The Contribution of lifestyle risk factors on Wealth-related inequalities in Self-assessed Health and Chronic Diseases in South Africa

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By

Gosego Mmereki Andrew

Rosaros

2366434

Supervised by Dr. Laura Rossouw

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Abstract

There is a growing epidemiological transition from communicable diseases to non-communicable diseases (NCDs) in low- and middle-income countries. The expected pace and scale of the shift to NCDs will overwhelm the healthcare systems of many lower-income countries. A significant contributor to NCDs is lifestyle risk factors such as episodic drinking, smoking, and an unhealthy diet. This study aims to measure the contribution of current alcohol and cigarette consumption to wealth-related health inequalities in South Africa. The health measures used will be self-assessed health (SAH) and specific NCDs. This study uses data from 4178 male and 6087 female participants captured in the South African Demographic and Health Survey (DHS) in 2016. This study estimated the wealth-related health inequalities using the Erreygers' corrected concentration index (CCI) and then estimated the Wagstaff decomposition of the concentration index to establish the contribution of alcohol and cigarette consumption to wealth-related inequalities in health outcomes. The concentration index findings indicate that the burden of morbidity is statistically significantly concentrated among individuals in wealthier quintiles for several health outcomes, except respiratory problems, which is significantly concentrated among lower wealth quintiles for males. The Wagstaff decomposition reveals that current alcohol consumption and cigarette consumption contributions to wealth-related health inequalities are smaller than the contributions of some socioeconomic and demographic factors, including wealth, educational attainment, marital status, and age. In conclusion, this study proposes that redistributing wealth towards poor individuals will likely decrease South Africa's income-related health inequalities and implement anti-smoking campaigns and advertising policies.

Keywords: Noncommunicable diseases, Alcohol and cigarette, Wealth inequality, Health inequality.

1. Introduction

There is a growing epidemiological transition from communicable diseases to non-communicable diseases (NCDs) in low- and middle-income countries (LMICs) (Bloom et al., 2012). The change occurred after World War II when medical research achieved vaccination and antibiotics for communicable diseases. As a result, NCDs became more prominent relative to communicable diseases (Boutayeb & Boutayeb., 2005). Then, by the beginning of the third millennium, NCDs appeared to be sweeping the entire globe, accounting for about 70% of deaths globally. Premature deaths from these diseases are disproportionately concentrated in LMICs (Allen et al., 2017). NCDs are the most significant cause of mortality in LMICs (Ndubuisi, 2021; World Health Organisation, 2015), particularly hypertension and diabetes mellitus (Correia et al., 2019).

A greater increase in NCDs is still expected, with 80% of these NCDs deaths occurring in LMICs (Wagner & Brath, 2012). Most NCDs, such as heart diseases, cancer, diabetes, hypertension, chronic pulmonary, and mental diseases, have caused major problems to their healthcare systems (Boutayeb & Boutayeb, 2005). According to Daniels et al. (2014), the expected pace and scale of the shift to NCDs will overwhelm the healthcare systems of many lower-income countries. This will increase the mortality and morbidity rates in these countries.

In addition, there are gendered differences in the prevalence of NCDs. Evidence from Ethiopia and South Africa shows that women are burdened with renal failure and ischemic heart diseases, while men are burdened with oesophageal cancer and chronic liver disease. This could point to differences in lifestyle risk factors by gender, such as women being overweight and obese and men smoking and excessively drinking alcohol (Abera et al., 2017; Nojilana et al., 2016).

A significant contributor to NCDs is lifestyle risk factors such as episodic drinking, smoking, and an unhealthy diet. One of the reasons for increasing NCDs and risk factors is urbanisation. Urbanisation and urbanicity are escalating continuously in LMICs and changing the disease burden and the structural and intermediate determinants of health (Elsey et al., 2019). Vlahov and Galea, 2002 (as cited in Jones-Smith & Popkin, 2010) defined urbanisation as the change in size, density and heterogeneity in places and migration into cities, while urbanicity is the adoption of urban characteristics. The impact of these processes on lifestyle risk factors has been investigated (Jones-Smith & Popkin, 2010; Van de Poel et

al., 2012), and studies have found urbanisation and urbanicity as a cause of increasing lifestyle risk factors in LMICs (Allender et al., 2010; Allender et al., 2011). Urbanicity has increased lifestyle risk factors in LMICs, such as unhealthy diets and sedentary lifestyles. Olatona et al., 2018 indicated that unhealthy diets such as consuming processed foods, take away fast foods, increased edible oils consumption, and sugar-sweetened beverages contribute to metabolic disorders (abdominal obesity, hypertension, and dyslipidaemia). Riha et al. (2014) found increasing urbanisation levels in rural communities to be primarily associated with increasing lifestyle risk factors, and urbanicity associated with lifestyle risk factors such as unhealthy diet and reduced physical activities.

Within LMICs, the occurrence of NCDs differs with socioeconomic status (SES), and thus disparities may be intensified by socioeconomic differences in peoples` lifestyle choices (Keetile et al., 2019; Mukong et al., 2017). There is sufficient evidence on the effects of lifestyle risk factors on socioeconomic-related health inequalities (Dieteren & Bonfrer, 2021; Hosseinpoor et al., 2012; Lawana & Booysen, 2018; Mutyambizi et al., 2019). Socioeconomically disadvantaged populations tend to record a higher prevalence of lifestyle risk factors (Hosseinpoor et al., 2012; de Mestral & Stringhini, 2017; Nagasu et al., 2019; Umuhoza & Ataguba, 2018), thereby exacerbating economic inequalities within societies (Nugent et al., 2018). The results imply that factors outside of the healthcare sector (such as tobacco use, alcohol consumption, unhealthy nutrition, physical inactivity, and obesity) contribute to health-related inequalities (social and economic inequalities) and have an important impact on health status. Understanding socioeconomic-related health inequalities and their association with lifestyle risk factors may aid effective direct interventions to end the persistent occurrence of NCDs (Yaya et al., 2018).

Recently in South Africa, Covid-19 lockdown regulations worsened socioeconomic inequalities in health. South Africa implemented one of the strictest lockdowns globally (Nwosu & Oyenubi, 2021). This Covid-19-related lockdown exacerbated the socioeconomic inequalities in health. The lockdown worsened health inequalities by race, income, and employment. Black South Africans are affected the most by Covid-19 lockdowns relative to their white counterparts, and this is because of their work occupations, such as working as cleaners and nurses or in fumigation of contaminated areas (Nwosu & Oyenubi, 2021). Similarly, to race, income inequality contributed to socioeconomic inequalities in health. Poor people lost their jobs during the pandemic because of the lockdown regulations, limiting their

access to private healthcare (Bambra et al., 2020). This exacerbated income-related inequalities and disproportionally worsened health outcomes among low-income people.

In South Africa, NCDs have been rising and are emerging as a leading cause of premature mortality (Wandai et al., 2017). It was recently found that one in six South African aged 18 and older reported suffering from chronic ill health (Amoateng et al., 2021). In response, the South African National Department of Health formulated a strategic plan (2013–2017) for curbing NCDs (Lawana et al., 2020). This strategic plan stresses the need to reduce alcohol consumption, tobacco use, and other lifestyle-related risk factors to curb the rise in NCDs. Limited studies have investigated the contribution of lifestyle risk factors to inequalities in health and NCDs in South Africa. Mutyambizi et al. (2019) found that in South Africa, lifestyle risk factors such as alcohol and tobacco consumption contributed about 22.2% and 34.7% to inequalities in self-assessed health and diabetes, respectively. Mukong et al. (2017) found similar evidence on the impact of alcohol and tobacco consumption on self-assessed health. This research report builds on the currently available evidence by calculating the contribution of lifestyle risk factors to wealth-related health inequalities in South Africa.

2. Thesis Statement and research question

This research report aims to measure the contribution of current alcohol consumption and current cigarette consumption to wealth-related health inequalities in South Africa. The findings will be interpreted within the Social Determinants of Health (SDH) model. The health measures used will be self-assessed health (SAH) and specific NCDs. The SAH is a subjective measure of health status (Wu et al., 2013). This measure has been used and recommended to compare health statuses between population groups (Jylha et al., 2009). A gender-disaggregated analysis will be undertaken, given gender differences in alcohol and cigarette consumption rates.

3. Literature review

3.1. The relationship between lifestyle risk factors and socioeconomic status

3.1.1. Evidence from HICs

Numerous studies in High-Income countries (HICs) have investigated the relationship between SES and lifestyle risk factors. Evidence from HICs using a logistic regression methodology suggests that tobacco consumption is more prevalent among low SES groups.

The evidence linking alcohol consumption to socioeconomic status is more mixed, although overall, the trend points to alcohol consumption being more concentrated among high SES than low SES households. A study in Switzerland by Charitonidi et al. (2016) investigates the association between SES indicators and lifestyle risk factors among young Swiss adults using C-SURF data collected in 2016. The authors found that living in a low-income household was associated with higher daily tobacco consumption, while alcohol consumption is concentrated among high-income households.

Similarly, using survey data, Nguyen et al. (2020) in the United States (US) found smoking to be more associated with individuals in low educational and income households than individuals in higher educational and income households. Cavelaars (2000) used a national health survey data from 12 different European countries. The study examines the relative and absolute differences in the prevalence of ever smoking and current smoking for both genders in each age group and educational level. The author found that for individuals aged 45 to 74, higher rates of current and ever smoking are associated with lower education levels. These trends were found in Britain, Norway, and Sweden among women, and a similar trend was found for men, although it was less noticeable than for women. Only among men in Portugal was smoking concentrated more among higher educated groups. The same trend was found for individuals aged 20 to 44.

A study by Melotti et al. (2011) in the United Kingdom examined the association between adolescents' SES and alcohol and cigarette consumption. The study found that binge drinking had a minor to no association with SES, and consuming alcohol in the last six months was linearly associated with higher income levels and inversely associated with educational attainment, while cigarette consumption was associated with low SES regardless of the SES indicator employed. Consistently, Beard et al. (2019) used a large representative data (AUDIT-C) surveyed in England and undertaken between the period March 2014 to April 2018 from the Alcohol Toolkit Study (ATS). The authors employed a ridge regression to assess the association of different socioeconomic indicators with alcohol consumption patterns (frequency of alcohol consumption, amount consumed on a drinking day and frequency of binge drinking). The authors found that income had a small association with alcohol consumption relative to educational attainment. Low levels of educational attainment are the best predictors of alcohol consumption quantity and frequency of binge drinking. Individuals with high school/college attainment drank more on a typical day and had a higher intake than those with university attainment.

3.1.2. Evidence from LMICs

Fewer studies in LMICs investigated the association between SES and lifestyle risk factors compared to HICs. A few studies using concentration indices found that, on average, tobacco consumption is concentrated among the poor (Dieteren & Bonfrer, 2021; Rossouw, 2021). Firstly, Rossouw (2021) examined individuals aged 50 and older using multi-country data from World Health Organization's Study on Global Ageing and Adult Health (WHO SAGE) collected between 2008-2010. The study aimed to measure the wealth-related inequalities in tobacco consumption in six LMICs. The author found that current tobacco consumption is more concentrated among the poor in China, Ghana, India, and South Africa and among the wealthy in the Russian Federation and Mexico. Similar to this study, Dieteren and Bonfrer (2021) assessed the prevalence of SES with lifestyle risk factors using Demographic and health Survey (DHS) data from 22 LMICs. The study's findings showed that tobacco and alcohol consumptions are consistently concentrated among the poor in LMICs.

Evidence from Sub-Saharan African (SSA) countries indicates consistent results to those in HICs and other LMICs. Keetile et al. (2019) investigated the socioeconomic inequalities in lifestyle risk factors using a cross-sectional survey data and found similar results as in other LMICs, namely that daily smoking was concentrated among the poor than the non-poor. A study by Umuhoza and Ataguba (2018) in six SSA countries used the World Health Survey (WHS) data to investigate socioeconomic inequalities in health and health risk factors in the Southern African Development Communities (SADC) region. The standardised and normalised concentration indices used found that smoking was significantly concentrated among the poor compared to the rich. Yaya et al. (2018) used a nationally representative survey data from DHS, conducted between 2008/09-2017, to investigate if there are significant differences between SES and lifestyle risk factors among women in 33 SSA countries. The concentration index used found that tobacco consumption is concentrated more among low SES women than among those in high SES. However, contrary to the literature Chisha et al. (2019) estimated concentration curves and indices for cigarette smoking prevalence and intensity to assess the respective inequalities in Namibia using 2013 Demographic and Health Survey. The study found that cigarette smoking is more prevalent among the wealthy and that they smoke more frequently compared to less wealthy Namibians.

However, evidence from LMICs predominantly shows that alcohol consumption is concentrated among the socioeconomically advantaged, different to the pattern in tobacco

consumption and SES. Lawana and Booysen (2018) in South Africa measured the socioeconomic inequalities in alcohol use among men residing in informal settlements. This study used data from the 2016 Study of South African Informal Settlements to estimate concentration index. The study found alcohol use to be concentrated among the poor in the case of males aged 15-34 and males aged 35-44 years. Keetile et al. (2019) in Botswana found that alcohol consumption is concentrated more among the non-poor than the poor. Umuhoza and Ataguba (2018) in the six SSA countries of the SADC region found that heavy episodic drinking results were significantly concentrated among the non-poor in Malawi and Zambia, while pro-poor inequalities in heavy episodic drinking were statistically insignificant. Yaya et al. (2018) also found that alcohol consumption is more concentrated among high SES groups than on low SES groups in 33 SSA countries. However, this trend is not always consistent. For instance, Dieteren and Bonfrer (2021) previously mentioned their study found that alcohol consumption in LMICs is predominantly concentrated among the poor.

Although studies in both LMICs and HICs found a similar association between SES and lifestyle risk factors, there are still very distinct differences in the patterns of lifestyle risk factors associated with SES in HIC and LMICs. Kim et al. (2004) used a lifestyle index to measure the link between SES and lifestyle risk factors between China and the United States, two countries in different stages of development. In China, as the SES improved, lifestyle choices became less healthy (i.e., smoking and alcohol consumption increased). As the income level increased, the likelihood of a healthier lifestyle decreased significantly in a linear trend. In the United States, the likelihood of a healthier lifestyle increased as the income level increased. These differences highlight that countries are still in different phases of the nutrition and tobacco use transition, dependent on their level of economic development (Popkin, 2010).

3.2. The contribution of lifestyle risk factors to socioeconomic inequalities

There is substantial evidence on the contribution of lifestyle risk factors to socioeconomic-related inequalities in health for both HIC and LMICs.

3.2.1. Evidence from HICs

Studies in HICs investigating the contribution of lifestyle risk factors to socioeconomic-related inequalities in health indicated that smoking increases health inequalities by a small proportion. In two HICs (Canada and the US), McGrail et al. (2009) used a joint Canada-US

health Survey data to estimate the factors contributing to income-related health inequalities. The findings indicated that current smoking contributed about 2% in both Canada and US. Similarly, a study by Vallejo-Torres & Morris (2010) used a health survey for England to measure the contribution of smoking to income-related health inequalities and found that the contribution of smoking slightly increases income-related inequalities in health. The available studies have focused on tobacco rather than alcohol consumption.

A study in Sweden by Mosquera et al. (2018) aimed to examine the contribution of demographic, socioeconomic, behavioural, and psychosocial determinants to income-related inequalities in eight biological cardiovascular risk factors in Swedish middle-aged women and men. The study used data from the Västerbotten Intervention Program" (VIP) to estimate a Wagstaff decomposition analysis disaggregated by gender. The authors found that smoking and alcohol consumption made slight contributions to observed inequalities for females, while for males smoking and alcohol consumptions had a considerable contribution to the inequalities.

3.2.2. Evidence from LMICs

Studies in LMICs show that smoking considerably increases socioeconomic-related inequalities in health. A Chinese study by Shao et al. (2016) used a decomposition of concentration index technique and found that smoking history, among other factors, considerably contributed to pro-rich inequalities on migrant workers` health. In Iran, Rezaei et al. (2018) estimated the decomposition technique to identify the factors contributing to wealth-related inequalities in poor health-related quality of life (HRQoL). The study found that current smoking has a positive contribution and increases wealth-related inequalities in HRQoL. Similar to the studies from HICs, the studies in LMICs focus more on the contribution of tobacco than alcohol. However, the previously mentioned study by Mukong et al. (2017) in South Africa used a nationally representative survey data from the South African National Income Dynamic Survey (NIDS). The authors applied a decomposition technique to estimate the contribution of smoking and alcohol use to inequalities in health. The findings suggest that alcohol consumption and smoking inequalities contribute to the widening of income-related health inequalities.

In a recent study by Nghipandulwa and Mukong (2023) the study used a 2015/16 Namibian Household Income and Expenditure Survey to estimate a separate and joint contribution of tobacco and alcohol use to income-related health inequalities using a decomposition

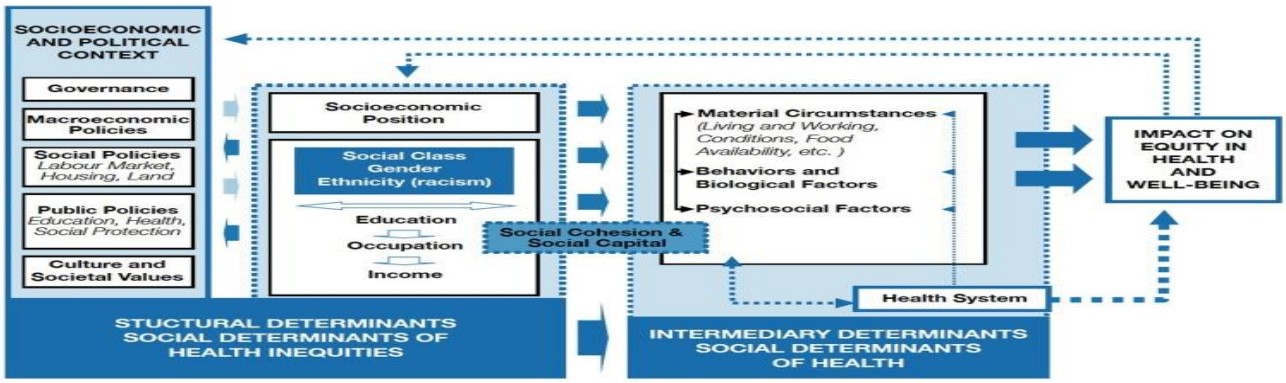
technique. The study found that tobacco use widens the income-related health inequality gap while alcohol consumption reduces health disparities.

The contribution of lifestyle risk factors to socioeconomic-related inequalities in individual chronic conditions. A study by Gatimu and John (2020) in Kenya aimed to quantify the socioeconomic inequality in hypertension. The study used a nationally representative data from the 2015 Kenya STEPwise survey to estimate the Wagstaff decomposition analysis. The results indicated that smoking and alcohol consumption contributions to socioeconomic inequalities in hypertension were inconsiderable. In the case of diabetes, a study by Mutyambizi et al. (2019) also aimed to examine the contribution of lifestyle factors to diabetes inequalities in South Africa. This study uses data from the 2012 South African National Health and Nutrition Examination Survey (SANHANES-1) and applied a decomposition method to measure the contributions of lifestyle factors to inequalities in diabetes. The authors found that alcohol consumption narrows the socioeconomic inequalities in self-reported and total diabetes, while smoking intensity made minimal contributions to inequalities in diabetes.

4. Theory: The contribution of alcohol and cigarette consumption to wealth-related health disparities

The contribution of differences in lifestyle risk factors to health disparities is a highly complex phenomenon to underpin. However, in response to the complex relationship, the World Health Organisation (WHO) developed the commission on social determinants of health (CSDH) conceptual framework in (figure 1).

Figure 1: Commission on the SDH final framework.



Adapted from the WHO (2008) conceptual framework for the social determinants of health

The CSDH model above distinguishes between the "Structural determinants" of health (such as all social and political mechanisms that maintain socioeconomic status (SES)) and "Intermediary determinants" (which include behaviours and biological factors, and psychosocial factors). Health-related inequalities occur from the interaction of structural and intermediary determinants.

4.1. The socioeconomic and political context

The socioeconomic and political context comprises society's structural and cultural characteristics that influence individuals' SES and health status (Sullivan & Thakur, 2020). This context includes social and political mechanisms that generate and maintain social hierarchies (e.g., labour markets, health, social protection, educational systems, and political institutions). The CSDH model suggests that the quality of government positively affects health status, and health outcomes of individuals.

4.2. Structural determinants and social position

The "structural determinants" is a term used to refer to the socioeconomic and political context, which is the structural instrument that creates social stratification and the resulting SES. The social determinants of health (SDH) result from social stratification and SES differences. Therefore, individuals will take different social positions according to their SES (i.e., income level, educational attainment, and occupation). Studies have associated educational attainments, wealth, and occupation with health outcomes through the life course (Bharmal et al., 2015).

4.2.1. Wealth and Income

Wealth is a measure of SES and relates to people's accumulation of assets. Like other socioeconomic indicators, wealth is associated with health by influencing certain lifestyle risk factors that directly affect health (such as alcohol consumption, unhealthy diet, and physical inactivity).

4.2.2. Educational attainment

The CSDH model indicates that educational attainment reflects information about the quality of educational experience, which relates to education's role on health status. Other scholars further found that educational attainment influences health through social and psychological

factors. Thus, higher education is linked to greater self-assessed health and healthy lifestyle choices (Bharmal et al., 2015).

4.3. Intermediary determinants

The intermediary determinants are factors that flow out of socioeconomic positions (Davis & Chapa, 2015). Social determinants of health dictate how intermediary determinants will be distributed and experienced throughout the population (Sullivan & Thukar, 2020). The social determinants of health inequalities are related to the intermediary determinants linked to health-related and physiological behaviours. Intermediary determinants include living conditions, physiological factors, and behavioural and biological factors. One of the biggest intermediary determinants of health is behavioural factors, including tobacco use, alcohol consumption, unhealthy diet, and physical inactivity.The model suggests that social inequalities in health are associated with social differences in behavioural factors. According to the model, behavioural factors are strongly associated with socioeconomic positions, including wealth, income, and education, significantly with morbidity and mortality.

5. Data and Methodology

5.1. Data

This study uses data from 4178 male and 6087 female participants captured in the South African Demographic and Health Survey (DHS) in 2016. Given the differences in alcohol and cigarette consumption rates between males and females, the samples will be assessed separately. The DHS dataset is a nationally representative survey that interviews individuals on various topics, including their SES, disease profile, and lifestyle attributes. This analysis focus on persons aged 15 years to 95 years. A description of health outcomes, lifestyle risk factors, and measures of socioeconomic status are reported in table 1 below:

5.1.1. Measure of Wealth

The DHS captures household wealth through a composite index of relative living standards derived from country-specific indicators of asset ownership, housing traits, and water and sanitation facilities (Rutstein & Johnson., 2004). The index is calculated using the methods of Filmer & Pritchett (2001) and provided with the standard DHS. Wealth quintiles will be used to proxy the socioeconomic status of individuals. The lowest wealth quintile represents 20 percent of the poorest part of the population, while the highest quintile represents the 20 percent better off.

5.1.2. Measures of lifestyle risk factors

The two lifestyle risk factors used are current alcohol and current cigarette consumption.

- Respondents are asked if they have consumed alcohol in the last 12 months. The variable is converted into a binary variable equal to one if an individual has consumed alcohol in the last 12 months and zero if otherwise.
- Cigarette use is measured based on self-reported information among males and females regarding current smoking and whether they smoke, i.e., daily, sometimes, or never. The variable is then converted into a binary variable and given a value of one if an individual smokes daily and zero otherwise.

5.1.3. Measurement of health

The health outcomes are subjectively captured through self-assessment reports from the respondents, as represented in table 1. Self-reported health is among the closest measures that capture all components of health (Mukong et al., 2017). The population's self-assessed health (SAH) status, which is subjective, will be used to measure overall health. SAH is an ordinal variable, where "1,2,3,4" represents "poor, average, good, and excellent." However, for this analysis, a binary variable has been created equal to one if the respondent reported experiencing poor health and zero if otherwise.

In addition to the SAH variable, a range of self-reported diagnosed health conditions will be included in the analysis based on the availability in the dataset employed and its association with lifestyle risk factors (alcohol and cigarette consumption). The analysed health outcomes include whether a respondent has been diagnosed with high blood pressure, diabetes, stroke, heart problems, cancer, asthma, heart attacks, high blood cholesterol, and chronic bronchitis. Reporting of these health conditions is based on whether an individual reports that they have been diagnosed by either doctor or nurse and are regarded as a slightly more objective health measure than SAH. Similarly, a binary variable for comorbidity is created where the variable is equal to one if the respondent has reported more than one health condition and zero if otherwise. One potential limitation of using self-reported objective health is that they are based on prior diagnoses based on healthcare accessibility. If access to healthcare is determined by wealth, then diagnoses are likely to occur among wealthier groups. These variables will not necessarily give an accurate depiction of health (Bonfrer et al., 2014; Rossouw et al., 2018).

In addition, whether the respondent experienced respiratory problems in the last 12 months was used to generate a health outcome for the analysis. The health outcome is coded as a binary variable, equal to one if the respondent reported having respiratory problems and zero if otherwise.

5.1.4. Independent variables

In addition to wealth, the analysis will control for other socio-demographic variables. This includes age categories (25-34 years, 35-44 years, 45-54 years, 55-64 years, 65-74 years, and ≥75 years), marital status (married, living with a partner, widowed, divorced, and separated) and education (no education, incomplete primary, complete primary, incomplete secondary, and complete secondary).

Table 1: Description of variables that will be assessed

	Indicator	Measurement
Health Outcomes	Self-assessed poor health	Respondent's perception of own health. Respondents are asked to rate their health from one to four, with one being the lowest and four the highest. The variable was changed to a binary indicator equal to 1 if they reported that they experienced poor health and 0 otherwise.
	Diabetes	Binary of Yes/No if doctor, nurse diagnosed with: Diabetes.
	High blood Cholesterol	Binary of Yes/No if doctor, nurse diagnosed with: High blood cholesterol.
	High blood pressure	Binary of Yes/No if doctor, nurse diagnosed with: High blood pressure.
	Respiratory problems	Binary of Yes/No if doctor, nurse diagnosed with: Respiratory problems.
	Cancer	Binary of Yes/No if doctor, nurse diagnosed with: Cancer.
	Stroke	Binary of Yes/No if doctor, nurse diagnosed with: Stroke.
	Chronic bronchitis	Binary of Yes/No if doctor, nurse diagnosed with: Chronic bronchitis.
	Asthma	Binary of Yes/No if doctor, nurse diagnosed with: Asthma.
	Comorbidities	Binary of Yes/No is respondent has two or more diseases.
Lifestyle risk factors	Current Alcohol Consumption	Binary, consumed alcohol in the last 12 months.
	Current Tobacco consumption	Binary, an individual frequently smoking a cigarette.
Socioeconomic status	Wealth status	Quintiles of wealth index from richest to poorest. The lowest wealth quintile indicates the 20% poorest part of the population, while the highest quintile indicates the 20% wealthiest households.
	Education	A categorical variable of educational attainments (no education, incomplete primary, complete primary, incomplete secondary, and complete secondary)
	Age	Categorical variable (25-34 years, 35-44 years, 45-54 years, 55-64 years, 65-74 years, ≥75 years).
	Marital status	Categorical variables (married, living with a partner, widowed, divorced, and separated).

5.2. Methodology

The empirical analysis will consist of two steps: Firstly, the concentration index of wealth-related health inequalities will be calculated using the Erreygers' corrected concentration index (CCI). The second step will involve decomposing the concentration index to establish the contribution of alcohol and cigarette consumption to wealth-related inequalities in health outcomes. The Wagstaff, Van Doorslaer and Watanabe (2003) decomposition method is used for this part of the analysis.

5.2.1. Concentration index

The concentration index (CI) will be used to calculate wealth-related inequalities in health outcomes (Ataguba et al., 2011; Nwosu & Oyenubi, 2021). The concentration index (CI) measures socioeconomic inequality of health based upon information on the socioeconomic ranks and the health levels of the entire population (Erreygers., 2009). The CI is a bivariate measure of inequality in health status. It takes up a number between -1 and +1. A positive concentration index indicates that wealth-related inequalities are concentrated among the wealthier individuals in the distribution, and a negative value indicates the opposite. The value of zero suggests that wealth-related health inequalities are evenly distributed across SES. Thus, the CI is used to measure the extent of inequalities in health (Ataguba et al., 2011; Wagstaff et al., 2007). The concentration index can be expressed as follows:

$$CI\ (y) = 2/\mu\ \ cov\ (h, r) \quad (1)$$

Where h is one of the selected health outcomes described in table 1, μ is the health outcome mean, and r is the fractional rank of the individual's wealth from the lowest to the highest category.

However, the concentration index is problematic when a binary and bounded variable such as the health outcome variables described in Table 1 are used. As a result, the binary health outcome variables used in the analysis require some form of normalization (Wagstaff, 2005). The Erreygers` corrected concentration index (CCI) is employed to overcome the limitation (Erreygers, 2009). The CCI normalizes the CI in the following:

$$CCI = 4\mu/(b - a)\ \ \times c \quad (2)$$

Where μ is the mean health status, b is the maximum level of the health variable, and a is the minimum level of the health variable; thus, (b - a) indicates the range of the health variable. Lastly, C is the standard concentration index. These CCIs will be calculated for each health outcome, disaggregated by gender.

5.2.2. Decomposition analysis

A decomposition analysis will be employed to determine the contribution of current alcohol consumption and current cigarette consumption to the observed wealth-related health inequalities. The decomposition will only be performed for inequalities with a statistically significant CCI. Following the calculation of CCI for each gender, the CCI can be decomposed to uncover which lifestyle risk factors contribute to the inequalities in wealth. The decomposition analysis follows Wagstaff et al. (2003) methodology. Firstly, a linear regression analysis expresses the health variables as a function of its determinant as follows:

$$S_i = \alpha + \Sigma_k \beta_{ki} x_{ki} + \varepsilon_i \quad (3)$$

Where S_i is the health status of individual i, while $\boldsymbol{x}_k$ is a set of demographic features and socioeconomic aspects, which includes current alcohol consumption and current cigarette consumption, other demographic features and socioeconomic aspects included in the analysis such as age, material status, and education. Wealth is also a potential socioeconomic contributor, as is common practice in other studies (Nwosu & Oyenubi, 2021; Gordon et al., 2020). α is a constant, and ε_i is the error term. The decomposition CCI is thus the weighted sum of the concentration index for each health covariate. Since the weights are partial effects, the CCI can be re-written as follows:

$$CCI = 4[\Sigma(\beta_k GC_k) + GC\boldsymbol{\varepsilon}]$$

$$= 4[\,\Sigma(\beta_k \overline{x}_k CI_k) + GC\varepsilon] \quad (4)$$

Where $\overline{\boldsymbol{x}}_k$ bar and CI_k are both the average variable of $\mathbf{X}_k$ and CI, respectively, while the GC_k and $GC\varepsilon$ are the generalized concentration indices for X_k and the error term (Wagstaff et al., 2003). This allows me to estimate the contribution of lifestyle risk factors (current alcohol consumption and current cigarette consumption) to wealth-related health inequalities. The contribution of lifestyle risk factors to wealth-related health inequalities for the different health outcomes is captured by three components in the equation (4). $\beta_k \overline{x}_k$ is the elasticity of

the lifestyle risk factors to changes in the selected health outcome measure, CI_k is the wealth concentration index for the lifestyle risk factors and other covariates, and GCε is the unexplained error term. The decomposition will be performed separately for each health outcome and gender. The variables in the analysis will be weighted.

The decomposition estimation fails to produce analytical standard errors, so as described by Efron (1986), I will apply a bootstrapping technique to calculate the standard error for the absolute contribution of a factor to wealth-related health inequalities. The bootstrapping technique accounts for the sampling variability and obtains statistical inferences from the decomposition analysis results (Guan, 2003). Therefore, similar to previous studies (Mutyambizi et al., 2019; Rossouw, 2021:), a robust bootstrapping at 500 replications will be applied.

6. Results

6.1. Descriptive statistics

The descriptive statistics for males and females are presented in table 2. The mean indicates that females have a higher prevalence of NCDs than males, although males have experienced a greater prevalence of respiratory problems. The most prevalent health condition among males is respiratory problems, with a 12.6 average. In comparison, the female's most prevalent health condition is high blood pressure, with an average of 22.8. In the sample, 7.7% of males report poor health, while 11.6% of females report experiencing poor health.

A large number of people in the sample have failed to complete secondary educational attainment, and over 50% of the population for both genders have not finished secondary schooling. The table further indicates the largest population in the sample are people in the age group (15-24) for both females and males, and the least populated age group is people aged older than 75.

6.2. Concentration indices

Table 3 reports concentration indices of various health conditions, disaggregated by gender. Poor SAH status is concentrated among the poor rather than wealthier individuals, with female poor health status' concentration index (E_c = -0.075, $p < 0.05$) being higher than males' concentration index (E_c = -0.035, $p < 0.05$) of poor health status. This output suggests that the gradient is such that, on average, poor individuals report higher levels of poor health status than wealthier individuals.

Table 2: Descriptive Statistics of variables included in the analysis

	Male				Female			
Variable	Obs.	Mean	[95%conf	Interval]	Obs.	Mean	[95% conf	Interval]
Self-assessed poor health	.	.	.					
0	3857	.923	.915	.931	5381	.884	.874	.893
1	321	.077	.069	.085	706	.116	.107	.126
Diagnosed with Heart Attack	.	.	.					
0	4082	.977	.972	.981	5853	.962	.956	.968
1	96	.023	.019	.028	231	.038	.032	.044
Diagnosed with high blood pressure	.	.	.					
0	3631	.869	.859	.879	4694	.772	.758	.785
1	547	.131	.121	.141	1386	.228	.215	.242
Diagnosed with high blood cholesterol	.	.	.		.			
0	4032	.965	.960	.971	5829	.959	.952	.966
1	146	.035	.029	.040	249	.041	.034	.048
Diagnosed with Stroke	.	.	.		.			
0	4132	.989	.986	.992	5984	.983	.980	.987
1	46	.011	.008	.014	103	.017	.013	.020
Diagnosed of Diabetes	.	.	.					
0	4011	.960	.954	.966	5783	.950	.943	.956
1	167	.040	.034	.046	304	.050	.043	.057
Diagnosed of Cancer	.	.	.		.			
0	4132	.989	.985	.992	6011	.988	.985	.991
1	46	.011	.008	.015	73	.012	.009	.016
Diagnosed of Asthma	.	.	.					
0	4048	.969	.963	.974	5836	.959	.953	.966
1	130	.031	.026	.037	250	.041	.034	.047
Diagnosed with Chronic Bronchitis	.	.	.					
0	4124	.987	.983	.990	5990	.984	.980	.988
1	54	.013	.010	.017	97	.016	.013	.019
Have respiratory problems	.	.	.		.			
0	3614	.874	.864	.884	5478	.900	.890	.909
1	564	.126	.115	.136	609	.100	.091	.110
Comorbidity								
0	3802	.913	.904	.921	5277	.870	.859	.880
1	376	.087	.079	.096	789	.130	.120	.140

Table 2: Descriptive statistics of variables included in the analysis (*continued*)

	Male				Female			
Variable	Obs.	Mean	[95%conf	Interval]	Obs.	Mean	[95% conf	Interval]
Wealth								
Poor	773	.185	.173	.197	1157	.190	.178	.202
Poorest	827	.198	.186	.210	1144	.188	.176	.200
Middle	890	.213	.200	.225	1230	.202	.190	.215
Rich	827	.198	.185	.210	1248	.205	.192	.219
Richest	861	.206	.194	.218	1303	.214	.200	.229
Educational attainment								
No education	213	.051	.045	.058	487	.080	.072	.088
Incomplete primary	464	.111	.101	.120	657	.108	.098	.117
Complete primary	209	.050	.044	.057	286	.047	.041	.054
Incomplete Secondary	1922	.460	.445	.475	2678	.440	.424	.456
Complete secondary	898	.215	.203	.228	1327	.218	.204	.232
Higher	472	.113	.103	.122	651	.107	.096	.117
Alcohol consumption	.	.	.			.		
0	1934	.463	.448	.478	4967	.816	.803	.828
1	2244	.537	.522	.552	1120	.184	.172	.197
Cigarette Consumption	.	.	.					
0	3004	.719	.705	.732	5764	.947	.940	.954
1	1174	.281	.268	.295	323	.053	.046	.060
AGE								
15 -24	1237	.296	.282	.310	1424	.234	.220	.248
25-34	961	.230	.217	.243	1388	.228	.214	.242
35-44	740	.177	.165	.188	1017	.167	.155	.189
45-54	485	.116	.107	.126	858	.141	.130	.152
55-64	393	.094	.085	.103	694	.114	.104	.124
65-74	230	.055	.048	.062	426	.070	.062	.078
=>75	130	.031	.026	.037	274	.045	.040	.051
Current marital status					.			
Never in union	2193	.525	.510	.541	3068	.504	.491	.520
Married	1245	.298	.284	.312	1577	.259	.244	.273
Living with partner	435	.104	.095	.113	597	.098	.087	.108
Widowed	108	.026	.021	.030	572	.094	.086	.102
Divorced	63	.015	.011	.019	116	.019	.015	.024
Separated	134	.032	.026	.037	164	.027	.022	.032

The findings from the remaining concentration indices differ across health conditions, and there is no consistent pattern. For males, high blood pressure (E_c= 0.130, $p < 0.05$), high blood cholesterol (E_c= 0.063, $p < 0.05$), and diabetes (E_c = 0.052, $p <0.05$), are statistically significantly likely to be more concentrated among the wealthier individuals. While for females, high blood pressure (E_c = 0.087, $p < 0.05$), high blood cholesterol (E_c = 0.075, $p < 0.05$), and diabetes (E_c = 0.044, $p < 0.05$) are statistically significantly likely to be more concentrated among wealthier individuals. In addition, cancer (E_c = 0.014, $p < 0.05$), asthma (E_c = 0.013, $p < 0.05$) and chronic bronchitis (E_c = 0.021, $p < 0.05$) are all statistically significantly concentrated among wealthier females compared to poorer females. Males experiencing respiratory problems (E_c = -0.068, $p < 0.05$) are more concentrated among the poor. The concentration index for respiratory problems is statistically non-significant among females. The comorbidity in NCDs is concentrated among the wealthier but is more so among females (E_c = 0.085, $p < 0.05$) than males (E_c = 0.070, $p < 0.05$). These findings may reflect the biased nature of self-reported diagnosed health conditions, which may determine healthcare access more than actual health.

Table 3: Erreygers' corrected concentration index, disaggregated by Males and Females

	Male		Females	
Erreygers CCI	**Index value**	**Std.error**	**Index value**	**Std.error**
Self-assessed poor health	-0.069***	0.010	-0.075***	0.011
High blood pressure	0.130***	0.016	0.087***	0.016
Heart attack	0.010	0.007	0.003	0.007
High blood cholesterol	0.063***	0.011	0.075***	0.009
Respiratory Problems	-0.068***	0.012	0.017	0.011
Stroke	0.003	0.005	0.006	0.005
Diabetes	0.052***	0.010	0.044***	0.008
Cancer	0.009	0.006	0.014**	0.004
Asthma	0.002	0.007	0.013*	0.007
Chronic bronchitis	0.005	0.006	0.021***	0.005
Comorbidity	0.070***	0.014	0.085***	0.013

Notes: index value indicates the concentration index, *** *p<.01,* ** *p<.05,* * *p<0.1*

6.3. Ordinary Least Squares Regression

Tables 4 and 5 show the ordinary least squares regression results of various health outcomes onto the covariates in the analysis, disaggregated by gender for males (table 4) and females (table 5). Alcohol consumption for males is statistically significant and positively associated with respiratory problems (Coeff = 0.019, SE = 0.011) and negatively associated with diabetes (Coeff = -0.016. SE = 0.006). At the same time, female's alcohol consumption reflects a statistically significantly positive association with being diagnosed with high blood

cholesterol (Coeff = 0.015. SE= 0.006) and respiratory problems (Coeff = 0.055. SE = 0.010).

Current cigarette consumption reflects a statistically significantly negative relationship with high blood pressure (Coeff = -0.020. SE = 0.011) and a positive relationship with males' respiratory problems (Coeff = 0.050. SE = 0.012). For females, cigarette consumption has a positive relationship with having respiratory problems (Coeff = 0.051. SE = 0.017) and having comorbidities (Coeff = 0.040. SE = 0.019).

Poor SAH status reflects a significantly positive association with all age categories. The eldest age categories (aged (65-74) and aged (=>75)) have a more prominent association, and females indicate a more substantial relationship than males. In terms of wealth, males in the poorest (Coeff = 0.109. SE = 0.016) and poor (Coeff = 0.060. SE = 0.015) wealth quintiles are more likely to report a poor SAH status relative to the richest quintile. While, for females, being in the poorest (Coeff = 0.074. SE = 0.016) and middle (Coeff = 0.067. SE = 0.014) wealth quintiles is strongly associated with poor SAH status compared to being in the richest quintile.

The age and wealth categories have statistically significant associations with various health outcomes. For comorbidities, being within the age categories of 64 – 74 years (Coeff = 0.301. SE = 0.022) and being 75 years and older (Coeff = 0.286. SE = 0.028) increases being diagnosed with comorbidities relative to being in the youngest category (age 15 -24). This is consistent for females as the highest contributors to comorbidity diagnoses is being within the age category 64 -74 years (Coeff = 0.315. SE = 0.020) and category 75 years and older (Coeff = 0.311. SE = 0.024), compared to being in the youngest category (15 – 24). However, for wealth, being in the poor (Coeff = -0.071. SE = 0.015) and middle (Coeff = -0.059. SE = 0.015) wealth quintiles have the largest negative association with having comorbidities for males, relative to being in the richest wealth quintile. Similarly, being in the poorest (Coeff = -0.056. SE = 0.015) and poor (Coeff = -0.053. SE = 0.015) wealth quintiles have the largest negative association with comorbidities for females relative to being in the richest wealth quintile.

Marital status for males indicates that being married is significant and negatively association with poor SAH status (Coeff = -0.033. SE = 0.013), respiratory problems (Coeff = -0.034. SE = 0.016), and cancer (Coeff = -0.008. SE = 0.005), and a positive association with high blood pressure (Coeff = 0.026. SE = 0.014). For females, being married (compared to never being

in a union) is more associated high blood pressure (Coeff = 0.042. SE = 0.013) and diabetes (Coeff = 0.013. SE = 0.007), and less likely to report poor SAH status (-0.038. SE = 0.011).

Table 4: Male OLS regression

VARIABLE	Poor self-assessed health (SAH)	High blood pressure	High blood cholesterol	Respiratory problems	Diabetes	Cancer	Chronic bronchitis	Comorbidity
Current alcohol consumption	0.014	-0.002	-0.000	0.019*	-0.016***	-0.001	-6.740	-0.006
	(0.009)	(0.010)	(0.005)	(0.011)	(0.006)	(0.003)	(0.004)	(0.009)
Current cigarette consumption	0.011	-0.020*	-0.007	0.051***	-0.011	0.005	-0.004	-0.006
	(0.010)	(0.011)	(0.006)	(0.012)	(0.007)	(0.004)	(0.004)	(0.010)
AGE								
Age (15-24)	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Age (25-34)	0.029**	0.026*	-0.005	0.012	0.002	-0.004	-0.003	0.008
	(0.012)	(0.014)	(0.007)	(0.016)	(0.009)	(0.004)	(0.005)	(0.012)
Age (35-44)	0.027*	0.074***	0.004	0.006	0.017	-0.001	0.002	0.012
	(0.015)	(0.017)	(0.009)	(0.019)	(0.010)	(0.005)	(0.006)	(0.015)
Age (45-54)	0.111***	0.184***	0.026**	0.042**	0.064***	0.012*	0.009	0.095***
	(0.017)	(0.019)	(0.010)	(0.021)	(0.012)	(0.006)	(0.007)	(0.017)
Age (55-64)	0.157***	0.298***	0.063***	0.086***	0.101***	0.007	0.022***	0.184***
	(0.019)	(0.022)	(0.012)	(0.024)	(0.014)	(0.007)	(0.008)	(0.019)
Age (65-74)	0.197***	0.458***	0.092***	0.154***	0.158***	0.034***	0.021**	0.301***
	(0.0222)	(0.025)	(0.013)	(0.028)	(0.016)	(0.008)	(0.010)	(0.022)
Age (=>75)	0.229***	0.368***	0.070***	0.155***	0.152***	0.036***	0.041***	0.286***
	(0.028)	(0.032)	(0.017)	(0.036)	(0.020)	(0.010)	(0.012)	(0.028)
Current Marital Status								
Never in union	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Married	-0.033**	0.026*	0.011	-0.034**	0.013	-0.008*	0.001	0.014
	(0.013)	(0.015)	(0.008)	(0.016)	(0.009)	(0.005)	(0.006)	(0.013)
Living with Partner	-0.022	0.017	0.012	0.009	-0.007	-0.005	0.010	0.026*
	(0.015)	(0.018)	(0.009)	(0.020)	(0.011)	(0.006)	(0.007)	(0.015)
Widowed	0.005	-0.0382	-0.019	-0.006	-0.013	0.027***	0.010	-0.049*
	(0.028)	(0.032)	(0.017)	(0.036)	(0.020)	(0.010)	(0.012)	(0.028)
Divorced	-0.017	0.109**	0.021	-0.055	0.005	-0.003	0.013	0.044
	(0.037)	(0.043)	(0.022)	(0.047)	(0.026)	(0.013)	(0.016)	(0.037)
Separated	0.020	-0.014	0.011	0.046	-0.006	-0.005	-0.013	0.003
	(0.026)	(0.029)	(0.015)	(0.033)	(0.018)	(0.009)	(0.011)	(0.026)

Table 4: Male OLS regression (*Continued*)

VARIABLE	Poor self-assessed health (SAH)	High blood pressure	High blood cholesterol	Respiratory problems	Diabetes	Cancer	Chronic bronchitis	Comorbidity
Wealth								
Poorest	0.109***	-0.097***	-0.046***	0.109***	-0.036***	-0.009	0.004	-0.050***
	(0.016)	(0.018)	(0.010)	(0.020)	(0.011)	(0.006)	(0.007)	(0.016)
Poor	0.060***	-0.079***	-0.049***	0.049**	-0.046***	-0.006	-0.008	-0.071***
	(0.015)	(0.017)	(0.009)	(0.019)	(0.011)	(0.005)	(0.007)	(0.015)
Middle	0.056***	-0.054***	-0.058***	0.052***	-0.041***	-0.010*	-0.009	-0.059***
	(0.015)	(0.017)	(0.009)	(0.019)	(0.010)	(0.005)	(0.006)	(0.015)
Richer	0.031**	-0.014	-0.037***	0.013	-0.025**	-0.010*	-0.005	-0.036**
	(0.015)	(0.017)	(0.009)	(0.019)	(0.010)	(0.005)	(0.006)	(0.015)
Richest	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Educational attainment								
No education	0.071***	0.013	-0.046***	0.046	-0.058***	0.005	-0.003	-0.025
	(0.024)	(0.027)	(0.014)	(0.030)	(0.017)	(0.008)	(0.010)	(0.024)
Incomplete	0.070***	0.058***	-0.024**	0.022	-0.028**	-0.001	0.006	0.024
Primary	(0.020)	(0.023)	(0.012)	(0.025)	(0.014)	(0.007)	(0.008)	(0.020)
Complete	0.038	0.025	-0.009	0.034	-0.009	-0.010	-0.001	0.040*
Primary	(0.023)	(0.026)	(0.014)	(0.029)	(0.016)	(0.008)	(0.010)	(0.023)
Incomplete	0.038**	0.033*	-0.016*	0.022	0.002	-0.003	-0.002	0.021
Secondary	(0.016)	(0.018)	(0.010)	(0.020)	(0.011)	(0.005)	(0.007)	(0.016)
Complete	0.001	0.017	-0.018*	0.007	-0.009	-0.002	-0.002	0.008
Secondary	(0.017)	(0.019)	(0.010)	(0.021)	(0.012)	(0.006)	(0.007)	(0.017)
Higher	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Constant	-0.062***	0.046**	0.067***	0.022	0.054***	0.016**	0.013	0.058***
	(0.018)	(0.020)	(0.011)	(0.023)	(0.013)	(0.006)	(0.008)	(0.018)
Observations	4,178	4,178	4,178	4,178	4,178	4,178	4,178	4,178
R-squared	0.090	0.208	0.059	0.037	0.084	0.020	0.015	0.126

Notes: standard deviation in brackets, ****** p<.01, ** p<.05, * p<0.1***

Table 5: Female OLS regression

VARIABLES	Poor self-assessed health (SAH)	High blood pressure	High blood cholesterol	Respiratory problems	Diabetes	Cancer	Chronic bronchitis	Comorbidity
Current alcohol	0.014	0.016	0.015**	0.055***	-0.009	0.006	0.003	0.012
Consumption	(0.011)	(0.013)	(0.006)	(0.010)	(0.007)	(0.004)	(0.004)	(0.011)
Current	0.024	-0.016	-0.013	0.051***	0.007	0.009	-0.004	0.040**
cigarette consumption	(0.019)	(0.022)	(0.010)	(0.017)	(0.013)	(0.006)	(0.007)	(0.019)
AGE								
Age (15-24)	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Age (25-34)	0.033***	0.052***	0.003	-0.001	0.003	8.230	-0.001	0.0158
	(0.013)	(0.015)	(0.007)	(0.012)	(0.008)	(0.004)	(0.005)	(0.013)
Age (35-44)	0.082***	0.134***	0.012	0.021	0.023**	0.015***	0.002	0.043***
	(0.014)	(0.017)	(0.008)	(0.013)	(0.009)	(0.005)	(0.005)	(0.014)
Age (45-54)	0.126***	0.299***	0.036***	0.051***	0.061***	0.014***	0.012**	0.149***
	(0.015)	(0.018)	(0.008)	(0.014)	(0.010)	(0.005)	(0.006)	(0.015)
Age (55-64)	0.185***	0.452***	0.074***	0.076***	0.121***	0.022***	0.030***	0.261***
	(0.017)	(0.020)	(0.009)	(0.016)	(0.011)	(0.006)	(0.007)	(0.017)
Age (65-74)	0.193***	0.515***	0.115***	0.112***	0.149***	0.0106	0.0305***	0.315***
	(0.020)	(0.024)	(0.011)	(0.019)	(0.014)	(0.007)	(0.008)	(0.020)
Age (=>75)	0.302***	0.541***	0.090***	0.076***	0.110***	0.027***	0.045***	0.311***
	(0.024)	(0.028)	(0.013)	(0.022)	(0.016)	(0.008)	(0.009)	(0.024)
Current marital status								
Never in union	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Married	-0.038***	0.042***	0.008	-0.001	0.013*	0.003	0.006	0.017
	(0.011)	(0.013)	(0.006)	(0.010)	(0.007)	(0.004)	(0.004)	(0.011)
Living with	0.010	0.049***	0.007	0.023*	-0.007	0.001	0.000	0.035**
Partner	(0.015)	(0.018)	(0.008)	(0.014)	(0.010)	(0.005)	(0.006)	(0.015)
Widowed	-0.022	0.049**	-0.020**	0.032**	-0.000	0.001	-0.003	0.011
	(0.016)	(0.019)	(0.009)	(0.015)	(0.011)	(0.005)	(0.006)	(0.016)
Divorced	-0.027	-0.019	0.029*	-0.009	-0.028	-0.003	-0.002	0.010
	(0.031)	(0.036)	(0.017)	(0.029)	(0.021)	(0.010)	(0.012)	(0.031)
Separated	0.036	0.078***	-0.020	0.008	0.005	-0.013*	0.008	0.037
	(0.024)	(0.028)	(0.013)	(0.022)	(0.016)	(0.008)	(0.009)	(0.024)

Table 5: Female OLS regression (*continued*)

VARIABLES	Poor self-assessed health (SAH)	High blood pressure	High blood cholesterol	Respiratory problems	Diabetes	Cancer	Chronic bronchitis	Comorbidity
Wealth								
Poorest	0.074***	-0.059***	-0.068***	0.011	-0.040***	-0.008	-0.015**	-0.056***
	(0.016)	(0.018)	(0.009)	(0.014)	(0.010)	(0.005)	(0.006)	(0.015)
Poor	0.065***	-0.035**	-0.075***	0.014	-0.027***	-0.012**	-0.019***	-0.053***
	(0.015)	(0.018)	(0.008)	(0.014)	(0.010)	(0.005)	(0.006)	(0.015)
Middle	0.067***	0.020	-0.061***	0.029**	-0.033***	-0.006	-0.011**	-0.014
	(0.014)	(0.017)	(0.008)	(0.013)	(0.010)	(0.005)	(0.005)	(0.014)
Richer	0.042***	0.032*	-0.037***	0.032**	-0.002	-0.002	-0.008	0.011
	(0.014)	(0.017)	(0.008)	(0.013)	(0.009)	(0.005)	(0.005)	(0.014)
Richest	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Educational attainment								
No Education	0.140***	0.044*	-0.014	-0.006	-0.013	-0.012*	-0.014*	-0.032
	(0.022)	(0.026)	(0.012)	(0.020)	(0.015)	(0.007)	(0.008)	(0.022)
Incomplete	0.100***	0.073***	-0.008	0.017	0.002	-0.008	-0.009	0.007
Primary	(0.020)	(0.023)	(0.011)	(0.018)	(0.013)	(0.007)	(0.008)	(0.020)
Complete	0.114***	0.077***	0.012	0.029	0.007	-0.009	0.005	0.029
Primary	(0.024)	(0.028)	(0.013)	(0.022)	(0.016)	(0.008)	(0.009)	(0.024)
Incomplete	0.058***	0.084***	0.013	0.013	0.008	-0.006	0.002	0.029*
Secondary	(0.016)	(0.018)	(0.009)	(0.014)	(0.010)	(0.005)	(0.006)	(0.016)
Complete	0.029*	0.037*	-0.001	-0.002	-0.012	-0.004	-0.001	-0.003
Secondary	(0.017)	(0.019)	(0.009)	(0.015)	(0.011)	(0.006)	(0.006)	(0.016)
Higher	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Constant	-0.070***	-0.038*	0.048***	0.021	0.026**	0.012**	0.016**	0.025
	(0.018)	(0.021)	(0.010)	(0.017)	(0.012)	(0.006)	(0.007)	(0.018)
Observations	6,087	6,080	6,078	6,087	6,087	6,084	6,087	6,066
R-squared	0.101	0.234	0.063	0.028	0.068	0.011	0.016	0.126

Notes: standard deviation in brackets, ****** p<.01, ** p<.05, * p<0.1***

6.4. The Wagstaff et al. decomposition

Wagstaff et al. decomposition results are presented in tables 6 and 7, disaggregated by gender. The Wagstaff et al. decomposition summarises percentage contributions, elasticities and concentration indices of current alcohol consumption, current cigarette consumption, and covariates to observed wealth-related health inequalities. The elasticity indicates the sensitivity of health conditions to changes in covariates. A positive elasticity means that individuals with these characteristics are more likely to be diagnosed with a specific health condition.

The percentage contribution may take a positive or negative sign. Given a negative concentration index of the health condition, each covariate's negative (positive) contribution implies that the covariate is associated with making the health outcome more (less) concentrated on the poor than would have otherwise been the case. Another way to understand these contributions to wealth-related health inequalities is that given a negative concentration index, and a covariate's negative (positive) contribution is removed, and the covariate is equalized across wealth quintiles, inequalities will decrease (increase) *ceteris paribus*.

6.4.1. The Wagstaff et al. decomposition for males

I begin by analysing the contribution of lifestyle risk factors to the health outcome variables with negative concentration indices. These are health outcomes that are concentrated among the poor. Current alcohol consumption contributes positively (0.066%) to poor SAH status, thereby widens inequalities in wealth-related poor SAH status and implying that when alcohol consumption is equalised across all wealth quintile groups, wealth-related inequalities in poor SAH status will decrease, although the contribution is small and statistically insignificant. The wealth-related inequalities in respiratory problems (-4.199%) significantly narrows with the contribution of alcohol consumption. Cigarette consumption percentage contributions are relatively small to health conditions and statistically insignificant. However, when removing the negatively and statistically significant contribution of cigarette consumption on poor SAH status then, wealth-related health inequalities reduce. These percentage contributions increase inequalities in poor SAH (-0.488%).

Next, I analyse the contribution of lifestyle risk factors to the remaining health variables concentrated among the wealthy. Alcohol consumption contributes negatively (-4.716%) towards diabetes and is concentrated among wealthier individuals, implying that when the

contribution of alcohol is equalised across all wealth quintiles, wealth-related inequalities in diabetes will increase among males. The positive contribution of alcohol consumption to high blood pressure (1.135%) increases wealth-related inequalities, and these inequalities would decrease if the contribution of alcohol consumption is removed.

For other health conditions that are concentrated among wealthier males, if the contribution of cigarette consumption is equalled across the wealth quintiles, then wealth-related inequalities in high blood pressure (-0.570%), high blood cholesterol (-0.339%), diabetes (-0.450%), and comorbidities (-0.360%) will increase. However, the contributions of cigarette consumption are statistically insignificant.

Wealth inequalities are the highest statistically significant direct contributor to reporting poor health status. The direct contribution of being in the poorest and poor quintiles relative to the wealthier quintiles contributes (61.902%) and (29.513%), respectively. My OLS results show that the poor, on average, report higher levels of poor SAH status. In other words, when all individuals are in the poorest or poor wealth quintiles, they would report poor health status and thus reduce wealth-related health disparities in poor SAH status. The large result is consistent with incomplete secondary education completion (28.240%) relative to tertiary education.

In addition, wealth and education contributions to wealth-related inequalities in health conditions indicate large contributions. The poorest wealth quintile contributes the highest to respiratory problems (54.298%) and these contributions in high blood pressure (34.343%) increases wealth-related health inequalities. The poor wealth quintile decreases inequalities in comorbidities (27.329%) and high blood cholesterol (21.776%) the most when equalised across wealth quintiles relative to the richest quintile. At the same time, educational attainment contributions reduce wealth-related comorbidity inequalities. Incomplete secondary education contribution to comorbidities is negative (-9.815%); thus, inequalities will increase when incomplete secondary education is equalised across the wealth quintiles than higher educational attainment.

6.4.2. The Wagstaff et al. decomposition for females

The Wagstaff et al. decomposition analysis for females is reported in table 7. The contributions of lifestyle risk factors are reported, indicating that current alcohol consumption contributions are statistically significant and small to all health conditions and poor SAH status. The contributions of current alcohol consumption to health conditions indicate that the

contribution to cancer (3.892%) is the largest, and given that cancer is concentrated among the wealthy, the contribution increases wealth-related health inequalities. While the contribution of alcohol consumption increases inequalities in high blood pressure (1.963%), high blood cholesterol (1.603%), chronic bronchitis (2.942%), and comorbidities (1.783), the contributions are relatively small, and they are all positive. This indicates that when alcohol consumption is equal across wealth quintiles, it decreases inequalities in these health conditions. However, these contributions are all statistically insignificant.

The current cigarette consumption has a negative elasticity and a positive concentration index, indicating concentration among wealthier females. Similar to current alcohol consumption, the percentage contributions of current cigarette consumption to health conditions are very small. This may arise from low smoking rates among wealthier females, suggesting that these smoking rates are not significant enough to cause health conditions.

The poorest wealth quintile (47.806%) is the largest direct contributor to reporting poor health status, and wealth directly increases inequalities in poor SAH status when wealth is equally distributed. The contribution of incomplete secondary (28.396%) is the second-largest contributor to female poor SAH status inequalities. The contribution suggests that if incomplete secondary educational attainment were equal across the Wealth quintiles, inequalities would decrease in reportedly poor health.

The poorest wealth quintile contribution to inequalities in other health conditions is also the largest contributor. The poorest wealth quintile contribution directly contributes to inequalities in high blood cholesterol (45.627%), high blood pressure (42.197%), and diabetes (38.892%). The contribution of the poorest wealth quintile is concentrated among the poor population and thus needs to decrease the wealth inequalities to curb the wealth-related inequalities in these health conditions. For the other covariates like age and marital status, the contribution varies by group and has no consistent trend. The contribution of being married relative to being in union contributes to high blood pressure (6.816%) and to cancer (8.261%); these contributions are the most considerable contribution from marital status. The contribution of marriage increases the inequalities of high blood pressure and cancer health conditions. However, the contribution of being widowed decreases inequalities by a small contribution.

Table 6: Male Wagstaff decomposition

		Poor self-assessed health (SAH)	High blood pressure	High Blood cholesterol	Respiratory problems	Diabetes	Comorbidity
Current alcohol consumption	Percentage contribution	0.066	1.135***	-0.843***	-4.199***	-4.716***	-0.986***
	Elasticities	-0.000	0.026	-0.009	0.051	-0.044	-0.012
	Concentration index	0.056	0.056	0.056	0.056	0.056	0.056
Current cigarette consumption	Percentage contribution	-0.488***	-0.570	-0.339	-1.310	-0.450	-0.360
	Elasticities	0.018	-0.039	-0.011	0.046	-0.012	-0.013
	Concentration index	0.019	0.019	0.019	0.019	0.019	0.019
AGE							
AGE (15-24)		Reference	Reference	Reference	Reference	Reference	Reference
AGE (25-34)	Percentage contribution	1.520***	-1.217*	-0.364*	0.314*	-0.002*	-1.357*
	Elasticities	(0.033)	(0.049)	(0.007)	(0.007)	(0.000)	(0.030)
	Concentration index	-0.032	-0.032	-0.032	-0.032	-0.032	-0.032
AGE (35-44)	Percentage contribution	0.925***	-2.065*	-0.898*	0.748*	-1.652*	-1.379*
	Elasticities	(0.022)	(0.091)	(0.019)	(0.017)	(0.029)	(0.033)
	Concentration index	-0.029	-0.029	-0.029	-0.029	-0.029	-0.029
AGE (45-54)	Percentage contribution	-3.571***	2.629***	1.275**	-1.112**	2.692**	2.570**
	Elasticities	(0.059)	(0.082)	(0.019)	(0.018)	(0.033)	(0.043)
	Concentration index	0.042	0.042	0.042	0.042	0.042	0.042

Table 6: Male Wagstaff decomposition *(continued)*

		Poor self-assessed health (SAH)	High blood pressure	High Blood cholesterol	Respiratory problems	Diabetes	Comorbidity
AGE (55-64)	Percentage contribution	-4.292***	4.129***	2.120***	-1.968***	3.543***	4.289***
	Elasticities	(0.055)	(0.100)	(0.024)	(0.025)	(0.034)	(0.056)
	Concentration index	0.054	0.054	0.054	0.054	0.054	0.054
AGE (65-74)	Percentage contribution	-1.996***	2.148***	1.041***	-1.568***	1.840***	2.449***
	Elasticities	(0.035)	(0.071)	(0.016)	(0.027)	(0.024)	(0.043)
	Concentration index	0.039	0.039	0.039	0.039	0.039	0.039
AGE (=>75)	Percentage contribution	-0.699***	0.608**	0.249**	0.387**	0.535**	0.723**
	Elasticities	(0.022)	(0.036)	(0.007)	(0.012)	(0.013)	(0.024)
	Concentration index	0.021	0.021	0.021	0.021	0.021	0.021
Total		-8.113	6.232	3.423	-3.199	6.956	7.295
Current marital status							
Never in union		Reference	Reference	Reference	Reference	Reference	Reference
Married	Percentage contribution	12.221	2.599***	6.913***	17.041***	-1.604***	1.668***
	Elasticities	(-0.037)	(0.015)	(0.018)	(-0.50)	(-0.004)	(0.005)
	Concentration index	0.232	0.232	0.232	0.232	0.232	0.232
Living with partner	Percentage contribution	-1.548	-0.405***	-1.086***	-0.265***	1.348***	-0.762***
	Elasticities	(-0.012)	(0.006)	(0.007)	(-0.002)	(-0.008)	(0.005)
	Concentration index	-0.091	-0.091	-0.091	-0.091	-0.091	-0.091
Widowed	Percentage contribution	-0.011	-0.001	-0.004	-0.004	-0.008	-0.004
	Elasticities	(-0.002)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
	Concentration index	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004

Table 6: Male Wagstaff decomposition (*continued*)

		Poor self-assessed health (SAH)	High blood pressure	High Blood cholesterol	Respiratory problems	Diabetes	Comorbidity
Divorced	Percentage contribution	-0.007***	0.037	0.012	0.009	0.021	0.045
	Elasticities	(0.001)	(0.005)	(0.001)	(-0.001)	(0.001)	(0.003)
	Concentration index	0.009	0.009	0.009	0.009	0.009	0.009
Separated	Percentage contribution	-0.020	0.009	0.003	-0.027	-0.001	0.033
	Elasticities	(-0.022)	(0.001)	(-0.000)	(-0.002)	(0.000)	(-0.003)
	Concentration index	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008
Total		10.455	2.239	5.838	16.754	-0.244	0.98
Wealth							
Poorest	Percentage contribution	61.902***	34.343***	26.004***	54.298***	26.559***	28.025***
	Elasticities	(0.071)	(-0.074)	(-0.027)	(0.061)	(-0.023)	(-0.033)
	Concentration index	-0.604	-0.604	-0.604	-0.604	-0.604	-0.604
Poorer	Percentage contribution	29.513***	18.328***	21.776***	21.283***	17.098***	27.329***
	Elasticities	(0.060)	(-0.069)	(-0.039)	(0.042)	(-0.026)	(-0.056)
	Concentration index	-0.342	-0.342	-0.342	-0.342	-0.342	-0.342
Middle	Percentage contribution	1.580***	0.720	1.484	1.332	1.079	1.241
	Elasticities	(0.063)	(-0.054)	(-0.054)	(0.052)	(-0.032)	(-0.050)
	Concentration index	-0.017	-0.017	-0.017	-0.017	-0.017	-0.017
Richer	Percentage contribution	-18.008***	-3.868***	-8.231***	-8.401***	-6.374***	-9.335 ***
	Elasticities	(0.040)	(-0.016)	(-0.016)	(0.018)	(-0.011)	(-0.021)
	Concentration index	0.308	0.308	0.308	0.308	0.308	0.308
Richest		Reference	Reference	Reference	Reference	Reference	Reference
Total		74.987	49.523	41.033	68.512	38.362	47.26

Table 6: Male Wagstaff decomposition (*continued*)

		Poor self-assessed health (SAH)	High blood pressure	High Blood cholesterol	Respiratory problems	Diabetes	Comorbidity
Educational attainments							
No education	Percentage contribution	1.691	-0.328***	0.416***	1.222	0.335***	-4.430***
	Elasticities	(0.015)	(0.006)	(-0.004)	(0.011)	(-0.002)	(0.004)
	Concentration index	-0.075	-0.075	-0.075	-0.075	-0.075	-0.075
Incomplete primary	Percentage contribution	5.835***	-2.682***	0.265*	2.240***	1.180***	-2.956***
	Elasticities	(0.033)	(0.029)	(-0.001)	(0.012)	(-0.005)	(0.017)
	Concentration index	-0.122	-0.122	-0.122	-0.122	-0.122	-0.122
Complete primary	Percentage contribution	0.728	-0.144***	-0.051***	0.163***	-0.026***	-0.803***
	Elasticities	(0.009)	(0.003)	(-0.001)	(0.002)	(0.000)	(0.011)
	Concentration index	-0.054	-0.054	-0.054	-0.054	-0.054	-0.054
Incomplete secondary	Percentage contribution	28.240*	-6.774 ***	2.243***	8.697***	-3.313***	-9.815***
	Elasticities	(0.120)	(0.054)	(-0.009)	(0.036)	(0.011)	(0.042)
	Concentration index	-0.164	-0.164	-0.164	-0.164	-0.164	-0.164
Complete secondary	Percentage contribution	2.225	2.543***	-1.818***	-0.598***	-1.240***	2.219***
	Elasticities	(-0.009)	(0.019)	(-0.007)	(0.002)	(-0.004)	(0.009)
	Concentration index	0.173	0.173	0.173	0.173	0.173	0.173
Higher		Reference	Reference	Reference	Reference	Reference	Reference
Total		38.719	-4.778	1.055	11.724	-3.064	-15.785

Notes*: standard deviation in brackets, *** p<.01, ** p<.05, * p<0.1. The results presented in this table are percentage contributions and elasticities of current alcohol contribution, current cigarette consumption, categories of age, current marital status, wealth quintiles and educational attainments to wealth-related health inequalities. The health outcomes are binary variables representing one if a responded is diagnosed by a doctor or nurse with a specific disease. The current alcohol consumption and current cigarette consumption are binary variables, with lower values indicating low consumption. The bootstrapping technique is used to calculate the standard errors and a robust bootstrapping is applied at 500 replications.

Table 7: Female Wagstaff decomposition

		Poor self-assessed health (SAH)	High blood Pressure	High blood cholesterol	Diabetes	Cancer	Chronic bronchitis	Comorbidity
Current alcohol consumption	Percentage contribution	0.576***	1.963***	1.603***	-0.787***	3.892***	2.942***	1.783***
	Elasticities	-0.004	0.015	0.011	-0.003	0.005	0.005	0.013
	Concentration index	0.114	0.114	0.114	0.114	0.114	0.114	0.114
Current cigarette consumption	Percentage contribution	-0.620***	-0.495***	-0.280***	-0.169***	0.892***	-0.409***	0.321***
	Elasticities	-0.006	-0.006	-0.003	-0.001	0.002	-0.001	0.004
	Concentration index	0.071	0.071	0.071	0.071	0.071	0.071	0.071
AGE								
AGE (15-24)		Reference	Reference	Reference	Reference	Reference	Reference	Reference
AGE (25 –34)	Percentage contribution	1.189 *	-3.145*	0.398*	-1.228*	-1.064*	0.084*	-1.288*
	Elasticities	0.032	0.100	-0.011	0.020	0.006	-0.001	0.040
	Concentration index	-0.027	-0.027	-0.027	-0.027	-0.027	-0.027	-0.027
AGE (35 -44)	Percentage contribution	-0.282	0.465	0.056	0.377	0.363	0.104	0.217
	Elasticities	0.075	0.145	0.015	0.058	0.018	0.008	0.066
	Concentration index	0.003	0.003	0.003	0.003	0.003	0.003	0.003
AGE (45 –54)	Percentage contribution	-4.932***	10.385***	1.974***	7.958***	4.901***	2.377***	6.545***
	Elasticities	0.076	0.188	0.031	0.072	0.015	0.010	0.116
	Concentration index	0.048	0.048	0.048	0.048	0.048	0.048	0.048
AGE (55 –64)	Percentage contribution	-4.421***	9.051***	1.927***	6.116***	4.450***	2.666***	5.524***

Table 7: Female Wagstaff decomposition (continued)

		Poor self-assessed health (SAH)	High blood Pressure	High blood cholesterol	Diabetes	Cancer	Chronic bronchitis	Comorbidity
	Elasticities	0.082	0.196	0.036	0.066	0.016	0.014	0.117
	Concentration index	0.040	0.040	0.040	0.040	0.040	0.040	0.040
AGE (65 –74)	Percentage contribution	-2.208***	4.770***	1.072***	3.398***	1.806***	1.432***	3.121***
	Elasticities	0.051	0.130	0.025	0.046	0.008	0.009	0.823
	Concentration index	0.032	0.032	0.032	0.032	0.032	0.032	0.032
AGE (=>75)	Percentage contribution	0.226	-0.420	-0.085	-0.238	-0.175	-0.147	-0.265
	Elasticities	0.043	-0.420	0.016	0.026	0.006	0.007	0.057
	Concentration index	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004
Total		-10.434	21.106	5.342	16.383	10.281	6.516	13.854
Current Marital status								
Never in union		Reference	Reference	Reference	Reference	Reference	Reference	Reference
Married	Percentage contribution	11.794***	6.816***	0.844***	3.109***	8.261***	4.932***	4.101***
	Elasticities	-0.047	0.032	0.003	0.007	0.006	0.005	0.019
	Concentration index	0.187	0.187	0.187	0.187	0.187	0.187	0.187
Living with partner	Percentage contribution	0.154***	-2.037***	-0.077***	1.482***	0.857***	1.713***	-1.337***
	Elasticities	0.001	0.022	0.001	-0.008	-0.002	-0.004	0.014
	Concentration index	-0.079	-0.079	-0.079	-0.079	-0.079	-0.079	-0.079
Widowed	Percentage contribution	-0.379***	-0.227***	0.237***	-0.069***	-0.307***	0.180***	0.019***
	Elasticities	-0.010	0.007	-0.006	0.001	0.002	-0.001	-0.001
	Concentration index	-0.028	-0.028	-0.028	-0.028	-0.028	-0.028	-0.028
Divorced	Percentage contribution	0.062***	-0.044***	0.033***	-0.128***	0.082***	-0.025***	0.001***
	Elasticities	-0.002	-0.002	0.001	-0.003	0.001	-0.000	0.000

Table 7: Female Wagstaff decomposition *(continued)*

		Poor self-assessed health (SAH)	High blood Pressure	High blood cholesterol	Diabetes	Cancer	Chronic bronchitis	Comorbidity
	Elasticities	-0.002	-0.002	0.001	-0.003	0.001	-0.000	0.000
	Concentration index	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Separated	Percentage contribution	0.000	-0.002	0.001	0.000	0.000	-0.000	-0.001
	Elasticities	0.001	0.009	-0.003	0.002	0.000	-0.000	0.004
	Concentration index	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
Total		11.631	4.506	1.038	4.394	8.898	6.8	2.783
Wealth quintiles								
Poorest	Percentage contribution	47.806***	42.197***	45.627***	38.893***	7.425***	30.921***	31.426***
	Elasticities	0.058	-0.060	-0.056	-0.028	-0.002	-0.010	-0.043
	Concentration index	-0.616	-0.616	-0.616	-0.616	-0.616	-0.616	-0.616
Poor	Percentage contribution	22.778***	9.876***	23.225***	13.655***	17.679***	25.143***	12.682***
	Elasticities	0.053	-0.027	-0.054	-0.018	-0.008	-0.016	-0.033
	Concentration index	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Middle	Percentage contribution	2.396***	0.082***	1.611***	1.525***	-0.495***	0.535***	0.331***
	Elasticities	0.054	-0.002	-0.037	-0.020	0.002	-0.003	-0.008
	Concentration index	0.301	0.301	0.301	0.301	0.301	0.301	0.301
Rich	Percentage contribution	-16.790***	4.949***	-5.958***	3.698***	4.086***	-4.498***	5.689***
	Elasticities	0.042	0.014	-0.015	0.005	0.002	-0.001	0.016
	Concentration index	0.672	0.672	0.672	0.672	0.672	0.672	0.672
Richest		Reference	Reference	Reference	Reference	Reference	Reference	Reference
Total		56.19	57.104	64.505	57.771	28.695	52.101	50.128
Educational attainments								
No education	Percentage contribution	5.917***	-2.703***	0.032***	-0.172***	3.013***	0.746***	0.410***

	Elasticities	0.043	0.023	-0.000	0.001	-0.004	-0.001	0.004

Table 7: Female Wagstaff decomposition *(Continued)*

		Poor self-assessed health (SAH)	High blood Pressure	High blood cholesterol	Diabetes	Cancer	Chronic bronchitis	Comorbidity
	Concentration index	-0.103	-0.103	-0.103	-0.103	-0.103	-0.103	-0.103
Incomplete primary	Percentage contribution	7.998***	-3.838***	-0.104***	-1.032***	2.318***	1.181***	-0.764***
	Elasticities	0.055	0.031	0.001	0.004	-0.003	-0.002	0.006
	Concentration index	0.108	0.108	0.108	0.108	0.108	0.108	0.108
Complete primary	Percentage contribution	1.475**	-0.717***	-0.081***	-0.040***	0.493***	-0.384***	0.254***
	Elasticities	0.029	0.016	0.002	0.000	0.493	0.002	0.006
	Concentration index	-0.038	-0.038	-0.038	-0.038	-0.038	-0.038	-0.038
Incomplete secondary	Percentage contribution	28.396***	-18.994***	-2.771***	-2.608***	7.470***	-1.366***	-3.739***
	Elasticities	0.181	0.141	0.018	0.010	-0.009	0.002	0.027
	Concentration index	-0.118	-0.118	-0.118	-0.118	-0.118	-0.118	-0.118
Complete secondary	Percentage contribution	-11.395***	4.414***	-4.029***	-4.443***	-1.233***	-0.460***	-2.110***
	Elasticities	0.055	0.025	-0.019	-0.012	-0.001	-0.001	-0.011
	Concentration index	0.156	0.156	0.156	0.156	0.156	0.156	0.156
Higher		Reference	Reference	Reference	Reference	Reference	Reference	Reference
Total		32.391	-21.838	-6.953	-8.295	12.061	-0.283	-5.949

Notes: standard deviation in brackets, **** p<.01, ** p<.05, * p<0.1.* The results presented in this table are percentage contributions and elasticities of current alcohol contribution, current cigarette consumption, categories of age, current marital status, wealth quintiles, and educational attainments to wealth-related health inequalities. The health outcomes are binary variables representing one if a respondent is diagnosed by a doctor or nurse with a specific disease. The current alcohol consumption and current cigarette consumption are binary variables, with lower values indicating low consumption. The bootstrapping technique is used to calculate the standard errors and a robust bootstrapping is applied at 500 replications.

7. Discussion

This research report aims to investigate the contribution of current alcohol consumption and current cigarette consumption to wealth-related inequalities in health.

Firstly, this research report seeks to present evidence on the concentration of poor SAH status and specific NCDs among wealth groups in South Africa for both males and females. I use the South African DHS 2016, a nationally representative household survey data which collects information on both health and socioeconomic outcomes. Secondly, I decompose the concentration index to establish the contribution of current alcohol consumption and current cigarette consumption to wealth-related inequalities in health outcomes.

The concentration index findings indicate that the burden of morbidity is statistically significantly concentrated among individuals in wealthier quintiles for several health outcomes, except respiratory problems, which is significantly concentrated among lower wealth quintiles for males. Similar to Vellakkal et al. (2015), the burden of diseases is mostly concentrated among wealthier individuals in South Africa and other LMICs (Yaya et al., 2018). This trend has been observed in other LMICs; Kunna et al. (2017) found single morbidity and multimorbidity concentrated among wealthier individuals in Ghana.

Various factors contribute to NCDs being more concentrated among wealthier individuals. Firstly, access to healthcare. Studies in LMICs found socioeconomic inequalities in accessing healthcare to be a major factor in reporting NCDs (Biswas et al., 2016; Vellakkal et al., 2013). Access to healthcare explains inequities in healthcare outcomes; wealthier households are more likely to be located around a 10km radius of a healthcare facility than poor households and have the advantage of affording medical insurance that improves their access to healthcare (Gordon et al., 2020). This allows wealthier individuals to know their health diagnoses and health status better than poor households. This is consistent with the assertion that wealthier individuals report more prevalence of NCDs relative to poor individuals.

Different from inequalities in self-reported NCDs, health inequalities in poor SAH status are significantly concentrated among poor individuals. These pro-poor inequalities in poor SAH status indicate the social gradient. This result is consistent with numerous studies in South Africa (Alaba & Chola, 2014; Gordon et al., 2020; Omotoso & Koch, 2018; Umuhoza & Ataguba, 2018), finding that poor SAH status is concentrated among poor individuals relative to wealthier individuals. Several factors contribute to the socioeconomic inequalities in poor

SAH status. Factors exacerbating poor SAH status among poor individuals relative to wealthier individuals is that poor individuals are more likely to postpone getting healthcare treatment and not receiving healthcare treatment (Gordon et al., 2020). McIntyer et al. (2009) found that affordability and the distance to healthcare facilities are reasons for poor individuals postponing receiving treatment. Harris et al. (2020) further found that poor respondents declare themselves not sick enough to receive treatment.

In addition, it is likely that these inequalities in poor SAH status are underestimated due to reporting heterogeneity. The subjective measure (SAH) of health status is prone to biased estimation from individuals in different SES groups. Rossouw et al. (2018) show that the poor are likely to underestimate their poor health relative to wealthier individuals. This could be due to a range of reasons, including different reference groups between the poor and the non-poor.

Socioeconomic inequalities in poor SAH status may be partially explained by inequalities in the structural determinants of SES (such as educational attainment, wealth, and occupation) and intermediate determinants (such as behavioural factors) of health as captured in the SDH framework. The socioeconomic inequalities in South Africa are vast and known as the most unequal in the world (Bhorat & Van der Westhuizen, 2010; Sulla et al., 2022). Changes in poor SAH inequalities may be attributed to the changes in structural and intermediate determinants of health as explained within the context of the SDH framework (Omotoso & Koch, 2018), which exacerbate poor SAH among people with low SES, signifying the influence of social and economic factors on an individual`s health status. Thereby signalling that the health sector`s external factors have an important impact on health status (Umuhoza & Ataguba, 2018).

Identifying the factors that impact inequalities in health status, the Wagstaff decomposition reveals that some socioeconomic and demographic factors, including wealth, educational attainment, marital status, and age, contribute to wealth-related health inequalities and poor health status. The decomposition analysis reveals that wealth inequalities are a major determinant of health, as the results indicate that the poorest and the poor wealth quintiles are the main direct contributors to wealth-related inequalities in health conditions. This is in line with previous studies that have found similar results for wealth inequalities in LMICs (Gu et al., 2019) and HICs (Gravelle & Sutton, 2003).

Wealth inequalities create inequalities in access to healthcare and health conditions. Individuals in the poorest and poor wealth quintiles predominantly use public hospitals (McIntyre et al., 2006). The transportation costs and distance to public hospitals are barriers to accessing healthcare (Gordon et al., 2020). However, transportation costs and physical access to health is not the only barrier to accessing healthcare in South Africa. Burger and Christian (2020) write that public hospitals are often characterised by problems such as old infrastructure, poor disease control and prevention practices, and poor-quality care services relative to private hospitals. Those accessing public healthcare facilities are likely to receive poorer quality care, putting them at a significant health disadvantage relative to their wealthier counterparts. Naledi et al. (2011) further stated that there is a gap between policy formulation and implementation in the public healthcare sector, and many interventions fail because of poor healthcare sector infrastructure (Naledi et al., 2011).

In addition to wealth inequalities, lifestyle differences contribute to NCDs' inequalities. The findings from the results section are summarised below.

For the males' analysis where the health outcomes had a negative CI (i.e., the health outcomes were concentrated among the poor), I found the following statistically significant findings.

Poor SAH status

- Current cigarette consumption: There is a small and negative percentage contribution (-0.488) to wealth-related inequalities in poor SAH status. This implies that the percentage contribution of current cigarette consumption increases the wealth-related inequalities in poor SAH status.

Respiratory problems

- Current alcohol consumption: The negative percentage contribution (-4.199) on wealth-related inequalities in respiratory problems implies that current alcohol consumption decreases the wealth-related gap. Alternatively, when the percentage contribution of current alcohol consumption is removed, then inequalities in respiratory problems will decrease.

For the males' analysis where the health outcomes had a positive CI (i.e., the health outcomes were concentrated among the wealthy), I found the following statistically significant findings.

High blood pressure

- Current alcohol consumption: The variable contributes positively (1.135) to the wealth-related gap in high blood pressure. The percentage contribution of current alcohol consumption increases the wealth-related gap in high blood pressure. However, when the positive contributions of current alcohol consumption are removed, then wealth-related inequalities in high blood pressure will decrease.

High blood cholesterol

- Current alcohol consumption: The percentage contribution (-0.843) to the wealth-related gap in high blood cholesterol. This implies that the percentage contributions of current alcohol consumption decrease the wealth-related gap in high blood cholesterol.

Diabetes

- Current alcohol consumption: The percentage contribution (-4.716), contributes negatively to the wealth-related gap in diabetes, thereby decreasing the wealth-related gap in diabetes. When the percentage contribution of current alcohol consumption is removed, then the wealth-related inequalities in diabetes will increase.

Comorbidities

- Current alcohol consumption: The percentage contribution (-0.986) of current alcohol consumption to comorbidities is negative and thereby decreases the wealth-related inequalities in comorbidities. Implying that when the percentage contributions of current alcohol consumption are equalized across wealth quintiles, then the wealth-related inequalities in comorbidities will increase.

For the female analysis where the health outcomes had a negative CI (i.e., health outcomes are concentrated among the poor), I found the following statistically significant findings.

Poor SAH status

- Current alcohol consumption: The percentage contribution (0.576) of current alcohol consumption positively contributes to the wealth-related inequalities in poor SAH status. Suggesting that the contributions of current alcohol consumption widens the wealth-related inequalities in poor SAH status closer to zero.

- Current cigarette consumption: The negative percentage contribution (-0.620) of current cigarette consumption contributes to the wealth-related gap in poor SAH status. This implies that current cigarette consumption contributions decrease wealth-related inequalities in poor SAH.

For the female analysis where health outcomes had a positive CI (i.e., health outcomes concentrated among the rich), I found the following statistically significant findings.

High blood pressure

- Current alcohol consumption: The positive percentage contribution (1.963) of current alcohol consumption contributes to the wealth-related gap in high blood pressure implying that current alcohol consumption percentage contributions increase wealth-related inequalities in high blood pressure.
- Current cigarette consumption: The negative percentage contribution (-0.496) of current cigarette consumption contributes to the wealth-related gap in high blood pressure. This implies that current cigarette consumption percentage contributions reduce the wealth-related inequalities in high blood pressure.

High blood cholesterol

- Current cigarette consumption: The positive percentage contributions (1.603) of current alcohol consumption to the wealth-related gap in high blood cholesterol implies that these contributions increase the wealth-related inequalities in high blood cholesterol.
- Current cigarette consumption: The negative percentage contributions (-0.280) of current cigarette consumption to the wealth-related inequalities in high blood cholesterol imply that cigarette consumption reduces the wealth-related inequalities in high blood pressure closer to zero.

Diabetes

- Current alcohol consumption: The percentage contribution (-0.787) of current alcohol consumption negatively contributes to the health gap in diabetes. Implying that the percentage contributions of current alcohol consumption reduce the gap in diabetes outcomes.
- Current cigarette consumption: The percentage contribution (-0.169) of current cigarette consumption negatively contributes to the health gap in diabetes. Implying

that the percentage contributions of current alcohol consumption reduce the wealth-related inequalities in diabetes.

Cancer

- Current alcohol consumption: The percentage contribution (3.892) of current alcohol consumption contributes positively to the wealth gap in cancer outcomes. This implies that current alcohol consumption increases the inequalities in cancer outcomes.

- Current cigarette consumption: The percentage contribution (0.892) of current cigarette consumption positively contributes to the inequalities in cancer. This implies that current cigarette consumption increases the wealth-related inequalities in cancer.

Chronic bronchitis

- Current alcohol consumption: The positive percentage contributions (2.942) of current alcohol consumption to the wealth-related gap in chronic bronchitis indicates that current alcohol consumption increases the wealth-related inequalities in Chronic bronchitis.
- Current cigarette consumption: The negative percentage contribution (-0.409) of current cigarette consumption to the wealth-related gap in chronic bronchitis implies that current cigarette consumption reduces the wealth-related inequalities in chronic bronchitis.

Comorbidities

- Current alcohol consumption: The positive percentage contributions (1.783) of current alcohol consumption to wealth-related inequalities in comorbidities suggests that current alcohol consumption increases wealth-related inequalities in comorbidities.
- Current cigarette consumption: The percentage contribution (0.321) of current cigarette consumption is positive to wealth-related inequalities in comorbidities. This implies that the percentage contribution of cigarette consumption increases wealth-related inequalities in comorbidities.

More specifically, the following overall trends in lifestyle risk factors contributions to inequalities in NCDs were identified from these results:

- The percentage contribution of lifestyle risk factors is relatively small compared to socioeconomic and demographic factors.
- On average, the percentage contribution of current cigarette consumption to inequalities in health outcomes was small and statistically insignificant among males.
- The lifestyle risk factors are more pronounced among wealthier individuals.
- The inequalities in lifestyle risk factors are closer to zero, suggesting that inequalities are low in both genders.

In this study, I have indicated that current alcohol and current cigarette consumption have a low contribution to wealth-related health inequalities. Lifestyle risk factors are concentrated among wealthier individuals (CCIs > 0) for both genders, and the percentage contributions of alcohol and cigarette consumption to NCDs are both statistically significant for females, while males' cigarette consumption percentage contribution is statistically insignificant. Numerous studies have found alcohol and cigarette consumption in South Africa to be concentrated among the poor (Dieteren & Bonfrer, 2021; Mukong et al., 2017; Rossouw, 2021; Umuhoza & Ataguba, 2018) and contribute positively to socioeconomic inequalities (Mukong et al., 2017).

8. Limitations

There are limitations to the current study. Firstly, lifestyle risk factors, i.e., current alcohol consumption and current cigarette consumptions, are subject to underreporting bias, particularly for females. The social stigma and entrenched social norms mean that females are more likely to report fewer instances of undesired behaviours than what they are actually participating in (Lavrakas, 2008). Illicit consumption of alcohol and cigarettes may be fundamental in the behaviour, although data is rarely collected in surveys on illicit consumption (Mukong et al., 2017). This makes it challenging to study the actual behaviour of the respondents. Secondly, the objective measure, health variables are self-reported and based on doctor/nurse diagnoses. Wealthier individuals are more likely to access healthcare than poorer individuals and thus know their health diagnoses (poor individuals may have these illnesses yet are unaware). The measurement error biases the results and may not reflect the true nature of wealth-related health inequalities. Thirdly, this study is cross-sectional and measures the wealth inequalities in health at a specific time. Therefore, it fails to uncover the changes in health inequalities fully. The changes in health inequalities are essential to

understand and to what degree they have been impacted as they identify key drivers of changes in health inequalities (Omotoso & Kock, 2018).

9. Conclusion

This research paper aimed to measure the contribution of current alcohol and cigarette consumption to wealth-related inequalities in health. The inequalities in the distribution of most selected NCDs are concentrated among wealthier individuals rather than the poor. Evidence from the decomposition analysis indicates that the percentage contribution of lifestyle risk factors is relatively small compared to socioeconomic and demographic factors. The contributions of current alcohol and current cigarette consumption are considerable, although healthy lifestyle promotion alone will not reduce wealth inequalities in health. Wealth inequalities and educational attainment contributions are higher than those of alcohol and smoking. It is difficult to discern and formulate policy recommendations given the size of current alcohol and current cigarette consumption. However, other factors, such as wealth inequalities, do have a larger contribution to health inequalities. Thereby redistributing wealth towards poor individuals is likely to decrease South Africa's health inequalities at a macro level. This policy can be implemented by improving the standard of living for the less wealthy individuals. These includes improving the services delivery of essential goods such as educational infrastructure, employment opportunities, access to adequate healthcare and water and sanitation. At an individual and behavioural level, it is important to implement policies like anti-smoking campaigns advertising.

10.References

Abera, S. F., Gebru, A. A., Biesalski, H. K., Ejeta, G., Wienke, A., Scherbaum, V., & Kantelhardt, E. J. (2017). Social determinants of adult mortality from non-communicable diseases in northern Ethiopia, 2009-2015: evidence from health and demographic surveillance site. *PLoS One*, *12*(12), e0188968.

Allen, L., Williams, J., Townsend, N., Mikkelsen, B., Roberts, N., Foster, C., & Wickramasinghe, K. (2017). Socioeconomic status and non-communicable disease behavioural risk factors in low-income and lower-middle-income countries: a systematic review. *The Lancet Global Health*, *5*(3), e277-e289.

Allender, S., Lacey, B., Webster, P., Rayner, M., Deepa, M., Scarborough, P., Arambepola, C., Datta, M., & Mohan, V. (2010). Level of urbanization and noncommunicable disease risk factors in Tamil Nadu, India. *Bulletin of the World Health Organization*, *88*(4), 297–304. https://doi.org/10.2471/BLT.09.065847

Allender, S., Wickramasinghe, K., Goldacre, M., Matthews, D., & Katulanda, P. (2011). Quantifying Urbanization as a Risk Factor for Noncommunicable Disease. *Journal of Urban Health*, *88*(5), 906. https://doi.org/10.1007/s11524-011-9586-1

Amoateng, A. Y., Biney, E., & Ewemooje, O. S. (2021). Social determinants of chronic ill-health in contemporary South Africa: a social disadvantage approach. *The Social Science Journal*, 1-15.

Ataguba, J. E., Akazili, J., & McIntyre, D. (2011). Socioeconomic-related health inequality in South Africa: evidence from General Household Surveys. *International journal for equity in health*, *10*(1), 1-10.

Bago d'Uva, T., Lindeboom, M., O'Donnell, O., & Van Doorslaer, E. (2011). Education-related inequity in healthcare with heterogeneous reporting of health. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, *174*(3), 639-664.

Bambra, C., Riordan, R., Ford, J., & Matthews, F. (2020). The COVID-19 pandemic and health inequalities. *J Epidemiol Community Health*, *74*(11), 964–968. https://doi.org/10.1136/jech-2020-214401

Beard, E., Brown, J., West, R., Kaner, E., Meier, P., & Michie, S. (2019). Associations between socioeconomic factors and alcohol consumption: a population survey of adults in England. *PLoS One*, *14*(2), e0209442.

Bharmal, N., Derose, K. P., Felician, M., & Weden, M. M. (2015). Understanding the upstream social determinants of health. *California: RAND*, 1-18.

Bhorat, H., & Van der Westhuizen, C. (2010). Poverty, inequality and the nature of economic growth in South Africa. *Testing democracy: Which way is South Africa going*, *46*, 70.

Biswas, T., Islam, M. S., Linton, N., & Rawal, L. B. (2016). Socio-economic inequality of chronic non-communicable diseases in Bangladesh. *PloS one*, *11*(11), e0167140.

Bloom, D. E., Cafiero, E., Jané-Llopis, E., Abrahams-Gessel, S., Bloom, L. R., Fathima, S., ... & Weiss, J. (2012). *The global economic burden of non-communicable diseases* (No. 8712). Program on the Global Demography of Aging.

Bonfrer, I., Van de Poel, E., Grimm, M., & Van Doorslaer, E. (2014). Does the distribution of healthcare utilization match needs in Africa?. *Health Policy and Planning*, *29*(7), 921-937.

Boutayeb, A., & Boutayeb, S. (2005). The burden of non-communicable diseases in developing countries. *International journal for equity in health*, *4*(1), 1-8.

Burger, R., & Christian, C. (2020). Access to health care in post-apartheid South Africa: availability, affordability, acceptability. *Health Economics, Policy and Law*, *15*(1), 43-55.

Cavelaars, A. E. J., Kunst, A. E., Geurts, J. J., Crialesi, R., Grötvedt, L., Helmert, U., ... & Mackenbach, J. P. (2000). Educational differences in smoking: international comparison. *Bmj*, *320*(7242), 1102-1107.

Charitonidi, E., Studer, J., Gaume, J., Gmel, G., Daeppen, J. B., & Bertholet, N. (2016). Socioeconomic status and substance use among Swiss young men: a population-based cross-sectional study. *BMC public health*, *16*(1), 1-11.

Correia, J. C., Lachat, S., Lagger, G., Chappuis, F., Golay, A., & Beran, D. (2019). Interventions targeting hypertension and diabetes mellitus at community and primary healthcare level in low-and middle-income countries: a scoping review. *BMC Public Health*, *19*(1), 1-20.

Daniels, M., Donilon, T., & Bollyky, T. J. (2014). The emerging global health crisis: noncommunicable diseases in low-and middle-income countries. *Council on Foreign Relations independent task force report*, (72).

Davis, S. L., & Chapa, D. W. (2015). Social determinants of health: Knowledge to effective action for change. *The Journal for Nurse Practitioners*, *11*(4), 424-429.

Demographic and health Survey (DHS) data available and downloaded at: https://dhsprogram.com/data/dataset/South-Africa_Standard-DHS_2016.cfm?flag=0.

de Mestral, C., & Stringhini, S. (2017). Socioeconomic status and cardiovascular disease: an update. *Current cardiology reports*, *19*(11), 1-12.

Dieteren, C., & Bonfrer, I. (2021). Socioeconomic inequalities in lifestyle risk factors across low-and middle-income countries. *BMC public health*, *21*(1), 1-12.

Efron, B., & Tibshirani, R. (1986). Bootstrap methods for standard errors, confidence intervals, and other measures of statistical accuracy. *Statistical science*, 54-75.

Elsey, H., Agyepong, I., Huque, R., Quayyem, Z., Baral, S., Ebenso, B., Kharel, C., Shawon, R. A., Onwujekwe, O., Uzochukwu, B., Nonvignon, J., Aryeetey, G. C., Kane, S., Ensor, T., & Mirzoev, T. (2019). Rethinking health systems in the context of urbanisation: Challenges from four rapidly urbanising low-income and middle-income countries. *BMJ Global Health*, *4*(3), e001501. https://doi.org/10.1136/bmjgh-2019-001501

Erreygers, G. (2009). Correcting the concentration index. *Journal of health economics*, *28*(2), 504-515.

Filmer, D., & Pritchett, L. H. (2001). Estimating wealth effects without expenditure data—or tears: an application to educational enrollments in states of India. *Demography*, *38*(1), 115-132.

Gordon, T., Booysen, F., & Mbonigaba, J. (2020). Socio-economic inequalities in the multiple dimensions of access to healthcare: the case of South Africa. *BMC Public Health*, *20*(1), 1-13.

Gu, H., Kou, Y., You, H., Xu, X., Yang, N., Liu, J., ... & Li, X. (2019). Measurement and decomposition of income-related inequality in self-rated health among the elderly in China. *International journal for equity in health*, *18*(1), 1-11.

Guan, W. (2003). From the help desk: bootstrapped standard errors. *The Stata Journal*, *3*(1), 71-80.

Gravelle, H., & Sutton, M. (2003). Income related inequalities in self assessed health in Britain: 1979–1995. *Journal of Epidemiology & Community Health*, *57*(2), 125-129.

Hosseinpoor, A. R., Bergen, N., Kunst, A., Harper, S., Guthold, R., Rekve, D., ... & Chatterji, S. (2012). Socioeconomic inequalities in risk factors for non-communicable diseases in low-income and middle-income countries: results from the World Health Survey. *BMC public Health*, *12*(1), 1-13.

Jones-Smith, J. C., & Popkin, B. M. (2010). Understanding community context and adult health changes in China: Development of an urbanicity scale. *Social Science & Medicine*, *71*(8), 1436–1446. https://doi.org/10.1016/j.socscimed.2010.07.027

Jylhä, M. (2009). What is self-rated health and why does it predict mortality? Towards a unified conceptual model. *Social science & medicine*, *69*(3), 307-316.

Keetile, M., Navaneetham, K., Letamo, G., & Rakgoasi, S. D. (2019). Socioeconomic inequalities in non-communicable disease risk factors in Botswana: a cross-sectional study. *BMC Public Health*, *19*(1), 1-9.

Kim, S., Symons, M., & Popkin, B. M. (2004). Contrasting socioeconomic profiles related to healthier lifestyles in China and the United States. *American journal of epidemiology*, *159*(2), 184-191.

Kunna, R., San Sebastian, M., & Stewart Williams, J. (2017). 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). *International journal for equity in health*, *16*(1), 1-17.

Lawana, N., & Booysen, F. (2018). Decomposing socioeconomic inequalities in alcohol use by men living in south African urban informal settlements. *BMC Public Health*, *18*(1), 1-9.

Lawana, N., Booysen, F., Tsegaye, A., Kapingura, F. M., & Hongoro, C. (2020). Lifestyle risk factors, non-communicable diseases and labour force participation in South Africa. *Development Southern Africa*, *37*(3), 446-461.

Lavrakas, P. J. (2008). *Encyclopedia of survey research methods*. Sage publications.

McGrail, K. M., van Doorslaer, E., Ross, N. A., & Sanmartin, C. (2009). Income-Related Health Inequalities in Canada and the United States: A Decomposition Analysis. *American Journal of Public Health*, *99*(10), 1856–1863. https://doi.org/10.2105/AJPH.2007.129361

McIntyre, D., Gilson, L., Wadee, H., Thiede, M., & Okarafor, O. (2006). Commercialisation and extreme inequality in health: the policy challenges in South Africa. *Journal of International Development*, *18*(3), 435-446.

McIntyre, D. I., Thiede, M., & Birch, S. (2009). Access as a policy-relevant concept in low- and middle-income countries. *Health Economics, Policy and Law*, *4*(2), 179-193.

Melotti, R., Heron, J., Hickman, M., Macleod, J., Araya, R., & Lewis, G. (2011). Adolescent Alcohol and Tobacco Use and Early Socioeconomic Position: The ALSPAC Birth Cohort. *Pediatrics*, *127*(4), e948–e955. https://doi.org/10.1542/peds.2009-3450

Mosquera, P. A., San Sebastian, M., Ivarsson, A., & Gustafsson, P. E. (2018). Decomposition of gendered income-related inequalities in multiple biological cardiovascular risk factors in a middle-aged population. International journal for equity in health, 17, 1-20.

Mukong, A. K., Van Walbeek, C., & Ross, H. (2017). Lifestyle and income-related inequality in health in South Africa. *International journal for equity in health*, *16*(1), 1-14.

Mutyambizi, C., Booysen, F., Stokes, A., Pavlova, M., & Groot, W. (2019). Lifestyle and socioeconomic inequalities in diabetes prevalence in South Africa: A decomposition analysis. *PloS one*, *14*(1), e0211208.

Nagasu, M., Kogi, K., & Yamamoto, I. (2019). Association of socioeconomic and lifestyle-related risk factors with mental health conditions: a cross-sectional study. *BMC public health*, *19*(1), 1-13.

Naledi, T., Barron, P., & Schneider, H. (2011). Primary health care in SA since 1994 and implications of the new vision for PHC re-engineering. South African health review, 2011(1), 17-28.

Ndubuisi, N. E. (2021). Noncommunicable Diseases Prevention In Low-and Middle-Income Countries: An Overview of Health in All Policies (HiAP). *INQUIRY: The Journal of Health Care Organization, Provision, and Financing*, *58*, 0046958020927885.

Nghipandulwa, M. T., & Mukong, A. K. (2023). Estimating Income-Related Health Inequalities Associated with Tobacco and Alcohol Consumption in Namibia. International Journal of Environmental Research and Public Health, 20(2), 1062.

Nguyen, L., Rashid, M., & Islam, M. M. (2020). Pattern of health behavior and its association with self-rated health: evidence from the 2018 behavioral risk factor surveillance system in the United States.

Nojilana, B., Bradshaw, D., Pillay-van Wyk, V., Msemburi, W., Laubscher, R., Somdyala, N. I., ... & Dorrington, R. E. (2016). Emerging trends in non-communicable disease mortality in South Africa, 1997-2010. *South African Medical Journal*, *106*(5), 477-484.

Nugent, R., Bertram, M. Y., Jan, S., Niessen, L. W., Sassi, F., Jamison, D. T., ... & Beaglehole, R. (2018). Investing in non-communicable disease prevention and management to advance the Sustainable Development Goals. *The Lancet*, *391*(10134), 2029-2035.

Nwosu, C. O., & Oyenubi, A. (2021). Income-related health inequalities associated with the coronavirus pandemic in South Africa: A decomposition analysis. International journal for equity in health, 20(1), 1-12.

Olatona, F. A., Onabanjo, O. O., Ugbaja, R. N., Nnoaham, K. E., & Adelekan, D. A. (2018). Dietary habits and metabolic risk factors for non-communicable diseases in a university undergraduate population. *Journal of Health, Population, and Nutrition*, *37*, 21. https://doi.org/10.1186/s41043-018-0152-2

Omotoso, K. O., & Koch, S. F. (2018). Assessing changes in social determinants of health inequalities in South Africa: A decomposition analysis. *International Journal for Equity in Health*, *17*(1), 1-13.

Popkin, B. M. (2010, June). Rank Prize Lecture Contemporary nutritional transition: determinants of diet and its impact on body composition. In *Conference on 'Nutrition and health: cell to community*.

Rezaei, S., Hajizadeh, M., Khosravipour, M., Khosravi, F., & Rezaeian, S. (2018). Socioeconomic inequalities in poor health-related quality of life in Kermanshah, Western Iran: A decomposition analysis. Journal of research in health sciences, 18(1), 405.

Riha, J., Karabarinde, A., Ssenyomo, G., Allender, S., Asiki, G., Kamali, A., Young, E. H., Sandhu, M. S., & Seeley, J. (2014). Urbanicity and Lifestyle Risk Factors for Cardiometabolic Diseases in Rural Uganda: A Cross-Sectional Study. *PLoS Medicine*, *11*(7), e1001683. https://doi.org/10.1371/journal.pmed.1001683

Rossouw, L. (2021). Socioeconomic status and tobacco consumption: Analyzing inequalities in China, Ghana, India, Mexico, the Russian Federation and South Africa. *Tobacco Prevention & Cessation*, *7*.

Rossouw, L., Bago d'Uva, T., & Van Doorslaer, E. (2018). Poor health reporting? Using anchoring vignettes to uncover health disparities by wealth and race. Demography, 55(5), 1935-1956.

Rutstein, S. O., & Johnson, K. (2004). The DHS wealth index. DHS Comparative Reports No. 6. Calverton (MD): ORC Macro; 2004.

Sullivan, K., & Thakur, N. (2020). Structural and social determinants of health in asthma in developed economies: a scoping review of literature published between 2014 and 2019. *Current allergy and asthma reports*, *20*(2), 1-12.

Umuhoza, S. M., & Ataguba, J. E. (2018). Inequalities in health and health risk factors in the Southern African Development Community: evidence from World Health Surveys. *International Journal for Equity in Health*, *17*(1), 1-15.

Vallejo-Torres, L., & Morris, S. (2010). The contribution of smoking and obesity to income-related inequalities in health in England. *Social Science & Medicine*, *71*(6), 1189-1198.

Vellakkal, S., Millett, C., Basu, S., Khan, Z., Aitsi-Selmi, A., Stuckler, D., & Ebrahim, S. (2015). 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*, *69*(3), 218-225.

Vellakkal, S., Subramanian, S. V., Millett, C., Basu, S., Stuckler, D., & Ebrahim, S. (2013). Socioeconomic inequalities in non-communicable diseases prevalence in India: disparities between self-reported diagnoses and standardized measures. *PloS one*, *8*(7), e68219.

Wagner, K. H., & Brath, H. (2012). A global view on the development of non communicable diseases. *Preventive medicine*, *54*, S38-S41.

Wagstaff, A. (2005). The bounds of the concentration index when the variable of interest is binary, with an application to immunization inequality. *Health economics*, *14*(4), 429-432.

Wagstaff, A., O'Donnell, O., Van Doorslaer, E., & Lindelow, M. (2007). *Analyzing health equity using household survey data: a guide to techniques and their implementation*. World Bank Publications.

Wagstaff, A., Van Doorslaer, E., & Watanabe, N. (2003). On decomposing the causes of health sector inequalities with an application to malnutrition inequalities in Vietnam. *Journal of econometrics*, *112*(1), 207-223.

Wandai, M., Aagaard-Hansen, J., Day, C., Sartorius, B., & Hofman, K. J. (2017). Available data sources for monitoring non-communicable diseases and their risk factors in South Africa. *South African medical journal*, *107*(4), 331-337.

World Health Organization. (2015). *World health statistics 2015*. World Health Organization.

WHO Commission on Social Determinants of Health, & World Health Organization. (2008). *Closing the gap in a generation: health equity through action on the social determinants of health: Commission on Social Determinants of Health final report*. World Health Organization.

Wu, S., Wang, R., Zhao, Y., Ma, X., Wu, M., Yan, X., & He, J. (2013). The relationship between self-rated health and objective health status: a population-based study. *BMC public health*, *13*(1), 1-9.

Yaya, S., Uthman, O. A., Ekholuenetale, M., & Bishwajit, G. (2018). Socioeconomic inequalities in the risk factors of non-communicable diseases among women of reproductive age in sub-saharan Africa: a multi-country analysis of survey data. *Frontiers in public health*, *6*, 307.

Van de Poel, E., O'Donnell, O., & Van Doorslaer, E. (2012). Is there a health penalty of China's rapid urbanization? *Health Economics*, *21*(4), 367–385. https://doi.org/10.1002/hec.1717