**Chronic multimorbidity among older adults in rural South Africa**

**Web Appendix**

# Table of Contents





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# Tables and Figures

## Tables



## Figures

## S1. Definitions of selected clinical conditions

*Cardiometabolic conditions.* For both hypertension and dyslipidemia, we applied the set of criteria listed in the South African and US guidelines [1–4]. One will be considered hypertensive if systolic blood pressure is greater than or equal to 140 mmHg or diastolic blood pressure is 90 mmHg or higher, or if use of anti-hypertensive medication is reported at the time of interview. For dyslipidemia, we classified those who meet at least one of the following criteria: total cholesterol >6.21 mmol/L, HDL-C <1.19 mmol/L, LDL-C >4.1 mmol/L, triglycerides >2.25 mmol/L, reported ever diagnosed with high cholesterol, or if use of medication is reported at the time of interview. Diabetes was diagnosed using the guideline published by the American Diabetes Association [5]: fasting glucose (defined as >8 hours) >7 mmol/L (126 mg/dL) or non-fasting glucose level >11.0 mmol/L (200 mg/dL), reported ever being diagnosed with diabetes, or if use of medication is reported at the time of interview. Finally, angina was diagnosed using the Rose Chest Pain Questionnaire, a widely used method in assessing angina [6].

*HIV***.** For HIV, individuals who test positive for HIV via dried blood spot ELISA test will be coded as having the condition.

*Mental disorders.* Symptoms of depression were screened using the Center for Epidemiological Studies – Depression Scale (CES-D) 8-item questionnaire. We used a cutoff of three or more symptoms as a diagnosis of depression [7]. PTSD was diagnosed using a seven-symptom screening scale developed by Breslau and colleagues [8], and individuals who score four or more on this scale were classified as having PTSD. Alcohol dependence was defined using the CAGE questionnaire, which includes four questions related to alcohol consumption [9].

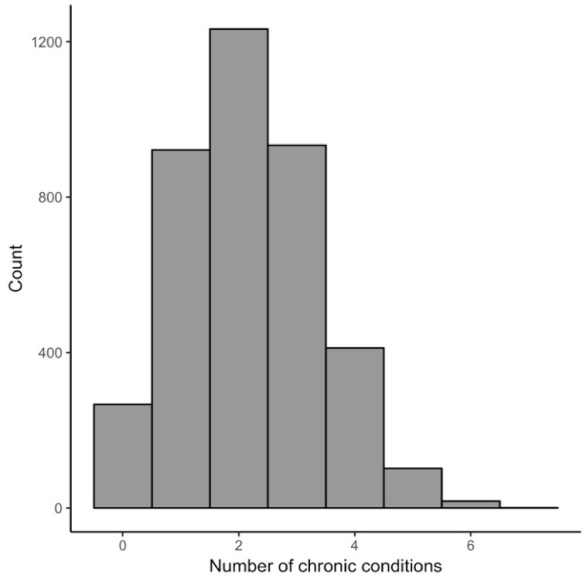
*Others***.** For anemia, we measured hemoglobin using HEMOCUE and we will use the recommended cutoffs from the South African National Health and Nutrition Examination Survey [10]. Chronic bronchitis was diagnosed based on questions asking whether the individual have experienced usual cough with phlegm every day for at least three months a year for at least two successive years [11].

## S2. Details on statistical analyses

In this section, we provide information on how the regression models were selected. The full results are presented in Appendix Section 7.

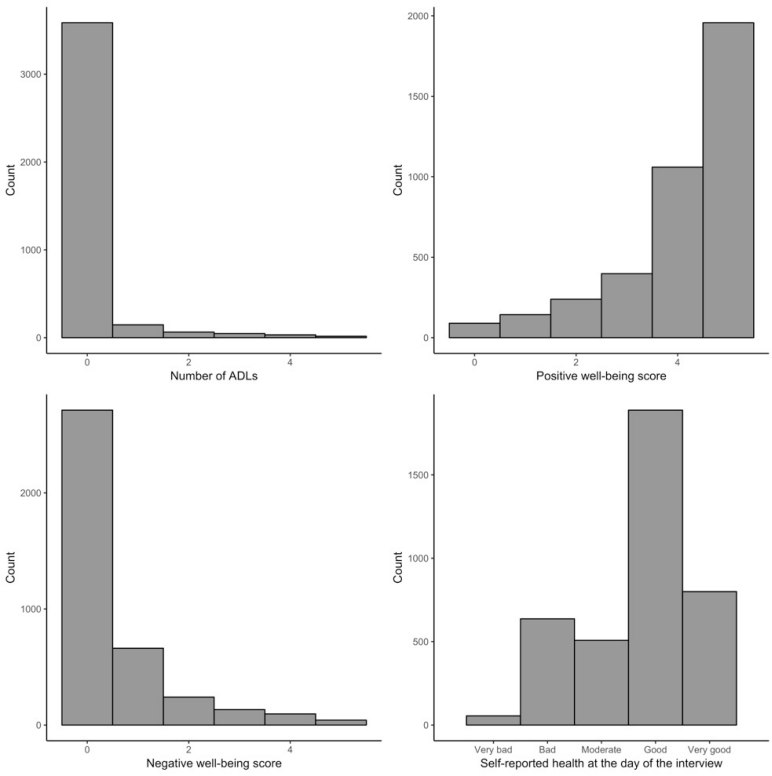
In model 1, we analyze the association between the number of chronic conditions and sociodemographic variables. Quasi-Poisson regression was applied since the number of chronic conditions in this sample follow a right-skewed distribution, and the dispersion test suggests that it is under-dispersed. Models 2 and 3 analyzed the association between a binary variable of whether one has multimorbidity or not with sociodemographic variables. Logistic regressions were applied for these two models.

Figure S2.1. Histogram of the number of chronic conditions in the study population




To analyze the relationship between multimorbidity and physical functioning and well-being, we first plotted the histograms of the functioning variables, including the number of limitations in activities of daily living (ADL), self-reported health index, negative well-being score, and positive well-being score. As shown in Figure S2.2, most respondents had zero ADLs and scored zero negative well-being score. For these two variables, we therefore applied zero-inflated Poisson regressions. We applied binomial regression for positive well-being scores (left-skewed), and ordinal logistic regression for self-reported health index.

Figure S2.2. Histograms of physical functioning and well-being variables: limitations in activities of daily living, self-reported health index, negative well-being score, and positive well-being score

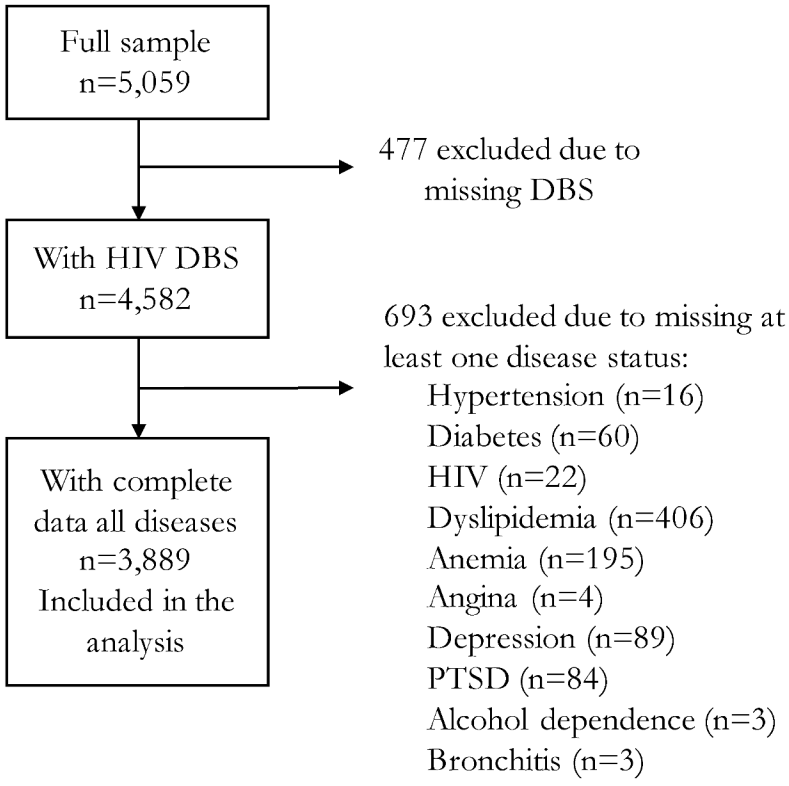


## S3. Selection process of the analytic sample

Out of the full sample (n=5,059), we excluded study participants who were missing one or more of the disease status of the ten selected clinical conditions. 477 were excluded due to missing dried blood spot sample, and additional 693 were excluded due to missingness of at least one disease status, described in Figure S3.

A comparison of a set of selected demographic characteristics and disease profiles between study participants who were included and excluded from the study (due to data missingness) are presented in Table S3.

Figure S3. Selection process of the analytic sample




DBS = dried blood spot

Table S3. Comparison of selected demographic characteristics and disease profiles between study participants who were included and excluded from the study

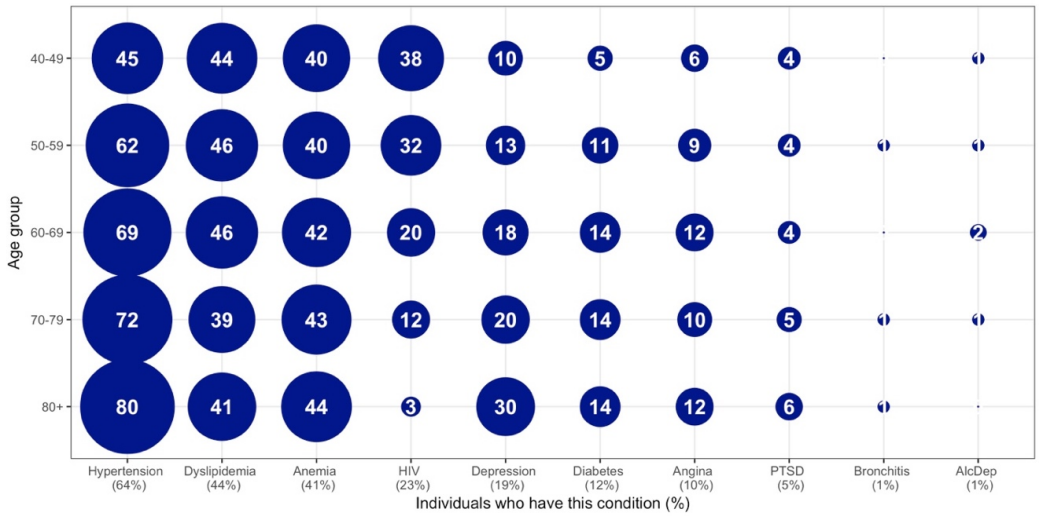
| | Included sample (% among included sample) | Excluded sample (% among excluded sample) | Proportion of excluded sample among full sample |
|---|---|---|---|
| Number of people | 3889 | 1170 | |
| Age group | | | |
| 40-49 | 685 (17.6%) | 233 (19.9%) | 25.4% |
| 50-59 | 1069 (27.5%) | 341 (29.1%) | 24.2% |
| 60-69 | 1056 (27.2%) | 248 (21.2%) | 19.0% |
| 70-79 | 686 (17.6%) | 192 (16.4%) | 21.9% |
| 80+ | 393 (10.1%) | 156 (13.3%) | 28.4% |
| Sex | | | |
| Female | 2131 (54.8%) | 583 (49.8%) | 21.5% |
| Male | 1657 (45.2%) | 587 (50.2%) | 26.2% |
| Education | | | |
| No formal education | 1761 (45.4%) | 545 (46.9%) | 23.6% |
| Some primary (1-7 years) | 1376 (35.5%) | 340 (29.2%) | 19.8% |
| Primary or more (8+ years) | 742 (19.1%) | 278 (23.9%) | 27.3% |
| Country of origin | | | |
| South Africa | 2716 (69.9%) | 812 (69.5%) | 23.0% |
| Mozambique/other | 1169 (30.1%) | 357 (30.5%) | 23.4% |
| Household size | | | |
| Living alone | 406 (10.4%) | 128 (10.9%) | 24.0% |
| Living with one other person | 403 (10.4%) | 135 (11.5%) | 25.1% |
| Living in 3-6 person household | 1866 (48.0%) | 572 (48.9%) | 23.5% |
| Living in 7+ person household | 1214 (31.2%) | 335 (28.6%) | 21.6% |
| Marital status | | | |
| Currently married or living with partner | 2018 (51.9%) | 557 (47.6%) | 21.6% |
| Never married | 188 (4.8%) | 102 (8.7%) | 35.2% |
| Separated/divorced | 504 (13.0%) | 146 (12.5%) | 22.5% |
| Widowed | 1177 (30.3%) | 363 (31.0%) | 23.6% |
| Employment | | | |
| Employed (part/full time) | 614 (15.8%) | 191 (16.4%) | 23.7% |
| Not employed | 3268 (84.2%) | 972 (83.6%) | 22.9% |
| Wealth quintile | | | |
| Quintile 1 | 809 (20.8%) | 237 (20.3%) | 22.7% |
| Quintile 2 | 773 (19.9%) | 228 (19.5%) | 22.8% |
| Quintile 3 | 765 (19.7%) | 226 (19.3%) | 22.8% |
| Quintile 4 | 754 (19.3%) | 253 (21.6%) | 25.1% |
| Quintile 5 | 788 (20.3%) | 226 (19.3%) | 22.3% |
| Disease prevalence* (among people without missing data) | | | |
| Hypertension | 64.3% | 60.4% | |
| Anemia | 41.4% | 42.9% | |
| Depression | 16.7% | 18.0% | |
| Diabetes | 11.5% | 14.5% | |
| Angina | 9.9% | 6.2% | |
| Post-traumatic stress disorder | 4.6% | 5.7% | |
| Bronchitis | 0.06% | 0.03% | |
| Alcohol dependence | 1.4% | 1.3% | |

* Dyslipidemia and HIV not included because more than 5% of the full sample did not disease status

## S4. The relationship between age and wealth, and the prevalence of ten clinical conditions by age, wealth groups, and sex

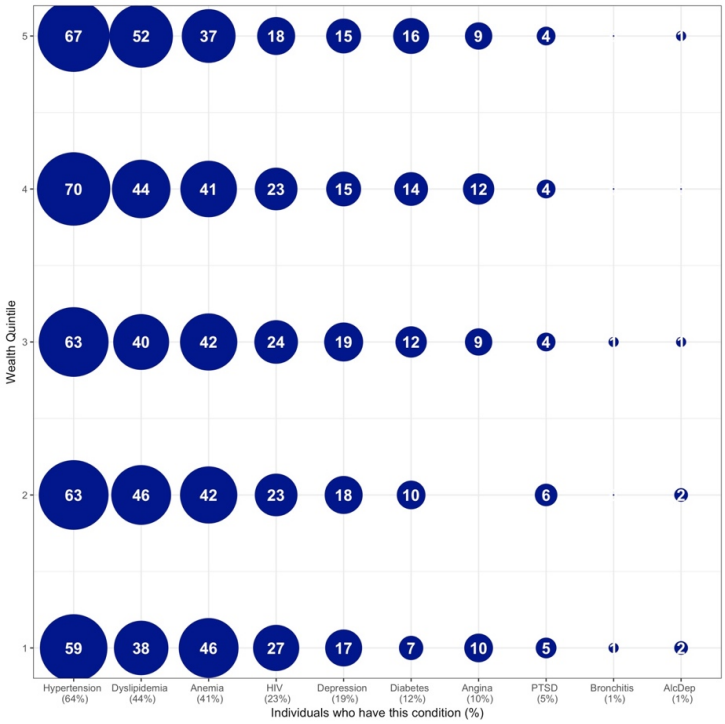
To understand the relationship between multimorbidity and age and wealth, we analyzed the prevalence of the ten chronic conditions by the age and wealth groups (Figures S4.1 and S4.2). The size of the bubbles reflects the relative magnitude of prevalence rates. To further examine the interplay between age and wealth, we estimated the average age of the study population by wealth quintile, and the average wealth index by age group, presented in Table S4.1. We found that the younger age groups had higher mean wealth index (in other words, they were from richer households). We cross-tabulated the average number of chronic conditions by age-wealth group in Table S4.2. First, looking at each wealth quintile, the third age group (60-69) has one of the highest means in wealth quintiles, and in the poorest quintile it has an even higher mean than the oldest age group. Second, looking at each age group, the relationship between wealth and multimorbidity is less consistent. In the youngest age group (40-49), the poorer wealth quintiles have higher means than the richer quintiles, while in the second (50-59) and fourth (70-79) age groups the mean increases with wealth index. In the third age group (60-69), the mean is similar across all wealth groups. The descriptive analyses presented in Tables S4.1 and S4.2 are consistent with the findings presented in the manuscript (Figures 1a and 1b).

Figure S4.1. Prevalence of ten clinical conditions by age group (percentage)




PTSD = post-traumatic stress disorder; AlcDep = alcohol dependence

Figure S4.2. Prevalence of ten clinical conditions by wealth quintile (percentage)




PTSD = post-traumatic stress disorder; AlcDep = alcohol dependence
Wealth quintiles: 1 is the poorest and 5 is the richest

Table S4.1. Mean wealth index by age group and mean age by wealth quintile

| Age group | Mean wealth index (range 1-5) |
|---|---|
| 40-49 | 2.99 |
| 50-59 | 3.00 |
| 60-69 | 3.12 |
| 70-79 | 2.95 |
| 80+ | 2.64 |

| Wealth Quintile | Mean age |
|---|---|
| 1 (poorest) | 62.10 |
| 2 | 62.59 |
| 3 | 61.87 |
| 4 | 61.81 |
| 5 (richest) | 60.35 |

Table S4.2. Mean number of chronic conditions by age-wealth group

| Age – Wealth group | 1 (poorest) | 2 | 3 | 4 | 5 (richest) |
|---|---|---|---|---|---|
| 40-49 | 2.09 | 2.06 | 1.88 | 1.81 | 1.86 |
| 50-59 | 2.15 | 2.15 | 2.12 | 2.24 | 2.27 |
| 60-69 | 2.26 | 2.33 | 2.24 | 2.29 | 2.27 |
| 70-79 | 1.96 | 2.12 | 2.22 | 2.35 | 2.17 |
| 80+ | 2.09 | 2.37 | 2.27 | 2.52 | 2.40 |

Table S4.3. Prevalence of ten clinical conditions by sex (percentage)

| | Female | Male | p-value |
|---|---|---|---|
| Hypertension | 68.2 | 59.6 | < 0.05 |
| Dyslipidemia | 43.2 | 45.0 | 0.2684 |
| Anemia | 42.7 | 39.8 | 0.0642 |
| HIV | 23.4 | 23.0 | 0.8044 |
| Depression | 18.3 | 14.8 | < 0.05 |
| Diabetes | 12.4 | 10.4 | 0.0550 |
| Angina | 11.6 | 7.8 | < 0.05 |
| Post-traumatic stress disorder | 5.1 | 3.9 | 0.0910 |
| Chronic bronchitis | 0.47 | 0.85 | 0.1972 |
| Alcohol dependence | 0.04 | 2.6 | < 0.05 |



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## S5. Unique disease profiles (combinations) among the study population

There were 212 mutually exclusive disease profiles (Table S5). The most common profile was having hypertension alone (11.7% of the full sample), followed by hypertension and dyslipidemia (9.4%), no condition (6.9%), and hypertension and anemia (6.4%). Profiles with more than 1 percent of the population are listed in the table.

Table S5. Unique disease profiles among all population
Profiles with more than 1 percent of the population listed below

| Profile (n=3,889) | Frequency | Percentage |
|---|---|---|
| Hypertension | 454 | 11.7 |
| Hypertension + dyslipidemia | 367 | 9.4 |
| None | 267 | 6.9 |
| Hypertension + anemia | 249 | 6.4 |
| Hypertension + dyslipidemia + anemia | 182 | 4.7 |
| Dyslipidemia | 151 | 3.9 |
| Anemia | 148 | 3.8 |
| Anemia + HIV | 103 | 2.6 |
| Hypertension + anemia + HIV | 103 | 2.6 |
| HIV | 93 | 2.4 |
| Dyslipidemia + anemia | 80 | 2.1 |
| Dyslipidemia + anemia + HIV | 79 | 2.0 |
| Hypertension + HIV | 75 | 1.9 |
| Hypertension + dyslipidemia + diabetes | 71 | 1.8 |
| Hypertension + depression | 68 | 1.7 |
| Dyslipidemia + HIV | 64 | 1.6 |
| Hypertension + dyslipidemia + HIV | 63 | 1.6 |
| Hypertension + depression | 56 | 1.4 |
| Hypertension + dyslipidemia + anemia + HIV | 52 | 1.3 |
| Hypertension + dyslipidemia + depression | 51 | 1.3 |
| Hypertension + angina | 47 | 1.2 |
| Hypertension + dyslipidemia + anemia + diabetes | 47 | 1.2 |
| Hypertension + dyslipidemia + anemia + depression | 42 | 1.1 |
| Hypertension + dyslipidemia + angina | 38 | 1.0 |

## S6. Distribution of combinations of categories of conditions (Venn diagram)

Figure S6. Venn diagram: distribution of combinations of categories of conditions

The numbers represent the percent of people with the combination of the following conditions:

Cardiometabolic: having at least one of the following conditions – hypertension, dyslipidemia, diabetes, angina

Mental: having at least one of the following conditions – depression, post-traumatic stress disorder, alcohol dependence

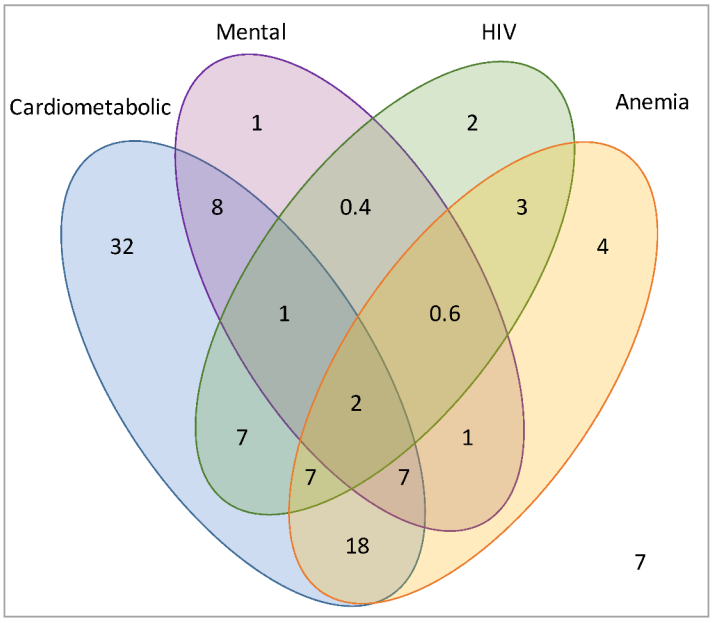



Table S6. Proportion of study sample with the combination of categories

| Number of categories | Proportion (%) |
|---|---|
| 1 | 39.2 (37.6-40.7) |
| 2 | 36.5 (34.9-38.0) |
| 3 | 15.8 (14.7-17.0) |
| 4 | 1.7 (1.3-2.2) |

## S7. Exclusion of anemia in the definition of multimorbidity

Individuals with HIV infection frequently suffer from anemia, due to causes such as blood loss, decreased and less effective red blood cell production, and increased red blood cell destruction.[12] In our sample, we found that 53% of people with HIV concurrently had anemia. Due to the high frequency of this combination, we reran the analyses by excluding anemia from the definition of multimorbidity and compared the results to the main findings in the paper. We present the same set of figures as the main manuscript but excluding anemia from the definitions of multimorbidity below. As expected, excluding anemia results in a lower proportion of the study population having multimorbidity, from 69 percent of the respondents having at least two conditions to 57 percent, and from 54 percent of the respondents having at least two categories of condition to 33 percent. While the proportion of people considered to be multimorbid decreased, excluding anemia led to qualitatively similar patterns across age and wealth, for both sets of multimorbidity definitions (Figures S8.1-8.4).

Excluding anemia leads to higher probability of multimorbidity among people with HIV, and this gap narrows with age (Figure S8.5). When applying the second definition of multimorbidity (and excluding HIV), respondents with HIV had a higher probability of multimorbidity for all age groups even after excluding anemia from the analysis.

Figure S7.1. Distribution of numbers of conditions by age group, excluding anemia from the definition of multimorbidity

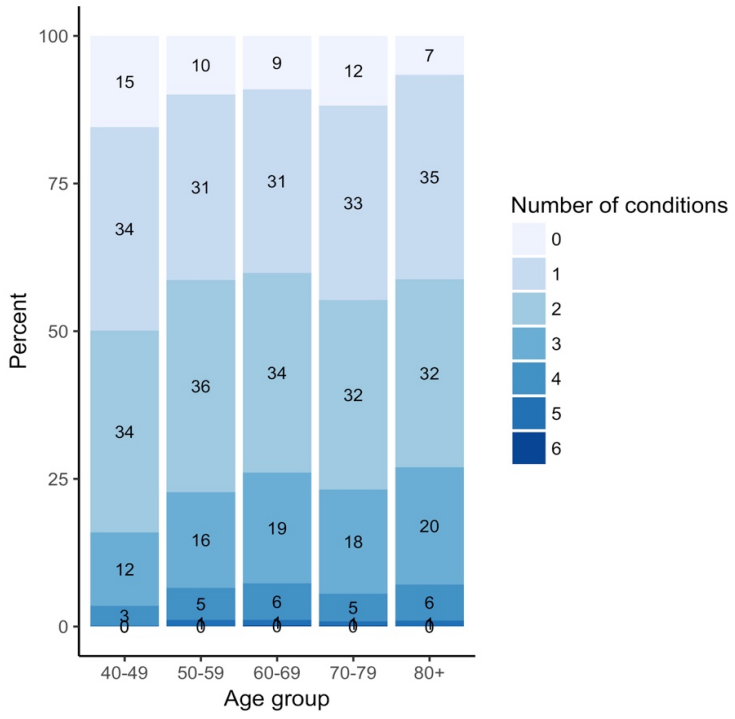


Figure S7.2. Distribution of numbers of conditions by wealth quintile, excluding anemia from the definition of multimorbidity

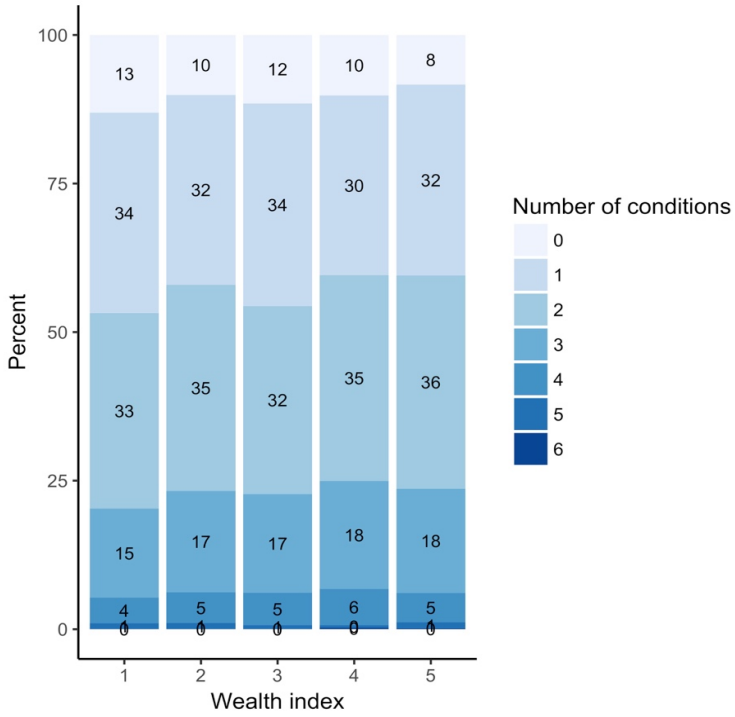



Figure S7.3. Distribution of numbers of categories of conditions by age group, excluding anemia from the definition of multimorbidity

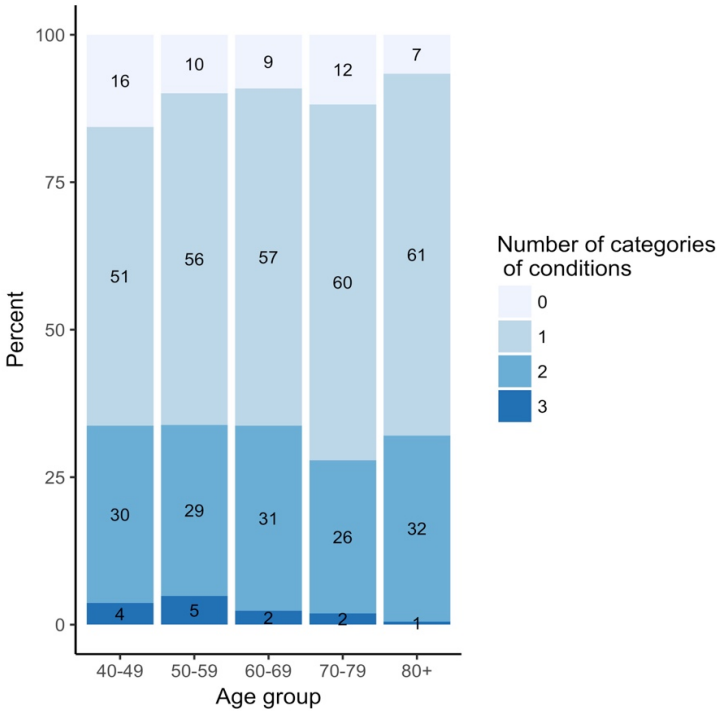


Figure S7.4. Distribution of numbers of categories of conditions by wealth quintile, excluding anemia from the definition of multimorbidity

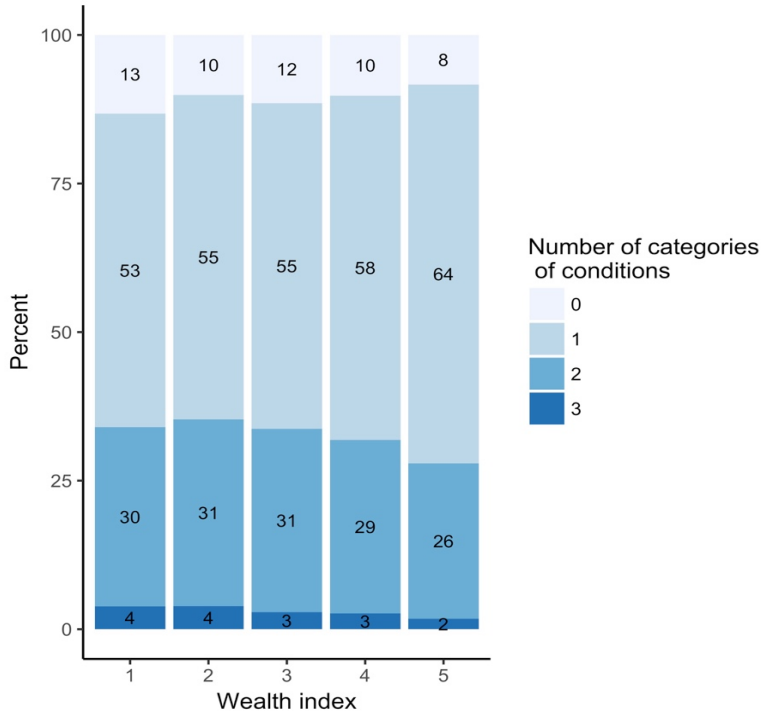
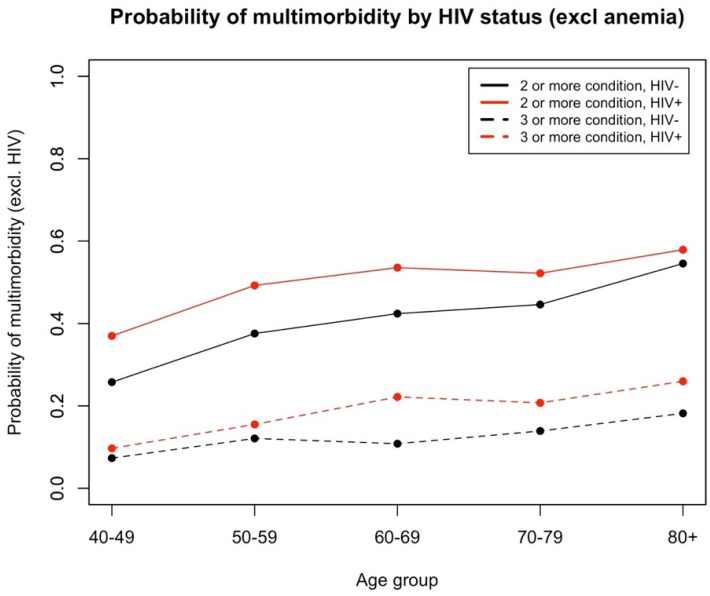



Figure S7.5. Probability of having multimorbidity, defined as having more than one condition (excluding HIV and anemia) or having more than one category of conditions (excluding HIV and anemia), by age and HIV status



## S8. Full regression tables on factors associated with number of conditions, multimorbidity (more than one condition), and multimorbidity (more than one category of conditions)

Age, marital status, and wealth were positively associated with higher numbers of chronic conditions. In applying the first definition of multimorbidity as the outcome, age (ref: 40-49; 50-59: OR=1.06, 95%CI 1.01-1.11; 60-69: OR=1.07, 95%CI 1.01-1.12, 80+: OR=1.09, 95%CI 1.02-1.16), marital status (ref: currently married or living with partner; separated/divorced: OR=1.07, 95%CI 1.02-1.12; widowed: OR=1.09, 95%CI 1.04-1.13), and wealth quintiles (ref: quintile 1; quintile 4: OR=1.06, 95% CI 1.01-1.11) were positively associated with having multimorbidity, whereas a larger household size was negatively associated (ref: living alone; living with 3-6 persons: OR=0.95; 95% CI 0.90-1.00). In contrast, under the second definition, only marital status (separated/divorced: OR=1.10, 95% CI 1.04-1.16; widowed: OR=1.13, 95% CI 1.08-1.19) was positively associated with having multimorbidity, while household size (living with 3-6 persons: OR=0.92; 95% CI 0.87-0.98; living with 7+ persons: OR=0.93; 95% CI 0.88-0.99) was negatively associated.

Table S8. Factors associated with number of conditions, multimorbidity (more than one condition), and multimorbidity (more than one category of conditions)

In model (1) the coefficients are expressed as incidence risk ratios.
In models (2) and (3) the coefficients are expressed as odds ratios.
95% confidence intervals presented in parentheses.

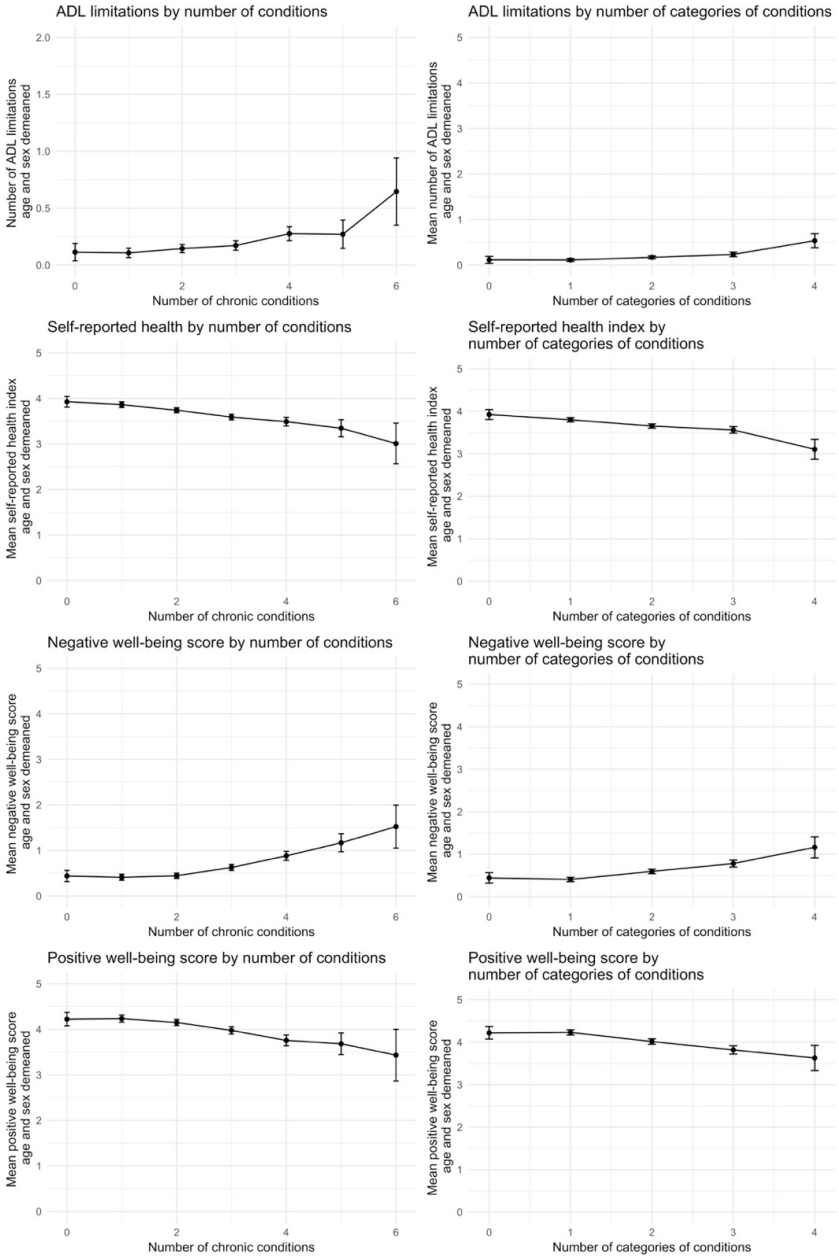
| | *Dependent variable* | | |
|---|---|---|---|
| | Number of conditions (counts) | Multimorbidity - more than 1 condition (binary) | Multimorbidity - more than 1 category (binary) |
| | *Quasi-Poisson* | *Logistic* | *Logistic* |
| | (1) | (2) | (3) |
| Age group (ref: 40-49) | | | |
| 50-59 | 1.10** | 1.06* | 0.99 |
| | (0.04, 0.15) | (1.01, 1.11) | (0.94, 1.04) |
| 60-69 | 1.13*** | 1.07* | 1.00 |
| | (0.06, 0.19) | (1.01, 1.12) | (0.95, 1.05) |
| 70-79 | 1.07 | 1.03 | 0.97 |
| | (-0.003, 0.14) | (0.97, 1.09) | (0.91, 1.03) |
| 80+ | 1.12** | 1.09* | 0.99 |
| | (0.04, 0.20) | (1.02, 1.16) | (0.92, 1.06) |
| Sex: Female | 1.06** | 1.02 | 1.01 |
| | (0.01, 0.09) | (0.98, 1.05) | (0.98, 1.05) |
| Education (ref: no formal edu) | | | |
| Some primary (1-7 years) | 1.02 | 1.02 | 1.02 |
| | (-0.03, 0.06) | (0.98, 1.06) | (0.98, 1.06) |
| Primary or more (8+ years) | 0.97 | 1.00 | 0.98 |
| | (-0.09, 0.03) | (0.95, 1.05) | (0.93, 1.04) |
| Country of origin (ref: South Africa) | | | |
| Mozambique/other | 0.99 | 1.03 | 1.03 |

| | | | |
|---|---|---|---|
| | (-0.05, 0.03) | (0.99, 1.07) | (0.99, 1.07) |
| Household size (ref: living alone) | | | |
| Living with one other person | 0.97 | 0.97 | 0.95 |
| | (-0.11, 0.05) | (0.91, 1.04) | (0.89, 1.02) |
| Living in 3-6 person household | 0.94 | 0.95* | 0.92** |
| | (-0.12, 0.01) | (0.90, 1.00) | (0.87, 0.98) |
| Living in 7+ person household | 0.98 | 0.97 | 0.93* |
| | (-0.09, 0.05) | (0.91, 1.02) | (0.88, 0.99) |
| Marital status (ref: Currently married or living with partner) | | | |
| Never married | 0.99 | 0.96 | 1.02 |
| | (-0.10, 0.08) | (0.90, 1.04) | (0.95, 1.10) |
| Separated/divorced | 1.08** | 1.07* | 1.10*** |
| | (0.02, 0.14) | (1.02, 1.12) | (1.04, 1.16) |
| Widowed | 1.09*** | 1.09*** | 1.13*** |
| | (0.04, 0.14) | (1.04, 1.13) | (1.08, 1.18) |
| Employed (part/full time) | 0.98 | 1.02 | 1.00 |
| | (-0.07, 0.03) | (0.97, 1.06) | (0.95, 1.05) |
| Wealth quintile (ref: wealth quintile 1) | | | |
| Wealth quintile 2 | 1.04 | 1.03 | 1.02 |
| | (-0.02, 0.09) | (0.99, 1.08) | (0.97, 1.07) |
| Wealth quintile 3 | 1.02 | 1.03 | 1.01 |
| | (-0.03, 0.08) | (0.98, 1.07) | (0.96, 1.07) |
| Wealth quintile 4 | 1.06* | 1.06* | 1.03 |
| | (0.01, 0.12) | (1.01, 1.11) | (0.98, 1.08) |
| Wealth quintile 5 (richest) | 1.06* | 1.05 | 1.00 |
| | (0.001, 0.12) | (1.00, 1.10) | (0.95, 1.05) |
| Constant | 1.88*** | 1.82*** | 1.70*** |
| | (0.54, 0.73) | (1.68, 1.97) | (1.57, 1.86) |

*p<0.05; **p<0.01; ***p<0.001

## S9. Relationships between physical functioning, well-being and multimorbidity: limitations in activities of daily living, negative and positive well-being experiences, and self-reported health

Figure S9. Physical functioning and well-being by number of conditions and number of categories of conditions: limitations in activities of daily living (ADL), self-reported health index, negative well-being score, and positive well-being score




All the functioning measures are demeaned for age and sex.

Models 1, 2, and 3 present the relationship between functioning and the number of conditions (count data, using zero-inflated Poisson/binomial/ordinal logistic regression models), whether one has multimorbidity defined as having more than one condition (binary data, using logistic regression), and whether one has multimorbidity defined as having more than one category of condition (binary data, using logistic regression), controlling for all covariates, respectively. Detailed descriptions of model and distribution selections are presented in Appendix Section 2.

Table S9.1. Association between multimorbidity and limitations in activities of daily living

Count model coefficients (Poisson with log link):

| | *Dependent variable:* | | |
|---|---|---|---|
| | Number of limitations in activities of daily living (Range: 0-5) | | |
| | (1) | (2) | (3) |
| Number of conditions | 1.06 | | |
| | (0.98, 1.14) | | |
| Multimorbidity: more than 1 condition | | 1.16 | |
| | | (0.88, 1.55) | |
| Multimorbidity: more than 1 category | | | 1.18 |
| | | | (0.94, 1.49) |
| Age group (ref: 40-49) | | | |
| 50-59 | 0.94 | 0.94 | 0.95 |
| | (0.58, 1.53) | (0.58, 1.53) | (0.59, 1.54) |
| 60-69 | 0.81 | 0.81 | 0.81 |
| | (0.50, 1.32) | (0.49, 1.32) | (0.50, 1.31) |
| 70-79 | 0.93 | 0.93 | 0.93 |
| | (0.56, 1.54) | (0.56, 1.54) | (0.56, 1.54) |
| 80+ | 0.90 | 0.89 | 0.89 |
| | (0.54, 1.48) | (0.54, 1.48) | (0.54, 1.48) |
| Sex: Female | 1.08 | 1.08 | 1.09 |
| | (0.82, 1.40) | (0.82, 1.40) | (0.84, 1.43) |
| Education (ref: no formal edu) | | | |
| Some primary (1-7 years) | 1.04 | 1.05 | 1.06 |
| | (0.81, 1.35) | (0.81, 1.35) | (0.82, 1.37) |
| Primary or more (8+years) | 1.14 | 1.15 | 1.16 |
| | (0.74, 1.75) | (0.74, 1.75) | (0.75, 1.80) |
| Country of origin (ref: South Africa) | | | |
| Mozambique/other | 0.88 | 0.88 | 0.88 |
| | (0.69, 1.12) | (0.69, 1.12) | (0.69, 1.13) |
| Household size (ref: living alone) | | | |
| Living with one other person | 0.90 | 0.91 | 0.91 |
| | (0.56, 1.44) | (0.56, 1.44) | (0.56, 1.46) |
| Living in 3-6 person household | 1.00 | 1.01 | 1.00 |
| | (0.69, 1.45) | (0.69, 1.45) | (0.69, 1.45) |
| Living in 7+ person household | 1.28 | 1.28 | 1.27 |
| | (0.86, 1.91) | (0.86, 1.91) | (0.85, 1.89) |
| Marital status (ref: Currently married or living with partner) | | | |
| Never married | 0.92 | 0.94 | 0.93 |
| | (0.45, 1.91) | (0.45, 1.91) | (0.45, 1.93) |
| Separated/Divorced | 0.80 | 0.80 | 0.79 |
| | (0.54, 1.20) | (0.54, 1.20) | (0.53, 1.19) |
| Widowed | 1.01 | 1.00 | 1.00 |
| | (0.76, 1.34) | (0.76, 1.34) | (0.75, 1.32) |
| Employed (part/full time) | 0.59 | 0.58 | 0.57 |
| | (0.31, 1.12) | (0.31, 1.12) | (0.30, 1.10) |
| Wealth quintile (ref: wealth quintile 1) | | | |
| Wealth quintile 2 | 0.72* | 0.71* | 0.71* |

| | | | |
|---|---|---|---|
| | (0.52, 0.99) | (0.52, 0.99) | (0.52, 0.98) |
| Wealth quintile 3 | 1.06 | 1.04 | 1.04 |
| | (0.79, 1.43) | (0.79, 1.43) | (0.78, 1.41) |
| Wealth quintile 4 | 0.71 | 0.69* | 0.71 |
| | (0.49, 1.02) | (0.49, 1.02) | (0.49, 1.02) |
| Wealth quintile 5 | 0.89 | 0.88 | 0.89 |
| | (0.60, 1.32) | (0.60, 1.32) | (0.60, 1.31) |
| Constant | 1.73 | 1.78 | 1.77 |
| | (0.91, 3.28) | (0.93, 3.38) | (0.94, 3.32) |

*p<0.05; **p<0.01; ***p<0.001
Standard errors in parentheses

Zero-inflation model coefficients (binomial with logit link):

| | *Dependent variable:* | | |
|---|---|---|---|
| | Number of limitations in activities of daily living (Range: 0-5) | | |
| | (1) | (2) | (3) |
| Number of conditions | 0.76*** | | |
| | (0.68, 0.85) | | |
| Multimorbidity: more than 1 condition | | 0.59** | |
| | | (0.68, 0.85) | |
| Multimorbidity: more than 1 category | | | 0.60*** |
| | | | (0.45, 0.81) |
| Age group (ref: 40-49) | | | |
| 50-59 | 0.61 | 0.60 | 0.58 |
| | (0.34, 1.10) | (0.34, 1.10) | (0.33, 1.04) |
| 60-69 | 0.53* | 0.51* | 0.49* |
| | (0.29, 0.97) | (0.29, 0.97) | (0.27, 0.89) |
| 70-79 | 0.30*** | 0.30*** | 0.29*** |
| | (0.16, 0.56) | (0.16, 0.56) | (0.16, 0.53) |
| 80+ | 0.14*** | 0.13*** | 0.13*** |
| | (0.07, 0.26) | (0.07, 0.26) | (0.07, 0.24) |
| Sex: Female | 1.17 | 1.14 | 1.14 |
| | (0.84, 1.63) | (0.84, 1.63) | (0.82, 1.58) |
| Education (ref: no formal edu) | | | |
| Some primary (1-7 years) | 0.96 | 0.96 | 0.96 |
| | (0.69, 1.34) | (0.69, 1.34) | (0.69, 1.34) |
| Primary or more (8+years) | 0.99 | 1.01 | 1.01 |
| | (0.59, 1.68) | (0.59, 1.68) | (0.60, 1.71) |
| Country of origin (ref: South Africa) | | | |
| Mozambique/other | 0.93 | 0.95 | 0.96 |
| | (0.67, 1.29) | (0.67, 1.29) | (0.69, 1.32) |
| Household size (ref: living alone) | | | |
| Living with one other person | 0.72 | 0.73 | 0.73 |
| | (0.39, 1.33) | (0.39, 1.33) | (0.39, 1.34) |
| Living in 3-6 person household | 0.70 | 0.70 | 0.69 |
| | (0.42, 1.15) | (0.42, 1.15) | (0.42, 1.13) |
| Living in 7+ person household | 1.02 | 1.00 | 0.98 |
| | (0.60, 1.74) | (0.60, 1.74) | (0.57, 1.67) |
| Marital status (ref: Currently married or living with partner) | | | |
| Never married | 1.01 | 0.98 | 1.02 |
| | (0.43, 2.35) | (0.43, 2.35) | (0.44, 2.36) |
| Separated/Divorced | 0.72 | 0.72 | 0.73 |
| | (0.44, 1.17) | (0.44, 1.17) | (0.45, 1.18) |
| Widowed | 0.88 | 0.88 | 0.89 |
| | (0.61, 1.27) | (0.61, 1.27) | (0.62, 1.28) |
| Employed (part/full time) | 1.84 | 1.87 | 1.83 |

| | | | |
|---|---|---|---|
| | (0.92, 3.68) | (0.92, 3.68) | (0.91, 3.69) |
| Wealth quintile (ref: wealth quintile 1) | | | |
| Wealth quintile 2 | 0.71 | 0.70 | 0.70 |
| | (0.47, 1.08) | (0.47, 1.08) | (0.47, 1.07) |
| Wealth quintile 3 | 0.98 | 0.97 | 0.97 |
| | (0.65, 1.47) | (0.65, 1.47) | (0.64, 1.45) |
| Wealth quintile 4 | 1.07 | 1.04 | 1.03 |
| | (0.67, 1.70) | (0.67, 1.70) | (0.65, 1.64) |
| Wealth quintile 5 | 1.44 | 1.42 | 1.39 |
| | (0.88, 2.36) | (0.88, 2.36) | (0.85, 2.27) |
| Constant | 49.15*** | 40.25*** | 38.27*** |
| | (21.09, 114.57) | (21.09 114.57) | (16.72 87.62) |

*p<0.05; **p<0.01; ***p<0.001
Standard errors in parentheses

Table S9.2. Association between multimorbidity and negative well-being score

Count model coefficients (Poisson with log link):

| | Negative well-being score (Range: 0-5) | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Number of conditions | 1.12*** | | |
| | (1.07, 1.17) | | |
| Multimorbidity: more than 1 condition | | 1.12 | |
| | | (0.97, 1.30) | |
| Multimorbidity: more than 1 category | | | 1.24** |
| | | | (1.08, 1.41) |
| Age group (ref: 40-49) | | | |
| 50-59 | 1.05 | 1.08 | 1.07 |
| | (0.86, 1.30) | (0.88, 1.33) | (0.87, 1.32) |
| 60-69 | 0.92 | 0.96 | 0.95 |
| | (0.73, 1.16) | (0.76, 1.21) | (0.75, 1.20) |
| 70-79 | 0.85 | 0.87 | 0.87 |
| | (0.66, 1.08) | (0.68, 1.12) | (0.68, 1.11) |
| 80+ | 0.91 | 0.94 | 0.94 |
| | (0.69, 1.20) | (0.71, 1.25) | (0.71, 1.24) |
| Sex: Female | 1.04 | 1.05 | 1.05 |
| | (0.90, 1.19) | (0.91, 1.20) | (0.92, 1.21) |
| Education (ref: no formal edu) | | | |
| Some primary (1-7 years) | 1.04 | 1.02 | 1.02 |
| | (0.90, 1.20) | (0.88, 1.18) | (0.88, 1.19) |
| Primary or more (8+years) | 1.02 | 1.00 | 1.01 |
| | (0.82, 1.28) | (0.80, 1.25) | (0.81, 1.26) |
| Country of origin (ref: South Africa) | | | |
| Mozambique/other | 1.03 | 1.00 | 1.00 |
| | (0.89, 1.19) | (0.86, 1.15) | (0.87, 1.15) |
| Household size (ref: living alone) | | | |
| Living with one other person | 0.77* | 0.76* | 0.77* |
| | (0.59, 1.00) | (0.58, 0.99) | (0.59, 1.00) |
| Living in 3-6 person household | 0.87 | 0.86 | 0.88 |
| | (0.71, 1.07) | (0.70, 1.06) | (0.71, 1.08) |
| Living in 7+ person household | 0.80* | 0.80* | 0.81 |
| | (0.64, 0.99) | (0.64, 0.99) | (0.65, 1.01) |
| Marital status (ref: Currently married or living with partner) | | | |
| Never married | 0.70 | 0.69 | 0.69 |
| | (0.48, 1.01) | (0.47, 1.01) | (0.47, 1.01) |
| Separated/Divorced | 0.83 | 0.84 | 0.83 |
| | (0.68, 1.01) | (0.69, 1.02) | (0.68, 1.00) |
| Widowed | 0.88 | 0.87 | 0.87 |
| | (0.75, 1.02) | (0.75, 1.02) | (0.74, 1.02) |
| Employed (part/full time) | 1.02 | 1.02 | 1.03 |
| | (0.84, 1.25) | (0.84, 1.25) | (0.85, 1.26) |
| Wealth quintile (ref: wealth quintile 1) | | | |
| Wealth quintile 2 | 0.95 | 0.94 | 0.94 |
| | (0.79, 1.13) | (0.78, 1.12) | (0.78, 1.12) |
| Wealth quintile 3 | 1.00 | 0.99 | 0.99 |
| | (0.83, 1.19) | (0.83, 1.19) | (0.83, 1.19) |
| Wealth quintile 4 | 0.98 | 0.98 | 0.98 |
| | (0.81, 1.18) | (0.81, 1.18) | (0.81, 1.19) |
| Wealth quintile 5 | 0.80* | 0.80* | 0.80* |
| | (0.65, 1.00) | (0.64, 0.99) | (0.65, 1.00) |
| Constant | 1.36 | 1.66** | 1.56* |
| | (0.96, 1.92) | (1.17, 2.34) | (1.11, 2.19) |

*p<0.05; **p<0.01; ***p<0.001. Standard errors in parentheses

Zero-inflation model coefficients (binomial with logit link):

| | *Dependent variable:* | | |
|---|---|---|---|
| | Negative well-being score (Range: 0-5) | | |
| | (1) | (2) | (3) |
| Number of conditions | 0.80*** | | |
| | (0.73, 0.86) | | |
| Multimorbidity: more than 1 condition | | 0.65*** | |
| | | (0.52, 0.82) | |
| Multimorbidity: more than 1 category | | | 0.62*** |
| | | | (0.51, 0.77) |
| Age group (ref: 40-49) | | | |
| 50-59 | 0.63** | 0.62** | 0.60** |
| | (0.46, 0.86) | (0.46, 0.85) | (0.44, 0.82) |
| 60-69 | 0.64* | 0.63** | 0.61** |
| | (0.45, 0.91) | (0.45, 0.90) | (0.43, 0.86) |
| 70-79 | 0.39*** | 0.39*** | 0.38*** |
| | (0.26, 0.58) | (0.26, 0.59) | (0.25, 0.56) |
| 80+ | 0.30*** | 0.31*** | 0.28*** |
| | (0.18, 0.49) | (0.19, 0.50) | (0.17, 0.46) |
| Sex: Female | 0.75* | 0.74** | 0.73** |
| | (0.59, 0.94) | (0.59, 0.92) | (0.58, 0.92) |
| Education (ref: no formal edu) | | | |
| Some primary (1-7 years) | 0.94 | 0.92 | 0.92 |
| | (0.72, 1.21) | (0.72, 1.19) | (0.72, 1.19) |
| Primary or more (8+years) | 1.24 | 1.24 | 1.23 |
| | (0.87, 1.76) | (0.87, 1.75) | (0.87, 1.75) |
| Country of origin (ref: South Africa) | | | |
| Mozambique/other | 0.97 | 0.97 | 0.97 |
| | (0.75, 1.25) | (0.75, 1.24) | (0.76, 1.25) |
| Household size (ref: living alone) | | | |
| Living with one other person | 0.71 | 0.71 | 0.70 |
| | (0.44, 1.14) | (0.44, 1.14) | (0.43, 1.13) |
| Living in 3-6 person household | 0.97 | 0.97 | 0.96 |
| | (0.68, 1.39) | (0.68, 1.39) | (0.67, 1.38) |
| Living in 7+ person household | 0.79 | 0.79 | 0.78 |
| | (0.54, 1.17) | (0.54, 1.16) | (0.53, 1.15) |
| Marital status (ref: Currently married or living with partner) | | | |
| Never married | 0.91 | 0.88 | 0.92 |
| | (0.52, 1.61) | (0.50, 1.56) | (0.52, 1.62) |
| Separated/Divorced | 0.84 | 0.84 | 0.85 |
| | (0.59, 1.18) | (0.60, 1.18) | (0.60, 1.19) |
| Widowed | 0.94 | 0.92 | 0.95 |
| | (0.72, 1.24) | (0.70, 1.20) | (0.72, 1.24) |
| Employed (part/full time) | 1.30 | 1.33 | 1.33 |
| | (0.97, 1.75) | (1.00, 1.78) | (0.99, 1.78) |
| Wealth quintile (ref: wealth quintile 1) | | | |
| Wealth quintile 2 | 0.73 | 0.72* | 0.71* |
| | (0.53, 1.00) | (0.53, 0.98) | (0.52, 0.98) |
| Wealth quintile 3 | 0.82 | 0.82 | 0.82 |
| | (0.60, 1.13) | (0.61, 1.12) | (0.60, 1.12) |
| Wealth quintile 4 | 1.03 | 1.02 | 1.01 |
| | (0.75, 1.42) | (0.74, 1.39) | (0.73, 1.39) |
| Wealth quintile 5 | 1.06 | 1.03 | 1.02 |
| | (0.74, 1.52) | (0.73, 1.47) | (0.71, 1.45) |
| Constant | 5.83*** | 5.00*** | 4.98*** |
| | (3.28 10.36) | (2.86, 8.75) | (2.85, 8.71) |

*p<0.05; **p<0.01; ***p<0.001. Standard errors in parentheses

Table S9.3. Association between multimorbidity and positive well-being score

| | *Dependent variable:* | | |
|---|---|---|---|
| | Positive well-being score (Range: 0-5) | | |
| | (1) | (2) | (3) |
| Number of conditions | 0.84*** | | |
| | (0.79, 0.90) | | |
| Multimorbidity: more than 1 condition | | 0.74** | |
| | | (0.61, 0.89) | |
| Multimorbidity: more than 1 category | | | 0.70*** |
| | | | (0.59, 0.83) |
| Age group (ref: 40-49) | | | |
| 50-59 | 0.80 | 0.79 | 0.77 |
| | (0.60, 1.05) | (0.59, 1.04) | (0.58, 1.02) |
| 60-69 | 0.89 | 0.87 | 0.86 |
| | (0.66, 1.21) | (0.64, 1.17) | (0.63, 1.15) |
| 70-79 | 0.75 | 0.74 | 0.73 |
| | (0.54, 1.04) | (0.53, 1.03) | (0.52, 1.01) |
| 80+ | 0.62* | 0.61** | 0.60** |
| | (0.43, 0.90) | (0.43, 0.89) | (0.41, 0.86) |
| Sex: Female | 0.88 | 0.87 | 0.87 |
| | (0.73, 1.07) | (0.72, 1.05) | (0.72, 1.05) |
| Education (ref: no formal edu) | | | |
| Some primary (1-7 years) | 0.96 | 0.96 | 0.96 |
| | (0.78, 1.18) | (0.78, 1.18) | (0.78, 1.18) |
| Primary or more (8+years) | 1.13 | 1.14 | 1.13 |
| | (0.84, 1.53) | (0.85, 1.54) | (0.84, 1.54) |
| Country of origin (ref: South Africa) | | | |
| Mozambique/other | 0.90 | 0.91 | 0.91 |
| | (0.74, 1.10) | (0.75, 1.11) | (0.75, 1.12) |
| Household size (ref: living alone) | | | |
| Living with one other person | 1.06 | 1.06 | 1.05 |
| | (0.74, 1.51) | (0.74, 1.51) | (0.74, 1.50) |
| Living in 3-6 person household | 1.21 | 1.21 | 1.20 |
| | (0.90, 1.61) | (0.91, 1.62) | (0.89, 1.60) |
| Living in 7+ person household | 1.26 | 1.26 | 1.24 |
| | (0.92, 1.72) | (0.92, 1.71) | (0.91, 1.69) |
| Marital status (ref: Currently married or living with partner) | | | |
| Never married | 1.10 | 1.09 | 1.11 |
| | (0.72, 1.73) | (0.71, 1.71) | (0.72, 1.75) |
| Separated/Divorced | 0.94 | 0.93 | 0.95 |
| | (0.72, 1.24) | (0.71, 1.23) | (0.72, 1.25) |
| Widowed | 0.96 | 0.95 | 0.96 |
| | (0.77, 1.19) | (0.76, 1.18) | (0.78, 1.20) |
| Employed (part/full time) | 1.18 | 1.20 | 1.19 |
| | (0.91, 1.55) | (0.92, 1.56) | (0.92, 1.55) |
| Wealth quintile (ref: wealth quintile 1) | | | |
| Wealth quintile 2 | 0.89 | 0.88 | 0.88 |
| | (0.69, 1.14) | (0.68, 1.14) | (0.68, 1.14) |
| Wealth quintile 3 | 0.86 | 0.86 | 0.86 |
| | (0.66, 1.12) | (0.66, 1.12) | (0.66, 1.12) |
| Wealth quintile 4 | 1.02 | 1.01 | 1.00 |
| | (0.77, 1.34) | (0.77, 1.33) | (0.76, 1.32) |
| Wealth quintile 5 | 1.09 | 1.08 | 1.06 |
| | (0.82, 1.46) | (0.81, 1.44) | (0.80, 1.42) |
| Constant | 7.64*** | 6.55*** | 6.66*** |
| | (4.79, 12.29) | (4.13, 10.48) | (4.22, 10.60) |

*p<0.05; **p<0.01; ***p<0.001
Standard errors in parentheses

Table S9.4. Association between multimorbidity and self-reported health status

| | Health today (Range: 1-5) | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Number of conditions | 0.79*** | | |
| | (0.75, 0.83) | | |
| Multimorbidity: more than 1 condition | | 0.64*** | |
| | | (0.56, 0.73) | |
| Multimorbidity: more than 1 category | | | 0.70*** |
| | | | (0.62, 0.79) |
| Age group (ref: 40-49) | | | |
| 50-59 | 0.76** | 0.74** | 0.72*** |
| | (0.63, 0.92) | (0.61, 0.90) | (0.60, 0.87) |
| 60-69 | 0.64*** | 0.62*** | 0.61*** |
| | (0.52, 0.79) | (0.51, 0.77) | (0.49, 0.75) |
| 70-79 | 0.46*** | 0.45*** | 0.44*** |
| | (0.36, 0.58) | (0.36, 0.57) | (0.35, 0.56) |
| 80+ | 0.25*** | 0.25*** | 0.24*** |
| | (0.19, 0.33) | (0.19, 0.32) | (0.18, 0.31) |
| Sex: Female | 0.97 | 0.95 | 0.95 |
| | (0.85, 1.11) | (0.83, 1.09) | (0.83, 1.09) |
| Education (ref: no formal edu) | | | |
| Some primary (1-7 years) | 1.03 | 1.03 | 1.03 |
| | (0.89, 1.19) | (0.89, 1.20) | (0.88, 1.19) |
| Primary or more (8+years) | 1.31* | 1.32** | 1.31* |
| | (1.06, 1.61) | (1.07, 1.63) | (1.06, 1.62) |
| Country of origin (ref: South Africa) | | | |
| Mozambique/other | 0.92 | 0.94 | 0.94 |
| | (0.80, 1.07) | (0.81, 1.09) | (0.81, 1.09) |
| Household size (ref: living alone) | | | |
| Living with one other person | 1.01 | 1.01 | 1.01 |
| | (0.77, 1.31) | (0.78, 1.32) | (0.77, 1.31) |
| Living in 3-6 person household | 1.16 | 1.16 | 1.15 |
| | (0.93, 1.44) | (0.93, 1.44) | (0.92, 1.43) |
| Living in 7+ person household | 1.08 | 1.07 | 1.06 |
| | (0.85, 1.36) | (0.85, 1.35) | (0.84, 1.33) |
| Marital status (ref: Currently married or living with partner) | | | |
| Never married | 0.87 | 0.87 | 0.89 |
| | (0.65, 1.18) | (0.64, 1.17) | (0.66, 1.20) |
| Separated/Divorced | 0.87 | 0.86 | 0.86 |
| | (0.71, 1.06) | (0.70, 1.05) | (0.71, 1.06) |
| Widowed | 0.90 | 0.89 | 0.89 |
| | (0.76, 1.05) | (0.76, 1.04) | (0.76, 1.04) |
| Employed (part/full time) | 1.54*** | 1.56*** | 1.55*** |
| | (1.29, 1.84) | (1.31, 1.86) | (1.30, 1.85) |
| Wealth quintile (ref: wealth quintile 1) | | | |
| Wealth quintile 2 | 1.06 | 1.06 | 1.05 |
| | (0.88, 1.28) | (0.88, 1.27) | (0.87, 1.27) |
| Wealth quintile 3 | 0.93 | 0.94 | 0.93 |
| | (0.77, 1.13) | (0.77, 1.13) | (0.77, 1.13) |
| Wealth quintile 4 | 1.12 | 1.11 | 1.09 |
| | (0.92, 1.36) | (0.91, 1.34) | (0.90, 1.33) |
| Wealth quintile 5 | 1.28* | 1.26* | 1.24* |
| | (1.04, 1.57) | (1.03, 1.55) | (1.01, 1.52) |
| 1 Very good \| 2 Good | 0.00 | 0.01 | 0.01 |
| | (0.00, 0.01) | (0.00, 0.01) | (0.00, 0.01) |
| 2 Good \| 3 Moderate | 0.09 | 0.10 | 0.11 |
| | (0.06, 0.12) | (0.07, 0.15) | (0.08, 0.16) |
| 3 Moderate \| 4 Bad | 0.19 | 0.23 | 0.25 |
| | (0.14, 0.27) | (0.16, 0.32) | (0.18, 0.34) |

| | | | |
|---|---|---|---|
| 4 Bad \| 5 Very bad | 1.99 | 2.34 | 2.50 |
| | (1.42, 2.78) | (1.68, 3.26) | (1.80, 3.48) |

$^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$. Standard errors in parentheses

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