# Inequalities in non-communicable disease multi-morbidity among South Africans: A gender-specific cross-sectional decomposition analysis

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## Abstract

*Background*: Multi-morbidity and its burden on the health systems of low- and middle-income countries is on the increase worldwide. This health challenge is particularly relevant to South Africa with its emergent epidemic of non-communicable disease. This paper investigates gender-based inequalities in non-communicable disease multi-morbidity in South African adults.

*Methods*: The study applies decomposition analysis to data from wave 5 of South Africa's nationally representative National Income Dynamics Study. Non-linear Blinder-Oaxaca decomposition is employed to determine how compositional and behavioural effects of various covariates contribute to gender differences in multi-morbidity. Erreygers concentration indices are constructed for men and women separately. Wagstaff decomposition is used to establish the contribution of various factors to these gender-based income inequalities in multi-morbidity.

*Results*: Non-communicable disease (NCD) multi-morbidity is significantly more pronounced in women than men. Gender differentials are mainly accounted for by differences in characteristics rather than behavioural responses. In terms of endowments, an equal gender distribution of age and BMI will see the gender gap in multi-morbidity decrease, while an equal distribution of smoking will see the gender gap increase in size. Multi-morbidity in non-communicable disease is concentrated among the rich, but significantly more so among men than women. BMI contributes equally to inequality in NCD multi-morbidity in men and women, but ageing, race, urban residence, region and smoking matter more for inequality among women.

*Conclusion*: This paper finds that gender-based inequalities in non-communicable disease multi-morbidity are a stark reality in South Africa. The paper also shows that there are some common, but many gender-specific factors that give rise to these inequalities. Thus, the paper illustrates the complexity of gender-based inequalities in health. Differently tailored responses are required to address gender-based inequalities in non-communicable disease multi-morbidity.

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Key words: multi-morbidity; non-communicable disease; inequality; decomposition; gender

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## 1. Introduction

Non-communicable disease (NCD) is associated with increased financial burdens [1-2] and catastrophic healthcare expenditure [3]. In fact, NCD's close association with socioeconomic status [4-5] has also been described as a syndemic [6]. NCDs in economic terms also has a large and negative impact on national income [7] and macroeconomic productivity [8-9]. These impacts fall disproportionately on poorer households and nations [10]. Likewise, multi-morbidity and NCD-related multi-morbidity is accompanied by substantial personal health care costs, which falls disproportionately on the poor, as well as considerable societal costs [11-17].

The epidemiologic transition has seen a rise in the prevalence of non-communicable disease (NCD) in developing countries [18-19], including sub-Saharan Africa [20] and South Africa [21]. Reviews of epidemiological studies moreover suggest that multi-morbidity is also on the increase in low- and middle-income countries such as South Africa [22]. Yet, major gaps remain in regards to multi-morbidity research in low- and middle-income countries [23].

Female gender is an important risk factor for multi-morbidity [24-27], including NCD and chronic disease multi-morbidity [28-30]. For this reason, sex-specific analysis of NCD multi-morbidity is a prerogative for policymakers. This paper sets out to achieve three objectives. Firstly, this paper aims to determine the nature and extent of gender-based disparity and inequality in the prevalence of NCD multi-morbidity in the general South African population. Secondly, the paper explores the role of characteristics and behavioural responses in explaining these gender disparities. Lastly, the paper investigates differences in the factors that determine the observed income inequalities in NCD multi-morbidity in women and men.

Although the uptake of sex- or gender-specific reporting in research on health inequalities has been slow [31], sex-specific or gender-based decomposition analysis in the health arena however is not new, be it Blinder-Oaxaca-type decompositions of gender differences in health outcomes [32-35] or Wagstaff-type decompositions of health inequalities conducted separately for men and women [36-38]. Decomposition analysis of multi-morbidity, however, is restricted to two studies [39-40], neither of which embarks on sex-stratified analysis. Insofar as we could ascertain, no previous study has applied decomposition analysis to the gender differences so often observed in empirical studies of multi-morbidity. Furthermore, not one of the studies on multi-morbidity in South Africa has included sex-stratified or gender-specific analysis [41-48].

## 2. Data and methods

The study employs data of 22,741 individuals aged 15 years and older from wave 5 of South Africa's nationally representative National Income Dynamics Study (NIDS) conducted in 2017. NIDS is a panel data survey undertaken at an approximate interval of 2 years since 2008 by the Southern Africa Labour Development Research Unit [49]. The dataset contains extensive individual and household level variables relating to income, expenditure, health, education and other demographic characteristics. Post-stratification sampling weights are used in the study to ensure national representativeness despite systematic non-response and attrition.

The study identifies non-communicable disease multi-morbidity based on two questions in the NIDS survey. The first being Question J13: *"Have you ever been told by a doctor, nurse or health care professional that you have [condition]?*" The response is restricted to six conditions, including high blood pressure, diabetes or high blood sugar, stroke, asthma, heart problems, and cancer. The following Question J14 is more open ended: *"Do you have any other major illnesses or disability not mentioned above?"* and allows the respondent to list any condition not included in the response to J13. From the various responses, epilepsy and emphysema were picked out to be the two most commonly reported non-communicable conditions further to the ones listed under question J13. Therefore, based on the two above questions, we include eight non-communicable disease conditions in constructing an indicator of multi-morbidity. Multi-morbidity for the purpose of this analysis is defined as a condition of an individual suffering from two or more of these eight non-communicable diseases. The bivariate variable is defined as one for individuals with multi-morbidity and zero otherwise.

We start our analysis by providing a description of the sample. Next, we present the gender-specific results on the prevalence of NCDs and NCD multi-morbidity before we undertake an Oaxaca-Blinder decomposition to partition the components of the observed gender group difference in means, into a component attributable to compositional differences between groups (that is, differences in characteristics or endowments, E) and to differences in the effects of characteristics (that is, differences in coefficients, or behavioral responses, C). Building on the Oaxaca-Blinder decomposition, Yun [50] suggested using weights obtained from a first-order Taylor linearization to decompose non-linear models. The detailed decompositions obtained this way are invariant to the order that variables enter the decomposition, thus providing a convenient solution to path dependency.

$$Y_m^- - Y_f^- = E + C = \sum_{k=1}^{K} W_{\Delta xk} E + \sum_{k=1}^{K} W_{\Delta \beta k} C = \sum_{k=1}^{K} Ek + \sum_{k=1}^{K} C\mathrm{k}$$

We decompose the observed male–female difference in the prevalence of multi-morbidity using a logit model by *mvdcmp* command using *Stata 15* [51]. This determines how compositional and response effects of various covariates contribute to gender differences in multi-morbidity.

As a next step, we estimate the gender-specific health concentration indices to analyse the income inequality in the prevalence of multi-morbidity in South Africa. The Concentration Index C($h$) , introduced by Kakwani [52] and Wagstaff, Paci and Van Doorslaer [53], is defined as follows:

$$C(h)=\frac{2}{n\mu}\sum_{i=1}^{n} h_i r_i - 1$$

Where, $n$ is sample size, $h$ the multi-morbidity variable, $\mu$ its mean and $r$ the rank of individual '$i$' by income from poorest to richest. C($h$) is expected to lie between +1 and -1 for non-binary outcomes, with a positive value of C($h$) indicating that multi-morbidity is distributed more among the affluent, and a negative value indicating that it is distributed more among the poor. Further, the absolute value of the index indicates the level of concentration, with higher values indicating the greater extent of the pro-rich or pro-poor character of the distribution.

However since our multi-morbidity variable is binary, we follow Erreygers [54] to correct the Concentration Index through normalization of the concentration index (C($h$)) using the mean and the bounds of the multi-morbidity variable. The Erreygers-corrected concentration index is defined as:

$$E(h) = 4\frac{\mu}{b_h - a_h}C(h)$$

Where, $b_h$ and $a_h$ are the maximum (1) and minimum (0) of the multi-morbidity variable ($h$) and $\mu$ its mean. We employ the *conindex* function available in Stata to estimate the concentration indices [55].

Further to the estimation of the Erreygers-corrected concentration indices, decomposition analysis is also used to establish the contribution of sociodemographic, economic, health and lifestyle factors to gender-based income inequalities in multi-morbidity. Health conditions are determined by both current and past income levels. In order to control for them the study includes individual income (log of per capita household income) and well as childhood economic conditions (based on the ordinal response to Question M3.1: "*On which step was your household when you were 15?*"). Age is without question fundamental in determining the health status of individuals and therefore included as a key variable in the analysis. Obesity is often cited in literature as being a risk factor for many of the NCDs prompting us to include BMI as an explanatory variable. Further, education is also expected to impact on health through awareness and life style practices. Last but not the least, we include a variable for smoking, which is a key risk factor for NCDs. Apart from the above provincial level fixed effects are included to account for regional and ethnic heterogeneity across the country.

Through the decomposition of the concentration indices we are able to quantify the source of overall inequality among the various determinants for the whole sample and, for men and women separately, with bootstrapped standard errors of absolute contributions. Given the binary nature of our health outcome variable, probit model is used for decomposition of the concentration indices:

$$\Pr(\mathrm{h} = 1|\mathrm{X}) = \emptyset(X\beta)$$

Where, $\emptyset$ is the CDF of normal distribution, $\beta$ the estimated parameters, and X the determinants.

The linear approximation of the probit model is:

$$h_i = \alpha^m + \sum_k \beta_k^m X_{ki} + u_i$$

Where, $u_i$ is the error produced by the linear approximation to estimate marginal effects ($\beta_k^m$).

Given the above, CI (h) can be decomposed as:

$$CI(h) = \sum_k (\frac{\beta_k X_k^-}{\mu}) CI_k + \frac{GCI_\epsilon}{\mu}$$

Where, $\mu$ is the mean of h, $X_k^-$ is the mean of Xk, $CI_k$ is the mean of CI of $X_k$, and $GCI_\epsilon$ is the generalised CI for the error term [39].

## 3. Results

The basic sociodemographic characteristics of the sample, disaggregated across sexes, are provided in Table 1. The sample has a predominantly African black population (81.9%) with females constituting 53.3% of the total sample. The high share of younger population in South Africa is reflected in our sample with the average age being 37 years (over 40% of the sample being under the age of 31 years). The average years of females is statistically higher than that of males (36.1 year, 95% CI 35.8- 36.4). Further differences between male and female are noticed with regards to other variables like BMI, smoking, medical aid, urban residence as well as income levels. While females have a statistically higher BMI (29, 95% CI 28.9- 29.1) compared to men (23.7, 95% CI 23.6- 23.8), their proportion of smokers (6.9%, 95% CI 6.5-7.4) is lower than the male share (34.4, 95% CI 33.4-35.4). Further, while income for females averages R3515 (95% CI 3359.9-3671.6), it is statistically higher for males at R5122 (95% CI 4809.7-5434.3). Following from this, it is not surprising that a higher proportion of male (12.2%, 95% CI 11.5-12.9) enjoy medical aid compared to females (10.4%, 95% CI 9.9- 10.9).

**Table 1**: Sample characteristics

| | Total | % | | Male | % | | Female | % | |
|---|---|---|---|---|---|---|---|---|---|
| Sample size | 2271 | 100 | | 9301.0 | 40.9 | | 13440.0 | 59.1 | |
| Weighted sample | 2271 | 100 | | 10627.7 | 46.7 | | 12113.3 | 53.3 | |
| | Total | 95% CI | | Male | 95% CI | | Female | CI 95% | |
| African (0/1) | 81.9 | (81.5, 82.5) | | 82.4 | (81.6, 83.2) | | 81.6 | (81, 82.3) | |
| Age (years) | 37.0 | (36.8, 37.2) | | 36.1 | (35.8, 36.4) | | 37.9 | (37.6, 38.2) | |
| Smoke (0/1) | 19.7 | (19.2, 20.3) | | 34.4 | (33.4, 35.4) | | 6.9 | (6.5, 7.4) | |
| Urban (0/1) | 65.3 | (64.7, 65.9) | | 67.1 | (66.2, 68.1) | | 63.7 | (62.9, 64.5) | |
| BMI | 26.5 | (26.4, 26.6) | | 23.7 | (23.6, 23.8) | | 29.0 | (28.9, 29.1) | |
| Medical aid (0/1) | 11.1 | (10.1, 11.5) | | 12.2 | (11.5, 12.9) | | 10.4 | (9.9, 10.9) | |
| Childhood SES (1-6) | 2.1 | (2.16, 2.19) | | 2.1 | (2.14, 2.18) | | 2.19 | (2.18, 2.21) | |
| Education (years) | 12.4 | (12.3, 12.5) | | 12.2 | (12.1, 12.3) | | 12.6 | (12.5, 12.7) | |
| Income (ZAR) | 4266.5 | (4101, 4428.9) | | 5122 | (4809.7, 5434.3) | | 3515 | (3359.9,3671.6) | |
| | Total | | | Male | | | Female | | |
| Income Quintile: | % | Median | (IQR) | % | Median | (IQR) | % | Median | (IQR) |
| 1 | 26.39 | 480.4 | 364.3, 597.1 | 27.20 | 488.2 | 366.5, 600 | 25.19 | 474.9 | 360, 594.6 |
| 2 | 25.25 | 983.3 | 835.7, 1150 | 25.86 | 989.4 | 35.7, 1162.5 | 23.50 | 979.6 | 830, 1146.6 |
| 3 | 19.65 | 1738.4 | 1507.3, 2000 | 18.82 | 1770 | 1542.2, 2000 | 21.26 | 1710 | 1500, 2000 |
| 4 | 16.09 | 3270.2 | 2750, 3985 | 15.68 | 3316 | 2800, 4015.2 | 16.38 | 3200 | 2705, 3896.3 |
| 5 | 12.63 | 10000 | 6800, 17229.6 | 12.45 | 9948 | 6800, 17300 | 13.66 | 10039 | 6800, 17000 |

Source: Calculated with weighted NIDS sample.

Hypertension is seen to have the highest prevalence rate among the eight conditions at 15%, followed by diabetes at 4% (Table 2). The prevalence rate of the NCDs is seen to be higher for females as compared to males across all the conditions analysed except epilepsy and emphysema. However, it needs to be highlighted that the prevalence rate differences across males and females are not statistically significant for stroke and cancer as indicated by the overlapping confidence intervals. Non-communicable disease morbidity is significantly more pronounced in women (5.2%; 95% CI 4.8-5.6) than men (3.4%; 95% CI 3.0-3.7).

**Table 2**: Prevalence of NCD and NCD multi-morbidity (%), by gender

| | Total (95% CI) | | Male (95% CI) | | Female (95% CI) | |
|---|---|---|---|---|---|---|
| Hypertension | 14.94 | (14.48, 15.41) | 10.58 | (9.94, 11.20) | 18.77 | (18.11, 19.46) |
| Diabetes | 3.90 | (3.7, 4.25) | 3.14 | (2.79, 3.49) | 4.75 | (4.38, 5.11) |
| Stroke | 0.85 | (0.73, 0.97) | 0.70 | (0.53, 0.87) | 0.97 | (0.81, 1.1) |
| Asthma | 3.38 | (3.14, 3.62) | 2.59 | (2.27, 2.91) | 4.07 | (3.47, 4.41) |
| Heart | 1.87 | (1.69, 2.04) | 1.31 | (1.08, 1.54) | 2.36 | (2.10, 2.62) |
| Cancer | 1.27 | (1.12, 1.42) | 1.09 | (0.88, 1.3) | 1.42 | (1.22, 1.62) |
| Epilepsy | 0.61 | (0.52, 0.72) | 0.75 | (0.58, 0.94) | 0.49 | (.37, .61) |
| Emphysema | 0.08 | (.04, .11) | 0.14 | (.06, .21) | 0.03 | (.00, .06) |
| Multi-morbidity | 4.39 | (4.13, 4.66) | 3.41 | (3.04, 3.78) | 5.27 | (4.89, 5.65) |
| Number of conditions: | Proportion (%) | | Proportion (%) | | Proportion (%) | |
| 0 | 76.23 | | 77.00 | | 75.81 | |
| 1 | 19.39 | | 19.18 | | 19.50 | |
| 2 | 3.79 | | 3.23 | | 4.11 | |
| 3 | 0.43 | | 0.44 | | 0.43 | |
| 4+ | 0.16 | | 0.15 | | 0.16 | |
| Total | 100.00 | | 100.00 | | 100.00 | |

Source: Calculated with weighted NIDS sample.

Gender differentials in non-communicable disease multi-morbidity are accounted for by differences in characteristics or endowments (70.8%) rather than behavioural responses (29.2%) (Table 3). In terms of endowments, three factors are of particular importance. An equal gender distribution of age will see the gender gap in multi-morbidity decrease by a margin of 39.4%. Similarly, under the condition that women are distributed similarly to men with regards to BMI, the gender gap will significantly decline by 83.1%. However, if women were equal to men in regards to smoking, the gender gap in NCD multi-morbidity will increase by as much as 53.1%. The same is true for urban residence, but the increase in the gender gap is small (4.3%). Similarly, the gender gap will only decline marginally (1.4%) if women's access to medical insurance was equivalent to that of men. In regards to behavioural effects, the variables included in the model do not have a statistically significant gender-specific role to play in explaining the observed gender gap. As is indicated by the large contribution of the constant, a substantial component of the gender gap is explained by other factors not included in the decomposition model.

**Table 3**: Decomposition of gender difference in NCD multi-morbidity

| | Endowments | | | Behavioural responses | | |
|---|---|---|---|---|---|---|
| | Coefficient | SE | % | Coefficient | SE | % |
| Income | -0.234 | 0.0002 | -1.26 | 0.000 | 0.0001 | -0.0075 |
| Childhood SES | 0.000 | 0.0001 | 0.107 | -0.0025 | 0.0026 | -13.28 |
| Age | 0.007*** | 0.0007 | 39.43 | -0.003 | 0.0026 | -16.73 |
| Education | -0.0001 | 0.0001 | -0.573 | 0.0023 | 0.0023 | 12.27 |
| BMI | 0.0155*** | 0.002 | 83.08 | -0.006 | 0.005 | -30.98 |
| African | 0.0001 | 0.000 | 0.57 | 0.004 | 0.004 | 22.65 |
| Smoke | -0.0098** | 0.004 | -53.07 | 0.002 | 0.002 | 11.35 |
| Urban | -0.0008*** | 0.0003 | -4.323 | 0.000 | 0.002 | 0.91 |
| Medical insurance | 0.00026** | 0.00012 | 1.39 | -0.001 | 0.001 | -4.1 |
| Constant | | | | 0.008 | 0.009 | 46.25 |
| Total | 0.0132*** | 0.0026 | 70.76 | 0.0054 | 0.0042 | 29.24 |

Notes: SE indicates standard errors, *** p<0.01, ** p<0.05, * p<0.1

Multi-morbidity in non-communicable disease is concentrated among the rich (C +0.020), but significantly more so among men (C +0.035) than women (C +0.015) (p<0.001) (Table 4). Condition-specific NCD multi-morbidity also is seen to be concentrated among the rich, except for epilepsy and stroke, for which the concentration index is not significantly different from zero (equality).

**Table 4**: Erreygers-corrected concentration index, by NCD and gender

| | Total | | | Male | | | Female | | |
|---|---|---|---|---|---|---|---|---|---|
| | C | 95% CI | | C | 95% CI | | C | 95% CI | |
| Hypertension | 0.020*** | 0.020 | 0.020 | 0.060*** | 0.060 | 0.060 | 0.019** | 0.019 | 0.019 |
| Asthma | 0.008*** | 0.008 | 0.008 | 0.006 | 0.006 | 0.006 | 0.014*** | 0.014 | 0.014 |
| Heart | 0.009*** | 0.009 | 0.009 | 0.019*** | 0.019 | 0.019 | 0.006* | 0.006 | 0.006 |
| Diabetes | 0.022*** | 0.022 | 0.022 | 0.033*** | 0.033 | 0.033 | 0.019*** | 0.019 | 0.019 |
| Cancer | 0.011*** | 0.011 | 0.011 | 0.011*** | 0.011 | 0.011 | 0.012*** | 0.012 | 0.012 |
| Epilepsy | -0.002 | -0.002 | -0.002 | -0.004** | -0.004 | -0.004 | -0.002 | -0.002 | -0.002 |
| Stroke | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Emphysema | 0.001** | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001* | 0.001 | 0.001 |
| Multi-morbidity | 0.020*** | 0.020 | 0.020 | 0 .035*** | 0.035 | 0.035 | 0.015*** | 0.015 | 0.015 |

Notes: C indicates concentration index, *** p<0.01, ** p<0.05, * p<0.1

Overall, age, at +59%, is by far the most significant contributor to increases in inequality in NCD multi-morbidity (Table 5). This is the case among both men (+35.8%) and women (+81.8%), but especially among women. BMI, being African, and urban residence also contribute substantially and significantly to increases in overall inequality, but to a lesser extent. On the other hand, residence in the Kwa-Zulu Natal province contributes to a decrease in NCD multi-morbidity inequality. The contribution of BMI to NCD multi-morbidity inequality is more or less similar among men (+25.9%) and women (+29.9%). As was the case for ageing, the three other contributors to overall inequality also exhibits quite different gender dynamics. Urban residence is only significant for women. The contributions of African race and the regional dummy for Kwa-Zulu Natal province in relative terms is much greater for women compared

to men. In contrast, smoking is seen to contribute significantly to inequality in NCD multi-morbidity but only among women (+14.1%).

**Table 5**: Decomposition of Erreygers-corrected Concentration Index of multi-morbidity, by gender

| TOTAL | Elasticity | CI | Absolute | SE | % |
|---|---|---|---|---|---|
| Female | -0.0004 | -0.0839 | 0.0001 | 0.000735 | 0.6628 |
| Income | -0.0077 | 0.0863 | -0.0027 | 0.006044 | -13.1798 |
| Childhood SES | 0.004 | 0.0622 | 0.001 | 0.001099 | 4.9727 |
| Age | 0.1043 | 0.0286 | 0.0119*** | 0.001375 | 59.0557 |
| Education | -0.0043 | 0.0728 | -0.0013 | 0.001102 | -6.2644 |
| BMI | 0.0596 | 0.018 | 0.0043*** | 0.000703 | 21.2501 |
| African | -0.0159 | -0.0802 | 0.0051*** | 0.001361 | 25.2621 |
| Smoke | 0.0013 | 0.0518 | 0.0003 | 0.000273 | 1.3066 |
| Urban | 0.011 | 0.1372 | 0.006*** | 0.001648 | 29.8214 |
| Medical insurance | -0.0008 | 0.6694 | -0.0021 | 0.002597 | -10.2203 |
| Kwa-Zulu Natal | 0.0048 | -0.1335 | -0.0026*** | 0.000762 | -12.7356 |
| Other Provinces | | | | | -0.2966 |
| Residual | | | 0.00007 | 0.004937 | 0.3653 |
| MALE | Elasticity | CI | Absolute | SE | % |
| Income | 0.0188 | 0.0851 | 0.0064 | 0.007942 | 18.3769 |
| Childhood SES | 0.0074 | 0.0575 | 0.0017 | 0.001351 | 4.8923 |
| Age | 0.0846 | 0.0369 | 0.0125*** | 0.001687 | 35.7976 |
| Education | -0.0091 | 0.0789 | -0.0029 | 0.001704 | -8.2555 |
| BMI | 0.0556 | 0.0406 | 0.009*** | 0.001671 | 25.9075 |
| African | -0.0163 | -0.0676 | 0.0044*** | 0.001578 | 12.6119 |
| Smoke | -0.0001 | -0.0437 | 1.22E-05 | 0.000339 | 0.0349 |
| Urban | 0.0073 | 0.1174 | 0.0034 | 0.0021 | 9.7802 |
| Medical insurance | 0.0001 | 0.646 | 0.0002 | 0.003345 | 0.5831 |
| Kwa-Zulu Natal | 0.0036 | -0.1168 | -0.0017* | 0.00094 | -4.8228 |
| Other Provinces | | | | | -3.4493 |
| Residual | | | 0.002982 | 0.006691 | 8.5432 |
| FEMALE | Elasticity | CI | Absolute | SE | % |
| Income | -0.0235 | 0.0853 | -0.008 | 0.008448 | -52.1776 |
| Childhood SES | 0.0019 | 0.0682 | 0.0005 | 0.001585 | 3.3997 |
| Age | 0.1206 | 0.0261 | 0.0126*** | 0.001774 | 81.8149 |
| Education | -0.0023 | 0.0719 | -0.0007 | 0.00143 | -4.3337 |
| BMI | 0.0614 | 0.0187 | 0.0046*** | 0.001013 | 29.9124 |
| African | -0.0102 | -0.0928 | 0.0038 | 0.002501 | 24.6523 |
| Smoke | 0.0055 | 0.0997 | 0.0022*** | 0.000429 | 14.1589 |
| Urban | 0.0139 | 0.1548 | 0.0086*** | 0.002921 | 55.804 |
| Medical insurance | -0.002 | 0.6959 | -0.0056 | 0.00392 | -36.392 |
| Kwa-Zulu Natal | 0.006 | -0.139 | -0.0033*** | 0.001501 | -21.5487 |
| Other Provinces | | | | | 9.7153 |
| Residual | | | -0.00077 | 0.006449 | -5.0055 |

Notes: CI indicates Erreygers-corrected concentration index, *** p<0.01, ** p<0.05, * p<0.1. SE: bootstrapped standard errors (500 replications).

## 4. Discussion

Despite differences in the number and type of conditions, the overall prevalence of NCD multi-morbidity, at 4.4 percent, is similar to estimates of overall multi-morbidity obtained from NIDS [41,48] and other nationally representative surveys [42]. Facility-based studies of NCD or overall multi-morbidity as expected report considerably higher prevalence rates [43,46-47]. The single most prominent chronic NCD condition in the study population and among those with multi-morbidity is hypertension, thus validating earlier work on multi-morbidity in South Africa [42,44,46].

NCD multi-morbidity are significantly more pronounced among women than men, which in part is a function of the feminisation of population ageing [56]. This is reflected in the substantial contribution of age to gender differences in NCD multi-morbidity. Lifestyle-related factors are important drivers of gender differences in NCD multi-morbidity. Of particular importance is obesity [29,48,57-60], which amongst others is a function of diet and physical exercise, as well as smoking [28,59]. From the perspective of equality, programmes addressing the obesity epidemic should target women.

Although other studies are not directly comparable due to differences in the choice of the number and type of illnesses used to measure multi-morbidity, one can point out that Ataguba [42], in another nationally representative study, report small but negative concentration indices for multi-morbidity. In other words, multi-morbidity was found to be more concentrated among the poor rather than the rich. Weimann et al. [48], who also employs the National Income Dynamics Study, also found that socio-economic deprivation increases the likelihood of multi-morbidity. Similar to this study, however, Alaba and Chola [41] found the prevalence of multi-morbidity to increase with income. These differences in findings likely is the result of the inclusion of infectious diseases in the list of multiple chronic conditions used in these studies, seeing that the latter generally are more prevalent among those with lower socio-economic status. However, unlike in some settings [25-26,40,61], the socio-economic gradient in multi-morbidity has been found to be positive in many African countries [62], including Ghana [39].

Similar to previous studies [39-40], this study finds that gender is not a significant predictor of multi-morbidity once the regression analysis adjusts for differences in socio-demographic characteristics, socio-economic status, lifestyle factors, and other covariates [41,48].

Nevertheless, there are differences in the type of relative importance of the factors that explain observed inequality in NCD multi-morbidity in women and in men. Apart from smoking, which only matters for women, a similar set of factors, notably age, BMI, race, urbanisation and geographical location, contribute to inequality in men and women. In Ghana and China, BMI has also been found to be a main contributor to socio-economic inequality in multi-morbidity [39]. Yet, these factors matter much more for inequality among women compared to inequality among men. Unlike in Canada [40] and China [39], socioeconomic status, measured in income and wealth respectively, does not have a large,

significant and direct impact on inequality in NCD multi-morbidity, neither overall nor among men or women.

The study has a number of limitations. The rising co-morbidity of infectious and non-communicable disease in South Africa [46-47] poses a unique challenge to the health system. While NIDS did collect information on HIV and TB, which are considered chronic conditions [63-64], the self-reported prevalence of these two conditions, 5.26 percent for TB (95% CI 4.97-5.55) and 3.32 percent for HIV (95% CI 3.09-3.56), were too low, probably due to the stigma surrounding these conditions, to be considered reliable for conducting meaningful analysis of multi-morbidity from a fuller perspective of disease, hence the focus here on NCD. In regards to limitations, it is also important to recognise that gender differences in multi-morbidity are confounded by differential rates of health care utilisation, i.e. women visit health care services more often than men and hence are more likely to be diagnosed with multiple illnesses. This paper also cannot distinguish the extent to which the observed inequality in NCD multi-morbidity is a function of biological traits or gender relations [65].

## 5. Conclusion

This paper finds that gender-based inequalities in non-communicable disease multi-morbidity are a stark reality in South Africa. The paper also shows that there are many common, but some gender-specific factors that give rise to these inequalities. Thus, the paper illustrates the complexity of gender-based inequalities in health. Differently tailored responses are required to address gender-based inequalities in non-communicable disease multi-morbidity.

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