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Research Article

Comparative evidence of years lived with reproductive-age morbidity in sub-Saharan Africa (2010–2019)

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Abstract

BACKGROUND
Despite remarkable progress in reducing maternal mortality, maternal morbidities remain high, particularly in sub-Saharan Africa (SSA). This study estimates the life years that women of reproductive ages spend in poor health due to indirect maternal morbidities and measures how much each morbidity compromises the reproductive-age life expectancy.

METHODS
Demographic and Health Survey data from 23 SSA countries were used to estimate age-specific mortality prevalence in reproductive-age women and construct life tables to estimate the survival function and reproductive-age life expectancy (RALE) with and without HIV and anaemia using the Sullivan method.

RESULTS
HIV (4.9%) and anaemia (34.3%) prevalence is high among SSA women. These conditions compromise women's health by an average of 14.3 years (CI 95%, 14.3–14.4), approximately 42% of RALE life years. On average, SSA women spend 11.6 years (11.6–11.7) with anaemia, 1.7 years (1.7–1.8) with HIV, and 1.1 years (1.1–1.2) with both conditions.

CONCLUSIONS
The morbidities that women carry with them in these ages affect not only their health status but that of their infants as well. The high burden of life years with reproductive-

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age morbidities among SSA women highlights that to achieve healthy lives for women and children as part of Sustainable Development Goal 3, morbidity prevention and management measures will need to be enhanced over the entire reproductive-age span.

CONTRIBUTION

This study provides comparative evidence of the excess disease burden on the healthy lives of SSA women due to reproductive-age morbidities and quantifies the average number of years SSA women live with reproductive-age morbidities.

1. Introduction

Globally, about 295,000 maternal deaths were observed in 2017 (WHO 2019b). While remarkable progress has been made in reducing maternal mortality over the past three decades, marked regional disparities persist: 94% of all maternal deaths occur in lower- and middle-income countries (LMICs), and sub-Saharan Africa (SSA) alone accounted for roughly two-thirds of these deaths in 2017, with a maternal mortality ratio of 462 compared to 11 per 100,000 live births in high-income countries (World Bank 2019). Being a rare event, maternal deaths account for a small fraction of the overall burden of poor maternal health, and they do not represent a comprehensive measure to monitor progress in improving maternal health outcomes (World Bank 2019). However, maternal morbidities are still high. The World Health Organization (WHO) recommends including morbidity in the monitoring of maternal health as the years that women spend with illness and suffering compromise their healthy life years (Firoz et al. 2013). Maternal morbidity results in detrimental effects on women's health which may disrupt the achievement of Sustainable Development Goal (SDG) 3.1 (of reducing the global maternal mortality ratio to less than 70 per 100,000 live births) (United Nations 2016), and yet it has been neglected in the reproductive health agenda (WHO 2013).

When a pregnant woman has indirect maternal morbidities, such as HIV, malaria, and anaemia, they are also more likely to suffer from direct causes of mortality, such as sepsis. HIV-infected women have over five times higher risk of direct maternal mortality and are more likely to die from underlying causes than HIV-negative women (Calvert et al. 2020). A study in Mozambique showed that malaria, HIV, and anaemia were found in more than 40% of maternal deaths due to abortion, ectopic pregnancy, and sepsis (Bailey et al. 2015). Further, the risk of still births is doubled among HIV-infected women and fetal anaemia is increased among infants born to HIV-positive women (González et al. 2017). Haemorrhage is the leading cause of maternal mortality (WHO 2019b), and anaemia is one of the leading global causes of haemorrhage and disability (Frass 2015) and therefore should be treated as one of the most serious global public health problems.

While women in LMICs have higher life expectancy than men, they spend most of their life with diseases due to reproductive-age maternal morbidities (Case and Paxson 2005). Evidence shows that infants born to women with obstetric complications are 3.7 times more likely to die than those without complications (WHO 2020). Economically, women spend 11% more than men in similar age groups on reproductive-age morbidity-treatment expenditures, 24% have difficulty in resuming household work (Iyengar, Yadav, and Sen 2012), and socially, some women are neglected by their husbands due to reproductive-age morbidities, such as fistula (Mohamed, Ilesanmi, and Dairo 2018). The high levels of intimate partner violence among pregnant women may also exacerbate maternal morbidities (Rico et al. 2011).

Global evidence shows that for every maternal death, 30 to 40 women end up having maternal morbidities that undermine their normal functioning, including physical, mental, or sexual health issues that also lead to other socioeconomic repercussions (Chou et al. 2016; WHO 2013). Globally, about 27 million annual morbid episodes were estimated to have occurred in 2015 from the five main direct obstetric causes of maternal mortality: haemorrhage, sepsis, complications of abortion, obstructed labour, and hypertensive disorders (Graham et al. 2016). SSA has high rates of reproductive-age morbidity, including haemorrhage, eclampsia, abortions, and prolonged labour; indirect morbidities, including HIV, malaria, and anaemia (World Bank 2019; Chou et al. 2016); and the novel COVID-19 pandemic (Chmielewska et al. 2021). These estimates are mainly based on health facility data. The overall estimate of morbidity is not known as most countries' maternal incidence and disease burden data are not available or comparable: Many SSA countries do not have strong health systems for routine monitoring, and the definitions of morbidities may vary between countries. The data available in health facilities have limitations since some women do not use health facilities for deliveries, and hospitals tend to attract complicated cases which may not be representative of the actual morbidity prevalence (Huang et al. 2021; Streatfield et al. 2014).

Unlike mortality, the demographic impact of morbidity in pregnancy and in the postpartum period has rarely been examined, and yet many women face morbidities in almost every pregnancy and childbirth (WHO 2013; Yeatman and Smith-Greenaway 2021). In SSA, studies of maternal health impact estimate the life years lost for reproductive-age women as a result of maternal mortality (Banda et al. 2015, 2016; Canudas-Romo et al. 2014) and healthy life expectancy for the entire population (Institute for Health Metrics and Evaluation 2018; Philipov and Scherbov 2016). However, little is known about how long reproductive-age women spend with maternal morbidities, which may have an impact on their lifestyle and reproductive health choices as well as affect their infants' health (Iyengar, Yadav, and Sen 2012). There is limited research measuring the demographic impact of maternal morbidities on the health of women. Since the

reproductive-age period is limited to 15 to 50 years – even though some women give birth before and after these ages, which is even more risky – eliminating morbidities would allow women to have successful pregnancies and healthy children and support them to live longer and healthier lives even beyond the reproductive ages (Souza et al. 2013).

This study estimates the number of life years that women of reproductive ages spend in poor health due to reproductive-age morbidities. It highlights the demographic impact of reproductive-age morbidities on the health of women by showing the number of life years that are affected by morbidities and how each morbidity contributes to women's poor health in their reproductive ages. Although alternative measures for estimating the impact of morbidities were used by the Global Burden of Disease studies, including health-adjusted life expectancy, they show only maternal morbidities and leading causes of maternal deaths and not how they affect the reproductive-age life expectancy (Institute for Health Metrics and Evaluation 2018; Murray et al. 1996).

2. Data and methods

We used individual and HIV questionnaires of the Demographic and Health Survey (DHS) data for SSA countries that measured both HIV and anaemia prevalence between 2010 and 2019 to determine the prevalence of maternal morbidities (HIV and anaemia) among women of reproductive ages (15 to 50) in 23 countries (USAID 2021) (see additional Table A-1 for countries included, survey years, and sample sizes). The DHS is a representative, cross-sectional survey with information on a country's demographic and health status, which are comparable in many common indicators across countries (USAID 2021).

To estimate the number of years lived by reproductive age women with HIV and anaemia, we used the prevalence rates of the two diseases (Bailey et al. 2015; Calvert and Ronsmans 2013). SSA countries were excluded from the analysis if they listed only one disease (either HIV or anaemia) for women or if they measured only infant anaemia and not maternal anaemia. Cameroon, Chad, and Rwanda sampled different women for anaemia, and hence we could not calculate comorbidities for these countries.

The data analysis covered the years 2010 to 2019 due to inconsistencies in most country DHS data regarding reproductive-age morbidities before 2010. While HIV has been consistently collected over time, many countries had only child anaemia data before 2010 and introduced maternal anaemia measurement after 2010. Thus, the study was limited to HIV and anaemia as they are the only diseases in the DHS that have been measured in many countries at least once. As such, our estimates of the reproductive

years lived in poor health are only an underestimate of the real burden of diseases that SSA women experience.

3. Analysis

DHS female age-specific death and population counts were used to estimate the age-specific death rates (deaths over mid-year population), construct country-specific life tables, and from those estimates the survival function and reproductive-age life expectancy (RALE) (Canudas-Romo et al., 2014). RALE refers to the average number of years expected to be lived by a woman aged 15 during her reproductive-age period (15 to 50), based on observed age-specific death rates and is calculated as

$$RALE(t) = \frac{T(15,t) - T(50,t)}{\ell(15,t)}, \quad (1)$$

where $T(x,t)$ and $\ell(15,t)$ correspond to the life table measures for the person-years above age x and the number of survivors at age 15 at time t, respectively. In summary, RALE is a life expectancy where the life table starts at age 15 and is completed at age 50. Since the reproductive-age range is 15 to 50, the total number of years for RALE are 35 years if no woman dies. In addition, healthy and unhealthy RALE were calculated using the prevalence rates of HIV and anaemia of women in reproductive ages (the respective International Classification of Diseases 10th revision codes are HIV B20-B24 and anaemia D60–D64) (WHO 2019a).

We defined reproductive-age morbidities (HIV and anaemia) as morbidities which women have experienced due to indirect causes during their reproductive-age period. These were the only morbidities captured in the DHS across SSA between 2010 and 2019. However, HIV and anaemia have been associated with most indirect maternal deaths, including those from direct causes as they predispose a woman to direct causes of maternal deaths, such as postpartum haemorrhage leading to death (Bailey et al. 2015; Calvert et al. 2020). It is common to find HIV and anaemia as the contributing causes of death among women who die from direct maternal mortality causes (Bailey et al. 2015). The prevalence of HIV and anaemia are used to calculate the average number of years a woman will spend with HIV and anaemia in their RALE. These years can be interpreted as the number of reproductive years with HIV and anaemia which women aged 15 to 50 would experience if current age-specific rates of mortality and morbidity prevailed throughout the reproductive-age period.

The Sullivan method is usually used for separating life expectancy into disabled and disability-free life years (Jagar et al. 2007; Sullivan 1971). We used the Sullivan method

to calculate the reproductive years spent with and without HIV and anaemia. It uses the life table person-years combined with the age-specific prevalence of a disease to derive age-specific unhealthy person-years from a particular disease. After that, unhealthy total person-years between ages 15 and 50 and unhealthy RALE are derived (Jagar et al. 2007).

The resultant RALE is then the addition of healthy life expectancy (HLE), unhealthy life years due to HIV (UHIV) and anaemia (UA) only, and comorbidity only for women who had both anaemia and HIV (UHA):

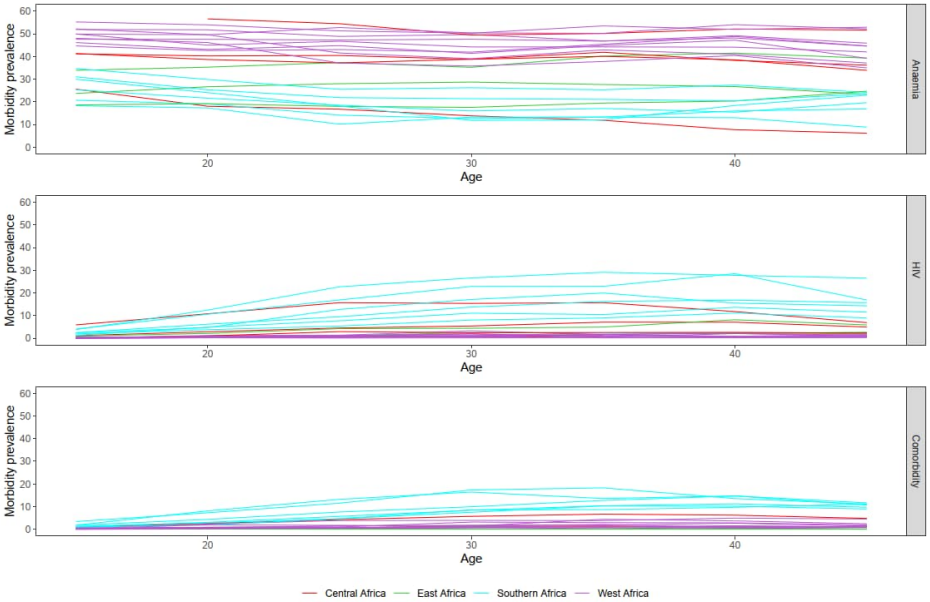
$$RALE(t) = HLE(t) + UHIV(t) + UA(t) + UHA(t). \quad (2)$$

The three studied groups were mutually exclusive, meaning that the women with comorbidities (HIV and anaemia) were not included among those with HIV only and the women with anaemia only. We calculated RALE with and without morbidities for each country in SSA, as well as an aggregate for the entire region. The latter was calculated as the average of the age-specific death rates across countries in the region – that is, aggregating information corresponding to 2010 (e.g., Burkina Faso) with more recent values from 2019 (e.g., Sierra Leone). The assumption in this SSA aggregate is that the country DHS data between 2010 and 2019 did not differ much from year to year (details of data for each country are available in Appendix additional Data A-1). Confidence intervals of 95% for all healthy and unhealthy life expectancies were calculated by bootstrapping (Shkolnikov and Andreev 2010). All calculations were conducted in the R statistical programming language (R Core Team 2020).

4. Results

Morbidity burden is high among the SSA countries. Anaemia is higher in almost all countries followed by HIV and the comorbidity of the two morbidities (Figure 1, detailed values in additional Table A-2). There is also heterogeneity in disease prevalence across SSA regions. There is generally a higher prevalence of anaemia in East, Central, and West Africa (having the highest prevalence) and a very low HIV prevalence as compared to Southern Africa, which has high prevalence of HIV, anaemia, and comorbidity. Anaemia prevalence is high at both younger and older reproductive ages compared to HIV, which is higher in middle and older reproductive ages. There is a higher comorbidity in countries that have a high HIV prevalence than those with anaemia, and the age pattern is similar to that of HIV.

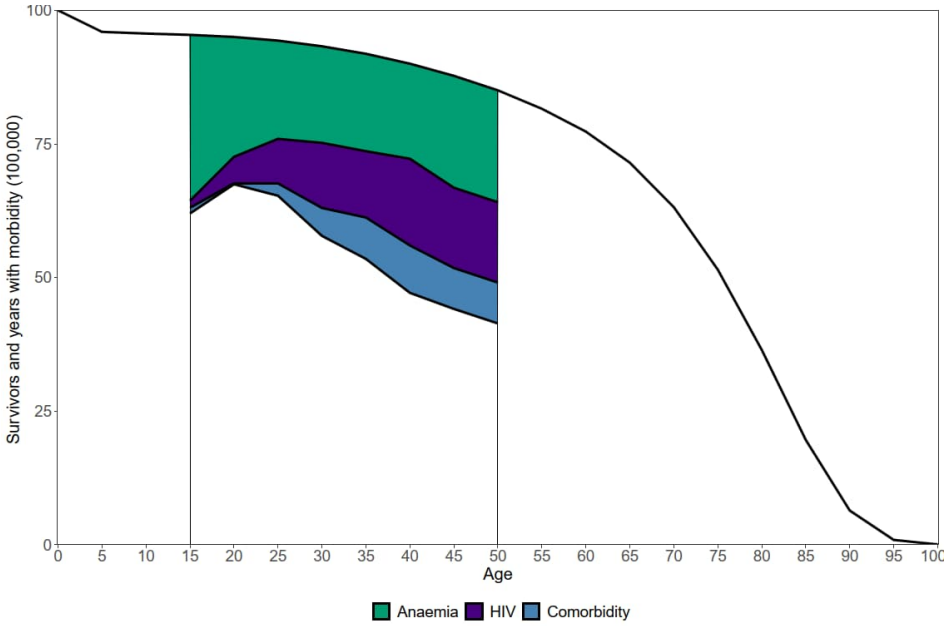
Figure 1: Age pattern of morbidity prevalence among SSA reproductive-age women, 2010–2019



Source: Authors' calculations based on DHS data (USAID 2021).

As an example of the calculation of healthy and unhealthy RALE for SSA countries, Figure 2 shows the life table survival function of Zambian women from age 0 to 100 and depicts morbidity of women in reproductive ages (15 to 50) in 2018 (United Nations 2019). The overall survival for females aged 0 to 100 is represented by the outer curve. The area under the curve between ages 15 and 50 shows the RALE for Zambian women of 34.3 years (95% CI 34.3–34.4), and it is divided by its healthy and unhealthy life years by each disease and comorbidity. Zambian women have a high number of morbidities due to anaemia (8.1 years [8.0–8.2]), HIV (3.0 years [3.0–3.1]), and comorbidity of the two diseases (2.4 years [2.4–2.5]). This is equivalent to a total of 39.4% of unhealthy life years of RALE (anaemia 23.6%, HIV 8.7%, and comorbidity 7.0%).

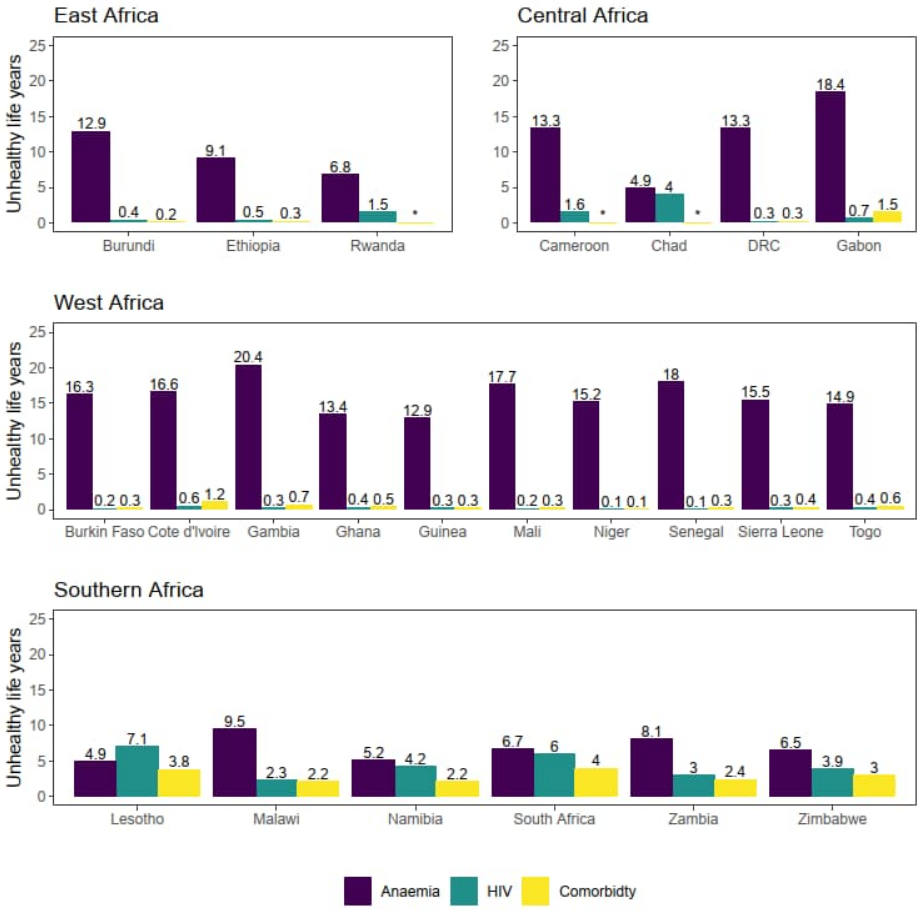
Figure 2: Survival function and years with and without HIV and anaemia for Zambian women, 2019



Source: Authors' calculations are based on DHS data (USAID 2021) and 2019 Life Table data from UN World Population Prospects (United Nations 2019).
Notes: Values for all ages from 0 to 100 of the life table survival function are presented to clearly visualize the corresponding RALE ages (vertical lines at ages 15 and 50 determine the reproductive ages and the area in colours the years in bad health by each of the morbidities).

Figure 3 shows the unhealthy life years spent with HIV and anaemia for SSA countries, 2010–2019. There is a higher number of years spent with anaemia than HIV for all countries except Lesotho, which has more HIV years. Many women spend more years with HIV than the comorbidity of HIV and anaemia, except for countries which are mainly in West Africa, where there are lower years spent with HIV than most parts of SSA.

Figure 3: Unhealthy years spent with HIV and anaemia for SSA countries, 2010–2019



Source: Authors' calculations based on DHS data (USAID 2021).
Note: Women who were sampled for anaemia and HIV in Cameroon, Chad, and Rwanda denoted by * are different, and hence it was not possible to calculate comorbidities for these countries.

The healthy and unhealthy RALE of SSA women between ages 15 and 50 and the years that they spend in reproductive ages with each disease are shown in Table 1. For the entire SSA region, on average women will spend 14.3 unhealthy years (14.3–14.4) of their RALE with morbidities, equivalent to 42.2% of total RALE: 11.6 years (11.6–11.7)

with anaemia (34.3%), 1.7 unhealthy years (1.7–1.8) with HIV (4.9%), and 1.1 unhealthy years (1.1–1.2) with the combination of HIV and anaemia (3.1%). Most of the countries in SSA have similar RALE except Gambia, Ghana, Guinea, and Lesotho, which have lower RALE. Rwanda has the highest RALE at age 15 (34.7 years [34.7–34.8]), while Guinea has the lowest (29.4 years [29.0–30.0]). Similarly, Rwanda has the lowest number of years of women with morbidities (8.3 years [8.3–8.4]) as compared to Gambia, which has the highest (21.4 years [21.4–21.5]). South Africa (11.8%) and Lesotho (11.2%) have the highest comorbidities as well as the highest HIV rates in SSA (see Appendix Figures A-1 to A-4 for maps of these and other results).

Table 1: Healthy and unhealthy reproductive-age life expectancy (RALE) by morbidity for SSA countries, 2010–2019

			Unhealthy life years [95% CI]				
Country	Year	RALE [95% CI]	HIV	Anaemia	HIV and anaemia	Total unhealthy	Healthy life years
Burundi	2016–2017	34.4 [34.4–34.5]	0.4 [0.4–0.5]	12.9 [12.8–13.0]	0.2 [0.2–0.2]	13.5	20.9
Burkina Faso	2010	34.3 [34.3–34.4]	0.2 [0.2–0.2]	16.3 [16.2–16.4]	0.3 [0.2–0.3]	16.8	17.5
Cameroon	2018	34.2 [34.2–34.3]	1.6 [1.6–1.7]	13.3 [13.2–13.5]	*	14.9	19.3
Côte d'Ivoire	2011–2012	34.1 [34.0–34.2]	0.6 [0.6–0.7]	16.6 [16.5–16.6]	1.2 [1.2–1.3]	18.4	15.7
Chad	2014–2015	34.2 [34.2–34.3]	4.0 [3.9–4.1]	4.9 [4.9–5.0]	*	8.9	25.3
DRC	2013–2014	34.0 [34.0–34.1]	0.3 [0.2–0.3]	13.3 [13.2–13.4]	0.3 [0.3–0.3]	13.9	20.1
Ethiopia	2016	34.4 [34.4–34.5]	0.5 [0.5–0.6]	9.1 [9.0–9.2]	0.3 [0.2–0.3]	9.9	24.5
Gabon	2012	34.3 [34.3–34.4]	0.7 [0.6–0.7]	18.4 [18.3–18.5]	1.5 [1.5–1.6]	20.6	13.7
Gambia	2013	33.9 [33.7–34.0]	0.3 [0.2–0.3]	20.4 [20.4–20.5]	0.7 [0.6–0.8]	21.4	12.5
Ghana	2014	33.5 [33.4–33.6]	0.4 [0.4–0.4]	13.4 [13.3–13.6]	0.5 [0.4–0.5]	14.3	19.2
Guinea	2018	29.4 [29.0–29.7]	0.3 [0.3–0.3]	12.9 [12.7–12.9]	0.3 [0.3–0.3]	13.5	15.9
Lesotho	2014	33.8 [33.7–33.9]	7.1 [7.0–7.3]	4.9 [4.8–5.1]	3.8 [3.7–3.9]	15.8	18.0
Malawi	2015–2016	34.2 [34.2–34.3]	2.3 [2.3–2.4]	9.5 [9.4–9.6]	2.2 [2.2–2.3]	14.0	20.2
Mali	2012–2013	34.5 [34.5–34.6]	0.2 [0.1–0.2]	17.7 [17.5–17.9]	0.3 [0.3–0.3]	18.2	16.3
Namibia	2013	34.3 [34.2–34.4]	4.2 [4.1–4.3]	5.2 [5.1–5.2]	2.2 [2.2–2.3]	11.6	22.7
Niger	2012	34.2 [34.1–34.3]	0.1 [0.1–0.1]	15.2 [15.1–15.3]	0.1 [0.1–0.1]	15.4	18.8
Rwanda	2014–2015	34.7 [34.6–34.7]	1.5 [1.4–1.6]	6.8 [6.7–7.0]	*	8.3	26.4
Senegal	2017–2018	34.2 [34.1–34.3]	0.1 [0.0–0.1]	18.1 [17.9–18.2]	0.2 [0.2–0.3]	18.4	15.8
Sierra Leone	2019	34.2 [34.1–34.3]	0.3 [0.3–0.3]	15.5 [15.3–15.6]	0.4 [0.4–0.5]	16.2	18.0
South Africa	2016	34.2 [34.1–34.3]	6.0 [5.8–6.1]	6.7 [6.6–6.9]	4.0 [3.9–4.1]	16.7	17.5
Togo	2013–2014	34.2 [34.2–34.3]	0.4 [0.3–0.4]	14.9 [14.7–15.0]	0.6 [0.6–0.7]	15.9	18.3
Zambia	2018	34.3 [34.3–34.3]	3.0 [2.7–3.0]	8.1 [7.6–8.1]	2.4 [2.2–2.4]	13.5	20.8
Zimbabwe	2015	34.1 [34.1–34.2]	3.9 [3.8–4.0]	6.5 [6.4–6.6]	3.0 [3.0–3.1]	13.4	20.7
SSA	2010–2019	34.0 [34.0–34.1]	1.7 (4.9%)	11.6 (34.3%)	1.1 (3.1%)	14.3 (42.2%)	19.6 (57.8%)

Source: Authors' calculations based on DHS data (USAID 2021).
Note: Women who were sampled for anaemia and HIV in Cameroon, Chad, and Rwanda denoted by * are different, and hence it was not possible to calculate comorbidities for these countries.

5. Discussion

To our knowledge, this is the first study to examine reproductive-age life expectancy and partition it into healthy and unhealthy life years for anaemia and HIV in SSA between 2010 and 2019. Results show that a 15-year-old woman in SSA is expected to live 34.0 more years (33.0–34.1) in her reproductive life. Maternal mortality reduced SSA RALE by one year despite being a rare event (Abubakari et al. 2019; Canudas-Romo et al. 2014). However, an extensive proportion of women's reproductive-age life expectancy is spent with morbidities (over one-third of their reproductive years). On average, the total number of years spent with reproductive health morbidities for women in SSA is 14.3 years (14.3–14.4). Of these, 11.6 years (11.6–11.7) will be spent with anaemia, 1.7 years (1.7–1.8) with HIV, and 1.1 years (1.1–1.2) with both anaemia and HIV. These diseases affect women's daily life functions and compromise their reproductive health life and that of their infants (Iyengar, Yadav, and Sen 2012).

The high prevalence of anaemia across all ages highlights the need to prevent and manage the disease so that women – and their children – can have a healthy life. Comparatively, a high prevalence of HIV in older ages could be a result of more women getting married as they get older and engage in sexual activities as well as ageing with HIV (Roomaney, van Wyk, and Pillay-van Wyk 2022). Additionally, older women are less likely to use protection depending on their partner's behaviour (Houle et al. 2018) and may regard themselves to be more mature and knowledgeable in disease prevention and other reproductive-age activities than younger women (Durvasula 2014). There is a need for more prevention and HIV management advocacy among all women of reproductive ages and their partners. The high HIV prevalence for older women is even more risky as they are likely to have anaemia and other comorbidities exacerbated by HIV due to a lowered immune system, which may further compromise their health if they intend to have more children. With increases in female education, many women are getting married or having children at older ages as compared to previous years, and this may have a positive impact on their health and that of their infants (d'Albis, Greulich, and Ponthière 2017).

The study shows the demographic implications of eliminating reproductive-age morbidities and their causes and the need for quality data that shows morbidity incidence rates by exact starting age to allow for a more comprehensive understanding of the causes of morbidities. Many of these morbidities are preventable or can be managed with low-cost measures (WHO 2013). This study also shows a high comorbidity of anaemia and HIV for countries that have high HIV rates in Southern Africa, such as South Africa and Lesotho, as HIV has been found to increase vulnerability to other diseases (Huang et al. 2021). The inter-country heterogeneity in terms of disease prevalence could be due to the type of HIV that different countries and regions experience. HIV-2 is more prevalent in

West and North Africa and is less severe than HIV-1, which is more prominent in Southern Africa (Campbell-Yesufu and Gandhi 2011). Additionally, HIV is easily transmitted when people have other sexually transmitted infections, and Southern Africa predominantly has syphilis and chancroid, which are ulcerative compared to West Africa, which predominantly has gonorrhoea (Goliber 2002). The prevalence of anaemia, HIV, and comorbidity of the two diseases across SSA is concerningly high. This is because many women may experience a higher burden of diseases, even though some of them may be fairly healthy due to anti-retroviral therapy (ARVs) and may have a healthier lifestyle. However, some ARVs – especially the ones administered in SSA – have continued to show side effects (mainly lipodystrophy) that have left many women impaired to live a healthy life and carry on with daily activities and even childbearing if they wish to because of these complications (Montessori et al. 2004; Soorju and Naidoo 2022).

Previous studies have shown the disease burden (Huang et al. 2021) and demonstrated the effect of maternal mortality on life expectancy but have not shown the impact of morbidity on RALE (Abubakari et al. 2019; Canudas-Romo et al. 2014). Our study highlights the demographic impact of reproductive-age morbidities on the health of women by showing the number of life years that are affected by morbidities and how each morbidity contributes to women's poor health in their reproductive ages. While for reproductive health policymakers, a decline in the maternal mortality ratio is a major milestone, unfortunately less attention has focused on how morbidities affect women's health after survival. Most of the women who survive continue to be affected by the morbidities that they suffered from during their reproductive life years, especially if the morbidities were severe, some of which have long-term consequences and also affect their infants' health (Calvert et al. 2020; Mohamed, Ilesanmi, and Dairo 2018; Zaba et al. 2013).

The finding that SSA women spend extensive periods of their reproductive years with morbidities is concerning. Studies have shown that despite women having longer life expectancy, they spend most of their older lives with morbidities (Koblinsky et al. 2012). Although maternal morbidity measures vary, our results are similar to previous studies that show that maternal morbidities vary across regions and countries and that West Africa has a higher disease prevalence. About a quarter of morbidities were attributed to indirect maternal causes, and older ages have higher morbidities, which applies only to HIV and not anaemia for this study (Huang et al. 2021; Souza et al. 2013). COVID-19 has added to this burden of maternal morbidities being faced by women from 2019 onwards. Global maternal and fetal outcomes have worsened during the COVID-19 pandemic, with an increase in maternal depression, still births, and ruptured ectopic pregnancies as well as maternal deaths (Chmielewska et al. 2021). These outcomes are

likely to be worse in LMIC regions (SSA inclusive) with an already high burden of morbidity prevalence (Chmielewska et al. 2021).

Reproductive ages are the most productive ages of human life and carry with them non-trivial demographic and socioeconomic implications for families, workforce, and communities (Canudas-Romo et al. 2014; WHO 2005). Women are known to run and take care of homes even though their level of autonomy is low in many countries (Ghose et al. 2017). Being affected by these morbidities means that they will not operate optimally and their contribution to household duties and running of the home, workforce, and society will be compromised. The morbidities that women carry with them in these ages affect not only their health status but that of their infants as well. This may compromise the normal fertility of reproductive-age women, increase the mortality of women and children, and impair the economic potential of the continent (WHO 2005; Palma et al. 2008).

The present study has limitations. The Sullivan method assumes that women with and without morbidities (based on cross-sectional morbidity prevalence) have the same age-specific mortality rates. As such, our results correspond to an underestimate of the mortality seen by women experiencing comorbidities. To account for this limitation, we conducted a sensitivity analysis to show the effect on our results of possible disparities in mortality between women with and without morbidities. Our simulations confirm the age pattern of our results, although different number of years with morbidity will be seen depending on the differential mortality assumptions taken (see Appendix Data A-2).

Similarly, this study could not show different health states of morbidity, such as the effect of ARVs on the health status of women living with HIV. Imai and Soneji's (2007) work extends the Sullivan method by using two consecutive cross-sectional surveys to obtain different health states as in a longitudinal survey. In our study, we could not use this perspective because some countries included in the analysis did not measure the two morbidities (HIV and anaemia) consistently over time. Furthermore, some countries measured maternal anaemia for the first time between 2010 and 2019, hence, this study gives only the average health expectancy for the entire population at a given age (Imai and Soneji 2007). Further, maternal morbidities are comprised of both direct and indirect causes. We do not have information on the prevalence of direct maternal morbidities in the DHS, such as haemorrhage, which leads to an underestimation of the total effect of reproductive-age morbidities on RALE. Similarly, the study was limited to HIV and anaemia as they are the only diseases in the DHS that have been measured in many countries at least once. Additionally, the study could not analyse the comorbidity of HIV and anaemia among reproductive-age women in Rwanda, Chad, and Cameroon as their methodology sampled different women for HIV and anaemia, which underestimates the morbidity burden that reproductive-age women face in these countries and in SSA.

However, our study presents comparative results of the morbidity burden (anaemia and HIV) among SSA women between 2010 and 2019 using nationally representative samples, which provides an important estimate of morbidity prevalence among reproductive-age women and informs programming and policy across the region, particularly as morbidity definitions and measurements vary across the region (Huang et al. 2021). Finally, mortality and morbidity data of SSA countries are incomplete, and our results should be taken as an approximation to the burden carried by women in the region. We have tried to compensate for this shortcoming by including confidence intervals in our estimates.

6. Conclusion

This study demonstrates the excess disease burden on the healthy lives of women due to reproductive-age morbidities. Many of these morbidities are preventable (Banda et al. 2015) or can be managed with low-cost measures (Kruk et al. 2018; Merdad and Ali 2018; Smith-Greenaway and Trinitapoli 2020). The measures used could be used to track maternal morbidity and mortality progress among reproductive-age women in SSA and will be valuable for population health scholars and analytically relevant for research on inequality, mortality trends, morbidity, and population dynamics. If successful management of women and children's health as well as SDG 3 is to be achieved, morbidity prevention and management measures and promotion, and women education and autonomy (Ghose et al. 2017) will need to be enhanced from pregnancy to the postpartum period.

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Appendix

Table A-1: Country, year of DHS, and sample size

Country	Year of DHS	Sample size
Burundi	2016/17	17,269
Burkina Faso	2010	14,424
Cameroon	2018	13,527
Côte d'Ivoire	2011/12	9,686
DRC	2013/14	18,171
Chad	2014/15	17,719
Ethiopia	2016	15,683
Gabon	2012	9,755
Gambia	2013	6,217
Ghana	2014	9,396
Guinea	2018	8,000
Lesotho	2014	6,621
Malawi	2015/16	24,562
Mali	2012/13	10,105
Namibia	2013	9,849
Niger	2012	10,750
Rwanda	2014/15	13,497
Senegal	2017/18	16,787
Sierra Leone	2019	15,574
South Africa	2016	8,514
Togo	2013/14	9,549
Zambia	2018/19	13,595
Zimbabwe	2015	9,955

Source: Authors' calculations based on DHS data (USAID 2021).

Table A-2: Percentage of morbidity prevalence among SSA reproductive-age women, 2010–2019

Age	No disease	HIV	Anaemia	Comorbidity
Burkina Faso				
15–19	52.3	0.1	47.6	0.0
19–24	52.0	0.2	47.6	0.3
25–29	51.5	0.7	47.3	0.6
30–34	50.1	0.7	47.7	1.6
35–39	51.5	0.9	46.8	0.8
40–44	48.5	0.9	49.2	1.3
45–49	52.4	0.6	45.9	1.1
Burundi				
15–19	65.9	0.1	33.9	0.1
19–24	64.0	0.4	35.3	0.3
25–29	61.3	1.0	37.4	0.3
30–34	63.1	1.0	35.2	0.7
35–39	56.9	1.8	40.2	1.2
40–44	56.0	2.1	41.5	0.4
45–49	57.4	2.6	39.3	0.7
Chad				
15–19	68.5	5.9	25.6	*
19–24	71.2	10.8	18.1	*
25–29	67.5	15.7	16.8	*
30–34	70.8	15.4	13.8	*
35–39	72.4	15.7	11.9	*
40–44	80.5	11.8	7.7	*
45–49	87.0	6.9	6.2	*
Côte d'Ivoire				
15–19	47.4	0.0	51.9	0.7
19–24	44.7	1.2	51.8	2.3
25–29	46.0	1.3	48.9	3.9
30–34	43.1	3.3	49.7	3.9
35–39	47.8	1.5	46.9	3.8
40–44	44.6	2.3	48.2	4.9
45–49	48.5	2.4	44.6	4.5
Cameroon				
15–19	57.58	1.12	41.30	*
19–24	58.46	2.86	38.68	*
25–29	58.31	4.51	37.18	*
30–34	55.81	5.39	38.8	*
35–39	51.04	7.08	41.88	*
40–44	54.64	7.07	38.29	*
45–49	58.88	4.94	36.18	*

Table A-2: (Continued)

Age	No disease	HIV	Anaemia	Comorbidity
Democratic Republic of Congo				
15–19	58.3	0.1	41.2	0.4
19–24	58.8	0.4	40.3	0.6
25–29	58.2	0.7	40.5	0.6
30–34	59.2	0.8	38.8	1.3
35–39	57.4	1.1	40.1	1.4
40–44	59.5	0.9	38.5	1.0
45–49	63.9	1.3	33.9	0.9
Ethiopia				
15–19	75.9	0.3	23.7	0.1
19–24	72.7	0.5	26.7	0.2
25–29	70.3	1.0	28.0	0.7
30–34	67.6	2.5	28.7	1.2
35–39	68.9	2.4	27.7	1.1
40–44	69.9	2.3	26.7	1.0
45–49	73.8	2.0	23.3	1.0
Gabon				
15–19	38.7	0.2	60.2	1.0
19–24	39.8	1.0	56.6	2.6
25–29	38.4	2.9	54.5	4.3
30–34	42.4	2.4	49.5	5.7
35–39	40.7	2.5	50.2	6.7
40–44	39.0	2.6	52.2	6.2
45–49	41.3	2.3	51.7	4.8
Gambia				
15–19	40.3	0.0	59.2	0.4
19–24	36.2	0.2	63.4	0.2
25–29	33.8	0.5	64.1	1.6
30–34	37.2	0.6	60.9	1.4
35–39	34.1	1.7	59.8	4.4
40–44	34.4	0.9	61.1	3.7
45–49	42.9	1.6	53.0	2.4
Ghana				
15–19	51.5	0.3	48.1	0.1
19–24	52.1	0.9	46.2	0.9
25–29	60.2	1.2	37.2	1.5
30–34	61.4	1.1	35.8	1.8
35–39	58.0	2.4	37.8	1.9
40–44	54.8	2.1	40.5	2.7
45–49	62.7	1.0	35.0	1.4

Table A-2: (Continued)

Age	No disease	HIV	Anaemia	Comorbidity
Guinea				
15–19	52.7	0.6	46.2	0.6
19–24	55.8	0.4	43.1	0.7
25–29	53.1	1.2	44.8	0.9
30–34	56.5	1.2	41.4	1.0
35–39	52.5	1.5	44.9	1.2
40–44	51.2	0.5	47.2	1.1
45–49	58.7	1.2	39.2	0.8
Lesotho				
15–19	73.7	3.8	20.7	1.8
19–24	60.4	12.4	19.1	8.1
25–29	50.0	22.7	14.1	13.2
30–34	44.4	26.6	12.6	16.4
35–39	44.0	29.1	13.3	13.6
40–44	44.5	27.7	13.0	14.7
45–49	53.0	26.5	8.8	11.7
Malawi				
15–19	62.1	1.9	34.7	1.3
19–24	63.6	3.8	29.9	2.8
25–29	64.5	5.4	25.5	4.7
30–34	58.2	8.0	26.2	7.5
35–39	55.4	9.0	25.3	10.3
40–44	51.3	11.1	27.5	10.2
45–49	57.9	8.9	24.2	8.9
Mali				
15–19	49.3	0.2	49.9	0.6
19–24	49.1	0.4	49.6	0.9
25–29	46.0	0.7	52.8	0.5
30–34	48.0	0.7	50.4	0.9
35–39	48.1	0.3	50.2	1.3
40–44	44.9	0.4	54.1	0.6
45–49	45.7	0.6	52.2	1.5
Namibia				
15–19	78.4	2.4	18.3	0.9
19–24	76.1	4.7	17.3	1.9
25–29	72.5	12.7	10.1	4.7
30–34	61.1	17.1	13.3	8.6
35–39	58.1	19.9	13.3	8.7
40–44	58.8	15.5	16.0	9.7
45–49	57.7	14.3	16.9	11.1

Table A-2: (Continued)

Age	No disease	HIV	Anaemia	Comorbidity
Niger				
15–19	55.3	0.0	44.7	0.0
19–24	57.1	0.2	42.6	0.1
25–29	56.5	0.2	43.1	0.2
30–34	56.7	0.7	41.9	0.7
35–39	54.1	0.2	45.4	0.3
40–44	50.2	0.2	48.8	0.7
45–49	55.0	0.3	44.7	0.0
Rwanda				
15–19	80.4	0.9	18.6	*
19–24	78.7	2.1	19.2	*
25–29	77.8	4.2	18.0	*
30–34	78.1	4.4	17.6	*
35–39	75.6	4.9	19.5	*
40–44	71.5	8.1	20.4	*
45–49	69.5	5.9	24.7	*
Senegal				
15–19	44.7	0.0	55.3	0.1
19–24	45.6	0.2	54.0	0.2
25–29	48.2	0.1	51.3	0.5
30–34	48.8	0.2	50.3	0.7
35–39	45.2	0.2	53.5	1.0
40–44	46.2	0.3	52.0	1.6
45–49	45.7	0.4	52.9	1.0
Sierra Leone				
15–19	49.5	0.4	49.9	0.2
19–24	52.4	0.7	45.0	2.0
25–29	50.3	1.2	46.7	1.7
30–34	52.5	1.8	44.2	1.5
35–39	52.7	1.0	44.2	2.1
40–44	54.6	0.5	44.1	0.8
45–49	56.4	0.8	42.0	0.8
South Africa				
15–19	62.6	4.0	30.0	3.4
19–24	58.1	10.6	24.1	7.3
25–29	53.4	16.9	18.2	11.5
30–34	48.0	22.9	11.8	17.3
35–39	46.8	22.9	12.1	18.3
40–44	39.6	28.5	18.4	13.5
45–49	49.1	16.9	22.9	11.1

Table A-2: (Continued)

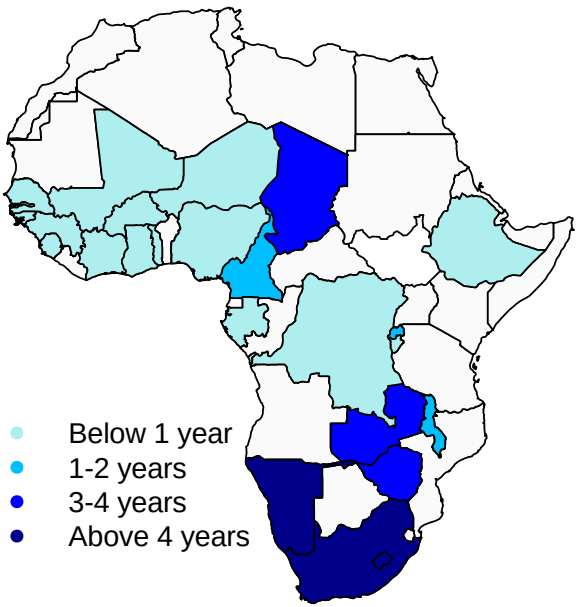
Age	No disease	HIV	Anaemia	Comorbidity
Togo				
15–19	47.4	0.1	52.2	0.3
19–24	49.1	0.5	49.6	0.8
25–29	56.5	1.0	41.6	1.0
30–34	55.8	2.0	39.1	3.2
35–39	53.7	0.5	42.9	2.9
40–44	54.2	2.0	41.0	2.8
45–49	59.5	1.5	37.1	1.9
Zambia				
15–19	66.6	1.3	31.1	1.1
19–24	66.7	4.9	25.4	3.1
25–29	64.8	7.7	21.9	5.7
30–34	59.2	11.0	21.4	8.4
35–39	58.1	10.5	21.1	10.4
40–44	54.7	13.7	20.4	11.2
45–49	55.3	11.5	23.6	9.7
Zimbabwe				
15–19	70.5	2.4	25.4	1.8
19–24	67.8	6.2	21.6	4.4
25–29	64.4	9.5	18.5	7.6
30–34	60.4	13.8	16.0	9.9
35–39	54.0	16.2	17.1	12.7
40–44	53.1	16.8	15.5	14.7
45–49	54.0	15.7	19.7	10.7

Source: Authors' calculations based on DHS data (USAID 2021).
Note: Women who were sampled for anaemia and HIV in Cameroon, Chad, and Rwanda denoted by * are different, and hence it was not possible to calculate comorbidities for these countries.

Appendix Data A-1: Methodology

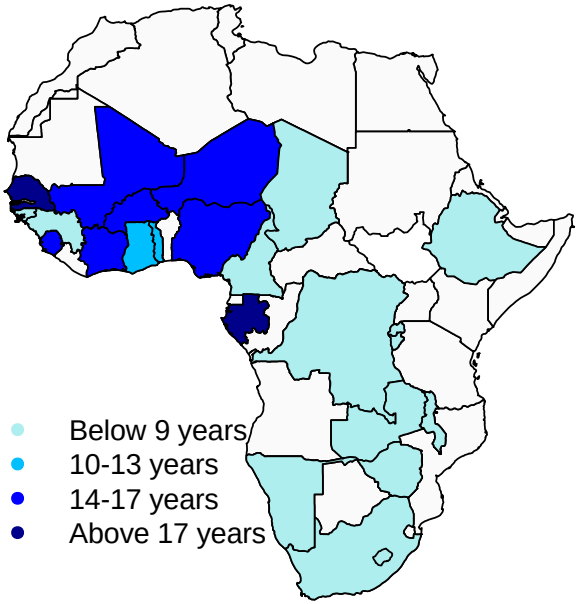
The uncertainty in life table measures was estimated with a simulation approach by generating 1,000 draws from the distribution of sex-age-year specific death numbers for each population. The uncertainty of death numbers was characterised using binomial distribution. With each draw of the death number, a simulated life table was created. We derived 95% uncertainty intervals from the 2.5 and 97.5 percentiles of the resulting 1,000 estimates of life expectancy and lifespan disparity (Shkolnikov and Andreev 2010).

Figure A-1: Sub-Saharan Africa HIV unhealthy years



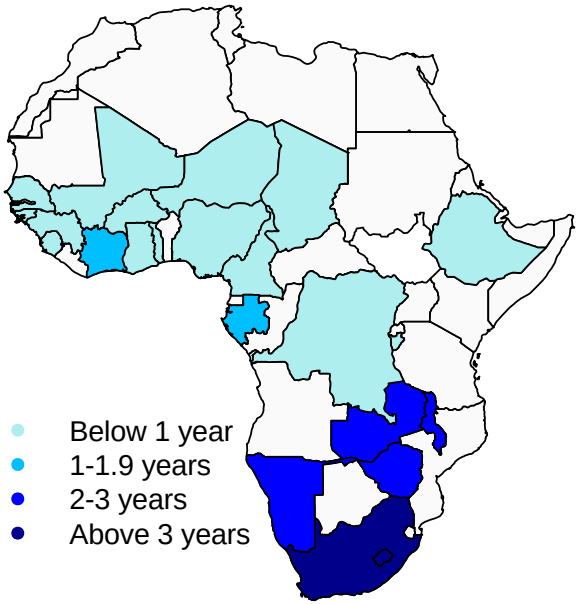
Source: Authors' calculations based on DHS data (USAID 2021).

Figure A-2: Sub-Saharan Africa anaemia unhealthy years



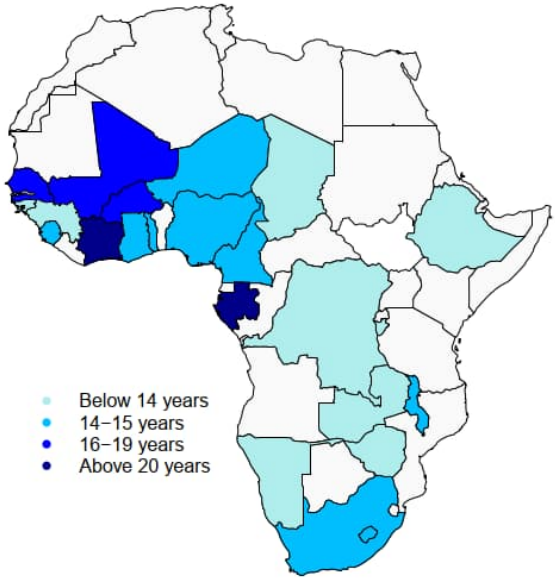
Source: Authors' calculations based on DHS data (USAID 2021).

Figure A-3: Sub-Saharan Africa comorbidity unhealthy years



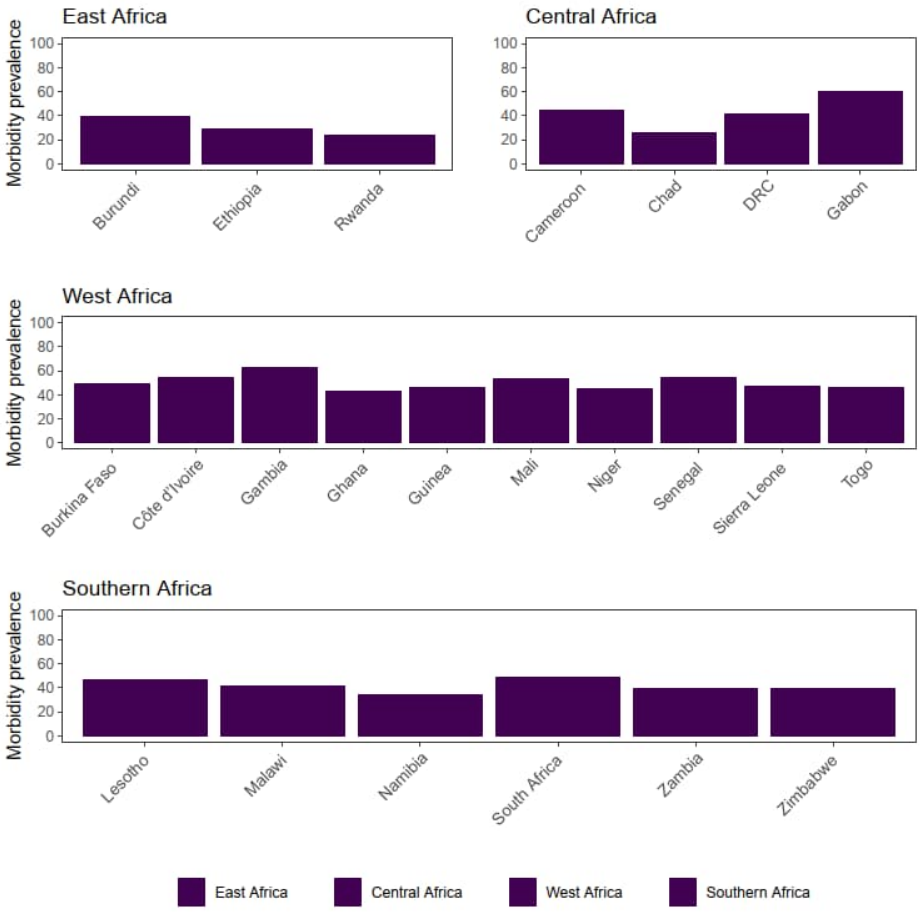
Source: Authors' calculations based on DHS data (USAID 2021).

Figure A-4: Sub-Saharan Africa total morbidity unhealthy years



Source: Authors' calculations based on DHS data (USAID 2021).

Figure A-5: Morbidity prevalence

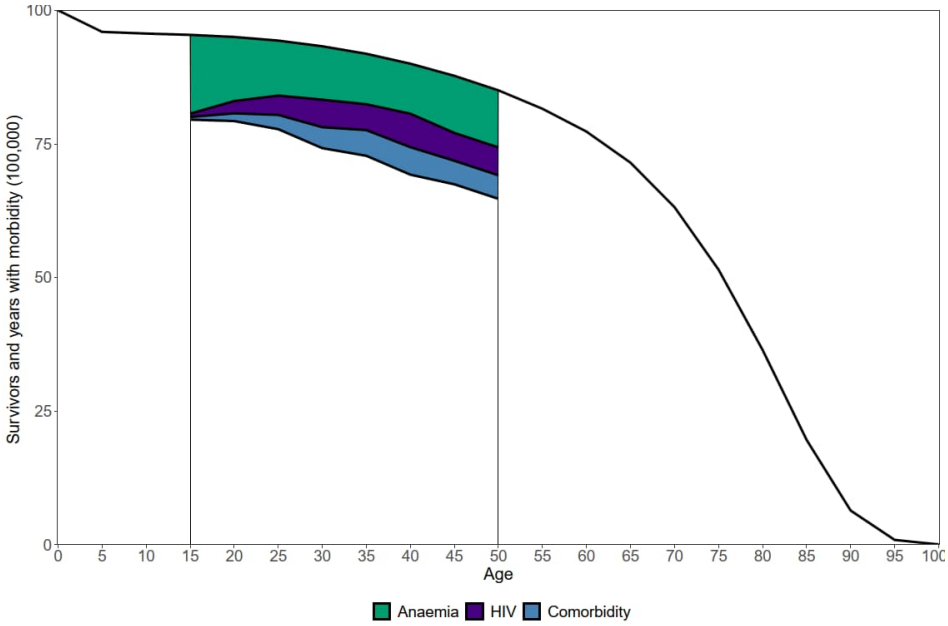


Source: Authors' calculations based on DHS data (USAID 2021).

Appendix Data A-2: Simulation methodology

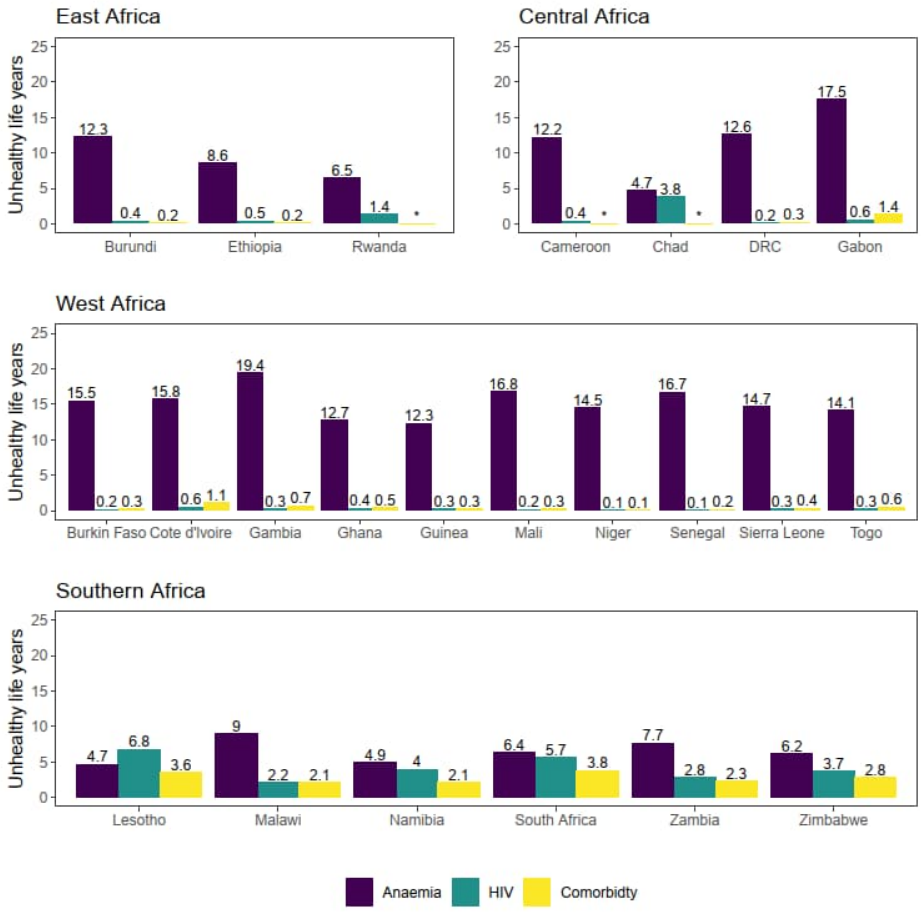
To illustrate how the underestimate of the mortality by women experiencing comorbidities affects our results, we have included the findings and a simple simulation showing what would happen if mortality changed in Figures A-6 and A-7. This was done by increasing the survival of the healthy women and decreasing the survival of those with morbidities by a comparable amount, say 5%. The latter percentage was selected to assure that the total number of reproductive-age life expectancy did not change substantially – that is, creating a scenario with higher mortality for those with a morbidity and lower mortality for those without. The number of healthy years has increased, and the number of unhealthy years has decreased for both Zambia (Figure A-6) and the rest of sub-Saharan Africa (Figure A-7). This could be welcomed news; however, they come with our assumption of greater mortality by those exposed to morbidity.

Figure A-6: Survival function for Zambian women 2019, under a simulation of increasing the survival of the healthy women by 5% and reducing the survival of women with morbidities by 5%



Notes: Originally Zambian women lived 34.3 years between reproductive ages, of those 8.1 were with anaemia, 3.0 with HIV, and 2.4 with both. Our simulation shows that although the number of years lived between reproductive ages has been constrained to 34.3 years, the number of years with anaemia, HIV, and both has reduced to 7.7, 2.8, and 2.3, respectively.

Figure A-7: Unhealthy years spent with HIV and anaemia for SSA countries, 2010–2019, under a simulation of increasing the survival of the healthy women by 5% and reducing the survival of women with morbidities by 5%



Note: Women who were sampled for anaemia and HIV in Cameroon, Chad, and Rwanda denoted by * are different, and hence it was not possible to calculate comorbidities for these countries.