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Prevalence and Demographic Patterns of Multimorbidity in Low-Income Countries of Sub-Saharan Africa

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Abstract

This study examined the occurrence and demographic features of multimorbidity (defined as ≥2 chronic conditions) among adults in three low-income nations in sub-Saharan Africa, drawing on secondary data from four population-based cohorts: Malawi (both urban and rural sites), The Gambia (rural), and Uganda (rural). All cohorts provided data on measured hypertension, diabetes, and obesity; two cohorts included measured hypercholesterolaemia, HIV status, and self-reported asthma; and one cohort had data on clinically diagnosed epilepsy. The analysis involved computing age-standardised prevalence rates of multimorbidity and exploring cross-sectional links between multimorbidity and demographic/lifestyle variables through regression models. The median ages of participants were 29 (IQR 22–38) in urban Malawi, 34 (IQR 25–48) in rural Malawi, 32 (IQR 22–53) in The Gambia, and 37 (IQR 26–51) in Uganda. Age-standardised multimorbidity prevalence was highest in urban Malawi (22.5%; 95% CI 21.6–23.4%) and rural Malawi (11.7%; 95% CI 11.1–12.3%), compared to The Gambia (2.9%; 95% CI 2.5–3.4%) and Uganda (8.2%; 95% CI 7.5–9%). In adjusted regression models, women showed higher multimorbidity risk than men in urban Malawi (IRR 1.97, 95% CI 1.79–2.16), rural Malawi (IRR 2.10, 95% CI 1.86–2.37), and Uganda (IRR 1.60, 95% CI 1.32–1.95), but not in The Gambia (IRR 1.16, 95% CI 0.86–1.55). Strong associations were observed between older age and elevated multimorbidity risk across all sites ($p < 0.001$). Greater educational level was linked to higher multimorbidity risk in urban Malawi (IRR 1.78, 95% CI 1.60–1.98), rural Malawi (IRR 2.37, 95% CI 1.74–3.23), and Uganda (IRR 2.40, 95% CI 1.76–3.26), though not in The Gambia (IRR 1.48, 95% CI 0.56–3.87). Additional studies are required to advance understanding of multimorbidity patterns in sub-Saharan Africa, focusing on comprehensive population-based data gathering for diverse chronic conditions and balanced inclusion of genders and urban/rural settings.

Keywords: Multimorbidity, Demographic patterns, Countries of Sub-Saharan Africa, Prevalence multimorbidity

Introduction

Multimorbidity, characterised by the coexistence of ≥2 long-term conditions (LTCs), has been recognised as a major and growing worldwide health issue by the United Kingdom Academy of Medical Sciences [1]. Evidence indicates rising rates among adults across all age groups and in countries spanning low- to high-income settings [1–3]. Although research highlights the negative consequences of multimorbidity on outcomes like mortality [4], health service use [5, 6], and quality of life [7, 8], significant knowledge gaps remain. Particularly limited is population-based evidence on multimorbidity in low- and middle-income countries (LMICs) [1, 2]. Key unknowns include the specific condition clusters imposing the heaviest burden on health outcomes, mortality, healthcare demands [1], and well-being. In LMICs, there is also inadequate insight into the drivers and evolving trends in multimorbidity patterns and impacts. Such data are essential for guiding health and social care strategies in diverse LMIC systems, amid ageing populations managing rising burdens of infectious diseases (especially HIV managed with antiretrovirals) [9], non-communicable conditions (such as hypertension, obesity, and diabetes), concurrent acute endemic

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illnesses like malaria, health effects of climate change [10], and limited healthcare resources.

In LMICs, health systems face extra pressures from prevalent chronic infectious diseases, potentially amplifying multimorbidity effects [11]. A 2020 scoping review of multimorbidity epidemiology in LMICs identified just six studies from sub-Saharan African countries among 76 total included studies [12]. This investigation seeks to evaluate and integrate existing epidemiological information from three sub-Saharan African nations. The aims were to determine and contrast multimorbidity prevalence and patterns in Malawi (urban and rural), The Gambia (rural), and Uganda (rural) using cross-sectional population data. Additionally, associations between demographic/lifestyle factors and multimorbidity prevalence/patterns were examined, with comparisons of main similarities and differences across the three countries and between urban and rural areas.

Materials and Methods

Ethics statement

Approvals for study protocols were granted by the Malawi National Health Sciences Research Committee (protocol #1072) and the London School of Hygiene and Tropical Medicine (protocol #6303). Protocols in The Gambia were assessed by the MRC Unit The Gambia Scientific Coordinating Committee before endorsement by the Joint Gambia Government/MRC Ethics Committee, covering the Keneba Biobank (SCC1185v2, L2010.97v2, & L2012.31); Keneba Electronic Medical Records System (KEMReS, L2009.62); and West Kiang Demographic Surveillance System (DSS, SCC961). In Uganda, approvals came from the Uganda National Council for Science and Technology (UNCST) (reference SS998ESl) and the Uganda Virus Research Institute Research Ethics Committee (reference GC/127/828).

Data

Cross-sectional datasets were utilised from the Malawi Epidemiology and Intervention Research Unit's rural and urban cohorts (2013–2017)(https://datacompass.lshtm.ac.uk/961/); the Kiang West Longitudinal Population Study in The Gambia; and the General Population Cohort in Kyamulibwa, Uganda. Summaries of the settings, designs, participants, and data collection methods for each cohort are outlined briefly here, with full details reported previously [13–15].

Malawi

An Eastern African nation classified as low-income, with an estimated population of around 20 million individuals [16], and a national HIV prevalence rate of 7.7% (95% CI: 7.1–8.0) among adults aged 15–49 years [17]. Between 2013 and 2016, the Malawi Epidemiology and Intervention Research Unit (MEIRU) carried out a community-based assessment of non-communicable diseases in both rural and urban settings in Malawi. The rural component was integrated into the Karonga Health and Demographic Surveillance Site (HDSS), a largely subsistence-based area spanning 135 km² in the southern part of Karonga district, home to about 40,000 inhabitants. The urban component took place in Area 25 of Lilongwe, a densely populated residential zone of mixed economic status covering 23 km², with approximately 66,000 residents (including 25,000 adults aged ≥18 years as of 2008). The rural location reflects common subsistence agriculture and fishing communities, featuring age and gender profiles similar to other Malawian districts [14]. Area 25 exemplifies the fast-expanding peripheral areas of the capital, Lilongwe. Eligibility extended to all adults aged 18 years or older residing in the selected areas. Data gathering occurred at participants' residences, scheduled to allow collection of fasting blood samples for analysis of blood lipids and glucose levels. All individuals provided written informed consent (and assent where needed) for structured interviews, body measurements, blood pressure assessments, and fasting blood draws for glucose, lipid profiling, and HIV screening. The assessment tool was adapted from the WHO STEPS framework and is fully detailed in prior publications [18]. In summary, it was translated into relevant local languages, with information captured via digital tablets. The questionnaire covered age, previous diagnoses or treatments for conditions such as hypertension, diabetes, asthma, and elevated cholesterol; behavioral factors like tobacco and alcohol use; and socioeconomic details including education and employment. Medical records held by participants were reviewed to verify earlier diagnoses of diabetes, hypertension, or hypercholesterolaemia. Procedures for blood pressure measurement, anthropometric assessments, and blood sampling are outlined comprehensively elsewhere [14]. Individuals found to have high blood pressure, elevated fasting glucose, or a new positive HIV test were directed to the project's chronic disease clinic or relevant local HIV programs, regardless of existing treatment status.

The Gambia

A West African low-income nation with an approximate population of 2.9 million [19], reporting a national HIV prevalence of 1.7% (95% CI: 1.4–2.2) in the 15–49 age group [20]. The Kiang West Longitudinal Population Study (KWLPS) encompasses over 12,000 people from 36 villages across the 750 km² rural district of Kiang West in The Gambia. Data sources include ongoing demographic monitoring [Kiang West Demographic Surveillance System (KWDSS)], clinical records [Keneba Electronic Medical Records System (KEMReS)], and biological sample storage (Keneba Biobank), with individual records connected via a unique West Kiang Number (WKNO) [15]. The study originated in the 1950s with longitudinal data from three primary villages (around 4,000 inhabitants), focusing on nutritional and health trajectories across the lifespan, especially growth/anthropometry and maternal well-being. Coverage later expanded progressively to additional villages in the district. Information was drawn from all three systems: KWDSS (quarterly updates), KEMReS, and the Keneba Biobank. Demographic details such as age, gender, marital status, migration history, and pregnancies were obtained from KWDSS. Records of current or previous diagnoses (hypertension, diabetes, asthma, epilepsy) and related treatments were retrieved from KEMReS. Socio-demographic information, including educational attainment and household assets, was gathered through a standardised survey in the Keneba Biobank. Physical measurements (weight, height, body composition, blood pressure) were performed, along with collection of fasting blood and urine specimens.

Uganda

An East African low-income nation with an estimated population of 45.6 million [21], featuring a national HIV prevalence of 5.2% (95% CI: 5.1–5.4) among individuals aged 15–49 years [22]. Between 2011 and 2012, the MRC/UVRI and LSHTM Uganda Research Unit performed a cross-sectional assessment as part of a general population cohort (GPC) located in Kyamulibwa sub-county, Kalungu district, in rural southwestern Uganda [13]. Enrolled individuals were adults over 18 years old who lived in the designated area. Consent was secured from all participants prior to involvement. Information was gathered through standardised structured interviews addressing demographic and behavioral aspects, including gender, age, educational background, tobacco use, and alcohol intake. The interviews also included details on family background, medical history (encompassing HIV status), and reproductive history (such as parity, gravidity, and previous pregnancy complications). Anthropometric measures—weight, height, waist and hip circumferences, and mid-upper arm circumference—were obtained using calibrated Seca scales, a stadiometer, and non-stretch tape measures. Following a 30-minute rest period, three blood pressure readings were taken at 5-minute intervals, with participants seated and measurements preferably from the right arm (or the left if the right was unsuitable due to medical reasons), employing portable OMRON Healthcare Co. devices (HEM-7211-E Model M6; Kyoto, Japan). Non-fasting venous blood samples were drawn from participants in the Uganda group.

Definitions

In this study, hypertension was identified by systolic blood pressure ≥140 mmHg, diastolic ≥90 mmHg [23], or ongoing use of antihypertensive drugs, or confirmation from clinical records. Diabetes was classified as fasting blood glucose ≥7.0 mmol/L [24] or a previous confirmed diagnosis (via self-report or records), regardless of current treatment with glucose-lowering medications. Where fasting glucose data were absent and no confirmed diabetes diagnosis existed from self-report or records, individuals were omitted from diabetes prevalence estimates. Obesity was determined from anthropometric data (pregnant women excluded) as BMI ≥30.0 kg/m², with overweight defined as BMI 25.0–29.9 kg/m² [25]. Elevated total cholesterol was based on laboratory results showing ≥5 mmol/L in venous samples [26]. Asthma and epilepsy were categorised according to previous diagnosis or active treatment. Epilepsy diagnosis from records was accessible solely for The Gambia dataset, whereas asthma diagnosis via self-report was limited to Malawi data. HIV serostatus was available for Malawi and Uganda cohorts, categorised as positive, negative, or unknown (if no prior test or last negative result >3 years before interview in Malawi, or >2 years in Uganda). Pregnant individuals were omitted from obesity calculations, but their data for other conditions (epilepsy, asthma, high cholesterol, HIV, hypertension) were retained in multimorbidity analyses, since these require ongoing care independent of pregnancy, and some are unrelated to or may continue after pregnancy.

Multimorbidity was characterised by the coexistence of at least two conditions from: hypertension, diabetes, HIV, obesity, asthma, epilepsy, or hypercholesterolaemia. Education level was grouped by highest achievement: none/primary, secondary, or tertiary. Smoking status was classified as never, former, or current, while alcohol use was recorded as any consumption in the previous 12 months or none. These behavioral variables were unavailable for The Gambia cohort.

Statistical methods

The harmonised datasets were used to describe categorical variables through counts and percentages. For continuous variables, summaries employed means (accompanied by standard deviations) or medians (with interquartile ranges), depending on the distribution patterns observed across the separate datasets from Malawi (urban and rural), Uganda, and The Gambia. A combined harmonised dataset was created to examine relationships between sociodemographic characteristics (age, gender, and educational level) and behavioral factors (tobacco use and alcohol intake) with the likelihood of multimorbidity. Chi-square likelihood ratio tests were applied to evaluate heterogeneity in the links between risk factors and multimorbidity across cohorts, guiding decisions on whether separate cohort-specific analyses and reporting were required. Age, gender, location, and education were pre-defined as key sociodemographic factors. Age-specific multimorbidity prevalence rates were computed, along with rates for pairwise combinations of the conditions comprising multimorbidity (hypertension, diabetes, asthma, hypercholesterolaemia, HIV, obesity, and epilepsy). Age-standardised prevalence figures were derived using the WHO standard population to enable comparisons across the three cohorts and with other populations.

Negative binomial regression models incorporating a log-link function were employed to derive risk ratios for multimorbidity associated with sociodemographic and behavioral variables, with adjustments for age and additional covariates such as gender and education (across all cohorts), plus smoking and alcohol use (limited to Malawi and Uganda). Departures from linearity were assessed, and linear trends for age were evaluated by treating age as continuous or by assigning ordinal scores (1 to 6) to 10-year age groups. Likelihood ratio tests were used to assess statistical significance of associations with multimorbidity. Robust standard errors were calculated to address potential clustering effects (arising from inclusion of all adult household members, who often share socioeconomic and dietary influences). Missing data affected less than 5% of values for all variables and were excluded from regression models. Pregnant women were omitted from analyses involving anthropometry. All analyses were conducted using STATA 15 software (StataCorp LP, College Station, TX), with two-tailed tests and P values <0.05 deemed statistically significant.

Results and Discussion

Data were provided by 44,359 adults aged 18 years and above residing in urban Malawi (N = 16,671), rural Malawi (n = 13,903; total Malawi N = 30,574), rural The Gambia (n = 7,917), and rural Uganda (n = 5,868), with females outnumbering males in every cohort. Participant median ages were 29 (IQR 22–38) in urban Malawi, 34 (IQR 25–48) in rural Malawi, 32 (IQR 22–53) in The Gambia, and 37 (IQR 26–51) in Uganda. Most individuals were under 40 years old in The Gambia (~60%), rural Malawi (~60%), urban Malawi (~80%), and Uganda (~55%), while higher proportions aged ≥60 years were seen in The Gambia (~18%), Uganda (~15%), and rural Malawi (~12%) than in urban Malawi (~5%). In rural Malawi, The Gambia, and rural Uganda, primary education or less was reported by the majority (65.6%, 66.4%, and 72.1%, respectively), with post-secondary attainment rare (1.82%, 1.78%, and 5.54%, respectively). In urban Malawi, secondary education completion was reported by 52.2%, and an additional 16.5% had post-secondary qualifications **(Table 1)**. Lifestyle data on tobacco and alcohol use, available only for Malawi and Uganda, are presented in **Table 2**. Never-smokers predominated among urban Malawi (93.9%), rural Malawi (92.3%), and rural Uganda (85.8%) participants, with current smoking rates of 3.2%, 5.8%, and 10.8%, respectively. Alcohol consumption in the past year was reported by 17% in urban Malawi, 19.8% in rural Malawi, and 35.5% in rural Uganda.

Table 1. Baseline socio-demographic factor prevalence estimates: Malawi, The Gambia and Uganda.

Data	Uganda (Rural)	The Gambia (Rural)	Malawi: (Rural)	Malawi: (Urban)
Sample Size	5,868	7,917	13,903	16,671

Female participants (%)	3,443 (58.6)	4,796 (60.5)	8,039 (57.8)	10,867 (65.1)
Mean age (SD)	40.2 (16.9)	38.7 (19.3)	37.9 (16.4)	32.4 (12.9)
Median Age (IQR)	37 (26–51)	32 (22–53)	34 (25–48)	29 (22–38)
Age categories (%)				
18–29	1,912 (32.5)	3,689 (46.6)	5,254 (37.7)	8,539 (51.2)
30–39	1,311 (22.3)	1,000 (12.6)	3,405 (24.4)	4,444 (26.6)
40–49	1,047 (17.8)	981 (12.4)	2,137(15.3)	1,835 (11.0)
50–59	711 (12.1)	832 (10.5)	1,411 (10.1)	991 (5.9)
60–69	446 (7.6)	665 (8.4)	838 (6.0)	559 (3.3)
>70	441 (7.5)	750 (9.5)	858 (6.1)	303 (1.8)
Education status (%)				
Pre-Primary or none	711 (12.1)	2,999 (37.9)	595 (4.3)	584 (3.5)
Primary	3,521 (60.0)	2,257 (28.5)	8,524 (61.3)	4,632 (27.8)
Secondary	1,308 (22.3)	2,248 (28.4)	4,531 (32.6)	8,701 (52.2)
Tertiary	325 (5.5)	141 (1.8)	253 (1.8)	2,754 (16.5)
Missing	3 (0.05)	272 (3.4)	0	0

SD = Standard Deviation; IQR = Interquartile range.

Table 2. Baseline socio-demographic factor prevalence estimates: Malawi, The Gambia and Uganda.

Data	Uganda (Rural)	Malawi: (Rural)	Malawi: (Urban)
Sample Size	5,868	13,903	16,671
Tobacco smoking status (%)			
Never	5,036 (85.8)	12,826 (92.2)	15,653 (93.9)
Former	194 (3.3)	272 (2.0)	485 (2.9%)
Current	635 (10.8)	805 (5.8)	533 (3.2%)
Missing	3 (0.05)	0	0
Alcohol consumed within last 12 months (%)			
No	3,780 (64.4)	11,154 (80.2)	13,836 (83.0)
Yes	2,085 (35.5)	2,749 (19.8)	2,835 (17.0%)
Missing	3 (0.05)	0	0

Age-standardised prevalence figures using the WHO population for individual chronic conditions are presented in **Table 3**. After standardisation for age, hypertension rates were similar across the four study sites, and HIV rates were similar between the Malawi and Uganda groups, with no corresponding data from The Gambia. By comparison, age-standardised rates for diabetes and obesity were higher in urban Malawi than in the remaining three sites. Likewise, although limited to data from two nations, asthma rates were elevated in both urban and rural Malawi relative to The Gambia, and hypercholesterolaemia rates were higher in urban and rural Malawi than in Uganda. Information on epilepsy was accessible only from the Gambian cohort. Age-standardised prevalence rates for multimorbidity and pairwise condition combinations are displayed in **Table 4**, revealing a heavier load in urban Malawi (22.4%; 95% CI 21.5–23.3%) and rural Malawi (11.7%; 95% CI 11.12–12.31) compared to The Gambia (2.9; 2.5–3.3%) or Uganda (8.2; 95% CI 7.4–8.9%). **Figure 1** illustrates multimorbidity rates stratified by age and gender across the study sites. The greatest rates appeared among older adults of both genders in every location, yet women in urban Malawi exhibited higher multimorbidity levels than men and women of similar ages in the other sites. Notably, N = 41 women were pregnant during data collection and were omitted from obesity-related anthropometric assessments.

Table 3. WHO age-standardised prevalence estimates for single long-term conditions: Malawi, The Gambia and Uganda.

Chronic Condition	Malawi (Urban)	Malawi (Rural)	The Gambia (Rural)	Uganda (Rural)
Hypertension				
Cases (crude %)	2,403 (14.4)	1,884 (13.5)	1,423 (17.9)	1,170 (19.4)
Age-standardised % (95% CI)	28.2 (27.3–29.1)	17.9 (17.2–18.5)	20.8 (19.9–21.8)	22.0 (20.9–23.0)
Diabetes				
Cases (crude %)	401 (2.4)	208 (1.5)	81 (1.0)	112 (1.0)
Age-standardised % (95% CI)	4.9 (4.4–5.4)	1.9 (1.6–2.2)	1.2 (0.9–1.4)	2.0 (1.6–2.4)
Asthma				
Cases (crude %)	864 (5.1)	623 (4.4)	177 (2.2)	No data available
Age-standardised % (95% CI)	5.3 (4.9–5.8)	4.4 (4.0–4.7)	2.5 (2.1–2.9)	-
Elevated Cholesterol (>5 mmol/L)				
Cases (crude %)	1,839 (11.0)	1,707 (12.2)	No data available	560 (9.5)
Age-standardised % (95% CI)	18.3 (17.5–19.2)	14.8 (14.1–15.4)	-	10.4 (9.6–11.2)
HIV Positive Status				
Cases (crude %)	1,313 (7.8)	1,217 (8.7)	No data available	575 (9.8)
Age-standardised % (95% CI)	10.1 (9.5–10.7)	9.8 (9.3–10.3)	-	9.9 (9.1–10.7)
Obesity (BMI ≥30 kg/m²)[1]				
Cases (crude %)	2,070 (12.4)	631 (4.5)	146 (1.8)	195 (3.3)
Age-standardised % (95% CI)	17.1 (16.3–17.9)	5.4 (5.0–5.8)	2.5 (2.1–2.9)	3.4 (3.0–3.9)
Epilepsy				
Cases (crude %)	No data available	No data available	53 (0.67)	No data available
Age-standardised % (95% CI)	-	-	0.66 (0.46–0.86)	-

CI = Confidence Intervals; BMI = Body Mass Index.
1 Excluding pregnant women N = 241

Table 4. WHO age-standardised and age-specific prevalence estimates for multimorbidity and pairwise combinations of chronic conditions: Malawi, The Gambia and Uganda.

Long-Term Condition / Combination	Malawi (Urban) N = 16,671	Malawi (Rural) N = 13,903	The Gambia (Rural) N = 7,917	Uganda (Rural) N = 5,868
Multimorbidity (≥2 chronic conditions)				
Cases	2004	1244	192	433
Age-standardised % (95% CI)	22.4 (21.5–23.3)	11.7 (11.1–12.3)	2.9 (2.5–3.5)	8.2 (7.4–8.9)
Pairwise Combinations – Group 1				
Hypertension + Diabetes				
Cases	233	107	55	49
Age-standardised % (95% CI)	3.4 (3.0–3.9)	1.1 (0.89–1.3)	0.79 (0.58–1.0)	0.92 (0.06–1.1)
Hypertension + Obesity				
Cases	668	242	65	62
Age-standardised % (95% CI)	8.2 (7.6–8.9)	2.46 (2.1–2.7)	1.1 (0.87–1.4)	1.1 (0.88–1.4)
Diabetes + Obesity				
Cases	159	47	8	8

Age-standardised % (95% CI)	2.1 (1.77–2.49)	0.45 (0.32–0.58)	0.12 (0.03–0.21)	0.15 (0.04–0.25)
Pairwise Combinations – Group 2				
Diabetes + Elevated Cholesterol				
Cases	164	65	Not available	16
Age-standardised % (95% CI)	2.3 (1.9–2.7)	0.65 (0.49–0.81)	-	0.33 (0.16–0.49)
Diabetes + HIV				
Cases	50	20	Not available	7
Age-standardised % (95% CI)	0.59 (0.42–0.77)	0.19 (0.11–0.27)	-	0.13 (0.03–0.24)
Elevated Cholesterol + HIV				
Cases	Not available	54	Not available	Not available
Age-standardised % (95% CI)	2.4 (2.1–2.7)	1.7 (1.4–1.9)	-	1.0 (0.73–1.2)
Elevated Cholesterol + Obesity				
Cases	490	184	Not available	49
Age-standardised % (95% CI)	5.5 (5.0–6.1)	1.7 (1.5–2.0)	-	0.92 (0.66–1.1)
HIV + Obesity				
Cases	158	40	Not available	20
Age-standardised % (95% CI)	1.4 (1.1–1.6)	0.36 (0.24–0.47)	-	0.36 (0.20–0.51)
Hypertension + Elevated Cholesterol				
Cases	635	497	Not available	200
Age-standardised % (95% CI)	9.3 (8.6–9.9)	5.0 (4.5–5.4)	-	3.9 (3.3–4.4)
Hypertension + HIV				
Cases	212	128	Not available	88
Age-standardised % (95% CI)	2.3 (2.0–2.7)	1.2 (1.0–1.4)	-	1.6 (1.3–1.9)
Hypertension + Asthma				
Cases	132	85	64	Not available
Age-standardised % (95% CI)	1.5 (1.2–1.8)	0.80 (0.62–0.97)	0.89 (0.66–1.1)	-
Diabetes + Asthma				
Cases	26	8	5	Not available
Age-standardised % (95% CI)	0.32 (0.19–0.45)	0.75 (0.21–0.13)	0.08 (0.01–0.15)	-
Obesity + Asthma				
Cases	166	37	5	Not available
Age-standardised % (95% CI)	0.4 (0.5–0.6)	0.32 (0.22–0.43)	0.08 (0.01–0.15)	-

1 Data contributing to the multimorbidity measure were present for all three cohorts.
2 Data contributing to the multimorbidity measure were present only for Malawi and Uganda.

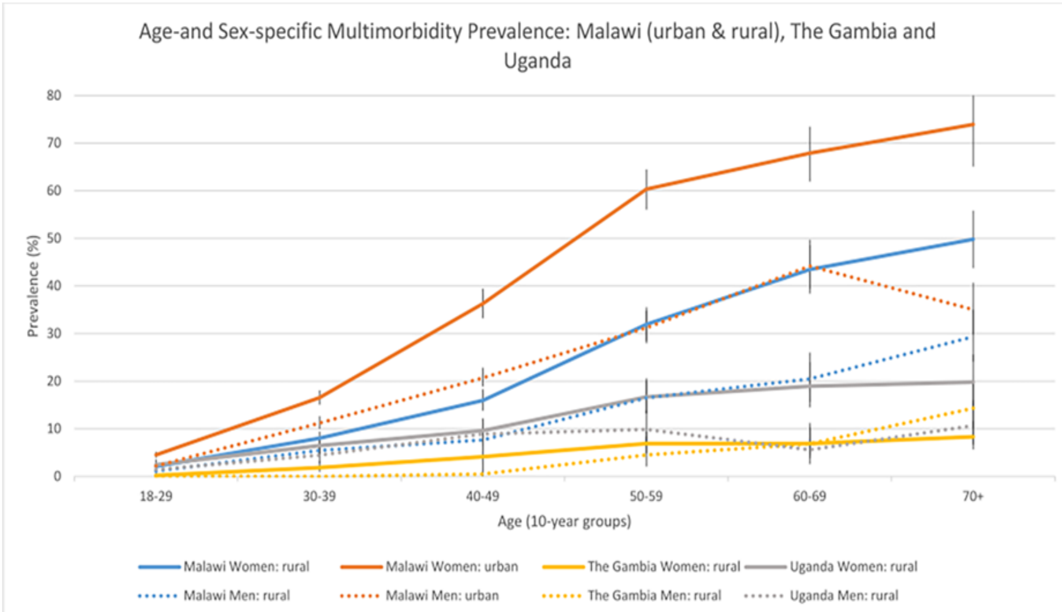

Figure 1. Multimorbidity prevalence stratified by age and gender: Malawi, The Gambia, and Uganda.

Analyses revealed heterogeneity in the relationships between sociodemographic/lifestyle variables and multimorbidity risk across cohorts, leading to cohort-specific reporting of results in **Table 5**. In adjusted models, women exhibited elevated multimorbidity risk compared to men in urban Malawi (IRR 1.97, 95% CI 1.79–2.16), rural Malawi (IRR 2.1, 95% CI 1.86–2.37), and Uganda (IRR 1.60, 95% CI 1.32–1.95), whereas no gender difference was detected in The Gambia. A robust association emerged between advancing age—whether assessed continuously or in 10-year bands—and heightened multimorbidity risk across all four sites ($p < 0.0001$ for trend). Elevated educational achievement was linked to greater multimorbidity risk in urban Malawi (IRR 1.78, 95% CI 1.60–1.98), rural Malawi (IRR 2.37, 95% CI 1.74–3.23), and Uganda (IRR 2.40, 95% CI 1.76–2.36), but not in The Gambia (IRR 1.48, 95% CI 0.56–3.87), after controlling for age and gender. Among Malawians, current smokers showed reduced multimorbidity risk relative to never-smokers in both urban and rural areas. In urban Malawi, recent alcohol users faced higher multimorbidity risk than non-users, an association absent in rural Malawi. No such links appeared in Uganda, and lifestyle data on smoking and alcohol were unavailable for The Gambia.

Table 5. Associations between sociodemographic/lifestyle variables and multimorbidity: Malawi, The Gambia, and Uganda.

Variable	Urban Malawi n = 12,726	Rural Malawi n = 11,368	Rural Gambia n = 7,917 (n = 6,643 for some)	Rural Uganda n = 5,868
Model 1[2]				
Gender: Male (ref)				
Female	1.73 (1.58–1.90)	1.84 (1.65–2.06)	1.10 (0.83–1.47)	1.60 (1.32–1.95)
P-value[1]	<0.0001	<0.0001	0.71	<0.0001
Age group: 18–29 (ref)				
30–39	3.91 (3.37–4.54)	4.03 (3.10–5.24)	7.43 (2.79–19.75)	2.74 (1.86–4.03)
40–49	8.27 (7.15–9.56)	7.23 (5.60–9.34)	16.91 (7.02–40.76)	4.56 (3.16–6.59)
50–59	13.40 (11.64–15.43)	14.74 (11.53–18.85)	31.97 (13.64–74.95)	6.75 (4.69–9.71)

60–69	16.17 (13.96–18.72)	19.57 (15.25–25.11)	35.55 (15.07–83.85)	6.66 (4.52–9.82)
≥70	15.79 (13.35–18.67)	24.12 (18.83–30.89)	55.59 (24.15–127.99)	7.76 (5.28–11.40)
P-value[1]	<0.0001	<0.0001	<0.0001	<0.0001
Model 2[3]				
Gender: Male (ref)				
Female	1.97 (1.79–2.16)	2.10 (1.86–2.37)	1.16 (0.86–1.55)	1.60 (1.32–1.95)
P-value[1]	<0.0001	<0.0001	0.31	<0.0001
Age group: 18–29 (ref)				
30–39	3.97 (3.42–4.60)	4.24 (3.25–5.51)	8.02 (2.89–22.24)	3.04 (2.04–4.50)
40–49	8.64 (7.46–10.0)	7.92 (6.10–10.26)	19.22 (7.29–50.65)	5.51 (3.75–8.10)
50–59	14.80 (12.80–17.08)	16.91 (13.12–21.79)	37.59 (14.00–100.94)	8.42 (5.74–12.36)
60–69	18.15 (15.61–21.09)	22.71 (17.53–29.41)	41.94 (14.90–118.03)	9.32 (6.16–14.11)
≥70	19.62 (16.43–23.42)	28.82 (22.21–37.39)	68.82 (24.82–190.81)	11.90 (7.80–18.17)
P-value[1]	<0.0001	<0.0001	<0.0001	<0.0001
Education: Primary (ref)				
None/Pre-primary	0.76 (0.65–0.89)	0.93 (0.78–1.11)	0.99 (0.60–1.63)	0.60 (0.45–0.80)
Secondary	1.22 (1.11–1.34)	1.48 (1.30–1.69)	1.52 (0.79–2.94)	1.60 (1.24–2.05)
Post-secondary	1.78 (1.60–1.98)	2.37 (1.74–3.23)	1.48 (0.56–3.87)	2.40 (1.76–3.26)
P-value[1]	<0.0001	<0.0001	0.54	<0.0001
Model 3[4]				
Gender: Male (ref)				
Female	2.18 (1.97–2.43)	1.98 (1.72–2.27)	—	1.84 (1.47–2.30)
P-value[1]	<0.0001	<0.0001	—	<0.0001
Age group: 18–29 (ref)				
30–39	3.96 (3.42–4.59)	4.31 (3.31–5.62)	—	2.96 (1.99–4.41)
40–49	8.74 (7.55–10.12)	8.02 (6.18–10.41)	—	5.35 (3.62–7.91)
50–59	15.25 (13.21–17.62)	17.21 (13.35–22.19)	—	8.16 (5.52–12.08)
60–69	18.98 (16.33–22.05)	22.91 (17.68–29.65)	—	9.05 (5.93–13.81)
≥70	20.78 (17.39–24.80)	28.78 (22.19–37.33)	—	11.72 (7.63–17.99)
P-value[1]	<0.0001	<0.0001	—	<0.0001
Education: Primary (ref)				
None/Pre-primary	0.75 (0.64–0.88)	0.94 (0.79–1.12)	—	0.60 (0.44–0.80)
Secondary	1.21 (1.10–1.33)	1.47 (1.29–1.68)	—	1.61 (1.25–2.07)
Post-secondary	1.73 (1.55–1.93)	2.31 (1.70–3.14)	—	2.40 (1.77–3.27)
P-value[1]	<0.0001	<0.0001	—	<0.0001
Smoking: Never (ref)				
Former	1.07 (0.82–1.38)	1.17 (0.86–1.58)	—	0.94 (0.56–1.57)
Current	0.58 (0.41–0.82)	0.45 (0.30–0.65)	—	1.05 (0.76–1.46)
P-value[1]	0.016	0.0001	—	0.93
Alcohol (past 12 months): No (ref)				

Yes	1.59 (1.40–1.80)	1.06 (0.89–1.26)	—	1.12 (0.93–1.35)
P-value[1]	<0.001	0.53	—	0.28

*Estimates represent incidence rate ratios

1 P values derived from likelihood ratio tests, indicating trend tests for age using it as a continuous measure.

2 Model 1: Negative binomial regressions adjusted for age (18–29, 30–39, 40–49, 50–59, 60–69, 70+) or gender (male, female), as relevant.

3 Model 2: Negative binomial regressions adjusted for age (18–29, 30–39, 40–49, 50–59, 60–69, 70+), gender (male, female), and education (none/pre-primary, primary, secondary, tertiary), as relevant.

4 Model 3: Negative binomial regressions adjusted for age (18–29, 30–39, 40–49, 50–59, 60–69, 70+), gender (male, female), education (none/pre-primary, primary, secondary, tertiary), alcohol use in past 12 months (no, yes), and tobacco use (never, former, current), as relevant.

This study represents the initial comparison of multimorbidity prevalence across three sub-Saharan African nations, incorporating both rural and urban settings. Age-standardised rates varied markedly: urban Malawi (22.5%), rural Malawi (11.7%), The Gambia (2.9%), and Uganda (8.2%), with urban Malawi bearing the heaviest load. A prominent pairwise combination involved hypertension and obesity. Women displayed higher multimorbidity risk than men in all sites except The Gambia, aligning with patterns reported in higher- and middle-income settings [27–29]. Multimorbidity rates rose consistently with age across cohorts, echoing observations from diverse income contexts [30, 31]; however, urban Malawian women aged 30–50 years showed notably elevated rates compared to men and rural women. In Malawi and Uganda, individuals with advanced education faced greater multimorbidity risk, while those with minimal education had lower risk in urban Malawi and rural Uganda. This education-risk relationship—highest among the most educated in three cohorts—contrasts with typical high-income country patterns, where burden concentrates among the least educated and socioeconomically disadvantaged [32]. Although causal factors remain unclear from these data, variations likely stem from differing lifestyle exposures, such as higher physical demands in manual occupations (e.g., agriculture, fishing) among lower-educated groups and limited access to calorie-dense processed foods. Comparable patterns emerged in a rural northern Indian cohort [33], though a systematic review of 19 Southeast Asian studies revealed mixed education-multimorbidity associations [34].

The differences in prevalence rates across our four study sites align with prior multi-country investigations, including African contexts [30, 31, 35]. For instance, the WHO SAGE survey indicated an overall multimorbidity rate of 23% among 44,715 community-based adults from China, India, Mexico, Russia, South Africa, and Ghana [36]. Yet, substantial site-specific variation existed: South Africa showed 22.8% urban and 13.7% rural, while Ghana recorded 24.8% urban and 12.4% rural [36]. A meta-analysis encompassing 193 studies—with one from Ethiopia [37], three from South Africa [38–40], and another from Ethiopia [37]—yielded a pooled crude African multimorbidity estimate of 13.8% (ranging 4.5–35.2). Individual estimates varied widely, from 2.7% in community settings [40] to 35% in primary care [38]. Additional sub-Saharan African research has documented varying multimorbidity rates [12], potentially attributable to methodological and contextual disparities. Investigations in Ghana [41], Nigeria [42], and Ethiopia [37] occurred in secondary care facilities, relying on self-reported [37, 41] or recorded [42] data for crude rates. A Zimbabwean study among HIV-positive secondary care patients combined self-report and objective measures for crude estimates [43]. Conversely, community-based work in Burkina Faso [44] and Malawi [14] reported comparable crude rates around 65%, despite differences in inclusion (adults >60 years in Burkina Faso versus ≥18 years in Malawi) and data approaches (self-report alone in Burkina Faso versus self-report plus records in Malawi). In rural Tanzania, a modest older-adult (>60 years) study found self-reported multimorbidity at 26.1% (frailty-adjusted), rising sharply to 67.3% with clinical screening, underscoring self-report underestimation risks [45]. A large rural South African sample of adults >40 years revealed markedly higher rates at 69.4%, attributable to assessing a broader array of chronic conditions [46].

Strengths and limitations

This investigation characterised and contrasted multimorbidity epidemiology—using age-standardisation—across three sub-Saharan African nations, incorporating four sites (one urban, three rural), spanning diverse age ranges, both genders, and combining self-reported with objectively measured outcomes. Nevertheless, several constraints apply. Cross-sectional design precludes causal inference for associations between examined factors and multimorbidity, given potential reverse causality. Residual confounding from unmeasured variables and non-differential misclassification remain possible. Critically, numerous relevant conditions—such as mental health issues, musculoskeletal disorders, and chronic pain—lacked data. With at most seven conditions assessed, reported multimorbidity rates likely underestimate true prevalence. Variations in included conditions across sites probably influenced overall rates, introducing comparability bias. Protocol differences in anthropometry and biomarker assessments may have affected estimates and inter-site differences. Behavioral data were sparse, confined to smoking and alcohol (available in only three sites), restricting risk factor analyses. More granular details on consumption patterns, intensity, and duration are required to clarify findings, including the apparent protective smoking effect. Key lifestyle elements—like diet, physical activity, and pollution exposure—were absent despite probable relevance [47]. Emerging urbanisation-driven NCD rises in southern sub-Saharan Africa could not be examined due to data constraints [48]. Lastly, reliance on self-report for some outcomes risks prevalence underestimation.

Conclusion

Multimorbidity rates differed considerably within and across the three sub-Saharan African nations. The heaviest loads affected urban residents, women, individuals over 50 years, and those with advanced education. However, notable prevalence emerged among 30–50-year-olds, especially urban women, signaling potential future healthcare strain. Enhanced research is essential to elucidate multimorbidity patterns in low-income sub-Saharan settings. This requires comprehensive community-based data via screening and clinical evaluation for diverse chronic illnesses (encompassing disability, additional infectious diseases, pain syndromes, and psychiatric conditions), with balanced gender and urban/rural sampling. These insights are vital for shaping effective health policies and services in the region.

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