Socioeconomic Inequalities in Non-Communicable Diseases in South Africa

Thesis presented for the degree of

Doctor of Philosophy

in the School of Public Health

by

Tryphine Zulu

UNIVERSITY OF CAPE TOWN

August 2019

Supervisor:

A/Prof. John Ataguba

Declaration

I declare that this thesis is my own work, except where acknowledged in the text. I further declare that this thesis has not been submitted for a degree at any other university.

Tryphine Zulu

……Signed by candidate…..
Signature

19/01/2020
Date

Abstract

Non-communicable diseases (NCDs) have reached epidemic proportions globally and in South Africa. This thesis is situated within the health equity framework. The aim is to assess the extent of wealth related inequalities in NCDs and to assess the impact of the social determinants of health in mediating these inequalities. Data from the first South African National Health and Examination Survey (SANHANES-1) and wave 4 of the South African National Income Dynamics Study (NIDS) were used. The methods used include the concentration curve, concentration index and decomposition analysis to assess the drivers of socioeconomic inequality in NCDs and some causes of NCDs including smoking, obesity, high blood pressure; use of screening services and effective coverage for hypertension management.

The prevalence of smokers is 18.7%, the population average BMI is 26.38 kg/m2, and the prevalence of hypertension is 29.7%. The distribution of these risk factors is pro-wealthy with concentration indices ranging from 0.048 for hypertension, 0.057 for smoking prevalence to 0.115 for obesity. While these risk factors are prevalent amongst the wealthy, the outcomes are worse amongst the poor. The concentration index for expenditure on cigarettes is strongly pro-poor, (-0.130) compared to the pro-wealthy smoking prevalence. The hypertensive poor suffer more severe hypertension with a concentration index of -0.054 for depth and -0.079 for severity, respectively. Obesity affects the wealthiest the most. However, the overweight adults who are poor tend to suffer more severe obesity as shown by a relatively smaller concentration index of depth (0.015) and severity (0.033) respectively.

The overall utilisation of screening services is below 50% for eligible respondents. The two wealthiest quintiles benefit disproportionately more than they should, given their share of the population. This is particularly true for diabetes and cholesterol with a concentration index of 0.27 for cholesterol, 0.129 for diabetes and 0.052 for hypertension. Adults that do not take up screening services are predominantly the black race group, poor, rural, male, unemployed and uninsured.

Only 23% of those with hypertension are diagnosed, on treatment and are controlled. Wealth-related variables such as education, wealth, health insurance coverage and province of residence drive most of the observed pro-wealthy inequalities in this thesis. Wealthier adults benefit to a larger extent from the care cascade, compared to the poor. Therefore, until there is a substantial increase in early diagnosis and effective treatment, high levels of mortality from NCDs will persist in South Africa. And until the poor are prioritised through radical policy change in all economic sectors, the observed inequalities will continue.

Acknowledgements

I am most grateful to the many wonderful people that have shaped this PhD journey. I am profoundly grateful to Prof John Ataguba for agreeing to supervise my thesis.

I would like to thank my family and friends for the encouragement on this journey-Betina, Thandazile, Yasteel, Jane, Faith, Monica, Farayi, Odwa, Nono, Lerato and Nokwanda for their unwavering belief in me and who, in many small and big ways kept the flames of hope going, long after the academic bite had waned and I had moved on to the corporate environment. And for the conversations that always reminded me of the why of Health Economics.

I would also like to thank my mentor Prof Di McIntyre for her guidance on my journey as a Health Economist long before the idea of mentorship was formalised or even thought of.

I dedicate this work to my heart on legs- Minwenhle Angeliqué and Ntongenhle Samuel -to know what's possible and to build on this foundation, to dream, to grow and to thrive in whatever passions they choose to pursue. To be aware of the prevailing socioeconomic inequalities in their time and contribute to reversing them in whatever small ways……

To Nqobile-for some of the life lessons that have shaped my becoming.

To the memory of my mom, uMaNdebele- on whose shoulders I stand and on whose prayers I depend.

Now to Him who is able to do exceedingly and abundantly beyond that which we could ever ask or imagine! To him be the glory for ever and ever. Amen

1.1 Table of Contents

1.2 List of tables

1.3 List of figures

1.4 List of acronyms

Acronym	Explanation
AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral Therapy
CSDH	Commission on Social Determinants of Health
CVD	Cardiovascular Diseases
DHS	Demographic and Health Surveys
EQuAL	Equity-Oriented Analysis of Linkages Between Health and Other Sectors
HbA1c	Glycated Haemoglobin
HIV	Human Immuno Deficiency Virus
HPLC	High-Pressure Liquid Chromatography
LMICs	Low- and Middle-Income Countries
MCA	Multiple Correspondence Analysis
NCDs	Non-Communicable Diseases
NHI	National Health Insurance
OLS	Ordinary Least Squares
OOP	Out of Pocket
PCA	Principal Component Analysis
SANHANES	South African Nutrition and Health Examination Survey
SDGs	Sustainable Development Goals
SDH	Social Determinants of Health
SES	Socioeconomic Status
TB	Tuberculosis
UHC	Universal Health Coverage
WHO	World Health Organization

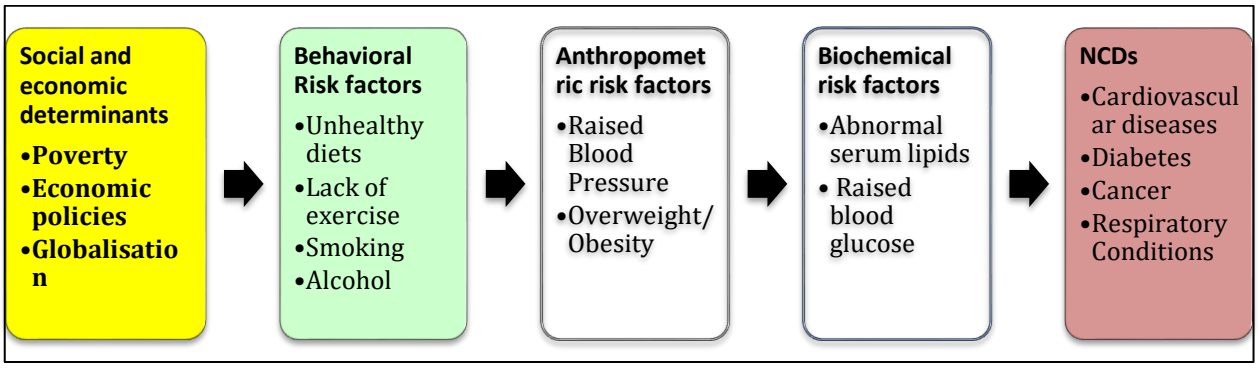
Chapter 1 Introduction

1.1 Background

Non-communicable diseases (NCDs) are non-infectious chronic diseases that are characterised by slow progression and long duration such as diabetes and hypertension (World Health Organisation 2015). Globally, NCDs have reached epidemic proportions both in terms of morbidity and mortality (Mendis et al. 2014). In 2016, 71% of all-cause mortality were due to NCDs, while more than 46% of these deaths were premature deaths in people under 70 years (World Health Organization 2018a). Low- and middle-income countries (LMICs) including South Africa bear the greatest burden of these deaths with nearly three-quarters of all NCD deaths and the majority of the premature deaths occurring in these countries (Mendis et al. 2014; World Health Organisation 2015). Also, these countries' health systems are simultaneously battling with other health issues such as communicable diseases like HIV and tuberculosis (TB), and maternal and child mortality (Kengne and Mayosi 2014). Furthermore, NCD prevalence in these poorer countries is fuelled by the disproportionate risk factor exposure amongst the poor, who constitute the majority in those countries (Di Cesare et al. 2013).

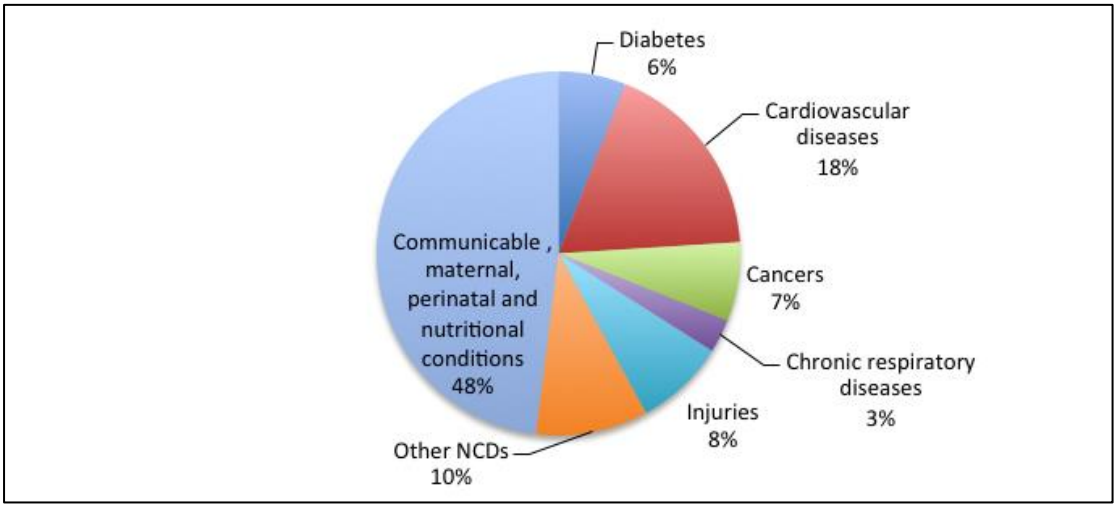
Globally, the four major NCDs are cardiovascular diseases, cancers, chronic respiratory diseases and diabetes (World Health Organisation 2015). These share a common set of risk factors that are driven by the social determinants of health (Figure 1-1). Social determinants of health are the circumstances in which people grow, live, work, and age, and the systems put in place to deal with illness (CSDH 2008). Since the social determinants of health are unequally distributed across social groups, the exposure to risk factors, the prevalence of NCDs and effective coverage of NCD services also tends to follow a socioeconomic gradient. This aspect of NCDs poses unique challenges to the realisation of the goal of Universal Health Coverage (UHC) by 2030.

Figure 1-1 The NCD Cascade Adapted from (Smith et al. 2012)



In South Africa, diabetes and cardiovascular diseases (CVDs) are the major NCDs responsible for a significant proportion of deaths in the 2016 mortality statistics report (StatsSA 2018). Data from the WHO show that these two groups of diseases combined, constitute almost a quarter of all-cause mortality in South Africa (World Health Organization 2014) (Figure 1-2).

Figure 1-2 Causes of mortality in South Africa 2014



Source: World Health Organization (2014)

1.2 The burden of NCDs in South Africa

In South Africa, mortality due to NCDs is conspicuous from around the ages of 45-49 years for females and from 50-56 years for males (Statistics South Africa 2014). Since these groups comprise the most economically productive, the rise in the NCD epidemic has social and economic implications that affect individuals, households, health care systems, national and global economies (Bloom et al. 2014; Wallingford 2012). In their analysis, Kengne *et al.* (2013) note that diabetes and CVDs may increase further the dependency ratio in African states, which is already high and has been blamed for some of the poor economic performance of African countries. In many cases, this is heightened by the HIV epidemic as premature mortality of income earners leaves behind vulnerable orphans that increase the burden on social support systems. As such, NCDs constitute a challenge that undermines social and economic development (Bloom et al. 2014; Wallingford 2012), with the potential to further exacerbate the current inequalities between and within countries (United Nations 2011). Recognition of this effect has seen the inclusion of NCDs in the Sustainable Development Goals (SDGs) agreed upon in September 2015 (United Nations 2015). This entails the prioritisation of actions on the risk factors shared among the major NCDs: tobacco use, physical inactivity, the harmful use of alcohol, and unhealthy diets. It also requires a reduction in mortality associated with these conditions, while

increasing access to prevention and treatment modalities across all sections of the population so that no one is left behind (Schmidt and Barnhill 2015; United Nations Development Program 2018).

As argued by Kengne et al (2013) that the increased demand for healthcare has the potential to negatively affect countries' capacity to invest in other priority sectors, potentially compromising sustained development(Kengne et al. 2013). This is similar to the United Nations position that NCDs are a threat to global economic development (United Nations 2015). The failure to invest in other social services such as education and improved living conditions results in disproportionate exposure of economically disadvantaged people to the NCD and their risk factors. This fuels the vicious cycle of inequity, poverty and NCDs (Kengne et al. 2013). At the individual level, poor health outcomes and increased poverty ensue, negatively affecting economic development and prosperity of individuals and societies. The combined effects of the direct and indirect costs impact on national productivity and competitiveness, which in turn creates fiscal pressures as demands on governments to provide health and social services increase.

1.3 Global and local responses to NCDs

Since 2000, the WHO World Health Assembly has adopted a number of resolutions towards the control and prevention of NCDs. However, the year 2011 was a turning point for the prioritisation of NCD as many initiatives were launched nationally and globally. In September 2011, the United Nations held a high-level meeting of heads of state and governments on the prevention and control of NCDs under the leadership of the WHO. At the meeting, global mechanisms to reduce preventable NCD burden were agreed upon which culminated in the drafting of the *Global action plan for the prevention and control of NCDs 2013-2020* (World Health Organization 2013a). The action plan aims to reduce the number of premature deaths from NCDs by 25% by 2025 through nine voluntary global targets. These focus primarily on reducing exposure to risk factors such as tobacco, alcohol, physical inactivity and obesity. Also, key recommendations from this meeting included the recognition of NCDs as a major development issue with the capacity to worsen inequities between and within countries. As such, a multi-pronged approach involving all sectors, including the health sector, is required in response to the NCDs (World Health Organization 2013a).

Before the UN meeting, Health Ministers from Africa adopted the Brazzaville Declaration on NCD prevention and control in the WHO Africa region, in April 2011 (National Department of Health 2013). The commitment from this declaration was to develop integrated plans to respond to NCDs. Again, in the same month of April of 2011, the First Global Ministerial Conference on Healthy

Lifestyles and NCD Control was held in Moscow, Russia, which was attended by Ministers of Health. In this meeting, the prioritisation of NCDs as a multi-sectoral problem was further highlighted with the decision that it required a holistic government approach given that these conditions are not only influenced by biomedical factors but also by social, behavioural, environmental and economic factors (Mendis et al. 2014). However, it was only in 2015 that NCDs were classified as a developmental priority and consequently included in the SDGs (United Nations Statistical Commission 2015).

In September 2011, The South African Minister of Health hosted a summit on the Prevention and Control of NCDs. Many stakeholders attended this summit, and it culminated in the adoption of the South African Declaration on the Prevention and Control of Non-Communicable Diseases to reduce NCD incidence and improve care, treatment and support (National Department of Health 2013).

It is these meetings and conventions that set the pace for the development and publishing of the *Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2013-2017* by the South African National Department of health (National Department of Health 2013). This Strategic Plan has three components and sets out key targets to be achieved by 2020, towards the reduction of the prevalence, morbidity and mortality due to NCDs. The three components are:

i) Prevention of NCDs and promotion of health and wellness at population, community and individual levels.
ii) Improvement in the control of NCDs through health systems strengthening and reform.
iii) Monitoring of NCDs; their main risk factors and conduct innovative research.

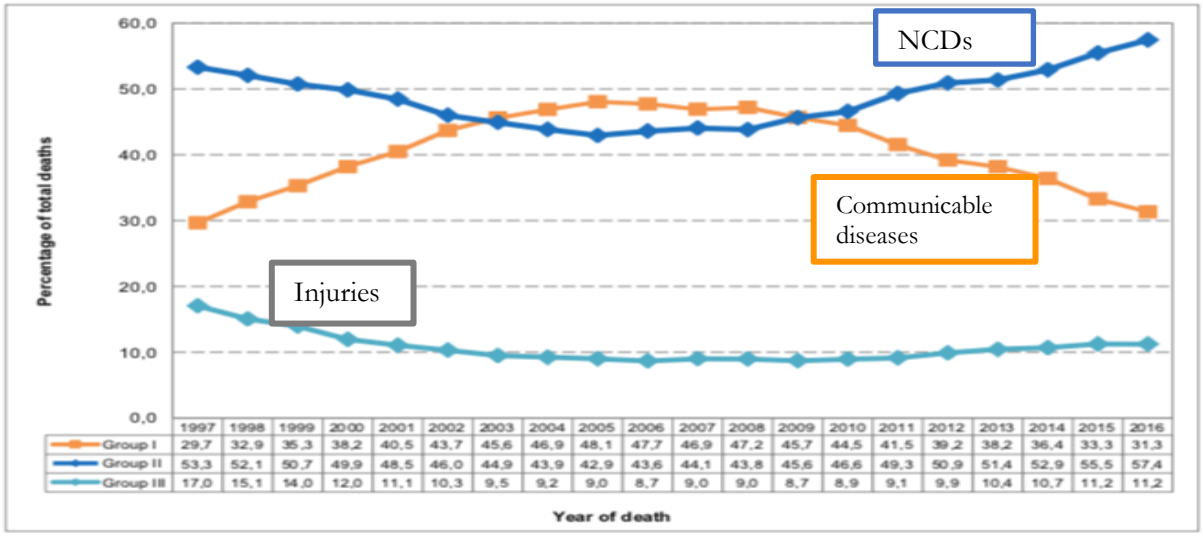
Despite the strong written policies in the form of strategic plans and ratification of conventions, prioritisation of resources for NCDs still lags behind that of communicable diseases in South Africa. This has been written about before (Mayosi et al. 2009) and finds expression in the mortality statistics published by Statistics South Africa as shown in Figure 1-3 with mortality due to communicable diseases slowly reducing as a result of successful HIV treatment implementation (Statistics South Africa 2014; StatsSA 2018).

Due to the morbidity and mortality patterns associated with chronic diseases, non-communicable diseases have been described as a challenge of epidemic proportions that undermines social and economic development with the potential to further exacerbate the prevailing inequalities between and within countries hence their addition to the SDGs (Schmidt and Barnhill 2015; United Nations

2011). As part of the commitment to realise the SDG goals, heads of state are being called upon amongst other things to:

- Reduce by one-third, premature mortality from NCDs,
- Strengthen responses to reduce the harmful use of alcohol,
- Achieve universal health coverage,
- Strengthen the implementation of the WHO Framework Convention on Tobacco Control (FCTC),
- Support the research and development of vaccines and medicines for NCDs that primarily affect developing countries,
- Provide access to affordable essential medicines and vaccines for NCDs.

Figure 1-3 Percentage distribution of deaths by group type and year of death, 1997–2016



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Group I	29,7	32,9	35,3	38,2	40,5	43,7	45,6	46,9	48,1	47,7	46,9	47,2	45,7	44,5	41,5	39,2	38,2	36,4	33,3	31,3
Group II	53,3	52,1	50,7	49,9	48,5	46,0	44,9	43,9	42,9	43,6	44,1	43,8	45,6	46,6	49,3	50,9	51,4	52,9	55,5	57,4
Group III	17,0	15,1	14,0	12,0	11,1	10,3	9,5	9,2	9,0	8,7	9,0	9,0	8,7	8,9	9,1	9,9	10,4	10,7	11,2	11,2

Adapted from (StatsSA 2018)

As HIV/AIDS comes under control, more people are surviving longer, increasing the risk of NCDs. In South Africa, the overall life expectancy increased from 57.1 years in 2009 to 62.2 years in 2013 (South African Medical Research Council 2015). Furthermore, South African studies on the life expectancy of people living with HIV show that those on antiretroviral therapy (ART) have a comparable life expectancy to those without HIV (Johnson et al. 2013). HIV is also directly linked to NCDs through the effect of the virus on such organs as the kidneys and the heart. It is also indirectly connected to NCDs through the adverse effects of antiretroviral drugs which are associated with an increase in insulin resistance, dyslipidaemia, lipodystrophy and kidney disease (Kagaruki et al. 2014; Mayosi et al. 2009).

1.4 Inequality and inequity in health and health care use

The various dictionary definitions of equity are consistent in describing equity as fairness or justice and impartiality. However, central to its definition is fairness in the distribution of resources rather than equality (Bambas and Casas 1992). Equity and equality are often conflated yet they refer to two distinct phenomena- equality is sameness whereas equity is fairness. Hence, in pursuit of this fairness, equity demands that similar cases are treated in similar ways (horizontal equity) and relevantly different cases in different ways, i.e. vertical equity (Bambas and Casas 1992). Horizontal equity describes the allocation of equal resources for equal need while vertical equity is the allocation of different levels of resources for unequal needs. These two concepts of equity apply to different policy scenarios, e.g. horizontal equity would be most relevant in the context of universal access to health services whereas vertical equity is useful in assessing health care financing such as programmes targeted for specific population groups (Bambas and Casas 1992).

Many ideological viewpoints have emerged with regards to equity in health and health care, and as explained by Culyer, there is no single universal agreement (Culyer 2001). However, of the various debates, the most prominent is the libertarian and egalitarian approaches. The libertarian approach sees health and health care as goods whose consumption should be determined by free-market forces with minimal government interference or regulation (Blas et al. 2011; Culyer 2001). Libertarians argue that health and health care should be provided according to the ability to pay principle. This is the basis of the private health care market. On the other hand, the egalitarian approach sees health as a public good that should be equally distributed in society according to need and not according to the ability to pay (Blas et al. 2011; Culyer and Wagstaff 1992; Fleurbaey and Schokkaert 2009). This is the basis of many pro-poor health care reforms in many countries including the recent move towards universal health coverage. Indeed, many of South Africa's health reforms such as the free primary health care, free ART for those that qualify based on clinical criteria and the National Health Insurance (National Department of Health 2015), reflect some aspects of the egalitarian approach to equity in the provision of health services. On this basis, this thesis does not attempt to discuss the various theories in detail but rather uses the egalitarian approach as the point of departure for the evaluation of inequality and inequity in the area of non-communicable diseases in the South African context with a bigger focus on the socioeconomic determinants of health as drivers of this inequality.

Policymakers are concerned with inequality in health because the distribution of health and health outcomes are seen as a cause and a consequence of the distribution of income (Donnell et al. 2015). Health remains a social phenomenon whose distribution in the population is seen from a social justice

perspective wherein avoidable inequalities in health based on socioeconomic status is unjust and unfair (Solar and Irwin 2010). As a result, the vast inequalities in health between the rich and the poor remain a cause for concern for policymakers. Health is a basic need that is valued not only for its own sake but also because it enables participation in other aspects of daily life such as work, maintaining social relationships like family and participating in the economy (World Health Organisation 2011).

The inequalities that exist between the rich and the poor manifest themselves in health outcomes, utilisation of health services and benefits received from public expenditures on health services (Ataguba and McIntyre 2012a; Wagstaff et al. 2003). Therefore, the guiding principle in the social justice approach and for this thesis is that health equity is the absence of unfair and avoidable differences in health among social groups (Solar and Irwin 2010). This takes into account that there will be differences in health that are due to biological factors such as age and gender as these are natural and unalterable through any policy tools (Wagstaff et al. 2003).

1.5 Socioeconomic status and health

Socioeconomic status is an indicator of access to social and economic resources. It is a measure of command of social relationships and economic assets that may vary over time (Duncan et al. 2002; Oakes and Rossi 2003). A considerable body of scientific evidence has demonstrated a strong association between socioeconomic position and morbidity, and mortality. Further, many different pathways have been used to explain the relationship such as standards of living, working conditions, social and psychological interactions at home, work and other settings (Krieger et al. 1997). However, the critical role of society has been highlighted in mediating these pathways through its role in regulating living and working conditions (Krieger et al. 1997). It is imperative to examine the relationship between socioeconomic status (SES) and health as SES related health-inequalities can be changed through social policy (Oakes and Rossi 2003). Further, the study of the link between socioeconomic inequality and health is imperative given that inequalities in income and wealth presage growing socioeconomic inequalities in health particularly in South Africa, one of the world's most unequal societies as measured by the Gini coefficient of 0.69 in 2011 (Alam 2014).

An understanding of the relationship between SES and the causation of diseases is essential in formulating policies to address socioeconomic inequality and identifying the relevant medical interventions to be implemented (Oakes and Rossi 2003). This is important in the management and prevention of NCDs. Bringing out the relative contribution of SES to inequality may illuminate how social stratification along racial, ethnic or other strata may be the cause of inequality due to past or

present policies (Oakes and Rossi 2003). This observation is particularly relevant in the South African context where the apartheid legacy of separate development by race and ethnicity comes to bear on many health outcomes (Coovadia et al. 2009).

1.6 NCDs and financial risk protection

The rise in the burden of NCDs in many developing countries represents a considerable burden on the available financing instruments for health. While universal health coverage actively advances the notion of pooled prepayment mechanisms to finance health care services, out of pocket payments remain in use in many countries. Out of pocket payments are direct payments made by households or individuals at the point of accessing health care when they have no access to prepaid health insurance cover or the services are not covered by health insurance reimbursement or both. Out-of-pocket (OOP) payments as a health financing vehicle are regressive in many countries, including South Africa (Ataguba and McIntyre 2012a). This form of healthcare financing goes against the financial protection and equity goals of UHC as they expose households, especially the poorer households, to financial risk and in some cases, catastrophic expenditure if households face financial hardship when paying for health care at the point of accessing care. Compounding (in)equity in the financing of NCDs is the historical marginalisation of NCDs as a public health priority compared to communicable diseases like HIV/AIDS, receiving disproportionate financial and human resources commitment (Azenha et al. 2012). The authors argue further that the tendency to view NCDs as diseases of the affluent and the elderly in society has compounded the lack of urgency in confronting the challenge of NCDs to mitigate the financial risk experienced by the low socioeconomic groups (Azenha et al. 2012).

The lack of prioritisation of NCDs plus the view that these are diseases of the rich together unduly disadvantage the poor when these diseases are also prevalent amongst the poor. This is further compounded by the high cost typically associated with the preventative care and the continuous need for treatment of NCDs. Beaglehole *et al.* also note that the chronicity of NCDs results in households being kept in a cycle of debt and ill-health further perpetuating health and economic inequalities, including poverty (Beaglehole et al. 2011b). Also, most NCD-related deaths are preceded by a long period of illness, lost economic productivity and unemployment, which can lead to financial insecurity, as households are caught up in the "medical poverty trap" (Whitehead et al. 2001). Therefore, given the chronic nature of NCDs, the use of OOP payments as a financing mechanism for NCDs has an impoverishing potential because of the long term need for care and the associated high costs of diagnosis and treatment (Mcintyre 2015; Whitehead et al. 2001). Thus, the poor either face

indebtedness and poverty in pursuit of health care or succumb to these NCDs due to their inability to pay.

The poor are more likely to experience these economic shocks for a prolonged period because they do not have the social security nets such as health insurance and access to other financial resources to cushion them thus creating a burden on social services where such exist (Alleyne et al. 2013). However, even with health insurance, the level of out of pocket co-payments may also lead to financial shocks at the household level as has been found in South Africa (Ataguba and Goudge 2012; Joshi et al. 2013). Consequently, as the poor are unlikely to afford nor access sustained treatment compared to the wealthier members of society, mortality is higher amongst the poor than the rich (Alleyne et al. 2013). Therefore, monitoring equity in health and healthcare and health care financing is key to the equitable and progressive realisation of universal health coverage (Ataguba 2016).

1.7 The South African Health System

The South African health system is comprised of the public and private sectors. The government runs the public sector and the private sector is run by private companies and individual health care practitioners. In the public sector where the majority of the population seeks care, the health system is made up of a network of health facilities providing primary health care services such as clinics and community health centres supported by several higher levels of care in the form of district, regional and academic hospitals (Visser et al. 2012). Public primary health care services are free at the point of use, while user fees may apply for higher levels of care based on affordability.

Approximately 71.2% of South African households report using public facilities as their first point of contact while 27.1% consult private providers first for their health needs (Statistics South Africa 2019). In the private sector, community pharmacies, family practitioners, private nurse practitioners and other allied health care professionals provide out of hospital primary healthcare services including screening with private hospitals providing specialist services.

The public sector is financed through general taxation while the private sector is financed mostly through private voluntary health insurance and some OOP payments from private households (McIntyre 2010). The proportion of individuals covered by voluntary health insurance funds increased from 15.9% in 2002 to 17.1% in 2016 before declining to 16.4% in 2018. More than one-fifth (22.6%) of households in South Africa had at least one member who belonged to a health insurance fund in 2018 (Statistics South Africa 2019). Overall, general taxation accounted for 54% of total health spending in 2017, while private health expenditure made up 44%, of which voluntary medical insurance contributed 36% (World Health Organization 2017). Almost all the private health funding

is spent on private sector providers serving the 27.1% who use the private providers as their first port of call. This drives most of the inequality in health care access as the distribution of health care providers is also along affordability lines with more health care workers per 1000 patients in the private sector compared to the public sector, driven by ability to pay (South African Department of Health 2011). This has necessitated the strong policy direction towards the National Health Insurance implementation that seeks to "ensure the equitable and fair distribution and use of health care services" in South Africa as articulated in the NHI Bill (Ministry of Health 2019).

1.8 Motivation for the research

Monitoring inequality in health and health care has become an essential imperative globally, especially in light of the current world agenda of progressive realisation of universal health coverage (Hosseinpoor et al. 2014). The ultimate goal of universal health coverage is to eliminate inequality in access and use of services between and within population groups (Carrin et al. 2008; World Health Organization & The World Bank 2015). There is also a focus on access to health services of sufficient quality to be effective as a means of monitoring progress towards the realisation of Universal Health Coverage. Hence studies on the analysis of not only equity and inequality in general but inequality in effective coverage concerning NCDs are relevant in the context of UHC. These studies help to guide policymakers on what interventions to implement, which segments of the population to focus on and which service to improve the quality service delivery on. This is important and topical as governments strive to ensure that no one is left behind—the rallying call of the Sustainable Development Goals (United Nations Development Program 2018). The issue is of particular concern in South Africa due to the ever-widening income inequality including inequalities in health outcomes between the rich and the poor, and across racial groups (Ataguba 2016; Ataguba 2013; Schneider et al. 2009). Consequently, South Africa has embarked on many policy reforms, including free primary healthcare services, free antiretroviral therapy for all who test positive for HIV and the current deliberations on the National Health Insurance (Ministry of Health 2019). All these seek to even out disparities in health care that are driven inter alia by socioeconomic status.

With NCDs, equity has become an important policy consideration because of the associated disease and financial burden and the importance of the social determinants of health in the spread of NCDs. The strategic plan on NCDs, developed by the National Department of Health is also cognizant of this. It states that there is a need for research to understand and influence the social and the macro-economic determinants of NCDs and exposure to the risk factors to guide inter-sectoral action (National Department of Health 2013).

Despite all these efforts, empirical evidence indicates that inequality in health and health care use persists in South Africa (Cleary et al. 2011; Cois and Ehrlich 2014; Nkonki et al. 2011; Omotoso and Koch 2018; Schneider et al. 2009). In particular, Omotoso and Koch, (2018), find that socioeconomic inequality in ill-health status and disability widened between 2004 and 2010 although these inequalities narrowed from 2010 to 2014. There are, however, no studies that decompose inequalities in NCDs, explicitly looking at exposure to the risk factors, use of screening services and effective treatment coverage for NCDs. It is important to assess who is exposed to these risk factors and what contribution the social determinants of health make in perpetuating the observed inequalities in health. Beyond the analysis of risk factor exposure, it is critical to understand who is more likely to develop NCDs and who has access to screening services and what determines the utilisation of these services. Further, one also must explore the extent effective coverage is achieved and by who as part of monitoring and quantifying progress towards achieving UHC (World Health Organization & The World Bank 2015). Access to services according to need and of sufficient quality to be effective is critical to the achievement of UHC goals. Effective coverage seeks to quantify the proportion of the population that is aware of their disease, are on treatment and are adequately controlled (Ng et al. 2014). Such analyses are useful in guiding the implementation of specific policies designed to ensure not only service provision but quality service delivery that advances quality health outcomes.

Some authors reiterate that a reduction in the overall NCD burden will require a reduction in the NCD inequalities because the poor, comprising the majority of the population, bear the highest burden of NCDs (Di Cesare et al. 2013). Thus, the poor's overall contribution to the NCD burden is also disproportionately large. Therefore, to address these inequities, the focus should not only be on pursuing cost-effective interventions if access to these interventions is still along the same socioeconomic gradient but also in targeting the poor and marginalised to reduce inequalities (Schmidt and Barnhill 2015). This requires the prioritisation of innovative approaches for targeting the poor guided by research such as undertaken through this thesis.

Despite the known economic and patho-physiological impact of NCDs, levels of undiagnosed disease are very high globally. For example, 50% of people with diabetes are unaware of their diabetes status and about 20-30% present with complications at diagnosis (International Diabetes Federation 2013). In South Africa, 50-85% of people with diabetes, particularly in rural areas, remain undiagnosed (Amod et al. 2012). Delays in diagnosis result in patients presenting to health care facilities at an advanced stage of disease with the possibility of incurring costly and sometimes debilitating complications. This is further exacerbated by the lack of coherent, systematic screening programmes for NCDs in many developing countries, including South Africa. Therefore, this thesis will assess inequality in NCD risk factors, screening and effective coverage for hypertension.

1.9 Aim and objectives

1.9.1 Aim

To assess inequality in NCDs, including the risk factors, prevalence, use of screening services and effective coverage of NCD treatment services.

1.9.2 Objectives

This thesis seeks to assess:

1. Socioeconomic inequality in the distribution of behavioural risk factors for NCDs in South Africa,
2. Socioeconomic inequality in the distribution of anthropometric risk factors,
3. Socioeconomic inequality in the use of screening services for NCDs in South Africa,
4. Socioeconomic inequality in the distribution of effective treatment coverage for hypertension and diabetes.

1.10 Structure of the thesis

This thesis is organised into ten chapters. Chapter one is the introduction and chapter two contains the conceptual framework that underpins the study together with a brief synopsis of selected literature. Substantive review of literature for each of the objectives is contained in the relevant chapters. Chapter 3 describes the main methods common to all the analyses in this thesis, including a description of the datasets used. Methods that are unique to a specific analysis are described in the relevant chapters. Chapters 4-9 address each of the objectives. Chapter four focuses on inequalities in smoking, chapter five focuses on obesity, chapter 6 addresses inequalities in hypertension while chapters 7 and 8 are on screening for NCDs and chapter 9 covers effective coverage of services for NCDs. Chapter 10 ties together the findings from the analyses in chapters 4-9 and concludes the thesis

Chapter 2 Conceptual framework

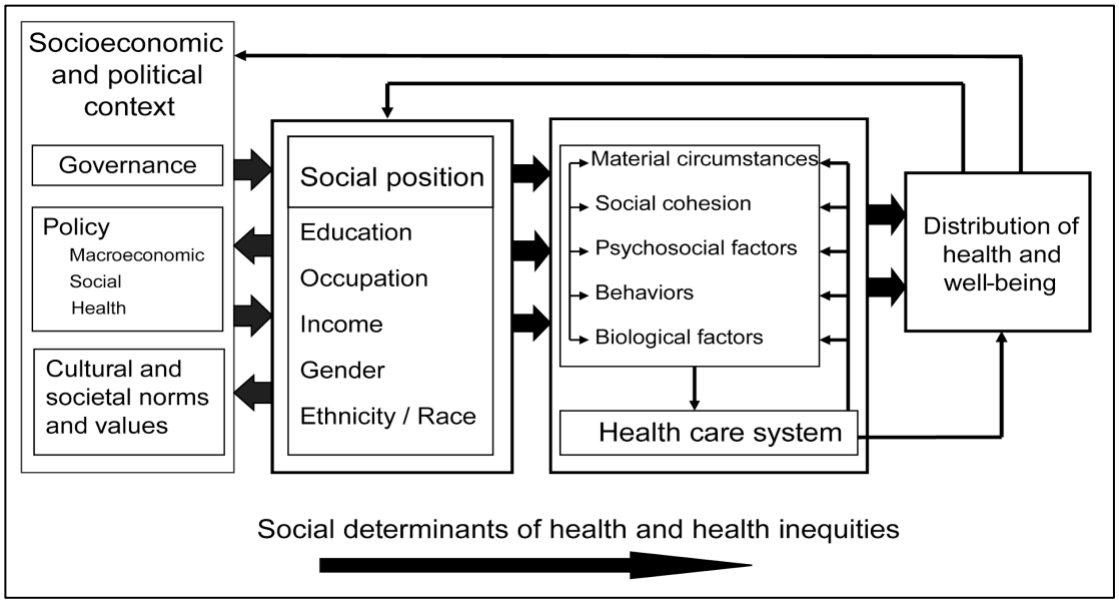
2.1 Background to the development of the conceptual framework

This thesis is situated within the health equity framework, whose aim is to assess and quantify the magnitude of inequality in NCDs. The thesis also aims to assess the extent of the influence of the social determinants of health in mediating these inequalities.

2.2 Causes of NCDs

The major NCDs, including cardiovascular diseases and diabetes, are often preceded by unhealthy behaviours such as unhealthy eating habits, lack of physical activity, smoking and alcohol abuse followed by the development of metabolic and physiological risk factors (World Health Organization: Western Pacific Region 2010). However, exposure to these risk factors and subsequent prevalence of NCDs are influenced by policies and initiatives across a wide range of sectors such as health, education, environment, and the economy – broadly defined as the social determinants of health (Smith et al. 2012) as depicted in Figure 2-1.

Figure 2-1 The social determinants of health



Source: Solar and Irwin (2010)

2.3 The social determinants of health and NCDs

The impact of the social determinants of health on health inequalities has been widely recognised with the World Health Organization setting up the Commission on Social Determinants of Health (CSDH) in 2005 (Solar and Irwin 2010). This commission conceptualised the framework that explains how the social determinants of health interact, at different levels, in a complex manner to determine equity in health and health outcomes among individuals (Venkatapuram et al. 2013). At the proximal individual level, the individual's material circumstances, level of social cohesion, psychosocial, behavioural and biological factors as well as the level of the health system's functioning influence health outcomes. Further, Venkatapuram, Bell and Marmot, (2013) state that people's social position determines the way they experience these proximal factors as comprised of wealth, income, occupation, education, gender, race and geographic location. In turn, these intermediary factors are influenced by distal factors mediated by the socioeconomic and political context (Figure 2-1).

The socioeconomic and political context in this framework refers to the set of structural, cultural and functional aspects of a social system that influence social stratification and the social distribution of wealth, health and sickness (Solar and Irwin 2010). These include governance, policy, cultural and societal norms and values. Culture and societal values shape individual health in defining what behaviours are acceptable, how health is valued and how health is prioritised in the government and societal agenda (Babitsch et al. 2012; Solar and Irwin 2010). These values also influence how society assumes the distributional responsibility of health and how society assumes collective responsibility for financing and organising health care services. This also determines how specific issues and health conditions are prioritised, including the expected roles of the individual versus the state (Solar and Irwin 2010).

Governance includes among other things how needs are defined, how patterns of discrimination come to bear; whether or not there is civil society participation and accountability, and transparency in public administration (Solar and Irwin 2010). In the policy landscape, macro-economic policies influence fiscal matters, trade and labour market structures. The role of trade and labour market structure on NCDs is the basis for focusing on the political economy of NCDs as a possible avenue of tackling the social determinants of NCDs (Glasgow and Schrecker 2015). This recognises the need to move away from overemphasising the biomedical basis of NCDs as the panacea to solving the epidemic to a societal approach. Incorporating the political economy of NCDs in the solutions to the NCD epidemic means the focus should include upstream factors, the cause of the causes, especially the role of economic policies and multinational corporations in the spread of NCDs. As argued by Schram and Goldman (2019), policies that over-emphasise the individual responsibility find support

in the economic growth mindset of neo-liberal policies through their deference to market forces, agnostic to the source of the economic growth, because whether "the market is selling sickness or health, sales contribute equally to the gross domestic product" (Schram and Goldman 2019). Therefore, the focus should be on designing economic policy to reshape the economy towards healthier economic activity rather than a sole focus on growing the economy regardless of the health consequences. This is encapsulated in the Commission on Social Determinants of Health's statement that it is the "toxic combination of poor social policies and programmes, unfair economic arrangements, and bad politics" (CSDH 2008) that is largely responsible for the unequal distribution of ill health.

Social policies in health, labour, housing and social welfare are influenced by the redistributive elements within society which have a bearing on the individuals' welfare and wellbeing, hence this thesis' focus on understanding the social determinants of health as drivers of inequality in relation to NCDs. This whole of society approach is largely recognised as the precursor to solving the attendant health challenges. These challenges can only be solved through a radical change of public policies in all sectors not only the health sector but sectors with a bearing on wealth generation and its distribution such as education, trade, taxation, agriculture, urban development, food and pharmaceutical production. Therefore, changing health policy alone will not bring the change required to reverse the observed inequalities (Glasgow and Schrecker 2015).

Since the work of the CSDH, the subject of equity in health has gained tremendous attention (Schmidt and Barnhill 2015). The social determinants of health (SDH) are further developed through the EQuAL (equity-oriented analysis of linkages between health and other sectors) project to monitor equity in health (Pedrana et al. 2016). EQuAL provides an inter-sectoral and interdisciplinary approach to monitoring the SDH and improving equity in health. It consists of three socioeconomic related domains of environment quality; accountability and inclusion; and livelihoods and skills (the acronym EQuAL).

There was an improvement on the frameworks by Dover and Belon (2019) with an additional focus on measuring health equity to incorporate the complexity of the social determinants of health in influencing and generating health inequity through their unequal distribution in society. This was done through the Health Equity Measurement Framework (HEMF) (Dover and Belon 2019). This framework synthesises existing SDH and various scholarly models from the public health literature such as frameworks on health system utilisation, the Andersen health-seeking behaviour model (Aday and Andersen 1974), the Donabedien health care quality model (Donabedian 1966) and other current literature. Dover and Belon (2019) explain that this framework is designed to assist in identifying and

measuring interrelationships between many facets of society. These include the political and socio-cultural context, health system-related policies and programmes, material and social circumstances, environment, biological and psychosocial factors, perceived and evaluated needs, social location, health-related behaviours, beliefs, and health state and outcomes (Dover and Belon 2019). While this model is useful in the breadth of its focus, some of the factors such as power and prestige are not always readily available in survey data, nor can they be easily quantifiable. Further, in statistical modelling, it is not apparent how some interconnectedness can be separated out such as the intersection of prestige and social capital in variables. This is relevant for variables such as gender and occupational class which represent both prestige and social capital, and challenges with measuring biological factors such as genetics and hormonal influence.

In this thesis, the framework of the social determinants of health (SDH) (Solar and Irwin 2010), is therefore used to guide the choice of the indicators to describe the influence of the SDH on NCD inequalities. This takes into account the contribution of each determinant to inequality through a decomposition analysis. In decomposing the factors associated with inequality in the risk factors for NCDs, the prevalence of NCDs, and use of preventive services for NCDs, this thesis contributes to an understanding of the extent to which each of these SDH contributes to socioeconomic inequalities in NCDs.

2.4 Socioeconomic status and NCD risk factors

While some studies have not established any clear relationships in LMIC (Schmidt and Barnhill 2015), findings from Umuhoza and Ataguba (2018) show a clear pro-poor inequality in poor self-assessed health status. Their study was done in six of the 15 South African Development Community (SADC) countries. In addition, few studies have attempted to decompose the relative contribution of socioeconomic indicators to the observed socioeconomic inequality in relation to non-communicable diseases (Alaba and Chola 2014; Averett et al. 2014).

In South Africa evidence of the SES gradient in risk factor exposure and NCD is not so clear-cut. Some studies have found a significant drift of cardiometabolic risk factors from the wealthy to the poor as evidenced by a study in North West province amongst blacks (Pisa et al. 2012). Another study found similar smoking rates between rural and urban areas while alcohol consumption was likely to be higher amongst the urban groups than the rural groups (Oyebode et al. 2015). Racial disparities have also been noted, with Hamer *et al.*, (2015) finding that black people compared to Whites had an adverse progression of CVD risk factors and had a substantially higher prevalence of composite CVD.

This study, therefore, incorporates the elements of race, urban/rural location, smoking and alcohol consumption amongst others to ascertain the extent to which these influence the levels of inequality in South Africa for NCDs.

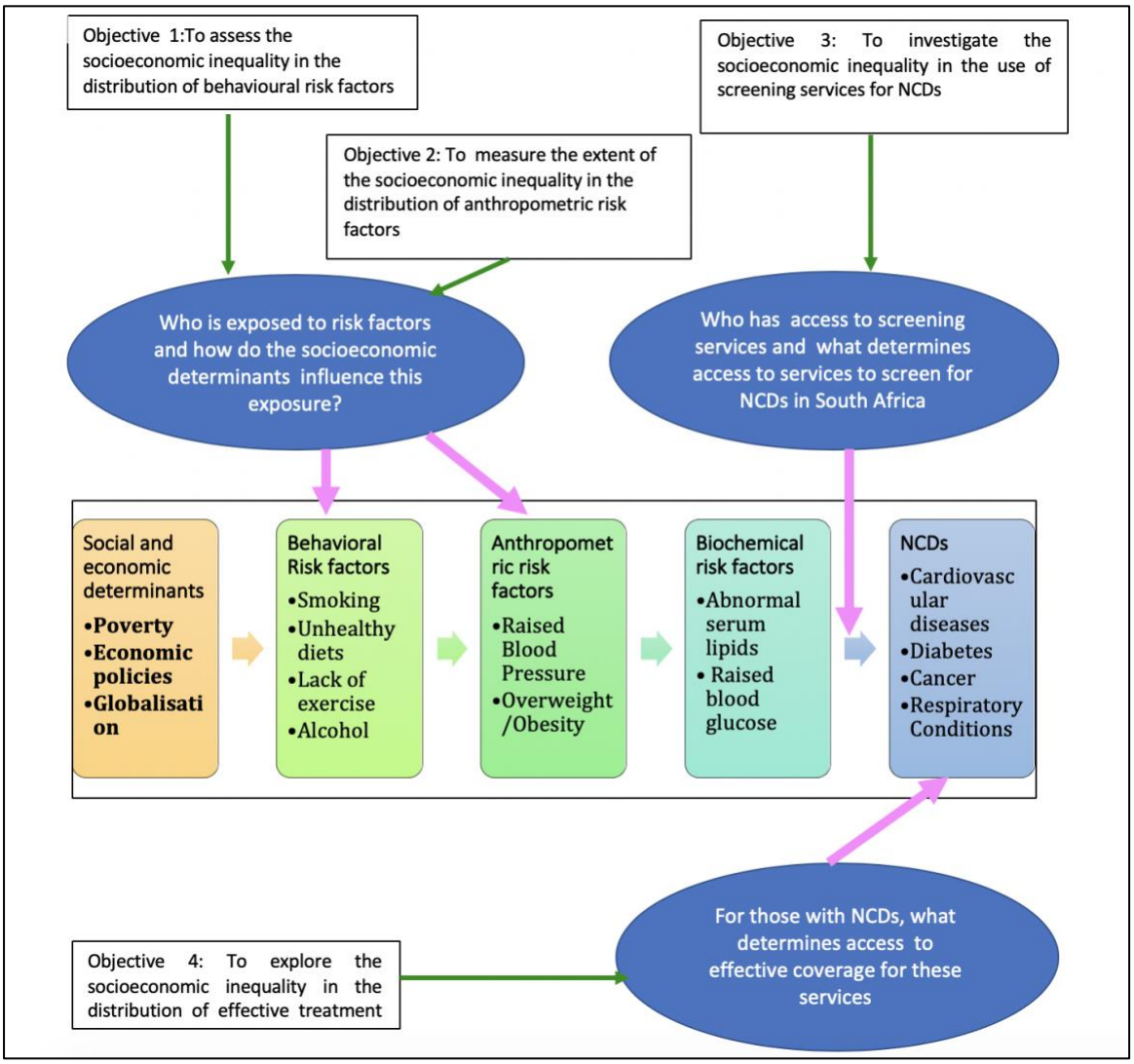
2.5 Socioeconomic status and the prevalence of NCDs

For a long time, chronic diseases like diabetes were seen as diseases of the wealthy. However, with the demographic and nutrition transition, that pattern has changed, although awareness amongst the poor has remained much lower (Vellakkal et al. 2015a). This has been explained in terms of coping strategies wherein it has been found that the poor often delay seeking treatment or alter the perception of their illness, amongst other strategies, due to lack of financial resources (Sauerborn et al. 1996). This was observed in an inter-country study by the WHO that included South Africa (Vellakkal et al. 2015a). The study found that particularly for depression, hypertension and respiratory conditions, self-reported illness was concentrated more amongst the rich than among the poor (Vellakkal et al. 2015a). However, using symptom-based or criterion-based measures, the pattern was found to be pro-poor as these chronic conditions are more prevalent amongst the lower SES groups than the wealthier members of society even though the poor are less likely to be aware of their disease status. In contrast, a pro-poor distribution of hypertension and depression with self-reported data amongst South Africans was reported using General Household Surveys (Ataguba et al. 2011). While lower self-report or awareness may be a consequence of poverty, the different findings from these two studies may be due to the sample focus of the two studies. The WHO inter-country study by Vellakkal *et al.* (2015) focused on the elderly from the age of 50 years who may be prone to recall bias because of age and are likely to underreport illness compared to the younger population. On the other hand, Ataguba et al. (2011) focused on all respondents, including those younger than 50 years. In light of this, this thesis also interrogates the differences between self-reported and criterion-based prevalence rates for non-communicable diseases across all age groups from the age of 15 years.

2.6 The conceptual framework for the thesis

The conceptual framework for this thesis is shown in Figure 2-2 and was developed given the foregoing discussion on the different approaches to the analysis of the role of social determinants of health in the development of NCDs.

Figure 2-2 Conceptual framework for the thesis



2.7 Contribution of this thesis

The contribution of this thesis is primarily empirical. This thesis contributes to a better understanding of socioeconomic inequalities in NCDs in South Africa in three critical ways. Firstly, it borrows from the poverty literature to assess inequality not only in the prevalence of important risk factors such as smoking for non-communicable diseases but also the depth and severity of obesity and high blood pressure to better understand inequalities in risk factors for NCDs. Secondly, it looks at socioeconomic inequality in the utilisation of screening services for the three major NCDs—diabetes, hypertension and hypercholesterolemia—to assess the determinants of inequality in utilisation of these services. Lastly, this thesis assesses socioeconomic inequality in effective coverage for NCDs

using hypertension as an example to ascertain the extent of the socioeconomic inequalities in access to quality service for hypertension management.

The rising prevalence of cardiovascular diseases, affecting a significant proportion of the workforce, is likely to lead to increased health care expenses both at the individual and national levels in South Africa (Bradshaw et al. 2011). Further, the focus of most inequality studies has been on the prevalence of risk factors such as obesity and high blood pressure without any regard for the severity of obesity amongst those who are obese or the severity of hypertension amongst those with high blood pressure. This is the case even though the health effects increase exponentially beyond the threshold of hypertension, for example (Poulter et al. 2015). This thesis goes further to assess the differences in socioeconomic inequality in the prevalence, depth and severity of hypertension and obesity.

There is evidence of underreporting of the self-reported prevalence of NCDs due to lack of awareness in South Africa. One study utilising the general household survey with self-reported data estimated hypertension rates at 10.4% (Hasumi and Jacobsen 2012) while studies that assess hypertension clinically, have found higher than 75% prevalence (Oyebode et al. 2015; Tyrovolas et al. 2015). Therefore, this thesis uses both self-reported and criterion-based (objective) measures of ill-health. Using more objective measures of illness such as blood pressure measurements reduce under-reporting, especially among the poor who have less frequent interactions with formal health services for an accurate diagnosis. This is important in the study of NCDs as they do not present with any immediately discernible signs and symptoms with hypertension in particular dubbed the "silent killer" (World Health Organization 2013b).

Chapter 3 Methods

3.1 Introduction

This chapter provides an overview of the key data sources used in the analysis of the objectives of this thesis and the main methods used in assessing socioeconomic inequality. For brevity, details of the analytical methods that are unique to certain chapters are presented in the respective chapters.

3.2 Data sources

This thesis utilises data from SANHANES-1 and NIDS wave 4. The SANHANES-1 is a nationally representative cross-sectional survey which utilised multi-stage disproportionate cluster sampling across all the nine provinces in South Africa (Shisana et al. 2014). There were 6,305 households included in the sample with 27,580 individuals interviewed. Information was collected using standardised questionnaires that recorded information on the demographic, self-reported health, physical activity level, nutritional status, smoking/alcohol intake and health care utilisation among others. The participants also underwent a clinical examination by a registered physician where findings of this full clinical examination were recorded on a standardised clinical examination questionnaire. The clinical examination included blood pressure and pulse measurement, cardiovascular fitness assessment, anthropometric measurements (weight, height, waist and hip measurements) and blood sample collection for analysis of cotinine, HbA1c, total cholesterol, high and low-density lipoproteins and triglycerides. The blood samples were analysed in accredited laboratories using automated techniques and high-pressure liquid chromatography (HPLC).

The NIDS is the first longitudinal survey with a nationally representative sample of households in South Africa (Chinhema et al. 2016). This survey is carried out every two years since 2008. The first wave contained a total of 28,226 individuals. In wave 1 a stratified, two-stage cluster sample design was used in sampling the households to be included. In the first stage, 400 Primary Sampling Units (PSUs) were randomly selected within the strata from Statistics South Africa's 2003 Master Sample of 3000 PSUs. The sample was proportionally allocated to the strata based on the Master Sample District council PSU allocation. The target population for NIDS was private households in all the nine provinces of South Africa and residents in workers' hostels, convents and monasteries. The frame excludes other collective living quarters such as students' hostels, old age homes, hospitals, prisons and military barracks (Chinhema et al. 2016).

The wave-on-wave attrition rates have declined over time. In wave 2 the attrition rate was 21.95% which fell to 15.94% in wave 3 and to 14.01% in wave 4 (Brophy et al. 2018). At any point, the sample

consists of continuing sample members (CSM) and temporary sample members (TSM). Continuing sample members are those wave 4 respondents who were part of the original sample from wave 1 and who continued to the subsequent waves. Temporary sample members are those respondents who are not from the original wave 1 sample but were co-resident with a CSM at the time of the interview. Consequently, 78% of the individuals who were interviewed in Wave 1 were successfully interviewed in Wave 4. This thesis uses data from 22,453 respondents aged at least 15 years, who answered the individual adult questionnaire in wave 4, Table 3-1 shows the sample size at each wave. Wave 4 was used in this analysis as it was the most recent wave at the time of conducting the data analysis for this thesis.

Table 3-1 NIDS attrition across waves

		Interviewed in Wave 1	Interviewed in Wave 2	Interviewed in Wave 3	Interviewed in Wave 4
First Present in Wave 1	CSM	26776	21116	21394	20778
First Present in Wave 2	CSM		1856	1596	1557
	TSM		5565	3144	2281
First Present in Wave 3	CSM			1346	1234
	TSM			5102	2540
First Present in Wave 4	CSM				1723
	TSM				7255
First Present in Wave 5	CSM Total CSM Original Sample CSM Top-up				
	TSM Total TSM Original Sample				
Total successful individual interviews		**26776**	**26776**	**28537**	**32582**
CSMs attempted		28226	26776	29 431	32056
TSMs attempted			5739	5 736	18313

Source: Brophy *et al.* (2018)

3.3 Measuring socioeconomic inequality

Various measures of socioeconomic inequality have been used in literature to study disparities in health such as the range, the Gini coefficient (and the associated Lorenz curve), a pseudo-Gini coefficient (and an associated pseudo-Lorenz curve), the index of dissimilarity, the slope index of

inequality (and the associated relative index of inequality) and the concentration index (and the associated concentration curve). (Wagstaff et al. 1991). This thesis uses the concentration curve, concentration indices and the decomposition of the concentration index to assess socioeconomic inequalities in NCDs and the use of services for NCDs. A concentration curve is used to assess whether socioeconomic inequality in some health variable exists (O'Donnell et al. 2008). The concentration curve is plotted to depict the cumulative distribution of a health variable against the cumulative share of the population ranked from the poorest to the richest. This is unlike the range that only focuses on comparing the extremes of the socioeconomic groups disregarding the middle groups or the changes therein. By overlooking what is going on in the intermediate groups, there is a risk that while the gap between the top and bottom groups might, for example, remain unchanged, the extent of inequality between the intermediate groups might well be worsening.

The Gini coefficient and its associated Lorenz Curve is an improvement on the range with respect to including the entire population however it makes no reference to the socioeconomic distribution of the population with respect to health hence cannot answer the question on the extent to which the observed inequalities in health are related to inequalities in socioeconomic status. This limits its policy applications as inequalities in health without any reference to socioeconomic inequalities does not lend itself to any plausible interventions to address the observed disparities. There is consistent evidence throughout the world (O'Donnell et al. 2008; Wagstaff 2002) and in South Africa in particular,(Ataguba et al. 2015; Ataguba et al. 2011; Umuhoza and Ataguba 2018), that people at a socio-economic disadvantage suffer a heavier burden of illness and have higher mortality rates than their better-off counterparts (Mackenbach and Kunst 1997).

The pseudo-Gini and pseudo-Lorenz curves are an improvement on the Gini coefficient and Lorenz curve respectively in factoring in the socioeconomic measures however they order occupational classes according to their health status instead of ordering health status according to social classification. They too fall short in assessing inequality in health to influence policy as they are unable to capture the socioeconomic dimension to inequality in health.

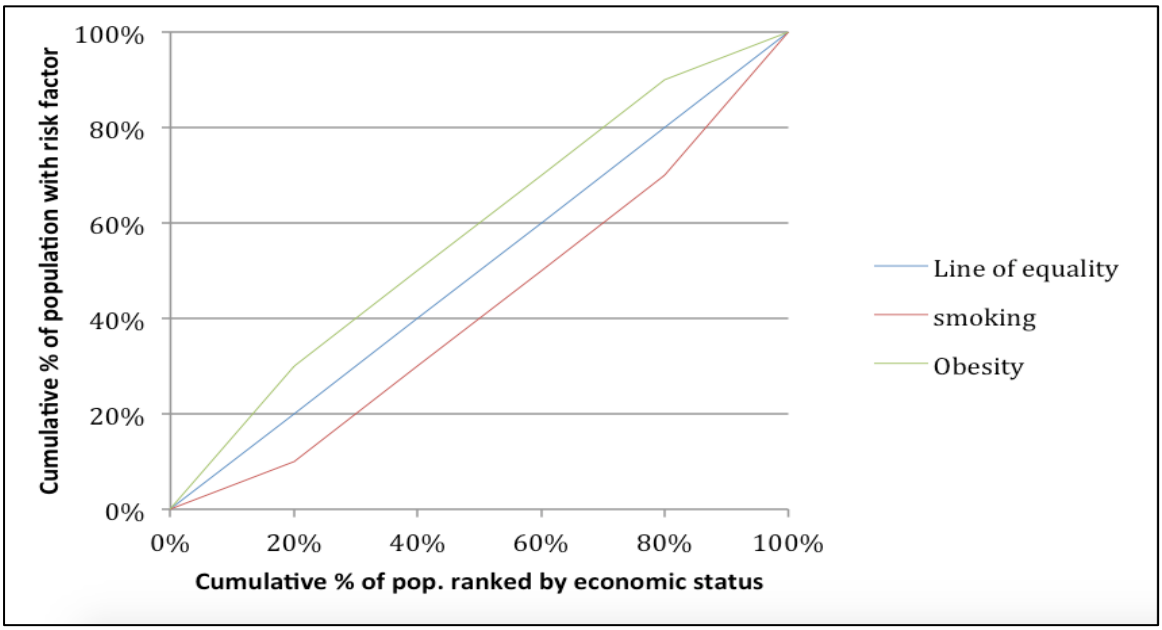
Another measure is the index of dissimilarity which also suffers from the same disadvantage of being insensitive to the socioeconomic dimension to inequalities in health. With the index of dissimilarity, each socioeconomic group's share of the population's health is compared with its population share, without reference to how this disparity compares with the socioeconomic status of the group. Therefore, to answer the question of inequality in health along a socioeconomic gradient, other measures have been proposed such as the slope and the relative index of inequality have been used. These two indices are similar to the concentration index in that they also reflect socioeconomic

dimension to the inequalities in health across the entire population while being sensitive to changes in the distribution of the population. However, the slope index of inequality has the additional quality of sensitivity to changes in the mean health status making it attractive to analyse absolute differences in health status rather than relative differences. The same outcome can be achieved with the generalisation of the concentration index. Therefore, the concentration index was chosen for this thesis because it reflects the socioeconomic dimension to inequalities in health, the experience of the entire population and it is also sensitive to changes in the distribution of the population across socioeconomic groups. It is ideal when assessing socio-economic inequalities in health and this method has been used extensively (Wagstaff et al. 1991). Further, the concentration index can be easily decomposed while the concentration curve has visual appeal (Erreygers 2009a).

3.3.1 The concentration curve

An illustration of the concentration curve is shown in Figure 3-1. The y-axis shows the cumulative percentage of the population that is exposed to the risk factors for NCDs, e.g. smoking or obesity. The x-axis shows the cumulative percentage of the population ranked by their socioeconomic status. The curves then plot the share of the risk factors (i.e. the health variable) against the measure of socioeconomic status. The 45-degree line represents the line of equality. In Figure 3-1, the concentration curve of obesity lies above the line of equality indicating a pro-poor distribution (i.e. the prevalence of obesity is disproportionately higher amongst the poor than the rich). On the other hand, the curve for smoking lies below the line of equality, indicating a pro-rich distribution (O'Donnell et al. 2008).

Figure 3-1 **A hypothetical example showing the concentration curves**



3.3.2 Concentration Index

Directly linked to the concentration curve is the concentration index, which quantifies the extent of inequality in the distribution of the health variable. It is defined as twice the area between the concentration curve and the line of equality. The concentration index is bounded between -1 and +1, and the closer its value to -1, the more the health care variable is concentrated amongst the poor (O'Donnell et al. 2008). For binary variables, the bounds of the concentration index depend on the minimum, the maximum and the mean (μ) of the health variable and will not lie between -1 and 1. Instead, it will lie between $\mu-1$ and $\mu+1$. There is some debate about the correct method for normalisation to ensure that the index lies between -1 and +1 (Erreygers 2009b; Wagstaff 2009). The Wagstaff's method of normalisation has been used extensively in previous studies on assessing inequality in the use of health services (Wagstaff et al. 2003) and similarly the Erreyger's method (Carrieri and Wuebker 2013). However, a concise technical review comparing both methods has been done (Kjellsson and Gerdtham 2013). This thesis presents results using the Wagstaff method.

For simplicity, the concentration index (C_y) can be computed as:

Equation 1

$$C_y = \frac{2}{\mu_y} Cov(h_i, R_i)$$

Where μ_y is the weighted mean of the health variable for the sample, y denotes the health variable, R_i is the fractional rank of the index of household socioeconomic status (for weighted data), and Cov denotes the weighted covariance.

A negative value of C_y depicts a pro-poor distribution while a positive value means that the health variable is distributed more amongst the non-poor.

Wagstaff's normalised concentration index (C_{y_w}) is written as (O'Donnell et al. 2008):

Equation 2

$$C_{y_w} = \frac{C_y}{(1-\mu_y)}$$

The Erreygers' normalisation C_{y_E} is computed as shown in Equation 3:

Equation 3

$$Cy_E = \frac{4\mu_y}{(b_n - a_n)}\ Cy$$

where C_y and μ_y remain as previously defined and b_n and a_n are the upper and lower bounds of the health variable, respectively.

All analyses were performed in Stata v13 using the Distributive Analysis Stata Package (DASP) (Araar and Duclos 2013), the *conindex* method (O'Donnell et al. 2016) and the decomposition analysis using the FGT_CI package (Bilger et al. 2016).

3.4 Measures of socioeconomic status

Approaches to measuring socioeconomic status include direct measures such as income, and consumption expenditure and indirect or proxy measures such as education or the more complex asset and wealth indices. These are described briefly below.

3.4.1 Income

Income is the amount of money received from labour or services, from the sale of goods, gifts or as profit from financial investments (O'Donnell et al. 2008). The advantage of income as a measure

socioeconomic status is that it is directly related to the material resources available to an individual (Galobardes et al. 2006), and as confirmed in a USA study, there is a dose-response association between health outcomes and income. This study found that the income-mortality gradient was much smaller at high-income levels than at low- to moderate-income levels (Backlund et al. 1996). In terms of data collection, income information can be easily collected from central government databases such as the revenue authorities were such exist. Although income has a cumulative effect over the life course, of the direct measures of SES, it is one measure that can change the most on a short-term basis (Galobardes et al. 2006). This makes income a less reliable measure in the long term compared to expenditure and consumption (Rutstein and Johnson 2004). Therefore, given the challenges with income such as seasonality variations and the high unemployment rates in some countries (see Box 1) alternative measures of wealth have been used in most of the inequality literature.

Box 1: Drawbacks of income as a welfare measure

1. Where there are high levels of unemployment, many respondents may not respond to the income question. Therefore, there will be a lot of missing data
2. In economies where most of the people are self-employed, it could be challenging to compute actual total income over a defined period
3. Seasonal variations in income may lead to inaccuracies in data collection as this will depend on the period
4. Income is prone to misrepresentations from respondents with under or over-reporting
5. Income earned by one member of a household may not be shared across the entire household
6. Problems with valuing home production
7. Problems with reporting unearned income such as interest, rental income etc.

Source: (Rutstein and Johnson 2004)

3.4.2 Consumption expenditure

Consumption refers to the goods and services consumed. Consumption expenditure has been proposed as a proxy for income. Its advantage is that consumption can be smoothed over time to indicate a long-term representation of actual income (Rutstein and Johnson 2004). Similar to income, consumption data also has some drawbacks such as recall bias, a lack of standardisation in the type of consumption goods used as a measure of welfare in data collection, and in most instances relying on only one individual in the household to capture the data (Rutstein and Johnson 2004).

Box 2 Challenges associated with consumption expenditure

1. Goods bought by different household members may not benefit the entire household, e.g. school fees, buying alcoholic beverages that only benefit certain members. Therefore, the allocation of such expenditure across the entire household may not give an accurate measure of welfare for all members of the household
2. Interviews on household consumption are typically done with the one member of the household mainly the household head, and such consumption data from the other members of the household may be captured incorrectly.
3. Most expenditure surveys use a limited list of consumption items in the calculation of the consumer price index leaving other significant but infrequent expenses such as school fees and holiday visits
4. There is also a lack of standardisation on the duration to be covered in the interviews, e.g. consumption for a week or month or a year. Also, in all these, the risk of recall bias increases proportionately with the recall period.
5. Construction of consumption aggregates requires the valuation of the use of goods which depends mainly on the availability of prices of goods, nominal interest rates and depreciation rates for durable and semi-durable goods. These are not always reliably available.

Source: (Rutstein and Johnson 2004)

3.4.3 The wealth index

The wealth index is computed based on the ownership of assets and access to certain publicly provided services such as running water and electricity. It measures SES at the household level and provides a means of ascertaining relative wealth within a sampled population (Howe et al. 2008). The Demographic Health Surveys popularised this measure, and it was conceptualised and implemented by Filmer and Pritchett (2001). As it is based on observable assets and living circumstances such as building materials, it is much easier to collect. The wealth index has been designed to deal with some of the problems experienced with income and expenditure data in surveys such as volatility as it represents a more permanent measure of living standards than income or consumption (Rutstein and Johnson 2004). The wealth index captures financial stock as opposed to financial flows in the form of income and expenditure (O'Donnell et al. 2008).

The wealth/asset index is not without its challenges. Concerns include combining rural and urban households in a single sample when wealth associated with ownership of certain assets has different implications in the two contexts (Chuma and Molyneux 2009). For example, urban households are more likely to own different types of assets such as an electric stove compared to owning cattle in rural areas. Further urban households have access to certain social services (if these are combined with assets to compute the wealth index) such as electricity and piped water which may not necessarily be available in rural areas. In some cases, it has been found that the ordering of households along the socioeconomic gradient using an asset index is not consistent due to weak correlations between expenditure and the asset index (Chuma and Molyneux 2009).

Despite the weak correlation between consumption and asset indices, Wagstaff and Watanabe (2003) found that using an asset-based wealth index, inequality in malnutrition in 19 countries was comparable to using a consumption-based index. Further, an asset index as a measure of socioeconomic status is still preferred for its ease of data collection. Secondly, assets reflect long-term wealth because asset ownership is unlikely to change due to short-term economic shocks compared to income (Rutstein and Johnson 2004). Thirdly, although consumption expenditure is generally accepted for measuring household wealth, the asset index was not intended to be a proxy for expenditure but rather an alternative indicator of household living standards, especially in the absence of reliable data on expenditure (Harttgen and Vollmer 2011).

To construct a wealth index, Principal Component Analysis (PCA) or other forms of factor analysis is typically used (Filmer and Pritchett 2001). PCA is a multivariate technique that involves replacing a set of correlated variables with a set of uncorrelated principal components which are a linear combination of the observed initial variables that represent the unobserved population characteristics (Howe et al. 2008; Vyas and Kumaranayake 2006). The first principal component is typically used in constructing the wealth index as it explains most of the variance in the population compared to the rest of the individual principal components. However, the first principal component, even though it has the largest variance of all the components, may only account for a low proportion of the total variation which is often less than 20% (Howe et al. 2008; Vyas and Kumaranayake 2006).

Multiple Correspondence Analysis (MCA) is an alternative method on empirical analysis of categorical data. It is computed analogously to PCA, and the outcomes are similar. For example, using data from Malawi, the indices generated by PCA and MCA demonstrated high agreement (Howe et al. 2008). Also, they both displayed similar agreement with consumption expenditure, a reliable measure of welfare (Howe et al. 2008). Given the high agreement between the indices generated by PCA and MCA, and the inclusion of quantitative paraments in addition to the categorical data in the calculation of the wealth index for this thesis, PCA was used for this analysis.

3.5 Computing the socioeconomic status measure for SANHANES

A wealth index was created using PCA on the set of variables contained in Table 3-2. The first component explains 38% of the variation in the data, which is higher than observed in most studies (Howe et al. 2008; Vyas and Kumaranayake 2006). Internal consistency of this wealth index was assessed by examining the sign on the correlations between the individual asset variables and the wealth index. Furthermore, the asset scores showed a near-normal distribution using the Kernel

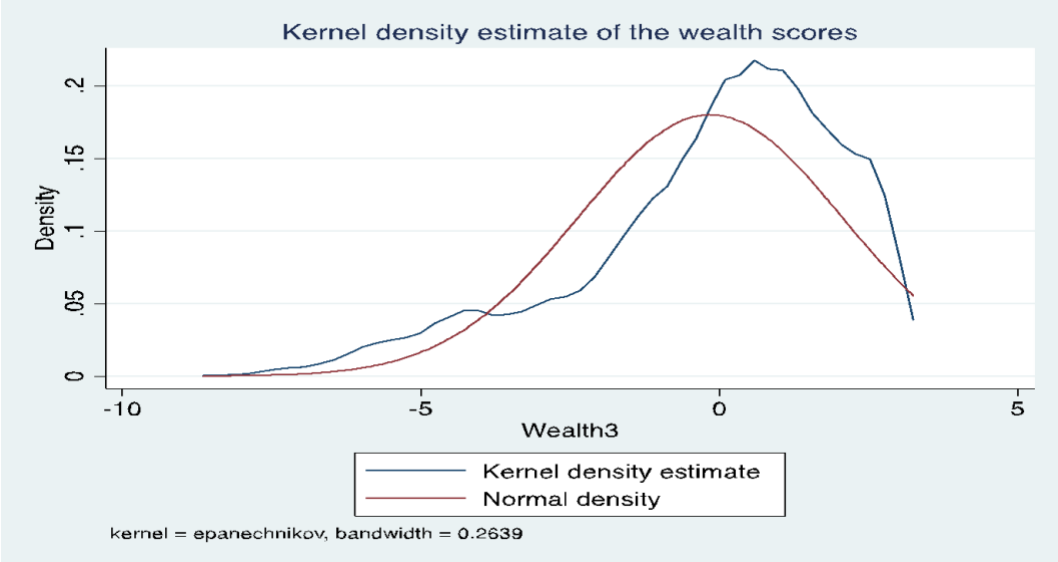
density estimate in Figure 3-2. Missing observations in all cases were assessed as missing at random and were excluded.

Table 3-2 Asset variables used to construct the wealth index and their distribution amongst the poorest and richest quintiles

Asset	% Ownership	
	Quintile 1	Quintile 5
Fridge	30%	100%
Stove	34%	99%
Vacuum cleaner	1%	79%
DSTV	2%	94%
DVD player	13%	99%
Car	6%	97%
Television	39%	100%
Radio	44%	96%
Cellphone	74%	99%
Buck toilet	12%	0%
Flush toilet	14%	100%
Paraffin lighting	12%	0%
In-house piped water	23%	95%
Number of People per room	3.14	1.4
Paraffin cooking	19%	0%
Access to a mailbox	18%	55%
Mail delivery	14%	90%

Source: Results based on the SANHANES data calculated by the author

Figure 3-2 The Kernel density plot of the wealth index scores



3.6 Computing the socioeconomic status measure for the NIDS dataset

The NIDS dataset contains household expenditure data which is used as the socioeconomic variable in chapters 4-7. The per capita annual household expenditure (dividing the household expenditure by the household size) was used to rank households according to socioeconomic status. The household expenditure data was not equivalised in this thesis to account for household composition. The NIDS dataset does not provide equivalised wealth measures in the data set. The choice of equivalence scale is also subject to debate (Woolard and Leibbrandt 1999) and studies using the NIDS dataset use different approaches in the equivalisation (Adjaye-Gbewonyo et al. 2018; Mukong et al. 2017), including per capita household income (Ataguba et al. 2015). Further, Mukong, Van Walbeek and Ross (2017) finds that the extent of socioeconomic inequality in health using the NIDS database is similar with both the equivalised and per capita household expenditure. This thesis, therefore, uses the per capita household expenditure similar to Ataguba, Day and Mcintyre (2015) which controls for household size.

In estimating socioeconomic inequality, a multivariate regression model was used to estimate the relationship between the health variables and the socioeconomic determinants. An ordinary least squares (OLS) regression model was used to estimate this relationship. While binary response models may be applied, previous studies have shown that the estimates obtained using the OLS model do not differ significantly from those obtained using binary response models (Yang 2013). Further, other components of the equity analysis linked to this, such as the decomposition analysis, require a linear model (or an approximation) for implementation for more straightforward interpretation (O'Donnell et al. 2008; Yang 2013). Therefore, if h represents the health variable in question (e.g. smoking, use of screening services, etc.), the linear additive model that links h to a set of its demographic and non-demographic determinants is given as:

Equation 4

$$h = \beta_0 + \beta_y y + \beta_x x + \beta_z z + \varepsilon$$

where h is an indicator of health; y is the measure of wealth, x are the standardising variables (age and sex); z are the non-standardising variables derived from SDH domains e.g. income, wealth, education; B_0, β_x, β_y and B_z are the OLS parameter estimates, and ε is the error term uncorrelated with any of the variables that affect health.

3.7 Age and sex standardisation of health variables

Both policy-relevant and non-policy relevant factors can explain inequalities in health and health care. The non-policy relevant factors are standardising variables, and the distinction between the two sets of variables depends on the context of the analysis (Gravelle 2003). In most cases, demographic factors such as age and sex are used as standardising variables because differentials due to biologic factors are unavoidable. As such, policy reforms tend to focus more on those inequalities brought about by the non-demographic factors (O'Donnell et al. 2008). However, in some cases, policy reforms may be directed at certain age groups or are sex specific. Hence, demographic factors are not necessarily always used as standardising variables (Gravelle 2003). Standardisation procedures, therefore, allow for netting out inequities that are as a result of non-policy relevant factors to understand the extent of disparities brought about by factors deemed relevant for policy intervention.

Indirect standardisation was used for this thesis as opposed to the direct standardisation process, which requires the use of grouped data (O'Donnell et al. 2008). For indirect standardisation, the actual distribution of the health variable is corrected by comparing it with the distribution that would be observed if all individuals had their age but the same mean age effect as the entire population. This is because age and sex are correlated with both health and socioeconomic status.

To obtain the predicted values of the health indicator, $\widehat{H}$, the OLS parameter estimates ($\hat{\beta}_0$, $\hat{\beta}_x$, $\hat{\beta}_y$ and $\hat{\beta}_z$), individual values of the standardising variables, x and sample means of the non-standardising variables ($\bar{z}$) are used as shown in Equation 5.

Equation 5

$$\widehat{H} = \hat{\beta}_0 + \hat{\beta}_y y + \hat{\beta}_x x + \widehat{\beta_z}\bar{z}$$

Assuming a linear model, estimates of indirectly standardised health, h^s are calculated by adding the overall sample mean $\bar{h}$ to the difference between the actual and predicted health variable as shown in Equation 6

Equation 6

$$h^s = h - \hat{h} + \bar{h}$$

Rearranging Equation 6 gives Equation 7 that shows that the process of standardisation subtracts the variation in health driven by the standardising factors from the actual health distribution.

Equation 7

$$h^s = h - \sum_j \hat{\beta}_j (x_j - \bar{x}_j)$$

The standardised health variable, h^s, as opposed to the observed health variable h, is used to plot the concentration curve and to calculate the concentration index. The distribution of h^s across income is, therefore, the health status we expect to observe in an individual, irrespective of differences in the distribution of standardising factors such as demographic characteristics.

3.8 Computing the concentration index

In this thesis, the concentration index of h^s is obtained by running a regression as shown in Equation 8:

Equation 8

$$2\sigma_r^2 \left(\frac{h^s{}_i}{\mu_{h^s}}\right) = \alpha + \beta r_i + \sum_j \gamma_j X_{ij} + \varepsilon_i$$

where r is the fractional rank of the index of household socioeconomic status, $h^s{}_i$ is a health variable, μh^s is the mean of the health variable h^s, α, β and γ are the OLS estimate, X is the confounding variables age and sex and β represents the standardised concentration index.

3.9 Decomposing the concentration index

Decomposition analysis is used to explain the factors that drive the inequalities in the health variables. It is the analysis of the "*inequalities that generate the inequalities*" observed (O'Donnell et al. 2008). Decomposition methods also take into account the multi-dimensionality of inequality - that is inequality occurs along different axes, e.g. sex, rural/urban etc. (Hosseinpoor et al. 2014). As such the World Health Assembly in its recognition of the work of the Commission for the Social Determinants of Health called upon countries to disaggregate data by age, sex, ethnicity, race, caste, occupation, education, income, and employment status, where permissible (Hosseinpoor et al. 2014) hence this use of decomposition methods in this thesis.

The decomposition analysis reveals how far inequalities in the health are explained by inequalities in factors that vary systematically with socioeconomic status. This requires an exploratory analysis of the

effect of each of the determinants on the observed inequality using regression analysis. Thus, the decomposition methods separate the contribution of each factor to the observed concentration index, e.g. the inequality brought about by differences in age from inequalities due to the province of residence (O'Donnell et al. 2008). This allows policymakers to understand what policy reforms to target and to predict the extent those specific policy reforms will address inequality in health care.

The methods proposed by Wagstaff et. *al* were used in the decomposition analysis to describe the contribution of each determinant to the observed socioeconomic inequalities (Wagstaff et al. 2003). Therefore, if *h* represents a health variable e.g. the prevalence of smoking or smoking intensity and the linear additive model that links *h* to a set of *k* determinants is given as:

Equation 9

$$h = \alpha + \beta_y x^y + \sum_k \beta_n x^n + \sum \beta_p x^p \ + \epsilon$$

where x^y is the wealth index, x^n is the aggregated demographic factors, x^p is the socioeconomic or policy amenable factors.

The concentration index C_h for health variable *h* can also be written as:

Equation 10

$$C_h = \left(\beta_r \frac{\bar{x}_r}{\mu_h}\right) C_r + \sum_k \left(\beta_n \frac{\bar{x}_n}{\mu_h}\right) C_n + \sum_k \left(\beta_p \frac{\bar{x}_p}{\mu_h}\right) C_p + GC_\epsilon/\mu_h$$

Equation 10 provides a way to decompose inequality in the health variable into four parts (van Doorslaer et al. 2004). The first term $\left(\beta_r \frac{\bar{x}_r}{\mu_h}\right) C_r$ denotes the contribution of wealth inequality. It is a product of $\left(\beta_r \frac{\bar{x}_r}{\mu_h}\right)$ which measures the degree of responsiveness of the wealth variable x_r with respect to health variable *h,* also called the elasticity of *h* with respect to x_r and C_r the concentration index of x_r. The second term and the third terms are defined similarly with the second term $\left(\beta_n \frac{\bar{x}_n}{\mu_h}\right) C_n$, describing the contribution of demographic variables, while the third term $\left(\beta_p \frac{\bar{x}_p}{\mu_h}\right) C_p$, describes the contribution of other, potentially policy-relevant variables and the last term (GC_ϵ/μ_h) is the generalised concentration index for the error term ε.

If $\left(\beta_k \frac{\bar{x}_k}{\mu_h}\right) C_k$ is positive and factor x contributes x% to C_h, then it means that all things being equal, income-related disparities in health variable (h) would be x% lower if factor x is either equally distributed across the income range or if the elasticity is zero i.e. $\left(\beta_k \frac{\bar{x}_k}{\mu_h} = 0\right)$ (O'Donnell et al. 2008). Equation 10 can be easily computed in Stata. The standard errors for the various components of the concentration index decomposition may be obtained by bootstrapping methods (O'Donnell et al. 2008).

In summary, the following stepwise approach may be used to decompose the contribution of each determinant to the concentration index.

1. Estimate a regression model of the health variable to obtain the coefficients of the explanatory variables β_k.
2. Calculate the mean of the health variable μ_h and the mean of each of the explanatory variables $\bar{x}_k$
3. Estimate the concentration index for the health variable C_h, the concentration index for each of the determinants C_k, and the generalised concentration index for the error term GC_ε
4. Quantify the absolute contribution of each determinant to the observed inequality through multiplying the elasticity of each determinant of the health variable by its concentration index i.e. $\left(\beta_k \frac{\bar{x}_k}{\mu_h}\right) C_k$
5. To ascertain the relative contribution of each determinant to the observed inequality, the result from (4) is divided by the concentration index of the health variable i.e.

$$\left(\left(\beta_k \frac{\bar{x}_k}{\mu_h}\right) C_k\right) \Big/ C_h$$

3.10 Ethical considerations

The protocol for this thesis was approved by the University of Cape Town's Human Research Ethics Committee of the Faculty of Health Sciences (ref 848/2016).

Chapter 4 Socioeconomic inequality in smoking

4.1 Introduction

This chapter assesses inequality in smoking behaviours using data from the NIDS and the SANHANES. Tobacco is the only 'drug' that kills many of its users when used exactly as intended by its manufacturers (World Health Organization 2012). The WHO describes the tobacco epidemic as one of the biggest public health threats the world has ever faced, killing more than 7 million people a year. Tobacco kills almost half of its users. More than 6 million tobacco-related deaths are a result of direct tobacco use, while around 890 000 are the result of exposing non-smokers to second-hand smoke. The burden of tobacco-related ill health and mortality is heaviest in the middle- and low-income countries (World Health Organization 2012).

Both smokers and non-smokers underestimate the risk of death as a result of smoking mainly because of the long lag period between initiation of smoking and mortality. This evolving risk is captured in the tobacco epidemic model proposed by Lopez et al. (1994). The model (Figure 4-1) shows the transition through the various phases of the tobacco epidemic. The transition is characterised by changes in the prevalence, consumption and mortality with at least four stages of the epidemic observed by epidemiological scholars (Thun et al. 2012).

4.1.1 The stages of the tobacco epidemic

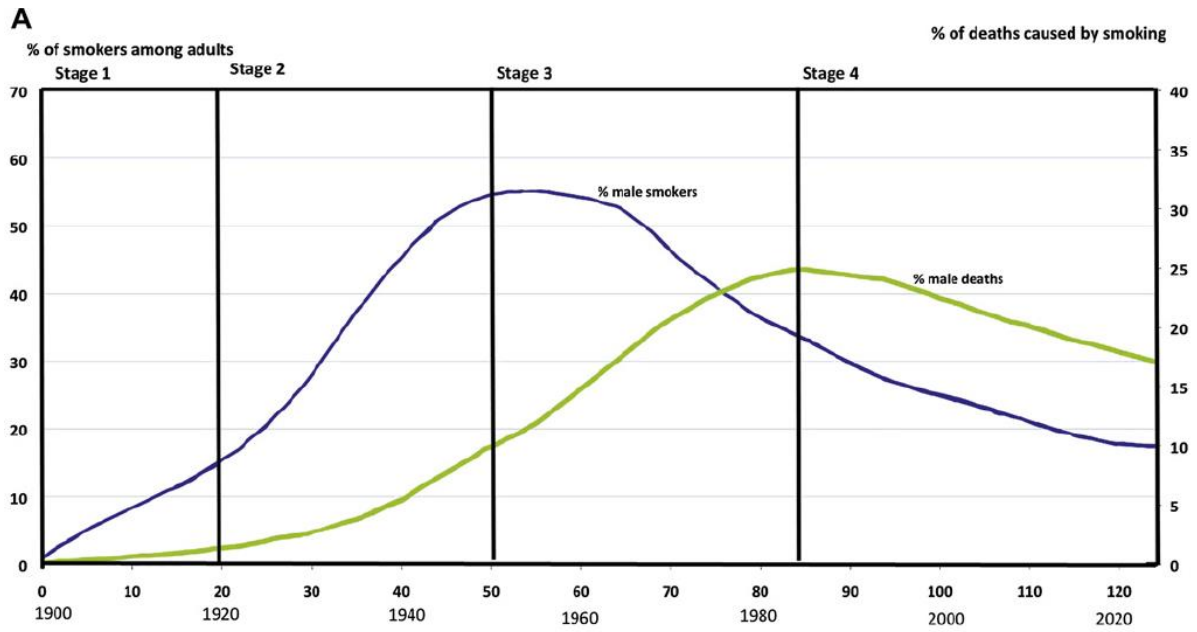
- **Stage 1**

The first stage defines the beginnings of the smoking epidemic in a population which may be relatively brief, typically covering one or two decades as smoking becomes socially acceptable. During this stage, tobacco control strategies are relatively underdeveloped. Also, diseases related to exposure to tobacco smoke such as lung cancer, for example, are rare, and in most cases, the incidence is comparable to non-smoking populations. Similarly, during this stage, the prevalence of smoking ranges from about 15% amongst men and around 10% and in some cases less than 5% in women.

- **Stage 2**

Stage 2 of the epidemic may stretch across two to three decades, with prevalence rising rapidly to about 50-80% with a very low proportion of those quitting smoking. The prevalence of smoking among women lags by about one-two decades, mainly due to gender-driven economic disparities and, to some extent, societal norms. Further, the anti-tobacco programmes, including information about the hazards of using tobacco during this period had little public and political support. By this time, tobacco will be responsible for about 10% of male deaths with a very low female mortality.

Figure 4-1 The stages of the tobacco epidemic



Source Thun et al. (2012)

- **Stage 3**

At the third stage, male prevalence begins to decline from a high of about 60% to about 40% with the lowest prevalence amongst the older men many of whom are ex-smokers. As the hazards of smoking became more widespread around the stage, female prevalence plateaus at about 35-45% with a marked age gradient and higher prevalence amongst younger females while prevalence falls to less than 10% for women older than 55-60 years. Declines in prevalence are significantly higher among the educated relative to the uneducated as the educated respond more favourably to health promotion messages. While the prevalence during this period drops, the intensity of smoking increases as a result of light smokers quitting while the heavy smokers increase their consumption. The significant public health observation during this stage is the increase in mortality from about 10% to about 25-30% within three decades. There is a rise in deaths to about 110-120 per 100 000 deaths amongst men and about 25-30 per 100 000 amongst women. At this point, the conditions for enacting stringent tobacco control policies are favourable such as smoke-free public places but not so favourable for smoke-free workplaces.

- **Stage 4**

During stage four, the prevalence for both sexes continues to decline by between 10 and 15 percentage points to about 30%. This occurs some 20-40 years after reaching the peak amongst females while amongst males the prevalence is slightly higher at about 35%. The model proposes that mortality amongst men peaks early in stage 4 with a decline to below 30%. Mortality amongst women peaks

about 20 years later, albeit to lower levels, as a result of delayed initiation and lower consumption and shorter exposure. During this stage, smoke-free personal environments become essential drivers for reducing exposure, with smoke-free worksite supported by legislation and worksite policies. To intensify efforts, an introduction of policies to support those that would like to quit but are unable to do so on their own make a significant impact.

4.1.2 International response to the tobacco epidemic

The model of the stages of the tobacco epidemic have played a role in formulating tobacco policies by the World Health Organization, chiefly the WHO Framework Convention on Tobacco Control (World Health Organisation 2005). The WHO FCTC was the first treaty negotiated under the auspices of WHO in response to the growing tobacco epidemic globally and adopted by the World Health Assembly on 21 May 2003. It entered into force on 27 February 2005 (World Health Organisation 2005). It has more than 180 signatories to date covering more than 90% of the world, including South Africa. Given the impact of tobacco smoking on health and its association with poverty, this framework, implementable at the national, regional and international levels, remains one of the key tools for achieving the sustainable development goals with a focus on both the demand and supply factors driving the epidemic (Gravely et al. 2017).

4.1.3 Tobacco control policies in South Africa

The year 1993 marked the beginning of strong tobacco control policies in South Africa. These policies included a ban on advertising tobacco products, restrictions on smoking in public places and an increase in excise duties on cigarettes, as well as interventions such as health education programmes (Winkler et al. 2015). As a result of these policies, per capita cigarette consumption declined by 54% while smoking prevalence among school children declined from 23.0% to 16.9% between 1999 and 2011 (Reddy et al. 2013). Between 1995 and 2010, smoking prevalence among men was estimated to have decreased from about 40% to 22%, while the prevalence among women remained almost unchanged at 9%.

In South Africa, it has been found that regular smoking among parents is positively correlated with smoking initiation among children while children with more educated parents are less likely to initiate regular smoking than those with less-educated parents (Vellios and van Walbeek 2016). Although taxation is advocated as a means of curbing smoking, it has been found that this has a differential impact across gender in South Africa. Vellios and van Walbeek, found that an increase in cigarette

prices significantly reduces regular smoking initiation among males, but not among females while Africans initiate later and at lower rates than other race groups (Vellios and van Walbeek 2016).

4.1.4 Inequality in exposure to smoking

Socioeconomic inequalities in smoking have been observed in both the well-developed and less developed countries. In India, data analysed from two rounds of the Indian National Family Health Surveys (2 and 3) conducted during 1998–1999 and 2005–2006, respectively found an increasing prevalence of smoking amongst men while the reverse was observed for women (Bhan et al. 2012). In this analysis, social gradients in tobacco use in India were found to differ distinctly by gender. (Bhan et al. 2012). There was a higher prevalence of tobacco use among men in each survey round in the socioeconomically disadvantaged groups while there were greater proportional increases in prevalence over time among higher SES groups. However, despite women's economic empowerment in India, the uptake of smoking had not increased significantly despite the envisaged higher uptake by women by the tobacco epidemic model (Bhan et al. 2012).

Closer to South Africa, Chisha *et al.* explored and decomposed the socioeconomic inequalities in both the prevalence and the intensity of smoking in Namibia (Chisha et al. 2019). They found that both the smoking prevalence and smoking intensity are pro-rich with a concentration index of 0.021 and 0.135, respectively. For smoking intensity, the biggest statistically significant contributors to inequality were marital status, wealth and region of residence while for smoking prevalence, education and place of dwelling (urban vs rural) were the main contributors (Chisha et al. 2019).

Compared to the less developed countries, socioeconomic inequalities in smoking are predominantly pro-poor (Schaap and Kunst 2009). In Japan, educational inequalities in current and heavy smoking were more pronounced and significant in the young population compared with older generations (Hanibuchi et al. 2016; Tabuchi and Kondo 2017). This was more pronounced in women compared to men. The same is observed in Norway, a country with comparatively lower levels of structural inequality has similar concerns regarding inequality in smoking. Low educational level was associated with high cigarette consumption, high cigarette dependence, and no intention to quit (Lund 2015). A review of studies on socioeconomic inequalities in smoking by Schaap and Kunst, confirms the above findings (Schaap and Kunst 2009). Schaap and Kunst, found a generalised pattern of higher smoking prevalence rates among lower socioeconomic groups. Lower socioeconomic groups were generally found to start smoking at a younger age, to smoke more cigarettes a day, and to quit smoking less often compared with higher socioeconomic groups. Measures of socioeconomic inequality most often

used in studies focusing on smoking include education, income, occupation class, household wealth and in some cases parental SES.

While tobacco consumption is a significant risk factor for many non-communicable diseases, the strongest association is with lung cancer (World health organization 2003). Studies also reveal a significant relationship with general ill-health. A study on the English population focusing on the impact of lifestyle factors on health inequality found that smoking and obesity make a significant but modest contribution to income-related inequality in health, 2.3% and 1.2%, respectively (Vallejo-Torres and Morris, 2010). They also found that while there was a decrease in smoking prevalence, the contribution of smoking had increased over time, due to its increased concentration among the poor and its adverse effect on health. In South Africa, a similar study found that that the burden of ill-health is significantly concentrated among individuals with high smoking intensity and longer smoking duration (Mukong et al. 2017). However, studies on prevalence based on neighbourhood deprivation do not show a linear relationship between smoking prevalence and wealth. Using nationally representative data and a validated measure for deprivation, Lau *et al.* found that the relationship between neighbourhood deprivation and smoking was non-linear with the smoking prevalence ratio highest among those in the middle range of the deprivation index (Lau et al. 2018). They also found significant differences by race, between the Black Africans and Coloured population. The association between deprivation and smoking was less clear for the Coloured population, which has the highest smoking rates in South Africa estimated at 42% versus 16% for the black population. Studies on the intention to quit smoking have shown varied results with demographic factors such as age, gender, income, education being used in models to describe the predictors of intention to quit smoking. However, the relationship between demographic characteristics and intention to quit is not consistent (Driezen et al. 2016). Nicotine dependence modulates this relationship as a predictor of quitting with those less dependent more likely to quit than heavy smokers.

The legislation also promotes quitting by restricting smokers to smoke in designated places. In Bangladesh, tighter legislation restricting smoking at both the household and work-place is associated with the intention to quit and successful cessation (Driezen et al. 2016). The role of health care professionals in assisting smokers in quitting was also found to be significant in Bangladesh. Visiting a doctor and receiving advice predicted smokers' intention to quit, thus reinforcing the role and effectiveness of the health care professional's advice (Driezen et al. 2016). While various studies have focused on inequality in smoking prevalence, none of the studies has looked at the inequality in the intensity of smoking with a view of decomposing the drivers of this inequality in South Africa. Smoking intensity is an important measure because of the dose-dependent impact of nicotine on ill-health as a result of the addictive nature of nicotine. This will assist in formulating policies on smoking

and in particular on smoking cessation as cessation is influenced to a larger extent by levels of nicotine dependence as measured by the number of cigarettes smoked per day (van Zyl-Smit et al. 2013).

4.1.5 Chapter Objectives

The objectives of this chapter are:

1. To estimate the prevalence of smoking amongst different socioeconomic and socio-demographic groups in South Africa using the NIDS survey,
2. To estimate the age at initiation across different age cohorts and across different socioeconomic quintiles,
3. To estimate inequality in the prevalence and intensity of smoking in South Africa,
4. To estimate the degree of inequality in relation to expenditure on cigarettes using the NIDS database,
5. To decompose the drivers of inequality in relation to smoking intensity using the SANHANES data.

4.2 Methods

This chapter uses both the data from the SANHANES databases and wave 4 of the NIDS, described in detail in 3.2. The NIDS is used for the assessment of inequality in smoking prevalence, intensity and expenditure on cigarettes because it contains data on household expenditure. However, the SANHANES dataset is used for the decomposition analysis to establish the drivers of inequality in smoking intensity. Although the SANHANES dataset does not contain expenditure data, it contains more relevant explanatory variables for the decomposition and indicators related to smoking/quitting than the NIDS survey. The additional indicators include the intention to quit smoking, the role of health warnings on cigarette cartons on driving, intention to quit and to smoke within households.

The concentration index described in 3.3 was used to assess the extent of socioeconomic inequality. All analyses were performed in Stata v13 (StataCorp 2013) using the Distributive Analysis Stata Package (DASP) (Araar and Duclos 2013). The `-igini-` command was used to calculate the concentration index and the `-fgt_ci-` (Bilger et al. 2016) command used to decompose the concentration index. All the analyses account for the survey design to produce nationally representative estimates. In some cases, bootstrapped standard errors were obtained using 1 000 bootstrap replications.

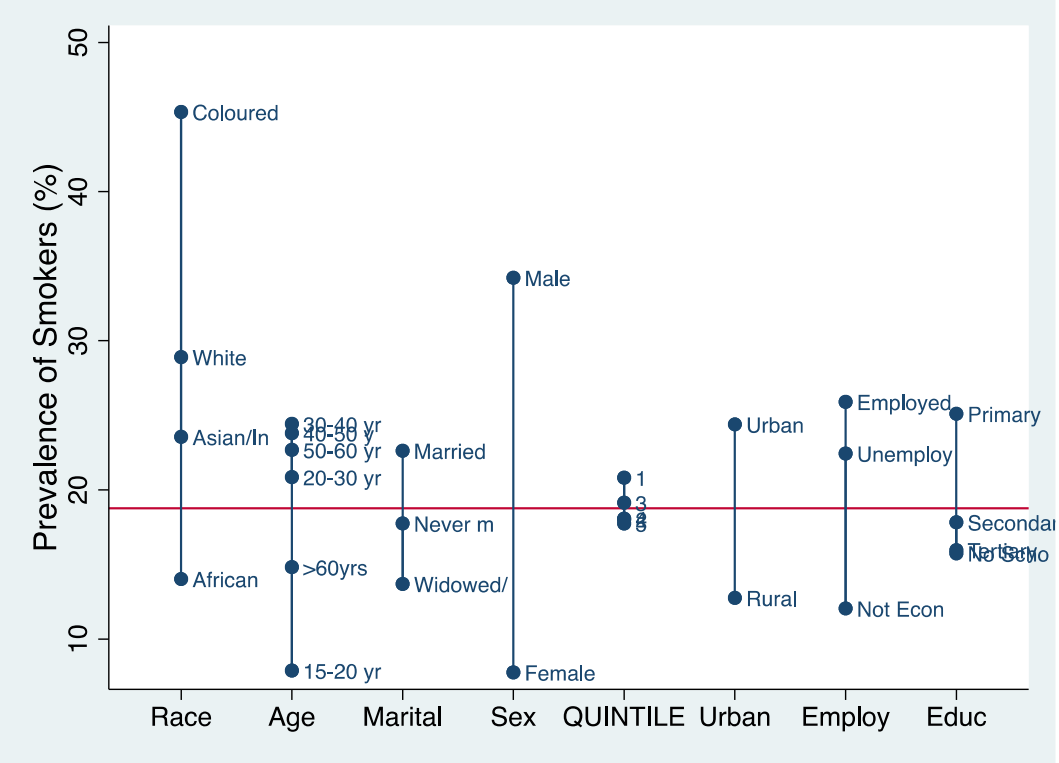
The smoking prevalence is assessed as a binary variable while smoking intensity is a continuous variable. Smoking prevalence refers to the proportion of current smokers in a specific population category while smoking intensity is defined as the number of cigarettes smoked per day for those that declared that they were current smokers for both men and women. The study also assessed inequality in relation to expenditure on cigarettes using the amount spent on cigarettes as a proportion of overall household expenditure.

4.3 Results

4.3.1 Prevalence of smoking

From the NIDS wave 4 survey, the prevalence of smoking is 18.76% shown by the horizontal red line in Figure 4-2. The highest prevalence is observed amongst the Coloured race (45%) and males (34.2%). Differences between socioeconomic quintiles are not as wide. However, the lowest quintile is higher at 20.82% compared to 17.75% for quintile 5 Table 4-2. The prevalence of smokers in urban areas is double that of rural areas, 24.4% vs 12.8%, respectively.

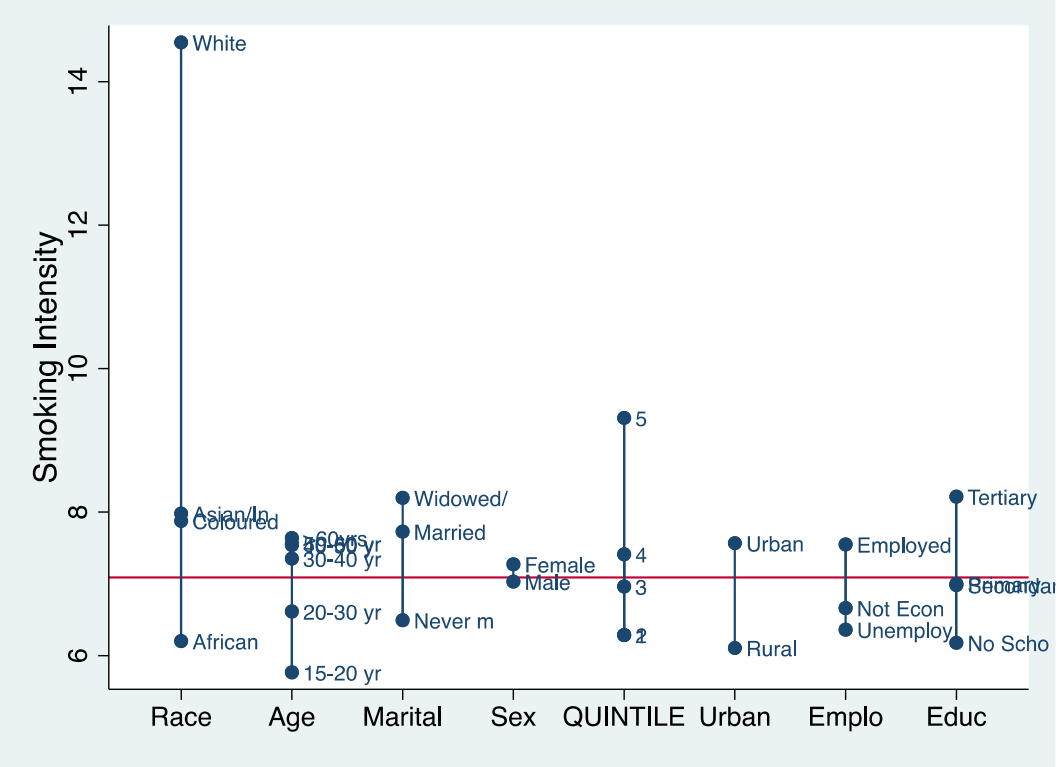
Figure 4-2 Prevalence of smoking



4.3.2 Smoking Intensity

The average number of cigarettes smoked per day based on the NIDS wave 4 surveys is 7.1 cigarettes per day, Table 4-2. The intensity of smoking assessed by socio-demographic variables shows that smoking intensity is associated with increasing wealth. The range is widest across races (Figure 4-3) with the Whites smoking 14.5 cigarettes/day, on average, compared to 6.2 cigarettes/day for Africans. Smoking intensity also increases across age groups with a low of 5.8 cigarettes/day for the 15-20-year-olds to 7.6 cigarettes for those aged 50 years and older. Smoking intensity also follows a socioeconomic gradient with the lowest average consumption of 6.3 cigarettes/day for the poorest households in quintiles 1 and 2 to 9.3 cigarettes/day for quintile 5. A similar picture is observed for education and employment status wherein the most educated smoke relatively more than the less educated; 8.2 cigarettes/day for those with tertiary education versus 6.2 cigarettes/day for those with no education. Those who are employed smoke 7.5 cigarettes/day versus 6.7 cigarettes per day for those who are not economically active.

Figure 4-3 Smoking Intensity by demographic categories



4.3.3 Age at initiation of smoking for the NIDS wave 4 respondents

Figure 4-4 shows the average age at which the different age cohorts started smoking. Compared to the age group between 15-20 years, those who are older than 60 years started smoking at the age of 20.8 years on average compared to 15.6 years for those aged between 15-20 years (Table 4-1 & Figure 4-4). This shows that the age of initiation is decreasing over time, from a high of 20.8 years for the generation older than 60 years to 15.6 years for those aged 15-20 years.

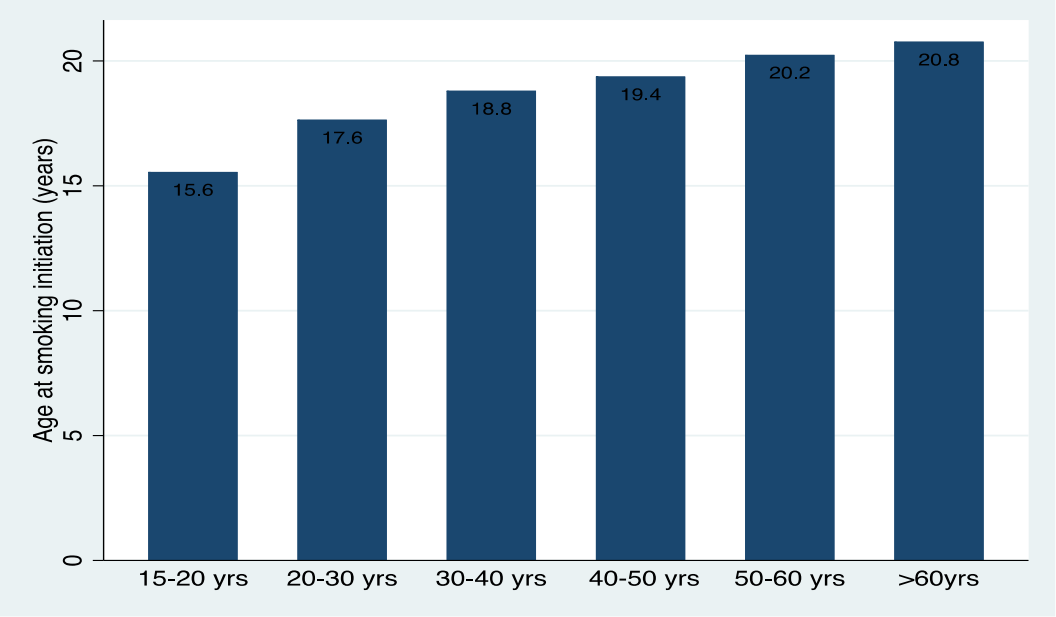
Table 4-1 Age at initiation by age cohorts

Age group	Mean (years)	Std. Err.	95% Conf. Interval	
15-20 years	15.56	0.101	15.36	15.75
20-30 years	17.65	0.094	17.46	17.83
30-40 years	18.81	0.154	18.50	19.11
40-50 years	19.38	0.218	18.95	19.80
50-60 years	20.24	0.293	19.67	20.82
>60 years	20.77	0.401	19.98	21.56

Table 4-2 Descriptive statistics for smoking prevalence and smoking intensity (NIDS, 2016)

Category	N	Prevalence	%	Smoking Intensity	Std Error	95% CI	
African	18,860	2,645	14.0%	6.20	0.09	6.02	6.38
Coloured	3,132	1,420	45.3%	7.88	0.16	7.57	8.18
Asian/Indian	208	49	23.6%	7.98	0.81	6.40	9.56
White	519	150	28.9%	14.55	0.70	13.18	15.91
15-20 years	4 477	353	7.9%	5.77	0.26	5.25	6.28
20-30 years	6 065	1 265	20.9%	6.62	0.15	6.33	6.90
30-40 years	3865	944	24.4%	7.35	0.18	7.00	7.70
40-50 years	3029	721	23.8%	7.54	0.22	7.12	7.96
50-60 years	2517	571	22.7%	7.56	0.25	7.07	8.06
>60 years	2766	410	14.8%	7.64	0.32	7.01	8.27
Married	6 931	1 568	22.6%	7.73	0.15	7.44	8.02
Widowed/Divorced	2 607	357	13.7%	8.20	0.36	7.49	8.91
Never married	13 172	2 338	17.8%	6.49	0.11	6.29	6.70
Female	13268	1030	7.8%	7.27	0.19	6.91	7.64
Male	9447	3233	34.2%	7.03	0.10	6.84	7.22
Quintile 1	4722	983	20.8%	6.29	0.16	5.98	6.59
Quintile 2	4631	835	18.03%	6.29	0.15	5.98	6.59
Quintile 3	4415	845	19.14%	6.96	0.19	6.59	7.34
Quintile 4	4111	743	18.07%	7.41	0.21	7.00	7.82
Quintile 5	3285	583	17.75%	9.31	0.30	8.72	9.91
Rural	10981	1401	12.76%	6.11	0.12	5.87	6.34
Urban	11738	2863	24.39%	7.57	0.11	7.35	7.79
Not economically active	10903	1314	12.05%	6.66	0.15	6.37	6.95
Unemployed	3053	685	22.44%	6.36	0.19	5.99	6.74
Employed	8729	2261	25.90%	7.55	0.12	7.31	7.79
No education	1931	304	15.74%	6.18	0.30	5.59	6.76
Primary	4362	1095	25.10%	7.00	0.17	6.67	7.33
Secondary	12895	2299	17.83%	6.98	0.11	6.76	7.21
Tertiary	3490	557	15.96%	8.22	0.27	7.69	8.75
Total	22678	4255	18.76%	7.09	0.09	6.92	7.26

Figure 4-4 Average age at smoking initiation across age cohorts NIDS wave 4



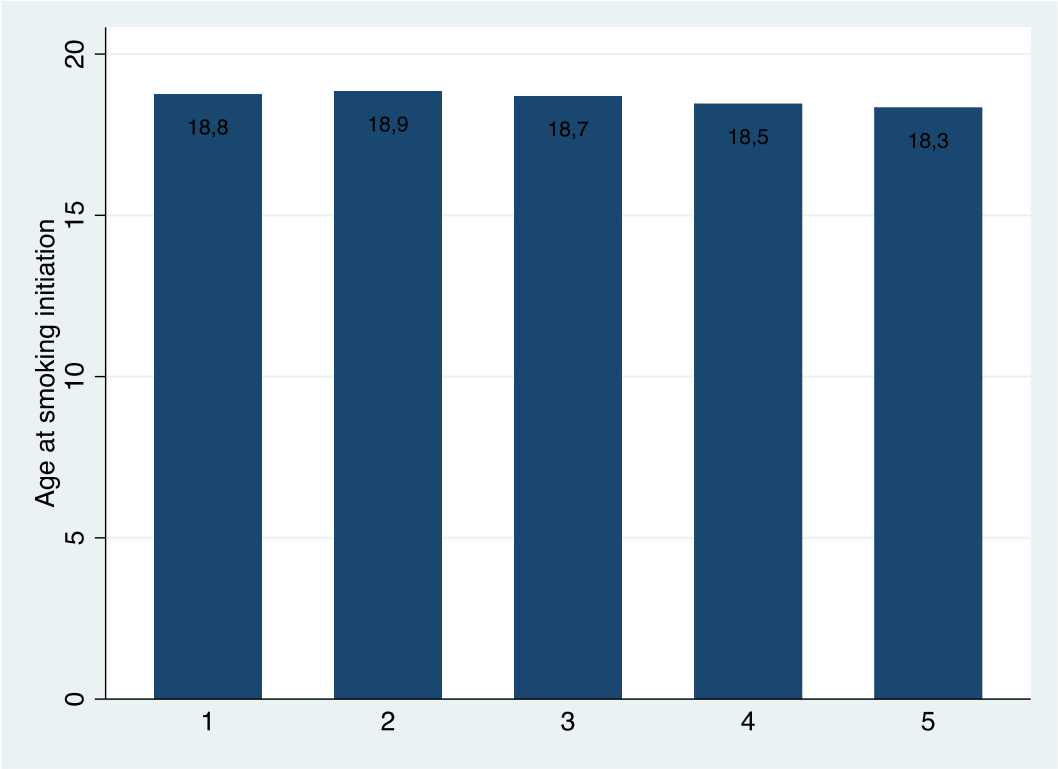
4.3.3.1 Age at smoking Initiation by quintile

There is no significant difference in the average age of smoking initiation across quintiles Figure 4-5, although the trend shows a slight decline from 18.8 years amongst smokers in the lowest quintile (Quintile 1) to 18.3 years for the highest quintile (quintile 5) Table 4-3.

Table 4-3 Age at initiation by quintile

Quintile	Mean age (yrs.)	Std. Err.	95% Confidence Interval	
1	18.76	0.183	18.40	19.12
2	18.86	0.183	18.50	19.21
3	18.70	0.191	18.33	19.08
4	18.46	0.196	18.08	18.85
5	18.34	0.188	17.97	18.71

Figure 4-5 Age at smoking initiation by quintile



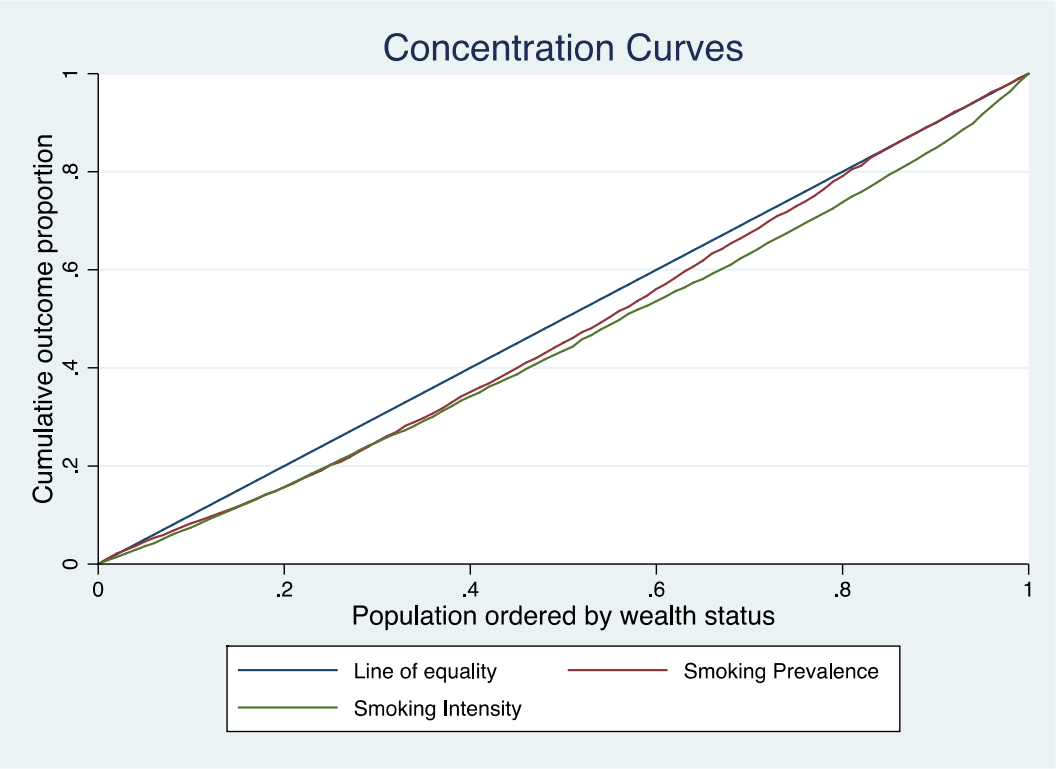
4.3.4 Socioeconomic inequality in smoking prevalence using the NIDS dataset

Both the smoking prevalence and smoking intensity are pro-rich as shown by the concentration curves in Figure 4-6 with the concentration curves lying below the line of equality. The concentration indices confirm this with the concentration index of 0.057 for prevalence and 0.099 for smoking intensity, respectively (Table 4-4).

Table 4-4 Concentration Indices for smoking prevalence and smoking intensity in South Africa (NIDS, 2014)

Group	Prevalence				Intensity			
	Concentration Index	Std Error	95% Confidence Interval		Concentration Index	Std. Error	95% Confidence Interval	
Female	0.158	0.016	0.126	0.190	0.110	0.015	0.081	0.139
Male	-0.007	0.008	-0.023	0.009	0.096	0.009	0.079	0.113
Population	0.057	0.008	0.042	0.072	0.099	0.007	0.085	0.114

Figure 4-6 Concentration curves for smoking prevalence and smoking intensity in South Africa



Smoking also brings about the gendered nature of socioeconomic inequalities in risk factors with a more strongly pro-rich inequality in females compared to males for prevalence, Figure 4-7. The concentration curve for males is closest to the line of equality signifying that there is no strong socioeconomic disparity in the prevalence of smoking for males across socioeconomic groups. This is confirmed by a small concentration index in absolute terms (-0.007) whose 95% confidence interval crosses zero, showing that even though the concentration index shows a pro-poor distribution, this is not statistically significant at 5%. On the other hand, the concentration curve for females lies clearly below the line of equality showing that the prevalence of smoking is strongly pro-rich amongst females. This is also confirmed by the positive concentration index (0.158) with a 95% confidence interval showing that this is statistically significant at 5%

The distribution of smoking intensity is strongly positive and similar across genders with the concentration curves for both males and females lying clearly below the line of equality. Figure 4-8. The concentration indices also confirm this finding. The concentration index for females is 0.110, and for males 0.096, respectively Table 4-4. Both of these indices are statistically significant.

Figure 4-7 Concentration curves for smoking prevalence in South Africa by sex (NIDS 2016)

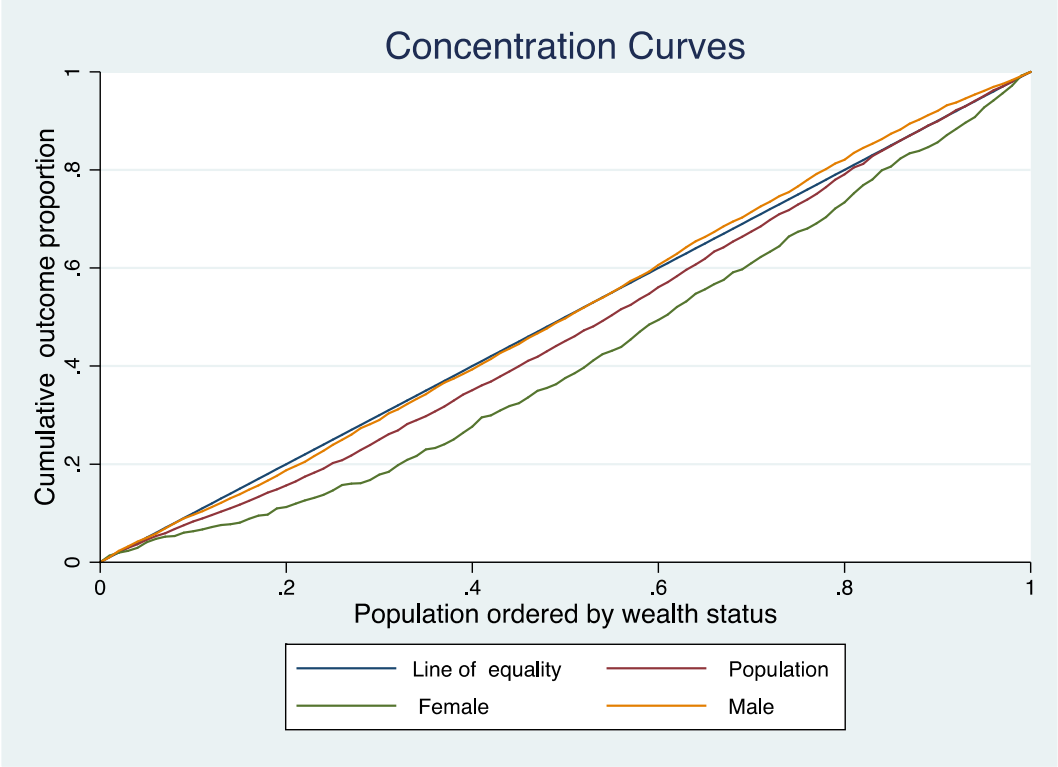
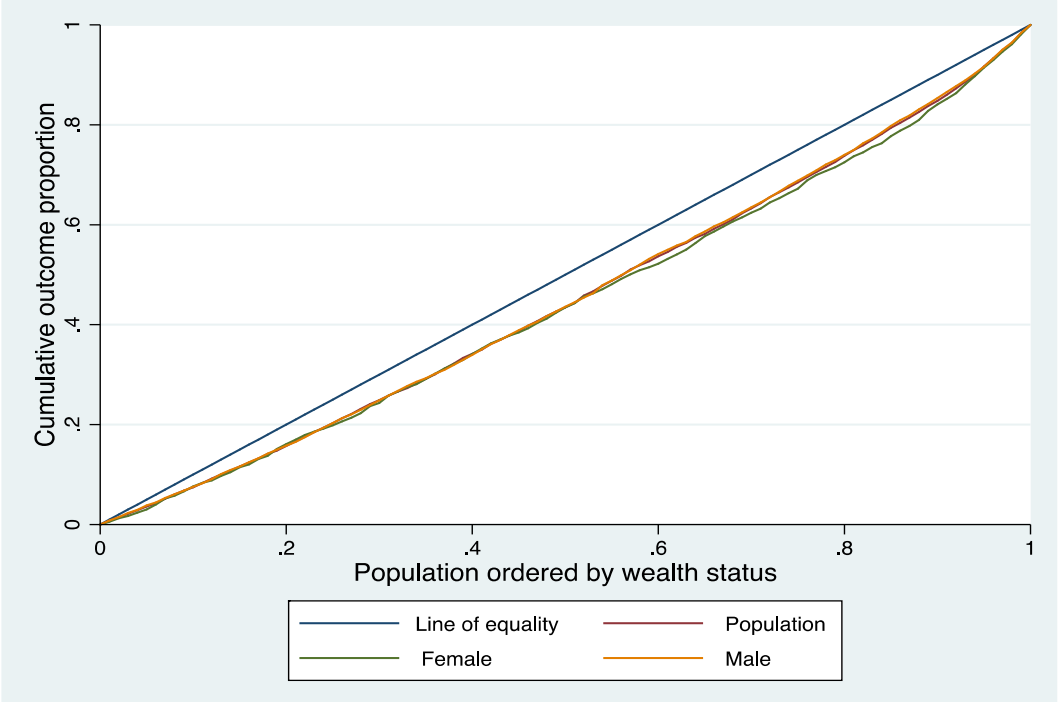


Figure 4-8 Concentration curves for smoking intensity in South Africa by sex (NIDS 2016)



4.3.5 Socioeconomic inequality in smoking intensity and the expenditures on cigarettes and tobacco

Figure 4-9 shows that poorer households (quintile 1) spend a higher proportion of their total monthly household expenditure on cigarettes relative to the richer households in quintile 5. On average, the household in quintile 1 spends 6.2% on cigarettes compared to 3% for households in quintile 5 (Table 4-5). The concentration curves lie above the line of equality in Figure 4-10, confirming the pro-poor distribution of inequality in expenditure on cigarettes. The concentration index for expenditure on cigarettes is also strongly pro-poor, -0.1301 [95% confidence interval [-0.142 - -0.119].

Figure 4-9 Smoking intensity and household expenditure on tobacco as % of total monthly expenditure by quintile

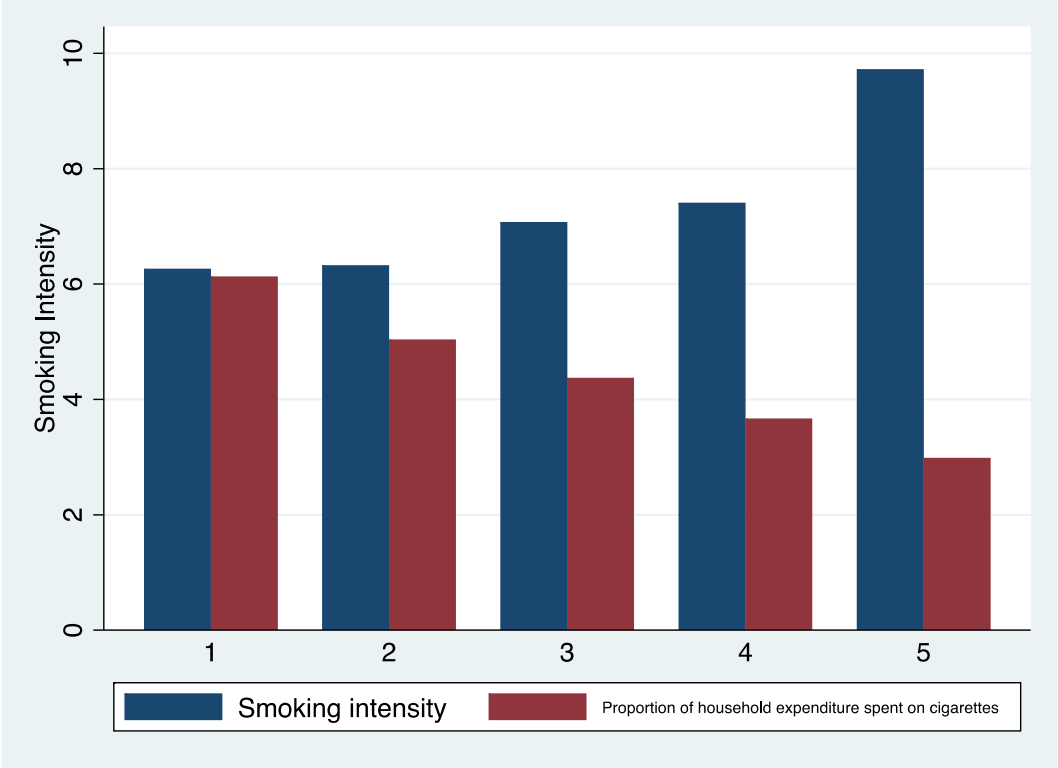
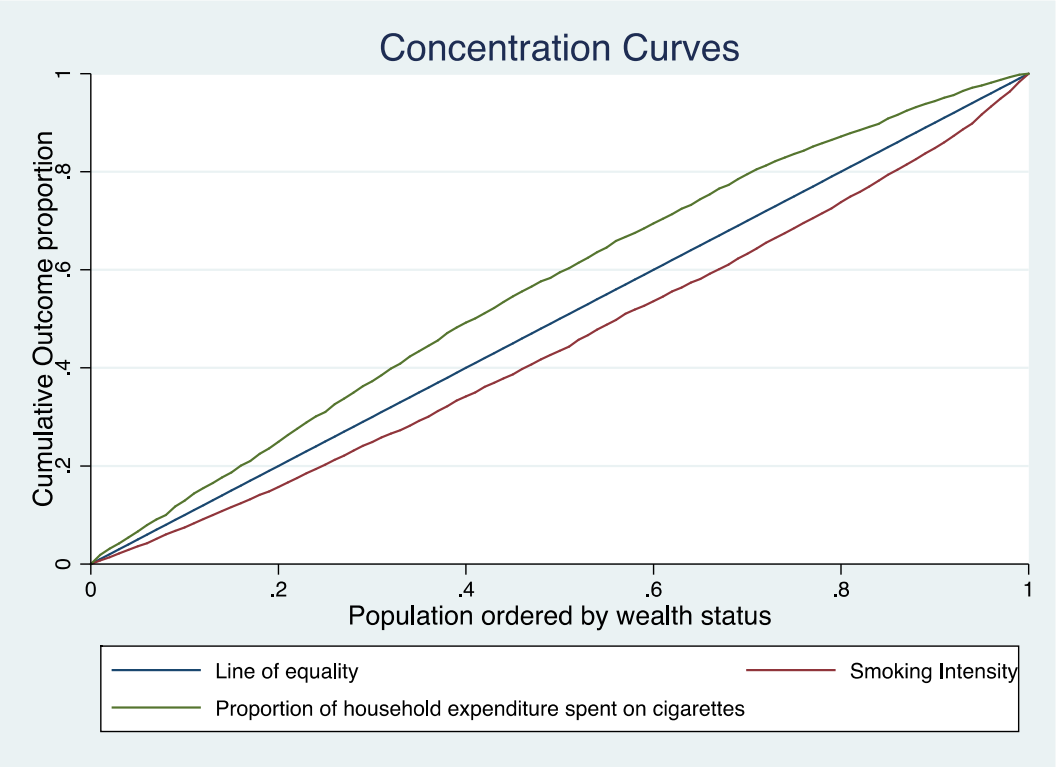


Table 4-5 Household expenditure on tobacco as a proportion of total household expenditure

Category	% Spend on cigarettes	Std. Err.	95% Confidence Interval	
Quintile 1	6.13	0.13	5.87	6.39
Quintile 2	5.04	0.10	4.84	5.24
Quintile 3	4.37	0.10	4.18	4.56
Quintile 4	3.67	0.09	3.49	3.85
Quintile 5	2.99	0.09	2.82	3.16

Figure 4-10 Concentration curves for smoking intensity and cigarette spend as a proportion of household expenditure



4.3.6 Decomposing the drivers of inequality in the intensity of smoking

This section uses data from the SANHANES to decompose the drivers of inequality in the intensity of smoking. Similar to the NIDS data, the concentration index for smoking intensity is positive (CI=0.076 [0.057-0.095]) with the CI for the female population showing a more pro-rich (CI=0.095) distribution than for the male population (CI=0.076), Table 4-6. The concentration curve supports the pro-rich inequality in smoking intensity in Figure 4-11, wherein the concentration curve lies below the line of equality.

Table 4-6 Comparison of the concentration index for smoking intensity based on NIDS (2014) and SANHANES 2012 survey

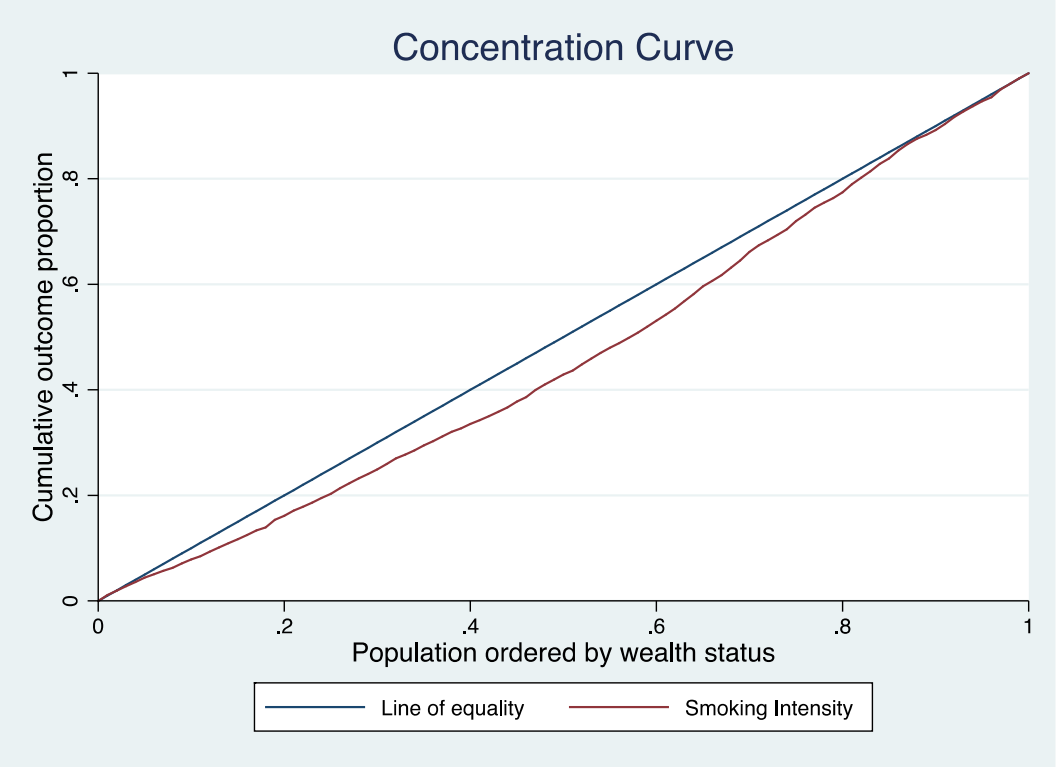
	SANHANES				NIDS			
	Concentration Index	Standard Error	95% Confidence Interval		Concentration Index	Standard Error	95% Confidence Interval	
Female	0.095	0.015	0.065	0.125	0.110	0.015	0.081	0.139
Male	0.071	0.012	0.048	0.094	0.096	0.009	0.079	0.113
Population	0.076	0.010	0.057	0.095	0.099	0.007	0.085	0.114

Table 4-7 Description of variables used in the analysis (SANHANES, 2012)

SDH	Factors	Variable	Current Smokers	Prevalence	Mean Smoking Intensity	Std. Error	95% Confidence Interval	
Socio-demographic factors		Current Smokers	3113	20.9%	7.6	0.13	7.34	7.86
	Sex	Female	1043	11.9%	7.46	0.35	6.77	8.16
		Male	2069	33.8%	7.43	0.21	7.02	7.84
	Race	African	1468	14.8%	6.59	0.21	6.19	7.00
		White	160	23.6%	11.08	1.16	8.81	13.36
		Coloured	1231	41.5%	7.80	0.28	7.24	8.35
		Indian	245	19.2%	11.41	0.60	10.24	12.58
	Age	15-20 yrs.	554	13.7%	5.24	0.29	4.67	5.80
		20-30 yrs.	669	23.3%	6.91	0.22	6.47	7.34
		30-40 yrs.	543	23.1%	7.78	0.32	7.15	8.41
		40-50 yrs.	556	26.5%	8.58	0.31	7.97	9.18
		50-60 yrs.	436	27.1%	7.90	0.31	7.28	8.51
		>60 yrs.	355	18.5%	8.54	0.56	7.43	9.65
	Marital Status	Married	1320	24.1%	8.25	0.31	7.65	8.85
		Never married	1126	20.0%	6.71	0.26	6.19	7.23
		Divorced	251	19.9%	8.21	0.66	6.91	9.50
Socioeconomic factors	Education	No education	202	20.0%	7.60	0.84	5.95	9.25
		Primary	636	26.8%	6.69	0.29	6.12	7.27
		Secondary	1629	20.4%	7.72	0.25	7.23	8.21
		Tertiary	205	16.2%	7.80	0.72	6.38	9.22
	Employment	Unemployed	1347	22.5%	7.39	0.28	6.85	7.93
		Employed	1278	25.5%	7.56	0.27	7.04	8.09
		Not econ. active	480	12.6%	7.27	0.51	6.26	8.27
	Urban/Rural	Rural	823	16.5%	6.86	0.34	6.20	7.53
		Urban	2290	23.1%	7.65	0.22	7.21	8.10
	Wealth status	Quintile 1	552	19.3%	5.91	0.33	5.26	6.57
		Quintile 2	489	19.2%	6.52	0.32	5.89	7.15
		Quintile 3	644	24.2%	6.54	0.32	5.93	7.16
		Quintile 4	570	23.1%	9.00	0.46	8.10	9.90
		Quintile 5	858	19.7%	8.06	0.38	7.31	8.80
Policy related factors	Indoor smoking at home	Yes	1650	48.3%	6.60	0.24	6.13	7.08
		No	990	9.5%	7.91	0.28	7.36	8.47
	Tried to quit	No	1384	51.1%	7.58	0.27	7.04	8.12
		Yes	1323	48.9%	7.17	0.22	6.74	7.59

SDH	Factors	Variable	Current Smokers	Prevalence	Mean Smoking Intensity	Std. Error	95% Confidence Interval	
	Aware of health warnings	No	498	18.5%	7.74	0.51	6.73	8.75
		YES	2191	81.5%	7.28	0.19	6.90	7.66
	Smoker warned to quit	No	1819	67.7%	7.94	0.28	7.39	8.49
		Yes	866	32.3%	6.98	0.23	6.53	7.42
	Health Insurance	No	2264	81.7%	7.36	0.21	6.95	7.77
		Yes	506	18.3%	7.79	0.44	6.93	8.64

Figure 4-11 Concentration curves for smoking intensity for the SANHANES-1 (2012)



4.3.7 Decomposing Inequality in relation to smoking intensity

The results of the decomposition analysis are shown in Table 4-8. On Table 4-8 the third column shows the concentration indices of the explanatory variables or socioeconomic determinants of inequality in smoking intensity. In other words, the column represents the concentration index for smokers in each category. The concentration index for age and age at initiation is positive showing that the older smokers are likely to be in the wealthier groups while those who initiate smoking at

older ages are likely to be from wealthier categories although this not statistically significant as shown by the overlapping confidence interval between the mean age for Quintile 1 [18.8 (18.4-19.1 years)] and the mean age at initiation for Quintile 5, [18.3 years (18.8-18.7 years)]. Compared to Black South African smokers, other racial groups are likely to be wealthier see column 3, Table 4-8.

The fourth column in Table 4-8 shows the elasticity of smoking intensity with respect to each of the covariates. The results show that smoking intensity is responsive to most of the covariates, with most showing a statistically significant response. A summary of this analysis is shown in Figure 4-12, depicting the proportion of inequality in percentage form driven by each of the socioeconomic factors.

The main focus of this analysis is to estimate the contributions of the different socioeconomic factors to the observed pro-rich inequality. The five biggest contributors in absolute terms, to the observed inequality to smoking intensity, are wealth status (69%), race (38%), health insurance (-19%), education (13%) and age (10%). The contribution of a covariate to the observed inequality is a product of the covariate's own concentration index and smoking intensity's elasticity with respect to the covariate. A negative contribution means the covariate promotes pro-poor inequality while a positive contribution means the covariate promotes pro-rich inequality.

The concentration index for smoking intensity is strongly pro-rich, and this is in part due to the positive contribution of wealth status, race, education, age and smokers having been advised to quit by their health care providers. The intensity of smoking is also a function of affordability; hence the wealthier smokers tend to smoke more cigarettes per day than their less wealthy counterparts; hence the positive contribution of socioeconomic status. Non-African smokers tend to be richer than the African smokers; hence the concentration indices for White, Coloured and Indian smokers is positive. These racial groups also tend to smoke more cigarettes per day than African smokers hence the positive contribution of race. Education contributes positively to the concentration index because higher education is associated with both higher socioeconomic status and higher smoking intensity. Smoking intensity increases with age as does the accumulation of wealth hence the positive contribution of age. Marital status confers an economic advantage and is also protective with respect to smoking intensity hence the pro-rich contribution to the observed inequality.

Smokers that have been advised to quit by their health care providers are likely to be significantly less wealthy smokers and they also smoke less than those smokers who reported that they had not been advised to quit by their health care provider. This explains the 5% positive contribution to the observed inequality in smoking intensity

Health insurance cover, urban residence, sex, employment and age at initiation of smoking contribute negatively to the observed pro-rich inequality in the intensity of smoking. While one would expect a positive contribution for health insurance, urban residence, age at initiation and employment because they all have a positive concentration index, their elasticities are negative. This means that a person with health insurance cover, or who lives in an urban area relative to rural, and those who are employed are wealthier but smoke relatively fewer cigarettes hence the negative contribution. Because of the addictive nature of nicotine, those who initiate smoking later on in life tend to be richer and also smoke fewer cigarettes as shown by a negative and statistically significant elasticity. Male smokers are significantly less wealthy than female smokers (CIk=-0.039), yet they tend to smoke significantly more than females with a statistically significant positive elasticity of 0.2.

The total contribution of the remaining factors-awareness of health warnings on a cigarette carton, indoor smoking within residential homes, previous smoking cessation attempts attribute minimally to the observed pro-rich inequality with a combined -5% contribution. It is, however, worth noting that indoor smoking intensity has a significant and positive elasticity with respect to individuals who come from families where indoor smoking is practised. Further smokers that have previously attempted to quit are likely to be significantly less wealthy than those who have not attempted to quit.

Figure 4-12 The relative contribution of the explanatory variables to the observed inequality in smoking intensity

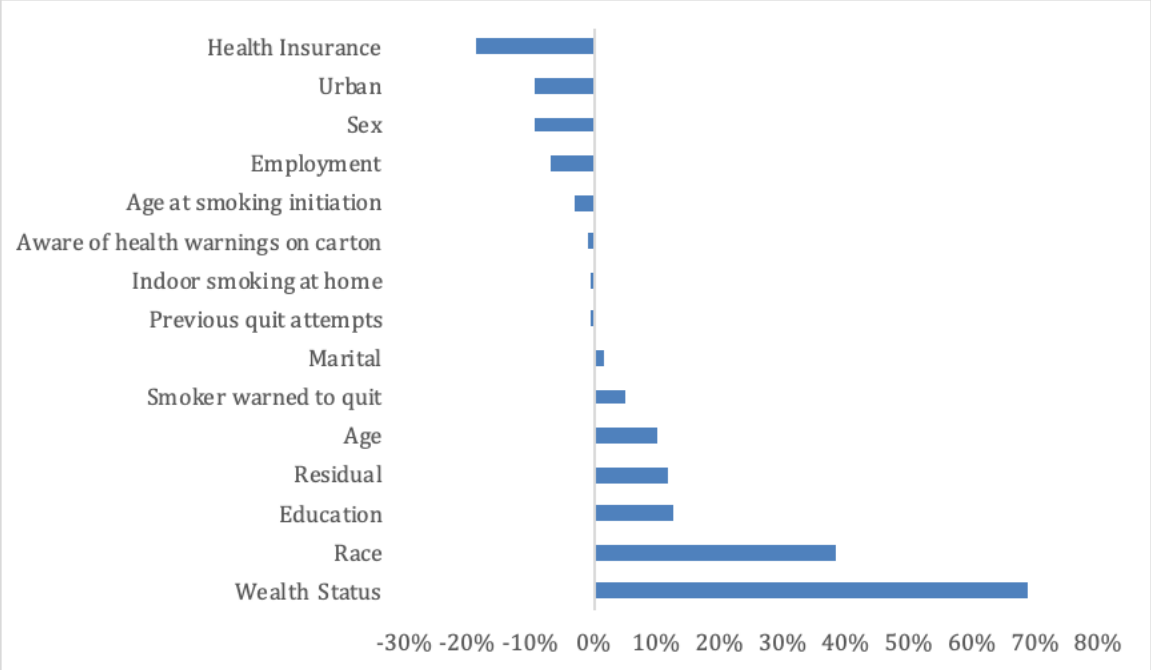


Table 4-8 Decomposition analysis of smoking intensity (SANHANES, 2012)

Factors	Variable categories	Concentration index (CIk)	Elasticity	Contribution of individual categories of factor variables	Contribution Total
Age	Age	0.018*	1.261**	N/a	0.023
	$(Age)_2$	0.039*	-0.354		-0.014
	Age at initiation	0.006	-0.373**		-0.002
Race	Black	Base			0.032**
	White	0.678**	0.039**	0.027**	
	Coloured	0.065	0.031**	0.002	
	Indian	0.368**	0.010**	0.004**	
Sex	Female	Base			-0.008**
	Male	-0.039**	0.200**	-0.008**	
Marital Status	Married	Base			0.001
	Widowed/Divorced	-0.093**	-0.015	0.001	
	Never married	0.027	-0.005	-0.0001	
Education	No education	Base			0.011
	Primary	-0.326**	-0.02	0.006	
	Secondary	0.064**	0.028	0.002	
	Tertiary	0.433**	0.006	0.002	
Employment	Not economically active	Base			-0.006
	Unemployed	0.078**	-0.048	-0.004	
	Employed	0.105*	-0.019	-0.002	
Urban/Rural	Rural	Base			-0.008
	Urban	0.128**	-0.061	-0.008	
Wealth status	Quintile 1	Base			0.058**
	Quintile 2	-0.534**	0.026	-0.014	
	Quintile 3	-0.157**	0.027	-0.004	
	Quintile 4	0.271**	0.072**	0.019**	
	Quintile 5	0.750**	0.075**	0.056**	
Indoor smoking at home	No	Base			-0.0004
	Yes	-0.004	0.079**	0.0004	
Tried to quit	No	Base			-0.0003
	Yes	-0.039*	0.006	0.0003	
Aware of health warnings on carton	No	Base			-0.001
	Yes	0.017	-0.052	-0.001	
Smoker warned to quit by healthcare professionals	No	Base			0.004
	Yes	-0.070**	-0.06	0.004	
Health Insurance	No	Base			-0.016
	Yes	0.574**	-0.027	-0.016	
	residual				0.01
	Total				0.084**

Note: *p<0.1, **<0.05

4.4 Discussion

This chapter assesses socioeconomic inequality in the prevalence and intensity of smoking. It also breaks down the drivers of inequality in smoking intensity through a decomposition analysis. Our findings are similar in nature and magnitude to the study by Chisha et al. (2019) in Namibia. We also

found a pro-rich socioeconomic inequality in both the prevalence and intensity of smoking in South Africa as they did in Namibia. A previous study in South African by Mukong et al. (2017) found a similar trend in relation to the extent of inequality in smoking prevalence however, no South African studies have focused on smoking intensity. Further, our study differs from Mukong et al. (2017) in that they studied the relationship between income-related health inequality and cigarette smoking while our focus is on inequality in relation to the smoking prevalence and smoking intensity.

Our findings on the pro-wealthy inequality in relation to smoking prevalence differ from previous studies that have focused on developed countries such as Japan (Fukuda et al. 2005; Hanibuchi et al. 2016; Tabuchi and Kondo 2017), Norway (Lund 2015) and Sweden (Eek et al. 2010). In these countries, the socioeconomic gradient is pro-poor. This could be explained by the fact that developed countries are likely to be much further along with the tobacco epidemic model unlike the developing world, wherein the smoking prevalence is higher among the poor than amongst the wealthy (Thun et al. 2012).

The five biggest contributors in absolute terms, to the observed inequality in smoking intensity, are wealth status (69%), race (38%), health insurance (-19%), education (13%) and age (10%).

While wealth plays a significant role in driving pro-rich inequality, contributing 69% to the observed inequality in the intensity of smoking, it is important to note that poorer households spend a higher proportion of their overall household expenditure on cigarettes. So while higher taxation is a desirable policy instrument to reduce the demand for cigarettes in South Africa (Mukong and Tingum 2018), increasing taxes may have the unintended consequence of deepening the observed pro-poor inequality in cigarette expenditure. Therefore, a multifaceted strategy such as assisted smoking cessation coupled with taxation may be more effective in bringing down smoking intensity in South Africa since the result showed that those who had previously attempted to quit are the poorer smokers predominantly.

Smoker's age and age at initiation are both significant determinants of smoking intensity and contribute 10% to socioeconomic inequality with regards to smoking intensity. The average age of the respondents who were current smokers is 41 years. This is supported by data from other studies in South Africa that have found the highest prevalence to be amongst those in the mid-age group of 30–59 years for both sexes (Winkler et al. 2015). Given the younger age of smoking initiation, around 18 years, this points to an average duration of smoking of almost 20 years. The long latency period between exposure and lung cancer (McCormack and Schüz 2012) and the early age of smoking initiation are likely to have huge public health consequences on morbidity and mortality in South Africa. Therefore, addressing the early initiation of smoking would contribute to curbing exposure to this risk factor and the associated long-term impact, particularly among more affluent households.

The urgency is compounded by the impact of NCDs on mortality (Statistics South Africa 2014). Efforts should be put into educating the youth to deter them or at least delay smoking initiation as this can reduce the smoking intensity.

It appears that higher levels of education are protective in as far as the prevalence of smoking is concerned in Figure 4-2 but it has a reverse impact on the intensity of smoking, Figure 4-3. It is expected that as people become more educated, as has been the case in South Africa since 1994, the prevalence of smoking will decrease, keeping other variables constant (Thun et al. 2012). This is supported by other studies in South Africa that found a negative gradient between parents' education and regular smoking initiation amongst young people (Vellios and van Walbeek 2016). However, because of the gendered nature of socioeconomic inequality in smoking, this is likely to have a greater impact on males compared to females as seen in the analysis. This is because a higher level of education is associated with being wealthy, and in this analysis, the prevalence of smoking is higher amongst wealthier women than poorer women. Wealthier women are more likely to smoke than their poorer counterparts. On the other hand, it is the poorer men that smoke more than men from richer households. This means that strategies to lower the prevalence and intensity of smoking ought to be tailored for the different groups, accordingly, given these sex differences. This is also reflected in the mortality forecasts on lung cancer that shows that while lung cancer mortality amongst men has decreased, it has generally remained stagnant for women (Winkler et al. 2015).

Similar to education, having health insurance cover confers a protective effect in relation to smoking intensity. While health insurance has a positive concentration index like smoking intensity, its contribution to smoking intensity is negative due to its negative elasticity with respect to smoking intensity. This could be a function of health promotion awareness activities that members of insurance funds are exposed to. Those with health insurance cover, compared to those without, tend to receive better clinical risk management because it is in the best interests of health insurers to ensure that the exposure to risk factors is minimised as exposure is associated with higher health care costs.

The proximal determinants of smoking intensity with a policy relevance contribute minimally to the observed inequality; however, they remain important policy levers as they influence smoking intensity to some extent. These are indoor smoking at home, individual attempts to quit smoking, awareness of health warnings on tobacco cartons and the influence of health care providers on the intention to quit. Although South Africa has introduced strict tobacco control policies, which include a ban on advertising tobacco products, restrictions on smoking in public places and an increase in excise duties on cigarettes, smoking within households is not regulated. This means non-smokers and particularly young children within those households are exposed to secondary smoke putting them at risk of the

negative health impact of smoking. This validates the assertion by Kamangar (2013) that, it is not only government or private medical funders that are solely responsible for improving health outcomes. He bases his argument on the fact that the health of any society is tightly woven into its fabric, which includes its politics, economics and the attitude of its people. Thus Kamangar (2013) argues that to have better health for all, efforts should also be made to educate and empower everyone and to share with them both the power and the responsibility to make improvements in their health and their lives. While the contribution of household behaviour to inequality in smoking in this analysis is minimal, Kamangar's (2013) assertions are still relevant in South Africa. While this analysis did not investigate causal associations, the fact that being advised by a health care provider is associated with less intense smoking may be worth exploring as it indicates the utility of this tool as a public health instrument to curb smoking intensity. This is the case in Sweden, where brief counselling was associated with a reduction in the consumption of tobacco products among regular users (Virtanen et al. 2014).

4.5 Conclusion

Understanding the drivers of inequality in the intensity of smoking is important in the formulation of policies for smoking cessation. This analysis shows that different elements drive inequality amongst the poor and the rich. Some of the determinants of inequality are more amenable to policy changes or government interventions such as improving access to education to delay or reduce the incidence of smoking at a young age, health insurance and employment etc. Approaches to addressing smoking have to be tailor-made with sensitivity to gender, race and age differences amongst other things, particularly amongst the wealthier groups. An additional vital factor to consider is the powerful impact of household-level behaviour on smoking. Although this is out of reach of government legislation, it requires societal education and individual empowerment to make decisions about exposure to smoking indoors.

Education alone is not sufficient; health literacy also plays a role. Health literacy has predictive capability over and above education for health outcomes (Lee et al. 2012; Solmi et al. 2015), hence the importance of understanding the health warnings on tobacco packaging.

Due to the negative externalities of smoking, there is value in implementing smoking cessation policies to assist smokers in quitting as this thesis shows that people are willing to quit, particularly the poorer smokers. This is grounded in the WHO Framework Convention on Tobacco Control as part of the EMPOWER, a framework to address, the use of tobacco products (World Health Organisation 2005). The study, therefore, argues for more engagement across different sectors of the economy to address the challenge of the increasing smoking prevalence and the high intensity of smoking, and the inequality observed.

Chapter 5 Wealth and obesity: looking beyond the threshold

5.1 Introduction

This chapter assesses inequality in the distribution of obesity, its depth and severity using the NIDS data. The chapter also investigates the drivers of inequality by a decomposition of the concentration indices for prevalence and depth of obesity. The main variables for this analysis are overweight (BMI≥25) and obesity (BMI≥30) based on the evaluation of the anthropometric data from the NIDS survey. Weight classification is shown in Table 5-1.

Table 5-1 BMI Classification

Classification	BMI
Underweight	≤18.5
Normal	18.5- 24.9
Overweight	25-29.9
Obese	≥30

Obesity is associated with significant morbidity and mortality. The mechanism of ill health due to obesity is complex and inadvertently affects many systems (Guh et al. 2009). It is hypothesised that in obesity there is an increase in leptin, free fatty acids and insulin, which independently and in synergy increase blood pressure, cardiovascular disease and leads to insulin resistance which results in type 2 diabetes. Obesity is also associated with pathology in the balance of triglycerides in the body leading to coronary heart disease and stroke. It has also been linked to some cancers and osteoarthritis as a result of pressure on the weight-bearing joints (Guh et al. 2009; Sieck 2014).

5.1.1 Obesity and health care costs

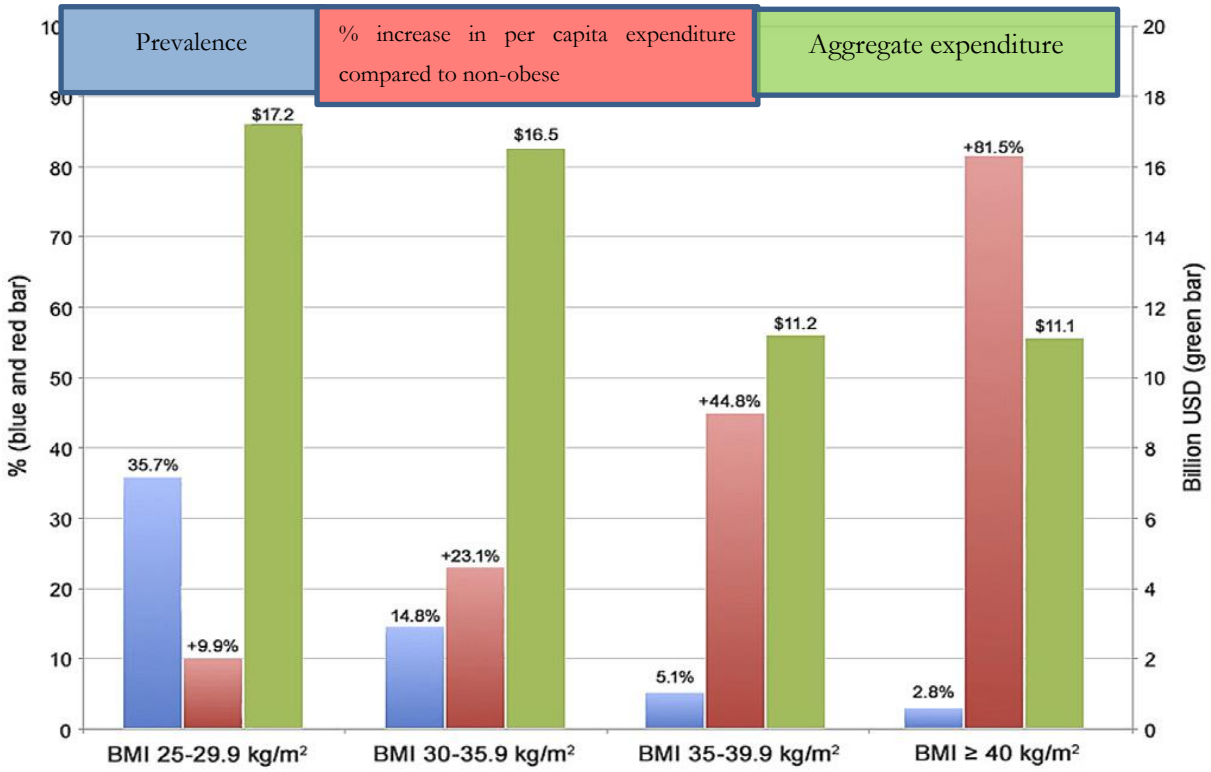
In the USA, there is a positive, curvilinear association between excess-weight and health care expenditures/costs, as shown in Figure 5-1. A similar result has been found in South Africa, with obesity associated with significantly increased health care expenditure of almost 11% higher than those with a BMI <30kg/m2 while severe obesity doubles these excess costs (Sturm et al. 2013).

5.1.2 Prevalence of obesity

Low- and middle-income countries including most of sub-Saharan Africa are experiencing a rise in the prevalence of obesity, which is the single most important driving force behind the increased prevalence of chronic diseases such as hypertension and coronary artery disease (Crowther and Norris

2012). South Africa is particularly impacted by childhood stunting and obesity, which co-exist, predisposing the youth to NCDs in adulthood, in addition to adults having higher levels of obesity (Mayosi et al. 2009). Rates of obesity vary by sex and race with higher rates of between 41% and 70% in women and 18-45% in men (Alaba and Chola 2014; Bradshaw et al. 2011; Erasmus et al. 2012a; Ker et al. 2007; Peer et al. 2015). This gendered weight pattern is particularly evident for the Coloured race group – Coloured men are disproportionately underweight, while Coloured women are disproportionately obese (Averett et al. 2014). The gendered nature of the racial differences in obesity is explained by socioeconomic status and background variables such as employment, education, residence etc. and not necessarily behavioural risk factors such as smoking and physical exercise. In their assessment of obesity prevalence in an urban African township in the Cape Town, Case and Menendez, (2009) conclude that the greater obesity rates among women are explained by nutritional deprivation that predisposes female children to a significantly higher likelihood of being obese as adults, while men who were deprived as children face no higher risk. This brings into focus the long-term impact of high rates of stunting that coexist with overweight in South Africa. Additionally, women from wealthier households are significantly more likely to be obese, while men are less likely to be so (Case and Menendez 2009).

Figure 5-1 Prevalence, the percentage increase in per capita expenditures (compared to BMI 18.5–24.9 kg/m2), and aggregate expenditures based on data from Medical Expenditure Panel Survey 2000



Source: (Lehnert *et al.*, (2013)

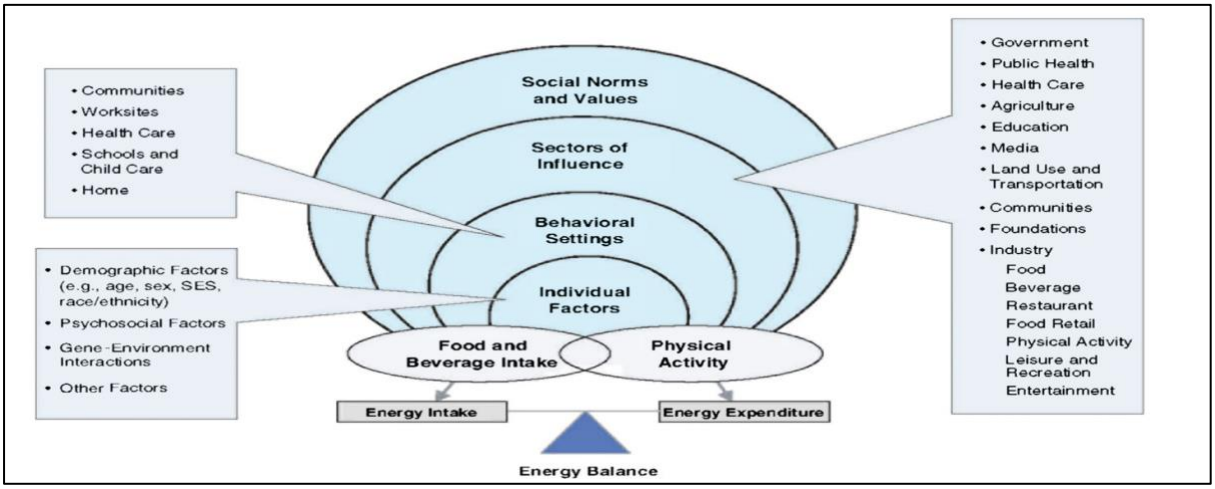
Although the prevalence of obesity appears to have levelled off in some developed countries, developing countries are experiencing a surge in obese children (Gupta et al. 2015; Levy-Marchal et al. 2010; Reilly and Kelly 2011; Weiss et al. 2013). In South Africa, the levels of obese and overweight children are comparable to those found in developed countries and are also amongst the highest in Africa. While earlier studies indicated a low prevalence of overweight and obese children (1.2% in 1994 to 13% by 2004), recent studies suggest an average of about 15% (Rossouw et al. 2012) while adult obesity prevalence increased significantly from 23.5% in 2008 to 27.2% in 2012, with a significantly higher prevalence among females, 37.9% in 2012 compared to males, 13.3% in 2012 (Sartorius et al. 2015).

In children, there is a dose-response relationship between obesity/overweight and socioeconomic status (Meko et al. 2015). For example, children whose parents have graduate occupations are significantly more overweight/obese than those with parents working in skilled occupations while stunting is higher in low socioeconomic groups compared to the high socioeconomic groups (Meko et al. 2015; Pienaar 2015). Also, children with obese parents tend to be obese (Griffiths et al. 2013) which has negative implications for general household health hence targeting households with obese adults may be recommended to stem the tide among adolescents.

Schools are in a strategic position to play a meaningful role in the prevention of obesity among school children through inculcating healthy behaviours by incorporating physical activity as part of the curriculum (Mokabane et al. 2014) or through sustainable school-based feeding schemes. However, there is little evidence of the effectiveness of current government programmes in schools (Monyeki et al. 2015). In addition, while educators can play a role, their impact as anti-obesity champions has not been studied widely and might be ineffective particularly in South Africa where levels of obesity and high waist circumference, amongst school teachers, is high (Senekal et al. 2015). Furthermore, many educators have a wrong perception of their actual body size and a lack of awareness about personal health (Senekal et al. 2015). This could potentially affect how messages of body size are filtered down to learners, particularly the adolescents who show increasing levels of obesity and other risk factors for NCDs. Parental influence may also play a role because there is a positive association between girls' BMI and their mothers' (Griffiths et al. 2013). This means that targeted anti-obesity measures are required both at the household level and within the school environment. Obesity in the elderly is also a matter of concern mainly because of escalating healthcare costs in addition to disease and disability in old age. However, hospitals and nursing homes are ill-equipped and inadequately resourced to serve the elderly in most countries, including the developed world (Salihu et al. 2009).

The primary cause of obesity and overweight is an energy imbalance between calories consumed and calories expended. This is due to the increase in energy-dense foods coupled with a lack of physical exercise. But the processes that influence excess adiposity are complex and involve an interplay of various factors that combine to produce this result such as genetic predisposition, behavioural, environmental, social, and cultural dynamics. Therefore, changes in dietary and physical activity patterns are founded on the social determinants of health which find expression in the implementation or lack of policies in sectors such as agriculture, transport, urban planning, environment, food processing, distribution, marketing, and education that influence both caloric consumption and calories expended (Figure 5-2).

Figure 5-2 Levels and sectors of influence on obesity and diabetes risk



Source: (Hill et al. 2013)

Socio-behavioural factors associated with obesity include living in formal urban areas, race, being married, lack of physical exercise, living in areas with higher crime rates, households with proportionate higher spending on food and unhealthy food options, and higher socioeconomic category (Sartorius et al. 2015). In South Africa, the apartheid legacy of spatial segregation still finds expression on the rates of deprivation across provinces. Noble *et al.* (2014) find that while poverty is declining in South Africa, the levels of material deprivation and poverty in the former homelands are still high. To capture this phenomenon, this thesis uses the Multiple Deprivation and Income Poverty at Small Area Level in South Africa to classify provinces into three categories by levels of deprivation, Table 5-2 (Noble et al. 2013).

Table 5-2 Ranking of provincial deprivation based on Noble et al 2013

Province	Rank Order (1=most deprived	Category
Eastern Cape	1	Most Deprived
Limpopo	2	
North West	3	
KwaZulu Natal	4	Moderately Deprived
Northern Cape	5	
Mpumalanga	6	
Free State	7	Least Deprived
Gauteng	8	
Western Cape	9	

Adapted from (Noble et al. 2013)

While Swinburn et al. (2011b) argue that the complexity of obesity management mandates policy interventions to be directed at the environment to make healthy choices easier rather than at the individual level (e.g. compelling them to make the healthy choices), individuals should still be supported to ensure better self-management in light of the role of citizens as "co-producers of health" (Gilson 2012).

5.1.3 Innovative approaches to obesity management in South Africa

Innovative approaches to weight management have been implemented by the private sector funders in South Africa through incentive schemes to promote behavioural change through a healthy lifestyle. One such scheme is the Discovery Health Vitality programme, an incentive scheme, run by South Africa's largest private health insurer, with over 2.5 million beneficiaries (Kolbe-Alexander et al. 2013). Members accumulate points for participating in various wellness services and programmes, such as health risk assessments, subsidised gym memberships, health checks including weight, height, cholesterol and plasma glucose, and blood pressure. Additional subsidised services include visits to dietitians and exercise specialists, smoking cessation and weight reduction programmes, access to online or in-person risk assessments; and online and print materials for health and wellness (Kolbe-Alexander et al. 2013). Members are then eligible to claim discounts on a range of purchases and services, including airline flights and subsidised gym memberships and cashback on purchases of healthy food. Outcomes from this programme show lower medical claims and hospitals admissions, lower obesity prevalence and healthier food purchases (Lambert and Kolbe-Alexander 2013a).

However, despite these positive trends in relation to overall health outcomes and healthcare utilisation and expenditure on the Discovery Vitality Programme, a significant proportion of the members still fail to use the benefits in a meaningful way. This suggests that the "carrot and stick" approach is not sufficient to overcome the utilisation barriers at the individual level (Kolbe-Alexander et al. 2013).

This could also be a function of access as a result of the location of gyms in predominantly upmarket urban areas and time constraints due to work pressures (Cheah and Goh 2017). However, this may lend credence to the assertion that policies with a systemic impact are required to make choosing a healthy lifestyle easier and less intrusive on human liberties (Swinburn et al. 2011b). The focus should be on food production and marketing and obesogenic environments that hinder participation in physical activity. This moves away from approaching obesity as an individual behavioural issue to a society-wide problem requiring policies with a global societal impact (Swinburn et al. 2011a).

5.1.4 Socioeconomic inequality in obesity

A significant concern in public health is that obesity might disproportionately affect the poor the most, compared to the wealthy as a result of the differential exposure to the social determinants of health (Bilger et al. 2016). In South Africa, however, studies show that obesity is predominantly pro-rich (Alaba and Chola 2014; Phaswana-Mafuya et al. 2013; Pienaar 2015; du Plessis et al. 2010) in keeping with the pro-consumption origins of obesity (Swinburn et al. 2011a). However, it is unknown if there is any socioeconomic inequality beyond the obesity threshold or if inequality levels differ if a lower BMI cut-off is used to include the overweight. While many studies have focused on the prevalence of obesity, no studies have assessed the extent of inequality in relation to being overweight or obese using a cut off of 25kg/m2. It has been proven from prospective cohort studies that both overweight and obesity are associated with the incidence of multiple comorbidities such as type 2 diabetes, different types of cancer, e.g. pancreatic and prostate cancer and cardiovascular diseases (Guh et al. 2009). Therefore, being overweight remains an equally important risk factor for ill-health (Guh et al. 2009) and driver of health care costs (Lehnert et al. 2013; Sturm et al. 2013) as being obese. Also chances of transitioning from overweight to obese are also as high as 25% (Hillemeier et al. 2011). Therefore, in addition to assessing inequality in relation to a BMI cut off of 25kg/m2 this thesis assesses the extent of overweight beyond the threshold, including its inequality. This chapter therefore assesses socioeconomic inequality in the prevalence, depth and severity of overweight and obesity in South Africa. It also decomposes the drivers of socioeconomic inequality in the prevalence and depth of overweight and obesity.

5.2 Methodology

5.2.1 Data

This chapter uses data from the South African National Income Dynamics Study (SA-NIDS) as described in section 3.2.

5.2.2 Measuring overweight/obesity

Each respondent's weight and height were measured according to standardised procedures in the NIDS. The BMI was calculated for each respondent and categorised as shown in Table 5-1.

5.2.3 Depth and severity of overweight

Previous studies on the socioeconomic inequality in obesity have focused on the obesity threshold with a binary description of whether one is obese or not. While that approach is useful, this chapter focuses on assessing overweight beyond the BMI thresholds. This is because the weight-related health impact of overweight/obesity will depend on how far above the threshold an individual lies. Bilger, Kruger and Finkelstein (2016) have developed an approach to account for how far individuals are from the threshold (depth and severity). Briefly, Bilger *et al.* extended their analysis to assess the socioeconomic gradient in obesity and decomposed the drivers of this socioeconomic inequality by combining the FGT indices with the concentration index (Bilger et al. 2016). Their approach is adapted and used for analyses in this chapter. Depth and severity are measured similarly to the Foster-Greer-Thorbecke (FGT) indices used in the poverty literature (Foster et al. 1984) where the depth is defined as the average excess BMI over the obesity threshold and severity as the average squared excess. The depth and severity indices provide a measure of the extent of obesity in relation to the obesity threshold Equation 11.

Equation 11

$$\mathrm{H}_{\alpha} = \frac{1}{n}\sum I(BMIi \geq 25)[BMI_i - 25)]^{\alpha}$$

where n is the sample size, BMI_i is the BMI of individual i, and 25 is the BMI cut-off point of identifying who is overweight. I is the indicator function which takes the value of one if the statement is true.

When $\alpha = 0, H_0$ represents the prevalence/status of BMI≥25 kg/m2. When $\alpha = 1$ then H_1 represents the average depth of overweight which is equal to the excess BMI of the overweight individual above the cut-off point for overweight and for obesity). When $\alpha = 2$ the resulting parameter represents the severity of overweight/obesity, which increases quadratically above the BMI threshold.

5.3 Analytical method

This thesis uses the concentration curve and concentration indices to assess socioeconomic inequality in the population that is overweight and/or obese. Prevalence or status of overweight and obese is defined as the population with BMI≥25. The intensity or depth of overweight/obese is defined as the

difference between the BMI cut off of 25kg/m2 and the individual's BMI for those who are overweight/obese while the severity is the squared function of this difference. A similar definition applies to obesity as illustrated in Table 5-3. A summary of the definition of the explanatory variables used is shown in Table 5-4.

Table 5-3 Definition of dependent variables

Category	Measure	BMI Category
Overweight/Obese	Prevalence/Status	BMI≥25
	Intensity/Depth	BMI-25 if BMI≥25
	Severity	$(BMI-25)_2$ if BMI≥25
Obese	Prevalence/Status	BMI≥30
	Intensity/Depth	BMI-30 if BMI≥30
	Severity	$(BMI-30)_2$ if BMI≥30

Table 5-4 Definition of explanatory variables

Socioeconomic determinants	Variables categorisation
Race	African
	Coloured
	Asian
	White
Sex	Female
	Male
Age	Age as a continuous variable
Marital Status	Married
	Widowed/Divorced
	Never married
Employment	Not economically active
	Unemployed
	Employed
Physical Exercise at least once a week	Never
	Yes
Smoker	No
	Smoker
Alcohol	Never
	Alcohol Rarely
	Weekly
Wealth status	QUINTILE 1
	QUINTILE 2
	QUINTILE 3
	QUINTILE 4
	QUINTILE 5
Education	No education
	Primary Education
	Secondary
	Tertiary
Health Insurance Cover	No
	Yes
Food Expenditure per capita	Amount spent on food per capita
Locality	Rural
	Urban
	Farms
Provincial deprivation status	Most deprived provinces
	Moderate deprivation
	Least deprived

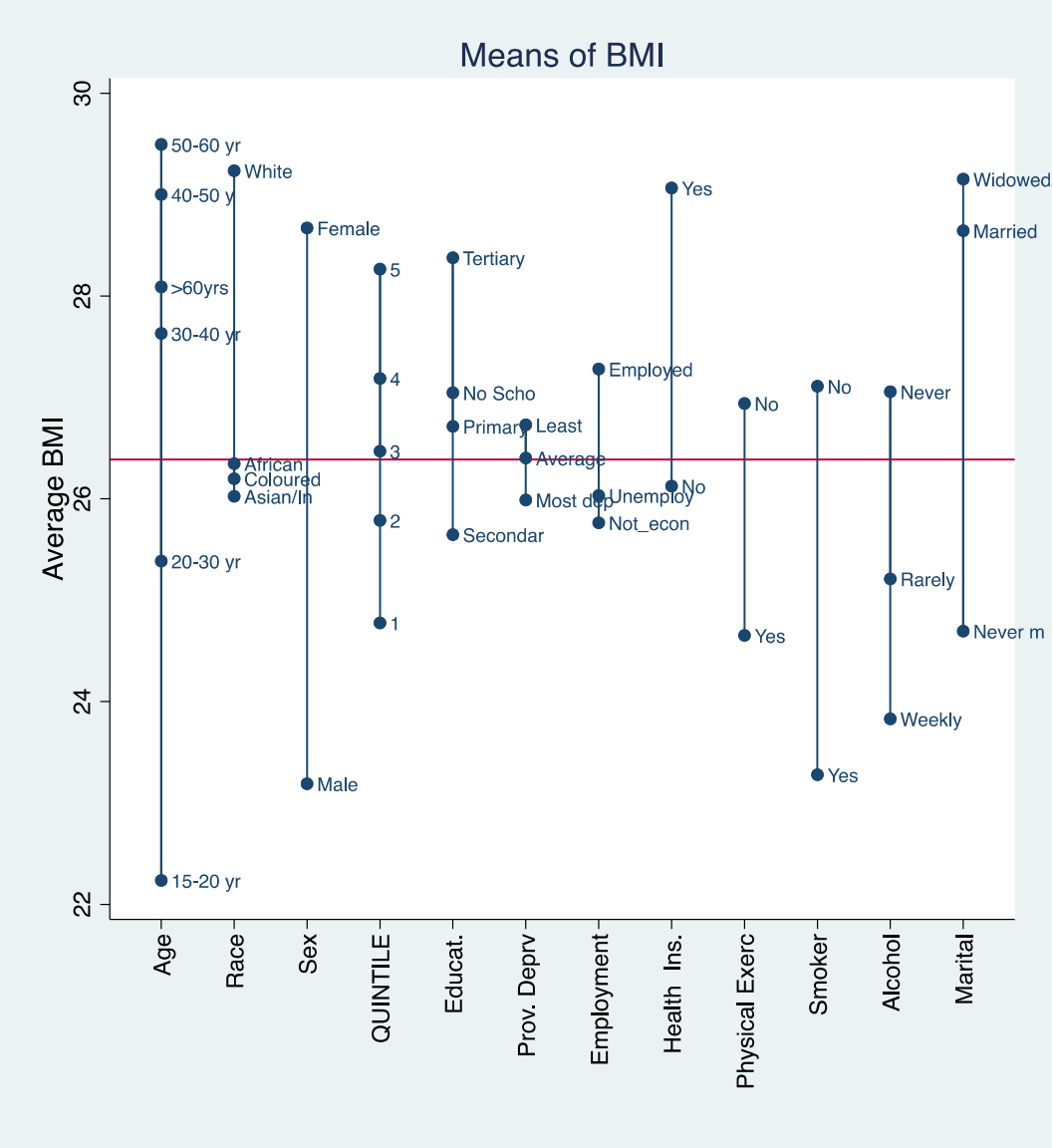
5.4 Results

5.4.1 Average BMI by socio-demographic categories

Figure 5-3 shows the distribution of average BMI across socio-demographic groups. The average BMI for the population is 26.38 kg/m2, which is within the overweight category with the highest BMI

average amongst Whites, females, older people and those who are married or widowed/divorced. The extremes of education are associated with being overweight or obese. Those with tertiary education and those with only primary level or no formal education are more overweight than those with only a secondary level of education. Alcohol and smoking are associated with lower average BMI, while average BMI increases monotonically with wealth quintiles.

Figure 5-3 Average BMI across socio-demographic groups

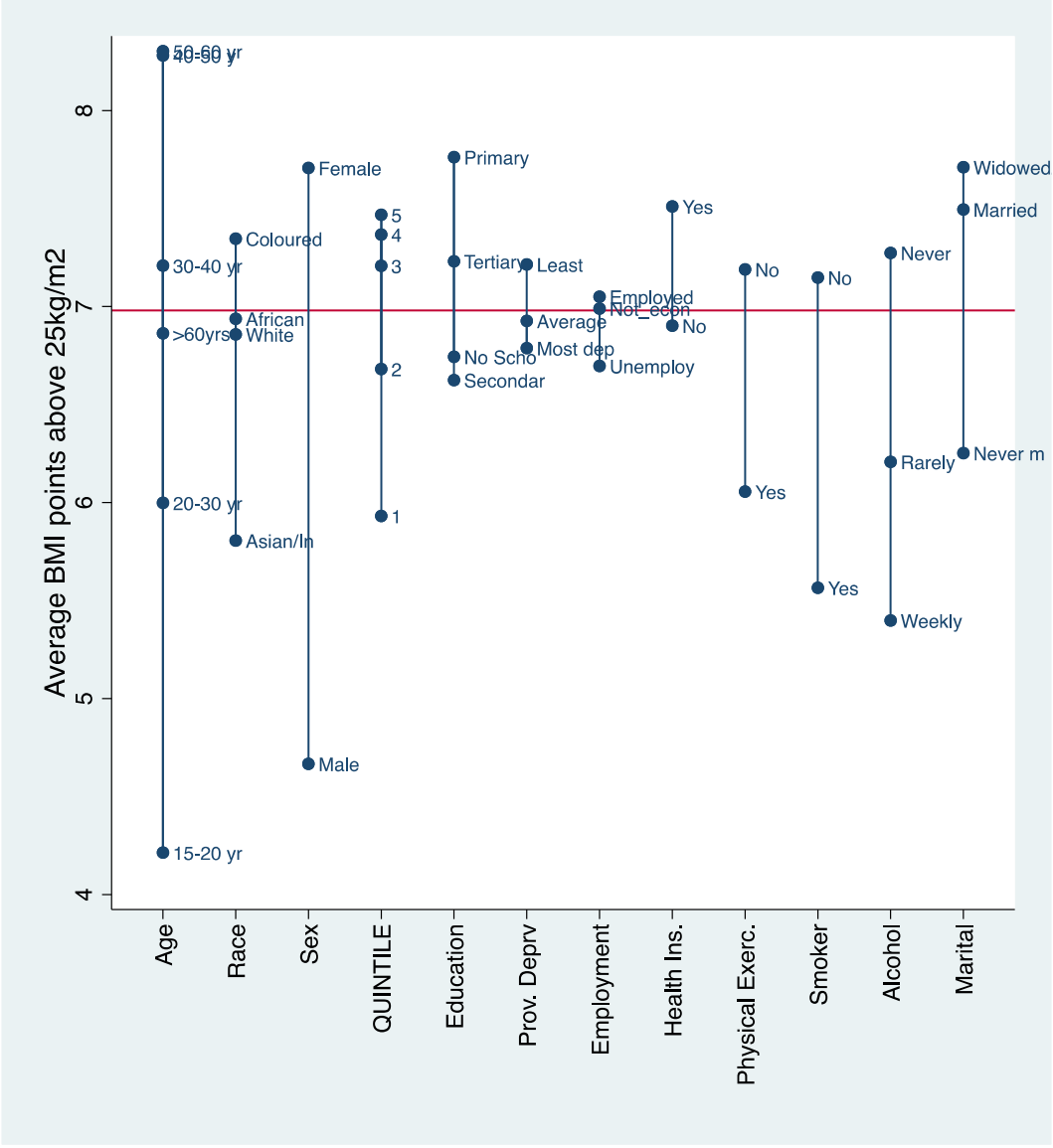


5.5 Overweight/obesity depth

The results on the prevalence of obesity and the results relating to the depth and severity of overweight follow a similar pattern for the categories of sex, marital status, physical activity, smoking, alcohol and

wealth groups. A divergence is noted, however for race and education. While obesity shows that Whites have the highest BMI on average, the obese Coloureds are more severely obese than the other races. The very educated and the uneducated are more likely to be obese, yet the depth shows that it is those with only a primary school level of education that are likely to suffer the severest form of obesity.

Figure 5-3 Average BMI depth



5.5.1 Socioeconomic inequality in obesity and overweight

The concentration curves show that overweight and obesity are strongly pro-rich, i.e. obesity and overweight occur more among the rich than the poor Figure 5-4 and Figure 5-6. However, the depth

and severity of both attenuate this showing that while absolute obesity affects the wealthiest the most, the extent of obesity severity is less pro-rich. There is no observed socioeconomic inequality for the depth and severity of obesity for the top 20-25% of the population as shown by the curves that mirror the line of equality.

Figure 5-4 Concentration curves for prevalence, depth and severity of overweight/obese

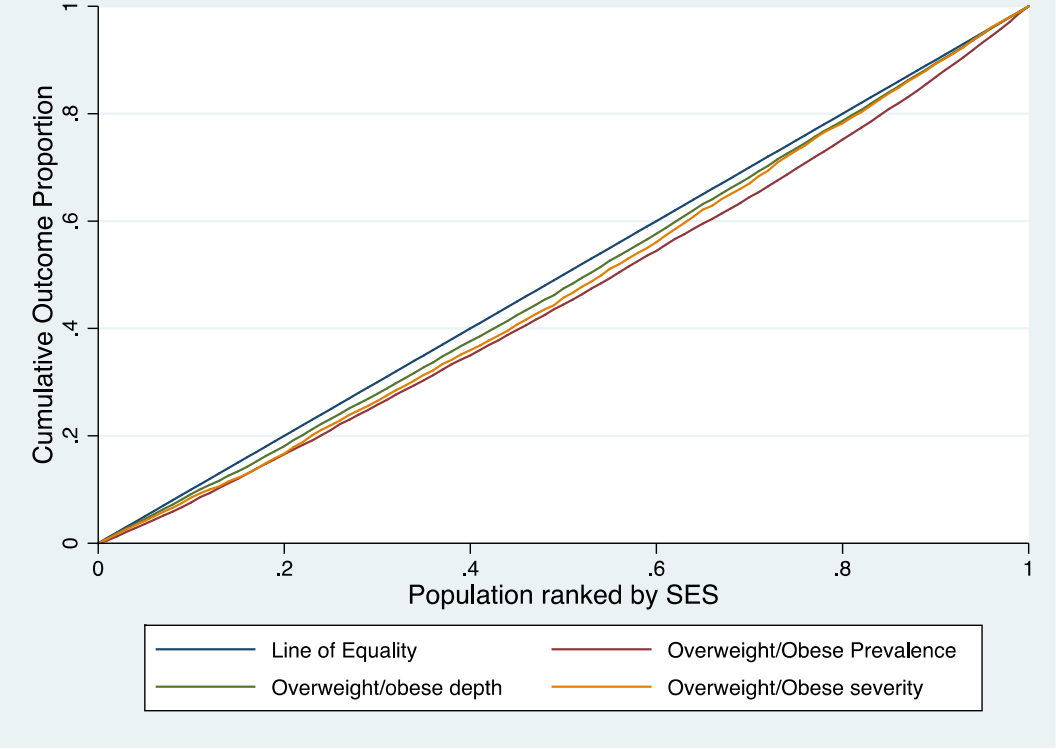
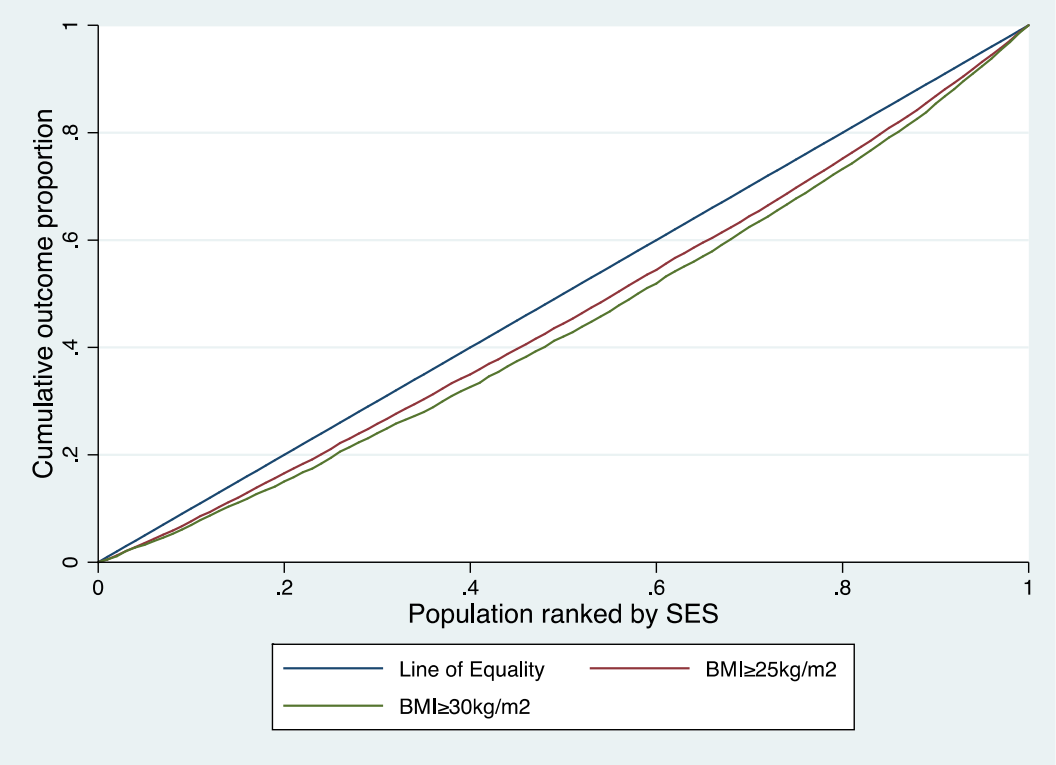
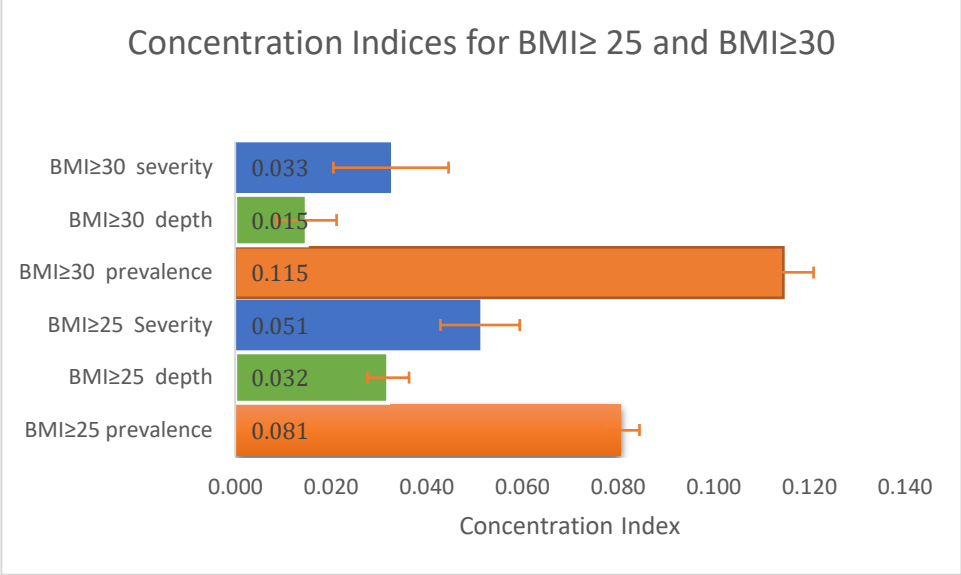


Figure 5-5 Concentration curve for overweight /obese and obesity



Concentration indices constructed using the two-weight categories-the BMI cut off of 25kg/m2 (all overweight and obese) and the cut off of BMI of 30kg/m2 (only obese) show that socioeconomic inequality is pro-wealthy and largest for the prevalence and least when one uses the depth measure. The results show that focusing on the BMI cut-off of 25kg/m2 reduces the concentration index by 30% from 0.115 to 0.081 (Figure 5-6) as a result of more poor respondents being on the overweight/obesity range.

Figure 5-6 Graphical illustration of the concentration indices



5.5.2 Decomposing inequality in overweight/obesity prevalence

Figure 5-7 and Table 5-5 show the breakdown of the factors contributing to the pro-rich inequality in the distribution of those with a BMI≥25. In absolute terms, the factors with the most impact on the observed inequality are wealth status (49%), marital status (29%), employment (26%), race (23%) and expenditure on food (17%) and age (17%).

Wealth status, marital status, employment, age and per capita expenditure on food, higher education, urban residence and health insurance cover promote pro-rich inequality. The analysis shows that respondents who are overweight or obese are likely to be wealthier than those with normal weight or underweight hence the pro-rich contribution. A similar explanation to the pro-rich contribution of age, expenditure on food, being married and being employed, higher education, urban residence, and having health insurance coverage applies. All these factors are associated with both greater wealth as shown by a positive concentration index and a higher propensity for weight gain as shown by the positive elasticity, Table 5-5.

Race, sex, provincial deprivation, smoking habits, alcohol and physical exercise promote pro-poor inequality. The Coloured South Africans are both wealthier and also more likely to have a BMI≥25 compared to Africans. On the other hand, Whites and Asians while wealthier than Black Africans, are less likely to be more overweight/obese. Overall the contribution of race is negative due to the varying influence of the different races on the observed inequality (Table 5-5). The contribution of sex is negative as a result of the wealthier males than females and the negative elasticity of

overweight/obesity with respect to the male gender. The pro-poor contribution of the province of residence is due mainly to the wealthiest provinces having a negative elasticity. Behavioural risk factors of smoking and alcohol and physical activity have positive concentration indices because they are concentrated amongst the rich while the rich are also more likely to be physically active compared to the poor. Overall, these behavioural risk factors have a negative contribution to the observed pro-rich inequality because while they are concentrated amongst the rich, they also have a negative elasticity with respect to obesity.

Figure 5-7 Contribution of the determinants of inequality in obesity prevalence

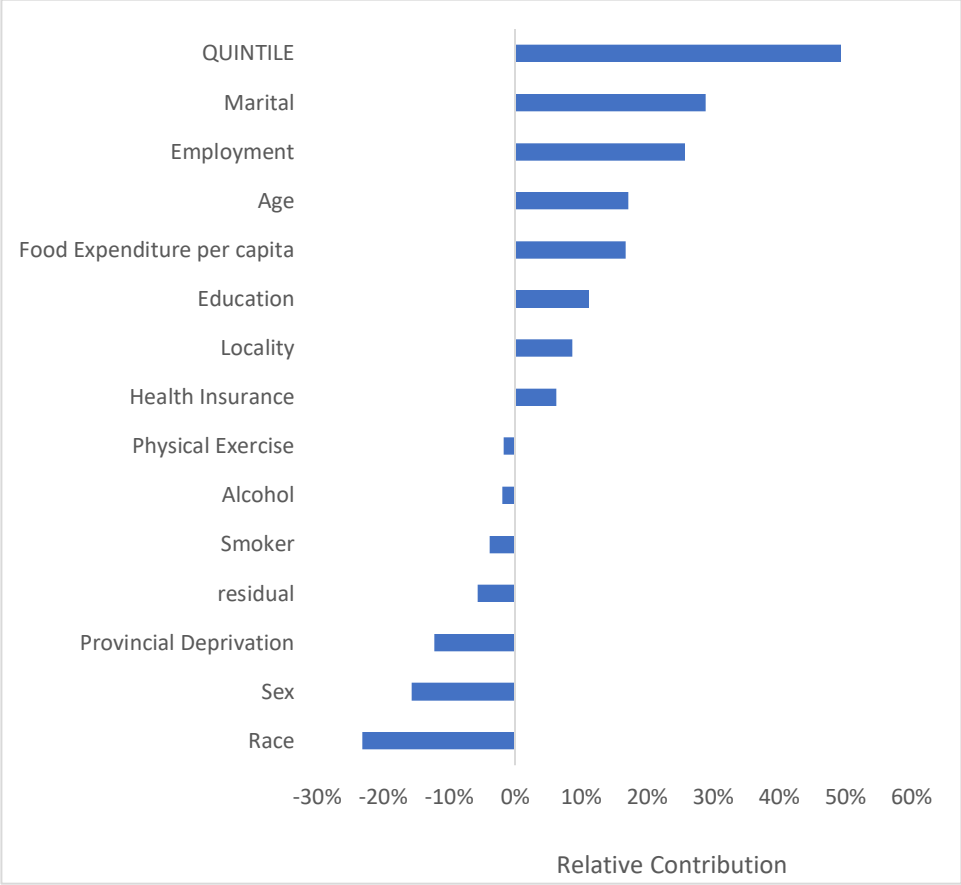


Table 5-5 Decomposition analysis of inequality in the distribution of respondents with BMI≥25

Socioeconomic determinants	Variables categorisation	Concentration Index	Elasticity	Contribution of factor variables	Contribution total
Race	African	Base			-0.025
	Coloured	0.192**	0.004	0.001	
	Asian	0.516**	-0.03	-0.015	
	White	0.785**	-0.013	-0.01	
Sex	Female	Base			-0.017
	Male	0.035**	-0.471**	-0.017*	
Age	Age	0.031**	0.580**	0.018**	0.018**
Marital Status	Married	Base			0.031**
	Widowed/Divorced	0.048	-0.012*	-0.001**	
	Never married	-0.108**	-0.288*	0.031**	
Employment	Not economically active	Base			0.027**
	Unemployed	-0.196**	-0.025**	0.005**	
	Employed	0.165**	0.136**	0.022**	
Physical Exercise at least once a week	Never	Base			-0.002
	Yes	0.141**	-0.013	-0.002	
Smoker	No	Base			-0.004
	Smoker	0.044**	-0.093	-0.004	
Alcohol	Never	Base			-0.002
	Alcohol Rarely	0.139**	-0.010*	-0.001	
	Weekly	0.071**	-0.008	-0.001	
Wealth status	QUINTILE 1	Base			0.052*
	QUINTILE 2	-0.285**	0.024**	-0.007**	
	QUINTILE 3	-0.110**	0.052	-0.006	
	QUINTILE 4	0.113**	0.051	0.006	
	QUINTILE 5	0.602**	0.098**	0.059**	
Education	No education	Base			0.012
	Primary Education	-0.277**	0.055	-0.015	
	Secondary	-0.059**	0.149**	-0.009**	
	Tertiary	0.410**	0.087**	0.036**	
Health Insurance Cover	No	Base			0.007
	Yes	0.672**	0.01	0.007	
Food Expenditure per capita	Amount spent of Food per capita	0.295**	0.060**	0.018**	0.018**
Locality	Rural	Base			0.009**
	Urban	0.168**	0.059**	0.010**	
	Farms	-0.077**	0.008	-0.001	
Provincial deprivation status	Most deprived provinces	Base			-0.013*
	Moderate	-0.166**	0.062	-0.01	
	Least deprived	0.203**	-0.013	-0.003	
	Residual				-0.006
	Total				0.106

Note: *p<0.1, **<0.05

5.5.3 Inequality in the depth of overweight/obesity (BMI≥25)

In absolute terms, African females, wealth status, per capita food expenditure, and age contribute the most to the observed inequality (Figure 5-8). Race and gender, physical activity, smoking and alcohol

contribute negatively to the pro-rich inequality. Demographic factors combined promote pro-poor inequality contributing negatively to the observed inequality. Females contribute -36% towards the pro-poor inequality as a result of negative elasticity and a strongly pro-rich concentration index. A breakdown of the analysis is shown in Figure 5-8 and Table 5-6.

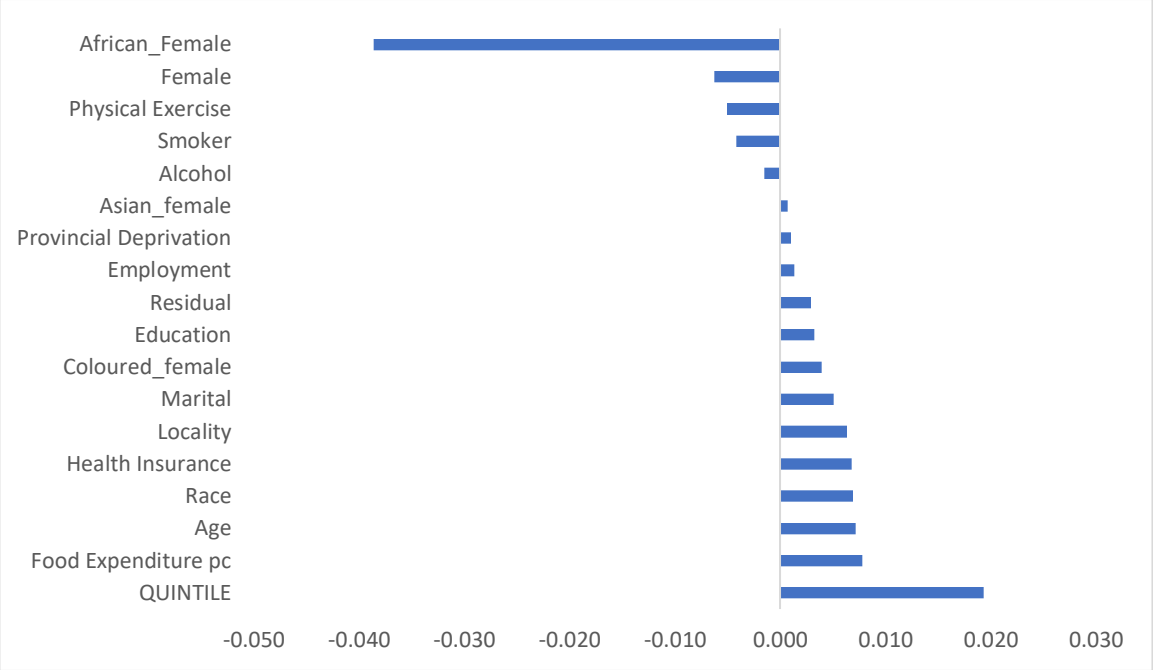
Table 5-6 Decomposing inequality in the depth of overweight/obesity

Socioeconomic determinants	Variables	Concentration Index	Elasticity	Contribution of factor variables	Total contribution
Age	Age	**0.025****	**0.287****	**0.007****	0.007***
Marital Status	Married	Base			**0.005****
	Divorced	0.016	-0.009	0.000	
	Never Married	**-0.152****	**-0.034****	**0.005****	
Race	African	**Base**			0.007
	Coloured	**0.223****	-0.010	-0.002	
	Asian/Indian	**0.389****	-0.005	-0.002	
	White	**0.734****	0.015	0.011	
Sex	Male	**Base**			-0.006
	Female	**-0.080****	0.077	-0.006	
Race& Sex	African Female	**-0.241****	**0.160****	**-0.039****	**-0.039****
	Coloured Female	**0.161****	**0.024****	**0.004****	**0.004****
	Asian Female	**0.370****	0.002	0.001	0.001
Wealth status	Quintile 1	**Base**			**0.019****
	Quintile 2	**-0.362****	**0.014***	**-0.005***	
	Quintile 3	**-0.214****	**0.026****	**-0.005****	
	Quintile 4	**0.029***	**0.036****	0.001	
	Quintile 5	**0.552****	**0.053****	**0.029****	
Education	No education				0.003
	Primary	**-0.318****	**0.020****	**-0.006****	
	Secondary	**-0.083****	**0.055***	-0.005	
	Tertiary	**0.378**	**0.038****	0.014**	
Employment	Not econ. active				0.001
	Unemployed	**-0.267****	0.007	-0.002	
	Employed	**0.147****	0.022	0.003	
Physical Exercise ≥once a week	No	**Base**			**-0.005***
	No	**0.243*****	**-0.021***	**-0.005****	
Smoker	No				**-0.004***
	Smoker	**0.219****	**-0.019***	**-0.004****	
Alcohol	No alcohol				-0.002**
	Alcohol rarely	**0.213****	0.001	0.000	
	Alcohol weekly	**0.211****	-0.008	-0.002	
Food Expenditure per capita	Food Exp	**0.301****	0.026	0.008	0.008**
Locality	Rural	**Base**			
	Urban	**0.164****	**0.038***	**0.006***	**0.006****
	Farms	**-0.122****	-0.001	0.000	

Socioeconomic determinants	Variables	Concentration Index	Elasticity	Contribution of factor variables	Total contribution
Health Insurance cover	Medical aid	**0.600*** **	0.011	0.007	0.007**
Provincial deprivation status	Most deprived	**Base**			0.001
	Average dep	**-0.194*** **	**0.019***	**-0.004***	
	Least deprived	**0.197*** **	0.024	0.005	
	Residual				0.003
	Total				**0.017***

Note: *p<0.1, **<0.05

Figure 5-8 Contribution of the various factors to inequality in depth of overweight and obesity



Behavioural risk factors of smoking, alcohol and physical exercise also contribute negatively to the observed pro-rich inequality with regards to the depth of obesity. However, the results at the individual factor level are mixed. The overweight/obese population that participates in physical activity are likely to be wealthier with a concentration index of 0.243 while their excess weight above the BMI threshold of overweight is less severe (elasticity -0.021) than those that do not participate in regular physical exercise hence the negative contribution. Overweight/obese smokers are significantly wealthier than those that do not smoke (concentration index = 0.219) with a negative elasticity of -0.019, resulting in a pro-poor contribution. Alcohol contributes to the pro-poor inequality as a result of the negative elasticity for regular drinkers who are also significantly wealthier compared to the non-

drinkers (i.e. the obese who drink regularly are likely to be less severely obese than those who do not drink or those who drink on occasion).

The observed pro-rich inequality in the distribution of those with BMI≥25 is driven mostly by indicators of wealth comprising food expenditure (45%), wealth (113%), education (19%), health insurance (40%) and place of residence (province and locality) (38%). These variables have an overall pro-wealthy distribution or positive concentration index and a positive elasticity with respect to the depth of overweight/obesity (Table 5-6).

The provincial deprivation indices from Noble *et al* (2013) were used to allocate the nine provinces into three groups- most deprived (Eastern Cape, Limpopo and North West) average deprivation (KZN, Northern Cape and Mpumalanga) and least deprived (Free State, Gauteng and Western Cape). This was based on the ranking of the South African Index of Multiple Deprivation 2011 at ward level for each province in South Africa, Table 5-6 (Noble et al. 2013). We find that the overweight and/or obese in the least deprived provinces are significantly wealthier (concentration index = 0.197) and more likely to be severely obese (elasticity = 0.024) than those in the most deprived provinces. On the other hand, the obese living in the provinces mid-way between the least and most deprived provinces are less wealthy (concentration index = -0.194) and more likely to be more severely obese than those in the most deprived provinces. Overall, the contribution of the provincial variable is positive. Similarly, locality contributes positively to the pro-rich inequality with the obese living in farms being less wealthy than those living in traditional rural areas and also less likely to be severely obese while the reverse is the case for urban dwellers.

The BMI of obese people increases with age with the most affected age group ranging from 30 to 60 years, the most economically productive group. The contribution of marital status is positive and significant—i.e. a pro-rich contribution. However, the obese widows/never married are likely to be poorer and have lower levels of obesity compared to the obese that are married.

5.6 Discussion

This chapter assesses the inequality in relation to the prevalence, depth and severity of respondents with a BMI ≥25, i.e. those who are overweight or obese. Our analysis finds a significantly pro-rich distribution of those with a BMI≥25 with a concentration index of 0.081. However, the distribution of depth and severity of overweight and obesity attenuates the extent of this pro-wealthy distribution leading to a much-reduced pro-wealthy inequality of 0.032 for depth and 0.051 for severity. This

means that while the prevalence of obesity/overweight is pro-rich, the overweight adults who are poor tend to suffer much more severe forms of obesity than the wealthy.

The concentration index for obesity prevalence (BMI≥30) is more pro-rich than the concentration index for BMI≥25. This indicates that a fair proportion of the less wealthy respondents are overweight, therefore focusing only on the obesity threshold overstates the pro-rich inequality in obesity. This thesis, therefore, used the lower cut off of BMI≥25 for the decomposition analyses to capture both the overweight and the obese. The depth and severity of both obesity and overweight are less pro-wealthy than their associated prevalence**.** Also, focusing on the obesity threshold misses the poor who are overweight but not obese.

This pro-wealthy inequality in prevalence and depth, particularly of overweight/obesity, is mostly driven by indicators of wealth comprising of food expenditure, wealth, education, health insurance and employment, and place of residence i.e. province and locality.

The results of this thesis are dissimilar to the findings by Bilger *et al.* who found that the pro-poor socioeconomic inequality in obesity is largest when using the severity measure and smallest when using the status measure (Bilger et al. 2016). In this thesis, firstly the outcome is pro-wealthy, and secondly, the depth is the least pro-rich relative to either the status or the severity. In the study by Bilger et al, the overall contribution of education was negative as a result of higher education being associated with a higher wealth status while it also had a negative elasticity with respect to obesity and its depth and severity (Bilger et al. 2016). In this thesis, the overall contribution is positive because higher education is associated with both wealth and obesity.

In the South African context, previous studies on the decomposition of inequality in obesity have focused only on the prevalence of obesity looking at obesity as a binary variable. Further, studies using the NIDS population have focused on the first wave collected in 2008 (Alaba and Chola 2014; Averett et al. 2014), while this thesis used the fourth wave of the NIDS collected in 2012 which was the most recent wave at the time of data analysis. In addition to using a more recent data set, this thesis includes respondents from the age of 15 years in keeping with current evidence that suggests an increase in obesity prevalence amongst children and adolescents compared to the study by Averett et al. (2014).

Compared to the study by Alaba and Chola, (2014) the degree of inequality has not changed much between waves 1 and 4 with the concentration index for obesity remaining positive and of a similar magnitude (0.13 wave 1 vs 0.12 in wave 4). However, the measure of living standards used between

the two analyses differs. Alaba and Chola (2014) used the wealth index while this thesis uses household consumption expenditure. The degree of inequality between males and females remains similar, with a stronger pro-rich inequality in men than in females. This shows some level of agreement between the wealth index and the consumption index for the NIDS population.

Previous studies have highlighted racial and gender disparities in the prevalence of obesity in South Africa. In this thesis, similarly to the study by Averett et al. (2014) it was found that on average, White respondents have the highest BMI which explains the positive concentration index for obesity given that the face of wealth in South Africa remains White.

This thesis found both alcohol intake and smoking to be "protective" against being overweight or obese. However, these results are not new and must be interpreted with caution given that binge drinking and hazardous or harmful drinking prevalence is increasing in South Africa (Peltzer et al. 2011). Also, alcohol is considered one of the main contributors to hypertension and liver toxicity (Zatu et al. 2014a). The study found that even though alcohol users had a below-average BMI of 19.8 kg/m2, during states of alcohol overuse, HDL-C levels were elevated, increasing blood pressure (Zatu et al. 2014b). The protective effect of smoking in relation to obesity is primarily due to its ability to increase energy expenditure and acts as an appetite suppressant leading to weight loss (Chiolero et al. 2008). Other studies in the South African population have found similar results, e.g. Peer *et al.* (2014a) found that higher BMI was directly associated with increasing age, wealth, hypertension and diabetes but inversely related to daily smoking. This means that smokers will need support to find alternative ways of weight management, particularly amongst females when advocating for smoking cessation.

Higher food expenditure is also associated with obesity. This is similar to the cross-country study by Sahal *et al* (Sahal Estime et al. 2014) which found a significant association between expenditure and caloric intake of 'unhealthy' and imported foods as well as between imported foods and obesity. Therefore, from a policy perspective, healthy food choices could be made easier by ensuring that such foods are accessible and affordable, thereby influencing the obesity trajectory (Swinburn et al. 2011a). Previous studies amongst South Africans have found very low rates of healthy eating habits, e.g. fruit and vegetable intake. Peltzer and Phaswana-Mafuya, (2012) found that rates of insufficient fruit and vegetable intake were 68.5% among older adults, 50 years and older. The racial disparities were also evident with Black African or Coloured households being less likely to eat adequate fruit and vegetables while lower educational level and daily tobacco use were also associated with low fruit and vegetable intake.

5.7 Conclusion

While the study confirms previous South African studies on the pro-wealthy inequality in relation to obesity, it also goes further to look at decomposing this inequality to understand the drivers of inequality. Further, this study goes beyond analysing inequality in relation to the obesity threshold to looking at inequality beyond the threshold for both the overweight and obese categories. This approach is important in ascertaining the extent of obesity and the distribution of the population that is overweight beyond the threshold.

While the concentration index is pro-poor for both obesity and overweight, there are significantly more poor people that are overweight compared to those who are obese hence focusing on the BMI cut off of 30kg/m2 only, overstates the extent of the pro-wealthy distribution of weight-related inequalities. While the CI for those with a BMI $\geq$ 25 is strongly pro-rich, its depth and severity attenuate this, showing that while absolute obesity affects the wealthiest the most, the extent of obesity severity is less pro-rich. Policy instruments must focus on making physical exercise accessible and possible, especially amongst the urban poor and healthy food choices easier, affordable and convenient.

Chapter 6 Socioeconomic inequality in systolic hypertension prevalence, its depth and severity

6.1 Introduction

This chapter examines socioeconomic inequality with respect to hypertension prevalence, its depth and severity using the NIDS data. The objective of this chapter is to assess inequality in prevalence, depth and severity of hypertension and further decompose the concentration indices for prevalence and depth. The exploration of socioeconomic inequality in relation to these hypertension variables remains an important field of study in so far as identifying who is at risk of the deleterious effects of high blood pressure. Previous studies have focused on hypertension prevalence without regard to socioeconomic inequality (Sarki et al. 2015), and none have decomposed the drivers of inequality nor estimated the inequality in terms of severity.

This thesis contributes to the literature on NCDs and specifically hypertension in two critical ways. Firstly, I estimate inequality in respect of status, depth and severity of hypertension borrowing from the poverty literature. Secondly, I explain the factors driving the observed inequality in both the prevalence and depth of hypertension through a decomposition analysis.

6.1.1 Measurement of hypertension

The South African hypertension guidelines define hypertension as a persistent elevation of blood pressure (BP) greater than or equal to 140/90 mmHg (Seedat et al. 2014). The threshold for optimal blood pressure is a BP value < 130/85 mmHg. High normal blood pressure is BP levels from 130–139 mmHg systolic and 85–89 mmHg diastolic pressure (Seedat et al. 2014).

The American College of Cardiology (ACC) and the American Heart Association released new stricter guidelines for the definition of hypertension in 2017 (Whelton et al. 2017). The new threshold is set at 130/80 compared to the standard 140/90 for patients at high risk of cardiovascular events. This is unlikely to be adopted just yet in South Africa. The preferred option is to first optimise blood pressure control in the current hypertensive population defined using the threshold of 140/90 (Black et al. 2019).

6.1.2 Prevalence of hypertension

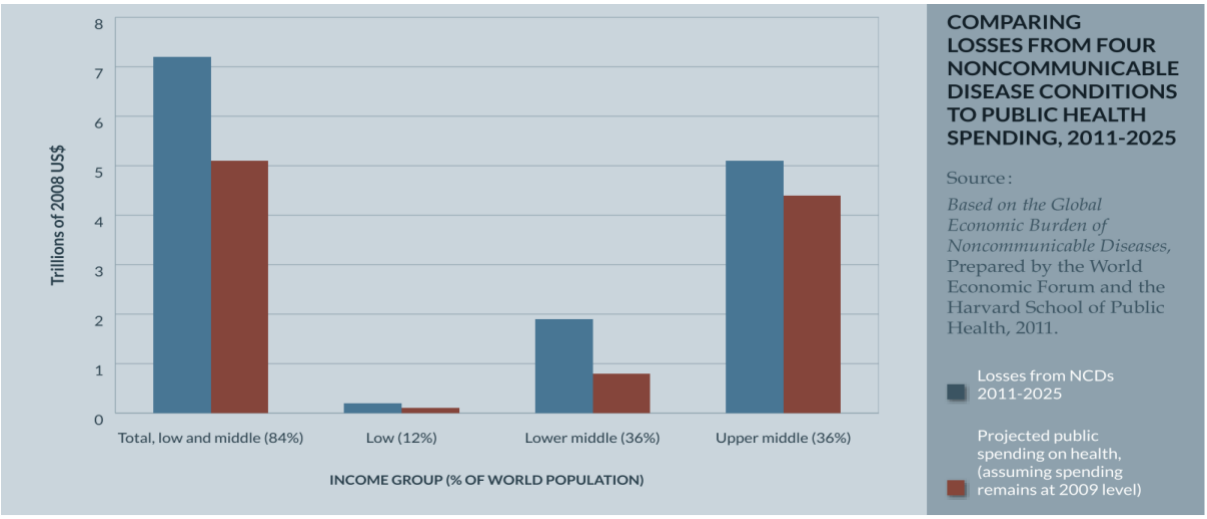
Across sub-Saharan Africa, the prevalence of diabetes, hypertension and coronary artery disease are increasing, and this is mirrored by rising levels of obesity (Crowther and Norris 2012). A metanalysis by Sarki *et al.* (2015) concluded that 1 in 3 adults in developing countries is hypertensive. The burden is not unique to any single region but shows a systemic increase across the globe. The overall prevalence of hypertension was 32.3% (95% confidence interval [29.4–35.3], with the Latin America and Caribbean region reporting the highest estimates, 39.1%. Pooled prevalence estimate was also highest in upper-middle-income countries, 37.8%, and lowest in low-income countries, 23.1%. Older age and increased body weight were found to be consistent predictors of hypertension. In this same study, pooled estimates of the prevalence of hypertension place South Arica in the category with high prevalence rates.

A metanalysis found that overall the prevalence of hypertension is higher amongst people of African origin than those of European descent. However, the role of socioeconomic status in moderating this relationship has also been found to be significant as a result of its association with body mass index which is also a risk factor for hypertension (Poulter et al. 2015). They also found that in the initial phases of economic development, high blood pressure tends to emerge in the wealthier segments of the population. As development progresses, blood pressure evens out across socioeconomic strata until when the country reaches a "developed" status, then an inverse relationship is observed with higher blood pressure observed amongst those in the lower socioeconomic strata. Economic development is associated with high blood pressure through various mechanisms such as longevity, excess intake of salt, alcohol, and saturated fats, and reduced exercise and intake of fresh fruit and vegetables (Poulter et al. 2015). Of concern in the epidemiology of hypertension is the low rate of diagnosis, treatment and control particularly in low-income countries and amongst the poor people in particular influenced significantly by availability and differential access to health care services moderated by wealth.

Trends in mortality show that mortality due to NCDs in South Africa has been slowly rising above communicable disease (Statistics South Africa 2014). The rise in the NCD epidemic has social and economic implications affecting individuals, households, health care systems, national and global economies (Bloom et al. 2014; Wallingford 2012). It is projected that by 2025, economic losses due to NCDs will surpass public spending on health, as shown in Figure 6-1 (World Health Organization 2013b). The economic burden of NCDs on health care systems is even more pronounced in low and middle-income countries as they are battling with other health issues such as communicable diseases

like HIV and TB and maternal and child mortality (Kengne and Mayosi 2014). Compounding this is the high levels of income inequality in South Africa wherein health care access is mainly along the inequality gradient.

Figure 6-1 Economic losses from NCDs vs Public spending on health

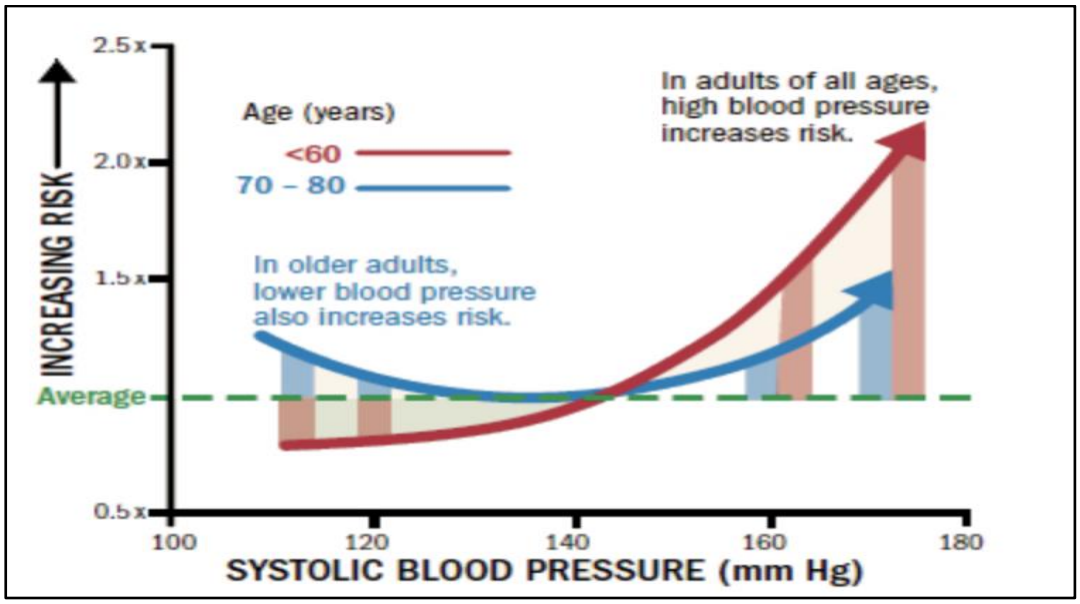


Source: World Health Organization (2013)

6.1.3 Cardiovascular risks of high blood pressure

High blood pressure is a significant risk factor for the major non-communicable diseases, notably coronary heart disease and ischemic as well as haemorrhagic stroke and remains the leading cause of mortality associated with NCDs. The complications of raised blood pressure include target organ diseases such as heart failure, peripheral vascular disease, renal impairment, retinal haemorrhage and visual impairment. Therefore, treating systolic blood pressure and diastolic blood pressure to less than 140/90 mmHg is associated with a reduction in cardiovascular complications (World Health Organization 2018b). Further, studies have confirmed a J-shaped relationship between blood pressure and mortality with greater mortality risk beginning at "normal" blood pressure of <140/90 mmHg (Poulter et al. 2015). The risk of cardiovascular disease doubles with each increment of 20/10 mmHg of blood pressure, starting from as low as 115/75 mmHg (World Health Organization 2018b). Therefore, treating hypertension as a discrete outcome by focusing only on status ignores the differential impact of blood pressure of 20/10 mmHg vs 10/5 mmHg above the threshold Figure 6-2. Cardiovascular risk is positively, continuously and independently associated with rising blood pressure (Pinto 2007).

Figure 6-2 Systolic blood pressure and Cardiovascular risk



Source: www.havard.edu

Therefore, this thesis borrows from the poverty literature to assess socioeconomic inequality with respect to the prevalence, depth and severity of hypertension (World Bank 2005). Depth is defined as the average excess blood pressure over the hypertension threshold and severity as the average squared excess. These indices provide a measure of the intensity of hypertension beyond the hypertension threshold. This thesis extends the work done on obesity by Jolliffe (2011) and by Bilger, Kruger and Finkelstein (2016) to hypertension, by using the Foster-Greer-Thorbecke (FGT) indices which are distribution-sensitive measures drawn from the poverty literature (Foster et al. 1984). Bilger, Kruger and Finkelstein (2016) extended Jolliffe's initial work on obesity to measure the socioeconomic gradient in obesity and decomposed the drivers of this socioeconomic inequality by combining the FGT indices with the concentration index. It is this method that is applied in this thesis.

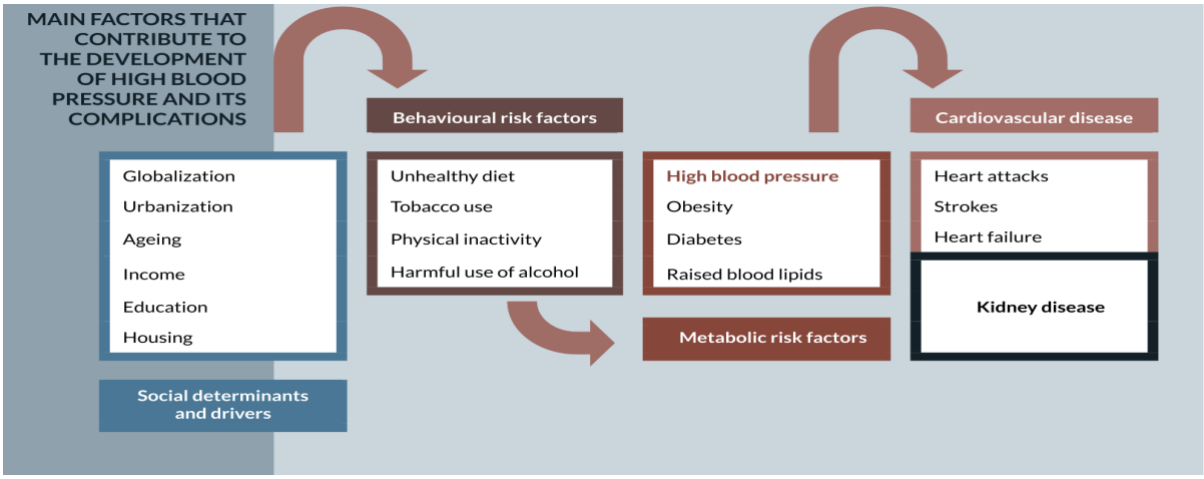
6.1.4 Social determinants of hypertension

The social determinants of health describe the contextual factors within the environments in which people live and work that influence health outcomes and the inequality thereof. These are the cause of the causes (Figure 6-3) which are the main forces behind the social, economic and cultural determinants of health such as globalisation, urbanisation, population ageing, and the overall policy environment (World Health Organization 2013b). These factors interact at different levels in a complex manner to determine health outcomes in individuals. Inequality in health is therefore brought about by their unequal distribution within society and how individuals experience these factors to

shape one's health. At the proximal individual level, the individual's material circumstances, level of social cohesion, psychosocial, behavioural and biological factors as well as the level of the health system's functioning influence health outcomes (Venkatapuram et al. 2013). Further, the way individuals experience these proximal factors is determined by their social position as comprised of wealth, income, occupation, education, gender, race and geographic location. In turn, these intermediary factors are influenced by distal factors of the socioeconomic and political context.

Since these social determinants are not evenly distributed within populations, it warrants an analysis of how this unequal distribution lends itself to the realised inequalities in hypertension, Figure 6-3. This will assist in crafting solutions to ensure that in the quest for sustainable development, no one is left behind as per the clarion call of the United Nations through the SDG goals (United Nations 2015; United Nations Development Program 2018).

Figure 6-3 Determinants of high blood pressure and its complications



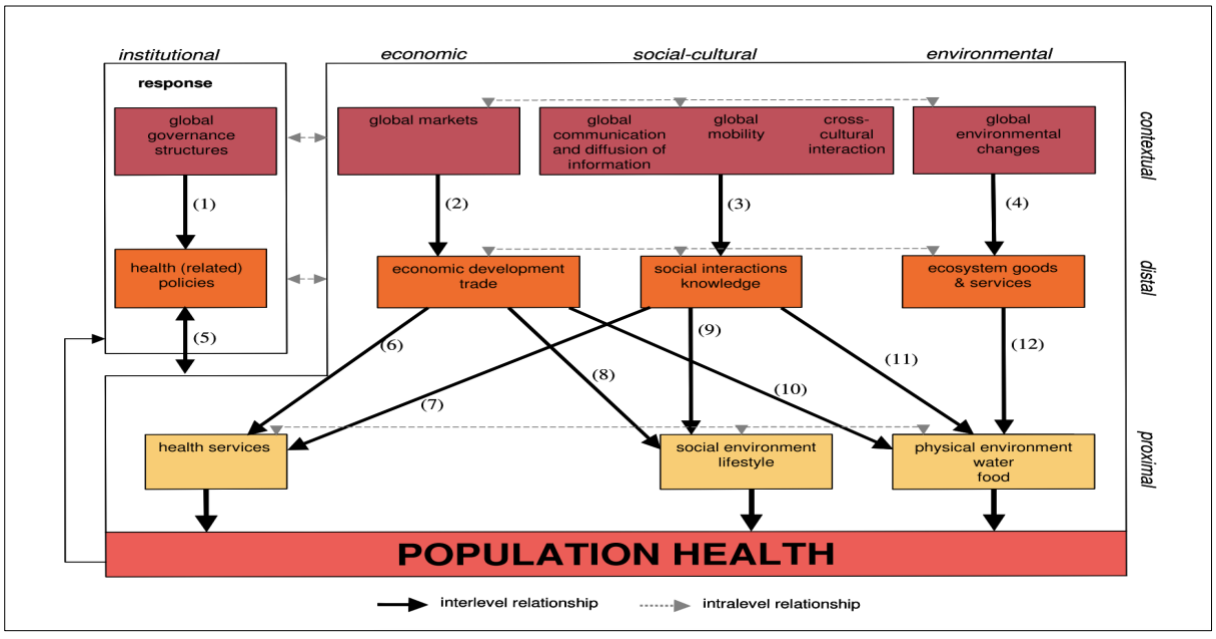
Source: World Health Organization (2013a)

6.1.5 Globalisation

The World Health Organization defines globalisation as "the increasing interconnectedness of countries and the openness of borders to ideas, people, commerce and financial capital" (World Health Organisation 2015). The influence of globalisation on health is captured in the conceptual framework in Figure 6-4 (Huynen et al. 2005). The framework seeks to illustrate how globalisation influences population health at the contextual, distal and proximal levels through an interplay of institutional, economic, socio-cultural and environmental factors. At the global level, governance structures such as the World Health Organization set health policies that influence service provision by member states. Globalisation has both advantages and disadvantages. Advantages include the

sharing of modern technologies, galvanising states through international health policies and treaties such as the Sustainable Development Goals and technological advances in health information systems for improved health care systems (World Health Organisation 2015). In relation to NCDs, the drawbacks of globalisation include the "nutrition transition" known as the move by LMIC towards western diets (World Health Organisation 2015). This has led to a significant proportion of low- and middle-income countries moving away from their traditional lifestyles and dietary habits consequently consuming diets high in trans fatty acids leading to obesity and consequently high blood pressure (Beaglehole and Yach 2003). Beaglehole and Yach, (2003) add that the widespread marketing of tobacco and alcohol, and salty, sugary, and fatty foods in many countries have contributed to the change in lifestyle and eating habits that contribute to the rise in NCDs. Global environmental changes also impact health in various ways, for example; global warming affects agricultural output and severe weather patterns with an impact on population health and delivery of and access to health care services.

Figure 6-4 The influence of globalisation on population health



Source: (Huynen et al. 2005)

6.1.6 Urbanisation

Urbanisation offers both opportunities and risks in as far as health and health inequality is concerned. Urbanisation facilitates access to health care services while on the other hand, urban crowding has harmful health effects such as the spread of infectious diseases (Aizawa and Helble 2016). Also, in many low and middle-income countries, urban poverty gives rise to urban slums that predispose

individuals to ill health exacerbated by environments with poor living standards (Anand et al. 2007). These informal urban settlements reduce the tendency to partake in physical activity such as cycling or walking due to the underdevelopment of these neighbourhoods as governments battle to keep up with demands for infrastructure in these unplanned urban neighbourhoods (World Health Organisation 2015).

Urbanisation is also associated with a "westernised" way of living which shifts the burden of illness from acute childhood infections to the chronic NCDs of adults as a result of sedentary lifestyles, unhealthy diets and higher levels of stress, and high blood pressure- all risk factors for NCDs (Mbanya et al. 2010; Schutte et al. 2003). Further, urbanisation creates conducive conditions for exposure to new technologies that promote less physically active occupations and the marketing of unhealthy products (Beaglehole and Yach 2003).

While urban living provides an opportunity to better access to health services, urban areas have greater socioeconomic gradients in health outcomes as a result of greater economic inequality in urban areas (Deaton 2013). This is because the urban advantage is not uniformly distributed as a result of differential access to care within urban centres demarcated by wealth status. Wealthy neighbourhoods tend to have better access to infrastructure, including health care services compared to poorer crowded neighbourhoods and urban slums (Deaton 2013). Further, the urban poor living in the informal settlements are more likely to be exposed to some of the shared risk factors of NCDs such as unhealthy diets, alcohol and smoking and air pollution. As a consequence, the poor are more likely to die earlier than the rich with similar disease profile due to living in conditions that exacerbate the illness with poorer access to adequate health services. Most studies often overlook this urban phenomenon by grouping all urban residents as one versus the rural, yet these urban nuances have an impact on health outcomes. For example, moving a child from a rural setting to the urban slums while keeping parental characteristics the same worsens health outcomes for the child (Portner and Yu-hsuan 2015). This chapter uses the crowding index, i.e. the average number of people per room as a proxy for population density in an area with an explicit assumption that overcrowding will be more common in poorer neighbourhoods.

6.1.7 Population ageing and hypertension

Most chronic diseases are more prevalent in the older group as are the risk factors for such conditions. As such, the risk of mortality is strongly age-dependent for most chronic conditions, possibly due to a cumulative impact of unhealthy lifestyles that reduce the chance of healthy ageing (Abegunde et al.

2007). With hypertension, in particular, the increase in blood pressure with age is also associated with structural changes in the arteries, especially large artery stiffness (Pinto 2007). Systolic blood pressure (SBP) shows a continuous increase from the ages of 30. On the other hand, diastolic blood pressure (DBP) has a different pattern with ageing, increasing until the fifth decade and slowly decreasing from the age of 60 years (Franklin 2007). Diastolic pressure is an independent risk factor for hypertension-associated cardiovascular risk, but in older individuals, high systolic blood pressure and high pulse pressure to compensate for a lower DBP and raised SBP are more powerful independent predictors of risk (Franklin 2007; Pinto 2007). The study focuses on systolic blood pressure to measure inequality because of its monotonic relationship with age compared to diastolic blood pressure.

6.1.8 Prevalence of risk factors for cardiovascular disease

South African adults have high levels of risk factors for cardiovascular disease. Also, childhood stunting and obesity co-exist predisposing the youth to cardiovascular diseases in adulthood (Mayosi et al. 2009). Many studies focusing on the risk factors related to cardiovascular diseases in South Africa show an ever-increasing prevalence of cardio-metabolic risk factors and in particular, obesity and being overweight. The high prevalence of metabolic risk factors in South Africa is primarily driven by high levels of abdominal obesity and the low fasting HDL serum concentration (Crowther and Norris 2012). Seventy per cent of women and 45% of men over 35 years old are overweight or obese in South Africa (Bradshaw et al. 2011). One study focusing on corporate executives found a metabolic syndrome prevalence of 31% (Ker et al. 2007), while another focusing on urban Africans in Cape Town found a prevalence of 30% with higher rates among women (43.5%) compared to men (16.5%) (Peer et al. 2014b). The metabolic risk factors that were higher in women compared with men were central obesity (86.0% vs. 20.1%) and low high-density lipoprotein cholesterol (75.0% vs. 33.4%) while in men, raised blood pressure (51.4%) was the most frequent (Peer et al. 2014b). Another study focusing on the coloured/mixed-race community of urban Cape Town found a prevalence range of between 55% and 62% of the cardio-metabolic risk factors presenting as metabolic syndrome (Erasmus et al. 2012b). In comparison to African women, Caucasian women have been found to have a higher risk of being diagnosed with metabolic risk factors. The study by Schutte and Olckers (2007) found that 30.4% of Caucasian women had metabolic syndrome compared to 24.8% of African women who had the syndrome. In a rural community, the prevalence of metabolic syndrome was found to be 22.1%, with a higher prevalence in women (25.0%) than in men (10.5%) (Motala et al. 2011).

6.2 Methods

6.2.1 Data

Data from the South African National Income Dynamics Study (SA-NIDS) wave 4, as described in 3.2, were used to examine socioeconomic inequality in hypertension prevalence, depth and severity.

6.2.2 Analytical method

6.2.3 Measurement of hypertension

Each respondent's blood pressure was measured according to standardised procedures as outlined in the NIDS. The blood pressure measurements are classified in Table 6-1:

Table 6-1 Classification of blood pressure

Classification	Systolic BP Measurement	Diastolic BP Measurement
Normal	<120	<80
Optimal	120-129	80-84
High Normal	130-139	85-89
Hypertensive	>140	>90

6.2.4 Measuring inequality in the prevalence, depth and severity of hypertension

This chapter uses the concentration curve to assess if there is inequality in hypertension and the concentration indices to assess the extent of this inequality as described in 3.3. For this thesis, high blood pressure is defined as a systolic BP of ≥140 mmHg. Depth of hypertension is defined as excess systolic blood pressure above the threshold of 140 mmHg and severity as the squared excess for individuals with systolic hypertension ≥140 mmHg. This accounts for both the mass and spread of systolic blood pressure of 140 mmHg. Inequality is assessed by measuring whether the correlation between income and hypertension varies at different points on the systolic blood pressure distribution beyond the cut-off point for hypertension. This chapter, therefore, extends the work done on obesity to study hypertension by using a combination of the Foster-Greer-Thorbecke indices and the concentration index (Bilger et al. 2016; Jolliffe 2011).

As introduced in Chapter 5, we also define H_α:

Equation 12

$$H\alpha = 1/n \sum I(SBPi) \geq 140)[(SBPi - 140)]\alpha$$

where n is the sample size, i is individual i, SBP_i is the systolic blood pressure of individual i, and 140 is the cut-off point of identifying who is hypertensive, I is the indicator function which takes the value of one if the statement ($SBP_i \geq 140$) is true.

When $\alpha = 0, H_0$ represents the prevalence/status of hypertension. When $\alpha = 1$ then H_1 represents the depth of hypertension which is equal to the excess blood pressure of the hypertensive individual above the hypertensive cut off point. When $\alpha = 2$ the resulting parameter (H_2) is the severity of hypertension which increases quadratically above the hypertensive threshold. The distribution of these values according to socioeconomic status is the subject of the analysis for this thesis. As per (Bilger et al. 2016), we then combine the concentration index and FGT metric to gain further insights into the relationship between status, depth, and severity of hypertension and socioeconomic status. The concentration index for hypertension status is only affected by the rank in the income distribution of those individuals that exceed the hypertension threshold but not by the extent to which the threshold is exceeded. For this reason, the study also extends the analysis to explore the concentration indices for both the depth and severity as they are sensitive to the rank in the income distribution and excess blood pressure above the SBP threshold of 140 mmHg (Bilger et al. 2016).

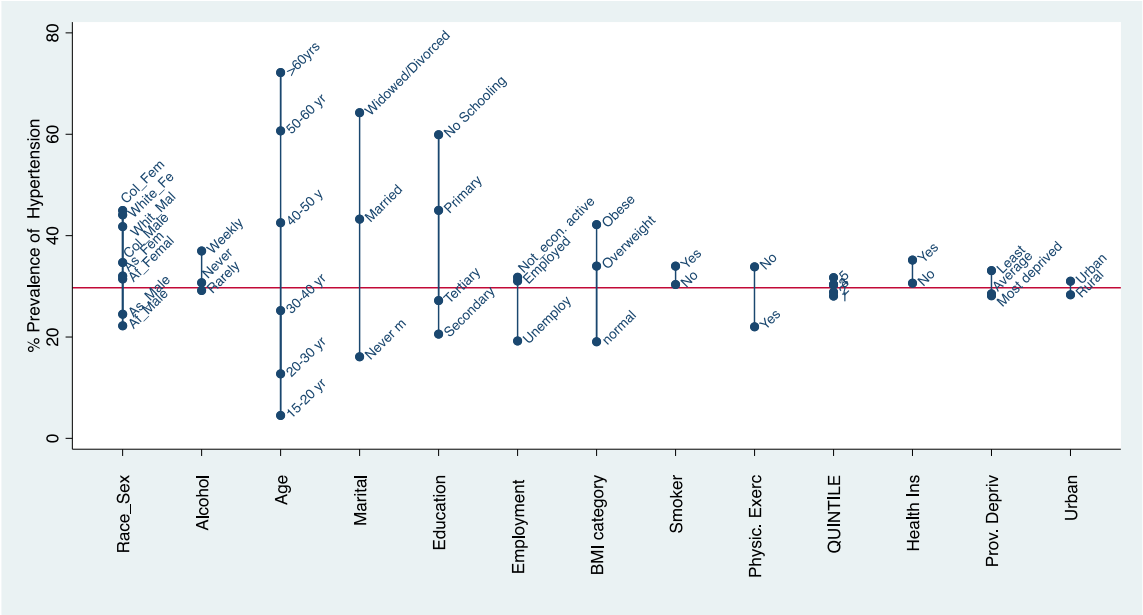
The depth and severity of hypertension are assessed as continuous variables while hypertensive status is modelled as a binary variable. Decomposition analysis was also used to explain the factors that drive the inequalities in hypertension status and depth as described in section 3.9.

6.3 Results

6.3.1 Prevalence of hypertension

We found an average prevalence of 29.7% for hypertension as measured by a blood pressure ≥140/90 with variations across demographic groups as shown in Figure 6-5. The prevalence of hypertension increases monotonically with age with a distinct grouping of races across the line, indicating the average prevalence rate. The prevalence of hypertension is highest for White and Coloured races, while Africans and Asians/Indians have lower rates.

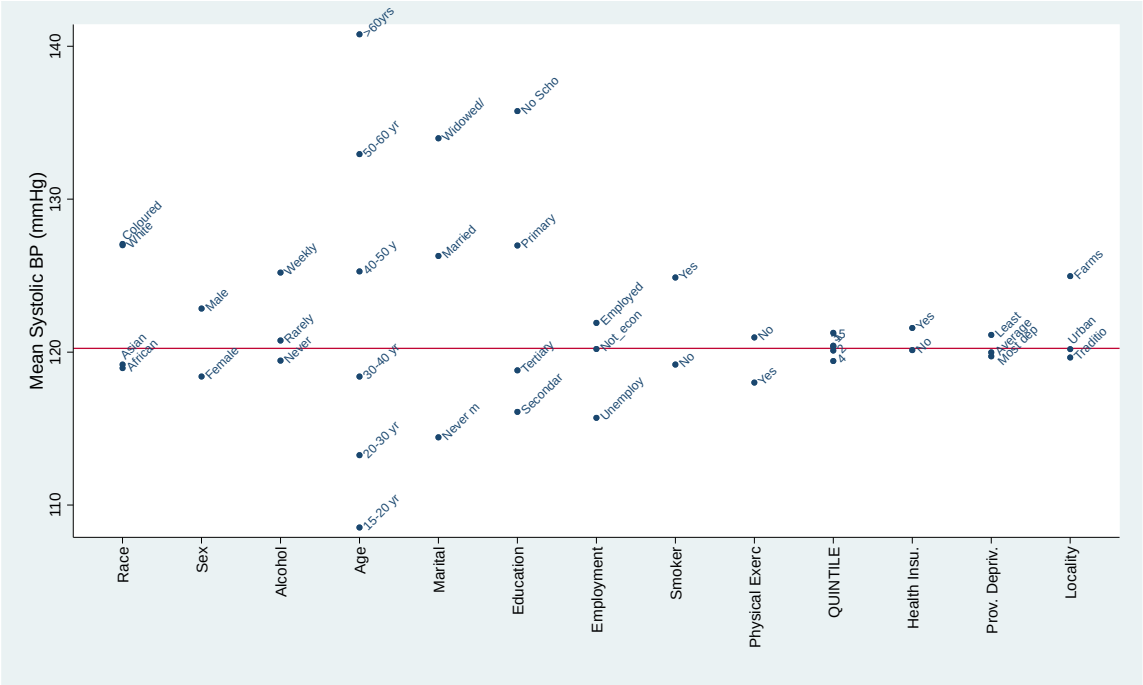
Figure 6-5 Prevalence of hypertension (BP ≥140/90)



6.3.2 Average systolic blood pressure

The average systolic blood pressure (SBP) is estimated at 120.25 mmHg with a range of 67-233 mmHg. Figure 6-6 shows how systolic blood pressure varies across demographic groups with the widest range observed across age groups while there is no discernible difference between the poor (quintile 1 and 2) and the non-poor (top 3 quintiles). There are two distinct racial groupings, however. The Coloured and White subgroups have a relatively higher systolic blood pressure compared to Blacks and Asians. On average, males have a higher systolic blood pressure than females. As expected, the risk factors for cardiovascular disease, i.e., lack of physical exercise and smoking are associated with higher systolic blood pressure. On the other hand, those with higher education or those who are unemployed have lower average systolic blood pressure.

Figure 6-6 Average systolic blood pressure across population groups (NIDS, 2014)

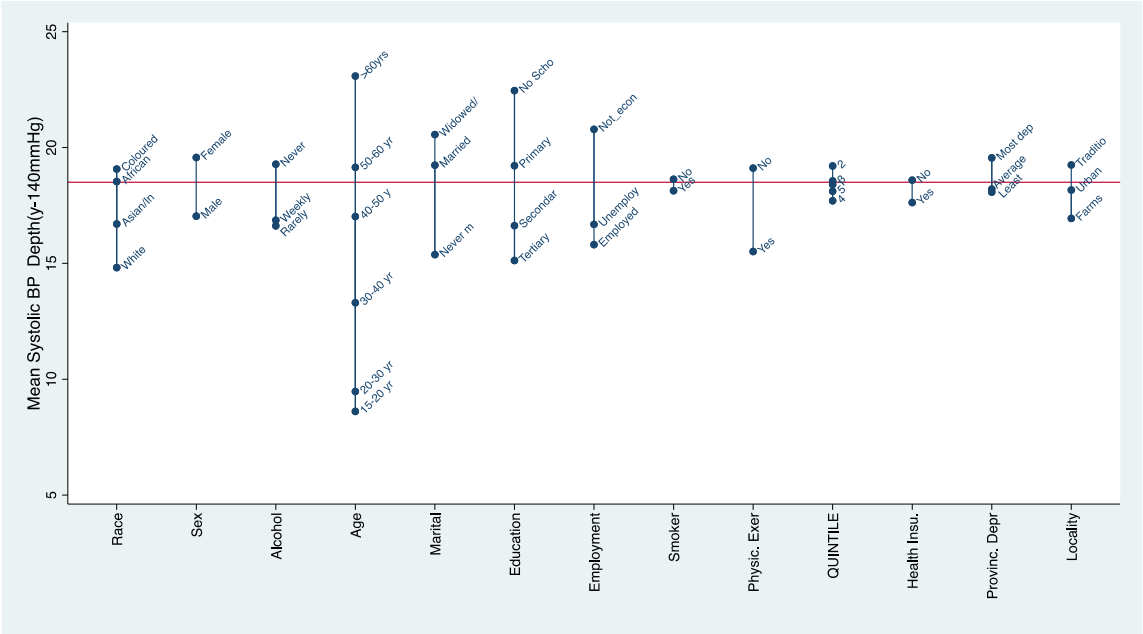


6.3.3 Depth and severity of systolic hypertension

The observed SBP depth ranges from 0 mmHg i.e. at the threshold of 140 mmHg to 93 mmHg. Compared to mean values for SBP for the different demographic groups shown in Figure 6-6, the results for the depth of hypertension show a different pattern for race, sex, wealth quintiles, race, and provincial deprivation as shown in Figure 6-7.

Looking at distinct demographic groups unadjusted for any other confounding factors, amongst those who are hypertensive, the poor have more severe hypertension than the rich. The differences along racial lines are more distinct when one considers the depth of hypertension compared to average systolic blood pressure. The Coloured group, on average, suffers from the most severe form of hypertension compared to other racial groups. While males on average have higher SBP, females when found to be hypertensive, are likely to suffer more severe hypertension than males. Being employed and having health insurance are associated with less severe hypertension. Younger age and education remain protective from high blood pressure and the depth of hypertension. As expected, risk factors appear to worsen the high blood pressure in an already hypertensive individual.

Figure 6-7 Unadjusted average depth of systolic blood pressure (NIDS, 2016)



6.3.4 Assessing socioeconomic inequality in the prevalence, depth and severity of high blood pressure

The analysis shows that there is pro-wealthy inequality in relation to the distribution of hypertension prevalence. However, the depth and severity are pro-poor. Figure 6-8 shows the concentration curves for hypertension prevalence, and systolic blood pressure depth and severity. The concentration curve for hypertension prevalence lies below the line of equality representing a pro-rich distribution of hypertension. On the other hand, the concentration curves for depth and severity of systolic blood pressure lie above the line of equality, indicating that they are disproportionately distributed amongst the poor. This is also confirmed by the FGT_CI indices in Figure 6-9 and Table 6-2 that show that while the prevalence of hypertension is pro-rich, the depth and severity of hypertension are borne more by the poor.

Figure 6-8 Concentration curves for hypertension status, depth and severity

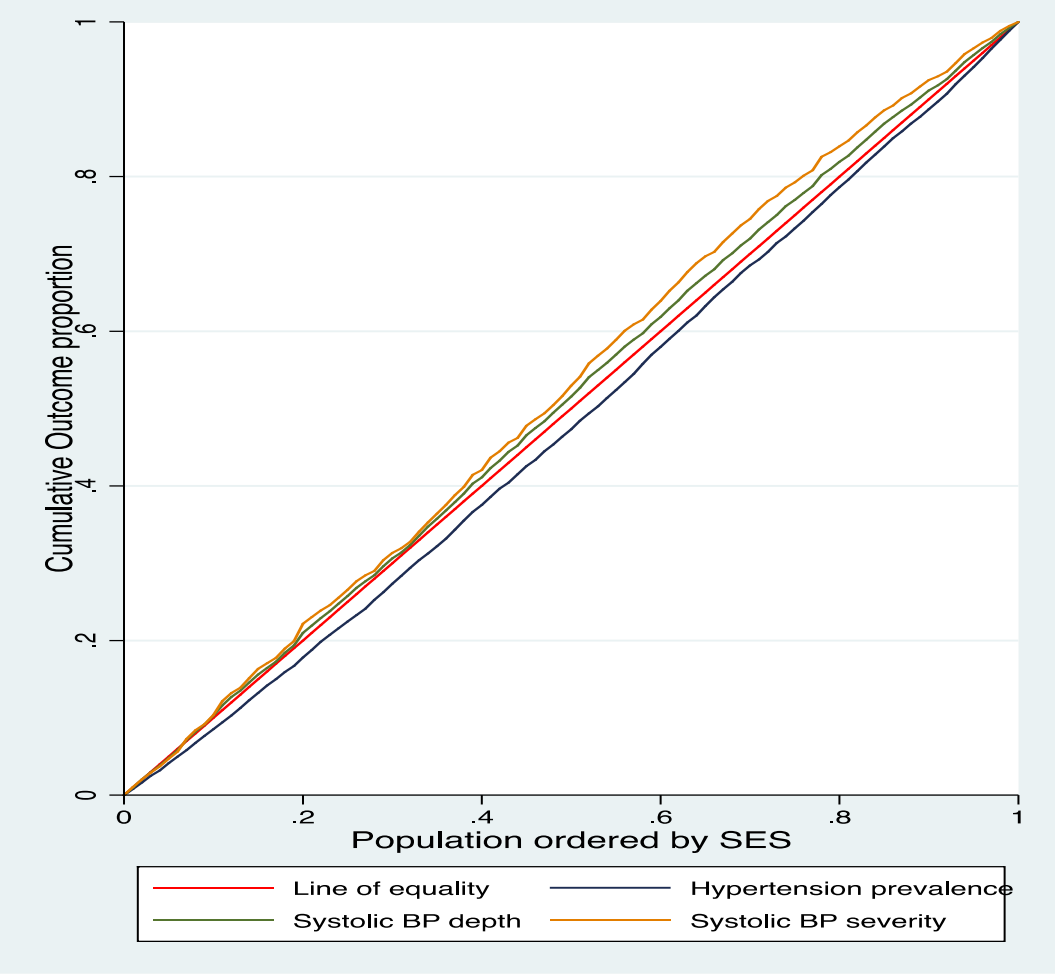


Figure 6-9 FGT_CIs for hypertension prevalence, systolic BP depth and severity

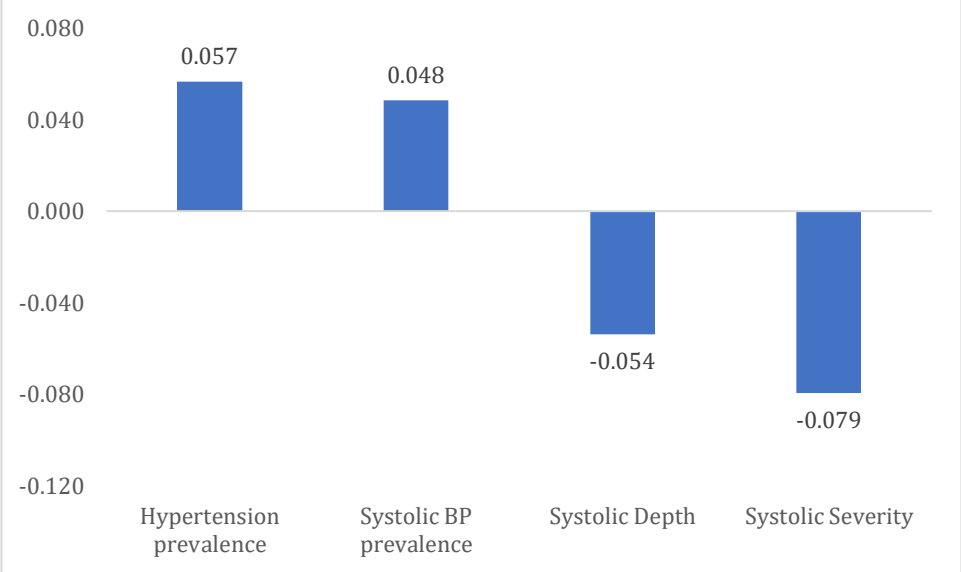


Table 6-2 Concentration indices for hypertension prevalence, depth and severity of systolic hypertension

Variable	Estimate	Standard Error	95% Confidence Interval	
Hypertension Prevalence	0.036	0.003	0.098	0.108
Systolic hypertension prevalence	0.014	0.009	-0.04	0.006
Systolic BP Depth	-0.023	0.009	-0.040	-0.006
Systolic BP Severity	-0.048	0.016	-0.079	-0.018

6.3.5 Decomposing socioeconomic inequality in hypertension prevalence

In respect to hypertension prevalence, urban residence, BMI, age, female gender and race are the biggest contributors to the observed pro-rich inequality (Figure 6-10). Higher BMI has both a positive concentration index and a positive elasticity with respect to hypertension Table 6-3. Age contributes 40% to the observed pro-rich inequality as a result of increasing age being associated with a higher socioeconomic status. Urban residence is positively correlated with higher socioeconomic status (CI=0.166) and positively correlated with hypertension (elasticity=0.2) as shown in Table 6-3.

Other factors with a positive contribution to the prevalence of hypertension are household level of crowding, being female, physical exercise and alcohol consumption. Those living in crowded conditions are likely to be poor (Concentration Index=-0.182) but living in these conditions is negatively associated with being hypertensive as indicated by the elasticity of -0.025. This drives the pro-rich contribution to inequality. Like being poor, being unemployed has a negative elasticity, while being employed is associated with a positive concentration index and also has a positive correlation with hypertension.

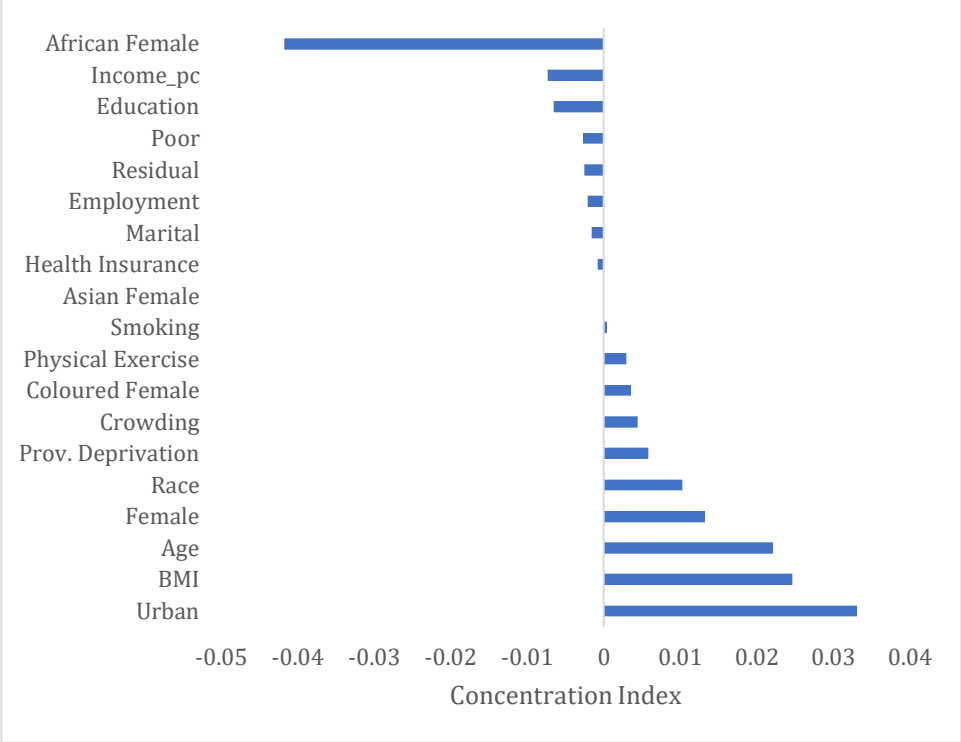
African females and education status contribute negatively to the pro-wealthy inequality of hypertension prevalence. Education and higher income contribute negatively to the observed inequality as a result of their negative association with the prevalence of hypertension, yet those with tertiary education are likely to be wealthier.

Table 6-3 Decomposing the drivers of inequality in hypertension prevalence

SDH	Variable	Concentration Index	Elasticity	Contribution of factor variables	Total variable contribution
Age	20-30 years	-0.036**	0.106	-0.004	0.022
	30-40 years	0.043**	0.153**	0.007**	
	40-50 years	0.070**	0.114**	0.008**	
	50-60 years	0.089**	0.081**	0.007**	
	>60 years	0.049*	0.085**	0.004	
Race and Sex	African Female	-0.175**	0.238	-0.042	-0.042
	Coloured female	0.186**	0.019	0.004	0.004
	Asian female	0.538**	<0.001	<0.001	<0.001
Race	Coloured	0.185**	0.015*	0.003*	0.01
	Asian	0.528**	0.006	0.003	
	White	0.776**	0.006	0.004	
Sex	Female	-0.033**	-0.406	0.013	0.013
Marital Status	Divorced	0.029	0.016**	0.000	-0.002
	Never married	-0.104**	0.020	-0.002	
Wealth status	Poor	-0.361**	0.007	-0.003	-0.003
Education	Primary	-0.274**	0.000	0.000	-0.007
	Secondary	-0.050**	-0.181	0.009	
	Tertiary	0.407**	-0.038	-0.016	
Employment	Unemployed	-0.195**	0.003	-0.001	-0.002
	Employed	0.166**	-0.009	-0.002	
Physical Exercise	Physical Exercise	0.144**	0.021	0.003	0.003
Smoking	Smoker	0.043**	0.011	<0.001	<0.001
BMI	Overweight	0.081**	0.104**	0.008**	0.025**
	Obese	0.116**	0.140**	0.016**	
Locality	Urban	0.166**	0.200	0.033	0.033
Health Insurance	Medical Aid	0.674**	-0.001	-0.001	-0.001
Household Population density	Ave. people per room	-0.182**	-0.025	0.004	0.004
Income	Per capita Income	0.553**	-0.013	-0.007	-0.007
Provincial Deprivation	Ave deprivation	-0.169**	-0.006	0.001	0.006
	Least Deprived	0.203**	0.024	0.005	
	residual				-0.003
	Total				0.055**

Note: *p<0.1, **<0.05

Figure 6-10 Decomposing socioeconomic inequality in hypertension prevalence



6.3.6 Decomposing inequality in hypertension depth amongst those with hypertension

The socioeconomic inequality in the depth of hypertension is driven mostly by racial, sex, wealth and education inequalities (Figure 6-11). Race's contribution is pro-poor as a result of the negative elasticity of the wealthier non-African racial groups compared to Africans with respect to depth of hypertension except for Coloureds, whom although wealthier than Africans have a marginally positive elasticity. White males contribute positively to the observed inequality because of the positive concentration of 0.811 and a positive elasticity of 0.134. Higher education is associated with both a higher SES and a lower prevalence of severe hypertension hence an overall negative contribution. Those with a low SES (quintile 1 and 2) are less likely to be hypertensive. However, compared to the hypertensive rich, the poor that are hypertensive are likely to suffer more severe hypertension than those who are rich. As expected, while obesity is concentrated amongst the rich, it is also associated with more severe hypertension. The hypertensive smokers are likely to be wealthier and suffer more severe hypertension than the hypertensive non-smokers while those that reside in urban areas are more likely to be rich and have more severe hypertension.

Figure 6-11 Decomposing socioeconomic inequality in systolic blood pressure depth

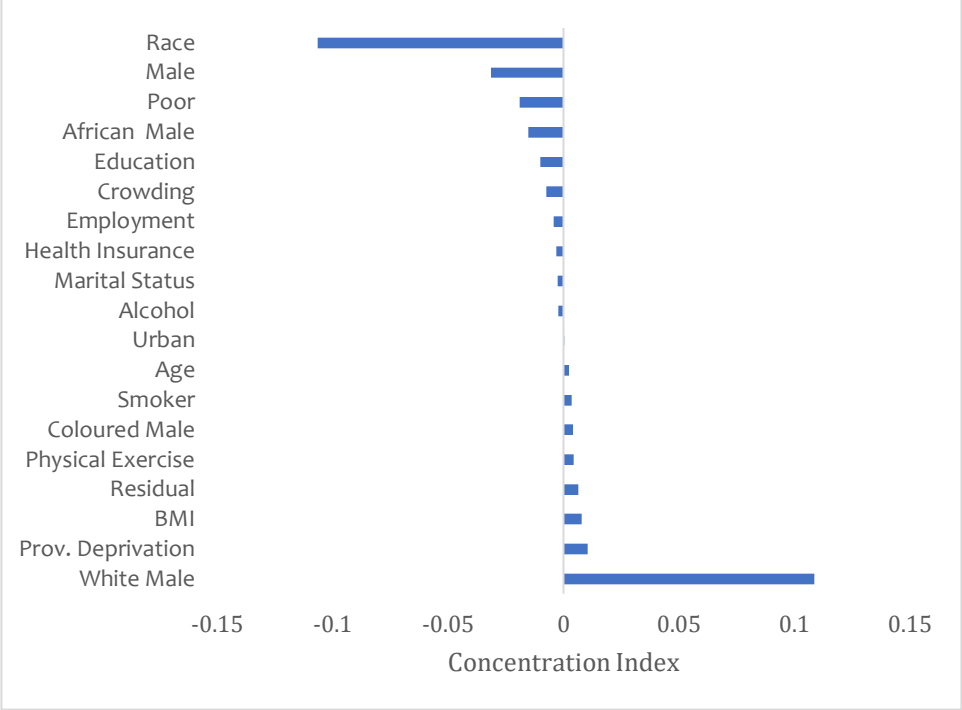


Table 6-4 Decomposing the drivers of inequality in hypertension depth

SDH	Variable	Concentration Index	Elasticity	Contribution of factor variables	Total contribution
Age	20-30 years	-0.06	-0.017	0.001	0.002
	30-40 years	0.053	0.041*	0.002	
	40-50 years	-0.023	0.086**	-0.002	
	50-60 years	0.004	0.117**	<0.001	
	>60 years	0.004	0.217**	0.001	
Sex	Male	0.076**	-0.414**	-0.032**	-0.032**
Marital Status	Divorced	0.045	-0.045	-0.002	-0.002
	Never married	-0.134**	0.003	<0.001	
Race	Coloured	0.129**	0.008	0.001	-0.107
	Asian	0.481**	<0.001	<0.001	
	White	0.788**	-0.136	-0.107	
	African Male	-0.065**	0.236*	-0.015*	-0.015*
	White Male	0.811**	0.134	0.109	0.109
	Coloured Male	0.122**	0.034	0.004	0.004
Wealth	Poor	-0.340**	0.056**	-0.019**	-0.019**
Education	Primary	-0.208**	-0.053**	0.011**	-0.01
	Secondary	0.083**	-0.070*	-0.006	
	Tertiary	0.461**	-0.033	-0.015	
Employment	Unemployed	-0.175**	0.010	-0.002	-0.004
	Employed	0.127**	-0.018	-0.002	

SDH	Variable	Concentration Index	Elasticity	Contribution of factor variables	Total contribution
Physical Exercise	Physical Exercise	0.175**	0.025	0.004	0.004
Smoker	Smoker	0.052	0.066**	0.003	0.003
Alcohol	Rarely	0.154**	-0.015	-0.002	-0.002
	Weekly Alcohol	0.019	0.002	<0.001	
BMI	Overweight	0.050	0.020	0.001	0.008**
	Obese	0.091**	0.075**	0.007**	
Locality	Urban	0.193**	0.001	<0.001	<0.001
Health Insurance	Yes	0.666**	-0.005	-0.003	-0.003
Provincial Deprivation	Average Deprivation	-0.175**	-0.025	0.004	0.011
	Least Deprived	0.203**	0.031	0.006	
Crowding Index	Crowding	0.227**	-0.032	-0.007	-0.007
	Residual	0.006			0.006
	Total	-0.054**			-0.054**

Note: *p<0.1, **<0.05 SDH-Social Determinants of Health

6.4 Discussion

Significant inequality exists not only in hypertension prevalence but also in its severity and depth. This analysis has shown that the magnitude and direction of the observed inequality differ between that observed for hypertension status and that observed for its depth and severity. Hypertension prevalence has a pro-wealthy distribution. However, among the poor, hypertension tends to be more severe as illustrated by the negative concentration index for hypertension depth and severity. BMI, urban residence and age play a significant role in the observed pro-rich socioeconomic inequality with respect to prevalence. BMI rises with socioeconomic status, and so does hypertension. This is similar to previous studies on obesity which is predominantly associated with higher levels of wealth in South Africa as in many other developing states (Alaba and Chola 2014) and also associated with hypertension in both men and women (Cois and Ehrlich 2014). Those living in urban areas are wealthier than the rural dwellers and also more likely to be hypertensive. Ageing is expected to be associated with a higher prevalence of hypertension due to pathophysiological changes that occur with age, and age is also associated with wealth (Pinto 2007).

There is a considerable body of literature with guidelines that focus on the prevention and preventable risk factors for hypertension globally (Whelton et al. 2017) and locally for the South African context (Seedat et al. 2014). However, there are no commensurate initiatives designed to prevent the unequal distribution of hypertension or its severity (Mosquera et al. 2018). To this end, the unequally

distributed social determinants such as BMI for hypertension status; education and wealth for depth are potentially more critical modifiable precursors to the observed inequalities in hypertension. On the other hand, behavioural risk factors such as smoking and sedentary lifestyle while important do not contribute substantially to hypertension inequalities, even if they are strong risk factors for hypertension itself. The small contribution of the behavioural risk factors of smoking and physical exercise to hypertension prevalence is not unique to this thesis (Mosquera et al. 2018). However, this should not be misconstrued to mean that smoking cessation is irrelevant, mainly because of the multiple biological pathways of harm caused by smoking. However, these risk factors have a moderate impact on the reduction of inequality in hypertension and reduction of inequalities in these factors will not significantly reduce the observed levels overall. In particular, it is the wealthy that participate more in physical activity (CI=0.150). While this could be explained by the Grossman model for health capital and demand for health and Kenkel's theory of demand for preventive medical care (Grossman 1972; Kenkel 2000; Kenkel 1994) there are likely other factors at play in the context of this thesis. (Grossman 1972) and (Kenkel 1994) argue that the demand for preventative health such as physical exercise is influenced by one's education and time preference with people with an increased rate of preference for the present less likely to engage in preventative activities. In this thesis, however, additional factors include spatial polarisation, and urban crowding, crime and poverty that play a role as poorer areas are less likely to have facilities for physical exercise and less likely to be safe enough to allow participation in physical exercise (Sartorius et al. 2015; World Health Organisation 2015).

The findings in this thesis are essential in identifying which population groups are likely to suffer a disproportionately higher burden of hypertension and for those with hypertension, who is likely to experience severe forms of high blood pressure. This thesis has also shown that race plays a compelling and significant role in the observed inequality, particularly for the depth of hypertension. While race is a non-modifiable social determinant, this thesis finds significant racial disparities which are useful in identifying who is at risk of more severe hypertension to reduce inequalities in outcomes of hypertension. The effects of the apartheid legacy remain in relation to racial, economic and spatial social polarisation as has been observed in previous studies that show that health outcomes differ along racial lines (Coovadia et al. 2009). In this thesis, the racial disparities are most significant in relation to the depth of hypertension with Africans experiencing disproportionately more severe hypertension than non-Africans. While Africans are less likely to be hypertensive compared to other races their outcomes are worse. The elasticity with respect to prevalence decreases from 0.006 for Whites compared to Africans to -0.136 for depth, respectively, showing that while Whites are 0.6% more likely than Africans to be hypertensive their propensity for severe hypertension is 13.6% less likely than for Africans.

This thesis has also found that education, wealth and urban residence are significant drivers of inequality. The elasticity with respect to the prevalence of hypertension decreases from <0.01 for those with primary education relative to no education to -0.181 for those with secondary education. A similar picture is observed for depth with elasticity decreasing from -0.056 to -0.07 for depth. The pattern peaks at secondary education and declines for those with tertiary education relative to no education.

This analysis has shown that both education and income are protective for hypertension prevalence and depth. As described in the Andersen model of health care, both education and wealth are enabling factors i.e. the "means" available to individuals to facilitate the optimal use of health care services (Aday and Andersen 1974). Further, education means one can use the information to their advantage compared to the less educated as proposed by the Grossman human capital model that the educated are more efficient producers of health (Grossman 1972). This also fits with Deaton's argument that education is doubly attractive in that it improves the socioeconomic status through both higher income and better health (Deaton 2002).

The impact of age on the elasticity of depth of hypertension is greater and more significant from the age of 40 years. This is supported by the pathophysiology of hypertension whose prevalence and severity increases with age as a result of stiffening arteries. This is consistent with Sarki *et al.* (2015) whose metanalysis concluded that older age and high BMI were consistent predictors of hypertension (Sarki et al. 2015). This supports the mortality statistics released by the StatsSA that show increasing mortality, particularly from cardiovascular diseases from the age of 45 years (StatsSA 2018). As such, the rise in the NCD epidemic has social and economic implications affecting individuals, households, health care systems, national and global economies(Bloom et al. 2014; Wallingford 2012) which brings to the fore the importance of risk reduction, early diagnosis and access to effective treatment.

6.5 Conclusion

This chapter has demonstrated the existence of socioeconomic inequalities in hypertension status, severity and depth. The findings show that the magnitude of socioeconomic inequalities and their determinants differ between hypertension status, depth and severity. Hypertension prevalence is pro-wealthy while hypertension outcomes are worse amongst the poor. This variation should be taken into consideration in population interventions aiming to prevent inequalities in hypertension. The main drivers of inequality are obesity and race.

Chapter 7 Determinants of the uptake of screening tests

7.1 Background

This chapter evaluates inequality in the use of screening services for NCDs in South Africa using data from the SANHANES. It is divided into two sections. The first section looks at the utilisation of screening tests compared to the population in need as well as the determinants of utilisation using logistic regression. The second part looks at socioeconomic inequality in the utilisation of screening tests and the drivers of this inequality.

7.1.1 Approaches to screening for diseases

Screening is defined as "the systematic application of a test or inquiry to identify individuals at sufficient risk of a specific disorder to benefit from further investigation or direct preventive action, among people who have not sought medical attention because of symptoms of that disorder" (Wald 2008). Based on this strict definition of screening, it may not be feasible to extract the population that underwent screening using survey data such as the SANHANES that does not ask screening related questions. The question "have you ever been tested for X" which is contained in the SANHANES, though it addresses testing, it does not explicitly separate those who have been tested based on symptoms, i.e. for diagnostic confirmation from those who have been indeed screened, i.e. tested without any prior complaint or symptoms. In addition, as this question relies on self-report, there is likely to be differences in cognition and recall bias by respondents. Taking into account these challenges and the lack of robust data on valid screening, this thesis uses this survey question cognisant of these limitations.

Three approaches to screening for diseases have been used globally, i.e. population-based, selective, and opportunistic approaches (Engelgau et al. 2000). Population-based approaches attempt to screen every person in the entire population. This method is costly and not generally preferred because of the low prevalence rates of some NCDs in the general population. Selective screening targets subgroups of the population with a high prevalence of risk factors for the disease in question usually through the use of a screening questionnaire. This approach is mostly used in community-level screening programmes. Lastly, opportunistic screening involves screening individuals during routine encounters with the health care system, such as primary care visits or periodic health assessments. Compared to the community-based screening, opportunistic screening in facilities has a low yield while tending to be misdirected towards the low-risk high users (Engelgau et al. 2000).

Levels of undiagnosed disease remain very high globally despite the known economic and pathophysiological impact of NCDs. For example, it is estimated that 50% of people with diabetes are not aware of their diabetes status and about 20-30% present with complications at diagnosis (International Diabetes Federation 2013). In South Africa, the picture is severe with at least 50-85% of people with diabetes, particularly in rural areas, undiagnosed (Amod et al. 2012). Delays in diagnosis result in patients presenting to health care facilities at an advanced stage of disease with the possibility of incurring costly and sometimes debilitating complications. This is exacerbated by the lack of coherent, systematic screening programmes for NCDs in many developing countries, including South Africa.

This thesis focuses on the uptake of screening for diabetes and cardiovascular diseases because these two condition groups combined, contribute significantly to mortality in South Africa (World Health Organization 2014). There is a dearth of literature on studies looking at the socioeconomic determinants of preventative service utilisation for chronic diseases in developing countries and South Africa in particular. Many studies have focused on cancer screening, mostly with a specific focus on developed countries (Bussière et al. 2015; Clarke et al. 2016; Fulton et al. 1995; Gallo et al. 2017; Kim and Hwang 2016; Martin-Lopez et al. 2013; Solmi et al. 2015).

7.1.2 The economics of the demand for preventive services

7.1.3 The human capital model

The Grossman model was used as the theoretical basis for the empirical analysis of the demand for preventative health care. The central tenet of Grossman's theory is that health can be viewed as a durable capital stock that produces an output of healthy time (Grossman 1972). It is assumed that consumers demand health not only for its sake but as both a consumption and an investment good (Grossman 1972). As a consumption good, sick days are a source of disutility. As an investment good, health also determines the amount of time available for market and nonmarket production; hence, an increase in health increases the amount of time available for production activities. Grossman's theory further states that gross investments in health capital are produced by household production functions whose direct inputs include the consumer's own time and market goods such as medical care, diet, exercise, recreation, and housing. The production function also depends on certain environmental variables, the most important of which is the level of education of the producer, that influences the efficiency of the production process. Grossman's assessment of the influence of environmental

variables is also supported by the recent work on the social determinants of health (Solar and Irwin 2010). The first prediction of this model is that the rate of depreciation of health capital increases with age such that the quantity of health demanded decreases over the life cycle while the quantity of medical care demanded increases leading to an increase in medical cost with age. The second prediction is that a consumer's demand for health and medical care will be positively correlated with wage rate, therefore, the higher a person's wage rate, the greater the value of an increase in healthy time. The last prediction relates to education: the educated are more efficient producers of health capital by choosing inputs optimally, which reduces the shadow price of health.

While Grossman's model is useful in explaining the demand for health, Kenkel (2000) argues that it does not adequately differentiate between the demand for curative and preventative care. However, Grossman's later work acknowledges this distinction noting that individuals with a lower depreciation rate would primarily demand preventative care (mostly the young) while those with a higher depreciation rate will primarily demand curative care, i.e. the elderly. This is also defined as the health risk effect wherein because the risk of illness increases with age, there is a tendency for the demand for curative health care to increase. On the other hand, Cropper, (1977) stresses that individuals at different points in their lifecycles have different incentives to invest in preventative health care hence as the payoff period for investment in healthcare shortens as one ages, older people are less likely to invest in preventative health care. As such, the relative importance of these two competing paradigms- the health risk effect and the lifecycle effect will determine whether age increases or decreases the propensity to invest in preventative health care (Cropper 1977). However, other factors modulate this relationship such as individuals' levels of knowledge and attitude towards the preventative services combined with treating physicians' knowledge, perceptions, practices and information sharing behaviours. Further, in contrast to the lifecycle phenomenon as described by Cropper, (1977) elderly members are likely to have more frequent contact with health care services, hence are more likely to have realised access to preventative services. The health capital model, therefore, plays an essential part in delineating the roles schooling, time preference (with people with an increased rate of preference for the present less likely to engage in preventative activities), initial health stock and age play in preventive health demand (Kenkel 2000).

7.1.4 The insurance model

The insurance model can also be used to explain human behaviour in the uptake of preventative care. (Erlich and Becker 1972) in their work, developed a theory of demand for insurance that illustrates the interaction between market insurance, self-insurance and self-protection. In building this theory, they postulate that there are three ways an individual can respond to uncertainty: - i) purchase a market

insurance policy that provides income if a bad state of nature[1] occurs; ii) engage in self-protection activities that reduce the probability of a bad state of nature occurring, or iii) engage in self-insurance activities that reduce the size of a loss if a bad state of nature occurs. Using this theory, Kenkel (2000) explains that self-protection would fall into the category of primary prevention, e.g. exercise, while self-insurance corresponds to secondary prevention such as screening underpinned by the fact that prognosis is a function of the earliness of detection particularly with terminal conditions such as cancer. The preventive services considered in this thesis are diagnostic screening services for hypertension, diabetes and hypercholesterolemia, which are examples of self-insurance. Use of these services, therefore, allows earlier detection hence a reduction in health loss (Kenkel 1994).

Insurance models can also be used to explain the interactions between insurance coverage for curative care and the demand for prevention. An increase in the price of curative medical care increases the demand for prevention, as consumers view prevention and cure as substitutes, hence the moral hazard problem where health insurance that lowers the out-of-pocket cost of curative care decreases consumer incentives to purchase preventive care (Kenkel 2000). As such, health insurance that reimburses prevention less generously than it does treatment costs artificially reduces the demand for preventive services (Barigozzi 2004). This has been proven empirically in one study of insured people in South Africa wherein colorectal cancer screening which at the time was not part of the insurance screening benefit, had the lowest uptake (Adonis et al. 2013). In Kenkel (1994) empirical work on the uptake of breast and cervical cancer screening tests found that coverage for curative care encourages the use of the two preventive medical services. However, the authors concede that early detection is valuable only in so far as early curative care is available and affordable. Therefore, individuals with insurance for curative care may find early detection more attractive. On the other hand, they posit that if curative care is prohibitively expensive for an uninsured individual, early detection, or secondary preventive medical care, is pointless. This may explain some of the behaviours of those without insured curative benefits for some of these diseases.

Insurance also introduces the phenomenon of an *ex-ante* moral hazard if the probability of self-protection is reduced in people with coverage for health insurance. Kenkel (2000) argues that if market insurance premiums are actuarially fair and reflect self-protection activities, the individual will have the correct incentives to spend on self-protection because it lowers the price of market insurance. In contrast, if the price of market insurance does not reflect the individual's spending on self-protection,

[1] Based on principles of decision theory. A state of nature is an outcome over which the decision maker has little or no control" e.g., coin-toss, car accident, acute illness

the availability of market insurance causes spending on self-protection to fall, creating *ex-ante* moral hazard. This type of *ex-ante* moral hazard associated with prevention is a type of externality in which the insured individual ignores the effect of his or her self-protection activities on the premiums paid by other members of the insurance pool. In the absence of risk-rated premiums, other insurance schemes in South Africa offer discounts in other non-premium related services such as gym membership, flight discounts etc. to encourage self-protection and self-insurance behaviours that reduce the insurer's downstream costs as a result of illness associated with inadequate preventative care efforts.

7.1.5 The Andersen behavioural model

This thesis borrows from the behavioural sciences to explain the determinants of preventative care uptake using the Andersen behavioural model. The Andersen model is premised on three domains of the utilisation of health care services, which are predisposing factors, enabling factors and need factors. Predisposing factors are those characteristics of an individual that exist before the onset of an illness that determine an individual's inclination or "propensity" to use health services (Aday and Andersen 1974). These include demographic variables of age and gender, social factors such as education, occupation, ethnicity/nativity, and social relationships. Enabling factors are the "means" available to individuals to facilitate the use of health care services (Aday and Andersen 1974). This includes resources available to the individual and his household such as income and health insurance, together with the elements of the community in which the individual lives such as urban/rural setting, availability of transport, accessibility of health care facilities etc. The need element refers to the immediate cause of health service use. This includes perceived need as exemplified by self-rated health status, evaluated health status by a healthcare professional or the presence of an individual's exposure to certain risk factors.

7.1.6 Empirical overview: the determinants of preventative care uptake

Empirical studies on the determinants of health care uptake have utilised the human capital theory as the theoretical basis on which to build the analyses (Grossman 1972; Kenkel 2000). Also, some researchers have made further iterations of the human capital theory based on sociological models. They focus more on individual and predisposing characteristics towards health and healthcare utilisation principally the Andersen behavioural model (Aday and Andersen 1974). However, although the uptake of preventative care would follow the same general principles as curative care, the two differ in that the demand for preventative care is influenced more by investment considerations whereas curative care has more to do with consumption behaviour (Carrieri and Bilger 2013). While the demand for any healthcare service is characterized by five key determinants including age, education, income, access costs and health status. Carrieri and Bilger (2013) argue that the marginal

cost of investment includes not only monetary costs (affordability) but also non-monetary barriers to utilisation as defined along the axes of geographic accessibility and acceptability as explained by McIntyre et al. (2009). These should be factored in when analysing determinants of health care access.

Most studies on the determinants of screening uptake have focused on cancer screening- breast cancer, colorectal cancer and cervical cancer. While the pathophysiology of and severity/prognosis of NCDs differs from cancer, the generic determinants of utilisation of screening services are likely to be similar. In their review article of the determinants of screening uptake, Jepson *et al.* (2000) categorise these determinants into five groups:- i) socio-demographic, ii) knowledge, behaviour, attitudes and beliefs, iii) barriers and facilitating conditions, iv) social influences and v) health status. In another review article focusing on colorectal cancer screening, Garcia (2012) categorises these determinants into similar groups, i.e. sociodemographic factors, health care system and provider, and psychosocial factors. Psychosocial factors are those related to knowledge about the condition and screening, risk perception of condition, and perceived barriers and benefits. A combination of these two lists is shown in Table 7-1, which is the basis of most empirical studies on the determinants of screening uptake.

Table 7-1 Factors influencing colorectal cancer screening participation

Category	Examples
Socio-demographic	Age Gender Education Socioeconomic status, e.g. Income Ethnic origin Employment status Insurance status Sexual orientation Area of Residence- urban or rural Marital status
Knowledge, behaviour, attitudes and beliefs	Knowledge of disease Knowledge of screening test Knowledge of screening guidelines Past screening behaviour and attendance for tests Lifestyle and health behaviours, e.g. tobacco, alcohol or drug use Risk perception of developing the condition Perceived seriousness of disease or condition for which being screened Expressed intention to attend the screening Participation in regular exercise Health system organisation of the screening programme- opportunistic vs. well-organised screening
Barriers and facilitating conditions	Lack of transport Costs involved in attending the screening Inconvenience due to time pressures The embarrassment of attending and undergoing a screening procedure Fear of finding test positive Fear of pain or discomfort of the test procedure Inconvenience Recommendation by a physician or another healthcare professional Having a regular source of care Having routine healthcare visits Adherence to other cancer screening behaviours
Social influences	Knowing someone with the disease or condition Support of family, friends, or significant others Support of physician or another healthcare provider Membership of a club, church or other organisation Knowing someone who has been screened
Health status	Family history of the disease or condition Experiencing symptoms of the disease or condition Type of visit to a healthcare provider (e.g. gynaecological, hospital) Number of previous visits to a doctor Self-reported health status and comorbidities Able to perform activities of daily living High BMI, anxiety

Adapted from Jepson *et al.*, (2000) and Garcia (2012)

In Mexico, being older and female, having a higher net worth and having health insurance were found to be associated with a higher likelihood of blood pressure, diabetes or cholesterol screening. Also, having had a physician visit in the past year was associated with greater use of blood pressure screening services compared to those with no insurance or no physician visits (Benjamins 2007). In this study, need variables as defined according to Andersen's behavioural model were associated with a higher uptake of preventative services. Those with poor subjective health, more depressive symptoms, and cognitive impairment were associated with an increased likelihood of reporting a blood pressure screening. Similar relationships were observed with both cholesterol and diabetes screening with access to health insurance being most strongly related to cholesterol screening compared to either diabetes or hypertension. Although not commonly studied, Benjamins (2007) used religious salience as a possible determinant of uptake of services. He found that religious salience is significantly related to the use of blood pressure and cholesterol screening services, even after controlling for a variety of social, demographic, and health-related factors. Further, Benjamins (2007) found that attending religious services and participating in religious activities were both positively associated with blood pressure and diabetes screening. This could also be explained by access to social capital through social networks where information dissemination is made possible and social support is made available such as offering transport and other means of support in ensuring that health care access is realised.

The gender bias with regards to the uptake of blood pressure screening is also reported in Pakistan with access associated with higher socioeconomic status, age, together with a preponderance of urban/rural and inter-provincial disparities (Ahmad and Jafar 2005). The proportion of adults ever having had their blood pressure checked was found to be very low (35.6%; 95% confidence interval, 33.9–37.3%) with far lower rates among men than women (29.0 versus 41.3%, $p < 0.001$). The proposed explanation is that women, particularly in their reproductive age, have more opportunities to get their blood pressure checked than men. The study also found that although Pakistanis visit health care providers at least 5 to 6 times a year, many practitioners do not measure blood pressure during those visits. This brings into question how medicine is generally practised as it seems physicians are incentivised to induce demand for curative services at the expense of preventative health care that could potentially lead to a reduction in the demand for their services as pointed out by Kenkel (2000).

Access to the different screening tests also tends to differ by type of tests with cholesterol test being less prevalent than hypertension screening tests. In the Central Pennsylvania Women's Health Study in the USA, 94.1% of the respondents had had previous blood pressure screening tests while only 49% had had a cholesterol test (McCall-Hosenfeld et al. 2012). Enabling factors included having a regular healthcare provider, seeing an obstetrician-gynaecologist, a higher wealth index, having

continuous health insurance coverage for the past 12 months, and never forgoing care in the past 12 months because of cost.

Individual-level variables associated with greater receipt of screening and vaccination services were higher self-esteem, higher educational status, lower self-reported health status, and having at least one chronic medical condition. Contextual variables associated with greater receipt of preventive screening and vaccinations included a higher density of primary care physicians, fewer persons in poverty in the county, and a more metropolitan county of residence (McCall-Hosenfeld et al. 2012).

Contrary to the Pennsylvanian study that found that urban residence or more metropolitan counties were associated with higher uptake of screening services, a study in Malaysia found different results. The probability of rural dwellers using blood pressure test was 4.8% higher than that of the urban dwellers. Similarly, employed individuals were less likely than the unemployed to use blood cholesterol and blood pressure tests with uptake 6.9% and 7.6% lower, respectively (Cheah and Goh 2017). The time constraint was therefore found to be a more dominant factor in predicting uptake of preventative activities than the income factor as evidenced by the lower uptake amongst the employed and the urban dwellers. This could be explained by the opportunity cost of time. Higher education is a strong determinant of screening uptake because educated adults have a better ability to interpret health information resulting in more efficient health production process (Grossman 1972).

Studies carried out on screening for NCDs in South Africa, point to low uptake of screening services for chronic diseases (Fryatt 2013; Hoque et al. 2014; Laubscher et al. 2015; Saloojee et al. 2014). Further, there are geographic disparities in the uptake of screening services for chronic diseases such as diabetes, colon and breast cancer, cholesterol etc. even amongst the insured population who may not face a direct cost at the point of care. In a study of the privately insured South African population, Adonis *et al.* (2013) found that despite similar insurance coverage, screening rates ranged from 30-95% lower in other provinces compared to Gauteng, a very affluent province. Of all the provinces, Gauteng had the highest annual screening rates for chronic diseases, breast cancer, prostate cancer and HIV ($p < 0.001$), while the Western Cape had the highest rate for cervical cancer screening ($p < 0.001$). This is possibly related to supply-side factors that influence access to screening services as advanced by the authors. Overall, they found that the uptake of screening services was less than 40% in South Africa. The type of insurance coverage is also a significant determinant of screening services uptake in South Africa. Having a more comprehensive plan compared to a basic hospital plans, province of residence, female gender and belonging to an incentivised wellness programme are associated with disproportionate utilisation of screening services (Adonis et al. 2014). While these studies provide a starting point to understanding the disparities in utilisation of screening services in

South Africa, they do not explain how the need and non-need factors drive the socioeconomic disparities in health care use.

7.1.7 Assessing horizontal inequity: defining need

The need for screening is defined as the expected utilisation according to preventative guidelines where these exist nationally. The South African Dyslipidaemia Guideline Consensus Statement states that screening for high blood cholesterol levels should commence from the age of 20 years (Klug et al. 2012) while the Type 2 diabetes guidelines state that adults from the age of 45 years should undergo regular blood glucose screening (Amod et al. 2012). There are no explicit screening guidelines for hypertension in South Africa. However, for this thesis, it is assumed that adults aged at least 18 years should be screened for hypertension. This is supported by leading international organisations on preventative health such as the US Preventive Services Taskforce (Siu 2015). These age categories were used to guide the regression, and decomposition analysis with the analysis limited to the population older than or equal to the age limit stipulated for each screening type. Also, inequality and inequity were assessed first based on the age limit and secondly based on diagnostic needs.

In addition to age as a determinant of need, this thesis also seeks to determine the drivers of inequality of use of screening services keeping in mind that use of screening services may be influenced by factors other than age. Therefore, for need factors, researchers also rely on proxy variables such as health status and morbidity variables (O'Donnell et al. 2008; Wagstaff and Waters 2005). This is in addition to the demographic variables of age and sex as these are likely to increase the propensity for the use of screening services. This is termed the diagnostic needs (Carrieri and Wuebker 2012). In this thesis, the diagnostic need variables included in the decomposition analysis in addition to age and sex, include self-rated health status, being a current smoker, presence of at least one chronic condition (high blood pressure, stroke, heart disease, history of heart attack or angina, heart failure, rheumatic heart disease, diabetes, or hypercholesterolemia) as enquired of in the questionnaire and family history of chronic conditions. It is expected that individuals with chronic diseases have more frequent interactions with the health services; hence a higher chance of being screened. Thus, having a chronic condition increases the probability of using screening services as part of the management for the conditions (Carrieri and Wuebker 2012; Hwang 2016; Kim and Hwang 2016; Solmi et al. 2015).

7.1.8 Non-need factors

In this thesis, non-need factors are included to assess their influence on the equitable distribution of screening services and to reduce the omitted variable bias (Carrieri and Wuebker 2012; van Doorslaer et al. 2004). These include education, employment status, health insurance, provincial and rural/urban

location and race. Education and employment are included as non-need variables based on Grossman's human capital model (Grossman 1972). Further, in South Africa, many corporations offer work-based wellness services; hence, employment is likely to be associated with increased uptake of screening services. Having health insurance has been shown to increase the utilisation of health services in South Africa as holders do not face a direct cost at the point of care (Ataguba and Goudge 2012; Harris et al. 2011). However, uptake of screening services is also dependent on how generously insurance plans cover preventative care (Adonis et al. 2014). While the impact of health insurance coverage on the use of health services, in general, has been studied in South Africa (Ataguba and Goudge 2012; Harris et al. 2011), studies on its impact on preventative care use has been limited to those insured by Discovery Health Insurance, one of the private health insurers in South Africa (Adonis et al. 2013). This would have excluded not only the uninsured but also those insured by other insurance companies. Hence this thesis attempts to bridge this gap by exploring how insurance coverage in general compared to being uninsured in the context of South Africa influences the uptake of screening services given the imminent introduction of the National Health Insurance. International literature has documented inter-jurisdiction or area level disparities in access to health care as a result of supply-side influences in the utilisation of care including screening services, e.g. in China (Wan and Zhou 2004). This has also been reported in the UK with regards to area-level health effects on the uptake of colorectal screening (Clarke et al. 2016; Solmi et al. 2015). Geographical disparities in access and provision of health care in South Africa are well documented (Adonis et al. 2013; Mcintyre 2000; Noble et al. 2014) however this has not been explored to a similar extent in respect of preventative care.

This chapter aims to assess the drivers of the use of screening tests for cholesterol, hypertension and diabetes across wealth groups. Specifically, it assesses the uptake of screening tests across wealth quintiles and compares the share of benefit to the share of the population in need for each of the screening tests.

7.2 Methods

7.2.1 Study population

This thesis uses data from the first South African Nutritional and Health Examination Survey (SANHANES-1) as described in section 3.2.

7.2.2 Dependent variables

This thesis uses the utilisation of testing services for the various NCDs as a measure for estimating screening coverage. Self-reported use of screening services for hypertension, dyslipidaemia and diabetes were considered using the following questions from the survey:

1) Have you ever had your blood pressure measured?
2) Have you ever had your blood cholesterol checked?
3) Have you ever been tested for blood sugar?

7.2.3 Explanatory variables used in the analysis

A logistic regression analysis was used to explore the impact of wealth on the uptake of screening tests. A list of the explanatory variables used in this analysis is contained in Table 7-2 based on a review of the literature and the frameworks mentioned above. The variables were split into the need and non-need variables. The primary need variable is eligibility based on age with secondary or diagnostic need variables such as chronic illness added to the list.

Table 7-2 Need and non-need factors influencing the uptake of screening services

Factors	Categorical Variable	Categories
Non need	Education	Levels of education dummies (no formal education; primary; secondary; tertiary)
	Labour market participation	Dummies for Employed, Unemployed and Other (students, retired & disabled)
	Race	Race dummies for African, Coloured; Indian and White)
	Marital Status	Dummies for each of the marital states Married Unmarried & Divorced
	Health Insurance	Private health insurance (1=Yes; 0= otherwise)
	Wealth	Dummies for Wealth index grouped into Poor (quintiles 1 & 2) and Non-poor (quintiles 3-5)
	Type of area	(1= Urban; 0= Rural)
	Province	Provinces: 9 dummies
	Sex	Male
Need	Obesity	BMI categories of underweight, normal and overweight
	Age eligibility for cholesterol screening	1= ≥20 years 0=otherwise
	Age eligibility for diabetes screening	1=≥ 45 years 0=otherwise
	Age eligibility for hypertension screening	1=≥18 years 0=otherwise
	Self-rated health status	Dummies for Good; Moderate and Bad
	Family history of either diabetes or any cardiac condition	1=Yes; 0=No
	Chronic condition	1=at least one chronic condition; 0=no chronic conditions
	Current Smoker	1= Yes 0=otherwise

7.2.4 Statistical Analysis

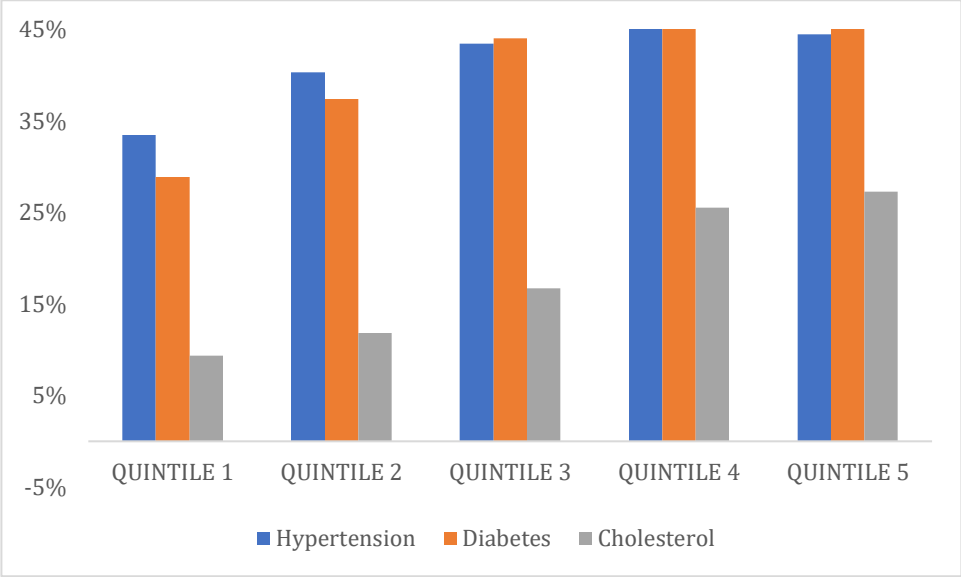
A simple descriptive analysis was performed to estimate the uptake of each of the screening tests by socioeconomic quantiles. To assess the relationship between socioeconomic status and uptake of screening services, a stepwise logit regression analysis using the svy command on Stata 13 was used. The first step was a bivariate analysis of wealth quintiles against the uptake of each type of test. The second and third steps were multivariate analyses. The second step included wealth quintiles and the need factors. This analysis was to assess the impact of need factors on the utilisation of screening tests across socioeconomic groups. The last step included the wealth quintiles, need factors and the non-need factors in the regression equation. In the analysis, p-values <0.05 were considered statistically significant.

7.3 Results

7.3.1 Uptake of screening tests by quintile

The uptake of screening tests by socioeconomic status is lowest for the poorest quintile (Quintile 1) and highest for the wealthiest quintile (Quintile 5). On average, the uptake of screening tests is highest for diabetes (42.6% of the eligible population) and hypertension (41.8%) compared to 19% for hypercholesterolemia. Figure 7-1 breaks this down by quintile for each screening test for the eligible age groups.

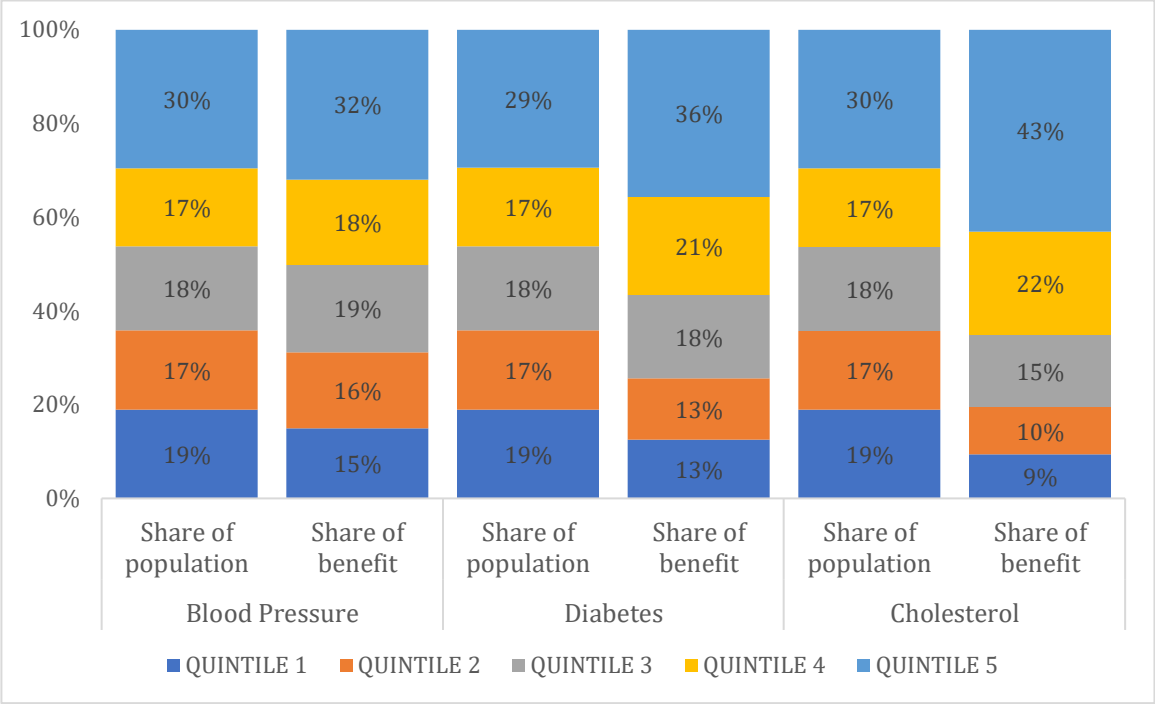
Figure 7-1 Uptake screening tests by socioeconomic groups



7.3.2 Share of the benefits vs. share of the population in need

An assessment of who benefits from the different screening services shows that the two wealthiest quintiles benefit disproportionately more than they should, given their share of the population. This is particularly the case for diabetes and cholesterol as shown in Figure 7-2.

Figure 7-2 Utilisation of screening services: share of benefit vs. share of the population in need



7.3.3 Relationship between wealth and the uptake of screening services

Table 7-3 shows the regression results for the utilisation of the screening tests against the four wealth quintiles in comparison to the highest quintile (quintile 5). The logit regression output is shown with and without controlling for need factors. The results show a strong, significant and increasing gradient of utilisation with and without controlling for the need factors, moving up the wealth gradient. However, the need factors appear to close the gap somewhat between the lowest quintile and the highest quintile for diabetes and cholesterol tests while for blood pressure screening, the need factors increase the gap slightly. For example, the likelihood of blood pressure screening for quintile 1 compared to quintile 5 is 50% lower when need is factored while it is only 42% lower without the need factors. However, this is not consistent from quintile 1 to quintile 4.

Most of the need variables are positively and strongly associated with the use of screening tests for all three tests as expected. All the recommended age categories as per preventative care guidelines are strongly associated with uptake compared to the reference age groups, although the association is less prominent for diabetes compared to cholesterol and hypertension. As expected, males are 0.31 times less likely than females to undergo any of the three tests with the gradient steepest for hypertension compared to either diabetes or cholesterol.

The weight status plays a significant role in the uptake of screening tests. Those who are underweight are less likely (though not statistically significant) than the "normal' weight individuals to undergo any tests, yet the obese are more likely to do so.

Current smokers are also more likely than non-smokers to undergo any of these three tests. Markers of health status- self-assessed health and family and personal history of chronic illness differ somewhat in their association with the utilisation of screening tests. Self-assessed health status shows an inconsistent association with screening uptake across the three tests. Those with a less than good/excellent self-assessed health status are more likely to have had their blood pressure and blood sugar measured than their cholesterol levels. However, having a chronic condition or a family history of chronic illness is strongly and significantly associated with the uptake of all screening tests.

Table 7-3 Logit regression output (regression coefficients) for the analysis of the uptake of screening tests

	High Blood Pressure		Cholesterol		Diabetes	
	Unadjusted	Need adjusted	Unadjusted	Need adjusted	Unadjusted	Need adjusted
QUINTILE 1	-0.42***	-0.50**	-1.46***	-1.24***	-0.74***	-0.68***
QUINTILE 2	-0.19**	-0.36**	-1.15***	-1.07***	-0.53***	-0.50***
QUINTILE 3	-0.12	-0.24	-0.84***	-0.93***	-0.28**	-0.32
QUINTILE 4	0.07	-0.27	-0.09	-0.15	0.12	-0.01
QUINTILE 5		Reference				
Age groups not recommended		Reference				
Recommended age		1.07***		1.02***		0.56***
Female		Reference				
Male		-0.31**		-0.0004		-0.08
Normal weight		Reference				
Underweight		-0.25		-0.53*		-0.09
Overweight/ Obese		0.40***		0.42***		0.50***
Non-smoker		Reference				
Current smoker		0.50***		0.41**		0.17
Good SAH		Reference				
Moderate SAH		0.37***		-0.28***		0.05
Bad SAH		0.25		-0.18		0.07
No family history		Reference				
Family Chronic history		0.51***		0.40***		0.87***
No chronic disease		Reference				
Chronic		1.74**		1.20**		1.07***
_cons		-2.06***		-3.07***		-1.99***

***p<0.001 **p<0.05 [data are presented as regression coefficients]

7.3.4 Association between wealth and the uptake of screening services adjusting for need and non-need factors

Table 7-4 shows the relationship between wealth and the uptake of the screening tests controlling for need and non-need factors. Compared to the unadjusted analysis, the results are inconsistent across the different quintiles. However, when one compares the lowest quintile to quintile 5, the non-need factors appear to close the gap to a larger extent than the need factors alone. The age categories for whom screening is recommended become even less significant compared to the other age groups when the non-need factors are included except for the diabetes test. Racial disparities in the uptake of screening tests are evident and significant, particularly for cholesterol, where White respondents are 1,01 times more likely to undergo the test compared to the African race group (Table 7-4). Marriage also confers an advantage for hypertension and diabetes screening, while those who are divorced are more likely to test for hypertension and cholesterol by 0.33 and 0.32 points.

While higher education is associated with an increased uptake of all of the three tests, the relationship is not entirely monotonous particularly for cholesterol compared to diabetes and cholesterol when one compares those who have reached the highest standard of education with the lower levels of education. Employment and living in urban areas do not confer any significant advantage over the unemployed for cholesterol and diabetes tests while those who live in urban areas are less likely than those who live in rural areas to undergo blood pressure and glucose tests. However, these differences are not statistically significant.

Provincial disparities (not shown in the table) are significant. Compared to those living in the KwaZulu Natal province, residents of the other provinces are less likely to undergo blood pressure screening. This is most noticeable in those residing in the Eastern Cape, North West, Mpumalanga and Limpopo where the difference is between 12-25% ($p<0.005$). On the other hand, Gauteng residents have the highest probability of testing for both diabetes and cholesterol.

As expected, health insurance has a strong positive association with the uptake of screening tests- this is most prominent for cholesterol (1.02 times higher) followed by diabetes (0.76 times higher) and blood pressure than those without health insurance, Table 7-4.

Table 7-4 Influence of need and non-need factors on the relationship between wealth status and the uptake of screening tests

	Hypertension screening		Cholesterol screening		Diabetes screening	
	Unadjusted	Need & Non-need adjusted	Unadjusted	Need & Non-need adjusted	Unadjusted	Need & Non-need adjusted
QUINTILE 1	-0.42***	-0.40*	-1.46***	-0.43	-0.74***	-0.70***
QUINTILE 2	-0.19**	-0.16	-1.15***	-0.31	-0.53***	-0.43
QUINTILE 3	-0.12	-0.07	-0.84***	-0.59**	-0.28**	-0.35
QUINTILE 4	0.07	-0.11	-0.09	-0.04	0.12	-0.40*
QUINTILE 5	Reference					
Other age groups	Reference					
Recommended age		0.87		-0.18		0.50***
Female	Reference					
Male		-0.38**		0.001		-0.31*
Normal Weight	Reference					
Underweight		0.17		0.11		0.29
Overweight/ Obese		0.46***		0.51**		0.16
Non-smoker	Reference					
Current smoker		0.32**		-0.08		0.05
Good SAH	Reference					
Moderate SAH		0.30**		-0.37*		0.17
Bad SAH		0.25		0.28		0.18
No chromic hisx						
Chronic hisx		0.36***		0.08		0.76***
No chronic illness	Reference					
Chronic		1.55***		1.44***		1.02***
African	Reference					
White		0.11		1.01**		-0.14
Coloured		0.05		0.95***		0.07
Indian		-0.42		1.33***		0.53*
Married	Reference					
Never married		-0.33***		0.09		-0.20*
Divorced		0.34*		0.32		-0.05
No-education		-0.51		-0.31		-0.69**
Primary		-0.51*		-0.66**		-0.58*
Secondary		-0.32		-0.47		-0.33
Tertiary	Reference					
Unemployed	Reference					
Employed		-0.09		0.26		0.11
Not insured	Reference					
Health Insurance		0.59***		1.02***		0.76***
Rural	Reference					
Urban		-0.10		0.06		-0.07
Constant		-1.02		-2.14***		-1.12***

***p<0.001 **p<0.05 *p<0.1 [data are presented as regression coefficients]

7.4 Discussion

This thesis presents the first estimation of needs-adjusted socioeconomic inequalities in the use of screening tests for specific NCDs in South Africa. A pragmatic approach is used in defining the need for prevention using both the strict guideline (age-specific definition) and a definition that incorporates other factors such as age, chronic diseases, family history of ill-health and smoking as generally used in horizontal equity literature. It is essential to widen the definition of need because preventative care is not routinely offered universally in both the public and private sectors as part of a structured programme. Hence in assessing respondents' answers to whether or not they had undergone any tests for high blood pressure, blood glucose or hypercholesterolemia, the responses would include tests done as part of the strict screening routine (Wald 2008) tests done as part of treatment due to pre-existing symptoms. The premise of this chapter is to assess the use of these tests as part of awareness of one's NCD status; therefore, whether one arrives at the answer through strict screening or through pre-existing symptoms is considered immaterial.

This thesis contributes two essential points to the debate on inequality in health care and universal health coverage of NCDs in South Africa. Firstly, the results confirm the disparities in coverage of services showing that the rich benefit disproportionately more than the poor in the use of health care services similar to findings elsewhere (Harris, Goudge and Ataguba, 2011; Ataguba and Goudge, 2012; Ataguba and McIntyre, 2012). The findings also show that the cost of the tests also determines the scale of this variation, with the rich-poor gap wider for the more expensive tests namely blood sugar and cholesterol tests compared to blood pressure measurements.

Secondly, this chapter assesses whether health shocks such as having a chronic condition, a poor self-assessed health status, risk factors such as smoking and being overweight, alter the rich-poor gap in any way. We find that adjusting for these need factors closes the gap between the rich and the poor somewhat for cholesterol and diabetes screening but not so much for blood pressure. Overall, the need factors are not sufficient on their own to drive utilisation of these tests. The non-need/enabling factors in the form of health insurance and other factors such as race (non-African), education, marital status and place of residence seem to play a more prominent role by further narrowing the gap. However, because these non-need factors are pro-rich in their nature and their distribution, the gap between the poor and the rich remains significant. For example, after controlling for all need and non-need factors, a person in the lowest quintile is still 43% and 70% less likely than the wealthiest quintile to undergo the cholesterol or the diabetic test, respectively. Race shows a particularly strong and consistent association between the uptake of screening tests for cholesterol relative to diabetes or hypertension. Racial disparities, in particular, have been noted in other studies, particularly in countries

with a similar history of racial segregation to South Africa such as the USA (McCall-Hosenfeld et al. 2012).

Compared to all marital categories, those who have never been married are the least likely to undergo blood pressure and diabetes screening (Table 7-4). These results are similar to what other studies have found. For example, a study found that that "lonely hearts" are less likely to be tested bringing to the fore the role of social support in encouraging uptake of screening tests (Petrova et al. 2015). Also, marriage may confer a higher wealth status by the shared wealth between two individuals hence its positive association with the uptake of the tests.

The gender disparities observed in this analysis have also been observed in the literature on health care seeking behaviour (Ahmad and Jafar 2005; Cheah and Goh 2017; Guariguata et al. 2015). Males are less likely than females to seek health care when ill and even less so for screening purposes. Yet in South Africa, mortality due to NCDs starts to be noticeable at least a decade earlier in females than in males. The 2016 mortality data released by Statistics South Africa in March 2018 showed that while the two top killers for males remain infectious causes, this has shifted for females. More females are dying from NCDs than males- with diabetes being the number one killer followed by cerebrovascular disease (StatsSA 2018). This could be because South Africa is in the midst of an epidemiological transition noticeable amongst females than males. The results may be an indictment on the effectiveness of the treatment cascade for chronic diseases, i.e. even though people get diagnosed, they get lost in the treatment cascade. Also, the findings bring to question the relevance of the guidelines that limit the diabetes screening tests to 45 years and older yet mortality for NCDs spikes at 45-49 years for females and from 50-56 years for males as this could be delaying the diagnosis.

This thesis also found that being underweight is associated with a reduced likelihood of screening compared to those with a normal weight or those who are obese. While this could be linked to perceptions about weight and NCDs, in this population, it is also linked to wealth. Those who are underweight are more likely than the obese to be poor and given the strong wealth – utilisation relationship of screening tests, the underweight are less likely to utilise these tests for affordability reasons.

Surprisingly, poor self-assessed health (SAH) status is negatively associated with the use of cholesterol tests compared to the other tests. This is likely related to affordability given the lower socioeconomic status of those with a poor SAH. On the other hand, a family history of chronic illness is strongly and positively associated with the use of all screening tests.

Overall, the uptake of the tests amongst the eligible population is highest for diabetes because the diabetes screening eligible population is older, on average, compared to either hypertension or cholesterol. Therefore, it is expected that as the uptake of any screening tests increases with age, this is more likely to be in favour of diabetes compared to the other two tests.

While one may debate the merits of expanding the definition of screening to include any use whether through screening for preventative purposes or diagnosis for treatment, the findings of this thesis have important implications. Firstly, the coverage of screening services is significantly low, ranging from 19% for cholesterol to just over 40% for diabetes and hypertension despite using the broader definition of the utilisation of these screening tests. The differences in uptake between hypertension and cholesterol tests are not unique to South Africa as similar results were found in the USA where blood pressure screening uptake was 94.1% compared to 49.8% for cholesterol (McCall-Hosenfeld et al. 2012). Overall, the low uptake of screening tests is a cause for concern particularly for hypertension which is on par with lower-income countries such as Pakistan (Ahmad and Jafar 2005) and which test should be done routinely in any clinical setting and be easily available at low cost for screening purposes.

The results also prove that inequality in the utilisation of preventative care exists in South Africa. This is of particular importance because if screening tests are to be used as a proxy for health care use for those with NCDs, coverage for the poor may also be disproportionately low. The enabling factors of health care insurance coverage; wealth and education play a pivotal role in the utilisation of these tests. Because health insurance is a major determinant of utilisation and is only available to about 16% of the population, screening services should be intensified in the public sector primary health care clinics where service are available free of charge and where the majority of South Africans access health care. Intensifying screening efforts in the public sector would improve coverage for the rural folk, the uninsured and the unemployed because the face of the unscreened is mainly black, poor, rural, male, unemployed and uninsured.

7.5 Conclusion

In conclusion, wealth driven inequalities in use of screening services are significant and appear to increase even in the presence of need factors. Urgent action is required to promote the uptake of screening tests especially amongst the poor given the rise of mortality due to NCDs and to reverse the economic costs of curative care associated with the hospi-centric health care provision. The current health care reforms, notably the National Health Insurance bill which seeks to provide universal health coverage to all South Africans, may be one such action needed to improve uptake.

However, an inter-sectoral collaboration between the health sector and other social and economic sectors is required to reduce the socioeconomic inequality in screening for NCDs significantly.

Chapter 8 Horizontal inequity in the use of screening tests for non-communicable diseases in South Africa

8.1 Introduction

This chapter investigates socioeconomic inequality and horizontal inequity in the use of screening services for NCDs using the SANHANES dataset. There is a dearth of literature on inequality and inequity with regards to preventative service utilisation for chronic diseases in developing countries and South Africa in particular. Many studies, particularly in developed countries, have focused on cancer screening (Bussière et al. 2015; Clarke et al. 2016; Fulton et al. 1995; Gallo et al. 2017; Kim and Hwang 2016; Martin-Lopez et al. 2013; Solmi et al. 2015). An analysis of horizontal equity in the area of NCDs, specifically, in the use of screening services has not been undertaken to any significant extent. A concise description of the available literature in relation to screening for NCDs has already been described in Chapter 7.

This chapter contributes to three things. Firstly, we assess inequality in use of screening services for NCDs with respect to wealth. Shedding light on the socioeconomic inequality in the use of preventative care is vital as it has both economic and social implications. As argued by Grossman, the less educated and the poor are less efficient producers of health (Grossman 1972). As such the social and economic costs of the poor not utilising preventive health care are higher and require more subsequent health care use and hence higher spending by government (Carrieri and Wuebker 2012; Grossman 1972).

Secondly, by focusing on screening services for NCDs, the results can be used as a proxy for assessing equity in the delivery of health care services for NCDs in South Africa given the straightforward way of defining the need for preventative health care as everyone in the targeted age group needs and should access preventive care (Carrieri and Bilger 2013).

Thirdly we decompose the drivers of inequality in use of screening services to assist policymakers in understanding the variables for intervention.

8.2 Methods

8.2.1 Study population

This chapter uses data from the first South African Nutritional and Health Examination Survey (SANHANES-1). Details of the SANHANES-1 data are described as explained in section 3.4 (Shisana et al. 2014)

8.2.2 Dependent variables

The self-reported use of testing services for the various NCDs (hypertension, dyslipidaemia and diabetes), as defined in Chapter 7 was used to assess screening coverage.

8.2.3 Analytical methods

This chapter uses the concentration curve and the concentration indices to assess horizontal inequity in the use of NCDs screening service. The concentration index is further decomposed as explained in section 3.4, using the fgt-ci methodology.

8.2.4 Measuring horizontal inequity in the use of screening services

While the concentration index measures inequality in health care utilisation, it does not measure the degree of inequity in the distribution of health care use because it does not directly take need-based use into account (van Doorslaer et al. 2004). The horizontal equity analysis seeks to explore if there is differential utilisation of health care by socioeconomic groups after standardising for differences in the need for health care (O'Donnell et al. 2008). The residual inequality in utilisation after standardisation is therefore interpreted as horizontal inequity (O'Donnell et al. 2008).

Standardisation for need variables in a linear model is done similarly to the age and sex standardisation method of health variables. However, the relevant standardising variables are not as straightforward with respect to need standardisation (O'Donnell et al. 2008). Need is an elusive concept, and its measurement in many surveys, including the Demographic Health Survey, is not as straightforward to assess and measure. Therefore, in addition to the demographic variables, researchers also rely on proxy variables such as health status and morbidity variables (O'Donnell et al. 2008; Wagstaff and Waters 2005). However, in relation to screening, need is relatively easier to define given the use of clinical guidelines that specify eligible populations.

The Wagstaff horizontal inequity index (HI) was used to assess horizontal inequity in screening services utilisation. The HI represents the socioeconomic differences in utilisation of screening services after controlling for need. Therefore, the HI is calculated as the difference between the concentration index of indirectly standardised use of screening services (C_y) and the concentration index for need, (C_N).

Equation 13

$$HI = C_y - C_N$$

A positive (negative) value of the HI indicates horizontal inequity favouring the better-off (worse-off), while a zero index value indicates no horizontal inequity, i.e. that the use of screening services and need are proportionally distributed across the distribution of socioeconomic status (van Doorslaer et al. 2004). To assess the contributions of each explanatory variable to the observed inequality, we used the FGT-CI method by in the decomposition analysis (Bilger et al. 2016).

8.3 Results

8.3.1 Socioeconomic inequality in the use of screening services

All screening types show a pro-rich inequality as shown by the concentration curves that lie below the line of equality (Figure 8-1). The concentration indices also confirm this with positive concentration indices for all three screening procedures Table 8-1. This is most pronounced for cholesterol screening, followed by diabetes and hypertension. This trend is observed using all three different methods.

Table 8-1 Concentration indices for screening in South Africa (SANHANES, 2012)

Screening test	CI standard (SE)	CI Erreygers	CI Wagstaff
Blood Pressure	0.052 (0.007)	0.076 (0.01)	0.082 (0.01)
Diabetes	0.129 (0.009)	0.132 (0.009)	0.165 (0.012)
Cholesterol	0.270 (0.012)	0.174 (0.007)	0.324 (0.014)

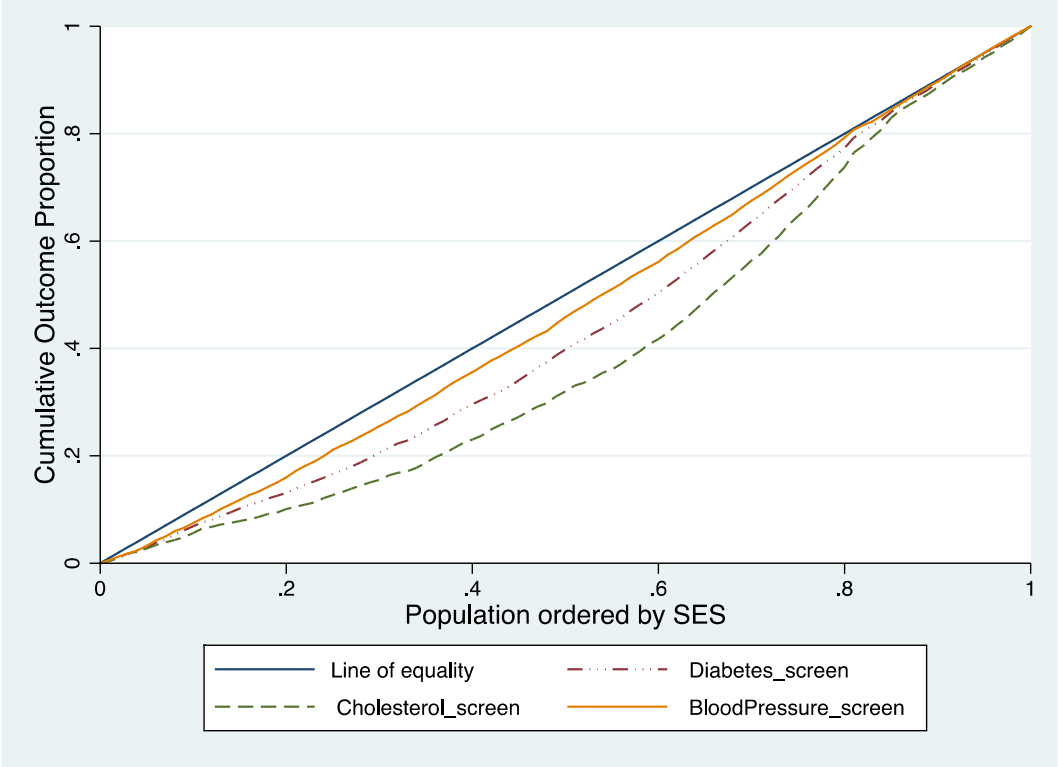
8.3.2 Horizontal inequity

An assessment of equity in the use of preventative services against the need for all three services favours the rich as shown by the positive horizontal equity indices. This is most pronounced for cholesterol Table 8-2. The strength of the gradient from blood pressure to cholesterol is somewhat reduced because the diabetic population in need is much richer than that for blood pressure as a result of the older minimum age of 45 years compared to 18 years for hypertension and 20 years for cholesterol screening.

Table 8-2 Horizontal inequity in the use of screening services in South Africa

Screening test	Concentration Index of Use	Concentration Index of Need	Horizontal Equity Index
Blood Pressure	0.052	0.039	0.013
Diabetes	0.129	0.097	0.032
Cholesterol	0.270	0.056	0.214

Figure 8-1 Concentration curves for the utilisation of screening services in South Africa (SANHANES, 2012)



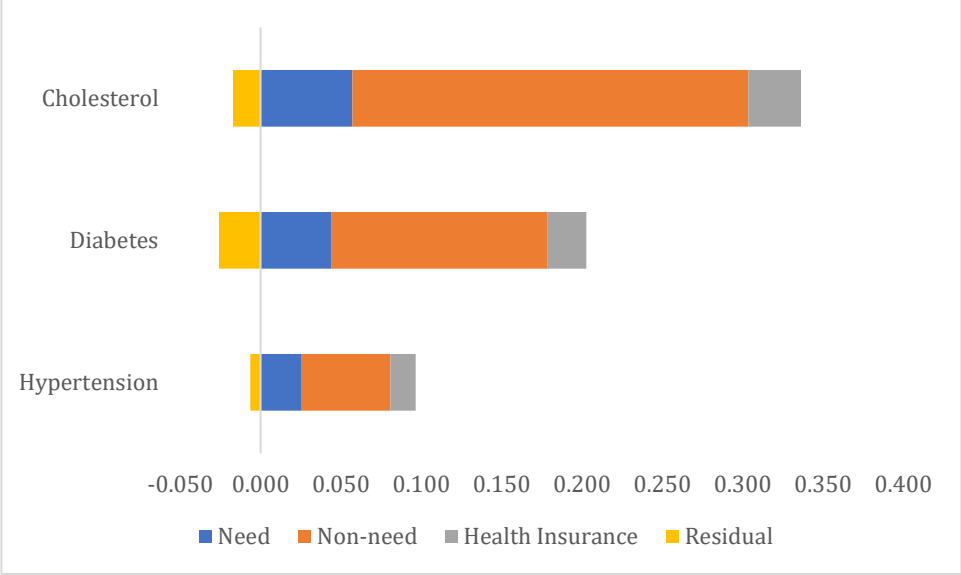
8.3.3 Decomposing inequality in the use of screening services

To understand the drivers of this observed health inequality, we decompose the concentration index of the use of these screening tests into its determinant factors and present the results in Table 8-4. The decomposition results show that the population in need of screening is concentrated amongst the rich more than the poor, as shown by a significant and positive concentration index (*CIk)*.

In Figure 8-2, need and non-need factors are grouped together, respectively. Need factors include age, risk factors such a smoking, BMI, family history of chronic diseases, having a chronic condition and

self-assessed health status. Non-need factors include race, marital status, education, employment, area of residence. Health insurance is analysed independently. Need factors contribute a smaller portion to inequality compared to the rest of the other factors (Figure 8-2). Amongst the need factors, BMI, family history of chronic conditions and having at least one chronic condition contributes the largest to the observed inequalities in all three tests Table 8-3. The non-need factors contribute the most to the observed inequality for all tests. Education, wealth, health insurance and province of residence are the most prominent. Area level influences are the most significant for cholesterol tests contributing more than half of the observed inequality (53%) while wealth is the stronger influence for hypertension and diabetes testing. A breakdown of this analysis is shown in Table 8-3 and on Table 8-4.

Figure 8-2 Decomposition of the socioeconomic inequality in the use of screening services in South Africa (SANHANES, 2012)



Smoking and moderate self-assessed health status show a similar pattern- they are both concentrated amongst the rich and are more likely to test for high blood pressure and high blood sugar than for cholesterol. However, those with a bad self-assessed health status are significantly poor though they show a positive elasticity in relation to all tests and ultimately their contribution to the observed inequality is negative. Those with a family history of chronic disease and those with a diagnosed chronic condition contribute significantly (15%) to the observed inequality and are likely to be rich and also have a positive elasticity with respect to use.

Table 8-3 Relative contributions of socioeconomic determinants to socioeconomic inequality in the use of screening services in South Africa

Social Determinants	Hypertension	Diabetes	Cholesterol
Residual	-7%	-15%	-5%
Urban	-6%	-4%	6%
Employment	-1%	1%	5%
Self-Assessed Health Status	-1%	-1%	-1%
Sex	0.2%	0.1%	0.01%
Current smoker	1%	0.5%	1%
Recommended age group	3%	0.5%	0.2%
Age	4%	6%	8%
Marital	6%	1%	-2%
Chronic	6%	3%	2%
Family History of Chronic Disease	7%	8%	1%
BMI	7%	8%	6%
Provincial Deprivation	10%	13%	25%
Race	10%	-3%	10%
Education	16%	16%	13%
Health Insurance	18%	14%	10%
Wealth Status	26%	52%	20%

8.4 Discussion

This chapter presents the first South African estimation of the inequality and horizontal inequity in the use of screening tests for specific non-communicable diseases in South Africa. The chapter uses the concentration index and the health inequity index and further decomposes the concentration index to understand the drivers of inequality. The analysis reveals a pro-wealthy distribution of the inequality in the use of screening tests driven predominantly by non-need factors.

This chapter contributes two important points to the debate on inequality in health care and universal health coverage of non-communicable diseases in South Africa. Firstly, the findings show that the cost of the type of tests determines the extent of inequality, with the concentration index strongly pro-rich for the more expensive tests namely blood sugar and cholesterol tests compared to blood pressure measurements. Secondly, there is significant horizontal inequity in the utilisation of these tests with the most significant level of inequity observed for cholesterol tests.

In the decomposition analysis, we find that need factors worsen the gap between the rich and the poor by contributing significantly to pro-rich inequality. This is most prominent for BMI, a family

history of chronic illness, and having a chronic disease. It is telling that the prevalence of diagnosed chronic conditions is distributed more amongst the wealthy than amongst the poor, yet the poor self-assessed health status is more amongst the poor. In this thesis, those with poor self-assessed health exhibit a positive elasticity with respect to utilisation of all tests. However, this means the poor do not access preventative services timeously to maximise the utility of screening as a mechanism of prevention (Carrieri and Wuebker 2012) but rather as part of diagnosis and treatment. The poor are likely to present for care acutely, at times at an advanced stage of ill-health and their encounter with screening services happens at a late stage of acute illness. Therefore, the benefit to the poor is less optimal - because it is sought too late in the illness continuum to be of much use in the prevention and/or early detection of illness. This could be explained by the disparities in access/utilisation of health services between the wealthy and the poor in South Africa (Ataguba and McIntyre 2012b). Therefore, there is a reason to suspect that the prevalence of chronic diseases and socioeconomic inequality is underestimated particularly amongst the poor through using self-reported prior diagnosis. This is further compounded by the observation that the poor are less likely to perceive themselves as ill so even the self-assessed health status commonly used in surveys underreports the extent of ill-health amongst the poor (Rossouw 2015).

The pro-rich distribution of family history of chronic diseases may be explained by the fact that the poor are not always aware of their family medical history possibly due to lower levels of education. This was confirmed in a USA study that found that males, those with only high school education or lower, and with lower income were less likely to collect their family's medical history (Yoon et al. 2004). Therefore, the pro-wealthy finding of family history of chronic disease in our study may not necessarily be due to the unequal distribution of chronic illness in favour of the rich but could be due to lower levels of awareness amongst the poor.

Age increases pro-rich inequality and is associated with both higher socioeconomic status and a higher propensity for utilisation of preventative services. Overall, screening rates increase with age for all three screening services. This means that generally, people access preventive health care late possibly as a result of ill-health which could have been prevented by early detection. As explained, the elderly have higher access to all types of health care, including preventative health care by default through their frequent interaction with health care systems as a result of ill-health (Cropper 1977).

Non-need factors drive most of the socioeconomic inequality in the use of screening services. There is marked pro-rich racial disparities in the utilisation of screening services, particularly for cholesterol and hypertension, where it explains 10% of the observed inequality. Similar racial disparities have

been reported for cholesterol screening in the USA with the highest rates for screening for White non-Hispanics (Brown et al. 2001).

Employment contributes a small percentage to the socioeconomic inequality with a pro-poor inequality in the utilisation of hypertension screening (-1%) and pro-rich inequality to both diabetes and cholesterol (1% and 5%, respectively) owing to higher utilisation amongst the employed. These findings differ somewhat from other middle-income countries such as Malaysia that cite the time cost of seeking health care as an impediment to utilisation for the employed (Cheah and Goh 2017). This could be explained by the availability of occupational health services that may counteract this time cost of seeking care in the South African setting. This is particularly true for cholesterol and diabetes screening. Additionally, as per the Grossman model, the employed place a higher value on their healthy time and hence are more likely to demand preventative care as an investment good than the unemployed (Grossman 1972). However, this means the unemployed fall through the cracks even for hypertension screening which is available at a much lower cost than the other two tests.

Living in an urban area promotes pro-poor inequality in the use of screening services for hypertension and diabetes. This significant contribution is driven by the pro-rich distribution of urban dwellers and negative elasticity compared to rural folk.

The findings of this chapter prove that there is inequality in the use of preventative care in favour of the rich in South Africa. Overall, coverage of screening services is very low (below 50%) for all screening services, including hypertension, which should be done routinely and be readily available at low cost or free of charge. This means the policy focus should be on both the demand and supply-side interventions. On the demand side, education and awareness programmes are likely to improve access by sensitising people to the need for screening. Therefore, an inter-sectoral collaboration between the health sector and other social and economic sectors is required to reduce the socioeconomic inequality in screening for NCDs. On the supply side, screening services should be intensified in the public sector in primary health care clinics where services are available free of charge and where the majority of South Africans access health care.

Intensifying screening efforts in the public sector would improve coverage for the rural folk, the uninsured and the unemployed because the face of the unscreened is mainly black, poor, rural, male, unemployed and uninsured.

The use of services reflects the ease with which tests are done and the accessibility of the tests in question. Of the three screening services, cholesterol is the most strongly pro-rich. This could be

driven by the lack of awareness and the fact that hypercholesterolemia is "not seen and heard of" as commonly as diabetes and raised blood pressure.

Fewer men than women and younger people are less likely than adults to have undergone screening for any one of these NCDs. As these are preventative tests meant to raise awareness of one's state of health and possibly prevent the onset of diseases in adulthood, policies must be in place to deliberately target men and the youth particularly because of the cost-effectiveness of screening younger populations. While race is not a significant determinant of screening for hypertension and diabetes, screening for cholesterol brings out the racial nature of access to services.

While the decomposition analysis does not provide causal pathways between socio-demographic determinants and screening services, it allows for the identification of those factors that contribute to the observed inequalities. This is of particular importance because if screening tests are to be used as a proxy for health care use for those with NCDs, it is possible that coverage for the poor is also disproportionately low. The enabling factors of health care insurance coverage, wealth and education play a pivotal role in the utilisation of these tests.

8.5 Conclusion

Poor South Africans utilise screening services to a lesser extent than the wealthier South Africans. This has implications for the early detection and optimum management of non-communicable diseases in South Africa. Measures should be put in place to increase awareness of the need for screening and to ensure these services are available mainly in the public sector clinics that serve the majority of South Africans.

Table 8-4 Results of the decomposition analysis of socioeconomic inequality in the use of screening services in South Africa

Socioeconomic determinants	Categories	Blood pressure				Diabetes				Cholesterol			
		CIk	Elasticity	CIy	CIy (total)	CIk	Elasticity	CIy	CIy (total)	CIk	Elasticity	CIy	CIy (total)
Age	Age	0.016**	0.23	0.004	0.004	0.018**	0.599	0.011	0.011	0.016**	1.639	0.026	0.026
Sex	Female	Reference											
	Male	-0.002	-0.079	0.000	0.000	-0.002	-0.039	0	0.000	-0.0004	-0.092	0	0.000
Recommended age	No												
	Yes	0.011**	0.221	0.002	0.002	0.063**	0.013	0.001	0.001	0.012**	0.060	0.001	0.001
Race	African	Reference											
	White	0.741**	0.006*	0.004*	0.009	0.740**	-0.006	-0.005	-0.005	0.748**	0.016**	0.012**	0.033
	Coloured	0.282**	0.016	0.005		0.280**	-0.007	-0.002		0.290**	0.058	0.017	
	Indian	0.487**	0.001	0.000		0.486**	0.004**	0.002**		0.487**	0.008	0.004	
Smoker	No												
	Yes	0.045*	0.028	0.001	0.001	0.052*	0.017	0.001	0.001	0.044	0.062	0.003	0.003
SAH	Good	Reference											
	Moderate	0.018	0.029	0.001	-0.001	0.019	0.004	0	-0.001	0.018	-0.247	-0.004	-0.004
	Bad	-0.126**	0.011	-0.001		-0.123**	0.011	-0.001		-0.120**	-0.003	0.000362	
Family history of Chronic Dis.	No	Reference											
	Yes	0.070**	0.091	0.006	0.006	0.072**	0.201	0.014	0.014	0.069**	0.051	0.003	0.003
≥1 Chronic Disease	No												
	Yes	0.042**	0.128**	0.005**	0.005	0.042**	0.118**	0.005**	0.005	0.043**	0.183*	0.008	0.008
Weight	BMIsq					0.051**	-0.147	-0.008	-0.008				
	BMI	0.025**	0.267	0.007	0.007	0.026**	0.826	0.022	0.022	0.026**	0.773	0.02	0.020
Marital Status	Married	Reference											
	Never Married	-0.085**	-0.06	0.005	0.005	-0.089**	-0.016	0.001	0.001	-0.085**	0.081	-0.007	-0.007
	Divorced	-0.006	0.010*	0.000		-0.007	-0.003	0		-0.01	0.023	-0.0002364	
Education	No Education	Reference											
	Primary	-0.224**	-0.003	0.001	0.015	-0.221**	0.014	-0.003	0.029	-0.228**	0.000	-0.0000698	0.041
	Secondary	0.065**	0.07	0.005		0.063**	0.248	0.016		0.063**	0.176	0.011	
Employment	Tertiary	0.474**	0.020**	0.009**		0.482**	0.033	0.016		0.474**	0.063	0.03	
	Employed	Reference											
	Unemployed	-0.070**	0.018	-0.001	-0.001	-0.071**	-0.022	0.002	0.002	-0.066**	-0.234	0.015	0.015
	Other	-0.009	0.003	0.000		-0.007	-0.073	0.001		-0.018	-0.004	0.000	
	No	Reference											

Socioeconomic determinants	Categories	Blood pressure				Diabetes				Cholesterol			
		CIk	Elasticity	CIy	CIy (total)	CIk	Elasticity	CIy	CIy (total)	CIk	Elasticity	CIy	CIy (total)
Health Insurance	Yes	0.600**	0.026**	0.016**	0.016	0.601**	0.04	0.024	0.024	0.600**	0.054	0.033	0.033
Urban	Rural	Reference											
	Urban	0.241**	-0.022	-0.005	-0.005	0.241**	-0.032	-0.008	-0.008	0.240**	0.084	0.02	0.020
Wealth Status	Quintile 1	Reference											
	Quintile 2	-0.271**	0.002	-0.001	0.024	-0.268**	0.044	-0.012	0.091	-0.267**	-0.005	0.001	0.064
	Quintile 3	0.176**	0.027	0.005		0.177**	0.106	0.019		0.180**	-0.002	-0.000	
	Quintile 4	0.598**	0.007	0.004		0.596**	0.045	0.027		0.601**	0.051	0.03	
	Quintile 5	0.898**	0.017	0.015		0.897**	0.064	0.058		0.898**	0.036	0.032	
Provincial Deprivation	Most	Reference			0.009								
	Average	-0.150**	0.067	-0.010		-0.155**	0.023	-0.004	0.023	-0.153**	0.058	-0.009	0.081
	Least	0.261**	0.074	0.019		0.261**	0.101	0.026		0.260**	0.347	0.09	
	Residual	-0.007			-0.007	-0.026			-0.026				-0.017
	Total				0.090				0.177				0.319

a-SAH-self assessed health status b-Other includes retired, students and disabled
* p<0.1, ** p<0.05

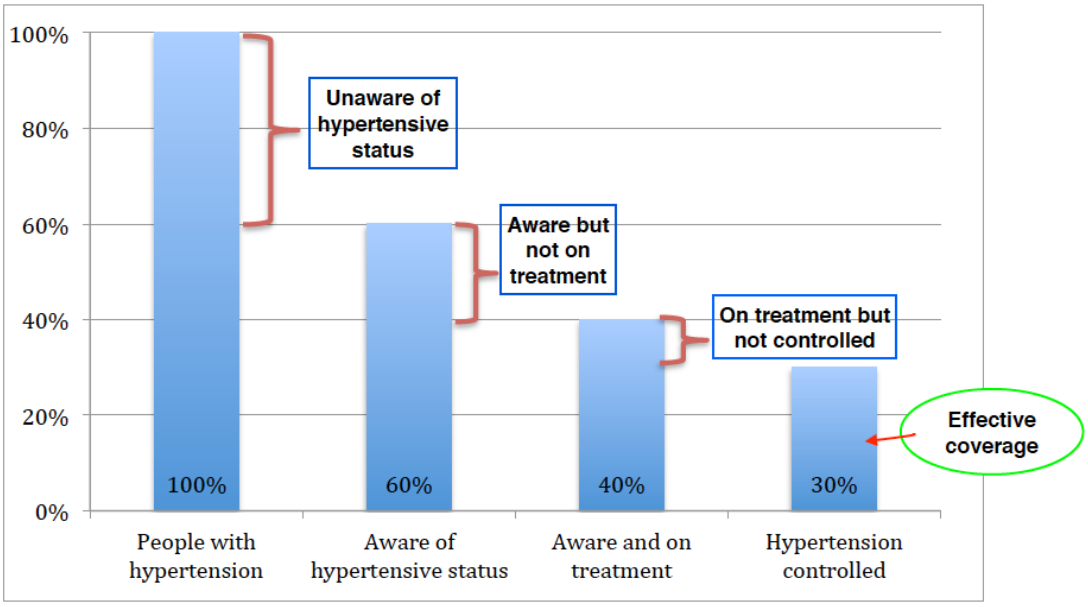
Chapter 9 Effective coverage for hypertension

9.1 Introduction and background

This chapter explores socioeconomic inequality in the distribution of effective treatment coverage for hypertension. Effective coverage refers to the proportion of the population in need of health services that obtain services promptly and at a level of quality sufficient to obtain the desired effect and potential health gains (Ng et al. 2014; World Health Organization & The World Bank 2015). Concerning the management of NCDs, effective coverage refers to the proportion of the population that is aware of their condition, are on treatment and are sufficiently controlled within the recommended therapeutic targets (Ng et al. 2014). A hypothetical example of the effective coverage cascade for hypertension is shown below in Figure 9-1. Effective coverage for hypertension treatment refers to the population that is aware of their disease condition, are on treatment and are within therapeutic targets for control. The goal of treatment for hypertension is a blood pressure level of <140/90 mmHg regardless of underlying comorbidities and cardiovascular risk (Seedat et al. 2014).

In the example in Figure 9-1, effective coverage is only 30%, i.e. only 30% of people with hypertension are aware of their status, are on treatment and are controlled on treatment. Therefore, effective coverage is composed of need, use and quality. Need refers to the population suffering from the condition in question, e.g. hypertension. Use refers to the utilisation of services for the treatment of the condition, e.g. hypertension treatment/medication and quality refers to the health benefit obtained from treatment, e.g. blood pressure control (Ng et al. 2014). Effective coverage is an important metric to measure progress towards universal health coverage for NCD services as these conditions constitute a larger share of disease burden and mortality. Effective coverage can also serve as a proxy for the effectiveness of a health system (Ng et al. 2014).

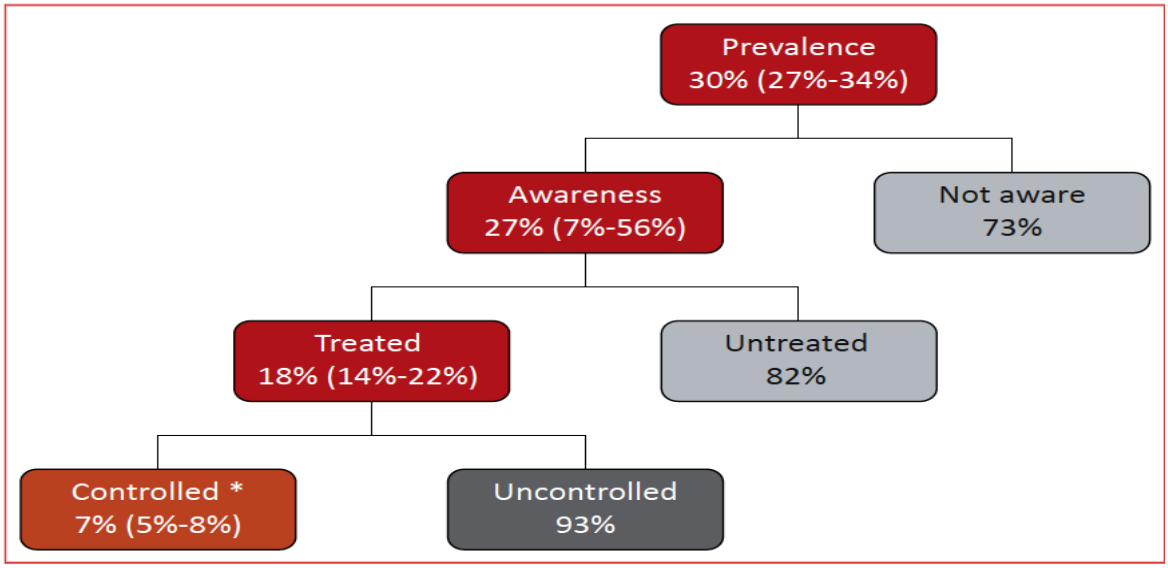
Figure 9-1 Hypothetical example of effective coverage cascade for hypertension



Adapted from the World Health Organization & The World Bank (2015)

It is estimated that the number of people affected by hypertension is highest in Africa, with about 46% of adults aged 25 years and older affected, compared to 35% to 40% in other parts of the world (Dzudie et al. 2018). Despite this high prevalence, effective coverage for hypertension remains very low. Also, a large proportion of the population with hypertension in Sub Saharan Africa remains undiagnosed, untreated, or inadequately treated, which contributes to the rising and costly burden of cardiovascular diseases in the region (Ataklte et al. 2015). This is summarised in Figure 9-2 to illustrate the hypertension care cascade in Africa. The schemata show that hypertension is poorly managed in sub-Saharan Africa (Dzudie et al. 2018).

Figure 9-2 Prevalence, awareness, treatment and control of hypertension



Source: (Dzudie et al. 2018).Roadmap to Achieve 25% Hypertension Control in Africa by 2025

A similar finding has been made in respect to South Africa using the SANHANES dataset (Berry et al. 2017). The hypertension prevalence was 35% and in addition 49% of the respondents were unscreened and undiagnosed while effective coverage was 8.9% (Berry et al. 2017). While this thesis is similar to this study, it goes beyond quantifying the level of effective coverage to assessing socioeconomic inequality within each stage of the hypertension care cascade to identify potential areas of intervention to alleviate the burden on the poor.

9.1.1 Socioeconomic inequality and non-communicable diseases

NCDs perpetuate socioeconomic inequality in that, as they require chronic treatment, the poor may not be able to afford nor access sustained treatment compared to the wealthier members of society, and consequently, mortality will be higher amongst the poor than the rich (Alleyne et al. 2013). This chronicity of NCDs results in significant expenditure for households resulting in households being kept in a cycle of debt and ill-health. This cycle perpetuates health and economic inequalities, including poverty (Beaglehole et al. 2011a). Although the direct costs of treatment may be low particularly in South Africa, where primary healthcare is available free of charge, socioeconomic conditions may be such that the indirect costs of seeking treatment are unaffordable for many. This has been observed with TB and HIV/AIDS care (Cleary et al. 2011; Cleary and McIntyre 2010). Further, in South Africa, a study by Schneider *et al.* found an increase in the prevalence of hypertension and obesity with increasing wealth but the quality of care indicators such as control of asthma and hypertension was inversely associated with wealth (Schneider et al. 2009).

There has been a worldwide move coordinated by the WHO to prioritise NCDs. However, Kengne and Mayosi argue that the goodwill of policymakers does not always translate to policy as practice in most countries (Kengne and Mayosi 2014). This has been proven in many studies for hypertension, including the metanalysis by Ataklte et al. that finds the levels of hypertension control to be as low as 7% among those on treatment (Ataklte et al. 2015). It is with these poor effective coverage levels in mind that the Pan-African Society of Cardiology (PASCAR) drafted a roadmap on hypertension. The roadmap aims to develop practical guidance on how to implement strategies that translate existing knowledge into effective action to improve detection, treatment and control of hypertension and cardiovascular health in sub-Saharan Africa by the year 2025 (Dzudie et al. 2018).

The prevalence of hypertension in South Africa is on the increase. The metanalysis by Ataklte et al. looked at data from several countries including South Africa. The three studies included in the metanalysis from South Africa covering the period from 2009 to 2013 reported increasing prevalence rates from 14.7% in 2009 to 46.2% in the 2011 and 49.8% in 2013 (Ataklte et al. 2015). In another multi-country study, hypertension awareness was lower than expected given national income in Sweden and South Africa but was higher than expected in Brazil, Saudi Arabia, Occupied Palestinian Territory and the Philippines. Overall, South Africa was found to perform worse than countries with much lower GDPs in awareness, treatment and control (Palafox et al. 2016).

Given the increasing prevalence, there is a need to understand the nature of socioeconomic inequality in effective coverage with a focus on awareness, treatment and control in South Africa. This is important to guide policymakers not only in formulating and implementing policies to manage hypertension more effectively as espoused in the road map (Dzudie et al. 2018), but also to identify which population groups to focus the interventions on in keeping with the Sustainable Development Goals. South Africa has implemented many strategies to improve service coverage in primary health care with at least 94% of the population within 7 km of a clinic (McLaren et al. 2014) however inequalities remain. Therefore, it is vital to assess the extent of inequality along the hypertension care cascade because an improvement in average service coverage may mean that the same people are accessing care while the poor remain uncovered (World Health Organization and International Bank for Reconstruction and Development / The World Bank; 2017 2017). Further, as a coping strategy, the poor often delay seeking treatment due to lack of financial resources (Sauerborn et al. 1996). This was observed in an inter-country study by the WHO that included South Africa (Vellakkal et al. 2015b). Vellakkal et al. found that for depression, hypertension and respiratory conditions like asthma and chronic lung disease, self-reported illness was concentrated more amongst the rich than the poor. On the other hand, using symptom-based or criterion-based measures, the concentration index was negative, indicating that asthma and chronic lung disease, depression and hypertension are more

prevalent amongst the lower socioeconomic groups than the wealthier members of society. However, the poor are less likely to be aware of their disease status. This chapter seeks to assess the extent of effective service coverage for hypertension as a tracer condition for non-communicable diseases. Specifically, it assesses socioeconomic inequality in hypertension awareness, treatment and control.

9.2 Methodology

9.2.1 Data

This chapter uses data from the fourth wave of the South African National Income Dynamics Study (SA-NIDS). See section 3.2 for details.

9.2.2 Primary variables

In this thesis, criterion-based hypertension was defined as a mean systolic blood pressure ≥140 mm Hg or diastolic blood pressure ≥90 mm Hg or reported prior diagnosis or self-reported treatment for hypertension at the time of the survey. This study included self-reported or prior diagnosed hypertension as these have a bearing on awareness and the measurement of blood pressure at the time of the survey. A similar approach has been used in previous studies on hypertension (Sarki et al. 2015). Self-reported hypertension was defined as those respondents reporting a history of hypertension diagnosis or being on treatment for hypertension. Undiagnosed hypertension was defined as those having hypertension by examination but with no prior diagnosis of hypertension. Untreated hypertension was defined as those with self-reported hypertension but with no history of treatment. Uncontrolled hypertension is a measured mean systolic blood pressure of >=140 mm Hg during the survey or measured the diastolic blood pressure of >=90 mm Hg while on treatment, Table 9-1

Table 9-1 Definitions used

Indicator	Definition
Criterion-based hypertension prevalence	Measured BP≥140/90
Self-reported/Awareness	Reported prior diagnosis or
	Self -reported high blood pressure treatment
Undiagnosed hypertension	BP≥140/90 without an associated self -report/awareness
Hypertensive on treatment	Self-reported hypertensive responded on treatment
Controlled	Hypertensive on treatment with SBP<140/90

9.2.3 Defining effective coverage

Effective coverage is measured with reference to the criterion-based hypertensive population. This is based on the normative assumption that all hypertensive respondents should be aware of their status, be on treatment and be controlled. Effective coverage is defined as shown in Equation 14 (Ng et al. 2014).

Equation 14

$$EC_{ih} = (Q_{ih}\, U_{ih} \mid N_{ih} = 1)$$

where

ECih is the effective coverage of individual i with intervention *h* e.g. hypertension diagnosis, treatment and control
Qih is the expected quality of intervention as delivered to person *i*, e.g. level of hypertension control (BP<140/90mmHg)
Uih is the probability of individual i receiving intervention *h*;
Nih is an indicator of whether individual *i* is in need of intervention *h*

9.2.4 Analytical method

This thesis uses the concentration curves and indices described in section 3.3, to assess socioeconomic inequality in hypertension care cascade.

9.3 Results

9.3.1 Hypertension care cascade

Figure 9-3 displays the hypertension care cascade among South Africans. The prevalence of hypertension is 29.7%. However, a significant proportion (41%) of those with high blood pressure remain undiagnosed.

Figure 9-3 Hypertension care cascade (NIDS, 2016)

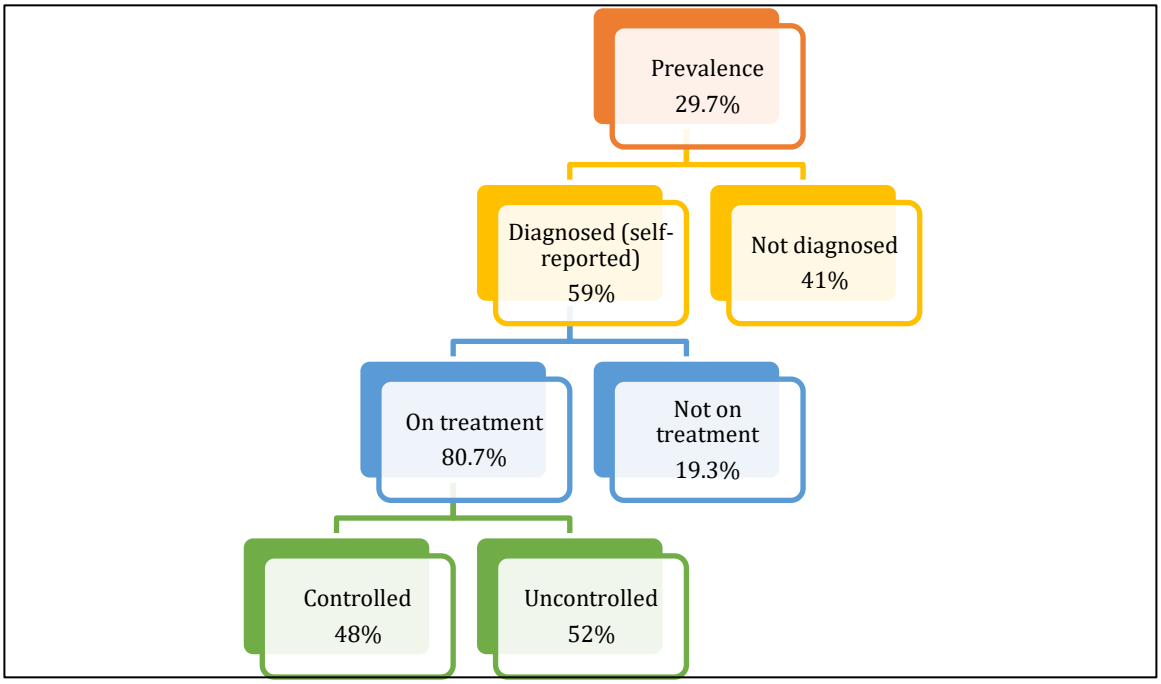


Figure 9-4 shows the extent of, and the level of socioeconomic inequality in effective coverage for hypertension in South Africa. Of all hypertensive respondents assessed using the criterion-based measurement, only 23% are diagnosed, on treatment and controlled.

Figure 9-4 Socioeconomic inequality in effective coverage

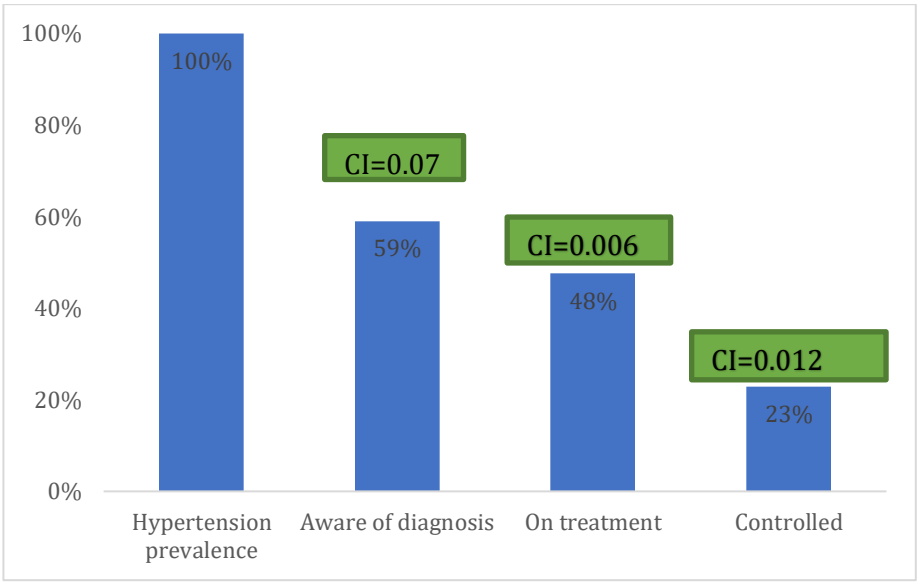


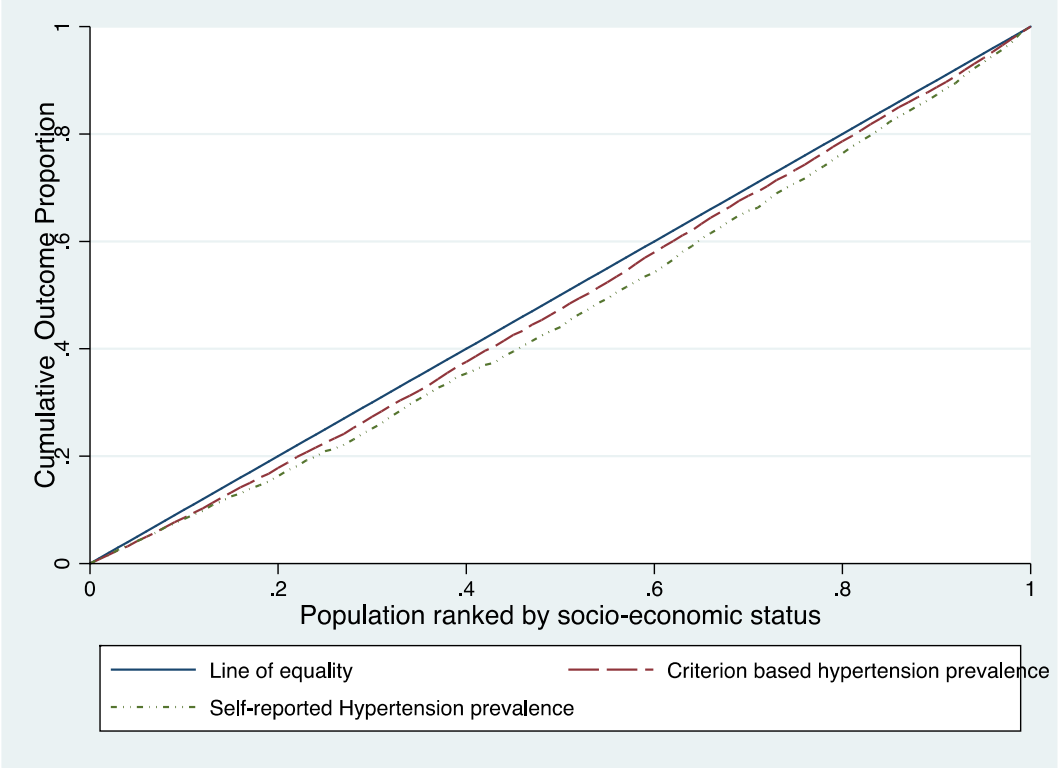
Table 9-2 Socioeconomic inequality in hypertension prevalence, treatment and control

Variable	Proportion	Conc. Index	Standard Error	95% Confidence Interval	
Prevalence of self-reported hypertension	10.65%	0.073	0.011	0.051	0.095
Criterion-based hypertension prevalence	29.74%	0.036	0.006	0.025	0.047
On Treatment	80.7%	0.006	0.004	-0.003	0.015
Controlled	67.9%	0.012	0.007	-0.002	0.026

9.3.2 The prevalence of self-reported vs criterion-based hypertension in South Africa

The prevalence of self-reported hypertension is 37% lower than the criterion-based prevalence indicating that a significant proportion of the population remains undiagnosed and therefore, unaware of their hypertension (Table 9-2). The concentration index for self-reported hypertension is significantly pro-rich (Concentration Index=0.073). However, this is attenuated to some extent by the criterion-based prevalence, which reduces this pro-rich inequality by 50% to 0.036 (Table 9-2). The concentration curves in Figure 9-5, also confirm this relationship.

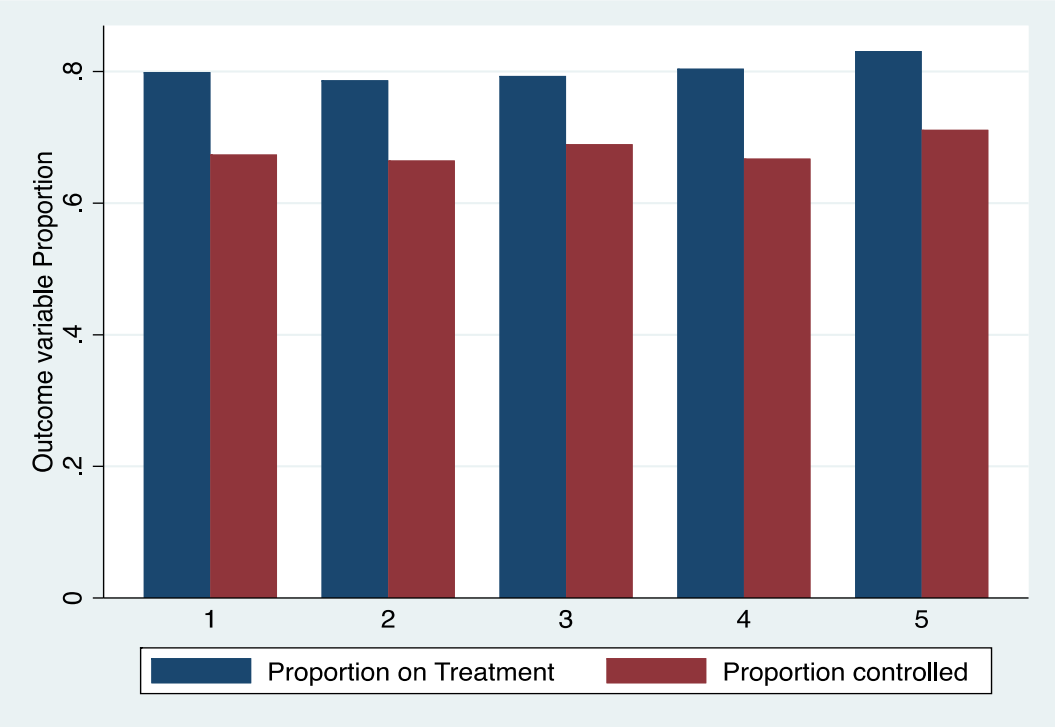
Figure 9-5 Concentration curve for self-reported and criterion-based hypertension



9.3.3 Hypertension treatment and control

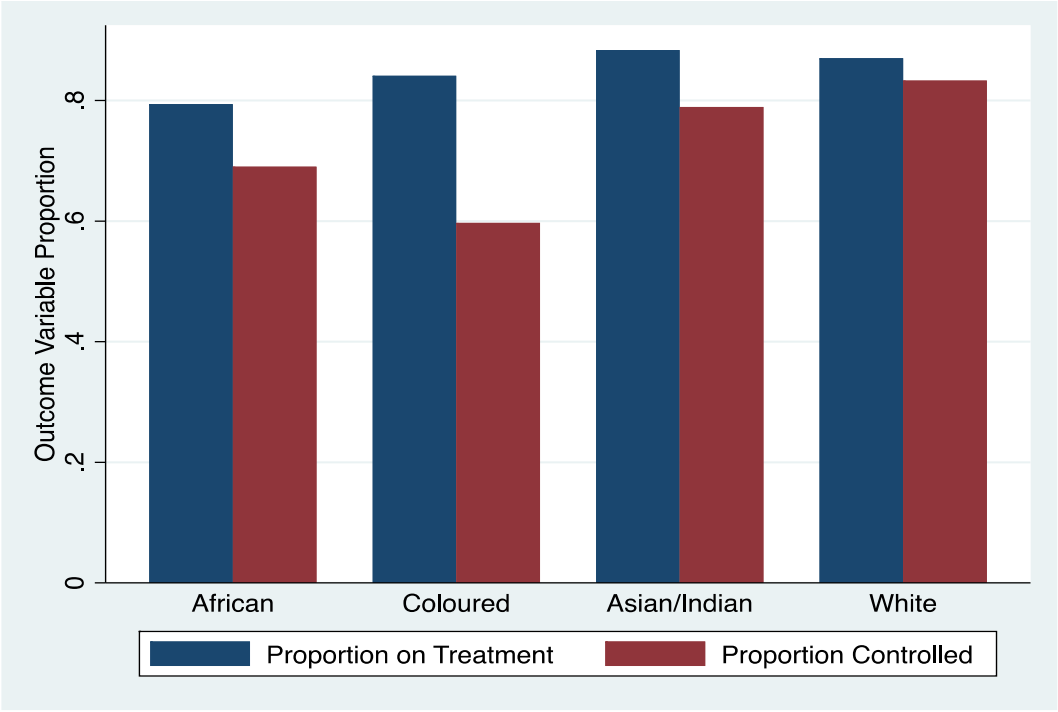
While the socioeconomic disparities in both access to treatment and control of hypertension are mildly in favour of the rich, these are not significant, Concentration Index=0.006 [95% CI -0.003 - 0.015] for treatment and Concentration Index=0.012 [95% CI -0.002 - 0.026] for control. When dissected by wealth quintiles, all quintiles have similar levels of both access to treatment and levels of hypertension control except for quintile 5, which stands out with the highest access to treatment, Figure 9-6.

Figure 9-6 Proportion on treatment and controlled by socioeconomic quintile



Racial disparities are apparent with Whites and Asians having access to treatment to a higher degree than other races as shown in Figure 9-7.

Figure 9-7 Racial inequalities in access to treatment and control of hypertension.



9.4 Discussion

This chapter assesses the socioeconomic inequality in the prevalence, levels of awareness, treatment and control of hypertension among adults aged at least 15 years in South Africa. Previous studies have focused on older respondents (Vellakkal et al. 2015b) while a study looking at the same age group used a different database and did not look at the extent of the socioeconomic inequality along the care cascade (Berry et al. 2017). The WHO Study on Global AGEing and Adult Health (SAGE study) looked at 18-49-year-olds in South Africa as part of a multi-country study (Vellakkal et al. 2015a) while the Prospective Urban Rural Epidemiology (PURE) study focused on adults aged between 35-70 years (Palafox et al. 2016). This thesis builds on previous studies by using data from respondents from the age of 15 years with no upper age limit. This is in recognition of an increasing burden of non-communicable disease, including increased cardiovascular risk factors amongst adolescents in South Africa (Mokabane et al. 2014; Reddy et al. 2012).

The treatment cascade reveals that it is the wealthy that are disproportionately affected by hypertension. The wealthy also have better access to diagnostic services, access to treatment, and are controlled on treatment hence reap the benefits of the care cascade. There is also a higher criterion-based prevalence associated with a relatively less pro-rich concentration index compared to that for the prevalence of self-reported hypertension. This indicates that criterion-based measurement brings

out the undiagnosed poor who are often unaware of their health status (Vellakkal et al. 2015a). The findings with respect to the pro-rich inequality are similar to those in the PURE study (Palafox et al. 2016). However, the levels of control are much higher here than those reported in PURE study where 38% were aware compared to 59% in this thesis and 8% controlled vs 23% respectively. However, the pro-rich criterion-based prevalence from this thesis (Concentration Index=0.036 [95% CI 0.006-0.025]) is different from the pro-poor prevalence observed in SAGE study (Vellakkal et al. 2015a) (Concentration Index=-0.02 [95% CI -.0.03—0.01]. This could be explained by the difference in the sample population studied. The SAGE study focused on those aged 18-49 years over the period covering 2007–2010. This thesis, on the other hand, focuses on respondents from the age of 15 years from the 2012 NIDS survey. Further, this thesis uses the consumption expenditure to rank households while the SAGE survey used the asset score index.

Gender and racial disparities are also evident. The prevalence of self-reported hypertension is higher for females than males and highest for Whites. The prevalence of self-reported hypertension increases monotonically across the socioeconomic groups from quintiles 1 to 5. The racial disparities in the prevalence of hypertension are different from those observed in the metanalysis by Poulter et al (Poulter et al. 2015). The metanalysis found a higher prevalence amongst people of African origin compared to those of European descent. However, the results presented in this chapter confirm the findings reported elsewhere that NCDs are more prevalent among the rich in economically less prosperous countries (Kunna et al. 2017; Poulter et al. 2015). This is also consistent with Palafox et al.'s findings in relation to South Africa (Palafox et al. 2016).

While a large proportion of the respondents remains undiagnosed, it is worth noting that the majority of those who are aware of their condition are on treatment. However, this should be interpreted with caution due to the pro-rich inequality in the uptake of treatment and levels of control. In addition, by focusing only on levels of access/treatment without dwelling on socioeconomic inequality, governments run the risk of availing and increasing services to the same population groups over time and reinforce existing inequalities (Azenha et al. 2012; Schmidt and Barnhill 2015; The NCD Alliance 2014).

Overall, only 23% of the hypertensive population is controlled although this is much higher than control rates reported in other studies (Ataklte et al. 2015; Berry et al. 2017; Palafox et al. 2016). This could be explained by the longitudinal nature of the NIDS survey, that could be viewed as a quasi-interventional study in that at each wave, the member's blood pressure is measured hence raising levels of awareness. However, the results of this chapter are comparable to findings by Maepe and Outhoff

who found that 42% of the hypertensive gold miners in South Africa were on treatment, while 31% were controlled (Maepe and Outhoff 2012).

Overall, the low levels of control have implications for cardiovascular disease management as uncontrolled hypertension can lead to deleterious complications such as stroke, target organ failure such as kidney failure whose management can be very costly (World Health Organization 2013b). These findings, therefore, highlight the need for implementing timely and appropriate strategies for diagnosis, control, and prevention (Ataklte et al. 2015). This has also been featured in the Pan-African Society of Cardiology's (PASCAR) call for a road map to achieve hypertension control in African states (Dzudie et al. 2018).

While the management of hypertension is predominantly a primary health care competence, and there is universal access to PHC clinics, stronger policies on improving access together with citizens taking care of their health are required. Primary healthcare services are available free of charge hence affordability barriers to access are minimised. However, some factors might mediate this relationship in South Africa. While PHC clinics are available and accessible to most of the South Africa population (McLaren et al. 2014), there are other access barriers such as overcrowding in public clinics, staff attitudes and medicine shortages that might impede access for the poor in South Africa (Scheffler et al. 2015). The low treatment rates and parity in terms of access to treatment mean that people do not take medicine irrespective of their socioeconomic status. A similar finding has been reported in Indonesia (Aizawa & Helble 2016).

The higher socioeconomic inequality in urban areas found in this thesis is a confirmation of Deaton's assertion that while living in urban areas provides an opportunity for better access to health, urban areas tend to have greater socioeconomic gradients driven by greater economic inequality (Deaton 2013). This is similar to the findings in Indonesia (Aizawa and Helble 2016).

9.5 Conclusion

The burden of hypertension is high in South Africa, yet the levels of diagnosis, access to treatment and control remain low. Further, socioeconomic inequalities abound with the wealthy having disproportionately more and better access to effective care for hypertension. As such, it is appropriate to formulate policies that address the structural issues in the health care sector that drive the inequalities. This includes addressing the enablers of access to diagnostic services like provision of mobile clinics for screening and adequate access to treatment. The findings highlight the need to focus not only on the prevalence of hypertension but also the outcomes along the treatment cascade.

Chapter 10 Conclusion

This thesis finds that smoking, obesity and high blood pressure as risk factors for NCDs are predominantly prevalent amongst the wealthier South Africans. However, the severity of overweight/obesity and hypertension is experienced by the less wealthy individuals to a more considerable extent than the wealthy.

This thesis also finds that there is inequitable access to screening services for hypertension, diabetes and hypercholesterolaemia. The wealthy are more likely to utilise screening services for NCDs and have better access to health care services after accounting for need. Also, the hypertensive rich are more likely to have their hypertension better managed than the poor. In the assessment of effective coverage for hypertension, the thesis finds that the NCDs are not managed effectively in the South African setting with low levels of awareness, diagnosis and control. This thesis also finds that the wealth-related variables such as education, health insurance and level of provincial deprivation drive most of the observed socioeconomic inequality in the uptake of screening tests for NCDs. The levels of inequity are highest for tests for hypercholesterolemia, followed by diabetes and hypertension.

The following section summarises the findings from each of the chapters, the policy recommendations, limitations and areas of future research.

10.1 Policy Implications

10.1.1 Smoking

The findings of this thesis reveal that the rich smoke disproportionately more from than the poor in keeping with the developmental stage of South Africa in comparison to wealthier countries. While the rich smoke more cigarettes per day, the poor spend disproportionately more on cigarettes than the rich hence increasing excise taxes is likely to worsen the regressivity of taxes further. It may also potentially increase the consumption of illegal cigarettes. On the other hand, the South African government has been progressive in implementing legislation to prevent smoking indoors. However, household-level smoking behaviour continues to influence the prevalence, intensity and inequality in smoking with respondents from households in which indoor smoking occurs being more likely to smoke more. Tighter legislation of household smoking similar to Bangladesh may be warranted since this has been shown to be successful in reducing smoking (Driezen et al. 2016). The age at smoking initiation is decreasing across generations with people progressively starting to smoke at younger ages. Wealthier women are more likely to smoke than their poorer counterparts and also White and

Coloured women are more likely than African women to be smokers. On the other hand, it is the poorer men that smoke more than the men from wealthier households.

- Efforts to curb smoking prevalence and reduce smoking intensity should be gender sensitive as the inequality in smoking intensity differs across genders.
- The poor relative to the non-poor were more likely to express a desire to quit smoking. However, smoking cessation programs come at a cost, which might be a challenge and expensive undertaking given the addictive nature of cocaine, therefore, they should be supported to quit smoking through State-funded programs.
- Indoor smoking is associated with secondary smoking and the attendant health consequences, therefore efforts to reduce indoor smoking within households are urgently needed through, for example, awareness campaigns.
- While fiscal policies such as taxes remain useful instruments for reducing smoking prevalence (Ho et al. 2017; Vellios and van Walbeek 2016), the prevalence of illegal cigarette use is likely to worsen the prevalence particularly amongst the poor who may prefer to buy illicit cigarettes because of affordability.

10.1.2 Overweight and obesity

The obesity pandemic in South Africa is mainly driven by wealth indicators such as higher per capita household expenditure on food, employment and education. Possible policy instruments that can be used to address this inequality include healthier affordable food options on shelves, employer-based interventions such as work environments that promote exercise, healthy food at work cafeterias etc.

Since demographic factors play a significant role, anti-obesity policies should focus on the younger population to prevent obesity in adulthood. Obesity prevention in adolescents goes beyond its immediate benefits as it reduces medical costs and increases quality adjusted life years (QALYs) substantially in later life (Wang et al. 2010). Additionally, compared to other marital groups, married people tend to be obese. This could be related to food choices, accessibility and affordability of fast food, which although convenient for families also drive the obesity pandemic. Hence the call for more accessible and affordable healthy food options. While smoking may be "protective" as shown in the analysis, it cannot be advocated as a policy to achieve weight loss. Studies show that people who quit smoking are likely to gain weight, which can discourage smokers from quitting. Also, weight gain increases the risk of relapse, particularly among normal-weight or underweight (Chiolero et al. 2008). Therefore, those that quit smoking should receive additional weight-loss support so that the health benefits of smoking cessation are not offset by regaining the lost weight (Cois and Day 2015).

Although obesity affects predominantly the better off in the South African society, there is still a strong role for the state to change the trajectory of this epidemic because of the negative impact of obesity on the economy. Uncontrolled obesity rates amongst the rich have serious health implications with an increased demand for health care in a country facing a quadrupple burden of disease (Lehnert et al. 2013; Teuner et al. 2013). While obesity affects the non-poor the most, the poor who depend on the rich through the progressive taxation system and at the household level given the high dependency ratio also stand to lose out. Also, South Africa is an economy in transition hence it is a matter of time before the face of obesity changes from being pro-wealthy to pro-poor as has been observed in developed economies (Bilger et al. 2016; Swinburn et al. 2011b). Therefore, the non-obese poor are likely to be obese in the future given that the obesity epidemic is driven by the global food system, which is producing more processed, affordable, and effectively marketed food than ever before (Swinburn et al. 2011a). South Africa has responded to the obesity crisis by fiscal reform through introducing the sugar tax in 2017 (National Treasury 2016). However, the sugar tax has the potential to be regressive, much like the sin taxes in South Africa (Ataguba 2012). Therefore, other sectors of the economy such as agriculture, education, the built environment, transport etc. that play a significant role in modulating this obesogenic environment need to be effectively engaged.

The Discovery Vitality Programme discussed in 5.1.3 provides lessons for South Africa in as far as promoting physical exercise and healthy eating to manage obesity is concerned. The Vitality Programme has been effective in driving down health care costs in those that participate in physical activity and healthy eating programmes (Lambert and Kolbe-Alexander 2013b). However, its "carrot and stick" approach has not been able to achieve uptake amongst the majority of its eligible members despite providing attractive incentives. Therefore, it is essential to support individuals in addressing obesity, through sustained implementation of evidence-based and population-based policies to combat obesity. This includes making regular physical activity and healthier dietary choices available, affordable and easily accessible to everyone, across the socioeconomic stratum. Examples include addressing the built environment, the cost and availability of healthy food and better urban planning (Gortmaker et al. 2011). Therefore, individual responsibility can only have its full effect when people have access to a healthy lifestyle at minimal cost and within a system that does not affect individual liberties. Until then, appeals to change behaviour and habits to reduce the obesity epidemic are likely to ring hollow.

10.1.3 Screening

This thesis also finds low levels of screening uptake of between 19-42% for hypertension, diabetes and hypercholesterolaemia screening. Given the increasing prevalence of NCDs even amongst the

teenage population and the mortality from the age of 45 years, the relevance of a higher age limit of 45 years for eligibility for diabetes screening is questionable. This higher age limit for diabetes, in particular, may be contributing to the low uptake of screening.

The weight status appears to play a significant and yet dichotomous role in the uptake of screening tests. Those who are underweight are less likely (though not significantly so) than the "normal' weight individuals to undergo any tests, yet the obese are more likely to do so. This means that if only weight is used as a risk factor, then there is a possibility of missing out on those within normal weight limits yet have some underlying disease. Overall, the need factors are not sufficient to drive the utilisation of screening tests. This is more so for the more expensive tests for diabetes and cholesterol. Efforts to promote screening must focus on the poor, males, Africans, the uninsured who mainly use public sector clinics, no clinics at all or delay care. Need factors drive the uptake of screening tests to a significant extent. Of note is that those with a family history of chronic diseases are more likely to test. Hence, those already seeking care for chronic diseases could be the vehicle through which campaigns for screening are used to reach out to the rest of the population least likely to undergo screening.

The poor are likely to present for care acutely, at times at an advanced stage of ill-health. Also, their encounter with screening services happens at a late stage of acute illness hence the benefit to the poor is less optimal -because it is sought too late in the illness continuum to be of much use in the prevention and/or early detection of illness. Therefore, there is a need to intensify preventative screening amongst the poor, in particular, to realise the benefit of early diagnosis. Enablers of health care utilisation such as wealth and health insurance, are the most significant drivers of access to screening services, particularly for diabetes and cholesterol. Since health insurance is a significant determinant of utilisation and is only available to about 16% of the population, screening services should be intensified in the public sector primary health care clinics where services are available free of charge and where the majority of South Africans access health care. Intensifying screening efforts in the public sector would improve coverage for the rural folk, the uninsured and the unemployed because the face of the unscreened is mainly black, poor, rural, male, unemployed and uninsured. However, acceptability and availability of services within primary health care clinics as avenues for screening still needs to be addressed. Even though access is free of charge, most clinics are unable to provide curative care which is seen as urgent care let alone screening for diseases due to overcrowding and inadequate resourcing.

10.1.4 Prevalence and depth of hypertension

The findings of this thesis confirm the hypothesis that there is a positive relationship between hypertension prevalence and socioeconomic status, which has massive implications for economic development due to the associated mortality. Also, many poor individuals with hypertension remain uncontrolled—an interplay of late diagnosis, poor access to treatment and non-adherence to care. Obesity is the single most important contributory factor to the observed inequality in hypertension prevalence. While obesity affects the rich the most, obesity-reducing policies should still be mindful of not further deteriorating the economic condition of the poor such as the sugar tax which may be regressive (Cabrera Escobar et al. 2013; Tugendhaft et al. 2016).

By focusing on the elasticities of the socioeconomic determinants with respect to hypertension, in addition to their overall contributions to inequality, this thesis identifies possible policy interventions. The findings provide policymakers with additional information on specific groups for whom interventions to reduce the prevalence or at least the severity of hypertension could be targeted. This is in line with Deaton's argument that targeting according to position on the socioeconomic gradient is less likely to be effective in reaching people in need of care compared with simply treating people who are sick or at high risk of being sick (Deaton 2002). So, in this case, the findings have shown that while race contributes to the observed socioeconomic inequality, it is specifically Coloured and White population sub-groups who are more likely to be hypertensive. However, for Africans, their hypertension tends to be more severe than other groups. The results also show that even though Africans are relatively less likely to be hypertensive, when African females present with hypertension, they are at least 18% more likely than other groups, all things equal, to have more severe hypertension. As Africans are in the majority, this has implications for the demand for health care due to complications of high blood pressure such as stroke, renal complications etc. and associated health care costs. While behavioural determinants such as smoking and physical exercise explain a small proportion of the observed inequality in the prevalence/status, preventative strategies remain important primarily because these risk factors worsen existing hypertension. It is also not surprising that race remains a significant modifier for hypertension and its severity.

While BMI is the number one driver of inequality in hypertensive status, services to manage obesity such as dietetics are not available in the majority of clinics in South Africa. For instance, the National Health Care Facilities Baseline Audit found that only 16% of the 3 074 PHC facilities surveyed provided dietetics with patients being referred to hospitals for care even though only 65% of the hospitals had dietetics services (Visser et al. 2012). This speaks to de-prioritisation of the management of NCDs in South Africa.

10.1.5 Effective coverage of NCD services

Chapter 9 brings to the fore both the poor outcomes in hypertension care cascade as a proxy for NCDs and the socioeconomic disparities in effective coverage for services for NCDs. WHO estimates that anti-retroviral therapy is now provided to over half the population who are eligible in South Africa yet less than 10% of the people with hypertension have access to effective hypertension treatment (Lloyd-sherlock et al. 2014). Also, South Africa has adopted the universal test and treat strategy for HIV, yet only less than 40% of hypertensive people are aware of their condition (Palafox et al. 2016). The lessons learnt in the management of HIV and the resources and infrastructure built around these vertical programmes for HIV could be used to strengthen the management of NCDs such as hypertension to improve their diagnosis, treatment and control.

10.2 Strengths and limitations

The main strength of the analyses in this thesis is the use of two large datasets, i.e. the NIDS and the SANHANES, to explore inequality related to risk factors and effective coverage of NCD services in South Africa. The datasets have been used independently of each other for most of the chapters, except for the analysis of smoking where the datasets were used in combination to assess inequality in smoking prevalence using the NIDS and smoking intensity using the SANHANES. The SANHANES has specific questions relating to smoking, such as the intention to quit smoking and other policy-relevant variables such as household smoking behaviour from the first SANHANES. The thesis also uses novel statistical methods originally developed for assessing inequality in obesity to assess inequality in hypertension (Bilger et al. 2016). Further, this work adds to the literature on effective coverage by not only quantifying the extent of effective coverage but also quantifying the extent of inequality along the hypertension care cascade.

The limitations of this thesis mostly relate to data and interpretation of the findings. The NIDS data set has a limited representation of the Indian racial group primarily and White racial subgroups to a smaller extent. This limits, to some extent, the generalisability of this thesis' findings by racial groups.

By assessing socioeconomic inequality in health variables such as obesity, smoking and hypertension, the results may be misconstrued to mean that because it is bad for the poor to be exposed to risk factors relative to the rich, then the converse is acceptable. However, that is not the purpose of this thesis. By exposing that inequalities are also to the detriment of the rich, we do not absolve policymakers from acting to end the scourge of risk factors for NCDs. Instead, the results should be used to galvanise all sectors, beyond health, to commit to ending the exposure to these risk factors

for NCDs as these diseases have both economic and health consequences for the entire country through the increased demand for healthcare and fiscal and social challenges.

The decomposition of the concentration indices is a useful method to identify factors behind the observed health inequality; however, it does not provide causal inference and does not identify mediating pathways (Wagstaff et al. 2003).

While the thesis relies on the concentration index as the measure of inequality, the concentration index is far from perfect. It has been criticised on the grounds that its bounds may depend upon the mean of the health variable and hence making a comparison of populations with different mean health levels a challenge (Erreygers 2009b). Further different rankings might be obtained if inequalities in ill-health rather than inequalities in health are considered (Erreygers 2009a). While this may be a concern for cross country comparison, this was not seen to be a major stumbling block for this thesis as the analysis was confined to the South African population with no external comparison to other countries. Further, the concentration index obtained differs according to the approach used e.g. the conventional CI and the Erreygers concentration index. In this thesis, where this was of consequence both indices were computed, and the direction of inequality was consistent i.e. they were both either pro-poor or both pro-rich even though the absolute inequality may have differed somewhat. This was not a major concern as the main aim of the this was to establish qualitatively if there is some measure of inequality and thereafter to decompose the concentration index to established drivers of the observe inequality.

Concerning the NIDS dataset, it should be noted that respondents with raised blood pressure in prior waves were given information about seeking care for the management of their condition. This means the NIDS survey is also quasi-interventional, which would influence levels of awareness and hence the prevalence of undiagnosed hypertension in this thesis. While this is expected to influence awareness of hypertension, the impact on the observed inequality would be minimal as all respondents have access to the same information regardless of the economic status. In the analysis of hypertension care cascade, individual behaviour may influence the extent of effective coverage. Respondents who were on treatment and not compliant to therapy would negatively influence the extent of BP control. Lastly, hypertension is measured at a single point and this could be subject to "White coat" hypertension, which could give higher readings than otherwise would be the case. Therefore, this analysis could be repeated with a larger sample size to ascertain the degree of inequality after repeated readings. However, to minimise this risk, at least three BP measurements were taken within the NIDS dataset.

The NIDS dataset is also limited in the range of socioeconomic determinants used to explain inequality in NCDs such as dietary behaviours. Therefore, using a different or more comprehensive set of determinants such as dietary behaviours could have a different outcome with respect to inequality assessments. However, our results are consistent with existing studies in South Africa with respect to socioeconomic inequalities in the risk factors for hypertension (Alaba and Chola 2014; Steyn et al. 2012) and hypertension itself (Cois and Ehrlich 2014; Sookram et al. 2015).

Other limitations relate to the recall bias due to the reliance on self-report. This was however not felt to significantly influence the inequality measurements as shown by similar values for smoking prevalence and intensity using both datasets, i.e. the NIDS using consumption expenditure as the socioeconomic variable to rank households and the SANHANES using the wealth index. Self-report is prone to recall bias, which would negatively influence the extent of awareness of ill-health.

10.3 Future research agenda

- Given the rise in NCDs amongst the youth, further studies are required to explore in-depth the socioeconomic disparities in self-reported hypertension and other chronic conditions compared to criterion-based prevalence amongst younger population groups.
- A deeper understanding of what makes the more affluent population more able to quit smoking and the poor less so in South Africa is required given the addictive nature of nicotine. Also, further studies on scalable interventions to curb smoking, particularly in light of the illicit cigarette trade in South Africa are required to craft supportive measures to promote smoking cessation.
- An understanding of household-level indoor smoking behaviour is required. Even though there is legislation to govern smoking behaviour in public spaces, this is not the case in private homes, thereby exposing non-smokers and young children in confined spaces to the hazards of smoking.
- Further research on the strategies to improve the levels of effective coverage for non-communicable diseases and specifically hypertension is required to drive better outcomes in the management of chronic diseases and improve population health.
- Future surveys should collect data on policy-relevant questions particularly concerning exposure to risk factors of NCDs and access to both screening and curative services to enable a more holistic analysis of the NCD care cascade.

Bibliography

Abegunde DO, Mathers CD, Adam T, Ortegon M, Strong K. Chronic Diseases 1 The burden and costs of chronic diseases in low-income and middle-income countries. 2007;

Aday L a, Andersen R. A framework for the study of access to medical care. Health Serv. Res. 1974;9(3):208–20.

Adjaye-Gbewonyo K, Kawachi I, Subramanian S V., Avendano M. Income inequality and cardiovascular disease risk factors in a highly unequal country: A fixed-effects analysis from South Africa. Int. J. Equity Health. International Journal for Equity in Health; 2018;17(1):1–13.

Adonis L, An R, Luiz J, Mehrotra A, Patel D, Basu D, et al. Provincial screening rates for chronic diseases of lifestyle, cancers and HIV in a health-insured population. South African Med. J. 2013;103(5):309–12.

Adonis L, Basu D, Luiz J. Predictors of adherence to screening guidelines for chronic diseases of lifestyle, cancers, and HIV in a health-insured population in South Africa. Glob. Health Action. Sweden; 2014;7:23807.

Ahmad K, Jafar TH. Prevalence and determinants of blood pressure screening in Pakistan. J. Hypertens. 2005;23(11):1979–84.

Aizawa T, Helble M. ADBI Working Paper Series Urbanization and Inequality in Hypertension Diagnosis and Medication in Indonesia Asian Development Bank Institute. 2016;(556).

Alaba O, Chola L. Socioeconomic inequalities in adult obesity prevalence in South Africa: a decomposition analysis. Int. J. Environ. Res. Public Health. Switzerland; 2014 Mar;11(3):3387–406.

Alam A for the WB. South Africa economic update: Fiscal policy and redistribution in an unequal Society. Worldbank. Washington DC; 2014.

Alleyne G, Binagwaho A, Haines A, Jahan S, Nugent R, Rojhani A, et al. Embedding non-communicable diseases in the post-2015 development agenda. Lancet. 2013 Mar 16;381(9866):566–74.

Amod A, Ascott-Evans B, Berg G, Blom D, Brown S, Carrihill M, et al. The 2012 SEMDSA guideline for the management of type 2 diabetes. … Metab. Diabetes S Afr. 2012;17(2):S1–95.

Anand K, Shah B, Yadav K, Singh R, Mathur P, Paul E, et al. Are the urban poor vulnerable to non-communicable diseases? A survey of risk factors for non-communicable diseases in urban slums of Faridabad. Natl. Med. J. India. India; 2007;20(3):115–20.

Araar A, Duclos J-Y. USER MANUAL DASP version 2 . 3 DASP : Distributive Analysis Stata Package. 2013.

Ataguba JE. Alcohol Policy and Taxation in South Africa An Examination of the Economic Burden of Alcohol Tax. Appl. Heal. Econ Heal. Policy. 2012;10(1):65–76.

Ataguba JE. Inequalities in multimorbidity in South Africa. Int. J. Equity Health. England; 2013

Jan;12(1):64.
Ataguba JE. Assessing equitable health financing for universal health coverage: a case ...: Business Source. 2016;48(35):3293–306.
Ataguba JE, Akazili J, McIntyre D. Socioeconomic-related health inequality in South Africa: evidence from General Household Surveys. Int. J. Equity Health. England: BioMed Central Ltd; 2011;10(1):48.
Ataguba JE, Day C, Mcintyre D. Explaining the role of the social determinants of health on health inequality in South Africa. 2015;1:1–11.
Ataguba JE, Goudge J. The Impact of Health Insurance on Health-care Utilisation and Out-of-Pocket Payments in South Africa. Geneva Pap. Risk Insur. Issues Pract. 2012 Oct;37(4):633–54.
Ataguba JE, McIntyre D. Who benefits from health services in South Africa? Heal. Econ. Policy Law. 2012a;(April 2012):1–26.
Ataguba JE, McIntyre D. Paying for and receiving benefits from health services in South Africa: is the health system equitable? Health Policy Plan. 2012b Mar;27 Suppl 1:i35-45.
Ataklte F, Erqou S, Kaptoge S, Taye B, Echouffo-Tcheugui JB, Kengne AP. Burden of Undiagnosed Hypertension in Sub-Saharan Africa: A systematic review and meta-analysis. Hypertension. 2015;65(2):291–8.
Averett SL, Stacey N, Wang Y. Decomposing race and gender differences in underweight and obesity in South Africa. Econ. Hum. Biol. Netherlands; 2014 Dec;15:23–40.
Azenha G, Rojhani A, Kooijmans M. Addressing Global Inequalities in Ncd Prevention and Control for a Healthy Future. 2012.
Babitsch B, Gohl D, von Lengerke T. Re-revisiting Andersen's Behavioral Model of Health Services Use: a systematic review of studies from 1998–2011. GMS Psychosoc. Med. 2012;9(11):1–15.
Backlund E, Sorlie PD, Johnson NJ. The shape of the relationship between income and mortality in the United States evidence from the national longitudinal mortality study. Ann. Epidemiol. 1996;6(1):12–20.
Bambas A, Casas JA. ASSESSING EQUITY IN HEALTH: CONCEPTUAL CRITERIA. 1992;(1991):12–21.
Barigozzi F. Reimbursing preventive care. GENEVA Pap. Risk Insur. Theory. 2004;29(2):165–86.
Beaglehole R, Bonita R, Alleyne G, Horton R, Li L, Lincoln P, et al. UN High-Level Meeting on Non-Communicable Diseases: addressing four questions. Lancet. 2011a Jul 30;378(9789):449–55.
Beaglehole R, Bonita R, Horton R, Adams C, Alleyne G, Asaria P, et al. Priority actions for the non-communicable disease crisis. Lancet. Elsevier Ltd; 2011b Apr 23;377(9775):1438–47.
Beaglehole R, Yach D. Globalisation and the prevention and control of non-communicable disease: the neglected chronic diseases of adults. Lancet. 2003 Sep 13;362(9387):903–8.
Benjamins MR. Predictors of preventive health care use among middle-aged and older adults in

Mexico: the role of religion. J. Cross. Cult. Gerontol. 2007;22(2):221–34.
Berry KM, Parker WA, McHiza ZJ, Sewpaul R, Labadarios D, Rosen S, et al. Quantifying unmet need for hypertension care in South Africa through a care cascade: Evidence from the SANHANES, 2011-2012. BMJ Glob. Heal. 2017;2(3):2011–2.
Bhan N, Srivastava S, Agrawal S, Subramanyam M, Millett C, Selvaraj S, et al. Are socioeconomic disparities in tobacco consumption increasing in India? A repeated cross-sectional multilevel analysis. BMJ Open. 2012;2(5).
Bilger M, Kruger EJ, Finkelstein EA. Measuring Socieconomic Inequality in Obesity: Looking Beyond the Obesity Threshold. Health Econ. 2016;19(11):1300–17.
Black A, Parrish AG, Rayner B, Leong TD, Mpongoshe V. Editorial Target blood pressure : a South African perspective. Cardiovasc. J. Afr. 2019;30(2):71–3.
Blas E, Sommerfeld J, Kurup AS. Social determinants approaches to public health : from concept. Organization. 2011;222.
Bloom DE, Cafiero-Fonseca E, Candeias V, Adashi E, Bloom L, Gurfein L, et al. Economics of Non-Communicable Diseases in India: The Costs and Returns on Investment of Interventions to Promote Healthy Living and Prevent, Treat, and Manage NCDs. 2014.
Bradshaw D, Steyn K, Levitt N, Nojilana B. Non-Communicable Diseases – A race against time. Burd. Dis. Res. Unit, South African Med. Res. Counc. Cape Town; 2011.
Brophy T, Branson N, Daniels RC, Mlatsheni C, Leibbrandt M, Woolard I. National Income Dynamics Study Wave 2 User Manual. Cape Town; 2018.
Brown DW, Giles WH, Greenlund KJ, Croft JB. Disparities in cholesterol screening: falling short of a national health objective. Prev. Med. (Baltim). 2001;33(6):517–22.
Bussière C, Le Vaillant M, Pelletier-Fleury N. Screening for cervical cancer: What are the determinants among adults with disabilities living in institutions? Findings from a National Survey in France. Health Policy. Elsevier Ireland Ltd; 2015;119(6):794–801.
Cabrera Escobar MA, Veerman JL, Tollman SM, Bertram MY, Hofman KJ. Evidence that a tax on sugar sweetened beverages reduces the obesity rate: a meta-analysis. BMC Public Health. England; 2013;13:1072.
Carrieri V, Bilger M. Preventive care : underused even when free . Is there something else at work ? Appl. Econ. 2013;45:239–53.
Carrieri V, Wuebker A. Assessing inequalities in preventative care use in Europe : A special case of health-care inequalities ? 2012;(July).
Carrieri V, Wuebker A. Assessing inequalities in preventive care use in Europe. Health Policy (New. York). Elsevier Ireland Ltd; 2013;113(3):247–57.
Carrin G, Mathauer I, Xu K, Evans DB. Universal coverage of health services: Tailoring its

implementation. Bull. World Health Organ. 2008;86(11):857–63.
Case A, Menendez A. Sex differences in obesity rates in poor countries: evidence from South Africa. Econ. Hum. Biol. Netherlands; 2009 Dec;7(3):271–82.
Di Cesare M, Khang Y-HH, Asaria P, Blakely T, Cowan MJ, Farzadfar F, et al. Inequalities in non-communicable diseases and effective responses. Lancet. 2013 Feb 16;381(9866):585–97.
Cheah YK, Goh KL. Determinants of the demand for health screening in Malaysia: The case of the aged population. Soc. Sci. J. Western Social Science Association; 2017;54(3):305–13.
Chinhema M, Brophy T, de Villiers L, Brown M, Woolard I, Daniels RC, et al. National Income Dynamics Study Panel User Manual. 2016;1–43.
Chiolero A, Faeh D, Paccaud F, JCornuz J. Consequences of smoking for body weight , body fat distribution ,. Am. J. Clin. Nutr. 2008;87:801–9.
Chisha Z, Nwosu CO, Ataguba JE. Decomposition of socioeconomic inequalities in cigarette smoking: The case of Namibia. Int. J. Equity Health. International Journal for Equity in Health; 2019;18(1):1–9.
Chuma J, Molyneux C. Estimating inequalities in ownership of insecticide treated nets: Does the choice of socio-economic status measure matter? Health Policy Plan. 2009;24(2):83–93.
Clarke N, McNamara D, Kearney PM, O'Morain CA, Shearer N, Sharp L. The role of area-level deprivation and gender in participation in population-based faecal immunochemical test (FIT) colorectal cancer screening. Prev. Med. (Baltim). Elsevier B.V.; 2016;93:198–203.
Cleary S, McIntyre D. Financing equitable access to antiretroviral treatment in South Africa. BMC Health Serv. Res. 2010 Jan;10 Suppl 1(Suppl 1):S2.
Cleary S, Silal S, Birch S, Carrara H, Pillay-van Wyk V, Rehle T, et al. Equity in the use of antiretroviral treatment in the public health care system in urban South Africa. Health Policy. Elsevier Ireland Ltd; 2011 Mar;99(3):261–6.
Cois A, Day C. Obesity trends and risk factors in the South African adult population. BMC Obes. 2015;2(1).
Cois A, Ehrlich R. Analysing the socioeconomic determinants of hypertension in South Africa: a structural equation modelling approach. BMC Public Health. England; 2014;14:414.
Coovadia H, Jewkes R, Barron P, Sanders D, McIntyre D. The health and health system of South Africa: historical roots of current public health challenges. Lancet. 2009 Sep 5;374(9692):817–34.
Cropper ML. Health, Investment in Health, and Occupational Choice. J. Polit. Econ. 1977;85(6):1273–94.
Crowther NJ, Norris SA. The current waist circumference cut point used for the diagnosis of metabolic syndrome in sub-Saharan African women is not appropriate. PLoS One. United States; 2012;7(11):e48883.
CSDH. Closing the gap in a generation. Closing gap a Gener. Heal. Equity Through Action Soc.

Determ. Heal. Final Rep. Comm. Soc. Determ. Heal. Geneva; 2008.
Culyer A. Equity - some theory and its policy implications. J. Med. Ethics. 2001;27:275–83.
Culyer T, Wagstaff A. Need, equity and equality in health and health care. Work. Pap. 1992. p. 431--457.
Deaton A. Policy Implications Of The Gradient Of Health And Wealth. Health Aff. 2002;21(2):13–30.
Deaton A. The great escape : health, wealth, and the origins of inequality. Princeton, Oxford: Princeton University Press; 2013.
Donabedian A. Evaluating the quality of medical care, 1966. Milbank Q. 1966;83:691–729.
Donnell O, Doorslaer E Van, Ourti T Van. Health and Inequality. Handb. Income Disribution. Vol 2B. 1st ed. Elsevier B.V.; 2015. p. 1419–533.
van Doorslaer E, Koolman X, Jones AM. Explaining income-related inequalities in doctor utilisation in Europe. Health Econ. 2004;13(7):629–47.
Dover DC, Belon AP. The health equity measurement framework: a comprehensive model to measure social inequities in health. Int. J. Equity Health. International Journal for Equity in Health; 2019;18(1):1–12.
Driezen P, Abdullah AS, Quah ACK, Nargis N, Fong GT. Determinants of intentions to quit smoking among adult smokers in Bangladesh: findings from the International Tobacco Control (ITC) Bangladesh wave 2 survey. Glob. Heal. Res. Policy. Global Health Research and Policy; 2016;1(1):11.
Duncan GJ, Daly MC, McDonough P, Williams DR. Optimal indicators of socioeconomic status for health research. Am. J. Public Health. 2002;92(7):1151–7.
Dzudie A, Rayner B, Ojji D, Schutte AE, Twagirumukiza M, Damasceno A, et al. Roadmap to Achieve 25% Hypertension Control in Africa by 2025. Glob. Heart. Elsevier Ltd.; 2018;13(1):45–59.
Eek F, Ostergren P-O, Diderichsen F, Rasmussen N, Andersen I, Moussa K, et al. Differences in socioeconomic and gender inequalities in tobacco smoking in Sweden and Denmark; a cross sectional comparison of the equity effect of different public health policies. BMC Public Health. 2010;10(1):9.
Engelgau MM, Narayan KMV, Herman W. Screening for Type 2 Diabetes. Diabetes Care. 2000;231580(10):1563–80.
Erasmus RT, Soita DJ, Hassan MS, Blanco-Blanco E, Vergotine Z, Kegne AP, et al. High prevalence of diabetes mellitus and metabolic syndrome in a South African coloured population: baseline data of a study in Bellville, Cape Town. S. Afr. Med. J. South Africa; 2012a Nov;102(11 Pt 1):841–4.
Erasmus RT, Soita DJ, Hassan MS, Blanco-Blanco E, Vergotine Z, Kengne AP, et al. High

prevalence of diabetes mellitus and metabolic syndrome in a South African coloured population: Baseline data of a study in Bellville, Cape Town. South African Med. J. 2012b;102(11):841–4.
Erlich I, Becker GS. Market Insurance,Self-Insurance and Self-Protection. J. Polit. Econ. 1972;80(4):623–48.
Erreygers G. Correcting the Concentration Index. J. Health Econ. 2009a;28(2):504–15.
Erreygers G. Correcting the Concentration Index. J. Health Econ. 2009b;28(2):504–15.
Filmer D, Pritchett LH. Estimating Wealth Effects Without Expenditure Data — or Tears : Demography. 2001;38(1):115–32.
Fleurbaey M, Schokkaert E. Unfair inequalities in health and health care. J. Health Econ. 2009;28:73–90.
Foster J, Greer J, Thorbecke E. A Class of Decomposable Poverty Measures James. Econometrica. 1984;1(3):761–6.
Franklin SS. The importance of diastolic blood pressure in predicting cardiovascular risk. J. Am. Soc. Hypertens. 2007;1(1):82–93.
Fryatt R. Screening for chronic diseases in South Africa. South African Med. J. 2013;103(5):289.
Fukuda Y, Nakamura K, Takano T. Socioeconomic pattern of smoking in Japan: Income inequality and gender and age differences. Ann. Epidemiol. 2005;15(5):365–72.
Fulton JP, Rakowski W, Jones a C. Determinants of breast cancer screening among inner-city Hispanic women in comparison with other inner-city women. Public Health Rep. 1995;110(4):476–82.
Gallo F, Caprioglio A, Castagno R, Ronco G, Segnan N, Giordano L. Inequalities in cervical cancer screening utilisation and results: A comparison between Italian natives and immigrants from disadvantaged countries. Health Policy (New. York). Elsevier Ireland Ltd; 2017;
Galobardes B, Shaw M, Lawlor D a, Lynch JW, Davey Smith G. Indicators of socioeconomic position (part 1). J. Epidemiol. Community Health. 2006;60(1):7–12.
Garcia AZG. Factors Influencing Colorectal Cancer Screening Participation. Gastroenterol. Res. Pract. Heal. 2012;2012.
Gilson L. Health Policy and Systems Research A Methodology Reader. Gilson L, editor. Geneva: World Health Organisation; 2012.
Glasgow S, Schrecker T. The double burden of neoliberalism? Noncommunicable disease policies and the global political economy of risk. Heal. Place. Elsevier; 2015;34:279–86.
Gortmaker SL, Swinburn BA, Levy D, Carter R, Mabry PL, Finegood DT, et al. Changing the future of obesity: science, policy, and action. Lancet. 2011 Aug 27;378(9793):838–47.
Gravelle H. Measuring income related inequality in health: Standardisation and the partial concentration index. Health Econ. 2003;12(10):803–19.

Gravely S, Giovino GA, Craig L, Commar A, D'Espaignet ET, Schotte K, et al. Implementation of key demand-reduction measures of the WHO Framework Convention on Tobacco Control and change in smoking prevalence in 126 countries: an association study. Lancet Public Heal. 2017;2(4).
Griffiths PL, Johnson W, Cameron N, Pettifor JM, Norris SA. In urban South Africa, 16 year old adolescents experience greater health equality than children. Econ. Hum. Biol. Netherlands; 2013 Dec;11(4):502–14.
Grossman M. On the Concept of Health Capital and the Demand for Health. J. Polit. Econ. 1972;80(2):223–55.
Guariguata L, De Beer I, Hough R, Mulongeni P, Feeley FG, De Wit TFR. Prevalence and knowledge assessment of HIV and non-communicable disease risk factors among formal sector employees in Namibia. PLoS One. 2015;
Guh DP, Zhang W, Bansback N, Amarsi Z, Birmingham L, Anis AH. The incidence of co-morbidities related to obesity and overweight : A systematic review and meta-analysis. 2009;20:1–20.
Gupta N, Goel K, Shah P, Misra A. Childhood Obesity in Developing Countries : 2015;33(February 2012):48–70.
Hamer M, von Kanel R, Reimann M, Malan NT, Schutte AE, Huisman HW, et al. Progression of cardiovascular risk factors in black Africans: 3 year follow up of the SABPA cohort study. Atherosclerosis. Ireland; 2015 Jan;238(1):52–4.
Hanibuchi T, Nakaya T, Honjo K. Trends in socioeconomic inequalities in self-rated health, smoking, and physical activity of Japanese adults from 2000 to 2010. SSM - Popul. Heal. Elsevier; 2016;2:662–73.
Harris B, Goudge J, Ataguba JE. Inequities in access to health care in South Africa. J. Public Health Policy. Nature Publishing Group; 2011;32(S1):S102–23.
Harttgen K, Vollmer S. Kenneth Harttgen and Sebastian Vollmer. 2011;
Hasumi T, Jacobsen KH. Hypertension in South African adults: results of a nationwide survey. J. Hypertens. England; 2012 Nov;30(11):2098–104.
Hill JO, Galloway JM, Goley A, Marrero DG, Minners R, Montgomery B, et al. Scientific statement: Socioecological determinants of prediabetes and type 2 diabetes. Diabetes Care. 2013;36(8):2430–9.
Hillemeier MM, Weisman CS, Chuang C, Downs DS, McCall-Hosenfeld J, Camacho F. Transition to Overweight or Obesity Among Women of Reproductive Age. J. Women's Heal. 2011;20(5):703–10.
Ho LM, Schafferer C, Lee JM, Yeh CY, Hsieh CJ. The effect of cigarette price increases on cigarette consumption, tax revenue, and smoking-related death in Africa from 1999 to 2013. Int. J. Public Health. 2017;62(8).
Hoque ME, Ghuman S, Coopoosmay R, Van Hal G. Cervical Cancer Screening among University

Students in South Africa: A Theory Based Study. PLoS One. 2014;9(11):e111557.
Hosseinpoor AR, Bergen N, Koller T, Prasad A, Schlotheuber A, Valentine N, et al. Equity-Oriented Monitoring in the Context of Universal Health Coverage. PLoS Med. 2014;11(9).
Howe LD, Hargreaves JR, Huttly SR a. Issues in the construction of wealth indices for the measurement of socio-economic position in low-income countries. Emerg. Themes Epidemiol. 2008;5:3.
Huynen MMTE, Martens P, Hilderink HBM. The health impacts of globalization: A conceptual framework. Global. Health. 2005;1:1–12.
Hwang J. Decomposing socioeconomic inequalities in the use of preventive eye screening services among individuals with diabetes in Korea. Int. J. Public Health. Springer International Publishing; 2016;61(5):613–20.
International Diabetes Federation. IDF Diabetes Atlas. 6th ed. International Diabetes Federation; 2013.
Jepson R, Clegg A, Forbes C, Lewis R, Sowden A, Kleijnen J. The determinants of screening uptake and interventions for increasing uptake: a systematic review. Health Technol. Assess. (Rockv). 2000;4(25):i–iv, 1–191.
Johnson LF, Mossong J, Dorrington RE, Schomaker M, Hoffmann CJ, Keiser O, et al. Life Expectancies of South African Adults Starting Antiretroviral Treatment: Collaborative Analysis of Cohort Studies. PLoS Med. 2013;10(4).
Jolliffe D. Overweight and poor? on the relationship between income and the body mass index. Econ. Hum. Biol. Elsevier B.V.; 2011;9(4):342–55.
Joshi A, Mohan K, Grin G, Perin DMP. Burden of healthcare utilization and out-of-pocket costs among individuals with NCDs in an Indian setting. J. Community Health. 2013;38(2):320–7.
Kagaruki GB, Mayige MT, Ngadaya ES, Kimaro GD, Kalinga AK, Kilale AM, et al. Magnitude and risk factors of non-communicable diseases among people living with HIV in Tanzania: a cross sectional study from Mbeya and Dar es Salaam regions. BMC Public Health. 2014;14(1):904.
Kamangar F. Socio-Economic Health Inequalities: Ever-Lasting Facts or Amenable to Change? Int. J. Prev. Med. 2013;4(6):621–3.
Kengne AP, June-Rose McHiza Z, Amoah AGB, Mbanya J-C. Cardiovascular diseases and diabetes as economic and developmental challenges in Africa. Prog. Cardiovasc. Dis. 2013 Jan;56(3):302–13.
Kengne AP, Mayosi BM. Readiness of the primary care system for non-communicable diseases in sub-Saharan Africa. Lancet Glob. Heal. Kengne et al. Open Access article distributed under the terms of CC-BY-NC-ND; 2014;2(5):e247–8.
Kenkel DS. The demand for preventive medical care. Appl. Econ. 1994;26(4):313–25.
Kenkel DS. Prevention. Handb. Heal. Econ. 2000. p. 1675–720.
Ker J, Rheeder P, Van Tonder R. Frequency of the metabolic syndrome in screened South African

corporate executives. Cardiovasc. J. S. Afr. South Africa; 2007;18(1):30–3.
Kim S, Hwang J. Assessment of trends in socioeconomic inequalities in cancer screening services in Korea, 1998-2012. Int. J. Equity Health. International Journal for Equity in Health; 2016;15(1):30.
Kjellsson G, Gerdtham U-G. On correcting the concentration index for binary variables. J. Health Econ. 2013;32(3):659–70.
Klug EQ, Raal FJ, Marais AD, Taskinen MR, Dalby AJ, Schamroth C, et al. South african dyslipidaemia guideline consensus statement. South African Med. J. 2012;102(3):178–88.
Kolbe-Alexander TL, Conradie J, Lambert E V. Clustering of risk factors for non-communicable disease and healthcare expenditure in employees with private health insurance presenting for health risk appraisal: A cross-sectional study. BMC Public Health. 2013;
Krieger N, Williams DR, Moss NE. Measuring social class in US public health research: concepts, methodologies, and guidelines. Annu. Rev. Public Health. 1997;18(16):341–78.
Kunna R, San Sebastian M, Stewart Williams J. Measurement and decomposition of socioeconomic inequality in single and multimorbidity in older adults in China and Ghana: results from the WHO study on global AGEing and adult health (SAGE). Int. J. Equity Health. International Journal for Equity in Health; 2017;16(1):79.
Lambert E V., Kolbe-Alexander TL. Innovative strategies targeting obesity and non-communicable diseases in South Africa: What can we learn from the private healthcare sector? Obes. Rev. 2013a;14(S2):141–9.
Lambert E V, Kolbe-Alexander TL. Innovative strategies targeting obesity and non-communicable diseases in South Africa: what can we learn from the private healthcare sector? Obes. Rev. England; 2013b Nov;14 Suppl 2:141–9.
Lau YK, Tam J, Fleischer NL, Meza R. Neighbourhood deprivation, smoking, and race in South Africa: A cross-sectional analysis. Prev. Med. Reports. Elsevier; 2018;11(December 2017):202–8.
Laubscher N, Dreyer G, Mmed O, Sa M. The Vaccine and Cervical Cancer Screen project : experiences from a primary school-based vaccine implementation study in Gauteng and the Western Cape , South Africa. 2015;19(2):28–31.
Lee I-M, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet. 2012 Jul 21;380(9838):219–29.
Lehnert T, Sonntag D, Konnopka A, Riedel-Heller S, König H-H. Economic costs of overweight and obesity. Best Pract. Res. Clin. Endocrinol. Metab. 2013 Apr;27(2):105–15.
Levy-Marchal C, Arslanian S, Cutfield W, Sinaiko A, Druet C, Marcovecchio ML, et al. Insulin resistance in children: Consensus, perspective, and future directions. J. Clin. Endocrinol. Metab. 2010;95(February):5189–98.

Lloyd-sherlock P, Ebrahim S, Grosskurth H. Is hypertension the new HIV epidemic? Int. J. Epidemiol. 2014;43(1):8–10.
Lopez AD, Collishaw NE, Piha T. A descriptive model of the cigarette epidemic in developed countries. Tob. Control. 1994;3:242–7.
Lund M. Social inequality in cigarette consumption, cigarette dependence, and intention to quit among Norwegian smokers. Biomed Res. Int. Hindawi Publishing Corporation; 2015;2015.
Mackenbach JP, Kunst AE. MEASURING THE MAGNITUDE OF SOCIO-ECONOMIC INEQUALITIES IN HEALTH: AN OVERVIEW OF AVAILABLE MEASURES ILLUSTRATED WITH TWO EXAMPLES FROM EUROPE. Soc Sci Med. 1997;44(6).
Maepe LM, Outhoff K. Hypertension in goldminers. S. Afr. Med. J. South Africa; 2012 Jan;102(1):30–3.
Martin-Lopez R, Jimenez-Garcia R, Lopez-de-Andres A, Hernandez-barrera V, Jimenez-Trujillo I, Gil-de-Miguel A, et al. Inequalities in uptake of breast cancer screening in Spain: Analysis of a cross-sectional national survey. Public Health. 2013;127(9):822–7.
Mayosi B, Flisher AJ, Lalloo UG, Sitas F, Tollman SM, Bradshaw D. The burden of non-communicable diseases in South Africa. Lancet. 2009 Sep 12;374(9693):934–47.
Mbanya JCN, Motala AA, Sobngwi E, Assah FK, Enoru ST. Diabetes in sub-Saharan Africa. Lancet. 2010 Jun 26;375(9733):2254–66.
McCall-Hosenfeld JS, Weisman CS, Camacho F, Hillemeier MM, Chuang CH. Multilevel Analysis of the Determinants of Receipt of Clinical Preventive Services among Reproductive-Age Women. Women's Heal. Issues. Jacobs Institute of Women's Health; 2012;22(3):e243–51.
McCormack V a., Schüz J. Africa's growing cancer burden: Environmental and occupational contributions. Cancer Epidemiol. 2012 Feb;36(1):1–7.
Mcintyre D. The Costs and Perceived Quality of Care for People Living with HIV / AIDS in the Western Cape Province in South Africa. Int. Aff. 2000;(14).
Mcintyre D. Private sector involvement in funding and providing health services in South Africa : Implications for equity and access to health care. 2010. Report No.: 84.
Mcintyre D. WHO global coordination mechanism on the prevention and control of noncommunicable diseases Working Group on how to realize governments ' commitment to provide financing for NCDs by. 2015.
McIntyre D, Thiede M, Birch S. Access as a policy-relevant concept in low- and middle-income countries. Heal. Econ. Policy Law. 2009;4(02):179.
McLaren Z, Ardington C, Leibbrandt M. Distance decay and persistent health care inequality in South Africa. BioMed Cent. 2014;1–9.
Meko LNM, Slabber-Stretch M, Walsh CM, Kruger SH, Nel M. School environment,

socioeconomic status and weight of children in Bloemfontein, South Africa. African J. Prim. Heal. care Fam. Med. South Africa; 2015;7(1):E1-7.
Mendis S, Armstrong T, Bettcher D, Branca F, Lauer J, Mace C, et al. Global status report on noncommunicable diseases 2014. Geneva; 2014.
Ministry of Health. National Health Insurance Bill. South Africa; 2019 p. 1–15.
Mokabane NN, Mashao MM, van Staden M, Potgieter M, Potgieter A. Low levels of physical activity in female adolescents cause overweight and obesity: are our schools failing our children? S. Afr. Med. J. South Africa; 2014 Oct;104(10):665–7.
Monyeki MA, Awotidebe A, Strydom GL, de Ridder JH, Mamabolo RL, Kemper HCG. The challenges of underweight and overweight in South African children: are we winning or losing the battle? A systematic review. Int. J. Environ. Res. Public Health. Switzerland; 2015 Feb;12(2):1156–73.
Mosquera PA, San Sebastian M, Ivarsson A, Gustafsson PE. Decomposition of gendered income-related inequalities in multiple biological cardiovascular risk factors in a middle-aged population. Int. J. Equity Health. International Journal for Equity in Health; 2018;17(1):1–20.
Motala AA, Esterhuizen T, Pirie FJ, Omar MAK. The prevalence of metabolic syndrome and determination of the optimal waist circumference cutoff points in a rural South african community. Diabetes Care. United States; 2011 Apr;34(4):1032–7.
Mukong AK, Tingum EN. The demand for cigarettes : new evidence from South Africa. Cape Town; 2018. Report No.: 227.
Mukong AK, Van Walbeek C, Ross H. Lifestyle and Income-related Inequality in Health in South Africa. Int. J. Equity Health. International Journal for Equity in Health; 2017;16(1):1–14.
National Department of Health. Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2013-2017. Dep. Heal. Pretoria; 2013.
National Department of Health. NATIONAL HEALTH INSURANCE White paper. 39506 South Africa: Governemnt Gazette; 2015 p. 4–101.
National Treasury. Taxation of sugar sweetened beverages. Pretoria, South Africa; 2016.
Ng M, Fullman N, Dieleman JL, Flaxman AD, Murray CJL, Lim SS. Effective Coverage: A Metric for Monitoring Universal Health Coverage. PLoS Med. 2014;11(9).
Nkonki LL, Chopra M, Doherty TM, Jackson D, Robberstad B. Explaining household socio-economic related child health inequalities using multiple methods in three diverse settings in South Africa. Int. J. Equity Health. BioMed Central Ltd; 2011;10(1):13.
Noble M, Zembe W, Wright G, African S, Policy S. poverty are still worst in the former homelands. 2014;1–8.
Noble M, Zembe W, Wright G, Avenell D. Multiple Deprivation and Income Poverty at Small Area

Level in South Africa in 2011. 2013.
O'Donnell O, O'Neill S, Van Ourti T, Walsh B. conindex: Estimation of concentration indices. Stata J. 2016;16(1):112–38.
O'Donnell O, Wagstaff A, Lindelow M, O'Donnell O, Doorslaer E Van. Analyzing Health Equity Using Household Survey Data. … Heal. Equity Using …. Washington DC: The International Bank for Reconstruction and Development/ The World Bank; 2008.
Oakes JM, Rossi PH. The Measurement of Socioeconomic Status in Health Research: Current Practice and steps toward a new approach. Soc. Sci. {\&} Med. 2003;56:769–84.
Omotoso KO, Koch SF. Assessing changes in social determinants of health inequalities in South Africa: A decomposition analysis. Int. J. Equity Health. International Journal for Equity in Health; 2018;17(1):1–13.
Oyebode O, Pape UJ, Laverty AA, Lee JT, Bhan N, Millett C. Rural, urban and migrant differences in non-communicable disease risk-factors in middle income countries: a cross-sectional study of WHO-SAGE data. PLoS One. United States; 2015;10(4):e0122747.
Palafox B, McKee M, Balabanova D, Alhabib KF, Avezum A, Bahonar A, et al. Wealth and cardiovascular health: A cross-sectional study of wealth-related inequalities in the awareness, treatment and control of hypertension in high-, middle- and low-income countries. Int. J. Equity Health. 2016;15(1).
Pedrana L, Pamponet M, Walker R, Costa F, Rasella D. MONITORING HEALTH DETERMINANTS WITH AN EQUITY FOCUS Scoping review: national monitoring frameworks for social determinants of health and health equity. Glob. Health Action. 2016;1(9):1–10.
Peer N, Lombard C, Steyn K, Gwebushe N, Levitt N. Differing Patterns of Overweight and Obesity among Black Men and Women in Cape Town: The CRIBSA Study. PLoS One. 2014a;9(9):e107471.
Peer N, Lombard C, Steyn K, Levitt N. High prevalence of metabolic syndrome in the Black population of Cape Town: the Cardiovascular Risk in Black South Africans (CRIBSA) study. Eur. J. Prev. Cardiol. 2014b Sep;
Peer N, Steyn K, Levitt N. Differential obesity indices identify the metabolic syndrome in Black men and women in Cape Town: the CRIBSA study. J. Public Health (Oxf). 2015 Jan;
Peltzer K, Davids A, Njuho P. Alcohol use and problem drinking in South Africa: findings from a national population-based survey. Afr. J. Psychiatry. 2011;14(1):30–7.
Peltzer K, Phaswana-Mafuya N. Fruit and vegetable intake and associated factors in older adults in South Africa. Glob. Health Action. Sweden; 2012;5:1–8.
Petrova D, Garcia-Retamero R, Catena A. Lonely hearts don't get checked: On the role of social support in screening for cardiovascular risk. Prev. Med. (Baltim). 2015;81:202–8.

Phaswana-Mafuya N, Peltzer K, Chirinda W, Musekiwa A, Kose Z. Sociodemographic predictors of multiple non-communicable disease risk factors among older adults in South Africa. Glob. Health Action. 2013;6(1):1–8.

Pienaar AE. Prevalence of overweight and obesity among primary school children in a developing country: NW-CHILD longitudinal data of 6-9-yr-old children in South Africa. BMC Obes. England; 2015;2:2.

Pinto E. Blood pressure and ageing. Postgrad. Med. J. 2007;83(976):109–14.

Pisa PT, Behanan R, Vorster HH, Kruger A. Social drift of cardiovascular disease risk factors in Africans from the North West Province of South Africa: the PURE study. Cardiovasc. J. Afr. South Africa; 2012 Aug;23(7):371–8, e379-88.

du Plessis A, Malan L, Malan NT. Coping and metabolic syndrome indicators in urban black South African men: the SABPA study. Cardiovasc. J. Afr. South Africa; 2010;21(5):268–73.

Portner CC, Yu-hsuan S. What Explains Differences in Child Health between Rural, Urban, and Slum Areas? Evidence from India. Washington; 2015.

Poulter NR, Prabhakaran D, Caulfield M. Hypertension. Lancet. 2015;386(9995):801–12.

Reddy KK, Reddy KSN, Rao AP, Naik JL, Basha DA. Association of Anthropometric Parameters with Blood Pressure in Urban Adult Females of Andhra Pradesh. J. life Sci. 2012;4(2):107–11.

Reddy P, James S, Sewpaul R, Yach D, Resnicow K, Sifunda S, et al. A decade of tobacco control: The South African case of politics, health policy, health promotion and behaviour change. South African Med. J. 2013;103(11):835–40.

Reilly JJ, Kelly J. PEDIATRIC REVIEW Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood : systematic review. 2011;(July 2010):891–8.

Rossouw H, Grant C, Viljoen M. Overweight and obesity in children and adolescents: The South African problem. S Afr J Sci. 2012;108:1–7.

Rossouw L. Poor health reporting Do poor South Africans underestimate their health needs ? Laura Rossouw. 2015. Report No.: 2015 / 027.

Rutstein SO, Johnson K. The DHS Wealth Index. Maryland; 2004. Report No.: 6.

Sahal Estime M, Lutz B, Strobel F. Trade as a structural driver of dietary risk factors for noncommunicable diseases in the Pacific: an analysis of household income and expenditure survey data. Global. Health. England; 2014;10:48.

Salihu HM, Bonnema SM, Alio AP. Obesity: What is an elderly population growing into? Maturitas. Ireland; 2009 May;63(1):7–12.

Saloojee S, Burns JK, Motala AA. Very low rates of screening for metabolic syndrome among patients with severe mental illness in Durban, South Africa. BMC Psychiatry. England; 2014;14:228.

Sarki AM, Nduka CU, Stranges S, Kandala N-B, Uthman OA. Prevalence of Hypertension in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. Medicine (Baltimore). 2015;94(50):e1959.

Sartorius B, Veerman LJ, Manyema M, Chola L, Hofman K. Determinants of Obesity and Associated Population Attributability, South Africa: Empirical Evidence from a National Panel Survey, 2008-2012. PLoS One. United States; 2015;10(6):e0130218.

Sauerborn R, Adams a., Hien M. Household strategies to cope with the economic costs of illness. Soc. Sci. Med. 1996;43(3):291–301.

Schaap MM, Kunst AE. Monitoring of socio-economic inequalities in smoking: Learning from the experiences of recent scientific studies. Public Health. Elsevier Ltd; 2009;123(2):103–9.

Scheffler E, Visagie S, Schneider M. The impact of health service variables on healthcare access in a low resourced urban setting in the Western Cape, South Africa. African J. Prim. Heal. Care Fam. Med. 2015;7(1):1–11.

Schmidt H, Barnhill A. Equity and Noncommunicable Disease Reduction under the Sustainable Development Goals. PLoS Med. 2015;12(9):1–7.

Schneider M, Bradshaw D, Steyn K, Norman R, Laubscher R. Poverty and non-communicable diseases in South Africa. Scand. J. Public Health. Sweden; 2009 Mar;37(2):176–86.

Schram A, Goldman S. Paradigm Shift: New Ideas for a Structural Approach to NCD Prevention Comment on "How Neoliberalism Is Shaping the Supply of Unhealthy Commodities and What This Means for NCD Prevention" Commentary. Int J Heal. Policy Manag. 2019;2019(x):1–4.

Schutte AE, Olckers A. Metabolic syndrome risk in black South African women compared to Caucasian women. Horm. Metab. Res. Germany; 2007 Sep;39(9):651–7.

Schutte AE, van Rooyen JM, Huisman HW, Kruger HS, de Ridder JH. Factor analysis of possible risks for hypertension in a black South African population. J. Hum. Hypertens. England; 2003 May;17(5):339–48.

Seedat YK, Rayner BL, Veriava Y. South African hypertension guideline 2014. Cardiovasc. J. Afr. 2014;25(6):288–97.

Senekal M, Seme Z, de Villiers A, Steyn NP. Health status of primary school educators in low socio-economic areas in South Africa. BMC Public Health. England; 2015;15:186.

Shisana O, Labadarios D, Rehle T, Simbayi L, Zuma K, Dhansay A, et al. The South African National Health and Nutrition Examination Survey, 2012. Cape Town: HSRC Press Pretoria; 2014.

Sieck G. Physiology in perspective: the burden of obesity. Physiology (Bethesda). United States; 2014 Mar;29(2):86–7.

Siu AL. Screening for High Blood Pressure in Adults: U.S. Preventive Services Task Force Recommendation Statement. Ann. Intern. Med. 2015;163(10).

Smith R, Corrigan P, Exeter C. Countering Non-Communicable Disease through Innovation:

Report of the Non communicable Disease Working Group 2012. Glob. Heal. Policy Summit. 2012.
Solar O, Irwin AA. A Conceptual Framework for Action on the Social Determinants of Health: Determ. Heal. Discuss. (Policy Pract. Geneva; 2010. Report No.: 2.
Solmi F, Von Wagner C, Kobayashi LC, Raine R, Wardle J, Morris S. Decomposing socio-economic inequality in colorectal cancer screening uptake in England. Soc. Sci. Med. 2015;134.
Sookram C, Munodawafa D, Phori PM, Varenne B, Alisalad A. WHO's supported interventions on salt intake reduction in the sub-Saharan Africa region. Cardiovasc. Diagn. Ther. China (Republic : 1949-); 2015 Jun;5(3):186–90.
South African Department of Health. Human Resources for Health South Africa 2030: Draft HR Strategy for the Health Sector (Consultation Document V5). Hum. Resour. Health. 2011;(August):1–27.
South African Medical Research Council. Average life expectancy in South Africa continues to increase [Internet]. 2015. Available from: http://www.mrc.ac.za/Media/2015/1press2015.htm
StataCorp. Stata user's guide: release 13. statisitcal software. College Station, Texas; 2013.
Statistics South Africa. Mortality and causes of death in South Africa, 2013: Findings from death notification. 2014;(December).
Statistics South Africa. General Household Survey 2018. Pretoria; 2019.
StatsSA. Mortality and Causes of Death in South Africa , 2016: Findings from Death Notification. Mortality. Pretoria; 2018.
Steyn NP, Nel JH, Parker W, Ayah R, Mbithe D. Urbanisation and the nutrition transition: a comparison of diet and weight status of South African and Kenyan women. Scand. J. Public Health. Sweden; 2012 May;40(3):229–38.
Sturm R, An R, Maroba J, Patel D. The effects of obesity, smoking, and excessive alcohol intake on healthcare expenditure in a comprehensive medical scheme. S. Afr. Med. J. South Africa; 2013 Nov;103(11):840–4.
Swinburn BA, Sacks G, Hall KD, McPherson K, Finegood DT, Moodie ML, et al. The global obesity pandemic: shaped by global drivers and local environments. Lancet. 2011a Aug 27;378(9793):804–14.
Swinburn BA, Sacks G, Hall KD, McPherson K, Finegood DT, Moodie ML, et al. The global obesity pandemic: Shaped by global drivers and local environments. Lancet. Elsevier Ltd; 2011b;378(9793):804–14.
Tabuchi T, Kondo N. Educational inequalities in smoking among Japanese adults aged 25e94 years: Nationally representative sex- and age-specific statistics. J. Epidemiol. Elsevier Ltd; 2017;27(4):186–92.
Teuner CM, Menn P, Heier M, Holle R, John J, Wolfenstetter SB. Impact of BMI and BMI change

on future drug expenditures in adults: results from the MONICA/KORA cohort study. BMC Health Serv. Res. 2013;13:424.
The NCD Alliance. UNIVERSAL HEALTH COVERAGE AND NON-COMMUNICABLE DISEASES: A MUTUALLY REINFORCING AGENDA. 2014.
Thun M, Peto R, Boreham J, Lopez AD. Stages of the cigarette epidemic on entering its second century. Tob. Control. 2012;21(2):96–101.
Tugendhaft A, Manyema M, Veerman LJ, Chola L, Labadarios D, Hofman KJ. Cost of inaction on sugar-sweetened beverage consumption: Implications for obesity in South Africa. Public Health Nutr. 2016;19(13).
Tyrovolas S, Koyanagi A, Garin N, Olaya B, Ayuso-Mateos JL, Miret M, et al. Determinants of the components of arterial pressure among older adults – The role of anthropometric and clinical factors: A multi-continent study. Atherosclerosis. Ireland: Elsevier Ltd; 2015 Feb;238(2):240–9.
Umuhoza SM, Ataguba JE. Inequalities in health and health risk factors in the Southern African Development Community: Evidence from World Health Surveys. Int. J. Equity Health. International Journal for Equity in Health; 2018;17(1):1–15.
United Nations. United Nations NCD_draft_political_declaration.pdf. Geneva; 2011.
United Nations. TRANSFORMING OUR WORLD : THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT. New York; 2015.
United Nations Development Program. What does it mean to leave no one behind? 2018;(July):29.
United Nations Statistical Commission. First proposed priority indicator list. Geneva; 2015.
Vellakkal S, Millett C, Basu S, Khan Z, Aitsi-Selmi A, Stuckler D, et al. Are estimates of socioeconomic inequalities in chronic disease artefactually narrowed by self-reported measures of prevalence in low-income and middle-income countries? Findings from the WHO-SAGE survey. J. Epidemiol. Community Health. England; 2015a Mar;69(3):218–25.
Vellakkal S, Millett C, Basu S, Khan Z, Aitsi-Selmi A, Stuckler D, et al. Are estimates of socioeconomic inequalities in chronic disease artefactually narrowed by self-reported measures of prevalence in low-income and middle-income countries? Findings from the WHO-SAGE survey. J. Epidemiol. Community Health. 2015b;69(3):218–25.
Vellios N, van Walbeek C. Determinants of regular smoking onset in South Africa using duration analysis. BMJ Open. 2016;6(7):e011076.
Venkatapuram S, Bell R, Marmot M. THE RIGHT TO SUTURES : SOCIAL EPIDEMIOLOGY , HUMAN RIGHTS , AND SOCIAL JUSTICE. Health Hum. Rights. 2013;12(2):3–16.
Virtanen SE, Zeebari Z, Rohyo I, Galanti MR. Evaluation of a brief counseling for tobacco cessation in dental clinics among Swedish smokers and snus users. A cluster randomized controlled trial (the FRITT study). Prev. Med. (Baltim). Elsevier Inc.; 2014;70C:26–32.

Visser R, Bhana R, Monticelli F. The National Health Care Facilities Baseline Audit: National summary report 2012. Durban; 2012.
Vyas S, Kumaranayake L. How to do (or not to do) . . . Constructing socio-economic status indices : how to use principal components analysis. Health Policy. 2006;(October).
Wagstaff A. Poverty and health sector inequalities. Bull. World Health Organ. 2002;80(2):97–105.
Wagstaff A. Correcting the concentration index: A comment. J. Health Econ. 2009. p. 516–20.
Wagstaff A, Van Doorslaer E, Watanabe N. On decomposing the causes of health sector inequalities with an application to malnutrition inequalities in Vietnam. J. Econom. 2003;112(1):207–23.
Wagstaff A, Paci P, van Doorslaer E. On the measurement of inequalities in health. Soc. Sci. Med. 1991;33(5):545–57.
Wagstaff A, Watanabe N. What difference does the choice of SES make in health inequality measurement? Health Econ. 2003;12(10):885–90.
Wagstaff A, Waters H. REACHING THE POOR with Health, Nutrition, and Population Services. What works, What Doesn't, and Why. In: Gwatkin DR, Wagstaff A, Yazbeck AS, editors. Reach. POOR with Heal. Nutr. Popul. Serv. What Work. What Doesn't, Why. Washington DC: The World Bank; 2005. p. 27–47.
Wald NJ. Guidance on terminology. J. Med. Screen. 2008;15(1):50.
Wallingford M. Advancing Noncommunicable Disease Policymaking in the Americas : A Multi-Sectoral Policy Puzzle for the Pan American Health Organization. University of Toronto; 2012.
Wan G, Zhou Z. Income Inequality in Rural China. 2004;9.
Wang LY, Denniston M, Lee S, Galuska D, Lowry R. Long-term health and economic impact of preventing and reducing overweight and obesity in adolescence. J. Adolesc. Health. 2010 May;46(5):467–73.
Weiss R, Bremer A a., Lustig RH. What is metabolic syndrome, and why are children getting it? Ann. N. Y. Acad. Sci. 2013;1281:123–40.
Whelton PK, Carey RM, Aronow WS, E CD, Karen C, Himmelfarb CD, et al. 2017 Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults. J. Am. Coll. Cardiol. 2017;70(14):1785–822.
Whitehead M, Dahlgren G, Evans T. Equity and health sector reforms: can low-income countries escape the medical poverty trap? Lancet. 2001;358:833–6.
Winkler V, Mangolo NJ, Becher H. Lung cancer in South Africa: a forecast to 2025 based on smoking prevalence data. BMJ Open. 2015;5(3):e006993.
Woolard I, Leibbrandt M. Measuring poverty in South Africa. DPRU Work. Pap. Cape Town; 1999. Report No.: 99/33.

World Bank. Introduction to Poverty Analyses. Poverty Manual, All, JH Revis. 2005.
World Health Organisation. WHO Framework Convention on Tobacco Control. WHO Press. 2005;1(3):270–1.
World Health Organisation. Improving Equity in Health by Addressing Social Determinants. 2011;319.
World Health Organisation. Chronic diseases: causes and health impact [Internet]. Chronic Dis. Heal. Promot. Part Two Urgent need action. 2015. Available from: http://www.who.int/chp/chronic_disease_report/part2_ch1/en/index14.html
World Health Organization: Western Pacific Region. Noncommunicable disease risk factors and socioeconomic inequalities – what are the links ?A multicountry analysis of noncommunicable disease surveillance data Report to the WHO Regional Office for the Western Pacific Section. 2010.
World health organization. DIET , NUTRITION AND THE PREVENTION OF Report of a Joint WHO / FAO Expert Consultation. 2003;
World Health Organization. Mortality attributable to tobacco: WHO Global Report. Geneva; 2012.
World Health Organization. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. World Heal. Organ. 2013a.
World Health Organization. A global brief on Hypertension: Silent killer, global public health crisis. A Glob. Br. Hypertens. 2013b.
World Health Organization. Noncommunicable diseases (NCD) Country Profiles-South Africa [Internet]. Noncommunicable Dis. Ctry. Profiles. 2014. Available from: http://www.idrc.ca/EN/Resources/Publications/Pages/IDRCBookDetails.aspx?PublicationID=1194
World Health Organization. National Health Accounts Indicators- South Africa [Internet]. Glob. Heal. Expend. Database. 2017 [cited 2019 Dec 20]. p. 2017. Available from: http://apps.who.int/nha/database/ViewData/Indicators/en
World Health Organization. WHO | Deaths from NCDs [Internet]. WHO Glob. Heal. Obs. Data. World Health Organization; 2018a [cited 2019 Aug 9]. Available from: https://www.who.int/gho/ncd/mortality_morbidity/ncd_total/en/
World Health Organization. Raised blood pressure [Internet]. Glob. Heal. Obs. data. World Health Organization; 2018b [cited 2018 Sep 29]. Available from: http://www.who.int/gho/ncd/risk_factors/blood_pressure_prevalence_text/en/#.W6_GH4jnP5A.mendeley
World Health Organization & The World Bank. Tracking Universal Health Coverage: First Global Monitoring Report. 2015.
World Health Organization and International Bank for Reconstruction and Development / The

World Bank; 2017. Tracking Universal Health Coverage : 2017 Global Monitoring Report. 2017.
Yang W. An analysis of inequities and inefficiencies in health and healthcare in China. London School of Economics; 2013.
Yoon P, Scheuner M, Gwinn M, Khoury M. Awareness of Family Health History as a Risk Factor for Disease --- United States, 2004 [Internet]. Morb. Mortal. Wkly. Rep. 2004 [cited 2018 Mar 25]. Available from: https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5344a5.htm
Zatu MC, Van Rooyen JM, Kruger A, Schutte AE. Alcohol intake, hypertension development and mortality in black South Africans. Eur. J. Prev. Cardiol. 2014a Dec;
Zatu MC, Van Rooyen JM, Kruger A, Schutte AE. Alcohol intake, hypertension development and mortality in black South Africans. Eur J Prev Cardiol. 2014b;.
van Zyl-Smit RN, Allwood B, Stickells D, Symons G, Abdool-Gaffar S, Murphy K, et al. South African tobacco smoking cessation clinical practice guideline. South African Med. J. 2013;103(11):869–76.