficiency Syndrome
AYHP	Adolescent and Youth Health Policy
ART	Anti-Retroviral Therapy
ARVs	Anti-RetroVirals
CVD	Cardio-Vascular Diseases
CI	Confidence Interval
DALYS	Disability Adjusted Living Years
GAPRP	Global AIDS Response Progress Report
GHS	General Household Survey
HCT	HIV Counselling and Testing
HIV	Human Immunodeficiency Virus
HIV/HBP	Human Immunodeficiency Virus/Hypertension
LGBTQI	Lesbian, Gay, Bisexual, Transgender, Queer, Intersex+
MTCT	Mother-To-Child-Transmissions
MSM	Men who have Sex with Men
NCD	Non-Communicable Diseases
NGOs	Non-Governmental Organizations
NIDS	National Income Dynamics Survey
NSP	National Strategic Plan
OR	Odds Ratio
PLHIV	People Living with HIV
PMTCT	Prevention of Mother To Child Transmission
PoA	Programme of Action
TB	Tuberculosis
UN	United Nations
UNAIDS	The Joint United Nations Programme on HIV and AIDS

WHO	World Health Organization
MRC	Medical Research Council
CDIA	Chronic Disease Initiative for Africa
SSA	Sub-Saharan Africa
SDG	Sustainable Development Goal
STDs	Sexually Transmitted Diseases
STIs	Sexually Transmitted Infections
SANDoH	South African National Department of Health
StatsSA	Statistics South Africa

ABSTRACT

Background:

Over the last two decades, AIDS mortality rates has decreased substantially due to extensive HIV treatment in South Africa, which left HIV as a chronic illness. Therefore, since the disease nature of HIV predisposes patients to other clinical conditions; many HIV patients also suffers from other AIDS-related and non-AIDS diseases resulting in comorbidities. It is most prevalent among population aged 14-35 years. At the same time, NCDs are rapidly increasing among youth with hypertension being amongst the leading cause of HIV comorbidities. High prevalence of both HIV/AIDS and hypertension in this cohort rise a concern of their simultaneous occurrence to develop HIV-hypertension comorbidity.

Objective:

Hence, this paper aims to determine the prevalence and identify the predictors of HIV-hypertension comorbidity among youth living with HIV in South Africa.

Methodology:

This is a cross-sectional study using Statistics South Africa General Household Surveys (GHS) from 2010-2016. They provide demographic, socioeconomic information and disease profiles. The study use unweighted sample size of 25 165 include all young males and females living with HIV aged 15-24 years. In order to describe the study population characteristics, trend lines are used to describe the patterns of HIV and HIV-hypertension comorbidity throughout this period 2010-2016. Pearson Chi-squared tests are used for the bivariate analysis, whereas binary logistic regression is used at the multivariate level of analysis to determine the effects of selected demographic and socioeconomic factors.

Results:

Using the described GHS data, the total study population of a nationally representative sample of young people living with HIV aged between 15 to 24 years is 25 165. Out of those 25 165, about 22 446 had HIV only while 3 719 had HIV-hypertension comorbidity. The prevalence rate is 8.01 for every 1000 HIV positive youth population in South Africa. This increased by age, from 35.88 per 1000 population to 67.16 per 1000 population among youth aged 15-19 and 20-24 years respectively. Using the binary logistic regression, females have a 22% reduced probability of develop HIV-hypertension comorbidity compared to their male counterparts (OR = 0.78, 95%CI: 1.33-2.06). HIV-hypertension comorbidity is also observed to have increased chances among young people HIV treatment (ART) with (OR = 0.42, and 95%CI: 0.48-1.76).

Conclusion:

This study shows similar results as other studies done on HIV-hypertension comorbidity. It shows that although hypertension is thought of being an elderly health issue, it is rising rapidly among youth, particularly among those living with HIV. HIV-hypertension comorbidity is scarcely researched among youth in Africa, whereas it was supposed to be largely looked at as it South Africa is one of the fast developing countries in Africa and shows the emergence of non-communicable diseases at younger age.

Chapter One

1. Introduction

1.1 Background

Comorbidity is defined as the existence of any additional diseases that coexist or that may occur during the clinical course of a patient in relation to their index disease (Feinstein, 1970). This simply refers to the simultaneous occurrence of two or more distinct health or medical conditions on a particular individual (Fortin et.al, 2005; Valderas et.al, 2009; De Heer et.al, 2013). Since infectious diseases are viral and transferred via air, water and human contact, these various simultaneous exposures contribute to comorbidities in the populations (Valderas et.al, 2009).

Comorbidities are mostly common among working age adults (18-64 years) in all regions of the world, contributing 31.7% burden of diseases in the developed regions, 37.9% in the developing regions apart from Sub-Saharan Africa (SSA), and about 61.6% in SSA (Vos, Barber, Bell et, al., 2015). Globally, the most comorbidities are attributable to Non-Communicable Diseases (NCDs), especially Cardio-Vascular Diseases (CVD) (De Heer et.al, 2013; Christiansen et.al, 2016; Deeks & Phillips, 2009; Medina-Torne et, al., 2012). This is influenced by the widely spread westernized culture of sedentary lifestyle behaviours, poor diet, excessive alcohol consumption and tobacco smoking (Beaglehole et.al, 2011, Haregu et.al, 2012; Mayosi et. al, 2009; WHO, 2015). However, in SSA unlike most parts of the world, the prevalence of infectious diseases still outweighs that of NCDs even though NCDs have become the major sources of Disability Adjusted Living Years (DALYS) and premature deaths (Nyirenda, 2016). This explains the high prevalence of infectious and NCD comorbidities in the region, most of which are attributable to the aging of the population (Haregu et.al, 2012; Kelley-Moore et.al, 2005; Okoromah, Ojo, & Ogunkunle, 2012; Sani & Okeahialam, 2005; Tahir et.al, 2016; Twagirumukiza et al., 2007).

In South Africa, research has found that the burden of disease varies across age groups. The literature shows that infants and children (0-14 years) have the most common comorbidities from infectious diseases, particularly respiratory illnesses as well as the persisting child diarrhea and nutritional deficiencies, whereas older adults (30+years old) have the most NCD comorbidities (Lalkhen & Mash, 2015; Matthews et. al, 2016; Kahn, 2011; Bradshaw et.al,

2012; Reid et.al 2016). These variations of the cause of deaths in different age groups are more related to different biological and social exposures that change through the life course (Rogers et, al 2010).

Therefore, as HIV has always been the most prevalent infectious disease and a major health issue in SSA, with very high prevalence among youth and early adult population aged 14-35 years. It is of crucial importance to zoom into its non-AIDS comorbidities given the rapid global health burden of NCDs (Deeks & Phillips, 2009; Medina-Torne et, al., 2012; Tahir et.al, 2016). Since most literature has focused on assessing the NCDs among older populations, it is also imperative to have a closer look at the development of disease synergies that occur among younger populations (Njelekela t.al, 2016). Hypertension is one of the leading causes of morbidity and mortality in the entire world and South Africa is not an exception (WHO, 2017).

Therefore, with the predominantly high prevalence of both HIV and hypertension and it is crucial to understand their concurrent occurrence among youth considering the fact that most studies on NCDs and comorbidities are more focused on studying older persons. This is due to the fact that NCDs are considered health complications that comes with aging and longevity and never expected among youth (Lalkhen & Mash, 2015; Mangena et,al. 2016; Matthews et. al, 2016). There is a paucity of data on ways to improve the health of younger patients, and most recommendations are extrapolated from studies and data for older patients (Mangena et,al. 2016).

1.2 Research problem

HIV and AIDS is by far the most devastating infectious disease in SSA. West and Central Africa had 6.5 million People-Living-with-HIV (PLHIV) in 2012 (Global AIDS Response Progress Report (GARPR) 2016; UNAIDS 2016 estimates). While East and Southern Africa owns up to 20.5 million of PLHIV, with South Africa alone having the highest prevalence in the whole world at 7.4 million PLHIV, that is 19.2% of the world's HIV population (GAPRP, 2016; UNAIDS 2016 estimates).

In spite of such high HIV prevalence in the general population of South Africa, it has been declining among youth (15-24 years) , it came down from 6.3% in 2011 to 5.6% in 2016, with approximately 110 000 youth living with HIV (GAPRP, 2016; UNAIDS 2016 estimates; Mid-year estimates, 2016). However, this is pretty high, considering that neighbouring countries

like Namibia, Botswana and Lesotho, had less than 1000 PLHIV aged 15-24 years in the same year (GAPRP, 2016; UNAIDS 2016 estimates).

Over the last decade AIDS deaths has decreased substantially due to HIV treatment, leaving HIV as a chronic illness (Haregu et,al. 2012), which is increasingly complicated by other chronic medical comorbidities (NCDs) such as diabetes, hypertension and other CVDs (Monroe, 2013). Historically, NCDs were regarded as "western" health problems associated with affluence, but they are now the most common causes of morbidity and mortality in low and middle income countries (Malaza et,al. 2012). These are most commonly the health conditions that coexists with HIV. In most developing countries, the emergence of these NCDs onset earlier than other parts of the world, making young people vulnerable to health complications such as HIV and NCD comorbidities (Bigna et, al., 2016; Msemburi et.al, 2016; Rodriguez-Arboli et, at, 2017).

According to National Income Dynamics Survey (NIDS) 2008 shows that the prevalence of hypertension among youth was 11% and 12% for males and females respectively, which is among the most common NCDs among youth in South Africa (Bradshaw et, al. MRC and CDIA, 2011). Therefore, since HIV/AIDS is a very complex chronic disease, it predisposes PLHIV to a number of both infectious and non-infectious comorbidities (Goulet et, al.2007; Guaraldi et.al, 2011). Cardiovascular diseases, paricularly hypertension are the leading HIV non-infectious comorbidities (Goulet et,al. 2007; Torre et, al. 2004; Salter et, al, 2011). Studies have been seeking to explain the association between HIV infection and hypertension which results in of the gradually increasing hypertension among PLHIV, that is "HIV-hypertension comorbidity" (Rodriguez -Arboli et, al., 2017; Medina-Torne et, al., 2012; Mondy et.al 2007; Salter et, al., 2011). This comorbidity is then attributed to HIV infection or antiretroviral toxicity (Lorenc et, al. 2014).

This concurrent prevalence of both HIV and hypertension among youth in South Africa is shocking, considering the fact that most studies on NCDs and comorbidities are more focused on studying older people, as they are considered health complications that comes with aging and longevity and not expected among youth (Njelekela t.al, 2016) . For this reason, this HIV-hypertension comorbidity among other health issues faced by youth are not well studied and understood. There is a paucity of data on ways to improve the health of younger patients, and

most recommendations are extrapolated from studies and data for older patients (Mangena et,al. 2016).

Therefore, the purpose of this study is to determine the prevalence and other determinants of HIV- hypertension comorbidity among youth (15-24 years old) and identify the demographic and socioeconomic determinants of this form of comorbidity among youth in the country in order to provide a clearer understanding on the above mention health issue among youth.

1.3 Justification

This study is of crucial importance simply because the large proportion of persons aged 15-24 years, constitute of about 18.22% of the entire population in South Africa (StatSA, 2016 Mid-year population estimates). They are in a crucial period of their lives experiencing rapid emotional, physical and intellectual changes, transitioning from childhood to adolescence to independent adulthood, which comes with a lot of challenges on maintaining positive health and social behaviours (Layard et, al. 2013).

Their challenge on maintaining positive health and social behaviours is as a result of the growing academic expectations, changing social relationships with family and peers as well as the physical and emotional changes associated with maturation (Currie et, al. 2012). As part of growing up, they get to have experimental behaviours, such as tobacco use, alcohol consumption, dietary choices, sexual indulgence, which turn to be lifetime habits for most (Currie et, al. 2012). These are risk factors for most diseases like HIV/AIDS, CVD, hypertension, diabetes, depression and cancers. For an example, the hypertension prevalence in 2012 was about 12% among youth even though hypertension is considered "old age" illness, this shows that young people also suffer from this "old age" illness a lot more than expected and acknowledged (Bradshaw et, al. MRC and CDIA, 2011). At the same time, this is an onset period for sexual and reproductive behaviours and Sexually Transmitted Diseases (STDs) such as HIV/AIDS are likely to balloon in these ages. This is evident in the 2016 Mid-year estimates report, which showed that youth had 5.8% HIV prevalence (StatsSA- 2016 Mid-year estimates).

Therefore, since HIV/AIDS is a very complex illness and usually coexists with other diseases such as atherosclerosis and cardiovascular disease, and cancer (Farber, 2012; Lorenc et, al. 2014; Nyerenda, 2016). Both NIDS and the StatsSA 2016 Mid-year estimates shows that, the

possibility for concurrent occurrence of HIV and hypertension among youth is very high, which leads us to the main goal of this study – to determine the prevalence and predictors of HIV-hypertension comorbidity. This is heavily supported by the literature which shows that during HIV infection, it is very likely that the biology of the host exerts significant influence in determining the predisposition to develop hypertension, thus found to be the most common non-AIDS comorbidity among PLHIV (Deeks & Phillips, 2009; Farber, 2012; Lorenc et, al. 2014; Medina-Torne et, al., 2012). Furthermore, the deficiency of the immune increase the severity, duration and co-occurrence of other chronic health conditions (Salter et, al, 2011). Factors such as family history of hypertension, obesity, tobacco smoking, dietary choices, and lack of exercise as well as antiretroviral treatment exacerbates the occurrence of HIV-hypertension comorbidity. In other older age groups, the susceptibility might be influenced by age (Medina-Torne et, al., 2012). Hence, this paper also examines the predictors of this comorbidity among youth.

The results of this paper can be very useful in developing new policies and modifying the existing policies. The global fight against HIV/AIDS continues, as a result the global community leaders under the United Nations Development Programme (UNDP) enclosed in the Sustainable Development Goals (SDG) their third goal as to ensure healthy lives and promote well-being for all at all ages. The Joint United Nations programme on HIV and AIDS with the third SDG aims to end the epidemics of AIDS and other communicable diseases (tuberculosis, malaria), to reduce by one third premature NCD deaths through prevention and treatment and lastly to promote mental health and well-being. In this regard, there are policies in South Africa which aligns with this third SDG, these policies are guided by the National Strategic Plan (NSP) for HIV, TB and STIs 2017-2022 which shows that youth is one of the key vulnerable populations, and for that all Programmes of Action (PoA) in the public and private sector must ensure that their policies have customized and targeted interventions on HIV, STIs and TB as well as the related health issues among youth. It further emphasize that this can be improved and achieved through monitoring and evaluation of programmes, surveillance and surveys for detailed data as well as comprehensive research (see South Africa's National Strategic Plan for HIV, TB, and STIs 2017-2022).

In the South African NSP, one of the aims is its 90-90-90 targets for 2020 which aims to reach 90% of people living with HIV and does not know their statuses to test and know their status, give antiretroviral therapy to 90% of people who are diagnosed with HIV, and lastly to have

viral suppression for everyone who receives ART (SANDoHealth report, 2017). However, the increase in NCD prevalence in the country cannot be ignored. Therefore, the South African Declaration for Prevention and Control of Non-communicable diseases commits to prevent NCDs and promote health and wellness at population, community and individual levels (Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2013-17).

Population with such hypertension rates as high as 30% (WHO, 2016), there is need to simultaneously address the levels and determinants of HIV and hypertension in the country. One of the most imperative policies on youth in the country as guided by the NSP, is the Adolescent and Youth Health Policy (AYHP, 2016-2020) which aims to promote the health and wellbeing of young people through testing and treating HIV/AIDS and TB, promote healthy nutrition and reduce obesity, which will secure the health and development of youth, aged 15-24 years (see National Adolescent & Youth Health Policy, 2016-2020). The results could be used to modify this policy, by outlining the prevalence and predictors to give a well informed and direct interventions in line with its objectives of promoting good health and wellbeing of young people. It also seeks to strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol by 2030 (SANDoHealth report, 2017; Scott & Rajabifard, 2017).

Therefore, in order to reach the demographic dividend For this reason and to contribute to achieving national policies central objectives, there is need for research to examine the early onset of NCDs and STDs such as HIV/AIDS as they threatens the survival and healthy transition of youth into adulthood which will lead us to somehow forfeit demographic dividend. Hence, this study is of crucial importance as it identifies the extent of HIV-hypertension comorbidity among youth and the associated determinants for the purpose of making timely, accurate and comprehensive policy and programme recommendations.

1.4 Research Question:

What is the prevalence and determinants of HIV-hypertension comorbidity among youth living with HIV (15-24 years) in South Africa (2010-2016)?

1.4.1 Sub-Questions:

i. What are the levels of HIV-hypertension comorbidity among youth living with HIV in South Africa?

ii. What are the demographic and socioeconomic factors associated with HIV-hypertension comorbidity among youth living with HIV in South Africa?

1.5 General Objective:

- The main objective of this study is to determine the prevalence and predictors of HIV-hypertension comorbidity among youth living with HIV (15-24 years) in South Africa (2010-2016).

1.5.1 Specific Objectives:

i. To determine and examine the levels and trends of HIV-hypertension comorbidity among youth living with HIV in South Africa.
ii. To evaluate and assess the demographic and socio-economic factors in relation to HIV-hypertension comorbidity prevalence among youth living with HIV in South Africa.

1.5.2 Definition of terms:

1.5.2.1 *Youth* - These are young males and females who are between the ages 15-24 years.
1.5.2.2 *HIV-hypertension comorbidity* - A medical condition of having HIV or hypertension and due to its disease nature predisposing individuals to have another, either HIV or hypertension depending which one is the index disease between the two.

1.6 Organization of the study report

This study is organized in five chapters. Chapter one presents the introduction, which is sub-divided into background, problem statement, objectives and research questions, and justification of the study. Chapter two presents the review of the relevant literature on HIV-hypertension comorbidity, from a global, African and South African perspective. Chapter three outlines the study methodology further subdivided into introduction, source of data, study design, study population and sample, variable descriptions, ethical considerations, data management and statistical analysis plan as well as the limitations of the study. Chapter four presents the results of the study at the univariate, bivariate and multivariate levels while the last chapter five presents the summary of the main findings, conclusion and recommendations from the study.

Chapter Two

2. Literature Review and Theoretical Framework

2.1 Literature Review

2.1.1 Background

Globally, over the years there have been great revolutions in the medical settings which improved the provision of primary health-care services by introducing extensive disease control strategies and medical care (Fortin et.al, 2005). These transformations substantially prolonged life expectancy at birth by decreasing premature deaths from infectious disease illnesses which used to be fatal (Fortin et.al, 2005). Consequently, the prolonged life expectancy predisposes chronic disease patients and the aging population to poor quality of life defined as Disability Adjusted Living Years (DALYS) plagued by chronic complications such as concurrent occurrence of multiple medical conditions (Fortin et.al, 2005; Goodman et.al, 2012; Haregu et,al. 2012). For an example, the invention of antiretroviral therapy (ART) reduced morbidity and mortality rates of HIV/AIDS, on the other hand prolonged lives of people who are infected by this virus (Farber, 2012; Guaraldi et, al.,2011; Medina-Torne et.al 2015; Palmisano & Vella, 2011). However, since HIV is now a chronic disease, the prolonged lives of HIV-infected people exposes them to chronic non-infectious comorbidities, which affects the prognosis and the quality of life of PLHIV (Deeks & Phillips, 2009; Farber, 2012; Goulet et, al., 2007; Guaraldi et, al., 2011; Haregu et,al. 2012; Lalkhen & Mash, 2015).

2.1.2 History of HIV and NCDs (close focus on Hypertension)

Since HIV/AIDS joins the ranks of emerging epidemics of NCDs, with its persistently high prevalence rates, there is an increased burden of HIV/AIDS and NCDs, which results in a syndemic (HIV/NCDs comorbidities) which is a public population health concern, with high costs of care for overwhelming patients' needs (Haregu et,al. 2012; Malaza et,al. 2012). HIV patients are more susceptible to comorbidities from other chronic health conditions, especially NCDs including diabetes mellitus, hypertension and cardiovascular diseases, because of their complex interlinkages of the disease nature and traditional risk factors (Haregu et,al. 2012; Monroe et, al. 2013).

People living with HIV are no longer dying from AIDS related opportunistic illnesses, but the most recent research findings shows that NCDs are the major cause of deaths among HIV patients, as well as morbidity (Haregu et,al. 2012).

Among high NCD morbidity and mortality rates faced by PLHIV, hypertension is leading as the most common HIV comorbidity, with an estimated prevalence of 31.7%, followed by diabetes at a prevalence ranging from 2-14% among PLHIV (Haregu et,al. 2012; Monroe et, al. 2013).

2.1.3 Global prevalence of HIV and Hypertension

Globally, the prevalence of hypertension is relatively high, especially in the low and middle income countries, where more than 30% of the adults (15-64 years) have hypertensive complications (WHO, 2015). In 2015, South Africa alone had 28.2% hypertension prevalence among adults aged 18 years and above (WHO, 2015). In addition to this, according to NIDS 2008, the prevalence of hypertension among youth (15-24 years) in South Africa was 11% and 12% for males and females respectively. Therefore, the consequences of rapid acceleration of hypertension given the relatively high prevalence of HIV among youth in South Africa are the risk of HIV-hypertension comorbidities in the population. A number of studies supports this, by stating that, the leading non-infectious causes of illness among HIV-infected individuals are cardiovascular diseases (CVD); and hypertensive complications are the most prevalent (Deeks & Phillips, 2009; Medina-Torne et, al., 2012; Nam et, al., 2015). Hypertension is observed to be the most prevalent non-AIDS related comorbid illness among HIV infected individuals and most often than not, it is a confounding risk factor for HIV and other non-infectious comorbidities among HIV infected individuals, particularly youth (Guaraldi et, al., 2011; Rodriguez-Arboli et, al., 2017; Medina-Torne et, al., 2012; Mondy et.al 2007; Salter et, al., 2011).

Globally, studies have shown high prevalence of HIV-hypertension comorbidities, ranging from 0.05% to almost 33% (Rodriguez-Arboli et, al., 2017; Medina-Torne et, al., 2012; Mondy et.al 2007; Salter et, al., 2011). Although the vascular pathology for hypertension among people living with HIV and the idiopathic hypertension is identical, hypertension among PLHIV is higher than it is among the general population (Bigna et,al. 2015; Henriques-Forsythe et, al. 2015). For PLHIV, the prevalence of hypertension is 0.05%, whereas it only ranges from 0.0015%-0.005% among general population (Henriques-Forsythe et, al. 2015). In one study, the prevalence of hypertension among HIV infected individuals aged 15-36 years was 19%, this cohort incudes youth (Medina-Torne et, al., 2012). About 31.7% prevalence of

hypertension was reported among PLHIV compared to only 2-14% of diabetes mellitus (Monroe et, al. 2011).

There have been several studies conducted to evaluate the relationship between HIV and hypertension in Africa as well. In a study conducted on the epidemiology of hypertension among PLHIV in Africa, the prevalence of HIV-hypertension comorbidity was reported high by most studies cited, for an example a study among 116 vertically HIV-infected adolescents (10–19 years) which was conducted in Zimbabwe by 2012 showing a 7% prevalence of hypertension among them (Bigna et,al. 2012; Ferrand et,al. 2012). In the same paper, another study cited showed 13% prevalence of hypertension among HIV infected patients in Tanzania (Bigna et,al. 2012; Ferrands, et,al. 2012).

In Uganda, a study which was done on adults attending an ambulatory HIV clinic was in alignment with other studies which shows that the as PLHIV lives longer, there is an emergence of dual epidemic of HIV and NCDs. In the general population, the prevalence of hypertension was 20.9%, however among PLHIV it has substantially increased compared to other NCDs, from 16.9% in 2009 to 32.3% in 2013 (Kalyesubula et,al. 2016). All of these are results from cross sectional studies, another cross sectional study in South Africa which included 518 HIV infected patients, revealed 8 % prevalence of hypertension (Sliwa et,al. 2012). Another study done in the Demographic Surveillance Area (DSA) run by Africa Centre for Health and Population studies in rural Kwa-Zulu-Natal-South Africa, found 19.5% prevalence of hypertension among PLHIV (Malaza et,al. 2012). Generally, the prevalence of HIV-hypertension comorbidity in Africa ranges from 5% to more than 32%.

2.1.4 The determinants of HIV-hypertension comorbidity

Although there is a rise in the prevalence of HIV-hypertension comorbidity, the determinants of this relationship are still not clear. There are inconsistent findings, which contradicts on what really influences HIV-hypertension comorbidity. Although, there is insufficient evidence on the predictors of this comorbidity, a systematic review done on HIV/NCD prevalence and predictors showed that the major determinants of HIV and NCD comorbidities is the immune suppression measured in terms of viral load and CD4 cell count (Haregu et,al. 2012).

Biological and Medical determinants

People living with HIV have an excess risk to CVDs, because they are more likely to develop dyslipidemia, carotid athesclerosis and large vascular vessels with or without using ART, but rather as a result of the infection itself (Bloomfield et, al. 2011).

Although there are confounding factors that may cause HIV-hypertension comorbidity, more than 80% of this comorbidity is attributable to HIV infection and/or its treatment (L'Hullier et,al. 2015). HIV infection and its severity can exacerbate the occurrence of hypertension among PLHIV (Goulet et, al. 2007; Medina-Torne et, al. 2012). Some of the HIV proteins impair the adenosine triphosphate binding cassette transporter in macrophages, which is responsible for reversing cholesterol transport (Goulet et, al. 2007). When this happens, macrophages are converted into foam cells which creates a plaque formation in vessel walls (Guaraldi et, al. 2011). This plague then interferes with the normal blood flow, thus causing hypertension and other CVD among PLHIV (Salter et, al. 2011; Guaraldi et, al. 2011).

Other HIV viral proteins leads to chronic inflammation and endothelial dysfunction, which plays a significant role in HIV-hypertension pathogenesis (L'Hullier et,al. 2015).

The existing literature have shown contradicting findings on the real association between HIV-hypertension comorbidity and low CD4 T cell count (Goulet et,al. 2007; Guaraldi et,al. 2011; Mondy et,al. 2007; Medina-Torne et,al. 2012; Rodriguez-Arboli et,al. 2017). Some of these studies showed that HIV-hypertension comorbidity is dependent on the CD4 count cells, if CD4 count <200/mm3 this comorbidity is likely to occur (Goulet et,al. 2007; Guaraldi et,al. 2011; Mondy et,al. 2007). An increased CD4+ cell count is shown to have a strong relationship with the metabolic syndrome and an increased body mass index (BMI), which predisposes PLHIV to HIV-hypertension comorbidity (Mondy et, al. 2007). However, this is not true evidence for other studies as they revealed that HIV-hypertension can occur regardless of the strength of a patient's CD4 count cells, because a patient with an increased survival rate and an increased CD4 counts can still develop this synthetic (L'Hullier et, al. 2015; Medina-Torne et,al. 2012; Rodriguez-Arboli et,al. 2017).

One study done in the United States showed no correlation between CD4+ cell count, HIV load and HIV-hypertension comorbidity (Henriques-Forshythe et, al. 2015). Instead, it showed a correlation between the duration of HIV infection and HIV-hypertension comorbidity, which might be due to the fact that preclinical HIV-hypertension is not easily recognized, it may take years or even decades to manifest itself after infection (Henriques-Forshythe et, al. 2015;

L'Hullier et,al. 2015). This leaves the condition undetected and untreated for longer periods until late in some cases (Henriques-Forshythe et, al. 2015). Although tuberculosis (TB) as an opportunistic illness has shown to increase the likelihood of other NCD comorbidities among PLHIV, not much is shown in regard to hypertension (Haregu et.al, 2012).

Most of the studies direct the relationship between HIV and hypertension to HIV treatment (ART) (Mondy et, al., 2007; Malaza et,al. 2012; Medina-Torne et, al., 2012). As it is shown in the literature, since the advent of ART, HIV mortality has decreased and improved the life expectancy of PLHIV (Deeks & Phillips, 2009; Farber, 2012; Haregu et.al, 2012; Mondy et, al., 2007; Medina-Torne et, al., 2012). In this way the survival of people who are HIV positive improved and since ART reverse HIV related weight loss and wasting, often PLHIV on ART tend to gain weight which is a risk factor for hypertension (Magande et,al. 2017; Malaza et,al. 2012). This is better explained by the fact that ART protects PLHIV from opportunist infections that causes malabsorption syndrome and they increases proatherogenic lipid level and influence insulin resistance and visceral fat accumulation, which results in abnormal obesity, hyperglycemia, dyslidemia and eventually an elevated high blood pressure/ hypertension (Mondy et, al. 2007; Njelekela et,al. 2016).

However, not all but some types of ART (such as protease inhibitor-PI) delays the pace at which glucose metabolism occurs in fat and muscle, therefore resulting in metabolic syndrome (which causes obesity) and eventually hypertension among PLHIV (Magarande et,al. 2017). Long exposure to PIs influence the occurrence of hypertension among PLHIV, as well as other CVDs like myocardial infarction and obesity (Bloomfield et,al. 2011). People living with HIV on ART (PI) had a 14.6% and 22% prevalence of obesity among men and women respectively (Bloomfield et,al. 2011). Since, obesity is one of the risk factors of hypertension as indicated earlier, this influence HIV-hypertension comorbidity (Bloomfield et, al. 2011).

Additionally, tenofovir is another type of ART which may cause hypertension among PLHIV, by causing renal tubular toxicity resulting in renal dysfunction and renal disease which cause hypertension (Magarande et, al. 2017). A study shows a high prevalence of 31% hypertension among HIV patients who receives HAART and 28% of those who do not receive HAART (Medina-Torne et, al., 2012). In Zimbabwe-Kadoma, there was an estimated 30% hypertension prevalence among PLHIV on ART in 2015 (Magarande et.al, 2017). However, other studies shows no significant association between hypertension and ART among HIV infected

individuals (Farber, 2012 & Goulet et, al., 2007; Rodriguez-Arboli et, al., 2017; Torre et, al., 2004). For example, in one study, there were only 3 cases out of 544 (0.7%) HIV patients on HAART with hypertension (Torre et, al., 2004). These cases may be due to traditional risk factors of NCDs, other than HIV treatment, since this comorbidity cannot only be attributed to and controlled by medication alone, but rather entails additional self-care activities and certain personal behaviours (Monroe et,al. 2011). Another study shows that in a cohort done between 1990 and 2005, the prevalence of HIV-hypertension comorbidity among HIV individuals on treatment was 0.5% and 0.46% respectively, this shows no significant change (Farber, 2012).

Socio-economic and demographic determinants

Literature shows that socio-economic and demographic factors like age and sex, marital status, poverty measured as income or wealth status, access to health services also influence the occurrence of HIV-hypertension comorbidity (Guaraldi et, al., 2011; Medina et, al., 2012; Njelekela et, al., 2016; Nam et, al., 2015; Nyirenda, 2016). The prevalence of HIV-hypertension comorbidity is observed to increase with age in most of these studies. As indicated earlier, a study done in Tanzania, presented HIV-hypertension comorbidity, to be 8.1% and 10.7% among youth (15-30 years) and adults (30-44 years) respectively (Njelekela et, al., 2016). In a study done in Uganda, age was also a contributing factor to the HIV-hypertension comorbidity, shown by the increase of the prevalence with age, where under 20 years HIV patients had 1.0%, those between 20 and 29 years had 29.9%, lastly those who were 30-39 years had 41.5% prevalence of hypertension (Kalyesubula et, al. 2016). A recent study at Zimbabwe Kadoma City presented a 62% of females living with HIV and hypertension, compared to only 38% male counterparts. Again women had higher HIV-hypertension comorbidity prevalence than men for both the hospital discharge and national mortality data sets, 59.7% and 60.2% respectively (Henriques-Forshythe et, al. 2015). According to the National Hospital Discharge Survey, there are differentials of HIV-hypertension comorbidity among different population groups, this is shown by a white population having the least prevalence at 5.8%, while African Americans had the highest of about 54.2% prevalence of this condition (Henreriques-Forshythe et, al. 2015).

Behavioural and other biological determinants

Other behavioural and biological factors like body mass index (BMI), excessive alcohol consumption, tobacco use, diet, genetics and stigma also influence HIV-hypertension

comorbidity (Nyirenda, 2016). A study done in Baltimore, Maryland has shown that approximately 60% of youth and adults (15-44 years) behaved recklessly and were at high risks of HIV/AIDS and most of them had prehypertension to stage 2 hypertension, therefore they are more likely to develop HIV-hypertension comorbidities (Nam et, al., 2015).

Poverty is one of the fatal exposures to undernutrition, because people do not afford food. People suffering from malnutrition or undernutrition have a phenotype that helps them to survive in a nutrient-poor environment, but substantially increase the risks of cardio-metabolic diseases in times of abundant nutrients (Nyirenda, 2016). Then, since, a number of studies have shown a strong association between HIV/AIDS and poverty, this can exacerbate HIV-hypertension comorbidity especially among poor and unemployed youth in South Africa (Currie et. al, 2012; Goon et, al. 2013; HSRC, 2012; Prettner & Canning, 2012). Stigma on HIV/AIDS among Africans is relatively high and a larger body size is perceived as a sign of affluence and good living, it is deemed as a status symbol conferring respect, influence, and good health and attractive in most rural communities. Similarly, weight loss is associated with HIV/AIDS infection, then being overweight is deemed as the sign the absence of the disease and good health (Nyirenda, 2016). These myths seems to influence the prevalence of HIV-hypertension comorbidity.

Although most studies found a high prevalence of HIV-hypertension comorbidity, there is another study conducted in rural Kwa-Zulu Natal which shows reduced odds of hypertension among PLHIV compared to hypertension among HIV uninfected population, that is 19.5% prevalence of hypertension among PLHIV compared to 27.9% hypertension among HIV uninfected individuals aged 15-50 years (Malaza et,al. 2012).

2.2 Theoretical Framework

The study will build on two models, an epidemiological transition theory (ETT) to explain the progression of HIV and hypertension to eventually result in HIV-hypertension comorbidity. While, the commission of social determinants of health (CSDH) framework by World Health Organization (WHO) is used to assess the role of social determinants on this comorbidity among youth in South Africa.

2.2.1 Epidemiological transition theory

The Epidemiological Transition Theory (ETT) by Omran (1971) explains the complex change of health and disease pattern from predominant infectious diseases to man-made or non-infectious diseases as changes occur in demographic, economic and sociological spheres.

This theory explains the evolution of diseases and the improvement of population health in three stages, being parallel to socio-economic developments, which leads to demographic changes.

Stage one: Age of pestilence and famine, this is a pre-modern era which represents of health and disease to be determined by epidemics, particularly those of infectious diseases, famines and wars. Most of the deaths were attributed to infectious diseases, malnutrition and maternity complications, high infectious mortality rates and relatively low life expectancies.

Stage two: Age of Receding Pandemics, morbidity and mortality rates attributed to infectious disease declines and larger segments of the population survive childhood, because of the advancements in technology and improvements in social services, however, because of prolonged life-expectancies and aging, the degenerative (non-infectious) diseases emerges.

Stage three: Age of Degenerative and Man-Made Diseases, this is an era where infectious diseases are relatively low, and there is a rapid acceleration of degenerative or non-infectious diseases. These diseases are mainly because of the lifestyle behaviours.

Mortality data before 1994 is relatively scarce, however the available materials show that ETT pattern has been changing, causing a decline in the overall mortality. This trend was reversed after the emergence of HIV/AIDS epidemic which increased overall mortality from mid-1990s to mid-2000s (Kabudula et, al. 2014; Herbst et, al. 2009). However, the introduction of antiretroviral treatment reduced AIDS-related mortality, while increasing life expectancy and the survival of PLHIV (Herbst et, al. 2009). At the same time, social and economic development over the past few decades introduced lifestyle practices that expose South Africans to a variety of risk factors for NCDs. Hence, the cause of death profile and health reports of South Africans shows increasing burden (Hall et, al., 2011; Herbst et, al. 2009; Kabudula et, al. 2014; Sharp & Hahn, 2011; Volderding, 2008). Therefore, this means that people have better survival and longer life expectancies, but because of their lifestyles which are influenced by modernization, the incidence of NCDs is rapid (Medina-Torne et, al., 2012; Njelekela et, al., 2016; Rodriguez-Arboli et, al., 2017; Salter et, al., 2011; Torre et, al., 2004).

An early onset of non-infectious diseases, with predominantly high prevalence of HIV among younger people, lead to conclusions that South Africa is at an age of ETT where infectious diseases and man-made diseases join as shown in the diagram below, thus resulting in infectious and NCDs comorbidities such as HIV-hypertension in this case (Beaglehole et.al, 2011; Kabudula et, al. 2017).

Although, this theory explains the transition in the disease profile over an extended period of time, this study only provides a snapshot of how diseases can transition from one group of diseases to the other over a certain period using only two diseases – HIV and Hypertension. However, this theoretical framework does not necessarily imply that only HIV and hypertension can merge to create synergy over the transition, but it shows that these selected diseases represents their "disease groups" that is NCDs and infectious diseases to shows how these diseases can ultimately be prevalent at the same period. Thus, this theory is particularly relevant to this study.

2.2.2 Social Determinants of Health

Using the Commission on the Social Determinants of Health (CSDH) framework by WHO, we will assess the physical, social and emotional factors associated with HIV-hypertension comorbidity among youth in South Africa (CSDH, 2015; Wilkinson & Marmot, 2003).
HIV-hypertension comorbidity is caused by a number of behavioral factors, such as smoking, diet, alcohol consumption and physical exercise as mentioned in the literature review. These are certainly important determinants of health. In addition, these risks affects different socio-economic classes differently, hence they are the main determinants of health inequalities. For example, tobacco smoking is generally more prevalent among lower socioeconomic groups; however, in other regions, smoking rates are higher among population groups with higher household income, and in particular among women (Sachs, 2012). Other risks such as poor diet, alcohol consumption and physical activities seems not to be consistent and their contribution to health inequalities are not clear. This shows how social factors contributes to health of the population. Social determinants of health operate at every level of development—early childhood, childhood, adolescence and adulthood—both to immediately influence health and to provide the basis for health or illness later in life (CSDH, 2015).

2.3 Conceptual Framework

This study will be guided by the literature review, ETT and CSDH as described above. Therefore, the graph below demonstrate these two relate to result in HIV-hypertension comorbidity.

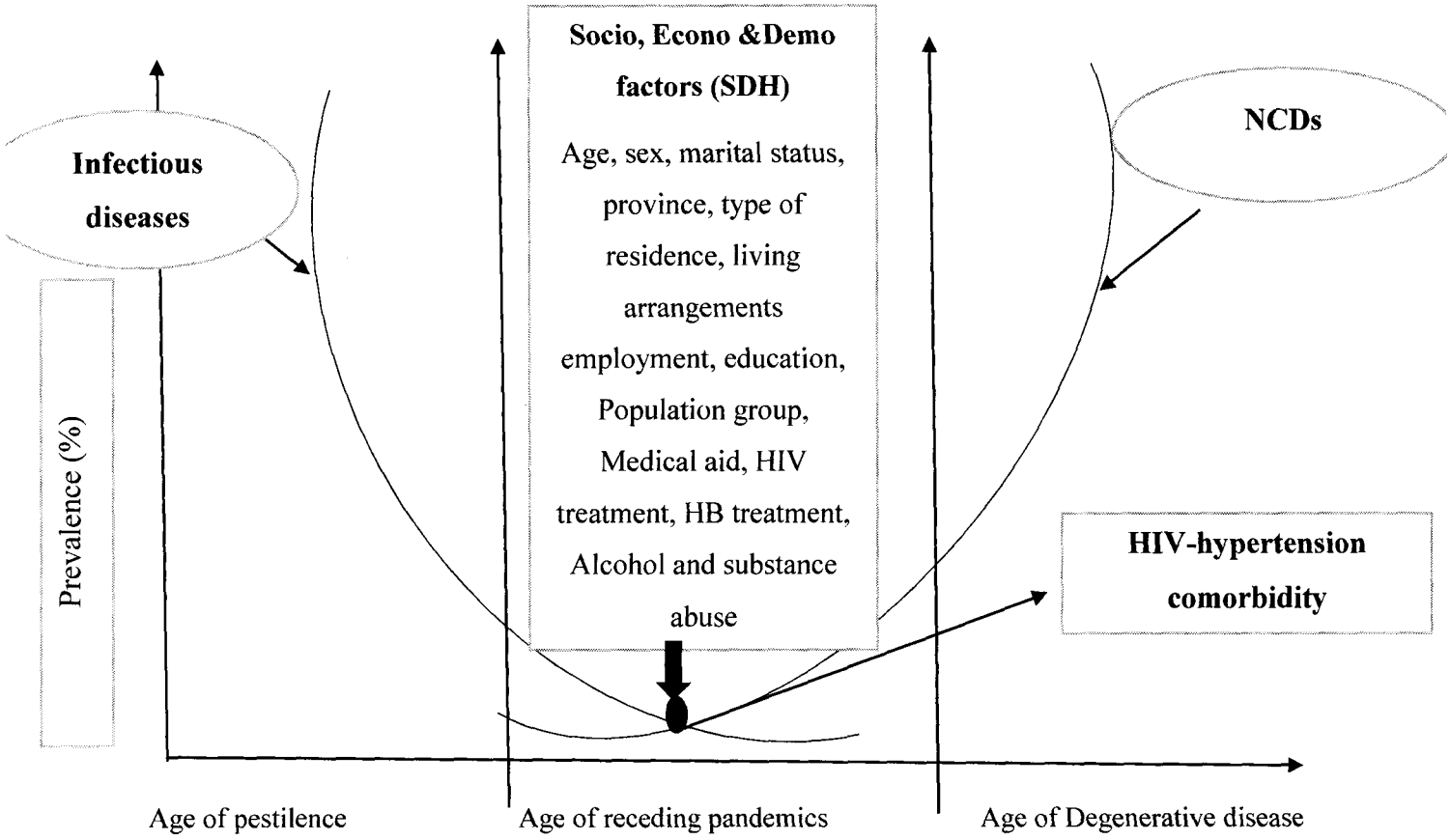


Figure 2.1: Conceptual framework adapted from Omran (1971) Epidemiological transformation Theory and Commission of Social Determinants of Health Conceptual framework

2.4 Hypothesis

Assessing from the conceptual framework above the following hypotheses will be tested:

- *H0 (Null):* The demographic and socioeconomic determinants are not associated with the prevalence of HIV-hypertension comorbidity among youth in South Africa.
- *H1 (Alternative):* The demographic and socioeconomic determinants are associated with the prevalence of HIV-hypertension comorbidity among youth in South Africa.
  Significance level: $\alpha=0.05$

Chapter Three

3. Research Methodology

3.1 Introduction

This chapter aims to outline the methodology of this study. It discusses the study design, source of data, study population, variables used as well as the statistical plan which responds to objectives of this study.

3.2 Data Source

This study uses General Household Surveys (GHS) 2010-2016 data. GHS is a cross-sectional survey which is collected annually by Statistics South Africa (Statistics South Africa, 2016). It is specifically designed to measure the demographic and socioeconomic characteristics, health and household access to services across all nine provinces of South Africa, which is inclusive of all South Africans, of all population groups, all age groups and both sexes. These datasets are therefore selected because they are the most recent and relevant data available for this study and to ensure a national representation of youth. The national coverage is guaranteed in this data, because the lowest level of geographic aggregation is provinces. Moreover, the data also included four settlement types - urban-formal, urban-informal, rural-formal (commercial farms) and rural-informal (tribal areas) within provinces (Statistics South Africa, 2016).

3.3 Study design

This research adapted a quantitative research design approach using cross-sectional survey data collected through face-to-face interviews with GHS questionnaires. These seven consecutive household surveys are part of the GHS series of data undertaken by Statistics South Africa yearly since 2002.

The sample design used for general household surveys employed a master sample (MS) which was initially designed for the Quarterly Labour Force Survey (QLFS) and was first used for GHS in 2008.

This sample used a two-stage, stratified design with probability-proportional-to-size (PPS) sampling of primary sampling units (PSUs) from within strata, and systematic sampling of

dwelling units (DUs) from the sampled PSUs. It was self-weighting design at provincial level and the stratification was done in two levels. Firstly, there was primary stratification defined by metropolitan and non-metropolitan geographic area type. Then, in the secondary stratification, Census 2001 enumeration areas (EAs) were used to form the basis of PSU. The following are the variables which were used for secondary stratification; household size, education, occupancy status, gender, industry as well as income.

Strata were drawn for PSUs using a randomized-probability-proportional-to-size (RPPS) systematic sample of PSUs, with the measure of size being the number of households in the PSU. Approximately 3 080 PSUs were selected each year for GHS, from which a systematic sample of dwelling units (DUs) was drawn. Every PSU had a different number DUs, depending on the Inverse Sampling Ratios (ISR) of each PSU (Statistics South Africa, GHS-2016)

3.4 Study Population and Sample

Target population of this study are youth living with HIV (15-24 years) in South Africa. However, although the National Youth Policy (NYP) 2020 defines youth as young people between (15-34 years), this study defines youth in alignment with WHO and United Nations (UN) definition of youth as all young males and females between the ages 15-24 years (NYD, 2016; UNDESA(2016), UNFPA(2016)). Therefore, this study focus on young males and females of all population groups and geographic areas in South Africa. Furthermore, the study restricts the analysis to only young people who have reported being HIV positive in GHS 2010-2016, at the time of the respective GHS interviews.

Since the focus of this research is to study the prevalence and predictors of HIV-hypertension comorbidity, the only relevant way to do so with the available data, is to use HIV/AIDS variable which asked a question "Have you been informed by a medical practitioner or nurse that you suffer from HIV/AIDS?" which was answered as "Yes", or "No" and use only HIV-infected individuals. A sample of 25 165 young people aged 15-24 years, between 2010 and 2016 have reported to be HIV positive or rather to have been informed by the medical practitioner or a nurse that they suffer from HIV/AIDS.

3.5 Variables and definitions

3.5.1 Dependent variable

The main dependent variable of this study is HIV-hypertension comorbidity, which is influenced by the socio-demographic as well as socio-economic predictors. Since this variable is not asked in the questionnaires, a new variable is created; that is "HIV-hypertension comorbidity" by coding respondents who suffer from both HIV positive and hypertension to be recorded as patients suffering from HIV-hypertension comorbidity. If the respondent has HIV only, does not suffer from the outcome variable "HIV-hypertension comorbidity" as seen in Table 3.1 below.

Therefore, variable HIV-hypertension comorbidity, is operationalized as a binary variable with "0" No comorbidity/HIV only and "1" HIV-hypertension comorbidity as seen in Table 3.1 below.

Table 3.1. Description of an outcome variable

Dependent Variable	
Variable	**Description**
HIV-Hypertension comorbidity	0 = No comorbidity/ HIV only 1 = HIV-hypertension comorbidity

3.5.2 Independent variables

Table 3.2 shows the demographic and socio-economic variables selected as controls in this study. These characteristics are as defined below.

Demographic information on the sex, age, population group, marital status, province of residence, type of place of residence and the living arrangements of the participants is of vital use in this study, in order to understand how these demographic factors which affects HIV-hypertension comorbidity among youth in South Africa. They are used as explanatory categorical variables, which assists in understanding the differentials among these key demographic factors and identifying focus areas for interventions. They are used as they appear in the original dataset, however age groups are restricted to the study population (15-24 years) resulting in only two 5-year age group categories; 1 "15-19 years" and 2 "20-24 years". Since this study includes both males and females, sex variable was used as it appears from the original

data source and operationalised as 1 "Males" and 2 "Females". These variables enabled us to draw the study population and sample of this study.

In order to indicate the type of domestic relationship that the respondent is in, a "marital status" variable is used with responses of the participants being recorded as 1 "single", 2 "married", 3 "cohabiting" and 4 "divorced". Racial/ population group variable is also included as it helps the study to document the racial differentials of HIV-hypertension comorbidity among youth found in our diversified South Africa and it is operationalized as 1 "Black", 2 "Coloureds", 3 "Whites", 4 "Indians/Asians". A variable "province of residence" explains the nine provinces youth who participated in the surveys originate from in South Africa as it will be shown in Table 3.2. Then variable "type of place of residence" is derived from a four category variable which was operationalized as 1 "urban", 2 "urban informal", 3 "tribal areas" and 4 "rural formal" which is transformed to only 1 "urban" or 2 "rural" by combining categories (1;2) to be 1 "urban" and (3;4) to be 2 "rural". As shown in the table below, there is a variable that gives information on the living arrangements of the participants, whether they are living with parents or living on their own/ by themselves. This "living arrangements" variable is created from "head of the household" variable from the original survey. It is now narrowed to only two categorised as 1 "head of the household/ living alone" or 2 "living with parents'.

On socio-economic status information, this study used "highest educational level" variable to indicate the level of education obtained by youth who participated in GHS 2010- 2016 by the time of the survey. Participants' highest level of education attained variable is categorised into 0 "No education", 1 "Primary", 2 "Secondary" and 3 "Tertiary education". A variable "employment status" also reveals the socio-economic status of youth on the study, whether the participant is 1 "employed" or 2 "unemployed" at the time of the survey as it is used in the original dataset 1 "employed" and 2 "unemployed".

On health, variables like "Medical aid scheme", "HIV treatment" and "hypertension treatment" are used to shed some light on the accessibility of health care services among youth. Medical aid scheme, hypertension/high blood pressure medication and HIV treatment are operationalised as 1 "Yes" or 2 "No", these three variables are proxies to measure access to health care services. There are also other health indicators such as variable "alcohol and substance use" which is used to explain the risky behavior by youth participated and the variable "pregnancy" used to account for pregnancy related hypertension such as preeclampsia among youth.Variables "alcohol and substance abuse" and pregnancy are also operationalized as 1 "Yes", or 2 "No". All these information is presented in Table 3.2 below.

Table 3.2 Description of the explanatory variables

Independent Variables	
Variables	**Description**
Sex	1=Males 2=Females
Age group	1=15-19 years 2=20-24 years
Population group	1=Africans/Blacks 2=Coloureds 3=Whites 4=Indians/Asians
Marital status *(recoded)*	1=Single 2=Married 3=Cohabiting 4=Divorced
Province of residence	1=Western Cape 2=Eastern Cape 3=Northern Cape 4=Free-State 5=Kwa Zulu Natal 6=North West 7=Gauteng 8=Mpumalanga 9=Limpopo
Type of place of residence	1= Urban 2= Rural
Living arrangements	1=Head of the household/ Living on their own 2=Living with parents
Highest educational level *(recoded)*	1=No education 2=Primary education 3=Secondary education 4=Tertiary education
Employment Status	1=Employed 2=Unemployed
Medical aid scheme	1=Yes 2=No
HIV treatment	1=Yes 2=No
Hypertension treatment	1=Yes 2=No
Alcohol and Substance abuse	1=Yes 2=No
Pregnancy (females only)	1=Yes 2=No

3.6 Ethical Considerations

Since this study is a secondary analysis of pre-existing data from Statistics South Africa which is available to the public and it includes no personal information or names of the respondents

in the sample, thus anonymity is guaranteed. Therefore, there is no need for any ethical clearance at this point.

3.7 Data Management

The South African General Household Survey from 2010-2016 data was downloaded from the Statistics South Africa website. The data is presented in STATA format and STATA software version 13 is used for the analysis. Seven sets of data are pooled together to combine youth who participated in the GHS from the 2010 to 2016 in one dataset.

3.8 Data Analysis

Statistical Analysis plan:

Analysis is done at the univariate, bivariate and multivariate level to achieve the objectives of determining the prevalence and predictors of HIV-hypertension comorbidity among youth in South Africa.

Objective 1 - To determine the prevalence of HIV-hypertension comorbidity among youth in South Africa.

At univariate level of analysis, the sample is described in terms of demographic and socio-economic characteristics using a series of descriptive tables and graphs.

In order to meet this objective, the graphs are used to describe HIV-hypertension comorbidity on the general sample, then further stratified by sex.

Then since this is a prevalence study, the prevalence of HIV-hypertension comorbidity is determined using the following formula:

$$Prevalence = (number\ of\ HIV\text{-}hypertension\ cases\ /total\ youth\ population\ size) * 1000$$

Objective 2 -To assess the association between demographic and socioeconomic characteristics and HIV-hypertension comorbidity of youth in South Africa. This objective is obtained at the bivariate level and multivariate levels.

In order to meet this objective the following statistical test methods is used:

Examining the relationships and association between each of the independent variables and the dependent variable. The significance and the strength of the relationship between variables under evaluation needs to be assessed. In this instance, Chi-square and the p-values are used to

determine the strength of association. Each of the independent variables is statistically analyzed against the dependent variable in cross tabulations format to generate the frequency tables and percentage distribution (Shumate & Palazzolo, 2010).

Pearson Chi- squared (X^2) test is therefore used to evaluate and assess the significance of association, since all the selected demographic and socio-economic characteristics are categorical and the outcome variable "HIV-hypertension comorbidity" is also categorical. The equation used for the Pearson Chi-square test is shown below:-

$$X^2 = \sum_{i=1}^{i} \frac{(Oij - Eij)^2}{Eij}$$

The associations were determined at 95% confidence interval and a 5% level of significance whereby variables which produced a p-value of less than 0.05 in the chi-square test were estimated to have a significant relationship with HIV-hypertension comorbidity. The bigger the p-value is from 0.05 the weaker the relationship between the predictor and the response variables.

The multivariate analysis refers to a broad category of methods used when multiple response variables are measured on a set of experimental units or sampling objects (Hennekens and Buring, 1987; Hosmer & Lemeshow, 2000). This is accessing the relationship between explanatory variables and outcome variable of interest, fitting all explanatory variables at once in one statistical model with the outcome variable.

In this level of the analysis of this study, there is a further testing and investigation of the statistical relationships between independent variables with the dependent variable applying binary logistic regression for at the multivariate level.

Estimating the probability of a dependent variable HIV-hypertension comorbidity - "0" No comorbidity, "1" HIV-hypertension comorbidity based on all independent variables to give the probability of how independent variables affect the outcome variables.

Binary logistic regression assumes that the outcome variable is dichotomous, the conditional mean is between 0 and 1; $0 < P < 1$, the error follows a binomial distribution, there is no highest degree of collinearity among explanatory variables with each other and there is no alternative outcome variables included as an explanatory variable. For the multichotomous explanatory variables, one category is set as a reference, most preferably the one with the lowest risk of the outcome. Lastly, goodness-of-fit will be established to check the extent to which the fitted model is able to predict the outcome (Hosmer & Lemeshow, 2000).

Binary logistic regression basically estimates the probability that dependent variable will occur given the values of explanatory variables, using this equation:

$$Logit\ (p_i) = log\ (p_i/(1-p_i) = b_0 + b_1x_1 + b_2x_2 + ...b_px_p$$

(Hosmer & Lemeshow, 2000)

That is: The log of odds equals the log of probability of the outcome to occur over the probability of the outcome's non-occurrence.

In this study the multivariate analysis is most applicable since the dependent variable or outcome of interest (HIV-hypertension comorbidity) had binary outcomes regardless of the nature of the predictor variables, whether they are continuous, binary or categorical.

All the demographic and socioeconomic variables will be included in the logistic regression model to establish the chances of HIV-hypertension comorbidity to occur using binary logistic regression under various measurements/ categories of predictor variables for example, under "highest educational level", measurement predictors were, "No education", "Primary education", "secondary education" and "tertiary education". The starting point is the demographic factors, followed by the socio-economic factors then finally one behavioral factor were part of the model to assess the occurrence of HIV-hypertension comorbidity among youth in South Africa when other explanatory variables are fixed. At the end of the modelling process, the best model or best combination of variables that better predict the HIV-hypertension comorbidity will be established.

The fit of the model will be examined using the model 'goodness of fit' and the limited difference between the expected and observed values will be a sign of goodness of fit. Odds ratios will be used to interpret the results. Odds ratio is defined statistically as the probability of a case divided by the probability of a non-case, in simple terms the odds is the ratio of the probability that the event of interest occurs to the probability that it does not (Bland, 2000). In this study, odds ratio is the likelihood of having HIV-hypertension comorbidity denoted as "1" compared to not having HIV-hypertension comorbidity denoted as "0". The greater the odds ratios are from one, the greater the likelihood of the HIV-hypertension comorbidity. In the model the reference category of the outcome variable is the measurement of no/less chances an individual may be caused by non-communicable diseases coded as "0".

3.9 Limitations of the study

This study however has few limitations. Firstly, it is a cross-sectional study where association is observed, but we cannot establish causality, since there is no temporality effect. Difficult to determine whether the outcome followed exposure in time or exposure resulted from the outcome, whether the explanatory variables came before HIV-hypertension comorbidity or after (Bland, 2000 & Sexton, 2000).

Secondly, the data we are using is a self-reported information, which may be influenced by social desirability leading to information bias, number of reported HIV cases might be affected by the fact that GHS is a self-reported data, therefore this brings social desirability aspect as an objection to real picture of HIV infected individuals in these 7 years (Sexton et, al. 2000).

Thirdly, the GHS questionnaire is responded by only one family member, most particularly the head of the households, so this leads to measurement and information bias since that one respondent might not know all necessary information about everyone in the household.

Fourthly, this study is also very limited in terms of factors such as Body Mass Index (BMI), physical activity and diet variables, which could have made it easier to attribute the increased fats (overweight/obesity) among young people in the study to contribute to high blood pressure among young people with HIV. There are other behavioural variables like alcohol consumption and smoking habits which might have helped in understanding HIV-hypertension comorbidity better, but our data source does not include them, also HIV treatment variables is not available for GHS 2016, therefore the assumption was that everyone with HIV was on treatment for analysis purpose (Bland 2000 & Solem, 2015).

Lastly, the GHS data was not doing justice to determining the accurate HIV-hypertension comorbidity, this study needed a more accurate data such as DHS. However, the available DHS data is long outdated and the most recently conducted has not being released as yet.

Chapter Four

4. Results

4.1 The characteristics of young people who reported HIV positive in South Africa GHS, 2010 -2016.

This section present results of this study at three levels of analysis as indicated in the methods section; univariate, bivariate and multivariate analysis. Figure 4.1 shows the trends of HIV and HIV-hypertension comorbidity over seven years among youth in South Africa in percentagesusing GHS 2010 – 2016.

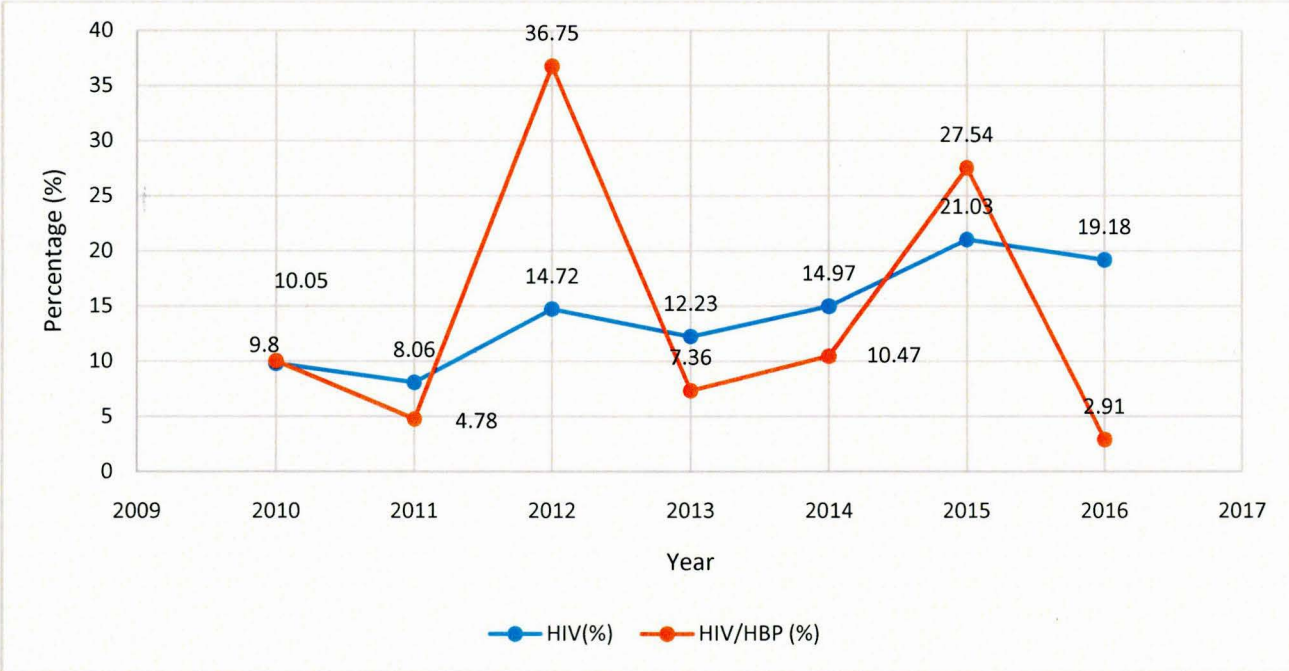


Figure 4.1 Trends of HIV and HIV-hypertension comorbidity over 2010-2016 period among youth in South Africa using GHS 2010-2016.

The patterns of HIV and HIV/hypertension comorbidity has been fluctuating over the years as shown in Figure 4.1 above. It shows that the percentage of youth with HIV was 9.8% in the year 2010, then decreased to 8.06% in 2011. It further rose to 14.72% in the year 2012. In 2013 it came back to 12.23% then went back to 14.97%. The percentage of youth with HIV reached its peak in 2015 with more than 20% of youth with HIV in South Africa, however these percentages declined to 19.18% in the year 2016.

Likewise, HIV/hypertension comorbidity has also been fluctuating during this period as shown in Figure 4.1 above. In the year 2010, about 10% of young people in South Africa had

HIV/hypertension comorbidity, which drastically declined to 4.78% in 2011. This HIV/hypertension comorbidity among youth in South Africa reached its peak in 2012, with more than 36.75% of young people having HIV/hypertension comorbidity. The percentages of HIV/hypertension comorbidity decreased to 7.36% in 2013 and gradually increased from 14.97% in 2014 and further increased to 27.54% in 2015. However, only 2.91% of young people had HIV/hypertension comorbidity in South Africa.

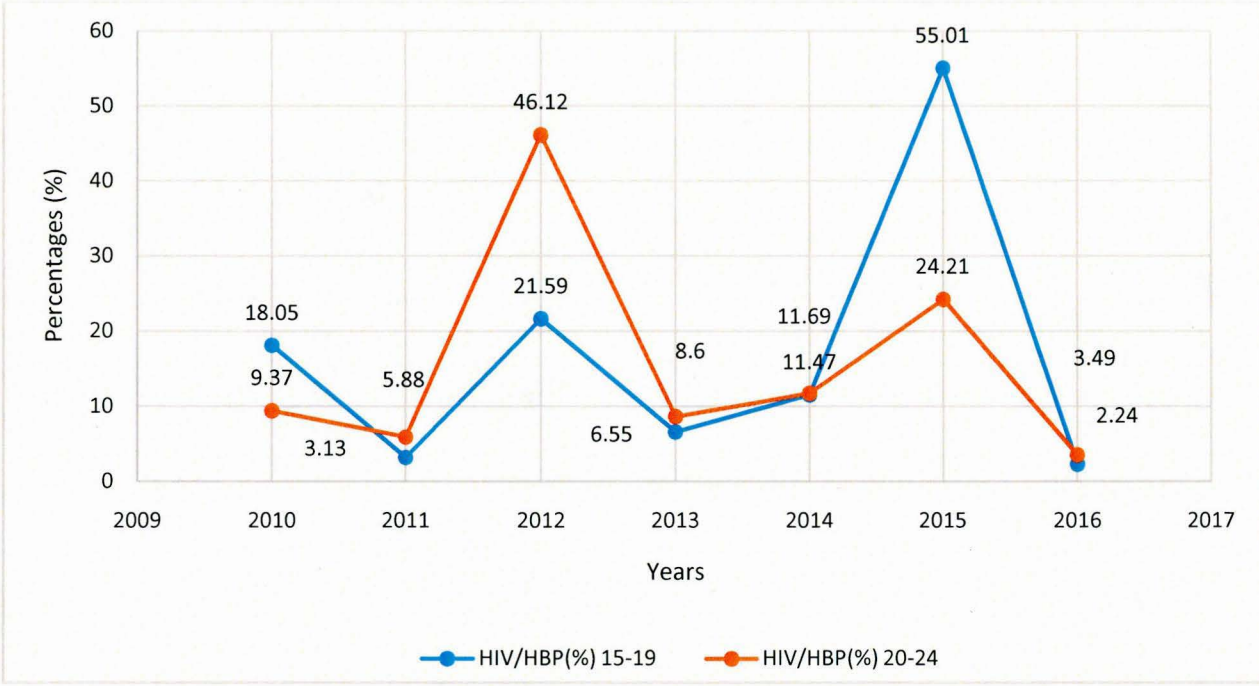


Figure 4.2 Trends of HIV-hypertension comorbidity over 2010-2016 period among youth as stratified by the age groups in South Africa using GHS 2010-2016.

The above Figure 4.2 shows the trend of HIV-hypertension comorbidity evolution over the period of 7 years among two distinct age groups. In 2010, almost 20% of young people between 15 and 19 years HIV-hypertension comorbidity, this is higher than the cases of HIV-hypertension comorbidity that was found among those who were between 20 and 24 years in the same year. The level of HIV-hypertension comorbidity among youth aged 15-19 years declined drastically in 2011 to level below 5%, then went20% in 2012. It then declined to around 8% in the same age group in 2013 and increased to 10%. The HIV/hypertension comorbidity hit its peak in 2015 among young people aged 15-19 years then drastically fell to less than 5% in 2016.

Among those who were 20 to 24 years, HIV/hypertension levels also show similar fluctuating trend as the one for youth aged 15-19 years. However, in 2010 HIV/hypertension comorbidity levels among young people aged 20-24 years was slightly lower with only 10% of youth with HIV/hypertension comorbidity than that of those who were 15-19 years. It

declined to less than 5% in 2011 then shot to its highest level among youth 20-24 years in these period with 46%in 2012.Then it declined to 8% in 2013 and it constantly increased to 10% in 2014. In 2015 HIV/hypertension comorbidity among youth aged 20-24 years was around 22% then it declined to less than 5%. Therefore, Figure 4.2 shows that the overall levels of HIV/hypertension comorbidity are generally low among youth aged 20-24 years than those among youth aged 15 to 19 years.

Figure 4.3belowrepresents univariate analysis of HIV and HIV-hypertension comorbidity among youth (15-24 years) who participated in answering the questionnaires during the surveysusing 2010-2016 GHS data.

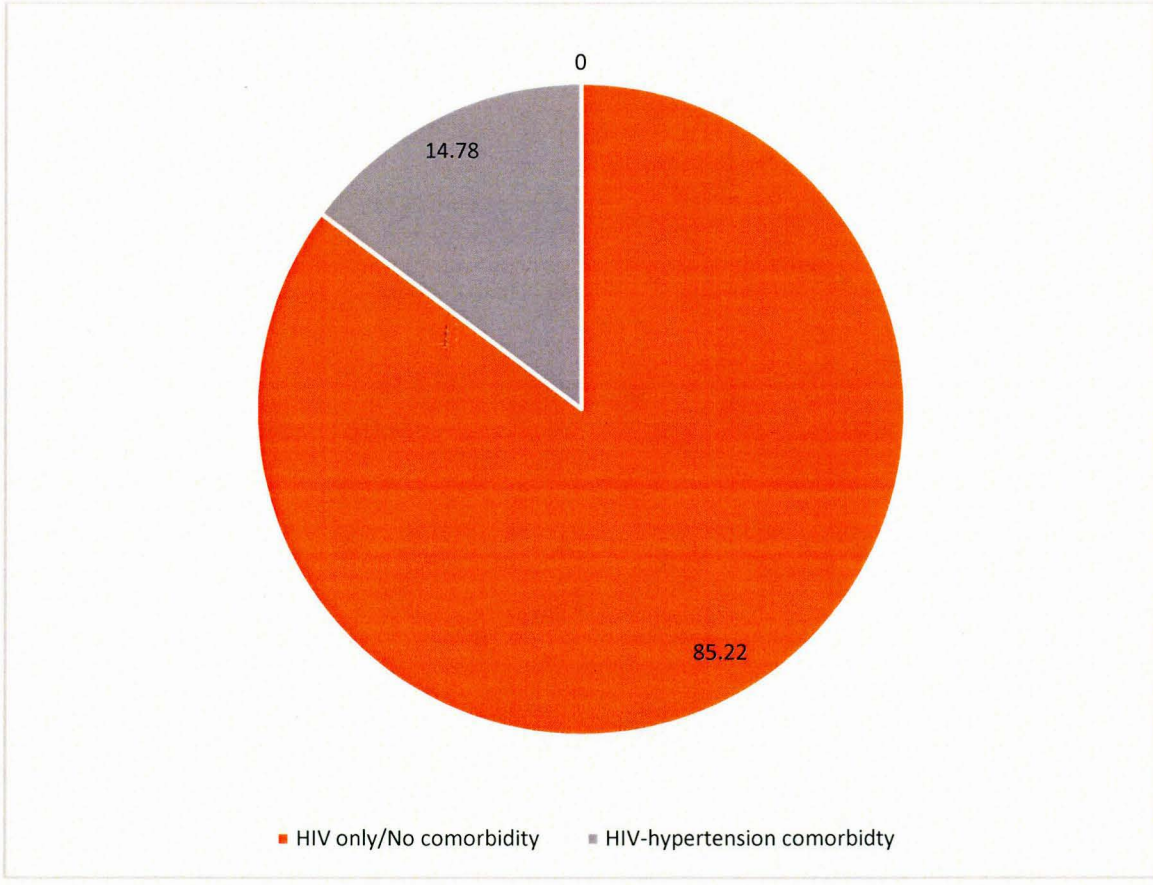


Figure 4.3The percentage (%) distribution of young people with HIV only and HIV-hypertension comorbidity

The above Figure 4.3 shows the distribution of young people with HIV only and those with HIV-hypertension comorbidity. Of the 25 165in the study, 85.22% were of young people aged 15-24 years with HIV only and about 14.78% young people with HIV-hypertension comorbidity between 2010 and 2016 in South Africa.

Additionally, Figure 4.4presents the percentage distribution of HIV-hypertension comorbidity among youth as stratified by sex of the participants as shown below. This figure shows that 91.36 % of young females aged 15-24 years have HIV only, this is higher compared to their male counterparts with 83.98% of HIV only. However, about 16.02% of young males aged 15-24 years have HIV only whereas only 8.64% of females aged 15-24 years have HIV-hypertension comorbidity as shown below.

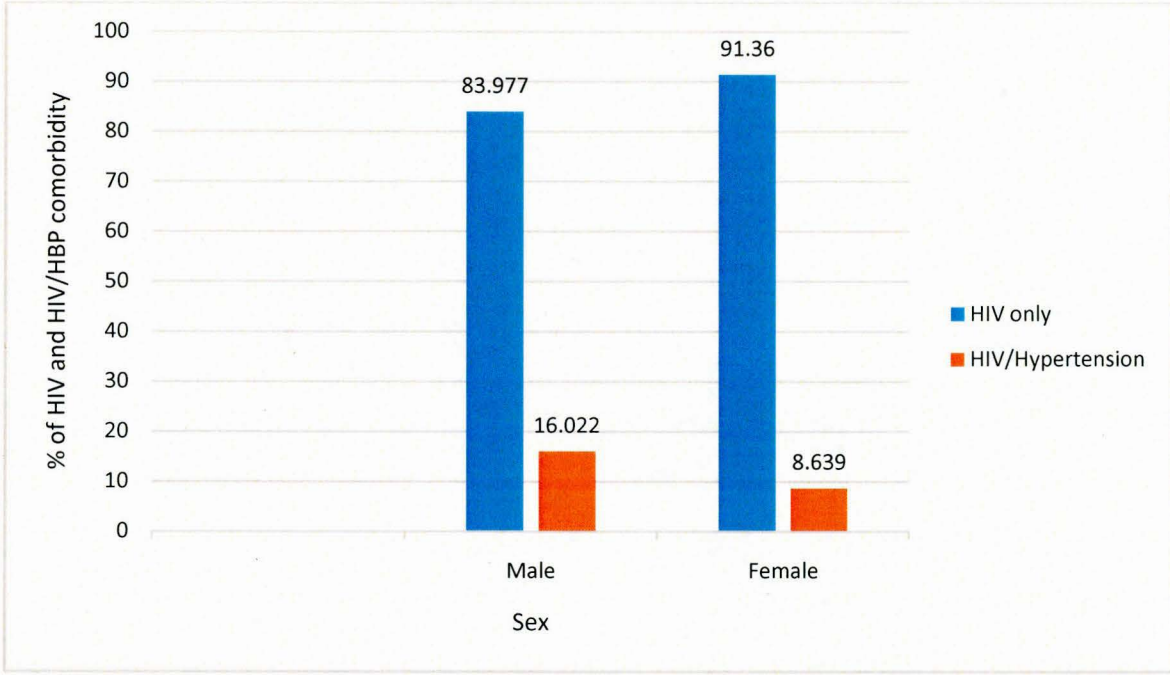


Figure 4.4The percentage distribution of HIV and HIV-hypertension among youth stratified by sex

Table 4.1 HIV-hypertension comorbidity according to background characteristics of young people (15-24 years) who reported HIV positive in South Africa GHS, 2010-2016.

Independent Variables			
Variables	**HIV only - n (%)**	**HIV-hypertension - n (%)**	**Chi-square (P-values)**
Sex			
Males	5 278 (83.98)	1 007 (16.02)	X^2= *7.89*
Females	17 250 (91.49)	1 631 (8.64)	*P-value = 0.005*
Total	21 446 (85.22)	3 719 (14.78)	
Age groups			
15-19 years	8 818 (90.71)	903 (9.29)	X^2=*0.70*
20-24 years	13 754 (88.76)	1 690 (11.24)	*P-value= 0.404*
Total	21 446 (85.22)	3 719 (14.78)	
Population groups			
Africans/Blacks	19 059 (92.71)	1 498 (7.29)	X^2= *12.45*
Coloureds	1 909 (90.81)	193 (9.18)	*P-value=0.002**
Indians/Asians	640 (84.01)	41 (15.99)	
Whites	608 (33.33)	1 217 (66.67)	
Total	21 446 (85.22)	3 719 (14.78)	
Marital status			
Single	19 669 (89.27)	2 305 (10.83)	X^2=*4.02*
Married	2 671 (90.59)	278 (9.41)	*P-value=0.259*
Cohabiting	151 (100.00)	0 (0.00)	
Divorced	47 (50.00)	47 (50.00)	
Total	21 446 (85.22)	3 719 (14.78)	
Province of residence			
Western Cape	1 560 (78.57)	426 (21.43)	X^2=*17.55*
Eastern Cape	3 019 (91.15)	293 (8.85)	*P-value=0.025**
Northern Cape	901 (90.32)	93 (9.38)	
Free-State	942 (94.74)	52 (5.26)	
Kwa Zulu Natal	5 444 (91.35)	515 (8.65)	
North West	2 006 (86.54)	312 (13.46)	
Gauteng	5 688 (81.08)	1 316 (18.92)	
Mpumalanga	1 561 (94.25)	95 (5.75)	
Limpopo	913 (91.89)	81 (8.11)	
Total	21 446 (85.22)	3 719 (14.78)	
Type of place of residence			
Urban	12 419(88.18)	1 673(11.82)	X^2= *1.28*
Rural	1 0108 (91.77)	907 (8.23)	*P-value = 0.264*
Total	21 446 (85.22)	3 719 (14.78)	
Living arrangements			
Head of the household	4 311 (89.21)	521 (10.79)	X^2= *0.02*
Living with parents	18 212 (89.57)	2 121 (10.43)	*P-value =0.900*
Total	21 446 (85.22)	3 719 (14.78)	
Highest educational level			
No education	555 (88.89)	69 (11.11)	
Primary education	5 797 (95.98)	243 (4.02)	
Secondary education	15 897 (88.76)	2 013(11.24)	X^2 = *40.72*
Tertiary education	277 (47.06)	312 (52.94)	*P-value = 0.000**
Total	21 446 (85.22)	3 719 (14.78)	
Employment Status			

Employed Unemployed ***Total***	2 519 (83.78) 19 679 (88.81) 21 446 (85.22)	488 (16.22) 2 479 (11.19) 3 719 (14.78)	***X^2 =1.58*** ***P-value = 0.209***
Medical aid scheme Yes No ***Total***	 972 (80.00) 21 555 (90.00) 21 446 (85.22)	 243 (20.00) 2 395 (10.00) 3 719 (14.78)	 ***X^2=5.97*** ***P-value= 0.059****
HIV treatment Yes No ***Total***	 21 223 (94.40) 1 810 (67.45) 21 446 (85.22)	 1 259 (5.60) 873 (32.55) 3 719 (14.78)	 ***X^2=0.10*** ***P-value= 0.752***
Alcohol and Substance abuse Yes No ***Total***	 1 741 (83.33) 22 353 (89.57) 21 446 (85.22)	 348 (16.67) 2 602(10.43) 2 593 (14.78)	 ***X^2=0.25*** ***P-value= 0.620***
Pregnancy (females only) Yes No ***Total***	 4 166 (94.49) 13 084 (90.41) 16 090 (85.22)	 243 (5.51) 1 388 (9.59) 2791(14.78)	 ***X^2= 2.05*** ***P-value= 0.152***

Table 4.1 shows that that 83.98% of males in this study were HIV only and 16.02% had HIV-hypertension comorbidity. Among females 91.49% had HIV only while 8.64% had HIV-hypertension comorbidity. Sex and HIV-hypertension comorbidity were statistically significant (p-value < 0.05 and X^2 =7.89).

In Table 4.1 again shows that 90.71% of young people aged 15-19 years had HIV only, while 9.29% had HIV-hypertension comorbidity in the same age group. At the same time among those who aged between 20-24 years, only 88.76% had HIV only while 11.24% had HIV-hypertension comorbidity in the same group. Age and HIV-hypertension comorbidity are not statistically significant, as shown by p-value =0.404 and X^2=0.70.

About 92.71% young Black population in the study shows to have HIV only, while 10.83% of them had HIV-hypertension comorbidity. These were followed by 90.81% Coloured youth who had HIV only, while 9.41% of Coloured youth had HIV-hypertension comorbidity. The statistics shows 84.01% of HIV only, and 15.99% HI-hypertension comorbidity among Indians/Asians. Among white population, about 33.33% of youth had HIV only, whereas 66.67% of them had HIV-hypertension comorbidity. The Pearson chi-squared shows a statistically significance relationship between population groups and HIV-hypertension comorbidity (p-value=0.000; X^2= 12.45)

The above Table 4.1 shows no statistical significant relationship between marital status and HIV-hypertension comorbidity, p-value =0.445 (X^2=4.02), however about 89.27% of young people who were single had HIV only, while 10.48% had HIV-hypertension comorbidity. Among those who were married 90.59% had HIV only while 9.41% had HIV-hypertension comorbidity. All of those who were cohabiting, had HIV alone and there is no one who reported HIV-hypertension comorbidity. About 50% of those who were divorced reported to have only HIV, and another 50% had reported to have both HIV and hypertension, that is HIV-hypertension comorbidity.

The province of residence and HIV-hypertension comorbidity have a statistically significant association (p-value= 0.00; X^2=17.55). HIV among youth ranged from 78.57% in the Western Cape to 94.74% in Free State. While HIV-hypertension comorbidity was the highest among youth in Gauteng province at about 18.92% yet it was the lowest at Free State province. About 78.57% of young people from Western Cape had HIV only and 21.43% had HIV-hypertension comorbidity. In Free State, 94.74% youth had HIV only, while only 3.74% had HIV-hypertension comorbidity, this is a province with the least HIV-hypertension comorbidity among youth, while Gauteng is a province with the highest HIV-hypertension comorbidity compared to other provinces, about 79.81% of youth have HIV only and 14.74% had HIV-hypertension comorbidity.

The type of place of residence also have an association with HIV-hypertension comorbidity, about 88.18% young people from urban areas had HIV only, while 11.82% of them had HIV-hypertension comorbidity. Young people from rural areas had the highest HIV only cases, at 91.77% and only 8.23% HIV-hypertension comorbidity. The Table 4.1 above shows relationship between type of place of residence and HIV-hypertension to be statistically significant (p-value=0.015; X^2=1.28)

About 89.21% of young people who are head of their households or were living on their own had HIV only while only 10.79% had HIV-hypertension comorbidity. Among those who lived with parents, there was 89.57% and 10.43% young people with HIV only and HIV-hypertension comorbidity respectively. The association was however not statistically significant, p-value=0.900 and X^2= 0.02.

Among youth who had no education, 88.89% had HIV only, while 11.11% had HIV-hypertension comorbidity. Those who had primary education as their highest level of education, 95.98% had HIV only and 4.02% had HIV-hypertension comorbidity. Among young people with secondary education 88.76% had HIV alone and 11.24% had HIV and hypertension. Within young people with tertiary education, 47.06% had HIV only and most of them had HIV and hypertension, about 52.94% youth with tertiary education had HIV-hypertension comorbidity. This association as shown in Table 4.1 is statistically significant p-value <0.05, X^2=40.72.

About 83.78% of young people who were employed had HIV only, while among those who were employed, 16.22% had HIV-hypertension comorbidity. Within those who were unemployed, 88.81% had HIV along, whereas 11.19% had HIV and hypertension comorbidity. The relationship between employment status and HIV-hypertension is shown by Table 4.1 is statistically significant, p-value=0.005, X^2=1.58.

About 80% of youth who had medical aid schemes had HIV only, while 20% had HIV-hypertension comorbidity. Those who had no medical aid schemes were 90% who had HIV only and 10% who had HIV and hypertension comorbidity, p-value=0.015 and X^2=5.97.

Only 5.60% of youth who were on HIV treatment had HIV-hypertension comorbidity, while 94.40% had only HIV. Among those who were not on HIV treatment, 67.45% were HIV only and 32.55% had HIV-hypertension comorbidity. The relationship is statistically significant, with p-value=0.000 and X^2=0.10.

About 16.67% of youth who reported to abuse drugs and substance had HIV-hypertension comorbidity which is higher than 10.43% among those who did not report to abuse drugs and substance. However, most young people who did not report to the use of drugs and substance had higher HIV only cases than those who reported to abuse and use drugs and substance, with 83.33% for those who used drugs and substance and 89.57% who did not use drugs and substance. This relationship as shown by Table 4.1 is not statistically significant, p-value=0.186, X^2=0.25.

Among young women who reported to be pregnant, about 94.49% had HIV only, while 5.51% reported to have both HIV and hypertension that is HIV hypertension comorbidity and 90.41%

of people who reported not to be pregnant had HIV only, while 9.59% of them had both HIV and hypertension, HIV-hypertension comorbidity. This relationship is statistically significant p-value= 0.152 and X^2= 2.05.

4.2 The prevalence of HIV-hypertension among youth living with HIV in South Africa, 2010-2016.

This section continues with the univariate analysis, however this shows the prevalence of HIV and HIV-hypertension comorbidity.

Table 4.2 the prevalence of HIV-hypertension among youth with HIV in South Africa.

Variables	Prevalence of HIV/HBP per 1000
Sex	
Males	40.01
Females	64.81
Age groups	
15-19 years	35.88
20-24 years	67.16
Population groups	
Africans/Blacks	72.88
Coloureds	16.81
Indians/Asians	2.11
Whites	51.02
Marital status	
Single	91.60
Married	11.05
Cohabiting	0.00
Divorced	1.87
Type of place of residence	
Rural	66.48
Urban	36.24
Living arrangements	
Head of the household	20.70
Living with parents	84.28
Highest educational level	
No education	2.74
Primary education	9.66
Secondary education	79.99
Tertiary education	12.40
Medical aid scheme	
Yes	9.66
No	95.00
HIV treatment	
Yes	50.03
No	11.33
Alcohol and Substance abuse	
Yes	13.83
No	103.40

Pregnancy	
Yes	12.87
No	73.51
Total prevalence	103.04

HIV-Hypertension comorbidity prevalence

There are sex differentials in the prevalence of HIV-hypertension comorbidity as well, with females having higher HIV-hypertension comorbidity compared to their male counterparts, in a 1000 population, there are 64.81 females with HIV-hypertension comorbidity compared to only 40.01 males with HIV-hypertension comorbidity. As indicated earlier, HIV increases with age, among youth aged 20-24 years there are 67.16 young people per every 1000 HIV population with HIV-hypertension comorbidity compared to only 35.88 young people with HIV-hypertension comorbidity aged 15-19 years. Black African youth have the highest HIV-hypertension comorbidity with 72.88 people with HIV-hypertension comorbidity per 1000 youth population compared to other population groups. This is followed by white young people with 51.02 per 1000 youth population with HIV-hypertension comorbidity prevalence.

Coloureds have about 16.81 HIV-hypertension comorbidity prevalence per 1000 youth population. Asians/Indians have the least HIV-hypertension comorbidity prevalence, with only 2.11 youth people with HIV-hypertension comorbidity per 1000 youth population.

Rural areas have the lower HIV-hypertension comorbidity prevalence compared to urban areas, with only 36.24 young people in rural areas have HIV-hypertension comorbidity prevalence per 1000 youth population, whilst HIV-hypertension comorbidity among youth in urban areas have 66.48 per 1000 youth population.

Living arrangements also shows differentials of HIV-hypertension comorbidity prevalence among young people. Young people who reported to be head of the households had 20.70 HIV-hypertension comorbidity prevalence per 1000 HIV positive youth population. While young people who are staying their parents have the highest prevalence of HIV-hypertension comorbidity prevalence at about 84.28 per 1000 youth who reported to have HIV.

Highest level of education shows that the highest prevalence of HIV-hypertension comorbidity is among young people who have secondary education with 79.99 per 1000 youth population with HIV, this is followed by 12.40 per 1000 youth population HIV-hypertension comorbidity prevalence among youth with tertiary education. The prevalence of HIV-hypertension comorbidity among young people who had primary education is 9.66 per 1000 youth

population, then lastly the Table 4.2 above shows that young people who does not any form of education had the least HIV-hypertension comorbidity with 2.74 per 1000 youth population with HIV-hypertension comorbidity.

Those young people on medical aid schemes have the lowest prevalence of HIV-hypertension comorbidity (9.66 per 1000 youth population) compared to 95.00 per 1000 youth population of those who does not have medical aid scheme.
About 50.03 per 1000 young people who are on HIV treatment have HIV-hypertension comorbidity compared to 11.33 per 1000 youth population who are not on HIV treatment with HIV-hypertension comorbidity.

The prevalence of HIV-hypertension comorbidity was only 13.83 per 1000 youth population among young people who reported to use drugs and substance compared to HIV-hypertensions comorbidity prevalence of 103.40 per 1000 youth population who did not report to abuse drugs and substance. Among female youth who were pregnant HIV-hypertension comorbidity prevalence was relatively lower than the one among females who were not pregnant, with only 12.87 per 1000 youth population with HIV-hypertension comorbidity among those who pregnant females compared to 73.51 per 1000 youth population among female youth who are not pregnant with HIV hypertension comorbidity.

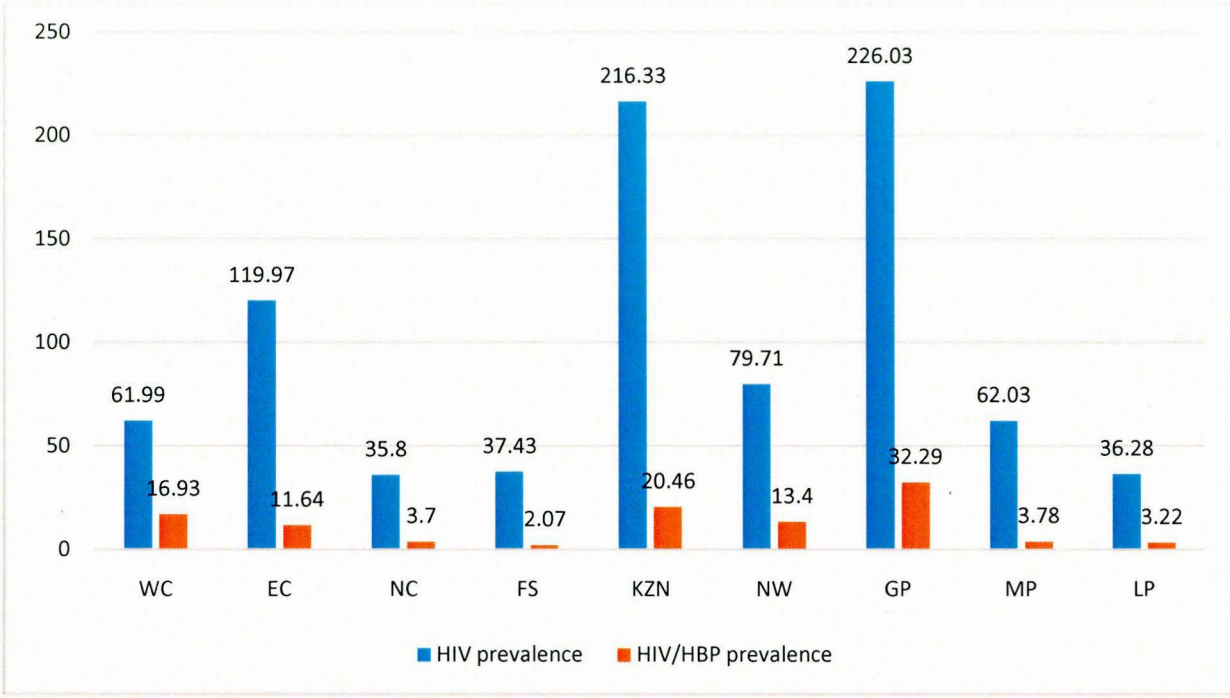


Figure 4.5 shows the differentials in HIV and HIV-hypertension comorbidity in different provinces.

[1]

The Figure 4.5 above is a presentation of HIV and HIV-hypertension comorbidity prevalence among youth in different provinces. It shows that GP has the highest HIV prevalence (226.03 per 1000 youth population)among youth aged 15-24 years in South Africa. This is followed by the HIV prevalence at KZN with 216.33 per 1000 youth population. NC and GP have the lowest HIV prevalence in South Africa, with NC having 35.8 per 1000 youth HIV prevalence and LP having 36 per 1000 youth with HIV.

GP and KZN are also the leading provinces with the prevalence of HIV-hypertension comorbidity, with 32.29 and 20.46 per 1000 youth population with the prevalence of HIV-hypertension comorbidity respectively. Another province with higher prevalence of HIV-hypertension comorbidity is WC, with 16.93 youth with HIV-hypertension comorbidity out of every 1000 youth population with HIV.

The provinces with the relatively low prevalence of HIV-hypertension comorbidity are NC, LP and FS. Youth from NC have 35.8 per 1000 youth population with HIV-hypertension comorbidity and those that are from LP have 36 per 1000 youth population HIV-hypertension

[1]WC - Western Cape; EC – Eastern Cape; NC – Northern Cape; FS – Free State; KZN – Kwa Zulu Natal; NW – North West; GP- Gauteng Province; MP – Mpumalanga Province; LP- Limpopo Province

comorbidity prevalence. Lastly, HIV-hypertension comorbidity among youth from FS was 37.43 per 1000 youth population.

As it is shown in Figure 4.5, the prevalence of HIV-hypertension comorbidity is different for all provinces.

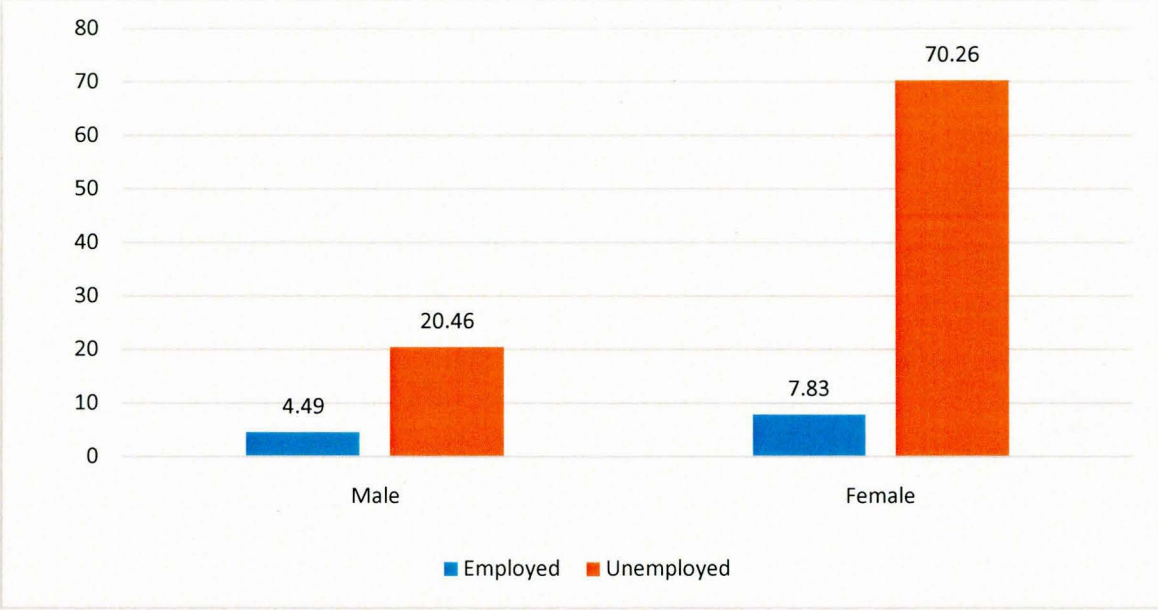


Figure 4.6 shows the differentials of the prevalence ofHIV-hypertension comorbidity among youth with different employment status.

The Figure 4.6 above shows that HIV-hypertension comorbidity is more prevalent among unemployed males and females at 20.46 and 70.26 per 1000 youth population with HIV, respectively. Again the prevalence of HIV-hypertension comorbidity is higher among young females who are employed than it is among young males who are employed. For employed females HIV-hypertension prevalence is 7.83 per 1000 youth population with HIV, while it is 4.49 per 1000 youth population with HIV.

4.3 Multivariate Analysis of the Association between demographic and socio-economic characteristics of youth in South Africa and HIV/hypertension comorbidity.

In this section, the focus will be in the strength of associations between the background characteristics of young people with HIV and their HIV/hypertension comorbidity status. In doing so, the best way to understand which variables have a significant relationship with HIV/hypertension comorbidity is by using a binary logistic regression model as the outcome variable ha two categories.

Table 4.3 Multivariate analysis (binary logistic regression) to show the strength of association between selected demographic and socio-economic characteristics of youth in South Africa and their HIV/hypertension status.

HIV/HBP comorbidity	Odds Ratio	P-Value	[95%-CI]
Sex			
Male (R.C)			
Female	0.78	0.000**	[1.3310 - 2.0611]
Age group			
15-19 years (R.C)			
20-24 years	1.94	0.000**	[1.0111 - 1.2201]
Population group			
Black (R.C)			
Coloured	0.17	0.005**	[0.7331 - 1.1261]
Indian/Asia	0.29	0.051	[1.0001 -2.0101]
White	1.78	0.013**	[3.0091 -3.3300]
Marital			
Single (R.C)			
Married	1.40	0.015*	[2.2811 - 3.3413]
Cohabiting	0.11	0.001**	[0.8885 - 1.0012]
Divorced	0.36	0.244	[1.0112 – 2.2102]
Province of residence			
Western Cape (R.C)			
Eastern Cape	0.95	0.810	[1.1522 - 7.2010]
Northern Cape	1.11	0.000**	[1.2332 - 2.0005]
Free State	0.10	0.071	[1.1301 - 2.1119]
KwaZulu-Natal	1.32	0.001**	[1.1801 - 2.2007]
North West	0.98	0.401	[1.5205 - 2.3575]
Gauteng	2.15	0.002**	[0.5101 - 1.8808]
Mpumalanga	0.26	0.041*	[1.4711 - 1.9109]
Limpopo	0.29	0.243	[0.2107 - 9.5402]
Place of residence			
Urban (R.C)			
Rural	0.46	0.001**	[1.3722 - 1.7821]
Living arrangements			
Head of the household (R.C)			
Living with parents	1.78	0.023*	[2.1012 - 4.2621]

Education			
No education (R.C)			
Primary School	0.17	0.001**	[2.2700 - 2.6121]
Secondary school	1.82	0.040*	[2.1724 - 3.6444]
Tertiary education	2.99	0.000**	[0.0632 - 2.9332]
Employment status			
Employed (R.C)			
Unemployed	0.99	0.051*	[1.1823 - 2.6824]
Medical aid scheme			
Yes (R.C)			
No	3.01	0.054	[0.9716 - 1.8910]
HIV medication			
Yes (R.C)			
No	0.42	0.001**	[0.4815 -1.7611]
Alcohol and drugs			
Yes (R.C)			
No	5.26	0.100	[1.0541 -2.5611]
Pregnancy (females only)			
Yes (R.C)			
No	2.19	0.141	[0.1522 - 4.2303]

R.C = Reference Category,*p<0.05, **p<0.01.

Table 4.3 presents a model which combined all selected demographic and socioeconomic characteristics of youth and their HIV-hypertension status. For this section, the HIV/hypertension status is discussed with regard to its relationship or rather association with each characteristic. This Table 4.3, therefore presents all of the findings together, for all variables used.

To start with, sex is one of the selected demographic characteristics, which shows that being a female reduces the probability of having HIV/hypertension comorbidity by 0.78 times than being a male and there is a statistically significant association between sex and HIV/hypertension comorbidity as shown in Table 4.3 with $P < 0.05$ at {95%CI:1.33 - 2.06}.

Age is also a demographic factor associated with HIV/hypertension comorbidity, this model shows that young people between the ages 20-24 years have 1.94 times increased probability

of HIV/hypertension comorbidity compared those aged 15-19 years. This association as shown in Table 4.3, it is significant, {$p < 0.05$ at 95%CI: 1.01-1.22}.

There are four officially recognized population groups in South Africa, using black population group as a reference category, coloured youth have 83% less chances of having HIV-hypertension comorbidity than black youth at {$p < 0.05$ and 95% CI: 0.73 -1.13}, while being an Indian/Asian reduces the chances of having HIV-hypertension comorbidity by 71% at {$p = 0.051$ and 95% CI: 1.00- 2.01}. However, young people who are have 78% more chances of having HIV-hypertension comorbidity as compared to black youth. This association is statistically significant {$p < 0.05$; 95%CI: 3.01- 3.33}.

Marital status is one of the selected demographic factors and it shows that being married increases the chance of having HIV-hypertension comorbidity by 40% when compared to being single at {$p = 0.021$ and 95% CI: 2.28 -3.34}. While youth who are cohabitating have 89% less chances of developing HIV-hypertension comorbidity when compared to the ones who are single, with $p = 0.000$, which shows a statistically significant relationship at {95% CI: 0.89 - 1.02}. Those who were divorced, had 64% less chances of having HIV-hypertension comorbidity compared to those who were single {$p > 0.05$ and 95% CI: 1.02 – 2.22}.

Young people who are staying in Northern Cape increases the probability of having HIV/hypertension comorbidity by 1.11 times than staying in the Western Cape Province and this relationship is significant {$p = 0.00$ and 95% CI: 1.23 - 2.00}. Those who were from KZN and Gauteng had 1.32 and 2.15 times more chances of having HIV-hypertension comorbidity respectively than young people from the Western Cape and their relationship are both statistically significant. However, young people from Mpumalanga had 74% less chances of having HIV-hypertension comorbidity than youth from Western Cape at {$p = 0.043$ and 95% CI: 1.47 - 1.91}. This also have a statistically significant relationship, since $p < 0.05$.

Young people who are from rural areas have 54% less probability of having HIV-hypertension comorbidity, compared to those who stays at urban areas, with {$p = 0.004$ and 95% CI: 1.37 – 1.78}.

Young people who lived with their parents have 78% more chances of having HIV-hypertension comorbidity compared to those who stays alone and/or are head of the households with {$p<0.05$ at 95% CI: 2.10 – 4.26}. This association is statistically significant.

The probability of HIV/hypertension comorbidity decrease by 1% when young people are unemployed compared to those who are employed, {$p < 0.05$ and 95% CI: 1.18 – 2.68}.

HIV-hypertension comorbidity increases with the level of educational attainment. Young people living with HIV who had primary education have 0.17 times chances with {$p < 0.05$ and 95% CI: 2.27 - 2.61} of having HIV/hypertension comorbidity compared to those who did not have education, while those who had secondary and tertiary education had 1.18 {95%CI: 2.17 - 3.64} and 2.99 {95%CI: 0.06 - 2.93} times chances of having HIV/hypertension comorbidity more than those who had no education at all. These were all significantly associated with HIV/hypertension comorbidity among youth with HIV, with $p<0.05$.

Young people who did not have medical aid scheme had 3.01 times probability to have HIV/hypertension comorbidity than those who had medical aid scheme. The relationship between medical aid and HIV/hypertension was not statistically significant, with $p>0.05$. Young people with HIV who were not on HIV medication (ART) had 58% less probability of having HIV/hypertension comorbidity than those who were on HIV medication {$p < 0.05$ and 95%CI: 0.48 – 1.76}. The relationship between HIV/hypertension comorbidity and youth who were not on HIV medication was statistically significant with $p<0.05$.

The probability of youth who were unemployed having HIV-hypertension comorbidity were 0.01 less than among youth who were employed, however the relationship was not significant $p>0.05$.

Young people who reported not to use alcohol and substance have 5.26 more times of HIV-hypertension comorbidity than those who agreed to use drugs and substance, with {$p = 0.103$ and 95% CI: 1.03- 2.56}. This relationship between use of drugs and substance and HIV-hypertension is not significant.

Young females who were not pregnant had 2.19 times probability of having HIV/hypertension compared to those who were pregnant, this relationship shows a statistically significant association not being pregnant and HIV/hypertension comorbidity, with $p=0.135$ and 95% CI: 0.15- 2.56.

Chapter Five

5. Discussions

5.1 Explanation of findings in comparison with the literature

The main objective of this study was to determine the prevalence and predictors of HIV-hypertension comorbidity among youth in South Africa. The results of this study shows that about 14.78% of youth had both HIV and hypertension – HIV-hypertension comorbidity. This finding corresponds with those of other studies among PLHIV, which also showed higher rates of hypertension among HIV infected persons (Bloomfield et.al 2011). This is an alarming state youth of any country can be at.

As shown in Figure 4.1, the patterns of HIV and HIV-hypertension comorbidity have been varying all throughout this period with fluctuating rates throughout this period 2010 to 2016. The highlight is in 2010 were the rates went down from 10% to about 5% in 2011. They then shoot up high to more than 35% in 2012, this is the time where NIDS had in the previous year reported hypertension to be generally high in South Africa, with 11.5% prevalence of hypertension among youth (Bradshaw et, al. MRC and CDIA, 2011). Hypertension was rising among youth in South Africa as well, like most cardiovascular diseases in developing countries.

Since HIV/AIDS is a medical condition which can only be circumscribed to a few modes of transmission, most social, economic, political, environmental and biological factors create an atmosphere which induces its transmission (Vearey, 2014). The fluctuations in the levels of HIV and HIV-hypertension comorbidity might be due to the ever changing socio-economic factors, as well as the demographic and biological factors. In 2010, both levels of HIV and HIV-hypertension comorbidity were almost the same at 10% among youth in South Africa. This is almost similar to HIV-hypertension comorbidity which was found among youth in Maryland, which was 14%. In fact, the HIV rates have been slightly increasing from almost 10% to 20% in this period. This is true when compared with the rates of HIV new infections in the sub-Saharan Africa that have been increasing gradually in this period (WHO-HIV/AIDS report, 2012).

Sexuality is a foundational phenomenon in youth life, it is in this time young people usually becomes sexually active at an earlier age because of peer pressure, ignorance, indifference and resistance to behavioral change through various forms of denial and rationalism. This is the same period were young people have explorative and experimental behaviours on drugs, alcohol, adapt certain eating habits and lifestyles. Unlike most studies, in this study there are many young people aged 20 -24 years with HIV-hypertension comorbidity, with the prevalence of HIV increasing with age. Again, being 20- 24 years increased the likelihood of developing or suffering from HIV-hypertension comorbidity. This study found that HIV-hypertension comorbidity increases with age, as youth who were 15-19 years had shown in one study done in Tanzania, which presented HIV-hypertension comorbidity, to be 8.1% and 10.7% among youth (15-30 years) and adults (30-44 years) respectively (Njelekela et, al., 2016). Another study done in Uganda, age was also a contributing factor to the HIV-hypertension comorbidity, shown by the increase of the prevalence with age, where under 20 years HIV patients had 1.0%, those between 20 and 29 years had 29.9%, lastly those who were 30-39 years had 41.5% prevalence of hypertension also support what was found in this study (Kalyesubula et, al. 2016).

As youth heavily forms part of what National Strategic Plan (NSP) 2012-2016/2017-2022 identified as key affected population at high risk of HIV, these are men who have sex with men (MSM) – these are mostly young people, since the modern day culture and the Constitution of the Republic of South Africa which ensure justice for lesbian, gay, bisexual, transgender, queer, intersex (LGBTQI) community and allow same sex marriage which was not practiced in the past. This allows young people to feel free with their unique sexualities. Since sex is the keystone of the identity LGBTQI society, they are often involved in risky sexual behaviours which predispose them to HIV/AIDS and associated health issues. Health arena finds this difficult to deal with since there is misunderstanding in the sex and sexual orientation among this society. These are mostly young people (Numer, 2007).This explains the increasing of both HIV and HIV-hypertension comorbidity among youth in as age increases as it is found.

NSP also identified adolescents and young females as key vulnerable population of HIV/AIDS, this is justified by the high prevalence of HIV that is found among general female population in South Africa. In this study, like other studies done on HIV, there are more females than males who were living with HIV. This study found that for every 1 male with HIV, there are 4

females with HIV. This can be attributable to the biological structure of female genitals. Due to this structure, females are more susceptible to infection, because during sexual intercourse semen enters the vagina where it be for a longer period. It is easier for a female who have had unprotected sex with an infected person to get virus, as it enters the bloodstream via tiny scratches that form in the sensitive lining of the vagina during intercourse. At times the times the cervix is not thick enough and can easily tear during rough sexual intercourse, which then predisposes females to STDs including HIV (Francois et, al., 2012).

It can also be attributed to the fact that young females also tend to have sexual relations with older men, who are married in most cases. Young females do this mostly in their financial difficulties, so that they can have some financial benefits from these men, most of which are married and have their families, only coming to the young girls "fresh meat" for sexual satisfaction (Njelekela et, al., 2016). These men are most likely to be HIV as they are not only having their wives as sexual partners but having sex with many other young females. In a nutshell, this is related to the socio-cultural beliefs on masculinity which also allow males to act superior and in control of females. Economic independence of females on males also reduce their ability to stand their ground and resist abusive behaviours from their partners (Nam et, al., 2015). Their ability to negotiate protected or safer sex is compromised by age and economic disparities and they are then forced to be submissive to their male partners (Longfield et, al., 2004).

These are some of the possible reasons as shown by literature of why females have high levels of HIV/AIDS, as also confirmed by this study. As it was discussed in earlier chapters, HIV alone predispose people living with it to hypertension and other diseases, therefore, these factors explain high prevalence of HIV-hypertension comorbidity among females.

As HIV is more common among females, one would also expect the HIV-hypertension comorbidity to also be high among them. However, this study shows that more males reported HIV-hypertension comorbidity than females and being a female actually reduces the chance of developing HIV-hypertension comorbidity. It is supported by the findings of one study which indicated that men are more likely to die and suffer from non-communicable diseases than their female counterparts due to reckless lifestyles, poor nutrition diet and excessive alcohol and drug abuse (Numer, 2008). Societal roles of men in the households often makes it difficult for them to be able to learn and know how to cook, particularly in the most traditional societies.

So, they rely mainly on the fast prepared food, which might contains high salt, high fats and no fruits and vegetables (Peltezer & Phaswana-Mafuya, 2013).

Again, it is observed that many people in this study are in secondary schools, while others are in university. Therefore, it is common for secondary scholars and varsity students to have experimental behaviours when they first find freedom and independence from parental control. Hence, many students when they get to colleges they take it as a good opportunity to interact with opposite sex students, most of which end up getting involved in HIV high-risk behaviors, including unsafe sex, multiple partnerships and inconsistent condom use (Menser, 2010).

They often overlook the risks involved in their behaviours and risk perception is the first step to changing the risk-taking behaviour to safer behaviour. Even when aware of HIV risk, youth often do not consider this risk and stay with steady partners. During these years young people are vulnerable to distinctive lifestyles that are influenced by a variety of socio-economic situations like poverty, unemployment, drug and substance use and abuse, reckless sexual behaviours – promiscuity, unsafe sexual engagements which leads young people to explore and experience different things, even if it means putting their health on risk for health issues like HIV/AIDS (Menser, 2010).

As the rates of HIV-hypertension comorbidity has been fluctuating from 2010 to 2016. The highlight is in 2010 were the rates went down from 10% to about 5% in 2011. They then shoot up high to more than 35% in 2012, this is the time where NIDS had in the previous year reported hypertension to be generally high in South Africa, with 11.5% prevalence of hypertension among youth (Bradshaw et, al. MRC and CDIA, 2011). Hypertension is rising among youth in South Africa as well, like most NCDs in developing countries. This is particularly caused by the unhealthy dietary habits that are popular particularly in urban areas where most young people live (Kalyesubula et, al. 2016).

Therefore, since hypertension is mainly caused by poor diet with too much salt and not enough fruit and vegetables, young people with HIV shows gradual increase of HIV-hypertension comorbidity, because of this modern fast food life. Again, because these lifestyles, young people tend to become overweight, due to unhealthy diets and not exercising enough, excessive tobacco smoking and alcohol drinking. Again just as youth experience high HIV rates, the

epidemiology of HIV alone also seems to be increasing the hypertension among people living with HIV (Vearey, 2014).

These are some of the proven reasons why hypertension is very high as shown by this study among young men compared to their female counter parts. However, this is inverse of what was found in Zimbabwe - Kadoma City which presented a 62% of females living with HIV and hypertension, compared to only 38% male counterparts. This might be attributed to the fact that in most cases women are found to be predominantly fat, or rather with high body mass index. The introduction ART ensured the survival of PLHIV, which reverse HIV related weight loss and wasting. Therefore, PLHIV are most likely to gain weight which is again a risk factor for hypertension which predisposes them to hypertension given their HIV positive status (Magande et,al. 2017; Malaza et,al. 2012). However, the results of this study are also not corresponding with another study which showed women to have higher HIV-hypertension comorbidity prevalence than men (Henriques-Forshythe et, al. 2015).

In this study, many of the young people who have reported to have the most HIV-hypertension comorbidity were Asians/Indians, however the levels of prevalence are high among black youth. This study also proved that coloureds and Asian/Indians have reduced chances of developing HIV-hypertension comorbidity, while being white increased the probability of developing HIV-hypertension comorbidity among youth compared to being young black person. White population usually have a better living standard, because of their socio-economic privileges (Farber, 2012 & Nyirenda, 2016). Literature supports the findings of this study that majority of white population are able to maintain healthy lifestyles because of their culture, including their food, they lifestyle habits of adventure, physical activity maintained by going and affording gym affiliations, affording healthy diets and learning these kind of habits at a very young age, which most of them hold on to these habits right from their childhood right through their adulthood (Goulet et, al., 2007& Malaza et,al. 2012). This is proven to reduce the risk to get most NCDs (Nyirenda, 2016). This results are related to the fact that there is usually a lack of early diagnosis of hypertension among black youth populations, as hypertension does not always show signs at early stages (Malaza et,al. 2012). Therefore, even the high frequency of it, which are observed among Asians/Indians instead of among black young people might be simply because of the lack of diagnosis among Black young people. As it is found in other studies, the most prevalence of HIV-hypertension comorbidity was among black youth. There is relatively few studies showing the differentials of HIV-hypertension comorbidity among

different population groups as reported by the results from National Hospital Discharge Survey (Henreriques-Forshythe et, al. 2015).

This study also shows the differentials of HIV-hypertension comorbidity among different marital statuses, whereby many young people who were divorced reported to have both HIV and hypertension – HIV-hypertension comorbidity. However, this HIV-hypertension comorbidity was more prevalent among young people who were single, and this makes sense as the age at first marriage in South Africa is generally postponed and the study population is fairly young. Divorces recorded among young people aged 15-24 years might have been simply as a result of forced child marriages and having fairly rough experiences at a very tender age. This affects the entire wellbeing of these young people, which may results in health issues such as HIV and hypertension, thus high HIV-hypertension comorbidity among these young people (Goodman et.al, 2012).

Young people from Gauteng province had the highest rates of HIV-hypertension comorbidity as per the results of this study. This is as the result of the youthful population found in this province, high HIV rates in this province as well as the high urbanized places and modern lifestyles that are found this province (MRC, 2016). Therefore, the lifestyles influence some of the explorative and reckless behaviours of young people which might increase the HIV rates. Again, the modernized lifestyles increases the risk of developing most of the non-communicable diseases such as hypertension, in such a way that people lead affluent lives, lack of physical activity, abuse drugs and alcohol and eat unhealthy diet – most particularly fast foods. These supports the finding in this study of high HIV-hypertension comorbidity in the Gauteng Province (Bradshaw et, al. 2011).

The role of alcohol and drugs are also shown to have impact on the spread of HIV in South Africa, these are the same risk factors of hypertension and thus they contribute to high levels of HIV-hypertension comorbidity among youth. The results only showed a very low number of people with HIV/hypertension comorbidity who also reported drug and substance abuse, this may have been due to the nature of self-reported information and stigma of morally wrong behaviours (Vos et,al. 2017). This affects youth from all the areas in South Africa, as a result of high numbers of taverns and "shebeens" around the country (Magande et,al. 2017).

In most urban "informal" areas, poverty is the most common social issue which also influences the health outcomes. It exposes people to high HIV-hypertension comorbidity in both urban and rural areas. It is one of the fatal exposures to undernutrition, as most people in these areas urban "informal" and rural do not afford food. Therefore young people who were suffering from malnutrition or undernutrition have a phenotype that helps them to survive in a nutrient-poor environment, but this also increase their chances of getting cardio-metabolic diseases in times of abundant nutrients (Nyirenda, 2016). As indicated the literature earlier, drugs and substance abuse plays a major role in the spread of HIV in South Africa (Kalichman et, al. 2008; Wechsberg et, al. 2008) in poor informal-urban South Africa. These kind of places are located in the poorest neighbourhoods and are often associated with sex work (Weir et, al. 2003). This above finding also responds to the influence of employment statuses and educational attainment as per study findings.

As many studies have shown a strong association between HIV/AIDS and poverty, this study however shows that youth who were employed had more cases of HIV-hypertension comorbidity than those who were unemployed (Currie et. al, 2012; Goon et, al. 2013; HSRC, 2012; Prettner & Canning, 2012).

Unlike most studies, this study has found that many young people with HIV/hypertension comorbidity were not on ART, which agrees with what other few studies has shown no significant association between hypertension and ART among HIV infected individuals. This study has found that most of the youth in the study who were not on HIV treatment had HIV/hypertension comorbidity compared to those who were on HIV/hypertension comorbidity (Farber, 2012 & Goulet et, al., 2007; Rodriguez-Arboli et, al., 2017; Torre et, al., 2004).

As the literature has shown, not all ART (only protease inhibitors- PI) cause hypertension among people living with HIV, therefore this study just confirms few studies which did not find ARVs to predispose people with HIV to hypertension. This could be attributable to the length of the period one has been on ARVs, as other studies explained that ARTs expose people living with HIV to hypertension on longer durations on the treatment. So this might mean that young people in this study might have been on treatment for shorter period.

5.2 Implications of the findings

These findings proves that there are appropriate policies in place, however the implementation is a challenge, therefore as this study shows that about 14.78% of young people have HIV-hypertension comorbidity, it is a way forward directive to inform the adjustment of the policies. It means that as all national policies must enclose NSP (2017-2022), there is still a need for more research to examine the early onset of NCDs and STDs such as HIV/AIDS as they threatens the survival and healthy transition of youth into adulthood, in order to develop evidence-based policies with appropriate effective and efficient implementation plans.

Chapter Six

6. Conclusions and recommendations

6.1 Conclusions

In conclusion, this study shows similar results as other studies done on HIV-hypertension comorbidity. However, the levels and trends of HIV-Hypertension comorbidity have been fluctuating over these period, which may be attributed to the political and socio-economic changes that affects the livelihood of the population indirectly (Hopwood, Mellor, & O'Brein: 2005). It shows that although hypertension is thought of being an elderly health issue, it is rising among youth, particularly among those living with HIV. HIV-hypertension comorbidity is scarcely researched among youth in Africa, whereas it was supposed to be largely looked at as it South Africa is one of the fast developing countries in Africa and shows the emergence of non-communicable diseases at younger age. As much as there have been campaigns to deal with the HIV epidemic, since it predisposes people a range of other NCDs particularly cardiovascular diseases, it would be better if the existing HIV counselling and testing programmes includes comprehensive CVDs tests, particularly hypertension. Because hypertension among people living with HIV is oftenly left undetected until it is already late to treat as sometimes it does not show any signs and symptoms. This study has shown that the prevalence of HIV-hypertension comorbidity is occurring and on the rise among youth in South Africa. The extent at which this population health issue is only restricted to the responses of the participants, therefore the fact that there are many limitations in this study cannot be ignored. Thus this study did not do enough justice to address the HIV/hypertension comorbidity at its core. This study did not incorporate all young people with HIV in South Africa, however they are all represented.

This study deals with the health issues among population that are brought by the era where communicable and NCDs are both at their high levels among the populations, not only in South Africa but Africa at large. These health issues particularly among youth are pertinent to development and the achievement of the SDG's and therefore requires urgent attention.

This study has evaluated and assessed the demographic and socio-economic factors contributing to the health issues particularly the comorbidities of non-communicable and

communicable diseases as a contribution to the knowledge body that still requires a lot of research in the African continent and South Africa as a country. And it found that different socio-economic factors influence the differentials in health among youth and that in order to deal with comorbidities, social and economic aspects must be considered and improved if needs be.

This study has shown, that there are many demographic and socio-economic factors that contributes a lot to the HIV/hypertension comorbidity among youth in South Africa. Of particular importance is the finding that HIV treatment does not necessarily cause HIV/hypertension comorbidity, it might just predispose some ART patients when it is accompanied by other factors.

Then, this suggest ART does not cause hypertension among patients of HIV who are using ART. This finding is explored with regard to socioeconomic and demographic characteristics of young people. Age is also an important factor when exploring the prevalence of non-communicable diseases, because usually non-communicable diseases are regarded as the "illnesses of age" so having had only youth as the objective of the study might give the misleading results as only young people who were sampled in the various GHS were recorded. As the results have indicated that there are more males with HIV-hypertension comorbidity, it implies that the policy makers must also consider males in their HIV related programme. They also need to ensure that in each and every HCT programme, there are hypertension screenings, so that the diagnosis is done earlier and the treatment is recommended for the patient as soon as they find out their status. The policies must also enclose interventions on non-communicable diseases at childhood, adolescence and youth population as they are often overlooked as they are considered to be "health" as a matter of fact, like it is indicated in this study, non-communicable diseases interventions must also be attended at earlier ages. These results are relevant to both public and private sectors policies which deals with health and behavioural issues and development among young people in the country.

As per conceptual framework of this study shows that the prevalence of HIV as an infectious disease is still high among young people and at the same time the non-communicable diseases are also in the rise which results in a syndemic burden of diseases. This is where the HIV and hypertension levels meet, or are in the same levels. It is further proved as shown by the results

that HIV-hypertension comorbidity among youth is influenced by some of the demographic and economic factors around young people.

Otherwise, this study has outlined the prevalence and the predictors of HIV/hypertension comorbidity. It has shown differentials of HIV-hypertension comorbidity within different demographic and socio-economic characteristics (Currie,et al, 2013). Although, these results are questionable as the data used is self-reported, appending different datasets have weighting limitations, the results have at least given the picture of what has been happening since 2010 until 2016 among youth in South Africa. It has given a picture of the prevalence and predictors of HIV/hypertension comorbidity in South Africa.

6.2 Recommendations

Firstly, the government need more integrated strategies on the implementation of the HIV and NCDs interventions. So that the prevention and treatment of both HIV and NCDs takes place in a parallel manner, to avoid such syndemic burdens. These strategies must be managed and supported through evidence based policies for appropriate and effective strategies. The government should also strengthen strategic information on how to deal with both infectious diseases as well as NCDs, it must develop interdepartmental programs which will bring together all the stakeholders to play part in implementing, monitoring and evaluation of these programs. Since data on these health issues is scarce, the government must also develop a systematic data collection, analysis and interpretation as well as the dissemination of the data on HIV and associated NCDs, particularly these CVDs. In order, to have integrated plans and programmes to have collective efforts in eliminating the simultaneous occurrence of diseases.

Secondly, the government and the independent funders must give financial aids to the researchers to produce more accurate data on the comorbidities of NCDs and infectious diseases especially among young people as they are often overlooked as they thought to be "young and health". They should also establish NGOs which will work closely with young people in ensure that they leave safer and healthy lives. Research will help in developing new prevention and treatment technologies as well as drugs - empirical studies.

Thirdly, all relevant stakeholders must work together to ensure the relevant policy development, the relevant data and research for these health issue in order to inform monitoring and evaluation of all these interventions. This will improve the kind of data used for studies,

which will help studies to inform policy development and interventions. This will also simplify, the monitoring and evaluation processes which will in turn strengthen the coordination of implementation systems in different sectors involved.

Lastly, this study did not extensively reveal the real issues associated with HIV-hypertension comorbidity, due to the insufficient information from the source of data. This study used a self-reported secondary data, this is due to the outdated relevant data. Therefore, it is recommended that there should be a repetition of this study, however the best results will be produced with a primary data, because secondary data does not really give the depth of this problem as it only answers generic questions. The nature of the future studies must also be focused on all youth even those who are disabled to learn more about factors influencing this comorbidity. In those studies, factors like physical activity, food consumption must also be considered as well as genetics because in some cases as the reviewed literature has outlined, these predisposes youth to hypertensive conditions.

References

Beaglehole, R., Bonita, R., Horton, R., Adams, C., Alleyne,G., Asaria, P., Baugh, V., Bekedam, H., Billo, N., Casswell, S., Cecchini, M., Colagiuri, R. et, al., & Lancet NCD Action Group; NCD Alliance. 2011. Priority actions for the non-communicable disease crisis. Lancet. 377(9775):1438-47. doi: 10.1016/S0140-6736(11)60393-0.

Bigna, J.J. R., Nansseu, J.R.N., Um, L. N., et, al. 2016. Prevalence and incidence of pulmonary hypertension among HIV-infected people in Africa: a systematic review and meta-analysis. BMJ Open, 6 (e011921).

Bland, M. 2000. An Introduction to Medical Statistics (Oxford Medical Publications) 3rd Edition

Bradshaw, D., Steyn, K., Levitt, N., Nojilana, B., Medical Reseach Council & CDiA. 2011. Non -Communicable Diseases – A race against time. (Policy Brief South Africa).

Chillo, P., Bakari, M., & Lwakatare, J. 2012. Echocardiographic diagnoses in HIV-infected patients presenting with cardiac symptoms at Muhimbili National Hospital in Dar es Salaam, Tanzania. Cardiovas J Africa; 23(2):90–7.

Christiansen, M.N., Køber, L., Weeke, P., Ramachandran, S. V., Jørgen. L. J.J., Smith, G., Gunnar, H.G., Torp-Pedersen, C. & Andersson, C. 2013. Age-specific Trends in Incidence, Mortality and Comorbidities of Heart Failure in Denmark 1995-2012.

Currie, C et al., 2013. eds. Social determinants of health and well-being among young people. Health Behaviour in School-aged Children (HBSC) study: international report from the 2009/2010 survey. Copenhagen, WHO Regional Office for Europe, 2012 (Health Policy for Children and Adolescents, No. 6).
Cramer, A. O. J., Waldorp, L. J., Van der Maas, H. L. J. & Borsboom, D. Comorbidity: A network perspective .Behavioral and brain sciences (2010) 33, 137–193

South African Medical Research Council, 2016. Corporate & Marketing Communications. www.mrc.ac.za/corporateaffairs/corporate.htm [date of access: 11 June 2017].

Deeks, S.G., & Phillips, A.N. 2009. HIV infection, antiretroviral treatment, ageing, and non-AIDS related morbidity. British Medical Journal, 338: (a3172).

De Heer , E.W., Marloes M. J. G., Aartjan T. F., Beekman, H.L., Dekker, J., Van Marwijk, H. W. J., De Waal, M. W. M., et, al., 2014. The Association of Depression and Anxiety with Pain: A Study from NESDA. PLOS ONE 9(12): e115077. https://doi.org/10.1371/journal.pone.0106907 [date of access: 17 May 2017]

Esack, I., Rayner, B., & Mangena, P. 2015. Hypertension in adolescents and young adults at a tertiary clinic in Cape Town, South Africa. UR@UCT 2015; 1: (2) http://journals.uct.ac.za/index.php/UR/index [Date of access: 06 June 2017].

Feinstein, A.R. 1970, 'The pre-therapeutic classification of comorbidity in chronic disease', *Journal of Chronic Disease*, 23:455–68.

Ferrand, R.A., Desai, S.R., Hopkins, C., Elston, C.M., Copley, S.J., Nathoo. K., Ndhlovu, C.E., Munyati, S., Barker, R.D., Miller, R.F., et al. 2012. Chronic lung disease in adolescents with delayed diagnosis of vertically acquired HIV infection. Clin Infect Dis Off Publ Infect Dis Soc Am; 55(1):145-52.

Fortin, M., Lapointe, L., Hudon, C., & Vanasse, A. 2005. Multimorbidity is common to family practice: is it commonly researched? Canadian Family Physician M??decin de Famille Canadien., 51, 244–245. https://doi.org/10.1370/afm.1363 [date of access: 23 June 2017].

Francois. I., Bagnol. B., Chersich. M., et, al., 2012. Prevalence and motivations of vaginal practices in Tete province, Mozabique. Source: International Journal of Sexual Health. Date: July 1, 2012

Global AIDS Response Progress Reporting (GARPR) 2016. https://aidsreportingtool.unaids.org/static/docs/GARPR_Guidelines_2016_EN.pdf [date of access: 17 July 2017]. Global statistics http://www.unaids.org/sites/default/files/media_asset/20140716_FactSheet_en.pdf [date of access: 16 September 2017].

Goon, D., Amusa, L., Mhlongo, D., Khoza, L., Any-Anwu. F. 2013. Elevated Blood Pressure among Rural South African Children in Thohoyandou, South Africa. Iranian Journals in Public Health. 42(5), pp.489-496 Original Article 489 Available at: http://ijph.tums.ac.ir [date of access: 22 July 2017].

Goulet, J.L., Fultz, S.L., Rimland, D., Butt, A., Gibert, C, Rodriguez-Barradas, M., Bryant, K. & Justice, A.C. 2007. Do Patterns of Comorbidity Vary by HIV Status, Age, and HIV Severity?. Clinical Infectious Diseases, 45 (12): pp. 1593-1601. Published Oxford University Press.

Gomez-Oliver, F.X., Thorogood, M., Clark B.D., Kahn, K. & Tollman, S.M., 2010. Assessing health and well-being among older people in rural South Africa. Global Health Action3 (Suppl2): 23-35.

Guaraldi, G., Orlando, G., Zona, S., Menozzi M., Carli, F., Garlassi, E., Berti, A., Rossi, E., Roverato, A. & Palella, F. 2011. Premature Age-Related Comorbidities Among HIV-Infected

Persons Compared With the General Population. Clinical Infectious Diseases. 53(11): pp. 1120-1126. Published by Oxford University Press.

Hennekens, C.H. & Buring, J.E. 1987. Epidemiology in Medicine. Lippincott Williams & Wilkins.

Henriques-Forsythe, M., Annangi, S. & Farber, H. W. 2015. Prevalence and hospital discharge status of human immunodeficiency virus–associated pulmonary arterial hypertension in the United States. Pulmonary Circulation, 5(3):506-512. DOI:10.1086/682222. Pulmonary Vascular Research Institute.

Herbst, A.J., Cooke, G.S., Bärnighausen, T., KanyKany, A., Tanser, F. & Newell, M.L. 2009. Adult mortality and antiretroviral treatment roll-out in rural KwaZulu-Natal. South Africa Bull World Health Organ, 87(10):754–62.

Hosmer, D. W., Hosmer, T. Le Cessie, S. Lemeshow, S. 1997. A comparison of goodness-of-fit tests for the logistic regression model. Statistics in Medicine Volume 16, Issue 9, pages 965–980

Houle, B., Clark, S.J., Gómez-Olivé, F.X,, Kahn, K., & Tollman, S.M. 2014. The Unfolding Counter-Transition in Rural South Africa: Mortality and Cause of Death, 1994–2009. PLoS ONE 9(6): e100420. https://doi.org/10.1371/journal.pone.0100420

Hopwood, B., Mellor, M. & O'Brein. G. 2005. Sustainable Development: mapping different approaches. Sustainable Cities Research Institute. University of Northumbria, Newcastle on Tyme, UK.

Hosmer, D.W. & Lemeshow, S. 2000. Applied logistic regression Second edition. A Wiley-Interscience Publication. John Wiley & Sons, Inc. New York.

Hunter, J.M., Sparks, B.T., Mufunda, J., Musabayane, C.T., Sparks, H.V. & Mohamed K. Economic Development and Women's Blood Pressure: Field Evidence from Rural Mashonaland, Zimbabwe. 2000. Social Science and Medicine, 50(6):773–95.

HSRC, 2012. South African National HIV Prevalence, Incidence and Behaviour Survey. www.hsrc.ac.za/uploads/pageContent/4565/SABSSM%20IV%20LEO%20final.pdf1 [date of access 17 May 2017].

Kahn, K. 2011. Population health in South Africa: Dynamics over the past two decades. Journal of public health policy Vol. 32, S1, S30-36. Macmillan Publishers Ltd. 0194 – 5897.

Kalyesubula. R., Kayongo. A., Semitala. F.C.,Muhanguzi. A., Katontazi. N., Ayers, D., Forest. J.I. & Mills. E.J. 2016. Trends and level of control of hypertension among adults attending an

ambulatory HIV clinic in Kampala, Uganda: a retrospective study. BMJ Global Health 2016;1: e000055. doi:10.1136/bmjgh-2016-000055

Kabudula, C.W., Houle, B. Collinson, M. A., Kahn, K., Gómez-Olivé, F. X., Clark S. J. & Tollman. S. 2017. Progression of the epidemiological transition in a rural South African setting: findings from population surveillance in Agincourt, 1993–2013. BMC Public Health BMC series, 17:424 https://doi.org/10.1186/s12889-017-4312-x [date of access: 20 May 2017].

Layard, S.B., et, al,. 2013. What Predicts A Successful Life? A Life course model of wellbeing, IZA, Discussion Paper No. 7682, October 2013.

Lorenc, A., Ananthavarathan, P., Lorigan, J., Banarsee, R., Jowata, M. & Brook, G. 2014. The prevalence of comorbidities among people living with HIV in Brent: a diverse London Borough. London Journal of Primary Care, 6:84–90.

Longfield K, Glick A, Waithaka M, Berman J. 2004. Relationships between older men and younger women: implications for STIs/HIV in Kenya. Stud Fam Plann.Jun;35(2):125-34.

Magande, P.N., Chirundu, D., Gombe, T.N., Mungati, M. & Tshimanga, M. 2017. Determinants of uncontrolled hypertension among clients on antiretroviral therapy in Kadoma City, Zimbabwe 2016. Clinical Hypertension, Case control 1:1.

Malaza. A., Mossong, J., Ba¨rnighausen, T., & Newell, M-L. 2012. Hypertension and Obesity in Adults Living in a High HIV Prevalence Rural Area in South Africa. PLoS ONE 7(10): e47761. doi:10.1371/journal.pone.0047761

Mangena, P., Saban, S., Hlabyago, K.E. & Rayner, B. 2016. An approach to the young hypertensive patient. South African Medical Journal, 106 (1):36-38. DOI:10.7196/SAMJ.2016.v106i1.10329.

Matthews, L. J., Martin, D., Coetzee, C., Scott, T., Naidoo, Y., Brijmohun, K. & Quarrie, B. 2016; The South African child death review pilot: A multiagency approach to strengthen healthcare and protection for children South African Medical Journal, 106(9): 895-889. DOI:10.7196/SAMJ.2016.v106i9.11234.

Matzopoulous, R., Du Toit, N., Dawad, S. & Van As .S. 2012. Assessing the prevention response to child road traffic injuries.

Mayosi, B.M., Flisher, A.J., Lalloo, U.G., Sitas, F., Tollman, S.M., & Bradshaw .D. 2009. Health in South Africa 4: The burden of non-communicable diseases in South Africa. African Health Sciences, 2 (9): 140-156.

Mondy, K., Overton, T. E., Grubb, J., Tong, S., Seyfried, W., Powderly, W. & Yarasheski, K. 2007. Metabolic Syndrome in HIV-Infected Patients from an Urban, Midwestern US OutpatientPopulation. Clinical Infectious Diseases, 44(5):, pp. 726-734. Published Oxford University Press.

Monroe, A. K., Rowe, T.L., Monroe, R.D. & Chander, G. 2013. Medication adherence in HIV positive patients with diabetes mellitus and hypertension: a focus group study. BMC Health Services Res, 13(488)

Msemburi, W., Pillay-van Wyk, V., Dorrington, R.E., Neethling, I., Nannan, N., Groenewald, P., Laubsche, R., Joubert, J., Matzopoulos, R., Nicol, E., Nojilana, B., Prinsloo, M., Sithole, N., Somdyala, N.& Bradshaw, D. 2016. Second national burden of disease study for South Africa: Cause-of-death profile for South Africa, 1997–2012. Cape Town: South African Medical Research Council, ISBN: 978-1-928340-06-5.

Niakara, A., Drabo, Y.J., Kambire, Y., Nebie, L.V.A., Kabore, N.J.P., & Simon, F. 2002. Cardiovascular diseases and HIV infection: a study of 79 cases in the national hospital of Ouagadougou (Burkina Faso). Bull Soc Pathol Exot ;95(1):23–6.

National Adolescent & Youth Health Policy 2016-2020. Available at: http://aviwe.wrhi.ac.za/adolescent-youth-health-policy-2016-2020/ [date of access: 25 May 2017].

National Youth Policy 2015-2020. Available at: http://www.gov.za/documents/national-youth-policy-2015-2020-8-jun-2015-0000 [date of access; 25 May 2017].

Norman, R., Bradshaw, D., Schneider, M., Pieterse, D., & Groenewald, P. 2007. What are the leading causes of death in older persons (60 years and older)?. www.mrc.ac.za/bod/RevisedBurdenofDiseaseEstimates1.pdf1 [date of access: 18 June 2017].

Numer, M. 2008. The Sexual Health of Gay Men: Exploring the Intersections of Identities, Masculinities and Health Promotion. Dalhousie University, NS, Canada

Numer, M. 2007. Forthcoming. The Dilemma of Young Gay Men's Sexual Health Promotion and Homosexual Hegemonic Masculinity. In Sexual Diversities and the Constructions of Gender, edited by L. Chamberlain. Montreal: Presses de l'université du Québec

Nyirenda, M.J. 2016. Non-communicable diseases in sub-Saharan Africa: understanding the drivers of the epidemic to inform intervention strategies. Int Health 8: 157–158. doi:10.1093/inthealth/ihw021.

Okoromah,C.A.N.,Ojo,O.O., & Ogunkunle,O.O. 2012. Cardiovascular dysfunction in HIV-infected children in A sub-Saharan African country: Comparative cross-sectional observational study. Journal of Tropical Pediatrics, 58(1):3-11.

Palmisano, L., & Vella. S. 2011. A brief history of antiretroviral therapy of HIV infection: success and challenges. Anna Ist Super Sanita, 47(1): 44-48.

Peltezer. K., & Phaswana-Mafuya. N. 2013. Hypertension and associated factors in older adults in South Africa. Cardiovascular Journal of Africa, 24 (3): 66-72.

Prettner, K., & Cannin, D. 2012. Increasing life expectancy and optimal retirement: does population aging necessarily undermine economic prosperity? PGDA Working Paper No. 91 http://www.hsph.harvard.edu/pgda/working.htm [date of access: 10 May 2017].

Reid, A.E., Hendricks, M.K., Groenewald, P., Bradshaw, D., & Phil, D. 2016. Where do children die and what are the causes? Under-5 deaths in the Metro West geographical service area of the Western Cape, South Africa, 2011, South African Medical Journal, 106(4): 359-364. DOI:10.7196/SAMJ.2016.v106i4.10521.

Rogers, R.G., Everett, B.G., Saint Onge, J.M., Krueger, P.M. 2010. Social Behavioural and Biological factors and sex differences in mortality. Demography Journal, 2010 Aug; 47 (3): 555-578

Sachs, J.D. 2012. From Millennium Development Goals to Sustainable Development Goals. Lancet 2012; 379: 2206-2211

Salter, M.L., Lau, B., Go, V. F., Mehta, S.H., & Kirk, G. D. 2009. HIV Infection, Immune Suppression, and Uncontrolled Viremia Are Associated With Increased Multimorbidity Among Aging Injection.

Sani, M.U., & Okeahialam, B.N. 2005. QTc interval prolongation in patients with HIV and AIDS. Journal of the National Medical Association, 97(12), 1657-1661.

Scott, G., & Rajabifard, A. 2017. Sustainable development and geospatial information: a strategic framework for integrating a global policy agenda into national geospatial capabilities, Geo-spatial Information Science, Wuhan University. Published by Taylor & Francis Group. DOI:10.1080/10095020.2017.1325594.

Sexton, B. J., Thomas, E.J., & Helmreich. R. J. 2000. Errors, stress and teamwork in medicine and aviation: cross sectional surveys. British Medical Journal, March 18; 320 (7237): 745-749

Sharp, P.M., & Hahn. B.H. 2011. Origins of HIV and the AIDS Pandemic. Cold Spring Harbour Perspective Medicine. 1 (a006841) available at http://perspectivesinmedicine.cshlp.org/ [Date of access 07 July 2017] Published by Cold Spring Harbor Laboratory Press.

Shumate, M., & Palazzolo, E. T. 2010. Exponential random graph (p*) models as a method for social network analysis in communication research. *Communication Methods and Measures*, *4*(4), 341-371. DOI: 10.1080/19312458.2010.527869

Sliwa. K., Carrington, M.J., Becker, A., Thienemann, F., Ntsekhe, M., & Stewart, S. 2012. Contribution of the human immunodeficiency virus/acquired immunodeficiency syndrome epidemic to de novo presentations of heart disease in the Heart of Soweto Study cohort. Eur Heart J;33(7):866–74.

Solem, R.C. 2015. Limitation of a cross sectional study. American Journal of Orthodontics &Dentofacial Orthipedics. Los Angeles, Calif. August 2015. Vol 148. Issue 2.

Statistics South Africa. 2015. Mortality and causes of death in South Africa: Findings from death notification, 2014, (November), Statistical release P0309.3. https://doi.org/Statistical release P0309.3 [date of access: 25 June 2017].

Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2013-17. RP06/2013 ISBN: 978-0-621-41510-0. Available at http://www.hsrc.ac.za/uploads/pageContent/3893/NCDs%20STRAT%20PLAN%20%20CONTENT%208%20april%20proof.pdf [Date of access: 14 September 2017].

Suhrcke, M., McKee, M., Arce, R.S., Tsolova, S. & Mortensen, J. 2006. Health economics: Investment in health could be good for Europe's economies. BMJ: British Medical Journal, 333(7576):1017- 1019.

Tahir, Z., Ahmad, M.U.D., Akhtar, A. M., Yaqub, T., Mushtaq, M. H., & Javed, H. 2016. Diabetes mellitus among tuberculosis patients: a cross sectional study from Pakistan. African Health Sciences, 16(3), 671–676. https://doi.org/10.4314/ahs.v16i3.5[date of access: 03 August 2017].

Torre, D., & Pugliese A. 2004. Impact of antiretroviral therapy in HIV-1–infected patients with pulmonary hypertension. Clinical Infectious Diseases, 39:1549-50.

Twagirumukiza, M., Nkeramihigo, E., Seminega, B., Gasakure, E., Boccara, F., & Barbaro, G. 2007. Prevalence of dilated cardiomyopathy in HIV---infected African patients not receiving

HAART: A multicenter, observational, prospective, cohort study in Rwanda. Current HIV Research, 5(1), 129-137.

UNAIDS, Geneva. South Africa takes bold step to provide HIV treatment for all Antiretroviral therapy to be offered to all people living with HIV as soon as possible after HIV-positive diagnosis 2016. www.unaids.org [Date of Access 07 June 2017].

UNAIDS, Review of data from People Living with HIV Stigma Index surveys conducted in more than 65 countries, 2016. www.unaids.org [Date of Access 07 June 2017].

Valderas, J.M., Starfield, B., Sibbald, B., Salisbury, C. & Roland, M. 2009. Defining Comorbidity: Implications for Understanding Health and Health Services. Ann Fam Med, 7(4): 357–363. doi: 10.1370/afm.983 PMCID: PMC2713155

Vos, A., Devillé, W., Barth, R., Klipstein-Grobusch, K., Tempelman, H., Venter, F., Coutinho, R. & Grobbee, D. 2017. HIV INFECTION AND CARDIOVASCULAR RISK PROFILE IN A RURAL SOUTH AFRICAN POPULATION: THE NDLOVU COHORT STUDY. 10.1136/bmjgh-2016-000260.22.