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Multimorbid Life Expectancy Across Race, Socioeconomic Status, and Gender in South Africa

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Abstract

The burden of multimorbidity is increasing globally as populations age. However, it is unclear how many years someone is expected to live with multimorbidity, and how it varies by social and economic factors particularly in low- and middle-income countries. We investigate this in South Africa, where its apartheid history further complicates the roles of race, socioeconomic, and gender inequalities in society. This underlines the importance of taking an intersectional perspective when trying to understand the interplay of these factors and how they influence health and mortality. We introduce the term 'multimorbid life expectancy' to describe the years lived with multimorbidity. Using an incidence-based multistate Markov modeling approach, we find that females had higher multimorbid life expectancy than males (17.7 years vs 9.9 years), and this disparity was consistent across all race and education groups. Asian/Indians and the post-secondary educated had the highest multimorbid life expectancy relative to other groups. White males seemed to benefit the most from having more education, while African males and females seemed to benefit the least. This suggests associations between structural inequalities and multimorbid life expectancy, highlighting the need for health system and educational policy changes that are proportionate to each group's level of need.

Keywords: Life expectancy, multimorbidity, South Africa, inequalities, intersectionality

Introduction

Multimorbidity is defined as the co-occurrence of two or more chronic conditions (Johnston et al. 2019). As people accumulate multiple diseases, they are faced with decreased quality of life and increased healthcare utilization which may include complex treatment regimens and multiple medications (Academy of Medical Sciences 2018; Alaba and Chola 2013). As populations age and the prevalence of non-communicable disease (NCD) risk factors (e.g. obesity, physical inactivity) continue to rise globally, the burden of multimorbidity is expected to increase (Academy of Medical Sciences 2018). This has implications for individuals and health systems worldwide, but particularly in low- and middle-income countries (LMICs), which already face a large burden of NCD-related deaths (Basto-Abreu et al. 2022). Existing research on multimorbidity has been highly concentrated in high-income countries (HICs), but the literature on multimorbidity in LMICs is expanding, with several studies recently published (Abebe et al. 2020; Chang et al. 2019; Kamkuemah et al. 2022; Keetile et al. 2020; Khorrami et al. 2020; Roomaney et al. 2021; Sharman and Bachmann 2019). The nature of multimorbidity and its potential risk factors may differ in LMICs compared to HICs. Many LMICs are undergoing a protracted epidemiological transition, suggesting overlaps in infectious and non-communicable disease stages, creating a dual burden of disease and different patterns of multimorbidity (Frenk et al. 1989; Oni et al. 2015). Multimorbidity is often defined as including only NCDs. However, this may not be the most representative definition in LMICs because infectious diseases such as HIV and tuberculosis are also considered chronic (Farmer 2013).

In this article, we focus on multimorbidity in South Africa, an upper middle-income country with a complex history of inequalities and disease. Longitudinal evidence on

multimorbidity in South Africa is lacking and cross-sectional prevalence estimates vary widely, from 3%-70%, due to differences in age distribution and multimorbidity definitions across studies (Alaba and Chola 2013; Chang et al. 2019; Oni et al. 2015; Roomaney et al. 2021; Weimann et al. 2016). Across 10 studies of multimorbidity prevalence in South Africa, the five most common disease clusters included various combinations of hypertension, diabetes, HIV, and tuberculosis (Roomaney et al. 2021). This supports the idea that infectious and non-communicable disease multimorbidity is an important concern. Further, continuing high rates of infectious disease also contribute to the distribution of multimorbidity shifting to younger ages, since the average age of people with HIV and tuberculosis is lower compared to those with only NCDs (Afshar et al. 2017; Oni et al. 2014; Oni et al. 2015). A recent study of people aged 15-24 with HIV in South Africa found that 5% had hypertension and 37% had central obesity (Kamkuemah et al. 2022). Already having these conditions at a young age increases the likelihood that multimorbidity will develop sooner. Additionally, antiretroviral therapy uptake has contributed to increases in life expectancy for people with HIV, which leads to them having a higher chance to develop multimorbidity earlier, but also spend a greater share of their lives with multimorbidity (Doan et al. 2022; Oni et al. 2014; Oni et al. 2015).

Life expectancy has long been used as a measure of population health. However, as people began to live longer with nonfatal diseases, it became relevant to understand how much time people spend in states of good or bad health. Development of an index of mortality and morbidity began in the 1960s and continued over the next several decades (Bone 1992; Chiang 1965; Ghana Health Assessment Project Team 1981; Sanders 1964; Sullivan 1966, 1971). This

resulted in different measures of health expectancy, including disability-free life expectancy, disability-adjusted life expectancy, and healthy life expectancy (Murray et al. 2000).

In this paper, we introduce the term "multimorbid life expectancy" (MMLE) – that is the years someone is expected to live with multimorbidity. Previous studies have estimated MMLE, but with different terminology which includes "years lived with multimorbidity" (Chan et al. 2019; Kingston et al. 2018), "time spent with multimorbidity" (Chan et al. 2019), and "life years with multimorbidity" (Botes et al. 2018; Tetzlaff et al. 2017). Other studies have not focused specifically on multimorbidity, but on multiple chronic conditions and have used such terms as "life expectancy with chronic morbidities" (Payne 2022) and "duration of chronic disease" (Murtaugh et al. 2011). The benefit of having a specific MMLE term is to encourage consistency, thus allowing for easier understanding and comparison of multimorbidity burden between and within populations and over time, provided that the multimorbidity definitions are comparable.

We estimate life expectancy and MMLE using an incidence-based Markov chain approach. This method maximizes use of the first national household panel study in South Africa, the National Income Dynamics Study. It is currently the only approach which allows us to accurately estimate the timings of transitions into and out of disease states using panel data (Schneider et al. 2021b). Using these timings, we can obtain expectancy estimates for various combinations of initial and target states, as well as life expectancy from any specified age.

Multimorbidity itself is already fraught with definitional complexity and trying to understand it within the context of life expectancy raises interesting questions. One major issue is whether longer time spent with multimorbidity might be considered a positive or negative

outcome. While disease accumulation might outwardly be thought of as a poor health outcome, longer survivorship with multiple conditions and a higher MMLE might reflect advantage through less disabling conditions and better disease management. On the other hand, lower MMLE might be a function of more severe conditions and poorer survivorship with those diseases.

Social and structural factors, such as race, socioeconomic status, and gender, likely also play a role in determining an individual's MMLE and how they experience it (Chan et al. 2019; Murtaugh et al. 2011; Payne 2022). In South Africa, apartheid was in place from 1948-1994 (Chopra and Sanders 2004), meaning that the majority of our study sample spent most of their lives under apartheid, with some being old enough to experience pre- and post-apartheid society. This apartheid legacy has resulted in persistent health and social inequalities by gender, and across racial and socioeconomic strata (Bell et al. 2022; Chopra and Sanders 2004; Coovadia et al. 2009; Payne et al. 2020). Some individuals may experience more or less of these inequalities depending on their social location, and their advantages or disadvantages may be amplified over time by changing historical and political contexts. It is important to note that these social inequalities do not act independently. They interact with each other and likely have differential effects at various points in the life course, especially at times when major social and structural changes occur. Thus, we use intersectionality and cumulative advantage/disadvantage theory as lenses to view the numerous constellations of inequalities and try to understand how the varying pathways may influence multimorbidity and mortality.

Our study brings novelty to existing multimorbidity and life expectancy research by using an incidence-based Markov chain approach with data from a middle-income country.

Further, by incorporating theories of intersectionality and cumulative advantage/disadvantage, we conceptualize the complex interactions between race, socioeconomic status, and gender that are deeply rooted in South African society. Using these approaches, we obtain a more holistic picture of the relationship between race, socioeconomic status, gender, and multimorbid life expectancy in South Africa.

Background

Race

Race[1] is a complex, socially constructed concept. It can contribute to differences in health and mortality outcomes, which may also vary depending on cultural, political, and country-specific factors. For example, in the United States, Blacks consistently have poorer health and higher rates of mortality compared to their White counterparts whereas Latinx and Asians tend to have better outcomes (National Academies of Sciences 2017).

In South Africa, the systemic racial discrimination during apartheid had a detrimental impact on how different racial groups were treated. Racial classification provided the basis for the function of society, with individuals being declared as either "White", "Asian", "Coloured", or "Native" (Posel 2001). Being "Coloured" indicated that someone was of mixed-race and "Native" was the label for Black South Africans. These racial categorizations remain ingrained in South African society, with the younger generations, who did not directly experience apartheid,

[1] We acknowledge that race and ethnicity are separate concepts, and that South Africa is home to a variety of ethnic groups, but for the purposes of this paper we will refer only to race.

still self-identifying in one of these four groups. Based on these racial classifications, apartheid policies to improve health and economy during most of the 20th century focused on the White population, leaving the rest of the country to deal with inferior healthcare and deteriorating living conditions (Benatar 2013). Black South Africans in particular had limited access to poor quality care, and in 1980, the life expectancy disparity between Blacks and Whites was 15 years (Kon and Lackan 2008).

Although there have been improvements in health and social systems since 1994 when apartheid ended, disparities remain entrenched and widespread. The health system evolved from highly fragmented region-specific systems during apartheid to a mixed and highly unequal pluralistic system post-apartheid, in which only the wealthy could afford higher quality private care (Kon and Lackan 2008). From 2012-2017, South Africa piloted the first phase of their National Health Insurance system as a step towards achieving universal health coverage and addressing the existing disparities, however the results were mixed (Murphy and Moosa 2021). While coverage increased, the main issue was the lack of decentralized governance and consequently, compliance in primary healthcare clinics and a lack of transparency and accountability (Day and Zondi 2019). The second implementation phase is currently in progress, with emphasis on legislation, including the National Health Insurance Bill which was passed in 2019 (Pauw 2021).

The direct association between multimorbidity and race is difficult to disentangle due to the inextricable link between race and socioeconomic status (SES) that manifested under apartheid (Weimann et al. 2016). This may contribute to the lack of evidence on racial differences in multimorbidity in South Africa. Many multimorbidity studies were conducted in

rural areas where almost all participants were Black (Oni et al. 2015; Wade et al. 2021; Wong et al. 2021), or race was not included in the analysis. Of the studies that examined racial differences, two found that Asian/Indian participants were more than twice as likely to have multimorbidity compared to African and Coloured participants (Sewpaul et al. 2021; Weimann et al. 2016). Another found that Asian/Indian and Coloured participants had about 1.5 greater odds of multimorbidity compared to White participants (Phaswana-Mafuya et al. 2013).

Socioeconomic Status

Socioeconomic status (SES) is often represented by one's education, occupation, and/or income. It is well-established that higher SES is associated with better health and lower mortality, and this is particularly true in settings with high inequality (Glymour et al. 2014; Lago et al. 2018; Mackenbach et al. 2008). In LMICs, the patterns of associations between SES and certain health conditions or risk factors seem to differ from those seen in HICs. For example, there seems to be a positive association between SES and obesity in low-income countries, whereas the association in middle- and high-income countries is more mixed (Dinsa et al. 2012). It has also been observed that in LMICs, low SES is associated with higher risk of certain cancers, cardiovascular disease, arthritis, and respiratory diseases, but there are mixed results for diabetes (Hosseinpoor et al. 2012; Sommer et al. 2015; Williams et al. 2018). Lower SES is also associated with an increased risk of multimorbidity (Afshar et al. 2015; Arokiasamy et al. 2015; Pathirana and Jackson 2018). This relationship is also seen in South Africa, where socioeconomically deprived individuals have a higher likelihood of multimorbidity compared to those who are not deprived (Ataguba 2013; Weimann et al. 2016).

The evidence for an association between education and multimorbidity is mixed, with some studies reporting a positive association, some reporting a negative association, and some reporting no association (Feng et al. 2021). A cohort study from Brazil found that there may be a reduction in risk of mortality for people with multimorbidity who have higher education, compared to those with less education (Bernardes et al. 2021). In South Africa, higher education seems to be protective against multimorbidity (Afshar et al. 2015; Alaba and Chola 2013; Garin et al. 2016).

Gender

It is well-established that gender differences exist within health and mortality, with males tending to have shorter but healthier lives compared to females. This phenomenon is known as the morbidity-mortality paradox or the male-female health-survival paradox. Males are generally more susceptible to fatal diseases earlier in life, whereas females have more nonfatal diseases later in life (Rieker and Bird 2005). Females are also more likely to have multimorbidity than males, and this pattern is consistent across several studies in countries of various income levels (Abebe et al. 2020; Agur et al. 2016; Garin et al. 2016; Xu et al. 2017). This may be due to females having a lower threshold to seek treatment and a higher likelihood of attending primary care and being diagnosed with disease, but could also be attributable to physiological factors such as obesity or hormonal differences (Afshar et al. 2017; Höhn et al. 2020; Weimann et al. 2016). There are also social, cultural, and environmental factors that impact the health and mortality of males and females, such as males being more likely to partake in risky behaviors (Mateos et al. 2020; Oksuzyan et al. 2010).

The morbidity-mortality paradox is also observed in South Africa, but the life expectancy gap between women and men seems to be growing, in part due to differing rates of HIV-related mortality (Bor et al. 2015). Although women have greater HIV prevalence, men have higher rates of mortality, largely due to women being more likely to seek and complete treatment at earlier stages of disease (Bor et al. 2015; Cornell et al. 2009; Cornell et al. 2012; Haal et al. 2018; Kranzer et al. 2010). Additionally, particularly under apartheid, the control and subordination of women alongside acts of physical and sexual violence increased their vulnerability to HIV, reproductive health problems, unsafe abortion, and mortality (Coovadia et al. 2009). Regardless of HIV status, South African women have higher rates of multimorbidity, hypertension, and obesity compared to men (Chang et al. 2019; Malaza et al. 2012; Oni et al. 2015; Wade et al. 2021; Wong et al. 2021).

Intersectionality and Cumulative Advantage/Disadvantage

The aforementioned factors of race, SES, and gender do not act independently upon individuals, and their effect also varies by context. They are, in combination with other characteristics such as age, sexuality, and disability, social stratifiers that interact and are shaped by the political, religious, cultural, and social environment (Hankivsky 2014). Intersectionality was first coined by Kimberlé Crenshaw when she wrote about how being Black and being a woman was a unique experience more complex than that of just being Black or just being a woman (Crenshaw 1989). Rather than being an additive approach, intersectionality describes the multidimensional interaction of various innate and acquired characteristics that shape human experiences (Bauer 2014; Hankivsky 2012). Whilst it has mainly been applied as

a way to explain the complexity of gender, race, and class through a feminist lens, it is gaining traction as a framework to understand health disparities and the stigma associated with certain health conditions (Bauer 2014; Bowleg 2012, 2021; Jackson-Best and Edwards 2018; Turan et al. 2019).

Like intersectionality, cumulative advantage/disadvantage (CAD) theory describes how individuals' lives are structured by the different risk and protective factors that surround them. The main tenant of CAD theory is the accumulation of these factors, resulting in some groups (e.g. less educated Black women) becoming progressively less advantaged while others (e.g. high educated White men) become more advantaged (Pais 2014; Shuey and Willson 2008). Over time, this advantage or disadvantage tends to grow, resulting in greater inequalities between the advantaged and disadvantaged groups (Dannefer 2020; Diprete and Eirich 2006; Seabrook and Avison 2012; Willson et al. 2007).

Using both intersectionality and CAD frameworks will allow for a more nuanced interpretation of the mechanisms of inequality in MMLE. There is limited research that uses these theories within the domain of multimorbidity. Rather, many studies investigate mid to late life health more generally, and often take a life course approach (Jackson and Engelman 2022; Singh-Manoux 2004). While CAD theory is not always explicitly mentioned, authors use terms such as "cumulative socioeconomic disadvantage" or "an accumulation of disadvantage" that suggest similar ideas. Based on previous literature, we would expect that individuals with more social and structural disadvantages would have poorer health outcomes. However, in LMICs certain diseases and risk factors, such as diabetes and obesity, tend to cluster in more

advantaged groups or there is no clear pattern (Dinsa et al. 2012; Seiglie et al. 2020; Templin et al. 2019).

Summary

Existing evidence indicates that race, SES, and gender have varying and potentially synergistic associations with multimorbidity. This study aims to quantify MMLE across race, SES, and gender groups. We will use intersectionality and CAD theory as frameworks to interpret the complex relationships between these factors in South Africa.

Because of the strong correlation between race and SES, we anticipate that Africans, who tend to have lower SES, will spend more time with multimorbidity than Whites, who tend to have higher SES. Accordingly, we expect that there will be a reverse socioeconomic gradient, with higher SES being associated with lower MMLE. We also expect to find that females will consistently have higher MMLE than males, due to the morbidity-mortality paradox. Based on intersectionality theory, we foresee that the role of race and SES will differ by gender, due to differences in gender norms across cultures and in access to education (Helman and Ratele 2016; Mabokela and Mawila 2004). From CAD theory, we expect that the groups with the most disadvantages (e.g., low educated African females) may have higher MMLE compared to the least disadvantaged groups (e.g., high educated White males). However, there is also potential to find evidence for the opposite relationship, whereby the most disadvantaged groups have lower MMLE and the least disadvantaged groups have higher MMLE.

Methods

Data

Data are from the South African National Income Dynamics Study (NIDS), a nationally representative household panel survey with five waves of data collected from 2008-2017 (Southern Africa Labour and Development Research Unit 2018a, 2018e, 2018d, 2018c, 2018b). The baseline sample was collected using a two-stage clustered sampling design and consisted of over 28,000 individuals from more than 7,300 households (Brophy et al. 2018). NIDS has two types of participants: continuing sample members (CSMs) and temporary sample members (TSMs). CSMs were followed-up each wave whereas TSMs were interviewed only when they were co-resident with a CSM. The questionnaires collected a variety of data, such as self-reported economic, health and well-being, sociodemographic, and household information. We included participants who were interviewed using the adult questionnaire, since it was the only one that provided detailed health information, such as anthropometric measurements. Death was measured through household reports of deaths that occurred in that household in the past 24 months.

Merging data from all five waves for adults aged 20 and over resulted in a total sample of N=28,237 participants. We excluded participants who were only present at one wave and subsequently lost to follow-up (n=9340), who did not have two or more adult questionnaires (n=447), and anyone missing essential sociodemographic or mortality information (n=420). Over 50% of excluded participants were TSMs, so were not tracked and followed-up. The excluded participants were more likely to be male, slightly younger, higher educated, Asian/Indian and White, and live in more urban areas than those in the analysis sample

(Appendix I). This is in line with attrition patterns identified by the NIDS investigators, where 39% of Asian/Indian and 52% of White participants were not re-interviewed at the second wave (Branson 2019). A top-up sample was conducted in the last wave to increase representativeness, particularly for Asian/Indian and White participants, but these individuals could not be included in our data because they were only present in one wave. Almost 44% of the excluded participants were also missing disease information at baseline.

The final analytic sample consisted of n=18,030 participants. Each participant had anywhere from one to four transitions between disease states, depending on the number of waves in which they were present, resulting in n=73,248 transitions. Over half of participants were present in all five waves (51%), 20% were present in four, 13% present in three, and 16% were present in only two waves.

Variables

Measurement of Multimorbidity

There is no consensus on a multimorbidity definition. While it is usually defined as the presence of two or more chronic conditions in an individual, the number and type of included diseases varies substantially (Academy of Medical Sciences 2018; Ho et al. 2021; Johnston et al. 2019). There are several different methods of measuring multimorbidity, including simple disease counts, weighted disease indices (e.g. Charlson comorbidity index), and weighted medication indices (Ho et al. 2021). The range of diseases included in multimorbidity indices also range from two to over 100, and are partly related to whether disease data is obtained through self-report or medical records (Ho et al. 2021). Additionally, the inclusion of certain diseases like

HIV and tuberculosis seem to be context dependent (Ho et al. 2021). Unless the focus is specifically on NCDs, South African studies on multimorbidity often include HIV and tuberculosis because they are both endemic chronic infections (Alaba and Chola 2013; Ataguba 2013; Chang et al. 2019; Peltzer 2018; Roomaney et al. 2022; Roomaney et al. 2021; Sharman and Bachmann 2019; Wade et al. 2021; Weimann et al. 2016; Wong et al. 2021).

We defined multimorbidity as having two or more of the following diseases: Alzheimer's Disease, arthritis, asthma, cancer, diabetes, emphysema, epilepsy, heart problems, HIV, hypertension, kidney problems, stroke, and tuberculosis. A state of 'one disease' was defined as having only one of any of the aforementioned diseases throughout follow-up. 'No disease' means having none of the above diseases. Most diseases were indicated as present if the participant reported ever being told by a doctor, nurse, or healthcare professional that they had the disease. Systolic and diastolic blood pressure were measured twice at each wave and the average of the two measurements was used to indicate whether hypertension was present. The cut-offs for hypertension were having a systolic blood pressure ≥ 140mmHg and a diastolic blood pressure ≥ 90mmHg, with the difference between the two being ≥ 15mmHg (Cois and Ehrlich 2018; Unger et al. 2020).

Other Covariates

Age was included as a continuous variable starting from 20 years, and no upper limit restrictions were used. Geography was defined as either being urban or rural, with urban indicating any built-up areas and rural indicating villages under jurisdiction of traditional leaders, and farms (Brophy et al. 2018). Participants were asked to identify as being part of

one of the following racial groups: African, Asian/Indian, Coloured, or White. Here 'African' is used to describe those of the native Black African group, and 'Coloured' is a uniquely southern African term used to describe someone of mixed race ancestry (Adhikari 2009), as used in both the NIDS survey and South Africa's census. Education was measured as the highest level of completed education at the baseline visit and split into three categories: some secondary school or less (up to grade 9), completed secondary school (grade 12), and post-secondary school including vocational training. We chose education as our SES indicator because it is commonly used in health research since it is easy to measure and generally stays consistent throughout life (Galobardes 2006).

Statistical Analysis

We obtained descriptive statistics of our analytic sample and computed the prevalence of each of the included diseases to identify the most common diseases and multimorbid disease combinations. We then used multinomial logit models to predict the probability of transitioning between different states: no disease, one disease, two or more diseases (multimorbidity), and death. Individuals can begin in any of these three disease states and either remain in the same state, transition to a subsequent state, or die (Figure 1). We did not allow for reverse transitions, in which individuals might become cured of a disease, due to the chronic nature of multimorbidity. Death is an absorbing state, meaning that once someone enters that state they cannot leave. All other states are considered transient.

The base model (model 1) was adjusted for linear age and geography, stratified by gender, and weighted using NIDS design weights which correct for nonresponse. Details of how

the weights were calculated can be found elsewhere (Brophy et al. 2018). Building off model 1, we ran the subsequent models with the addition of the following variables: race (model 2), education (model 3), or the interaction between race and education (model 4). The models take the general form:

$$log\left(\frac{p_{ij}}{p_{iN}}\right) = \alpha_{ij} + \beta_{1,ij}Age + \beta_{2,ij}Geo + \gamma_{ij}Cov$$

where p_{ij} is the biannual probability of moving from state *i* to state *j*; *j = N* indicates the reference target state of no disease; α_{ij} is the intercept; *Age* is the individual's exact age at each interview; *Geo* indicates the baseline proportion of participants living in urban areas; γ_{ij} is the coefficient for *Cov,* which includes the covariates race, education, or their interaction. The race and education variables in model 4 were simplified due to small sample sizes in some of the original strata. The Asian/Indian racial group was excluded, and education was dichotomized into "some secondary school or less" and "completed secondary school or more". This dichotomization of education was chosen to create a balanced distribution across the two categories.

The transition probabilities were estimated by setting the geography variable to its sample proportion (i.e., proportion in urban areas), and setting the categorical variables to equal a specific group (e.g., African or post-secondary educated). These probabilities were input into a matrix with each row representing two-year age intervals from ages 20-85. The transition probability matrix was truncated at age 85 because of small sample sizes in the oldest ages. Each column of the matrix represents the probability of transitioning from state j to state i.

The predicted transition probabilities were subsequently input into discrete-time multistate Markov models. They take a Markov assumption, meaning that the expectancy estimates are calculated based on the current state and covariate profile of an individual, regardless of their status or duration spent in any prior state (Kemeny and Snell 1983). They are analyzed using a matrix notation, with transition probabilities organized into matrices P = [p_{ij}] for each stratum of race and education, separately for males and females, by two-year age intervals (Hale et al. 2020; Lorenti et al. 2020). Below is a simplified transition matrix

$$P_{ij} = \begin{pmatrix} p_{11} & p_{12} & p_{13} & p_{14} \\ 0 & p_{22} & p_{23} & p_{24} \\ 0 & 0 & p_{33} & p_{34} \end{pmatrix}$$

where p_{11} represents the probability of remaining in the first state (no disease), p_{12} the probability of moving from no disease to one disease, p_{13} the probability of transitioning from no disease to multimorbidity, p_{14} the probability of transition from no disease to death, and so on. The zeroes demonstrate that reverse transitions that cannot occur (e.g., the transition from multimorbidity to one disease). Each transition occurs between an age interval *k* and *k+1* (e.g., age interval 20-22 to 22-24), but this notation was excluded from the matrix above for simplification.

These transition matrices were used to compute the time spent in each transient state through the fundamental matrix

$$N = (I_n - U)^{-1}$$

where U is a transient-state-only transition matrix; I_n is an $n \times n$ identity matrix; and superscript -1 denotes the inverse. The row sums of N indicate the life expectancy given initial

state i. The expected time in target state *j,* given an initial state *i,* is represented by N_{ij} (Hale et al. 2020; Lorenti et al. 2020)

We calculate truncated life expectancies from each initial state at age 20 until age 85, as well as a weighted average based on initial state distributions at the starting age. We calculated these initial state distributions for participants aged 20-29 to increase sample size and obtained these distributions separately for males and females. We present only the weighted expectancies, but expectancies from each initial state (0 disease, 1 disease, and multimorbidity) can be found in Appendix II. We also present MMLE in terms of absolute years and proportion of remaining life expectancy. The 95% confidence intervals are based on asymptotic theory and the delta method. This method does not set restrictions on the confidence limits, thus allowing the possibility for negative confidence limits to occur. In cases where this occurs, the limit was set equal to zero, as negative expectancies are not possible. The calculations for these 95% confidence intervals have recently been developed in Schneider (2022). The underlying variance-covariance matrix of the multinomial logit model accounts for the complex survey design.

We performed sensitivity analyses for different definitions of multimorbidity, and for state and life expectancies from age 40. Hypertension is often referred to as a risk factor for disease, but is also commonly included in multimorbidity studies (Ho et al. 2021; Lancet 2019; Stanaway et al. 2018). On the other hand, tuberculosis is often described as a chronic infectious disease, but many studies have investigated multimorbidity in people with tuberculosis rather than including it as one of the multimorbid diseases (Peltzer 2018; Reis-Santos et al. 2013; Siddiqi et al. 2020; Stubbs et al. 2021). Thus, we excluded hypertension and/or tuberculosis

from our multimorbidity definition to see what impact it had on the expectancy estimates. We estimated life expectancy at age 40 because we were interested in whether the patterns of time with multimorbidity and life expectancy would change given an older initial age since multimorbidity prevalence increases with age.

Analyses were conducted in both R version 4.0.3 (R Core Team 2020) Stata 17 (StataCorp 2021) to ensure robustness across both softwares. Expectancy estimates were obtained using the *mcwr* package in R (Schneider et al. 2021a) and expectancy estimates with confidence intervals were obtained in Stata based on methods developed by Schneider (2022).

Results

Table 1 details the sociodemographic characteristics of our sample. The average age was 42.0 years (SD 16.2), with males being younger than females. Age ranged from 20 years to 106 years. Sixty percent of the sample was female. Most participants were African (80%), followed by Coloured (15%), White (4%), and Asian/Indian (1%). Over half the participants (53%) had some secondary school education or less while 35% finished secondary school and 12% had post-secondary education. More males than females entered the study without any of the included diseases (77% vs. 66%) whereas more females entered with one disease (25% vs. 18%) or multimorbidity (9% vs. 5%). Figure 2 shows the most prevalent diseases at baseline, the top three of which were hypertension (females: 46%, males: 33%), tuberculosis (females: 11%, males: 14%), and diabetes (females: 13%, males: 8%). For males, the three most common multimorbid clusters were hypertension/diabetes (18%), hypertension/tuberculosis (10%), and hypertension/heart problems (9%). For females, the three most common multimorbid clusters

were hypertension/diabetes (20%), hypertension/heart problems (8%), and hypertension/asthma (6%).

Transitions and Transition Probabilities

Table 1 and Figure 3 show that most people remained in the state they were in when they entered the study (83%-94%). The most common transition for females was from one disease to multimorbidity (12%) and for males was from multimorbidity to death (11%). Figure 3 also shows how transition probabilities change with age. The probabilities of remaining in the same state decrease, while probabilities of transitioning to a subsequent disease state or death increase.

Across races, the Asian/Indian and White groups were generally most likely to remain in the same disease state and least likely to transition to death (Appendix III, Figure A1). The opposite was true for the African and Coloured groups, who were more likely to transition to death from all states and least likely to remain in the same disease state. There were no obvious racial differences for transitions to subsequent disease states. In terms of educational differences, individuals with post-secondary education had a higher probability of remaining in the same disease state whereas lower educated individuals were more likely to transition to multimorbidity, and particularly to death (Appendix III, Figure A2). Females were slightly more likely than males to remain in the same disease state or transition to a subsequent state, while males were more likely to die from all states. Gender differences in transition probabilities to death or further disease accumulation were more pronounced for some groups (e.g. Asian/Indians, Africans, and the lower educated) compared with others. Across both race and

education, males have a higher probability of death than females, while females are generally more likely to remain in their same initial disease state. The gender difference is more pronounced across races than across educational levels.

Life Expectancy at Age 20

Based on our estimates for the period 2008-2017, the average female life expectancy at age 20 was 44.4 years (95% CI: 43.0-45.8) and the average male life expectancy was 38.9 years (95% CI: 37.1-40.6) (Table 2). This pattern of females having greater life expectancy than males was consistent across all races and education levels, although to different magnitudes. Asian/Indian, White, and the post-secondary educated have the highest life expectancies for both males and females. WHO life table estimates for 2010 are similar for males (39.0 years) but lower for females (43.1 years) compared to our estimates, although they are within our 95% confidence intervals (World Health Organization 2020).

Multimorbid Life Expectancy at Age 20

As expected, females have higher MMLE and spend a greater fraction of their life with multimorbidity than males (17.7 years (40%) vs. 9.9 years (25%)) (Table 2, Figure 4). This pattern is observed regardless of race or education, with females consistently spending around 40% of their remaining life expectancy living with multimorbidity. For both males and females, Asian/Indians have the highest MMLE, followed by Whites, Coloureds, then Africans (Males: 16.4, 13.6, 12.7, and 9.1 years, respectively; Females: 20.5, 20.4, 17.6, and 17.3 years, respectively). This finding is contrary to our hypothesis that Africans would have the highest

MMLE. The inequality in MMLE across races is more pronounced in males than females and is also observed when comparing proportions.

Across education levels, the trends were also contrary to expectation in terms of MMLE, but the proportion of life expectancy with multimorbidity was similar. Post-secondary educated males and females have the highest MMLE: 12.4 and 20.2, respectively (Table 2), and we observe no education gradient. Those with secondary school education or less have the next highest MMLE amongst males (9.9 years) and females (18.4 years). The lowest MMLE belongs to those who completed secondary school – 8.9 years for males and 16.3 years for females.

Patterns of Intersectionality and Cumulative Advantage/Disadvantage

Looking at the intersection of race and gender, we observe that racial differences are more pronounced amongst males than females. There is very little percentage point (pp) difference in MMLE between the groups in females, but in males the difference is up to 13pp (Asian/Indian 37% vs. African: 24%) (Figure 4). The largest gender disparity is amongst Africans, with males spending 24% (9.1 years) of remaining life expectancy with multimorbidity whereas females spend 40% (17.3 years). There is less of a difference seen for gender and education, but females face greater educational inequalities than males. The group with the highest MMLE are the post-secondary educated (males: 12.4 years, females: 20.2 years), but the group that spends the greatest proportion of their life expectancy with multimorbidity are the lowest educated (males: 27%, females: 43%). The largest gender disparity is observed amongst the lowest educated group, with females spending 8.5 more years (16pp) with multimorbidity than males, compared to about a 7-year difference (13-15pp) in the other education groups.

The interaction between race and dichotomized education supports previous results which show larger differences in MMLE amongst males compared to females. In males, higher educated Africans have the lowest MMLE (8.5 years) and spend the smallest fraction of life expectancy with multimorbidity (22%), while lower educated Africans have the lowest life expectancy (36.6 years) (Figure 5). In contrast, lower educated White males have the highest MMLE (17.4 years) and spend the greatest share of their life expectancy with multimorbidity (43%), while higher educated White males have the longest life expectancy (47.0 years). White males also gain the most years of life from higher education compared to Africans or Coloureds. This suggests cumulative advantage in life expectancy for White males. However, results should be interpreted with caution due to wide confidence intervals, particularly for lower educated White males.

Educational disparities are not as drastic for females. As for males, higher educated African females have both the lowest MMLE (15.7 years) and fraction of life expectancy with multimorbidity (36%). Higher educated White females have the highest life expectancy (50.3 years) and MMLE (21.2 years), again suggesting cumulative advantage in life expectancy, but confidence intervals are very wide. Although White females have the highest life expectancy, Coloured females are the group who seem to benefit the most from higher education by gaining the most years of life. Compared to the less educated group, higher educated Coloured females gain an additional 6.4 years of life expectancy compared to White females' gain of four years. Lower educated African females have the greatest proportion of life expectancy spent with multimorbidity (43%), though it is only 1pp higher than that of lower and higher educated

Whites and 2pp higher than lower educated Coloureds, who have the lowest life expectancy (43.0 years).

Sensitivity Analyses

Appendix IV provides the initial disease state distribution, sample characteristics (only for the age 40+ analysis), and state and life expectancy estimates for all sensitivity analyses. These showed that excluding hypertension, tuberculosis, and both hypertension and tuberculosis from the definition of multimorbidity did not result in major changes to life expectancy. Males generally gained slightly more life expectancy when diseases were excluded, compared to females who gained less or slightly lost life expectancy. There were noticeable differences in MMLE, particularly when hypertension was excluded either individually or with tuberculosis, which is expected due to the high prevalence of hypertension in the sample. These patterns were observed across all race and education groups. When we conducted analyses for participants aged 40 and older, we found that the same general trends were also observed. However, there was a shift in the distribution of disease, with more people beginning from an initial state of multimorbidity and spending the majority of their life expectancy with multimorbidity.

Discussion

To our knowledge, this is the first paper to use an incidence-based multistate modeling approach to estimate life expectancy (LE) and multimorbid life expectancy (MMLE) in South Africa. We also introduce the term *multimorbid life expectancy* to promote the use of

consistent terminology in this field. Using an intersectionality and cumulative advantage/disadvantage framework, we examined the relationship between race, gender, and education as independent and intersecting factors with MMLE in South Africa.

We found that females had both higher LE and MMLE than males, and this pattern was consistent across all race and education groups. Inequalities in MMLE across race were more pronounced amongst males, and inequalities in MMLE across education were more pronounced amongst females. Observed patterns across absolute and relative time with multimorbidity generally remained consistent. In some cases, although the proportion of time with multimorbidity may be similar, the absolute years differ due to the wide variation in LE.

Multimorbidity is a complex outcome, especially so when considered in conjunction with LE. Considered on its own, it is clear that higher MMLE is worse than lower MMLE, i.e. spending more years suffering with multiple diseases is detrimental for individuals and societies. By contrast, higher LE is universally thought of as better than lower LE. Considering MMLE and LE simultaneously, however, leads to ambiguity in the interpretation: it is not always clear what combinations of LE and MMLE might be considered better or worse outcomes. It is easier to identify that the highly discordant pairs (low MMLE/high LE and high MMLE/low LE) correspond to the best and worst outcomes, respectively. However, the more concordant pairs (low MMLE/low LE and high MMLE/high LE) are where uncertainty lies. This is important to consider because most of our results focus on these concordant pairs; discordant patterns were not frequently observed. Groups that tended to have higher LE also tended to have higher MMLE and groups with lower LE had lower MMLE.

This is of particular relevance when thinking about MMLE and LE within a cumulative advantage/disadvantage framework because it is unclear whether having both high MMLE and LE is better or worse than having low MMLE but also low LE. People with higher MMLE and LE likely have less severe conditions or have more resources to access and manage their care. Thus, they can live longer with more disease and could be considered advantaged. This is unsurprising, as there is a well-established socioeconomic gradient in healthy LE, whereby people with higher SES spend more time in a healthy state (Crimmins and Hagedorn 2010; Islam et al. 2018; Pongiglione et al. 2015). In contrast, those with both low MMLE and LE may die earlier due to having more fatal diseases, or potentially lack the resources to manage their morbidities even though they have less disease overall, thus being disadvantaged. Some might argue that living longer, regardless of disease status, is the more advantaged position. However, one's perspective might also depend on whether we consider questions on disease severity, disability, and quality of life. Moreover, this discussion leads us to question the widely held notion that more disease is necessarily the worse outcome. As multimorbidity rates continue to increase, this will become an even more important question which requires further research.

Another approach to better understand the meaning of MMLE is to disaggregate multimorbidity into disease types, number of diseases, and whether conditions are controlled or progressively worsening. These characteristics would allow for a better understanding of the severity of multimorbidity and its impact on LE and quality of life. More severe and less manageable multimorbidity is likely a main contributor to lower MMLE and LE, and the reverse could also be said. If it is not feasible to disentangle multimorbidity into such a detailed form,

another option would be to consider disability within the context of multimorbidity. Activities of daily living are often used to determine the extent to which someone is disabled. It would be useful in this context as a proxy for multimorbidity severity and would allow a more nuanced understanding of how much time someone would spend with mild versus severe disease. This is also relevant because multimorbidity is beginning to develop at younger ages. If younger people have well-managed multimorbidity, then they should be able to live longer without much detriment.

The increasingly earlier incidence of multimorbidity provides one reason for future research to consider taking a life course approach. This is especially pertinent in South Africa, due to its apartheid history playing a significant role in people's upbringing and access to resources and opportunities. Apartheid likely has different effects on an individual, dependent on their social position but also on how much of the apartheid regime they lived through. An existing study took a life course approach to describe the relationship between life course trauma and later life health and found that traumatic events were associated with higher odds of mental health conditions and physical disability (Payne et al. 2020). The effect of apartheid is likely very different for someone who was born prior to and lived most their life under apartheid, compared to if someone was born towards the end. One major difference across these groups would be their access to education due to systemic racial segregation (Meek and Meek 2008). The significance of certain educational levels likely differs due to the range of availability and quality of education across racial groups and birth cohorts. This is supported by our findings which show that Africans and Coloureds tended to be lower educated and consistently had lower MMLE and LE compared to Asian/Indians and Whites. Further, Whites

appear to benefit more from the same levels of education as compared to other racial groups. This suggests structural differences in opportunities and systematic biases which are deeply embedded in South African society. It would be interesting for future research to conduct life course and cohort analyses to see how the relationships between race, education, and multimorbidity might differ over time.

This study has several limitations. First, although our male LE estimate at was comparable to that provided by the World Health Organization, our estimate for female LE was higher, although still within our 95% confidence intervals. This could be due to the females in our sample being healthier than the general population. There might also be confounding factors which were not accounted for in the analysis that affect females more than males. The second limitation is that the disease data is based on self-report, which makes it prone to recall bias. Third, the NIDS questionnaire only asked about a certain number of diseases, thus limiting what we could include within our definition of multimorbidity. Thus, although we classify people as having "no disease", they might have one or more diseases that were not included in our definition. There is also potential for underdiagnosis of disease, so participants may have one or more diseases, but just have not been diagnosed. This is also likely correlated with socioeconomic status, as groups with higher socioeconomic status are more likely to seek and access care compared to lower socioeconomic status groups. Both these instances would result in an underestimate of multimorbidity that might vary by social group. Factors which we were not able to account for in this paper (e.g., residence type, health system accessibility), might help explain these intersectional differences. Lastly, there were quite small sample sizes in some strata, particularly for the Asian/Indian group and when looking at the interaction

between race and education. This required us to either combine strata or exclude groups altogether. However, we were still left with some small groups in our analysis. This resulted in very wide confidence intervals, specifically in the higher educated Coloured and lower educated White groups, making it difficult to draw any strong conclusions. These smaller samples in the Asian/Indian and White groups are also related to the attrition patterns seen throughout the data. This highlights the need for larger and representative studies so that there are sufficient participants even in the smaller strata.

In this study, we found that race, socioeconomic status, and gender have independent and intersectional associations with MMLE in South Africa. White males and females have cumulative advantage in terms of LE, while African males and females face the most disadvantages, even at higher levels of education. This demonstrates that the racial and socioeconomic hierarchies in place during apartheid have had lasting impacts on life course health disparities, highlighting entrenched structural inequalities. As South Africa is beginning to implement a national health insurance system (Murphy and Moosa 2021; Pauw 2021), it is timely for actions to be taken to address these inequalities. Existing systems tend to be fragmented and were built to treat acute diseases, but people with non-communicable diseases and multimorbidity require different types of care (Basto-Abreu et al. 2022). There is a need to redesign health systems to properly care for patients with multimorbidity, and to overcome the structural inequalities that discourage and prevent certain groups of people from accessing health services. Efforts should also be made to develop a more equal education system and provide necessary educational resources to those in need. These recommendations revolve around the idea of proportionate universalism, in which actions should be implemented

universally, but the extent to which should be proportional to the level of disadvantage (Marmot and Bell 2012).

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Tables

Table 1. Baseline sociodemographic characteristics and distribution of transitions between states of the analytic sample, by gender and overall

	Male (n=7224)	**Female** (n=10,806)	**Overall** (n=18,030)
Age (years)			
Mean (SD)	40.9 (15.6)	42.7 (16.5)	42.0 (16.2)
Race			
African	5,633 (78.0%)	8,777 (81.2%)	14,410 (79.9%)
Coloured	1,158 (16.0%)	1,508 (14.0%)	2,666 (14.8%)
White	336 (4.7%)	393 (3.6%)	729 (4.0%)
Asian/Indian	97 (1.3%)	128 (1.2%)	225 (1.2%)
Education level			
Some secondary school or less	3,705 (51.3%)	5,889 (54.5%)	9,594 (53.2%)
Completed secondary school	2,584 (35.8%)	3,652 (33.8%)	6,236 (34.6%)
Post-secondary school	935 (12.9%)	1,265 (11.7%)	2,200 (12.2%)
Geography			
Rural	3,393 (47.0%)	5,591 (51.7%)	8,984 (49.8%)
Urban	3,831 (53.0%)	5,215 (48.3%)	9,046 (50.2%)
Initial 'from' state			
0 disease	5,528 (76.5%)	7,086 (65.6%)	12,614 (70.0%)
1 disease	1,308 (18.1%)	2,707 (25.1%)	4,015 (22.3%)
Multimorbidity	388 (5.4%)	1,013 (9.4%)	1,401 (7.8%)
Total number of transitions			
0 disease → 0 disease	17,400 (88.5%)	21,899 (87.3%)	39,299 (87.8%)
0 disease → 1 disease	1,602 (8.1%)	2,417 (9.6%)	4,019 (9.0%)
0 disease → Multimorbidity	217 (1.1%)	386 (1.5%)	603 (1.3%)
0 disease → Dead	439 (2.2%)	382 (1.5%)	821 (1.8%)
1 disease → 1 disease	5,331 (83.2%)	10,851 (84.8%)	16,182 (84.2%)
1 disease → Multimorbidity	708 (11.0%)	1,532 (12.0%)	2,240 (11.7%)
1 disease → Dead	372 (5.8%)	419 (3.3%)	791 (4.1%)
Multimorbidity → Multimorbidity	2,298 (88.9%)	6,278 (93.6%)	8,576 (92.3%)
Multimorbidity → Dead	287 (11.1%)	430 (6.4%)	717 (7.7%)

Table 2. Weighted life expectancy at age 20, multimorbid life expectancy, and percentage of life expectancy spent with multimorbidity

		Male			Female		
		Weighted LE (95% CI)	**MMLE (95% CI)**	**% LE w/ MM**	**Weighted LE (95% CI)**	**MMLE (95% CI)**	**% LE w/ MM**
Model 1: Adjusted for age		38.9 (37.1, 40.6)	9.9 (8.6, 11.2)	25	44.4 (43.0, 45.8)	17.7 (16.5, 18.9)	40
Model 2: Model 1 + race							
African		37.9 (36.1, 39.8)	9.1 (7.7, 10.5)	24	43.7 (42.2, 45.2)	17.3 (16.0, 18.7)	40
Asian/Indian		44.7 (33.5, 55.8)	16.4 (2.6, 30.1)	37	52.7 (45.4, 60.0)	20.5 (13.3, 27.8)	39
Coloured		40.0 (36.9, 43.0)	12.7 (9.0, 16.4)	32	45.3 (42.4, 48.2)	17.6 (14.6, 20.6)	39
White		47.0 (41.5, 52.5)	13.6 (9.1, 18.2)	29	50.0 (45.3, 54.7)	20.4 (15.4, 25.4)	41
Model 3: Model 1 + education							
Some SS or less		36.7 (34.8, 39.0)	9.9 (8.1, 11.7)	27	43.1 (41.4, 44.8)	18.4 (16.6, 20.1)	43
Completed SS		38.1 (35.7, 40.5)	8.9 (7.1, 10.8)	23	43.3 (40.7, 46.0)	16.3 (13.9, 18.8)	38
Post-SS		47.7 (43.0, 52.4)	12.4 (8.6, 16.2)	26	51.4 (46.8, 56.1)	20.2 (15.7, 24.7)	39
Model 4: Model 1 + interaction							
African	Lower educated	36.6 (34.1, 39.1)	9.7 (7.7, 11.6)	27	43.3 (41.5, 45.1)	18.6 (16.7, 20.5)	43
	Higher educated	39.1 (36.6, 41.6)	8.5 (6.7, 10.3)	22	43.4 (40.8, 46.0)	15.7 (13.2, 18.1)	36
Coloured	Lower educated	40.0 (36.5, 43.5)	14.6 (11.0, 18.2)	36	43.0 (39.0, 47.0)	17.6 (13.8, 21.4)	41
	Higher educated	39.0 (33.2, 44.9)	10.7 (4.4, 17.0)	27	49.4 (43.4, 55.4)	18.9 (13.5, 24.3)	38
White	Lower educated	40.1 (23.5, 56.6)	17.4 (0.0, 36.4)	43	46.4 (27.4, 65.4)	19.6 (0.0, 40.7)	42
	Higher educated	47.0 (41.1, 53.0)	13.6 (8.8, 18.4)	29	50.3 (45.1, 55.5)	21.2 (17.0, 25.4)	42

Notes: Lower educated refers to those with some secondary school or less. Higher educated refers to those who completed at least secondary school.
LE: Life expectancy, MM: Multimorbidity, MMLE: Multimorbid life expectancy; SS: Secondary school

Figures and figure titles

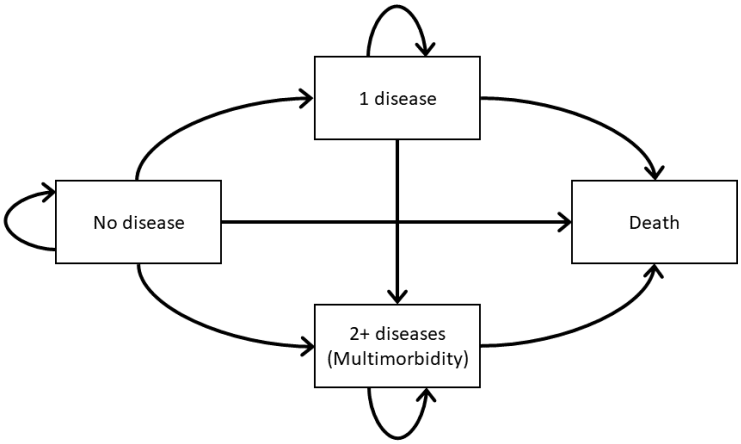


Figure 1. State space of the Markov model

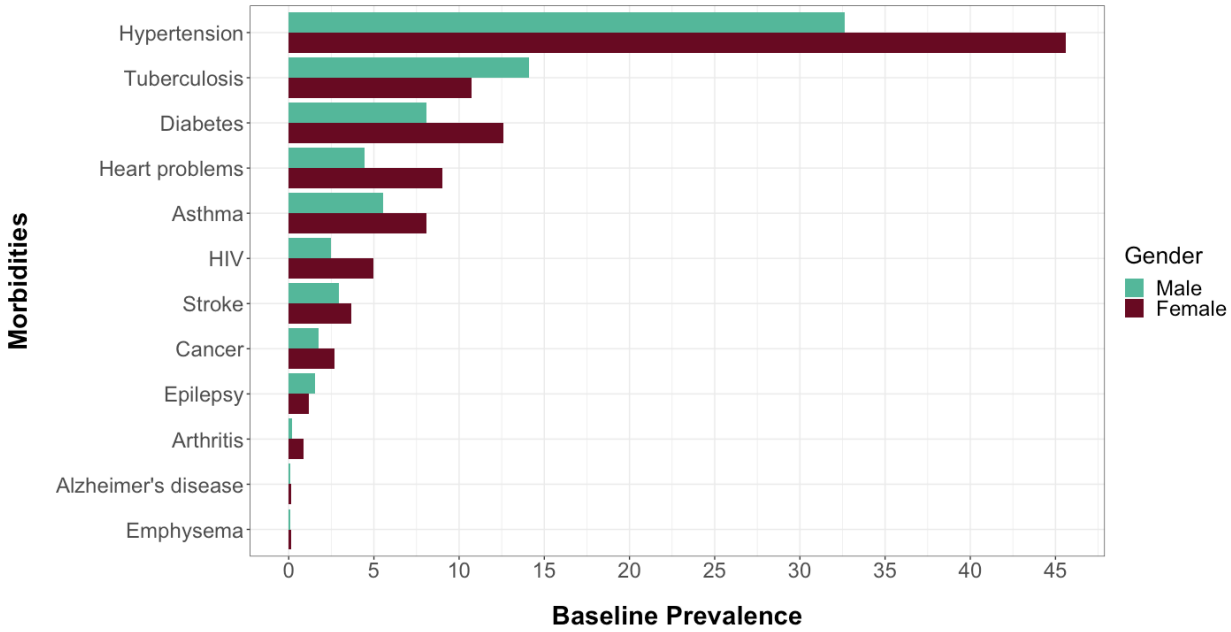


Figure 2. Baseline prevalence of each disease included in our definition of multimorbidity, by gender

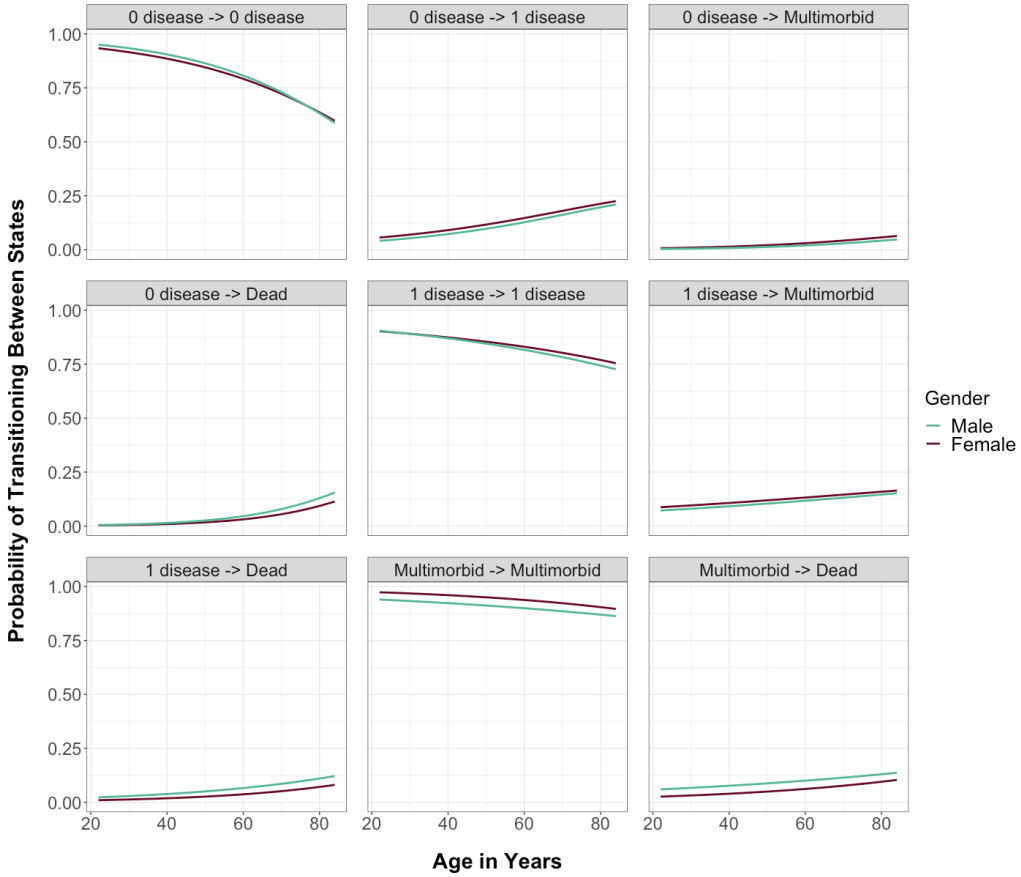
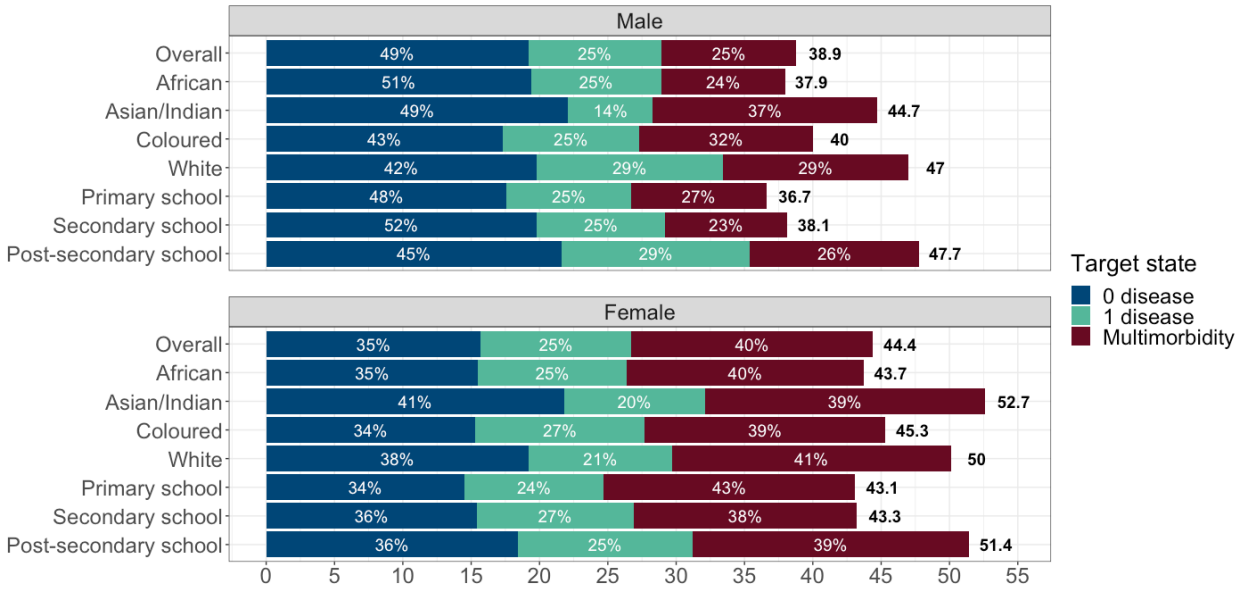
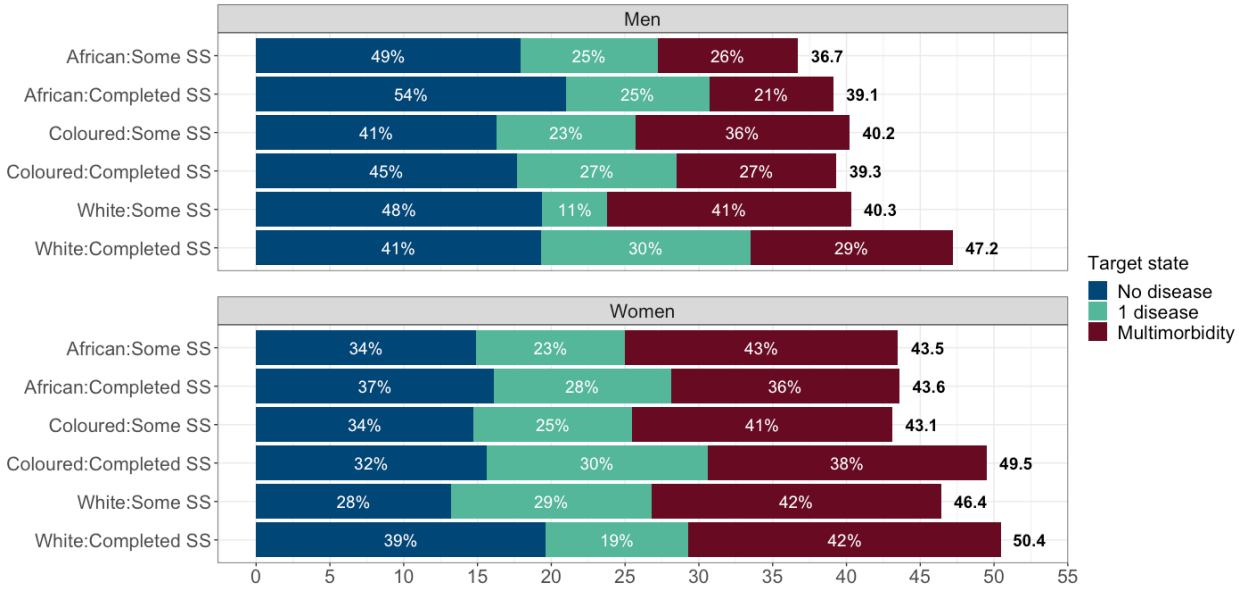


Figure 3. Probabilities of remaining in the same state or transitioning to a subsequent state over age for males and females



Years and Percent of Remaining Life Expectancy From Age 20

Figure 4. Weighted life expectancy from age 20 split by time spent in each state, overall and by each race and education group, for males and females. Estimates obtained from models 1, 2, and 3 from Table 2.



Years and Percent of Remaining Life Expectancy From Age 20

Figure 5. Weighted life expectancy from age 20 split by time spent in each state, overall and by each race and dichotomized education group, for males and females. Estimates obtained from model 4 in Table 2.

Appendix I: Excluded vs included sample comparison

	Excluded (N=10,207)	Included (N=18,030)	p-value
Gender			< 0.001
Female	5,583 (54.7%)	10,806 (59.9%)	
Male	4,624 (45.3%)	7,224 (40.1%)	
N missing	0	0	
Age (years)			< 0.001
Mean (SD)	44.5 (16.1)	42.0 (16.2)	
Range	20.0 – 106	20.0 - 106	
N missing	635 (6.2%)	0	
Education			< 0.001
Some secondary school or less	3,709 (36.3%)	9,594 (53.2%)	
Completed secondary school	4,198 (41.1%)	6,236 (34.6%)	
Post-secondary school	2,098 (20.6%)	2,200 (12.2%)	
N missing	202 (2.0%)	0	
Race			< 0.001
African	6,989 (68.5%)	14,410 (79.9%)	
Asian/Indian	379 (3.7%)	225 (1.2%)	
Coloured	1,285 (12.6%)	2,666 (14.8%)	
White	1,545 (15.1%)	729 (4.0%)	
N missing	9 (0.1%)	0	
Geography			< 0.001
Rural	3,752 (36.8%)	8,988 (49.9%)	
Urban	6,348 (62.2%)	9,042 (50.1%)	
N missing	107 (1.0%)	0	
Initial disease state			< 0.001
0 disease	4,404 (43.1%)	12,614 (70.0%)	
1 disease	1,011 (9.9%)	4,015 (22.3%)	
Multimorbidity	310 (3.0%)	1401 (7.8%)	
N missing	4,482 (43.9%)	0	

Appendix II: Complete expectancy estimates with 95% confidence intervals

Unadjusted, stratified by gender

Male

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	20.7	19.7	21.7	0.0	0.0	0.0	0.0	0.0	0.0	19.2	18.3	20.1
1 disease	9.4	8.6	10.2	15.6	13.9	17.3	0.0	0.0	0.0	9.7	8.9	10.5
Multimorbidity	9.5	8.3	10.7	14.6	12.5	16.8	23.9	20.3	27.4	9.9	8.6	11.2
Total	39.6	37.9	41.3	30.2	27.5	33.0	23.9	20.3	27.4	38.9	37.1	40.6

Female

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	17.9	17.0	18.8	0.0	0.0	0.0	0.0	0.0	0.0	15.7	14.9	16.5
1 disease	10.6	9.8	11.4	15.7	14.3	17.0	0.0	0.0	0.0	11.0	10.2	11.8
Multimorbidity	16.6	15.5	17.8	24.0	22.1	26.0	35.1	32.4	37.9	17.7	16.5	18.9
Total	45.1	43.8	46.5	39.7	37.9	41.5	35.1	32.4	37.9	44.4	43.0	45.8

Adjusted for geography, stratified by gender and race

Male, African

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	20.9	19.8	21.9	0.0	0.0	0.0	0.0	0.0	0.0	19.4	18.4	20.3
1 disease	9.1	8.3	9.9	15.4	13.8	17.1	0.0	0.0	0.0	9.5	8.7	10.3
Multimorbidity	8.7	7.3	10.0	13.6	11.3	16.0	22.6	19.0	26.2	9.1	7.7	10.5
Total	38.7	36.9	40.5	29.1	26.3	31.8	22.6	19.0	26.2	37.9	36.1	39.8

Male, Asian/Indian

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	23.8	16.2	31.4	0.0	0.0	0.0	0.0	0.0	0.0	22.1	15.0	29.1
1 disease	6.0	2.1	9.8	10.7	3.8	17.6	0.0	0.0	0.0	6.2	2.2	10.3
Multimorbidity	15.5	2.2	28.9	26.1	6.5	45.8	35.2	15.6	54.7	16.4	2.6	30.1
Total	45.3	34.5	56.1	36.8	20.7	53.0	35.2	15.6	54.7	44.7	33.5	55.8

Male, Coloured

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	18.6	15.8	21.5	0.0	0.0	0.0	0.0	0.0	0.0	17.3	14.6	19.9
1 disease	9.7	6.9	12.5	15.2	11.8	18.6	0.0	0.0	0.0	10.0	7.2	12.8
Multimorbidity	12.2	8.6	15.9	18.0	13.5	22.5	27.8	22.2	33.5	12.7	9.0	16.4
Total	40.5	37.7	43.4	33.2	28.0	38.4	27.8	22.2	33.5	40.0	36.9	43.0

Male, White

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	21.3	17.2	25.4	0.0	0.0	0.0	0.0	0.0	0.0	19.8	15.9	23.6
1 disease	13.2	9.6	16.8	20.4	15.1	25.6	0.0	0.0	0.0	13.6	10.0	17.3
Multimorbidity	13.0	8.7	17.4	20.0	13.4	26.6	32.8	24.0	41.5	13.6	9.1	18.2
Total	47.6	42.2	53.0	40.3	33.3	47.4	32.8	24.0	41.5	47.0	41.5	52.5

Female, African

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	17.7	16.7	18.6	0.0	0.0	0.0	0.0	0.0	0.0	15.5	14.7	16.3
1 disease	10.5	9.7	11.3	15.5	14.0	16.9	0.0	0.0	0.0	10.9	10.0	11.7
Multimorbidity	16.3	15.0	17.6	23.5	21.3	25.6	34.3	31.5	37.2	17.3	16.0	18.7
Total	44.4	43.0	45.9	38.9	37.0	40.9	34.3	31.5	37.2	43.7	42.2	45.2

Female, Asian/Indian

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	24.9	9.8	40.1	0.0	0.0	0.0	0.0	0.0	0.0	21.8	8.6	35.1
1 disease	9.8	4.8	14.9	15.7	9.6	21.8	0.0	0.0	0.0	10.3	5.3	15.3
Multimorbidity	18.7	10.7	26.7	31.8	26.3	37.4	44.4	36.8	52.1	20.5	13.3	27.8
Total	53.5	46.0	60.9	47.6	39.9	55.2	44.4	36.8	52.1	52.7	45.4	60.0

Female, Coloured

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	17.5	14.6	20.4	0.0	0.0	0.0	0.0	0.0	0.0	15.3	12.7	17.9
1 disease	12.0	8.7	15.3	17.3	13.5	21.0	0.0	0.0	0.0	12.4	9.1	15.7
Multimorbidity	16.5	13.6	19.5	23.6	19.6	27.6	35.5	31.0	40.0	17.6	14.6	20.6
Total	46.0	43.2	48.8	40.9	37.1	44.6	35.5	31.0	40.0	45.3	42.4	48.2

Female, White

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	21.9	18.1	25.7	0.0	0.0	0.0	0.0	0.0	0.0	19.2	15.9	22.5
1 disease	10.0	7.0	13.1	15.4	11.1	19.7	0.0	0.0	0.0	10.5	7.3	13.6
Multimorbidity	18.8	14.0	23.7	29.7	23.0	36.3	41.6	34.8	48.5	20.4	15.4	25.4
Total	50.8	46.2	55.3	45.1	39.2	50.9	41.6	34.8	48.5	50.0	45.3	54.7

Adjusted for geography, stratified by gender and education

Male, some secondary school or less

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	19.0	17.6	20.5	0.0	0.0	0.0	0.0	0.0	0.0	17.6	16.3	19.0
1 disease	8.8	7.9	9.7	14.2	12.4	16.1	0.0	0.0	0.0	9.1	8.2	10.1
Multimorbidity	9.5	7.8	11.2	14.3	11.2	17.4	22.9	18.4	27.4	9.9	8.1	11.7
Total	37.4	35.1	39.6	28.5	25.3	31.8	22.9	18.4	27.4	36.7	34.4	39.0

Male, completed secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	21.4	20.0	22.9	0.0	0.0	0.0	0.0	0.0	0.0	19.8	18.5	21.2
1 disease	9.0	7.9	10.2	15.1	13.2	17.0	0.0	0.0	0.0	9.4	8.2	10.5
Multimorbidity	8.5	6.7	10.3	13.5	10.8	16.1	22.1	18.4	25.8	8.9	7.1	10.8
Total	38.9	36.6	41.3	28.6	25.4	31.7	22.1	18.4	25.8	38.1	35.7	40.5

Male, post-secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	23.3	20.4	26.1	0.0	0.0	0.0	0.0	0.0	0.0	21.6	18.9	24.2
1 disease	13.3	10.2	16.5	20.9	16.1	25.7	0.0	0.0	0.0	13.8	10.5	17.0
Multimorbidity	11.7	8.1	15.4	18.9	13.1	24.7	31.4	23.8	39.1	12.4	8.6	16.2
Total	48.4	43.8	53.0	39.8	33.7	45.9	31.4	23.8	39.1	47.7	43.0	52.4

Female, some secondary school or less

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	16.6	15.3	17.8	0.0	0.0	0.0	0.0	0.0	0.0	14.5	13.4	15.6
1 disease	9.9	9.0	10.8	14.3	12.7	15.8	0.0	0.0	0.0	10.2	9.3	11.2
Multimorbidity	17.3	15.7	19.0	24.5	22.1	27.0	34.9	31.8	38.1	18.4	16.6	20.1
Total	43.8	42.2	45.5	38.8	36.5	41.1	34.9	31.8	38.1	43.1	41.4	44.8

Female, completed secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	17.6	16.5	18.8	0.0	0.0	0.0	0.0	0.0	0.0	15.4	14.4	16.5
1 disease	11.2	9.8	12.5	16.2	14.3	18.0	0.0	0.0	0.0	11.5	10.2	12.9
Multimorbidity	15.3	13.0	17.6	22.2	18.9	25.4	33.2	29.2	37.2	16.3	13.9	18.8
Total	44.1	41.5	46.7	38.3	35.2	41.5	33.2	29.2	37.2	43.3	40.7	46.0

Female, post-secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	21.0	18.9	23.1	0.0	0.0	0.0	0.0	0.0	0.0	18.4	16.6	20.2
1 disease	12.4	9.5	15.3	17.9	14.2	21.7	0.0	0.0	0.0	12.8	9.8	15.7
Multimorbidity	18.7	14.5	23.0	29.1	22.6	35.5	42.8	35.5	50.0	20.2	15.7	24.7
Total	52.1	47.7	56.6	47.0	41.2	52.8	42.8	35.5	50.0	51.4	46.8	56.1

Adjusted for geography, stratified by gender and race*binary education interaction

Male, African, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	19.0	17.4	20.5	0.0	0.0	0.0	0.0	0.0	0.0	17.6	16.2	19.0
1 disease	9.0	8.0	10.0	14.6	12.6	16.6	0.0	0.0	0.0	9.3	8.3	10.4
Multimorbidity	9.3	7.4	11.1	14.2	10.9	17.4	23.1	18.4	27.8	9.7	7.7	11.6
Total	37.3	34.8	39.7	28.7	25.3	32.2	23.1	18.4	27.8	36.6	34.1	39.1

Male, African, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	22.5	21.1	23.8	0.0	0.0	0.0	0.0	0.0	0.0	20.8	19.6	22.1
1 disease	9.4	8.1	10.6	16.0	14.0	18.0	0.0	0.0	0.0	9.7	8.5	11.0
Multimorbidity	8.0	6.3	9.8	13.3	10.6	15.9	22.4	18.6	26.1	8.5	6.7	10.3
Total	39.9	37.4	42.4	29.2	26.1	32.4	22.4	18.6	26.1	39.1	36.6	41.6

Male, Coloured, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	17.5	15.0	19.9	0.0	0.0	0.0	0.0	0.0	0.0	16.2	13.9	18.5
1 disease	9.0	6.8	11.2	13.7	10.7	16.6	0.0	0.0	0.0	9.3	7.1	11.4
Multimorbidity	14.0	10.5	17.5	20.4	15.4	25.3	30.1	24.2	36.0	14.6	11.0	18.2
Total	40.5	37.1	43.9	34.0	29.4	38.7	30.1	24.2	36.0	40.0	36.5	43.5

Male, Coloured, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	19.0	15.1	22.9	0.0	0.0	0.0	0.0	0.0	0.0	17.6	14.0	21.2
1 disease	10.4	5.6	15.2	16.2	10.7	21.8	0.0	0.0	0.0	10.7	6.0	15.5
Multimorbidity	10.2	4.1	16.4	15.4	7.4	23.4	25.1	15.2	35.0	10.7	4.4	17.0
Total	39.7	34.1	45.3	31.6	22.5	40.7	25.1	15.2	35.0	39.0	33.2	44.9

Male, White, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	19.5	11.3	27.7	0.0	0.0	0.0	0.0	0.0	0.0	18.1	10.4	25.7
1 disease	4.4	0.3	8.5	7.7	1.9	13.6	0.0	0.0	0.0	4.6	0.4	8.8
Multimorbidity	16.7	0.0	35.2	26.3	1.1	51.5	34.0	9.1	58.9	17.4	0.0	36.4
Total	40.5	24.5	56.6	34.0	11.1	57.0	34.0	9.1	58.9	40.1	23.5	56.6

Male, White, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	20.6	16.4	24.8	0.0	0.0	0.0	0.0	0.0	0.0	19.1	15.2	23.0
1 disease	13.9	10.0	17.9	20.7	15.1	26.4	0.0	0.0	0.0	14.3	10.3	18.3
Multimorbidity	13.0	8.4	17.7	19.9	12.8	26.9	33.0	23.5	42.5	13.6	8.8	18.4
Total	47.6	41.7	53.5	40.6	33.0	48.2	33.0	23.5	42.5	47.0	41.1	53.0

Female, African, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	16.8	15.5	18.1	0.0	0.0	0.0	0.0	0.0	0.0	14.7	13.5	15.8
1 disease	9.7	8.8	10.6	13.9	12.3	15.5	0.0	0.0	0.0	10.0	9.0	11.0
Multimorbidity	17.5	15.7	19.3	25.0	22.4	27.7	35.4	32.1	38.7	18.6	16.7	20.5
Total	44.0	42.2	45.7	38.9	36.5	41.4	35.4	32.1	38.7	43.3	41.5	45.1

Female, African, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	18.1	17.0	19.2	0.0	0.0	0.0	0.0	0.0	0.0	15.9	14.9	16.8
1 disease	11.5	10.2	12.8	16.6	14.7	18.4	0.0	0.0	0.0	11.9	10.6	13.2
Multimorbidity	14.6	12.3	17.0	21.6	18.3	24.9	32.8	28.9	36.8	15.7	13.2	18.1
Total	44.2	41.6	46.8	38.2	35.1	41.3	32.8	28.9	36.8	43.4	40.8	46.0

Female, Coloured, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	16.7	13.8	19.6	0.0	0.0	0.0	0.0	0.0	0.0	14.6	12.1	17.2
1 disease	10.5	8.2	12.8	14.9	11.7	18.1	0.0	0.0	0.0	10.8	8.4	13.2
Multimorbidity	16.5	12.8	20.3	23.6	19.1	28.2	34.3	29.1	39.6	17.6	13.8	21.4
Total	43.7	39.7	47.7	38.6	34.3	42.9	34.3	29.1	39.6	43.0	39.0	47.0

Female, Coloured, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	17.8	11.9	23.6	0.0	0.0	0.0	0.0	0.0	0.0	15.5	10.4	20.7
1 disease	14.6	8.9	20.3	19.9	13.8	26.0	0.0	0.0	0.0	14.9	9.3	20.6
Multimorbidity	17.7	12.3	23.0	25.5	18.9	32.2	39.9	31.3	48.5	18.9	13.5	24.3
Total	50.0	44.2	55.8	45.4	37.8	53.1	39.9	31.3	48.5	49.4	43.4	55.4

Female, White, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	15.0	7.0	23.0	0.0	0.0	0.0	0.0	0.0	0.0	13.1	6.1	20.2
1 disease	13.3	6.9	19.8	17.8	10.4	25.2	0.0	0.0	0.0	13.6	7.2	20.0
Multimorbidity	18.6	0.0	39.0	25.3	0.0	51.1	38.0	8.7	67.4	19.6	0.0	40.7
Total	47.0	28.6	65.4	43.1	20.5	65.6	38.0	8.7	67.4	46.4	27.4	65.4

Female, White, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	22.2	18.0	26.4	0.0	0.0	0.0	0.0	0.0	0.0	19.4	15.7	23.1
1 disease	9.3	6.2	12.5	14.0	9.8	18.2	0.0	0.0	0.0	9.7	6.5	12.9
Multimorbidity	19.6	15.5	23.6	31.5	25.4	37.5	42.8	36.1	49.5	21.2	17.0	25.4
Total	51.1	45.9	56.2	45.5	39.4	51.5	42.8	36.1	49.5	50.3	45.1	55.5

Appendix III: Transition probabilities by race and education

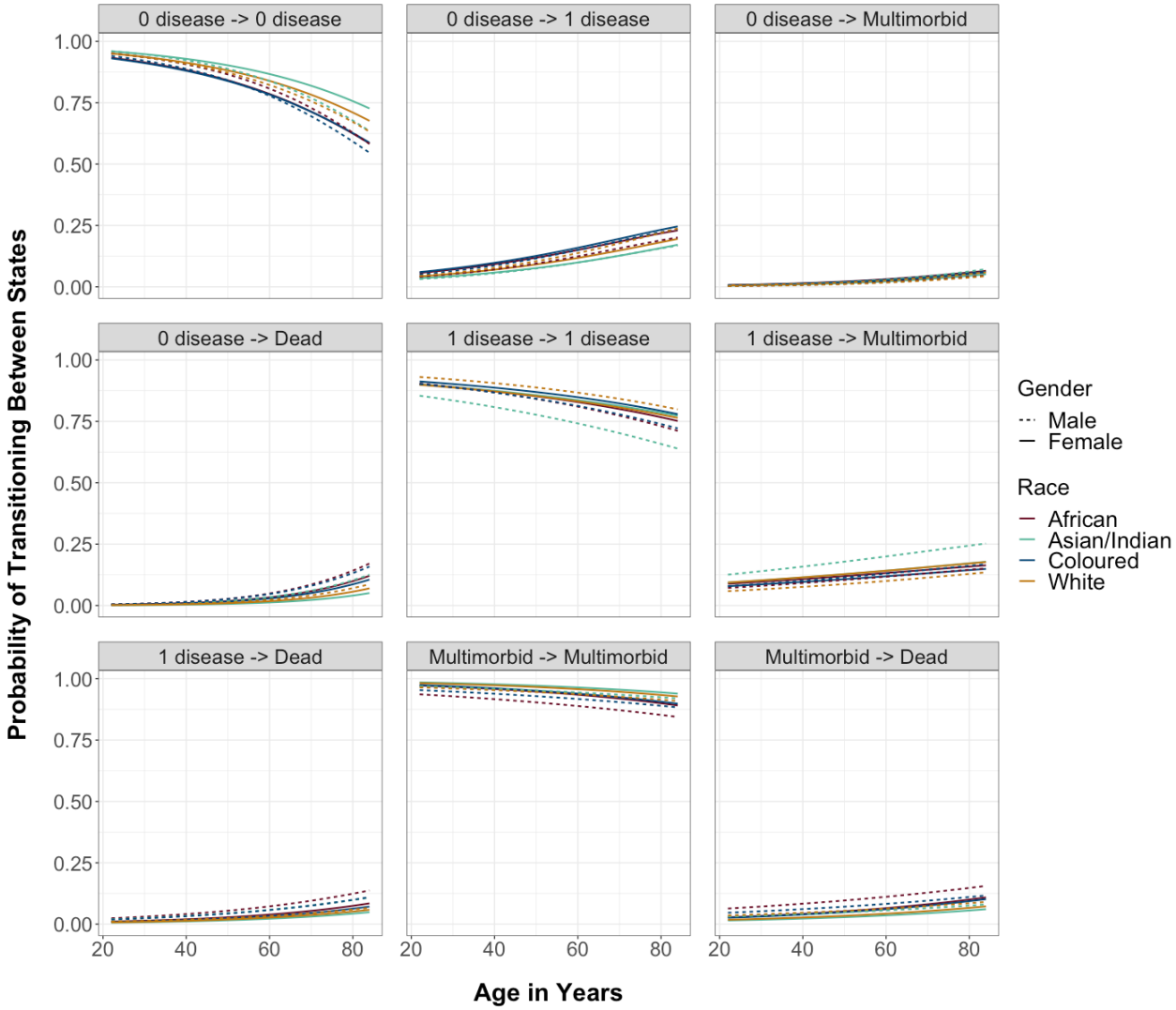


Figure A1. Probabilities of remaining in the same initial disease state or transition to a subsequent disease state or death over time, by gender and race

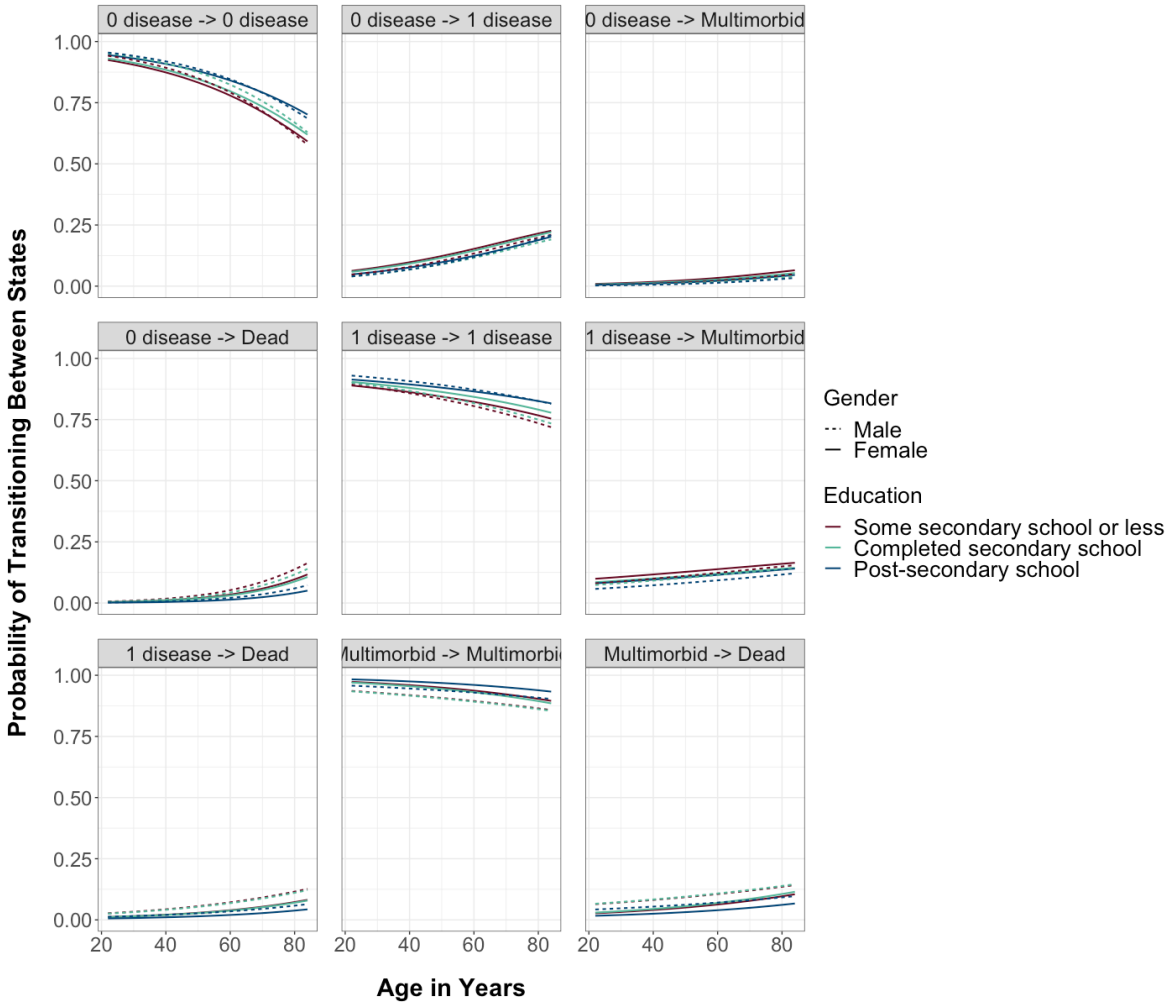


Figure A2. Probabilities of remaining in the same initial disease state or transition to a subsequent disease state or death over time, by gender and education.

Appendix IV: Sensitivity analyses

1 Exclude hypertension from multimorbidity definition

1.1 Initial disease state distribution

Initial disease state	Male (n=7224)	Female (n=10,806)	Overall (N=18,030)
0 disease	6236 (86.3%)	8864 (82.0%)	15,100 (83.7%)
1 disease	859 (11.9%)	1631 (15.1%)	2490 (13.8%)
Multimorbidity	129 (1.8%)	311 (2.9%)	440 (2.4%)

1.2 Expectancy estimates

Unadjusted, stratified by gender

Male

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	27.5	25.9	29.0	0.0	0.0	0.0	0.0	0.0	0.0	26.1	24.7	27.6
1 disease	7.9	7.1	8.7	17.2	15.2	19.3	0.0	0.0	0.0	8.3	7.5	9.1
Multimorbidity	4.7	3.8	5.7	9.7	7.5	11.9	20.6	16.2	25.1	5.0	4.0	6.0
Total	40.1	38.4	41.8	26.9	24.2	29.7	20.6	16.2	25.1	39.4	37.7	41.2

Female

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	24.9	23.7	26.2	0.0	0.0	0.0	0.0	0.0	0.0	22.9	21.7	24.0
1 disease	9.4	8.7	10.1	16.4	14.7	18.1	0.0	0.0	0.0	9.8	9.1	10.6
Multimorbidity	10.3	9.1	11.5	19.7	17.3	22.1	32.3	28.8	35.9	11.2	9.9	12.4
Total	44.6	43.2	46.0	36.1	34.1	38.2	32.3	28.8	35.9	43.9	42.5	45.3

Adjusted for geography, stratified by gender and race

Male, African

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	27.5	25.9	29.1	0.0	0.0	0.0	0.0	0.0	0.0	26.2	24.7	27.7
1 disease	7.4	6.5	8.2	16.6	14.6	18.6	0.0	0.0	0.0	7.7	6.9	8.6
Multimorbidity	4.5	3.5	5.5	9.4	7.2	11.6	20.3	16.1	24.5	4.8	3.7	5.8
Total	39.4	37.6	41.1	26.1	23.3	28.8	20.3	16.1	24.5	38.7	36.9	40.5

Male, Asian/Indian

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	25.5	15.7	35.4	0.0	0.0	0.0	0.0	0.0	0.0	24.3	14.9	33.7
1 disease	10.6	2.7	18.5	19.8	3.7	35.9	0.0	0.0	0.0	10.9	2.7	19.1
Multimorbidity	8.4	0.0	25.4	15.6	0.0	45.2	29.8	0.0	64.3	8.8	0.0	26.4
Total	44.5	34.0	55.0	35.4	17.2	53.6	29.8	0.0	64.3	44.0	33.2	54.9

Male, Coloured

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	26.1	23.1	29.1	0.0	0.0	0.0	0.0	0.0	0.0	24.8	22.0	27.7
1 disease	10.3	7.3	13.4	20.8	15.9	25.7	0.0	0.0	0.0	10.8	7.7	13.8
Multimorbidity	4.5	1.4	7.6	8.7	3.1	14.4	20.4	11.7	29.0	4.8	1.6	8.0
Total	41.0	38.3	43.6	29.6	24.5	34.7	20.4	11.7	29.0	40.4	37.7	43.0

Male, White

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	28.6	22.8	34.4	0.0	0.0	0.0	0.0	0.0	0.0	27.2	21.6	32.7
1 disease	11.2	8.2	14.3	22.0	17.1	26.8	0.0	0.0	0.0	11.7	8.6	14.7
Multimorbidity	7.8	3.0	12.5	15.6	5.8	25.4	30.8	18.0	43.6	8.2	3.2	13.2
Total	47.6	42.2	53.0	37.6	29.8	45.3	30.8	18.0	43.6	47.1	41.6	52.6

Female, African

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	24.6	23.3	25.9	0.0	0.0	0.0	0.0	0.0	0.0	22.6	21.3	23.8
1 disease	9.3	8.6	10.0	16.2	14.5	17.9	0.0	0.0	0.0	9.7	9.0	10.5
Multimorbidity	10.1	8.7	11.4	19.2	16.6	21.7	31.6	27.9	35.3	10.9	9.5	12.3
Total	43.9	42.4	45.4	35.3	33.2	37.5	31.6	27.9	35.3	43.2	41.7	44.7

Female, Asian/Indian

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	28.6	16.5	40.7	0.0	0.0	0.0	0.0	0.0	0.0	26.2	15.1	37.3
1 disease	11.6	7.1	16.1	20.1	11.4	28.8	0.0	0.0	0.0	12.2	7.5	16.8
Multimorbidity	11.9	2.5	21.2	24.3	9.2	39.5	40.2	25.6	54.8	13.0	3.3	22.7
Total	52.0	44.4	59.7	44.4	35.2	53.6	40.2	25.6	54.8	51.4	43.8	59.0

Female, Coloured

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	25.8	22.3	29.2	0.0	0.0	0.0	0.0	0.0	0.0	23.6	20.4	26.8
1 disease	10.2	7.9	12.5	17.9	15.0	20.8	0.0	0.0	0.0	10.7	8.4	13.0
Multimorbidity	9.2	6.9	11.6	18.1	13.9	22.2	31.1	25.7	36.5	10.1	7.6	12.5
Total	45.1	42.2	48.1	36.0	31.7	40.2	31.1	25.7	36.5	44.4	41.4	47.3

Female, White

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	28.2	21.7	34.8	0.0	0.0	0.0	0.0	0.0	0.0	25.9	19.9	31.9
1 disease	8.9	4.1	13.6	15.6	8.9	22.4	0.0	0.0	0.0	9.3	4.5	14.1
Multimorbidity	13.2	9.3	17.1	26.9	19.9	33.9	40.3	34.2	46.4	14.4	10.4	18.4
Total	50.3	45.8	54.7	42.5	36.8	48.3	40.3	34.2	46.4	49.6	45.1	54.1

Adjusted for geography, stratified by gender and education

Male, some secondary school or less

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	25.2	23.2	27.1	0.0	0.0	0.0	0.0	0.0	0.0	24.0	22.1	25.8
1 disease	7.8	6.8	8.8	16.2	14.0	18.5	0.0	0.0	0.0	8.2	7.1	9.2
Multimorbidity	4.9	3.6	6.1	9.5	6.6	12.5	20.2	14.7	25.6	5.2	3.8	6.5
Total	37.9	35.7	40.1	25.8	22.3	29.2	20.2	14.7	25.6	37.3	35.1	39.5

Male, completed secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	27.8	25.6	30.1	0.0	0.0	0.0	0.0	0.0	0.0	26.5	24.3	28.6
1 disease	8.2	6.7	9.7	17.9	15.2	20.6	0.0	0.0	0.0	8.6	7.1	10.1
Multimorbidity	3.7	2.3	5.0	7.6	4.8	10.4	17.7	12.7	22.8	3.9	2.5	5.3
Total	39.7	37.3	42.1	25.5	22.4	28.6	17.7	12.7	22.8	39.0	36.5	41.4

Male, post-secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	33.8	29.7	37.8	0.0	0.0	0.0	0.0	0.0	0.0	32.1	28.2	36.0
1 disease	8.1	5.9	10.2	18.3	14.6	22.0	0.0	0.0	0.0	8.5	6.3	10.7
Multimorbidity	7.0	3.4	10.7	16.9	9.1	24.7	30.7	20.7	40.7	7.6	3.7	11.4
Total	48.9	44.4	53.4	35.2	27.9	42.6	30.7	20.7	40.7	48.2	43.6	52.8

Female, some secondary school or less

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	22.9	21.1	24.7	0.0	0.0	0.0	0.0	0.0	0.0	21.0	19.4	22.6
1 disease	9.4	8.5	10.3	15.8	13.8	17.9	0.0	0.0	0.0	9.8	8.9	10.8
Multimorbidity	10.8	9.1	12.6	19.7	16.5	22.9	32.0	27.6	36.4	11.7	9.8	13.5
Total	43.2	41.4	44.9	35.5	32.9	38.1	32.0	27.6	36.4	42.5	40.7	44.3

Female, completed secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	24.8	23.1	26.5	0.0	0.0	0.0	0.0	0.0	0.0	22.7	21.2	24.3
1 disease	9.5	8.2	10.9	16.7	14.5	18.8	0.0	0.0	0.0	10.0	8.6	11.4
Multimorbidity	9.5	7.4	11.6	18.2	14.7	21.8	30.7	26.3	35.2	10.3	8.1	12.5
Total	43.8	41.3	46.3	34.9	31.6	38.2	30.7	26.3	35.2	43.1	40.5	45.6

Female, post-secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	30.5	26.9	34.0	0.0	0.0	0.0	0.0	0.0	0.0	28.0	24.7	31.2
1 disease	9.5	6.8	12.3	17.5	12.6	22.4	0.0	0.0	0.0	10.1	7.2	13.0
Multimorbidity	11.8	7.2	16.4	25.8	16.3	35.3	40.2	30.8	49.6	13.1	8.1	18.1
Total	51.8	47.1	56.5	43.3	36.3	50.2	40.2	30.8	49.6	51.1	46.2	56.0

Adjusted for geography, stratified by gender and race:binary education interaction

Male, African, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	25.2	23.1	27.2	0.0	0.0	0.0	0.0	0.0	0.0	23.9	22.0	25.9
1 disease	7.7	6.6	8.8	16.2	13.7	18.6	0.0	0.0	0.0	8.0	6.9	9.2
Multimorbidity	5.1	3.7	6.5	10.3	6.9	13.7	21.8	16.0	27.6	5.4	3.9	6.8
Total	37.9	35.6	40.3	26.5	22.8	30.1	21.8	16.0	27.6	37.4	35.0	39.7

Male, African, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	29.9	27.6	32.2	0.0	0.0	0.0	0.0	0.0	0.0	28.5	26.3	30.6
1 disease	7.1	5.8	8.4	17.0	14.5	19.4	0.0	0.0	0.0	7.5	6.2	8.9
Multimorbidity	3.9	2.3	5.5	9.0	5.9	12.1	20.2	15.3	25.0	4.2	2.5	5.8
Total	40.9	38.2	43.5	25.9	22.8	29.1	20.2	15.3	25.0	40.1	37.5	42.8

Male, Coloured, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	23.6	20.6	26.5	0.0	0.0	0.0	0.0	0.0	0.0	22.4	19.6	25.2
1 disease	10.1	7.3	12.9	18.7	14.1	23.4	0.0	0.0	0.0	10.4	7.6	13.3
Multimorbidity	6.9	4.2	9.6	12.7	7.3	18.1	25.9	18.2	33.7	7.2	4.4	10.1
Total	40.6	37.4	43.7	31.5	26.9	36.0	25.9	18.2	33.7	40.1	36.9	43.2

Male, Coloured, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	27.9	23.0	32.9	0.0	0.0	0.0	0.0	0.0	0.0	26.6	21.9	31.3
1 disease	10.7	4.7	16.8	23.0	14.7	31.2	0.0	0.0	0.0	11.3	5.2	17.3
Multimorbidity	2.6	0.0	5.5	5.4	0.0	11.0	15.8	5.7	25.8	2.8	0.0	5.8
Total	41.3	36.7	45.8	28.3	19.7	37.0	15.8	5.7	25.8	40.6	35.9	45.3

Male, White, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	17.7	6.4	29.0	0.0	0.0	0.0	0.0	0.0	0.0	16.8	6.1	27.6
1 disease	19.9	1.3	38.4	31.0	12.1	50.0	0.0	0.0	0.0	20.3	1.8	38.7
Multimorbidity	2.2	0.0	6.1	3.3	0.0	9.1	13.3	0.0	28.2	2.3	0.0	6.3
Total	39.8	24.9	54.6	34.4	14.4	54.4	13.3	0.0	28.2	39.4	24.4	54.4

Male, White, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	28.2	22.1	34.3	0.0	0.0	0.0	0.0	0.0	0.0	26.8	21.0	32.6
1 disease	10.8	7.7	13.8	20.5	15.4	25.6	0.0	0.0	0.0	11.2	8.1	14.2
Multimorbidity	9.0	3.8	14.2	18.1	7.4	28.9	33.9	20.7	47.1	9.5	4.0	14.9
Total	47.9	42.0	53.8	38.7	30.2	47.1	33.9	20.7	47.1	47.4	41.4	53.4

Female, African, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	22.7	21.0	24.5	0.0	0.0	0.0	0.0	0.0	0.0	20.9	19.2	22.5
1 disease	9.5	8.5	10.4	15.7	13.5	17.9	0.0	0.0	0.0	9.9	8.9	10.9
Multimorbidity	11.0	9.1	12.9	20.1	16.7	23.5	32.5	28.1	37.0	11.9	9.9	13.8
Total	43.2	41.4	45.1	35.8	33.0	38.6	32.5	28.1	37.0	42.6	40.7	44.5

Female, African, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	25.9	24.2	27.6	0.0	0.0	0.0	0.0	0.0	0.0	23.8	22.2	25.3
1 disease	9.2	7.9	10.4	16.4	14.5	18.3	0.0	0.0	0.0	9.6	8.4	10.9
Multimorbidity	9.0	7.0	10.9	18.1	14.7	21.4	30.5	26.1	34.9	9.8	7.7	11.9
Total	44.0	41.5	46.5	34.5	31.2	37.8	30.5	26.1	34.9	43.2	40.7	45.8

Female, Coloured, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	24.2	19.9	28.5	0.0	0.0	0.0	0.0	0.0	0.0	22.2	18.3	26.1
1 disease	8.9	7.6	10.2	15.4	13.0	17.8	0.0	0.0	0.0	9.3	8.0	10.6
Multimorbidity	9.9	6.8	13.0	19.0	13.6	24.3	31.1	24.6	37.6	10.7	7.5	14.0
Total	43.0	38.8	47.1	34.4	29.5	39.3	31.1	24.6	37.6	42.2	38.1	46.4

Female, Coloured, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	26.8	19.1	34.5	0.0	0.0	0.0	0.0	0.0	0.0	24.6	17.5	31.6
1 disease	13.6	6.3	20.9	23.2	14.8	31.7	0.0	0.0	0.0	14.3	6.9	21.6
Multimorbidity	8.7	5.8	11.5	17.2	12.8	21.7	33.1	26.0	40.2	9.5	6.6	12.4
Total	49.1	43.5	54.7	40.5	32.0	49.0	33.1	26.0	40.2	48.3	42.6	54.1

Female, White, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	27.1	4.5	49.6	0.0	0.0	0.0	0.0	0.0	0.0	24.8	4.1	45.5
1 disease	9.4	0.0	23.2	16.5	3.4	29.5	0.0	0.0	0.0	9.9	0.0	23.5
Multimorbidity	11.4	0.0	30.0	23.0	0.5	45.4	36.3	7.2	65.5	12.4	0.0	31.3
Total	47.9	33.6	62.1	39.4	10.6	68.2	36.3	7.2	65.5	47.2	31.9	62.4

Female, White, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	27.4	20.8	34.1	0.0	0.0	0.0	0.0	0.0	0.0	25.2	19.1	31.3
1 disease	8.8	4.4	13.2	15.0	8.2	21.9	0.0	0.0	0.0	9.2	4.7	13.7
Multimorbidity	14.2	8.6	19.7	28.3	17.2	39.4	41.5	32.2	50.9	15.4	9.5	21.3
Total	50.4	44.8	56.0	43.3	36.4	50.3	41.5	32.2	50.9	49.8	44.1	55.5

2 Exclude tuberculosis from multimorbidity definition

2.1 Initial disease state distribution

Initial disease state	Male (n=7224)	Female (n=10,806)	Overall (N=18,030)
0 disease	5805 (80.4%)	7365 (68.2%)	13170 (73.0%)
1 disease	1131 (15.7%)	2567 (23.8%)	3698 (20.5%)
2+ diseases	288 (4.0%)	874 (8.1%)	1162 (6.4%)

2.2 Expectancy estimates

Unadjusted, stratified by gender

Male

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	22.4	21.4	23.4	0.0	0.0	0.0	0.0	0.0	0.0	21.1	20.1	22.0
1 disease	10.0	9.1	10.9	18.6	16.5	20.7	0.0	0.0	0.0	10.4	9.4	11.4
Multimorbidity	7.8	6.6	9.0	12.5	10.1	14.8	22.3	17.7	26.9	8.2	6.9	9.4
Total	40.2	38.4	42.0	31.0	28.0	34.1	22.3	17.7	26.9	39.6	37.8	41.5

Female

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	19.3	18.4	20.1	0.0	0.0	0.0	0.0	0.0	0.0	17.3	16.6	18.1
1 disease	11.1	10.4	11.9	17.0	15.6	18.4	0.0	0.0	0.0	11.6	10.8	12.4
Multimorbidity	14.9	13.9	16.0	22.3	20.3	24.3	33.7	30.8	36.7	15.8	14.6	16.9
Total	45.3	44.0	46.7	39.3	37.4	41.2	33.7	30.8	36.7	44.7	43.3	46.1

Adjusted for geography, stratified by gender and race

Male, African

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	22.7	21.6	23.7	0.0	0.0	0.0	0.0	0.0	0.0	21.3	20.4	22.3
1 disease	9.7	8.7	10.6	18.5	16.4	20.5	0.0	0.0	0.0	10.1	9.1	11.1
Multimorbidity	6.8	5.6	8.1	11.1	8.6	13.5	20.4	15.8	25.0	7.1	5.8	8.5
Total	39.2	37.3	41.0	29.5	26.5	32.6	20.4	15.8	25.0	38.6	36.6	40.5

Male, Asian/Indian

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	23.9	16.4	31.5	0.0	0.0	0.0	0.0	0.0	0.0	22.5	15.4	29.7
1 disease	6.3	2.0	10.5	12.3	4.1	20.5	0.0	0.0	0.0	6.6	2.2	11.0
Multimorbidity	15.6	1.1	30.2	26.4	3.9	49.0	36.8	14.1	59.5	16.3	1.3	31.3
Total	45.8	34.1	57.6	38.7	21.2	56.2	36.8	14.1	59.5	45.4	33.4	57.4

Male, Coloured

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	20.0	17.5	22.6	0.0	0.0	0.0	0.0	0.0	0.0	18.9	16.5	21.3
1 disease	10.5	7.2	13.8	18.1	14.0	22.3	0.0	0.0	0.0	10.9	7.5	14.2
Multimorbidity	10.6	7.5	13.8	16.0	11.7	20.4	26.8	20.7	32.9	11.0	7.8	14.2
Total	41.2	38.2	44.2	34.2	28.9	39.5	26.8	20.7	32.9	40.7	37.6	43.8

Male, White

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	21.5	17.4	25.6	0.0	0.0	0.0	0.0	0.0	0.0	20.2	16.4	24.1
1 disease	13.8	10.0	17.6	22.5	17.0	28.1	0.0	0.0	0.0	14.2	10.4	18.1
Multimorbidity	13.0	8.5	17.4	19.7	13.0	26.4	33.8	24.4	43.2	13.4	8.9	18.0
Total	48.3	43.0	53.6	42.2	35.3	49.2	33.8	24.4	43.2	47.9	42.5	53.2

Female, African

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	19.1	18.2	20.0	0.0	0.0	0.0	0.0	0.0	0.0	17.1	16.3	18.0
1 disease	11.0	10.3	11.8	16.8	15.4	18.2	0.0	0.0	0.0	11.5	10.7	12.3
Multimorbidity	14.5	13.3	15.7	21.6	19.5	23.7	32.7	29.6	35.8	15.3	14.0	16.6
Total	44.6	43.1	46.0	38.4	36.4	40.4	32.7	29.6	35.8	43.9	42.4	45.4

Female, Asian/Indian

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	25.1	10.7	39.4	0.0	0.0	0.0	0.0	0.0	0.0	22.5	9.6	35.5
1 disease	9.8	4.8	14.8	15.9	9.8	22.0	0.0	0.0	0.0	10.3	5.4	15.2
Multimorbidity	18.7	10.8	26.5	31.9	26.4	37.4	44.6	37.1	52.2	20.1	12.9	27.4
Total	53.6	46.4	60.7	47.8	40.3	55.3	44.6	37.1	52.2	52.9	45.9	60.0

Female, Coloured

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	18.9	16.1	21.8	0.0	0.0	0.0	0.0	0.0	0.0	17.0	14.5	19.6
1 disease	12.8	9.3	16.4	19.0	14.8	23.3	0.0	0.0	0.0	13.3	9.7	16.9
Multimorbidity	14.5	11.8	17.3	21.4	17.2	25.6	33.7	28.9	38.6	15.3	12.4	18.2
Total	46.3	43.5	49.1	40.5	36.7	44.2	33.7	28.9	38.6	45.6	42.8	48.5

Female, White

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	22.4	18.7	26.2	0.0	0.0	0.0	0.0	0.0	0.0	20.2	16.8	23.6
1 disease	10.0	7.0	13.1	15.7	11.4	20.1	0.0	0.0	0.0	10.5	7.4	13.6
Multimorbidity	18.5	13.7	23.3	29.5	22.8	36.3	41.7	34.7	48.7	19.7	14.7	24.7
Total	51.0	46.4	55.5	45.3	39.4	51.1	41.7	34.7	48.7	50.4	45.7	55.0

Adjusted for geography, stratified by gender and education

Male, some secondary school or less

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	21.1	19.6	22.5	0.0	0.0	0.0	0.0	0.0	0.0	19.8	18.5	21.2
1 disease	9.6	8.5	10.8	17.6	15.2	20.0	0.0	0.0	0.0	10.0	8.8	11.2
Multimorbidity	7.3	5.7	8.9	11.3	8.2	14.4	20.2	14.7	25.7	7.6	5.9	9.3
Total	38.0	35.7	40.3	28.9	25.5	32.4	20.2	14.7	25.7	37.4	35.1	39.8

Male, completed secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	22.9	21.4	24.4	0.0	0.0	0.0	0.0	0.0	0.0	21.6	20.2	22.9
1 disease	9.2	7.9	10.4	17.4	15.2	19.7	0.0	0.0	0.0	9.6	8.3	10.8
Multimorbidity	7.7	5.7	9.6	12.3	9.3	15.3	21.4	16.6	26.2	8.0	6.0	9.9
Total	39.7	37.2	42.2	29.7	26.2	33.2	21.4	16.6	26.2	39.1	36.6	41.6

Male, post-secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	24.6	21.6	27.5	0.0	0.0	0.0	0.0	0.0	0.0	23.1	20.4	25.9
1 disease	14.0	10.7	17.4	24.3	18.9	29.7	0.0	0.0	0.0	14.5	11.1	18.0
Multimorbidity	10.5	7.0	14.0	17.0	11.2	22.7	30.5	22.1	38.9	10.9	7.3	14.5
Total	49.1	44.6	53.6	41.2	35.0	47.4	30.5	22.1	38.9	48.6	44.0	53.2

Female, some secondary school or less

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	18.0	16.8	19.2	0.0	0.0	0.0	0.0	0.0	0.0	16.2	15.1	17.2
1 disease	10.6	9.7	11.5	15.8	14.2	17.4	0.0	0.0	0.0	11.0	10.0	12.0
Multimorbidity	15.3	13.9	16.8	22.4	20.0	24.8	33.2	29.9	36.5	16.1	14.6	17.7
Total	43.9	42.3	45.6	38.2	35.9	40.5	33.2	29.9	36.5	43.3	41.6	45.0

Female, completed secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	19.2	18.0	20.4	0.0	0.0	0.0	0.0	0.0	0.0	17.3	16.2	18.3
1 disease	11.5	10.1	12.9	17.4	15.4	19.3	0.0	0.0	0.0	12.0	10.5	13.4
Multimorbidity	13.7	11.5	16.0	20.7	17.3	24.0	31.8	27.5	36.1	14.5	12.2	16.9
Total	44.5	41.9	47.0	38.0	34.8	41.2	31.8	27.5	36.1	43.8	41.1	46.4

Female, post-secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	21.9	19.8	24.0	0.0	0.0	0.0	0.0	0.0	0.0	19.7	17.8	21.6
1 disease	12.8	9.8	15.8	19.1	15.2	23.0	0.0	0.0	0.0	13.3	10.3	16.3
Multimorbidity	17.8	13.7	21.9	28.1	21.8	34.4	42.4	35.0	49.8	19.0	14.7	23.2
Total	52.5	48.2	56.9	47.3	41.5	53.1	42.4	35.0	49.8	52.0	47.4	56.5

Adjusted for geography, stratified by gender and race:binary education interaction

Male, African, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	20.9	19.3	22.4	0.0	0.0	0.0	0.0	0.0	0.0	19.6	18.1	21.1
1 disease	9.9	8.6	11.1	18.0	15.4	20.6	0.0	0.0	0.0	10.3	9.0	11.6
Multimorbidity	7.1	5.3	8.8	11.1	7.8	14.4	20.3	14.5	26.1	7.4	5.5	9.2
Total	37.8	35.4	40.3	29.1	25.5	32.8	20.3	14.5	26.1	37.3	34.8	39.8

Male, African, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	24.3	22.9	25.7	0.0	0.0	0.0	0.0	0.0	0.0	22.9	21.6	24.2
1 disease	9.6	8.3	10.9	18.7	16.3	21.1	0.0	0.0	0.0	10.0	8.7	11.4
Multimorbidity	6.7	4.9	8.4	11.2	8.4	14.1	20.7	15.9	25.4	7.0	5.2	8.8
Total	40.5	38.0	43.1	29.9	26.4	33.4	20.7	15.9	25.4	39.9	37.3	42.5

Male, Coloured, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	19.8	17.7	21.9	0.0	0.0	0.0	0.0	0.0	0.0	18.7	16.6	20.7
1 disease	9.8	7.2	12.5	16.9	13.0	20.9	0.0	0.0	0.0	10.2	7.5	12.9
Multimorbidity	11.4	7.7	15.0	17.2	11.4	23.0	27.9	20.5	35.3	11.7	8.0	15.5
Total	41.0	37.6	44.4	34.1	29.3	39.0	27.9	20.5	35.3	40.6	37.1	44.0

Male, Coloured, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	19.6	15.7	23.5	0.0	0.0	0.0	0.0	0.0	0.0	18.5	14.8	22.1
1 disease	11.3	5.7	16.9	19.0	12.5	25.6	0.0	0.0	0.0	11.7	6.1	17.2
Multimorbidity	9.7	3.5	15.9	14.5	6.1	22.9	25.2	14.1	36.3	10.0	3.7	16.4
Total	40.6	34.4	46.8	33.6	23.9	43.3	25.2	14.1	36.3	40.2	33.8	46.5

Male, White, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	20.0	11.7	28.4	0.0	0.0	0.0	0.0	0.0	0.0	18.9	11.0	26.7
1 disease	4.7	0.0	9.5	9.4	2.2	16.6	0.0	0.0	0.0	5.0	0.1	9.8
Multimorbidity	15.2	0.0	34.4	24.6	0.0	52.0	33.6	5.5	61.7	15.7	0.0	35.4
Total	39.9	22.9	57.0	34.0	9.2	58.9	33.6	5.5	61.7	39.6	22.1	57.1

Male, White, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	20.9	16.6	25.1	0.0	0.0	0.0	0.0	0.0	0.0	19.6	15.7	23.6
1 disease	14.6	10.4	18.8	23.3	17.2	29.3	0.0	0.0	0.0	15.0	10.8	19.3
Multimorbidity	12.9	8.2	17.6	19.4	12.3	26.4	33.8	23.6	44.0	13.3	8.5	18.1
Total	48.4	42.7	54.1	42.6	35.2	50.0	33.8	23.6	44.0	48.0	42.3	53.8

Female, African, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	18.2	17.0	19.5	0.0	0.0	0.0	0.0	0.0	0.0	16.4	15.2	17.5
1 disease	10.4	9.4	11.3	15.3	13.7	17.0	0.0	0.0	0.0	10.8	9.8	11.7
Multimorbidity	15.5	13.8	17.1	23.0	20.4	25.5	33.7	30.3	37.2	16.3	14.6	18.0
Total	44.1	42.3	45.8	38.3	35.8	40.8	33.7	30.3	37.2	43.4	41.6	45.2

Female, African, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	19.5	18.4	20.7	0.0	0.0	0.0	0.0	0.0	0.0	17.6	16.5	18.6
1 disease	12.0	10.6	13.4	17.9	15.9	19.9	0.0	0.0	0.0	12.4	11.1	13.8
Multimorbidity	13.0	10.7	15.3	19.9	16.5	23.3	31.4	27.1	35.6	13.8	11.4	16.2
Total	44.5	41.9	47.1	37.8	34.7	41.0	31.4	27.1	35.6	43.8	41.2	46.4

Female, Coloured, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	17.8	14.8	20.8	0.0	0.0	0.0	0.0	0.0	0.0	16.0	13.3	18.7
1 disease	11.3	9.0	13.6	16.5	13.2	19.8	0.0	0.0	0.0	11.7	9.4	14.0
Multimorbidity	14.7	11.2	18.1	21.5	17.0	26.1	32.6	27.1	38.1	15.4	11.9	19.0
Total	43.8	39.6	47.9	38.0	33.7	42.4	32.6	27.1	38.1	43.1	39.0	47.3

Female, Coloured, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	19.6	14.1	25.1	0.0	0.0	0.0	0.0	0.0	0.0	17.6	12.7	22.6
1 disease	15.8	8.7	22.8	22.4	14.4	30.3	0.0	0.0	0.0	16.3	9.2	23.3
Multimorbidity	15.2	10.8	19.6	23.0	16.1	29.8	38.1	29.7	46.5	16.1	11.5	20.7
Total	50.6	45.1	56.1	45.3	37.9	52.8	38.1	29.7	46.5	50.0	44.3	55.7

Female, White, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	15.6	7.6	23.6	0.0	0.0	0.0	0.0	0.0	0.0	14.0	6.8	21.2
1 disease	13.5	6.9	20.0	18.3	10.7	25.9	0.0	0.0	0.0	13.8	7.3	20.4
Multimorbidity	17.8	0.0	38.1	24.6	0.0	50.6	37.4	7.3	67.6	18.6	0.0	39.4
Total	46.9	28.5	65.3	42.9	20.1	65.6	37.4	7.3	67.6	46.5	27.6	65.3

Female, White, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	22.7	18.6	26.9	0.0	0.0	0.0	0.0	0.0	0.0	20.5	16.7	24.2
1 disease	9.4	6.2	12.6	14.4	10.1	18.7	0.0	0.0	0.0	9.8	6.5	13.0
Multimorbidity	19.2	15.2	23.2	31.3	25.3	37.4	43.0	36.2	49.7	20.5	16.4	24.7
Total	51.3	46.3	56.4	45.7	39.7	51.8	43.0	36.2	49.7	50.7	45.6	55.8

3 Exclude hypertension and tuberculosis from multimorbidity definition

3.1 Initial disease state distribution

Initial disease state	Male (n=7224)	Female (n=10,806)	Overall (N=18,030)
0 disease	6568 (90.9%)	9212 (85.2%)	15780 (87.5%)
1 disease	587 (8.1%)	1380 (12.8%)	1967 (10.9%)
2+ diseases	69 (1.0%)	214 (2.0%)	283 (1.6%)

3.2 Expectancy estimates

Unadjusted, stratified by gender

Male

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	30.8	29.3	32.4	0.0	0.0	0.0	0.0	0.0	0.0	29.8	28.3	31.3
1 disease	7.2	6.3	8.1	20.5	17.7	23.3	0.0	0.0	0.0	7.6	6.7	8.5
Multimorbidity	2.8	2.0	3.6	6.0	4.0	8.0	14.0	8.8	19.3	2.9	2.1	3.8
Total	40.8	39.1	42.5	26.5	23.2	29.8	14.0	8.8	19.3	40.3	38.6	42.0

Female

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	27.6	26.3	28.8	0.0	0.0	0.0	0.0	0.0	0.0	26.0	24.9	27.2
1 disease	9.3	8.6	10.1	17.6	15.7	19.5	0.0	0.0	0.0	9.7	9.0	10.5
Multimorbidity	8.2	7.1	9.2	17.4	14.9	19.9	30.5	26.6	34.4	8.7	7.6	9.8
Total	45.0	43.7	46.4	35.0	32.8	37.1	30.5	26.6	34.4	44.5	43.1	45.9

Adjusted for geography, stratified by gender and race

Male, African

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	31.0	29.4	32.7	0.0	0.0	0.0	0.0	0.0	0.0	30.0	28.5	31.6
1 disease	6.6	5.7	7.4	19.7	16.9	22.6	0.0	0.0	0.0	7.0	6.1	7.8
Multimorbidity	2.2	1.4	3.1	5.1	3.3	6.9	12.7	8.1	17.3	2.3	1.5	3.2
Total	39.8	38.1	41.6	24.8	21.6	28.1	12.7	8.1	17.3	39.3	37.5	41.1

Male, Asian/Indian

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	26.5	16.6	36.4	0.0	0.0	0.0	0.0	0.0	0.0	25.6	16.0	35.2
1 disease	10.7	2.6	18.8	22.4	4.8	40.1	0.0	0.0	0.0	11.0	2.7	19.4
Multimorbidity	8.4	0.0	25.7	15.7	0.0	47.1	29.4	0.0	70.0	8.6	0.0	26.5
Total	45.5	34.3	56.8	38.2	18.8	57.6	29.4	0.0	70.0	45.2	33.8	56.7

Male, Coloured

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	29.8	27.4	32.3	0.0	0.0	0.0	0.0	0.0	0.0	28.9	26.5	31.2
1 disease	8.8	5.4	12.2	22.7	16.1	29.3	0.0	0.0	0.0	9.2	5.7	12.6
Multimorbidity	3.3	0.8	5.8	7.0	1.3	12.7	16.2	6.5	25.9	3.5	0.9	6.1
Total	42.0	39.3	44.6	29.7	24.4	35.0	16.2	6.5	25.9	41.5	38.8	44.2

Male, White

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	29.5	23.7	35.3	0.0	0.0	0.0	0.0	0.0	0.0	28.5	23.0	34.1
1 disease	11.5	8.2	14.8	25.1	19.4	30.8	0.0	0.0	0.0	11.9	8.5	15.3
Multimorbidity	7.6	2.9	12.3	15.2	5.2	25.3	29.9	14.8	45.0	7.8	3.0	12.7
Total	48.6	43.3	53.8	40.3	32.3	48.3	29.9	14.8	45.0	48.3	43.0	53.6

Female, African

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	27.2	25.9	28.5	0.0	0.0	0.0	0.0	0.0	0.0	25.7	24.5	26.9
1 disease	9.3	8.6	10.1	17.6	15.7	19.5	0.0	0.0	0.0	9.7	8.9	10.5
Multimorbidity	7.7	6.5	8.8	16.3	13.7	19.0	29.1	25.0	33.2	8.2	6.9	9.4
Total	44.2	42.8	45.7	33.9	31.6	36.2	29.1	25.0	33.2	43.6	42.1	45.1

Female, Asian/Indian

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	28.9	17.6	40.2	0.0	0.0	0.0	0.0	0.0	0.0	27.3	16.6	38.0
1 disease	11.9	7.2	16.5	20.5	11.4	29.7	0.0	0.0	0.0	12.3	7.5	17.1
Multimorbidity	11.7	2.3	21.1	24.7	8.4	40.9	41.3	25.8	56.7	12.5	2.8	22.1
Total	52.5	45.2	59.8	45.2	35.8	54.7	41.3	25.8	56.7	52.1	44.7	59.4

Female, Coloured

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	29.5	26.3	32.7	0.0	0.0	0.0	0.0	0.0	0.0	27.8	24.8	30.9
1 disease	9.1	7.0	11.3	18.0	15.0	21.1	0.0	0.0	0.0	9.6	7.4	11.8
Multimorbidity	7.2	5.4	9.1	16.5	12.3	20.6	29.5	23.7	35.2	7.8	5.9	9.8
Total	45.9	42.9	48.8	34.5	30.2	38.8	29.5	23.7	35.2	45.2	42.3	48.2

Female, White

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	29.2	22.7	35.7	0.0	0.0	0.0	0.0	0.0	0.0	27.6	21.4	33.7
1 disease	8.9	4.1	13.6	15.8	8.7	22.9	0.0	0.0	0.0	9.2	4.3	14.1
Multimorbidity	12.8	8.7	16.9	27.5	19.9	35.1	41.5	35.1	47.8	13.7	9.5	17.9
Total	50.9	46.5	55.2	43.3	37.5	49.1	41.5	35.1	47.8	50.4	46.0	54.8

Adjusted for geography, stratified by gender and education

Male, some secondary school or less

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	29.4	27.3	31.5	0.0	0.0	0.0	0.0	0.0	0.0	28.4	26.4	30.4
1 disease	7.0	5.9	8.2	19.7	16.4	23.1	0.0	0.0	0.0	7.4	6.2	8.6
Multimorbidity	2.3	1.5	3.1	4.6	2.7	6.4	11.2	6.2	16.2	2.4	1.6	3.2
Total	38.7	36.5	40.9	24.3	20.3	28.2	11.2	6.2	16.2	38.2	36.0	40.4

Male, completed secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	30.6	28.3	33.0	0.0	0.0	0.0	0.0	0.0	0.0	29.6	27.4	31.9
1 disease	7.5	6.0	9.1	21.0	17.6	24.5	0.0	0.0	0.0	7.9	6.4	9.5
Multimorbidity	2.5	1.2	3.7	5.0	2.3	7.8	12.0	6.2	17.9	2.6	1.3	3.9
Total	40.7	38.3	43.1	26.1	22.5	29.6	12.0	6.2	17.9	40.2	37.8	42.6

Male, post-secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	36.4	32.3	40.5	0.0	0.0	0.0	0.0	0.0	0.0	35.2	31.2	39.2
1 disease	7.3	5.1	9.5	20.9	16.5	25.4	0.0	0.0	0.0	7.7	5.4	9.9
Multimorbidity	6.1	2.7	9.5	15.1	7.2	23.0	27.3	15.3	39.3	6.4	2.9	9.9
Total	49.8	45.4	54.1	36.0	28.2	43.9	27.3	15.3	39.3	49.3	44.8	53.7

Female, some secondary school or less

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	25.7	24.0	27.4	0.0	0.0	0.0	0.0	0.0	0.0	24.3	22.6	25.9
1 disease	9.3	8.3	10.2	16.8	14.6	19.1	0.0	0.0	0.0	9.6	8.7	10.6
Multimorbidity	8.5	7.1	9.9	17.3	14.0	20.6	30.1	25.3	34.9	9.0	7.5	10.6
Total	43.5	41.7	45.3	34.1	31.4	36.8	30.1	25.3	34.9	43.0	41.2	44.8

Female, completed secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	27.7	26.0	29.4	0.0	0.0	0.0	0.0	0.0	0.0	26.2	24.5	27.8
1 disease	9.6	8.2	11.0	18.1	15.8	20.5	0.0	0.0	0.0	10.0	8.6	11.4
Multimorbidity	7.1	5.4	8.9	15.4	12.0	18.8	28.3	23.5	33.0	7.6	5.8	9.5
Total	44.4	41.9	46.9	33.6	30.2	36.9	28.3	23.5	33.0	43.8	41.3	46.3

Female, post-secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	32.3	28.5	36.1	0.0	0.0	0.0	0.0	0.0	0.0	30.5	26.9	34.1
1 disease	9.6	6.7	12.6	18.4	12.8	24.0	0.0	0.0	0.0	10.1	7.0	13.1
Multimorbidity	10.6	6.0	15.1	25.2	15.1	35.3	40.5	30.6	50.4	11.5	6.6	16.3
Total	52.5	48.0	57.1	43.6	36.5	50.7	40.5	30.6	50.4	52.0	47.4	56.7

Adjusted for geography, stratified by gender and race:binary education interaction

Male, African, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	29.1	26.9	31.4	0.0	0.0	0.0	0.0	0.0	0.0	28.2	26.0	30.3
1 disease	7.0	5.8	8.2	20.0	16.5	23.5	0.0	0.0	0.0	7.4	6.1	8.7
Multimorbidity	2.3	1.4	3.1	5.0	2.9	7.0	12.8	7.2	18.4	2.4	1.5	3.3
Total	38.4	36.1	40.8	24.9	20.9	29.0	12.8	7.2	18.4	38.0	35.6	40.3

Male, African, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	33.3	31.0	35.6	0.0	0.0	0.0	0.0	0.0	0.0	32.2	29.9	34.4
1 disease	6.1	4.8	7.3	19.4	16.4	22.5	0.0	0.0	0.0	6.4	5.2	7.7
Multimorbidity	2.3	0.8	3.8	5.7	2.6	8.8	14.0	8.3	19.6	2.5	0.9	4.0
Total	41.6	39.0	44.3	25.2	21.5	28.8	14.0	8.3	19.6	41.1	38.4	43.7

Male, Coloured, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	29.0	26.2	31.8	0.0	0.0	0.0	0.0	0.0	0.0	28.0	25.3	30.8
1 disease	8.0	4.7	11.2	20.4	14.0	26.9	0.0	0.0	0.0	8.3	5.0	11.7
Multimorbidity	4.6	2.4	6.7	9.7	3.9	15.4	20.2	9.8	30.6	4.8	2.5	7.0
Total	41.5	38.5	44.6	30.1	24.4	35.7	20.2	9.8	30.6	41.1	38.0	44.2

Male, Coloured, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	30.0	25.1	34.9	0.0	0.0	0.0	0.0	0.0	0.0	29.0	24.3	33.7
1 disease	10.1	3.8	16.5	25.8	16.0	35.7	0.0	0.0	0.0	10.6	4.1	17.0
Multimorbidity	2.2	0.0	5.1	4.5	0.0	10.4	12.6	1.4	23.9	2.3	0.0	5.3
Total	42.3	37.4	47.3	30.3	20.6	40.0	12.6	1.4	23.9	41.9	36.8	46.9

Male, White, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	19.1	7.2	30.9	0.0	0.0	0.0	0.0	0.0	0.0	18.4	7.0	29.9
1 disease	19.6	0.0	40.7	34.2	12.8	55.6	0.0	0.0	0.0	20.0	0.0	41.1
Multimorbidity	1.9	0.0	5.3	2.8	0.0	7.7	10.3	0.0	24.1	1.9	0.0	5.4
Total	40.6	23.5	57.6	37.0	14.1	59.8	10.3	0.0	24.1	40.4	23.2	57.5

Male, White, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	29.3	23.2	35.4	0.0	0.0	0.0	0.0	0.0	0.0	28.3	22.5	34.2
1 disease	11.1	7.7	14.5	24.1	17.9	30.3	0.0	0.0	0.0	11.5	8.1	14.9
Multimorbidity	8.6	3.5	13.6	17.3	6.3	28.2	32.9	16.9	49.0	8.9	3.6	14.1
Total	49.0	43.3	54.6	41.4	32.8	50.0	32.9	16.9	49.0	48.7	43.0	54.5

Female, African, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	25.5	23.7	27.2	0.0	0.0	0.0	0.0	0.0	0.0	24.1	22.4	25.7
1 disease	9.3	8.3	10.4	16.5	14.2	18.9	0.0	0.0	0.0	9.7	8.6	10.8
Multimorbidity	8.7	7.1	10.2	17.9	14.4	21.3	30.7	25.9	35.5	9.2	7.6	10.9
Total	43.5	41.7	45.3	34.4	31.6	37.2	30.7	25.9	35.5	43.0	41.1	44.8

Female, African, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	28.6	26.9	30.3	0.0	0.0	0.0	0.0	0.0	0.0	27.0	25.4	28.6
1 disease	9.5	8.1	11.0	18.4	16.0	20.9	0.0	0.0	0.0	10.0	8.5	11.4
Multimorbidity	6.3	4.5	8.0	14.4	10.9	17.8	27.2	22.3	32.0	6.8	4.9	8.6
Total	44.4	41.9	46.9	32.8	29.3	36.2	27.2	22.3	32.0	43.7	41.2	46.3

Female, Coloured, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	27.2	23.1	31.3	0.0	0.0	0.0	0.0	0.0	0.0	25.7	21.8	29.6
1 disease	8.6	7.1	10.1	16.2	13.4	19.0	0.0	0.0	0.0	9.0	7.4	10.5
Multimorbidity	7.5	5.0	10.0	16.6	11.2	21.9	29.0	22.1	35.9	8.1	5.5	10.7
Total	43.3	39.1	47.5	32.7	27.8	37.6	29.0	22.1	35.9	42.7	38.5	46.9

Female, Coloured, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	31.9	25.7	38.1	0.0	0.0	0.0	0.0	0.0	0.0	30.1	24.3	36.0
1 disease	10.9	4.9	16.8	21.1	12.9	29.3	0.0	0.0	0.0	11.4	5.3	17.4
Multimorbidity	7.4	4.9	10.0	18.2	13.6	22.7	33.5	26.4	40.5	8.1	5.5	10.7
Total	50.2	45.0	55.4	39.3	30.9	47.6	33.5	26.4	40.5	49.6	44.3	54.9

Female, White, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	28.3	6.2	50.4	0.0	0.0	0.0	0.0	0.0	0.0	26.7	5.8	47.6
1 disease	9.0	0.0	22.7	16.1	3.0	29.1	0.0	0.0	0.0	9.4	0.0	22.9
Multimorbidity	10.7	0.0	28.9	23.2	0.4	46.0	36.8	7.5	66.1	11.4	0.0	29.8
Total	48.0	34.0	61.9	39.3	9.7	68.8	36.8	7.5	66.1	47.5	32.8	62.1

Female, White, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	28.4	21.7	35.1	0.0	0.0	0.0	0.0	0.0	0.0	26.8	20.5	33.2
1 disease	8.8	4.4	13.2	14.9	7.8	22.1	0.0	0.0	0.0	9.1	4.6	13.6
Multimorbidity	13.9	8.2	19.6	29.4	17.7	41.1	43.1	33.5	52.7	14.8	8.8	20.7
Total	51.1	45.7	56.4	44.3	37.3	51.4	43.1	33.5	52.7	50.7	45.2	56.1

4 Estimate life expectancy from age 40

4.1 Sample characteristics

	Male (n=3266)	Female (n=5404)	Overall (n=8760)
Age (years)			
Mean (SD)	55.3 (11.0)	56.3 (11.9)	56.0 (11.6)
Median [Min, Max]	53.4 [40.0, 99.2]	54.1 [40.0, 106]	53.8 [40.0, 106]
Race			
African	2406 (73.7%)	4268 (79.0%)	6674 (77.0%)
Asian/Indian	53 (1.6%)	74 (1.4%)	127 (1.5%)
Coloured	563 (17.2%)	772 (14.3%)	1335 (15.4%)
White	244 (7.5%)	290 (5.4%)	534 (6.2%)
Education level			
Some secondary school or less	2361 (72.3%)	4184 (77.4%)	6545 (75.5%)
Completed secondary school	562 (17.2%)	769 (14.2%)	1331 (15.4%)
Post-secondary school	343 (10.5%)	451 (8.3%)	794 (9.2%)
Geography			
Rural	1522 (46.6%)	2898 (53.6%)	4420 (51.0%)
Urban	1744 (53.4%)	2506 (46.4%)	4250 (49.0%)
Initial 'from' state			
0 disease	2006 (61.4%)	2595 (48.0%)	4601 (53.1%)
1 disease	932 (28.5%)	1944 (36.0%)	2876 (33.2%)
2+ diseases	328 (10.0%)	865 (16.0%)	1193.8%)

4.2 Expectancy estimates

Unadjusted, stratified by gender

Male

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	12.2	11.0	13.3	0.0	0.0	0.0	0.0	0.0	0.0	8.3	7.5	9.1
1 disease	7.8	7.1	8.5	12.0	10.5	13.4	0.0	0.0	0.0	8.3	7.5	9.1
Multimorbidity	8.1	7.1	9.1	12.6	10.9	14.2	21.5	19.1	23.9	10.1	8.9	11.3
Total	28.0	26.7	29.3	24.5	22.8	26.3	21.5	19.1	23.9	26.7	25.3	28.1

Female

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	10.8	10.1	11.6	0.0	0.0	0.0	0.0	0.0	0.0	6.5	6.1	7.0
1 disease	8.6	7.9	9.3	12.1	11.2	13.0	0.0	0.0	0.0	8.7	8.1	9.3
Multimorbidity	12.4	11.4	13.4	17.2	15.9	18.5	26.9	25.1	28.7	15.3	14.2	16.4
Total	31.8	30.7	33.0	29.4	28.0	30.7	26.9	25.1	28.7	30.6	29.4	31.8

Adjusted for geography, stratified by gender and race

Male, African

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	12.2	11.0	13.3	0.0	0.0	0.0	0.0	0.0	0.0	8.3	7.5	9.1
1 disease	7.8	7.1	8.5	12.2	10.7	13.6	0.0	0.0	0.0	8.4	7.6	9.2
Multimorbidity	7.4	6.3	8.6	11.6	9.8	13.4	20.4	18.0	22.9	9.4	8.0	10.7
Total	27.4	26.0	28.8	23.8	22.0	25.5	20.4	18.0	22.9	26.0	24.5	27.5

Male, Asian/Indian

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	16.3	5.2	27.3	0.0	0.0	0.0	0.0	0.0	0.0	11.1	3.6	18.6
1 disease	2.9	0.8	5.1	5.9	1.4	10.5	0.0	0.0	0.0	3.5	1.0	6.1
Multimorbidity	10.0	0.0	20.6	18.9	5.8	31.9	25.0	13.4	36.7	13.2	2.2	24.3
Total	29.2	21.0	37.4	24.8	14.4	35.2	25.0	13.4	36.7	27.8	19.6	36.0

Male, Coloured

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	11.3	8.5	14.2	0.0	0.0	0.0	0.0	0.0	0.0	7.7	5.8	9.7
1 disease	6.7	4.9	8.5	10.3	7.9	12.6	0.0	0.0	0.0	7.1	5.3	8.9
Multimorbidity	9.5	6.6	12.3	14.3	11.2	17.5	22.6	19.3	26.0	11.6	8.7	14.4
Total	27.5	25.8	29.1	24.6	22.0	27.2	22.6	19.3	26.0	26.4	24.6	28.3

Male, White

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	12.3	8.7	15.8	0.0	0.0	0.0	0.0	0.0	0.0	8.4	6.0	10.8
1 disease	9.6	7.0	12.3	13.8	10.1	17.6	0.0	0.0	0.0	10.0	7.3	12.7
Multimorbidity	11.1	7.9	14.2	16.5	12.2	20.9	27.5	22.5	32.4	13.5	10.1	17.0
Total	33.0	29.2	36.7	30.3	26.2	34.5	27.5	22.5	32.4	31.9	28.1	35.8

Female, African

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	10.4	9.7	11.2	0.0	0.0	0.0	0.0	0.0	0.0	6.3	5.8	6.7
1 disease	8.6	7.9	9.3	12.0	11.1	13.0	0.0	0.0	0.0	8.7	8.0	9.3
Multimorbidity	12.4	11.4	13.5	17.1	15.7	18.4	26.7	24.8	28.5	15.3	14.1	16.5
Total	31.5	30.3	32.7	29.1	27.7	30.5	26.7	24.8	28.5	30.3	29.0	31.5

Female, Asian/Indian

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	16.4	2.0	30.7	0.0	0.0	0.0	0.0	0.0	0.0	9.9	1.2	18.5
1 disease	6.0	2.2	9.7	9.6	6.5	12.7	0.0	0.0	0.0	6.4	3.3	9.4
Multimorbidity	14.3	6.4	22.1	23.9	19.0	28.8	32.7	27.7	37.7	19.0	13.6	24.5
Total	36.6	31.4	41.8	33.5	28.9	38.1	32.7	27.7	37.7	35.3	30.7	39.9

Female, Coloured

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	11.4	9.2	13.5	0.0	0.0	0.0	0.0	0.0	0.0	6.9	5.6	8.2
1 disease	9.2	6.6	11.8	13.2	9.9	16.4	0.0	0.0	0.0	9.4	6.9	11.9
Multimorbidity	9.9	6.9	13.0	14.2	10.5	18.0	23.9	19.9	27.9	12.7	9.4	15.9
Total	30.5	28.0	33.0	27.4	24.4	30.4	23.9	19.9	27.9	28.9	26.2	31.6

Female, White

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	12.7	9.7	15.7	0.0	0.0	0.0	0.0	0.0	0.0	7.7	5.9	9.5
1 disease	8.4	5.6	11.2	12.1	8.4	15.7	0.0	0.0	0.0	8.6	5.9	11.3
Multimorbidity	14.1	9.8	18.3	20.6	15.5	25.8	30.9	26.0	35.8	17.8	13.3	22.2
Total	35.2	31.7	38.7	32.7	28.5	36.9	30.9	26.0	35.8	34.0	30.3	37.8

Adjusted for geography, stratified by gender and education

Male, some secondary school or less

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	11.3	10.1	12.6	0.0	0.0	0.0	0.0	0.0	0.0	7.7	6.9	8.6
1 disease	7.6	6.8	8.4	11.6	10.2	13.0	0.0	0.0	0.0	8.1	7.3	9.0
Multimorbidity	7.9	6.6	9.1	11.9	10.0	13.9	20.5	17.8	23.1	9.7	8.3	11.2
Total	26.8	25.3	28.3	23.5	21.7	25.4	20.5	17.8	23.1	25.6	24.0	27.2

Male, completed secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	12.6	10.6	14.7	0.0	0.0	0.0	0.0	0.0	0.0	8.6	7.2	10.0
1 disease	6.9	5.7	8.1	10.8	8.9	12.7	0.0	0.0	0.0	7.4	6.2	8.7
Multimorbidity	8.9	6.5	11.3	14.1	10.9	17.2	22.6	18.9	26.2	11.1	8.5	13.7
Total	28.4	25.7	31.2	24.9	21.9	27.8	22.6	18.9	26.2	27.1	24.4	29.9

Male, post-secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	15.0	11.5	18.5	0.0	0.0	0.0	0.0	0.0	0.0	10.2	7.9	12.6
1 disease	10.6	7.2	14.1	16.2	11.3	21.1	0.0	0.0	0.0	11.3	7.8	14.9
Multimorbidity	8.6	5.4	11.8	14.2	9.2	19.2	26.1	20.3	32.0	11.2	7.5	14.9
Total	34.2	30.2	38.3	30.5	25.7	35.3	26.1	20.3	32.0	32.8	28.5	37.0

Female, some secondary school or less

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	10.4	9.6	11.2	0.0	0.0	0.0	0.0	0.0	0.0	6.3	5.8	6.8
1 disease	8.3	7.6	9.1	11.6	10.6	12.7	0.0	0.0	0.0	8.4	7.7	9.1
Multimorbidity	12.6	11.4	13.7	17.3	15.8	18.8	26.7	24.8	28.6	15.5	14.2	16.7
Total	31.3	30.2	32.5	29.0	27.6	30.3	26.7	24.8	28.6	30.1	28.9	31.4

Female, completed secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	10.4	9.1	11.7	0.0	0.0	0.0	0.0	0.0	0.0	6.3	5.5	7.0
1 disease	9.4	7.7	11.1	13.0	11.1	14.9	0.0	0.0	0.0	9.4	7.9	11.0
Multimorbidity	11.8	9.4	14.2	16.2	13.2	19.2	26.2	22.3	30.2	14.6	11.9	17.3
Total	31.6	28.6	34.5	29.2	25.8	32.5	26.2	22.3	30.2	30.3	27.2	33.5

Female, post-secondary school

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	13.0	10.9	15.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	6.6	9.0
1 disease	9.3	6.3	12.4	13.3	9.6	17.0	0.0	0.0	0.0	9.5	6.6	12.4
Multimorbidity	13.4	9.9	16.8	19.8	15.1	24.6	30.9	25.1	36.6	17.1	13.2	21.1
Total	35.7	31.3	40.0	33.1	27.9	38.3	30.9	25.1	36.6	34.4	29.7	39.1

Adjusted for geography, stratified by gender and race:binary education interaction

Male, African, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	11.4	10.0	12.8	0.0	0.0	0.0	0.0	0.0	0.0	7.8	6.8	8.7
1 disease	7.8	7.0	8.7	12.0	10.4	13.5	0.0	0.0	0.0	8.4	7.4	9.3
Multimorbidity	7.6	6.2	8.9	11.6	9.5	13.7	20.2	17.4	23.1	9.4	7.8	11.0
Total	26.8	25.2	28.5	23.5	21.5	25.6	20.2	17.4	23.1	25.5	23.8	27.3

Male, African, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	14.1	12.0	16.1	0.0	0.0	0.0	0.0	0.0	0.0	9.6	8.2	11.0
1 disease	7.9	6.2	9.5	12.6	10.2	15.1	0.0	0.0	0.0	8.5	6.8	10.2
Multimorbidity	7.4	5.0	9.7	12.3	8.7	15.8	21.5	17.5	25.4	9.5	6.8	12.2
Total	29.3	26.4	32.2	24.9	21.9	27.9	21.5	17.5	25.4	27.6	24.8	30.5

Male, Coloured, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	9.7	7.5	11.9	0.0	0.0	0.0	0.0	0.0	0.0	6.6	5.1	8.1
1 disease	7.1	5.2	9.0	10.2	7.7	12.8	0.0	0.0	0.0	7.4	5.5	9.3
Multimorbidity	11.1	8.2	14.0	15.6	11.8	19.3	24.1	20.4	27.7	13.1	10.0	16.2
Total	27.8	25.4	30.2	25.8	23.1	28.6	24.1	20.4	27.7	27.1	24.6	29.6

Male, Coloured, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	14.4	9.4	19.3	0.0	0.0	0.0	0.0	0.0	0.0	9.8	6.4	13.1
1 disease	5.8	3.0	8.5	10.1	6.3	13.8	0.0	0.0	0.0	6.5	3.7	9.2
Multimorbidity	6.8	2.7	11.0	12.0	7.0	17.0	19.8	14.6	25.0	9.0	4.7	13.3
Total	27.0	24.6	29.3	22.0	17.9	26.2	19.8	14.6	25.0	25.2	22.7	27.8

Male, White, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	8.0	3.7	12.3	0.0	0.0	0.0	0.0	0.0	0.0	5.5	2.5	8.4
1 disease	4.2	0.3	8.2	6.4	1.5	11.3	0.0	0.0	0.0	4.5	0.6	8.4
Multimorbidity	16.8	3.7	29.8	22.1	7.4	36.8	28.7	15.4	41.9	18.9	5.5	32.3
Total	29.0	17.8	40.2	28.5	16.0	41.0	28.7	15.4	41.9	28.9	17.3	40.5

Male, White, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	12.3	8.6	16.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	5.9	10.9
1 disease	10.1	7.2	12.9	14.4	10.4	18.4	0.0	0.0	0.0	10.5	7.6	13.4
Multimorbidity	10.8	7.6	14.0	16.1	11.6	20.6	27.3	22.0	32.7	13.2	9.7	16.8
Total	33.2	29.1	37.2	30.5	26.0	35.0	27.3	22.0	32.7	32.1	28.0	36.2

Female, African, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	10.6	9.7	11.5	0.0	0.0	0.0	0.0	0.0	0.0	6.4	5.8	6.9
1 disease	8.3	7.5	9.1	11.6	10.5	12.7	0.0	0.0	0.0	8.4	7.6	9.1
Multimorbidity	12.6	11.4	13.8	17.5	15.9	19.0	26.9	25.0	28.8	15.6	14.2	16.9
Total	31.5	30.3	32.6	29.1	27.6	30.5	26.9	25.0	28.8	30.3	29.0	31.5

Female, African, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	10.1	9.0	11.2	0.0	0.0	0.0	0.0	0.0	0.0	6.1	5.4	6.8
1 disease	9.7	8.0	11.3	13.2	11.3	15.0	0.0	0.0	0.0	9.6	8.1	11.2
Multimorbidity	11.6	9.0	14.2	15.9	12.6	19.2	26.0	21.9	30.1	14.4	11.5	17.3
Total	31.4	28.2	34.5	29.1	25.6	32.5	26.0	21.9	30.1	30.1	26.8	33.4

Female, Coloured, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	10.8	8.5	13.1	0.0	0.0	0.0	0.0	0.0	0.0	6.5	5.1	7.9
1 disease	8.3	5.7	10.9	11.7	8.4	15.0	0.0	0.0	0.0	8.4	5.9	10.9
Multimorbidity	11.3	8.5	14.1	15.9	12.5	19.3	25.1	21.3	28.9	14.1	11.1	17.1
Total	30.4	26.9	33.8	27.6	24.2	31.1	25.1	21.3	28.9	29.0	25.7	32.4

Female, Coloured, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	12.5	8.4	16.6	0.0	0.0	0.0	0.0	0.0	0.0	7.5	5.0	10.0
1 disease	12.9	8.5	17.4	18.7	13.5	24.0	0.0	0.0	0.0	13.2	9.1	17.4
Multimorbidity	5.6	1.3	9.9	8.5	2.6	14.4	19.1	10.3	27.8	7.9	2.7	13.0
Total	31.0	25.9	36.2	27.2	20.7	33.7	19.1	10.3	27.8	28.6	22.9	34.4

Female, White, lower educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	7.4	3.3	11.5	0.0	0.0	0.0	0.0	0.0	0.0	4.4	2.0	6.9
1 disease	11.2	6.3	16.1	14.2	8.8	19.5	0.0	0.0	0.0	10.9	6.4	15.3
Multimorbidity	14.2	0.0	28.7	17.5	0.6	34.4	28.7	9.5	47.8	16.7	1.1	32.3
Total	32.8	19.6	46.0	31.6	17.0	46.2	28.7	9.5	47.8	32.0	17.8	46.2

Female, White, higher educated

	Initial state											
	0 disease			1 disease			Multimorbidity			Weighted average		
Target state	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI	Est.	LCI	UCI
0 disease	13.3	9.9	16.8	0.0	0.0	0.0	0.0	0.0	0.0	8.0	6.0	10.1
1 disease	8.0	5.0	11.0	11.6	7.7	15.5	0.0	0.0	0.0	8.2	5.3	11.1
Multimorbidity	14.3	11.0	17.5	21.5	17.4	25.6	31.5	27.5	35.6	18.2	14.9	21.5
Total	35.6	32.1	39.2	33.1	29.2	37.0	31.5	27.5	35.6	34.5	30.8	38.1