Note: Charts below are illustrative placeholders and should be replaced with official series before publication.

Chapter 6

Mortality Levels and Trends (Ethiopia focus plus global lens)

Aynalem Adugna, October 2025

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CONTENT

Section	Scope (Ethiopia + global lens)	Outputs / visuals to include
6.1 Concepts, Indicators & Data Sources	Define mortality indicators; outline Ethiopian sources (censuses, surveys, CRVS, HMIS) with global comparators (UN WPP, WHO).	Glossary; indicator matrix; source reliability table
6.2 Period Measures: CDR, ASDRs & Standardization	Crude death rate and age-specific death rates; direct/indirect age standardization for Ethiopia vs global peers.	Table of ASDRs; plot of age-standardized death rates

6.3 Child Mortality (Neonatal, Infant, Under-5)	Trends in q0, 1q0, 5q0; cohort vs period; international SDG 3.2 comparisons.	Trend graphs; regional table; uncertainty bands
6.4 Adult Mortality (15–60): 45q15 & Adult Age Patterns	Levels/trends of 45q15; sex differences; HIV/shock signatures; comparisons regionally.	Trend graph; sex-disaggregated table
6.5 Older-Age Mortality & Longevity	60+ mortality, 60q15, 80+ rates; healthy life expectancy notes.	ASDRs at older ages; survival to 60/80 tables
6.6 Life Table Construction & Life Expectancy	From nMx → nqx → lx → Lx → Tx → ex; model life tables where needed.	Worked example table; survivorship curve
6.7 Causes of Death & Epidemiological Transition	CMNN–NCD–Injury shifts; top-10 causes; data caveats (verbal autopsy, ill-defined).	Stacked bars; top-10 table
6.8 Inequalities Over Time (Urban–Rural, Sex)	Disaggregate trends; decomposition of gaps; Ethiopia vs comparators.	Gap plots; decomposition table
6.9 Shocks & Excess Mortality	Drought, conflict, epidemics; methods for excess death estimation and uncertainty.	ITS/event-study schematic; excess deaths table
6.10 International Benchmarks & SDG Tracking	Ethiopia vs Sub-Saharan Africa and LIC/LMIC medians; SDG 3.2, 3.4 trajectories.	Benchmark ladders; SDG progress table
6.11 Data Quality & Reconciliation	Triangulate surveys, HMIS, CRVS, modelled estimates; underregistration and misclassification.	Quality diagnostics table; reconciliation rules
6.12 Summary: What Changed & Why	Synthesis of drivers behind trends (coverage, risk factors, shocks).	One-page dashboard

Core mortality & life table formulas

Quantity	Formula / notes
Age-specific death rate (nMx)	nMx = D_x / P_x
Probability of dying in age interval (nqx)	nqx = (n * nMx) / (1 + (n − nax) * nMx)
Survivors to exact age x (lx)	l0 = 100,000; lx+n = lx * (1 − nqx)
Deaths in age interval (ndx)	ndx = lx * nqx
Person-years in age interval (nLx)	nLx = n * lx+n + nax * ndx; Lω+ ≈ lω / Mω+
Total person-years above age x (Tx)	Tx = Σ_{y≥x} nLy
Life expectancy at age x (ex)	ex = Tx / lx; e0 = T0 / l0
Child mortality (5q0, 1q0)	5q0 = Pr(dying before 5); 1q0 = Pr(dying before 1)
Adult mortality (45q15)	45q15 = Pr(dying between 15 and 60)
Age-standardized death rate	Σ (nMx_age × standard population weights)
Excess mortality	Observed deaths − Expected deaths (baseline), with uncertainty

6.1) Concepts, Indicators & Data Sources

Purpose. Define core mortality concepts, clarify how indicators are constructed, and map Ethiopia's data sources alongside global modelled series. Figures and tables here are illustrative templates to be replaced with official numbers.

Indicators — definitions & computation

Indicator	Definition / computation
Crude Death Rate (CDR)	Deaths per 1,000 population per year.
Age-Specific Death Rate (nMx)	Deaths in age x to x+n divided by person-years in that age interval.
Probability of dying (nqx)	Probability of dying between ages x and x+n derived from nMx and nax.
Infant Mortality Rate (IMR, 1q0)	Deaths under age 1 per 1,000 live births.
Under-5 Mortality (5q0)	Probability of dying before age 5 per 1,000 live births.
Adult Mortality (45q15)	Probability of dying between ages 15 and 60 per 1,000.
Life Expectancy at Birth (e0)	T0/l0 from a period life table.
Cause-specific mortality rate	Deaths from specific cause per 100,000 population.
Age-standardized death rate	Weighted sum of age-specific rates using a standard population.
Excess mortality	Observed minus expected deaths versus a baseline scenario.

Life-table worked example (illustrative)

Age	n	nMx	nax	nqx	lx	ndx	nLx	Tx	ex
0	1	0.04	0.1	0.0386	100000	3861.0	96525.1	5852138.0	58.52
1-4	4	0.006	1.5	0.0236	96139	2273.0	378872.9	5755612.9	59.87
5-9	5	0.0015	2.5	0.0075	93866	701.0	467575.4	5376740.0	57.28
10-14	5	0.001	2.5	0.005	93164	465.0	464660.3	4909164.6	52.69

15-19	5	0.0014	2.5	0.007	92700	647.0	461882.1	4444504.2	47.95
20-24	5	0.0018	2.5	0.009	92053	825.0	458203.6	3982622.2	43.26
25-29	5	0.0025	2.5	0.0124	91228	1133.0	453308.5	3524418.6	38.63
30-34	5	0.0035	2.5	0.0173	90095	1563.0	446567.8	3071110.1	34.09
35-39	5	0.005	2.5	0.0247	88532	2186.0	437195.4	2624542.2	29.65
40-44	5	0.008	2.5	0.0392	86346	3386.0	423265.2	2187346.8	25.33
45-49	5	0.012	2.5	0.0583	82960	4833.0	402718.3	1764081.6	21.26
50-54	5	0.02	2.5	0.0952	78127	7441.0	372035.0	1361363.3	17.42
55-59	5	0.032	2.5	0.1481	70687	10472.0	327253.0	989328.3	14.0
60-64	5	0.05	2.5	0.2222	60215	13381.0	267620.3	662075.2	11.0
65-69	5	0.08	2.5	0.3333	46834	15611.0	195139.8	394455.0	8.42
70-74	5	0.12	2.5	0.4615	31222	14410.0	120086.0	199315.2	6.38
75-79	5	0.18	2.5	0.6207	16812	10435.0	57972.6	79229.2	4.71
80+	999	0.3	5.0	1.0	6377	nan	21256.6	21256.6	3.33

Data sources — Ethiopia and global comparators

Source	Strengths / caveats
Population & Housing Census (CSA)	Counts deaths by household in prior 12 months; denominators for rates; coverage varies.
Demographic & Health Surveys (DHS)	Full birth histories (child mortality), sibling histories (adult), background factors.
PMA (Performance Monitoring for Action)	Rapid survey platform; can track child/maternal indicators; smaller samples than DHS.
HMIS / DHIS2 (MOH)	Continuous admin data on facility deaths, deliveries; under-coverage of out-of-facility deaths.
CRVS (Vital Events Registration)	Legal registration of deaths/causes; improving but incomplete in many areas.

HDSS & Verbal Autopsy	Surveillance sites with cause-of-death assignment (VA); limited geographic scope.
WHO/UN modelled series (WPP, GHE, IGME)	Harmonized, model-based estimates with uncertainty; useful for long trends & cross-country.

Data quality checklist

Issue	What to check / fix
Under-registration	Compare CRVS/HMIS deaths to expected deaths from life table × population.
Age heaping / misreporting	Myers/Whipple indices; smooth before standardization.
Recall bias (surveys)	Heaping at 12 months; omission of neonatal deaths; sibling history survival bias.
Cause assignment error	Verbal autopsy misclassification; ill-defined codes.
Denominator issues	Population estimates vs gridded surfaces; migration/displacement effects.
Shock periods	Use excess mortality methods; avoid naive interpolation across crises.

Figure . Survivorship l(x) from worked example

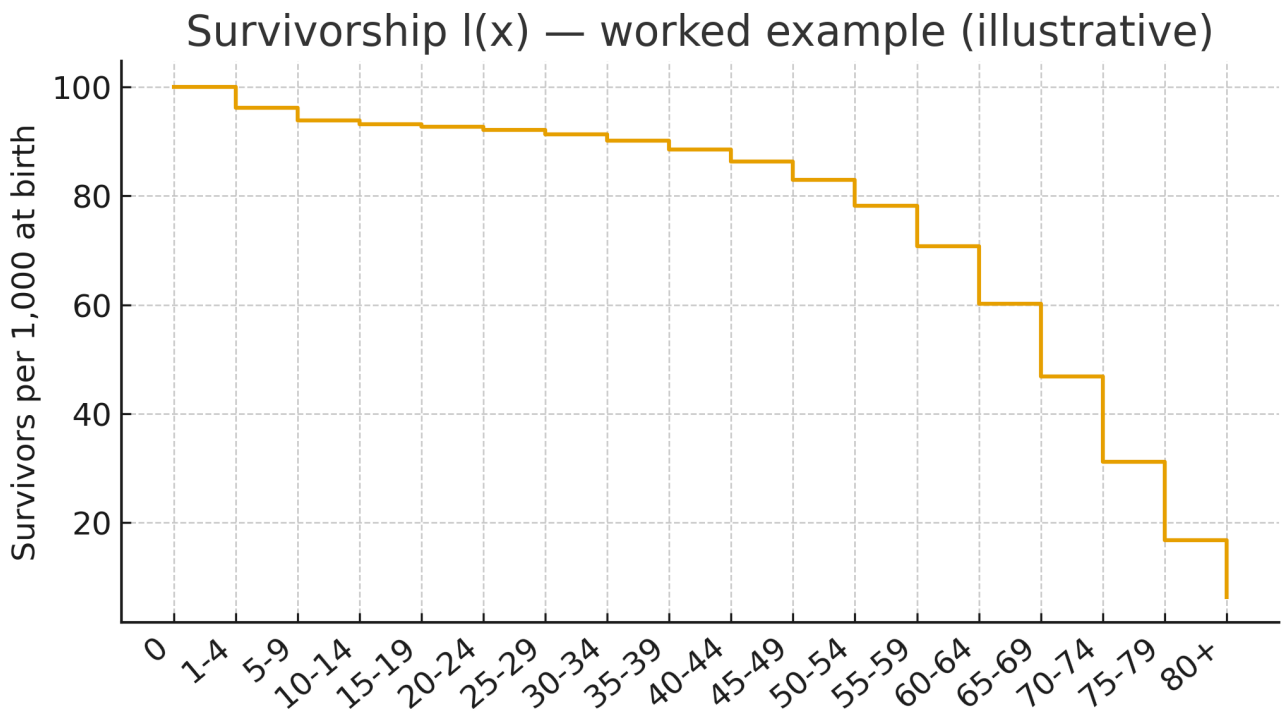
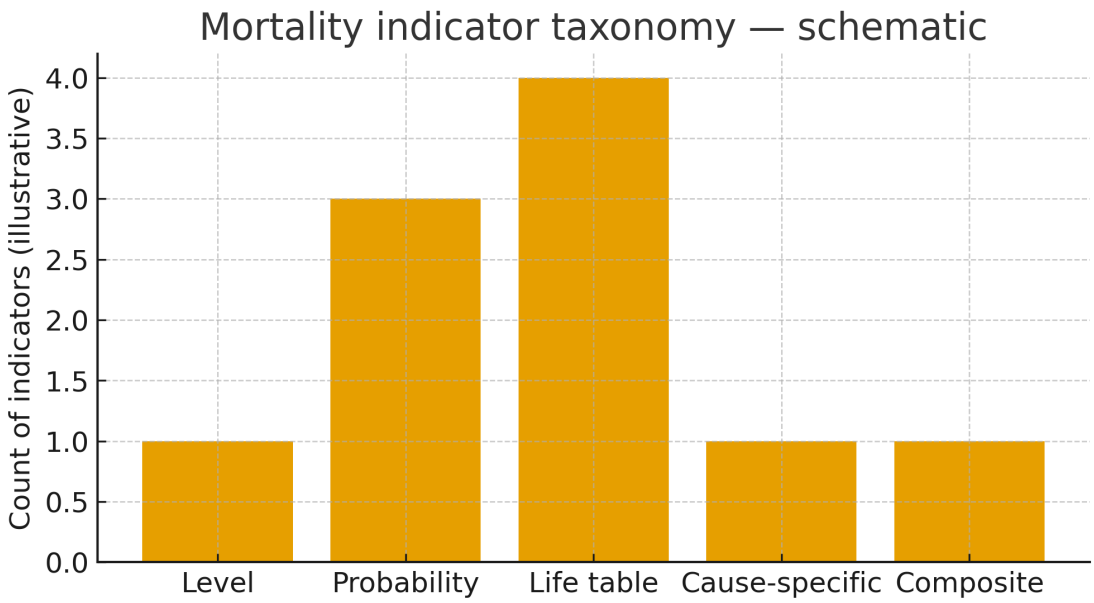


Figure . Mortality indicator taxonomy — schematic



Notes & scope

• Always state denominators and age definitions (e.g., 15–49 vs 12–49; births vs population).

• For child mortality, rely on full birth histories (DHS) and present uncertainty. For adult mortality, triangulate sibling histories, CRVS/HMIS, and modelled estimates.

• Ethiopia-specific caveats: pastoral/remote under-coverage; conflict/shock periods; out-of-facility deaths not captured by HMIS.

References — Section 6.1

- Preston, S., Heuveline, P., & Guillot, M. (2000). Demography: Measuring and Modeling Population Processes.

- United Nations (2017). Principles and Recommendations for a Vital Statistics System, Rev. 3.

- WHO Global Health Estimates (GHE) methodology notes.

- UN Inter-agency Group for Child Mortality Estimation (IGME).

- Ethiopia CSA: Census documentation; MOH: HMIS/DHIS2 guidelines; EPHI/HDSS verbal autopsy manuals.

6.2) Period Measures: CDR, ASDRs & Standardization

Purpose. Measure mortality levels in Ethiopia using the crude death rate (CDR) and age-specific death rates (ASDRs), and compare fairly to other settings via direct and indirect age standardization. Includes a Kitagawa decomposition to separate rate vs age-structure effects.

Figure . Age-specific death rates (nMx), Ethiopia

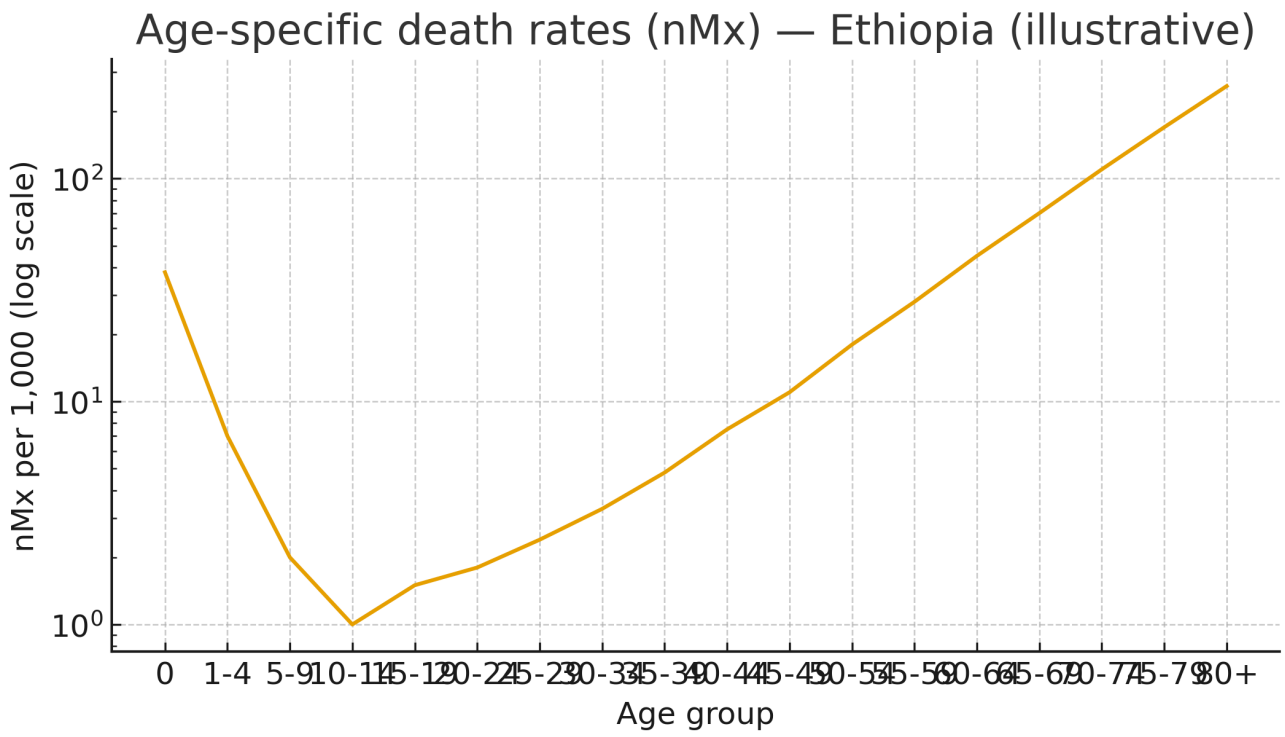


Figure . Population age structure — Ethiopia vs comparator

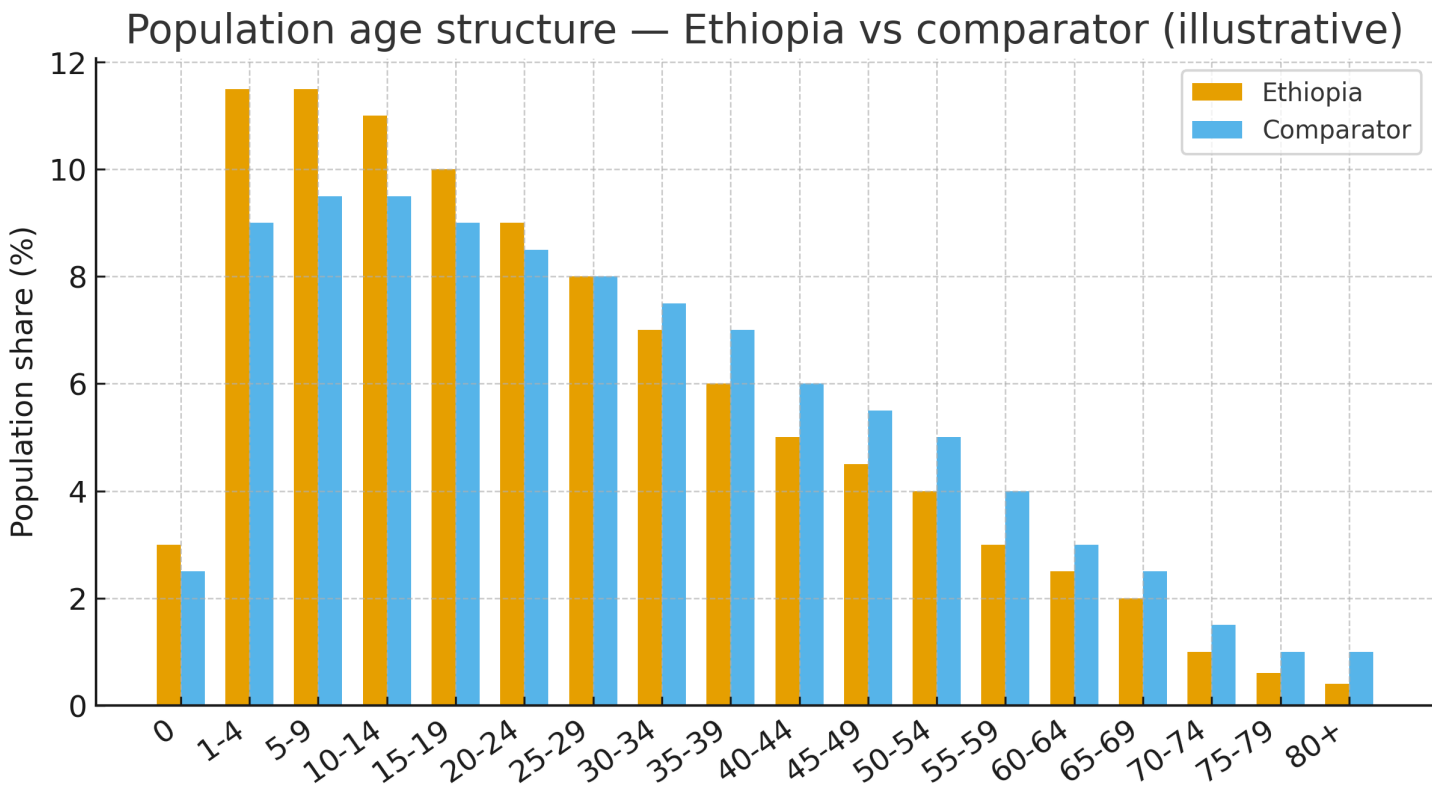


Figure . Crude vs standardized death rates

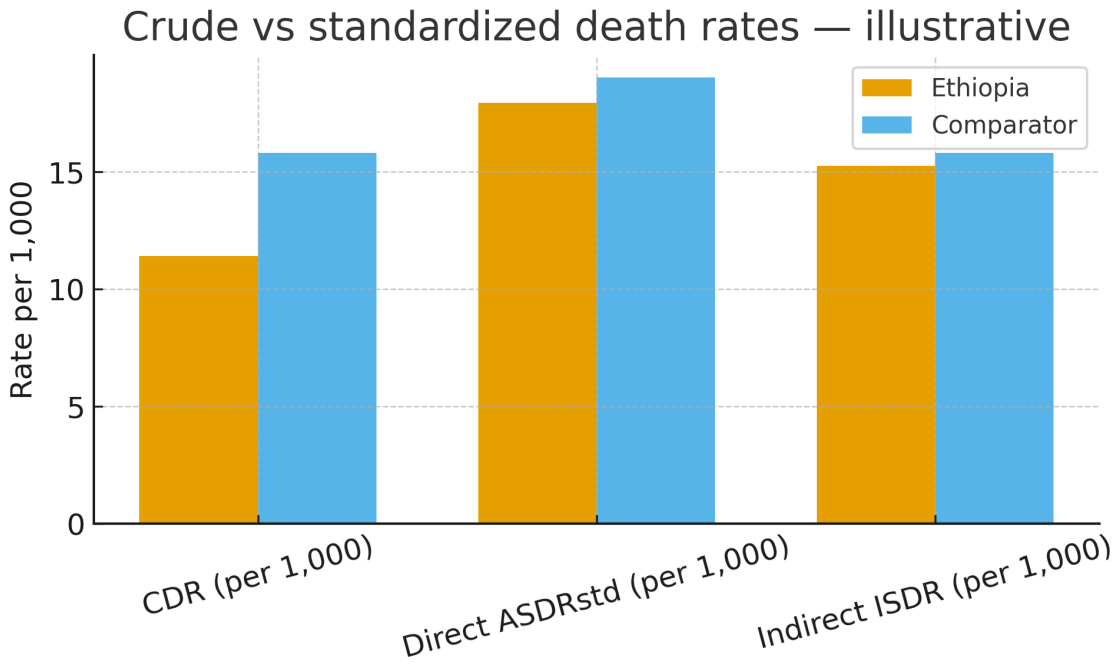


Figure . Decomposing CDR difference (Kitagawa)

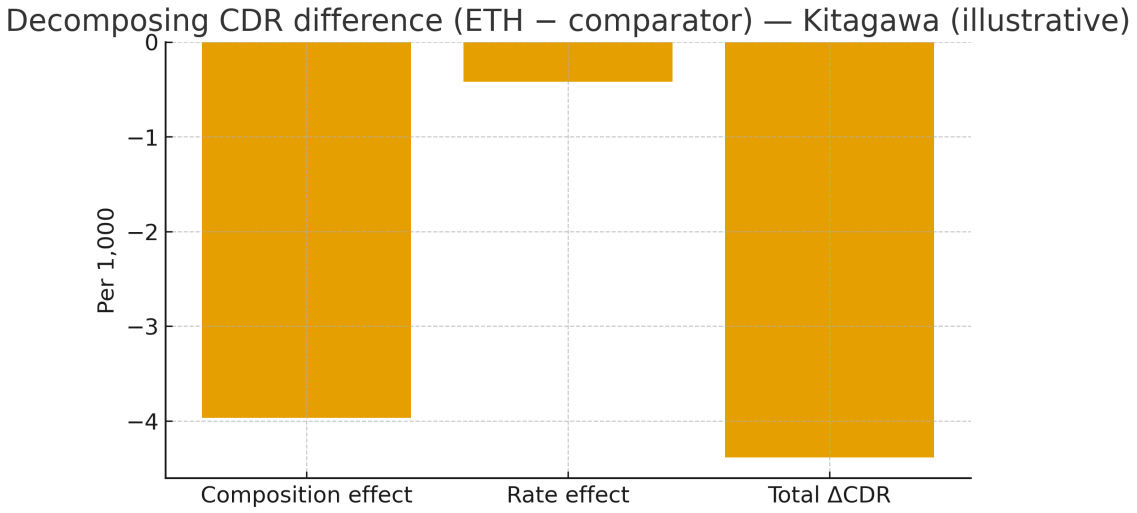


Table 6.2-A. Worked example — Ethiopia deaths by age

Age group	Population (ETH)	nMx ETH (per 1,000)	Deaths ETH
0	3000	38.0	114.0
1-4	11500	7.0	80.5
5-9	11500	2.0	23.0
10-14	11000	1.0	11.0
15-19	10000	1.5	15.0
20-24	9000	1.8	16.2
25-29	8000	2.4	19.2
30-34	7000	3.3	23.1
35-39	6000	4.8	28.8
40-44	5000	7.5	37.5
45-49	4500	11.0	49.5
50-54	4000	18.0	72.0
55-59	3000	28.0	84.0
60-64	2500	45.0	112.5

65-69	2000	70.0	140.0
70-74	1000	110.0	110.0
75-79	600	170.0	102.0
80+	400	260.0	104.0

Table 6.2-B. Comparator deaths by age

Age group	Population (CMP)	nMx CMP (per 1,000)	Deaths CMP
0	2500	35.0	87.5
1-4	9000	6.5	58.5
5-9	9500	2.0	19.0
10-14	9500	1.0	9.5
15-19	9000	1.4	12.6
20-24	8500	1.7	14.4
25-29	8000	2.3	18.4
30-34	7500	3.2	24.0
35-39	7000	4.9	34.3
40-44	6000	7.8	46.8
45-49	5500	11.8	64.9
50-54	5000	19.5	97.5
55-59	4000	30.0	120.0
60-64	3000	48.0	144.0
65-69	2500	75.0	187.5
70-74	1500	118.0	177.0
75-79	1000	185.0	185.0
80+	1000	280.0	280.0

Table 6.2-C. Summary rates & standardization

Metric	Ethiopia	Comparator
CDR (per 1,000)	11.42	15.81
Direct age-std (per 1,000)	17.95	19.03
Indirect (ISDR) (per 1,000)	15.25	15.81
SMR (ETH vs CMP)	0.964	1.0

Table 6.2-D. Kitagawa decomposition components

Component	Per 1,000
Composition effect	-3.97
Rate effect	-0.42
Total difference (ETH−CMP)	-4.39

Table 6.2-E. Key formulas

Quantity	Formula / notes
Crude Death Rate (CDR)	CDR = D / P × 1,000 (D=total deaths; P=mid-year population)
Age-Specific Death Rate	nMx = D_x / P_x
Direct age standardization	ASDR_std = Σ (nMx_region,age × w_std,age)
Indirect standardization (SMR, ISDR)	Expected D = Σ (P_region,age × M_std,age); SMR = D_obs / D_exp; ISDR = SMR × CDR_std
Kitagawa decomposition	ΔCDR = Σ (w_A − w_B)·M_B + Σ w_A·(M_A − M_B)

Notes & cautions

• CDR is highly sensitive to age structure; always pair with age-standardized rates for comparisons.

• Use consistent age bands and standard weights (e.g., WHO World Standard). Document data sources and uncertainty.

• For Ethiopia, consider under-registration of deaths and out-of-facility mortality in HMIS/CRVS when reconciling estimates.

References — Section 6.2

- Preston, Heuveline & Guillot (2000). Demography: Measuring and Modeling Population Processes.

- Ahmad et al. (2001). Age-standardization of rates: a new WHO standard.

- UN/WHO methodological notes on mortality measurement and standardization.

6.3) Child Mortality (Neonatal, Infant, Under-5)

Purpose. Track Ethiopia's neonatal (NNMR), infant (IMR), and under-5 mortality (U5MR) and compare subnational patterns and equity gaps. Figures are templates — replace with official estimates from DHS/IGME/CSA/MOH as you draft.

Figure . Trends with uncertainty: NNMR, IMR, U5MR

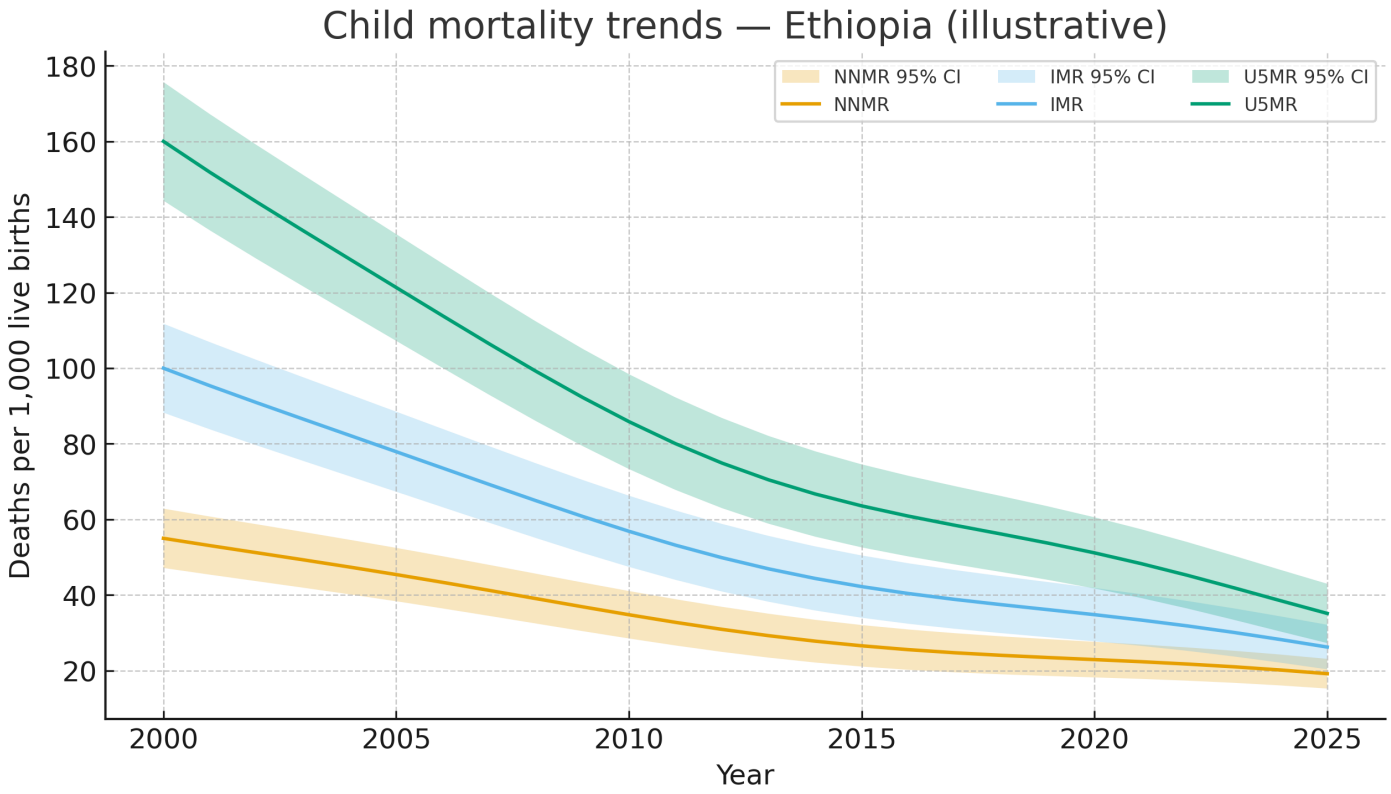


Figure . Neonatal share of under-5 deaths over time

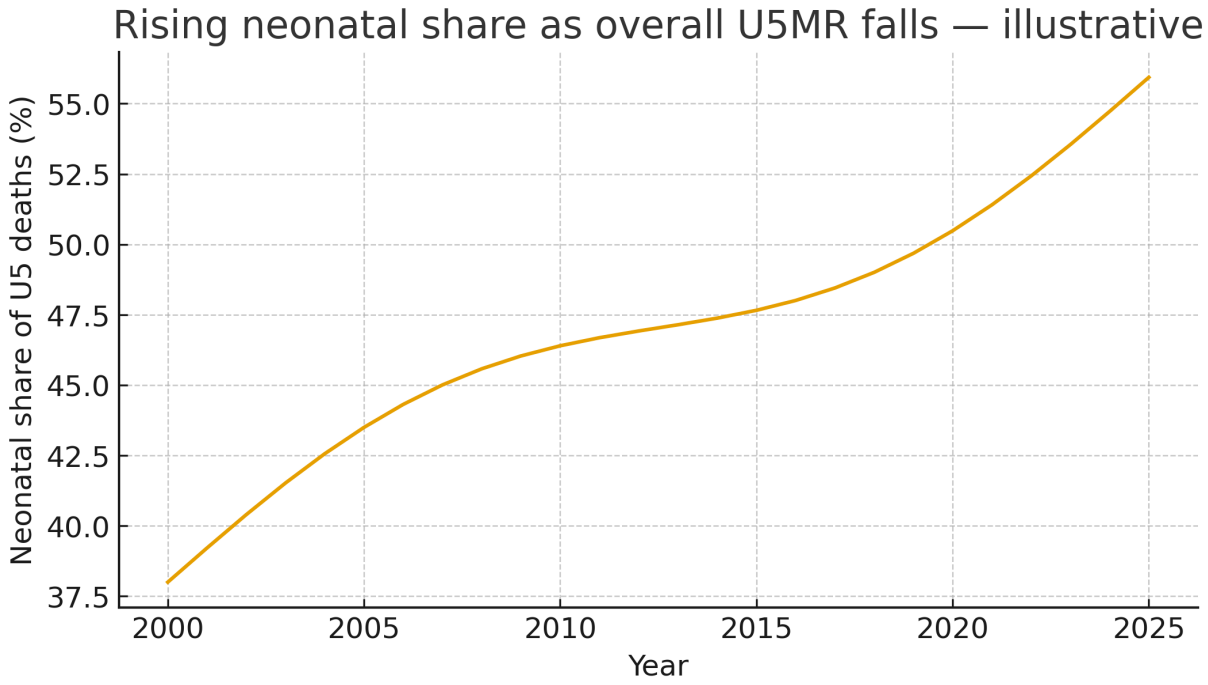


Figure . Regional snapshot: U5MR vs NNMR

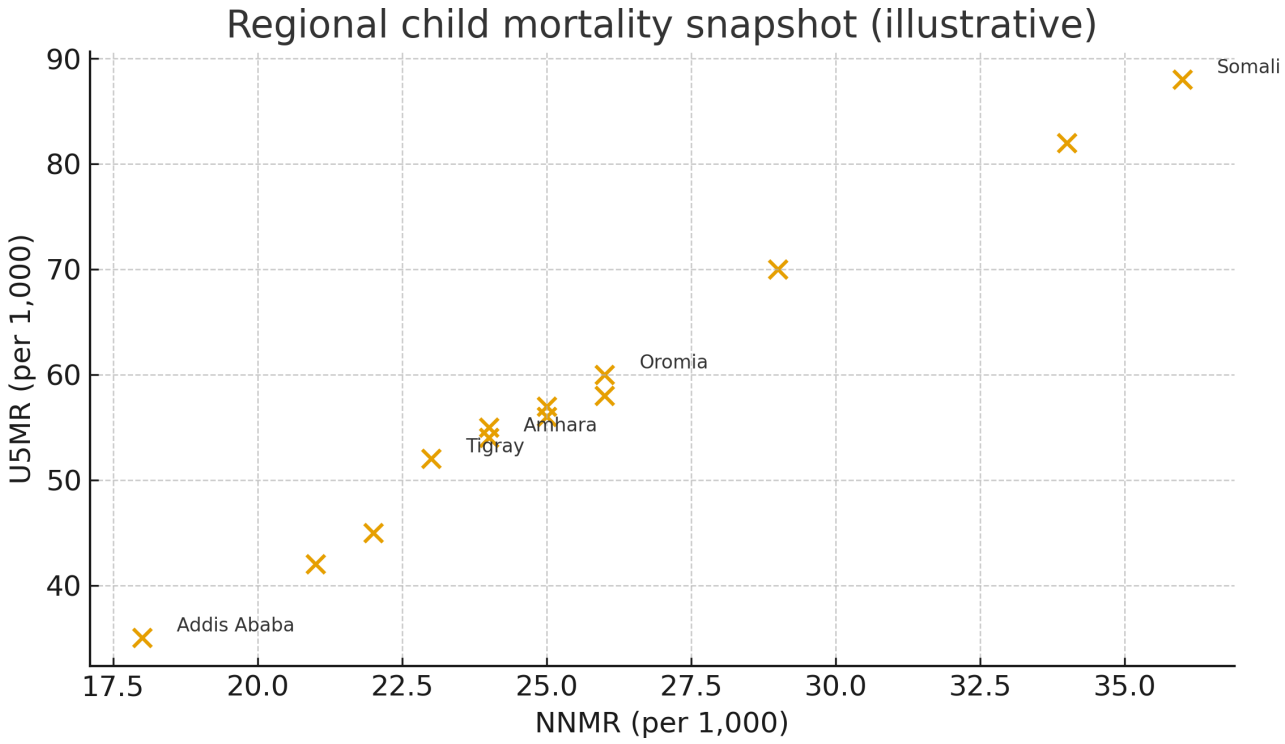


Figure . Urban–rural U5MR gap

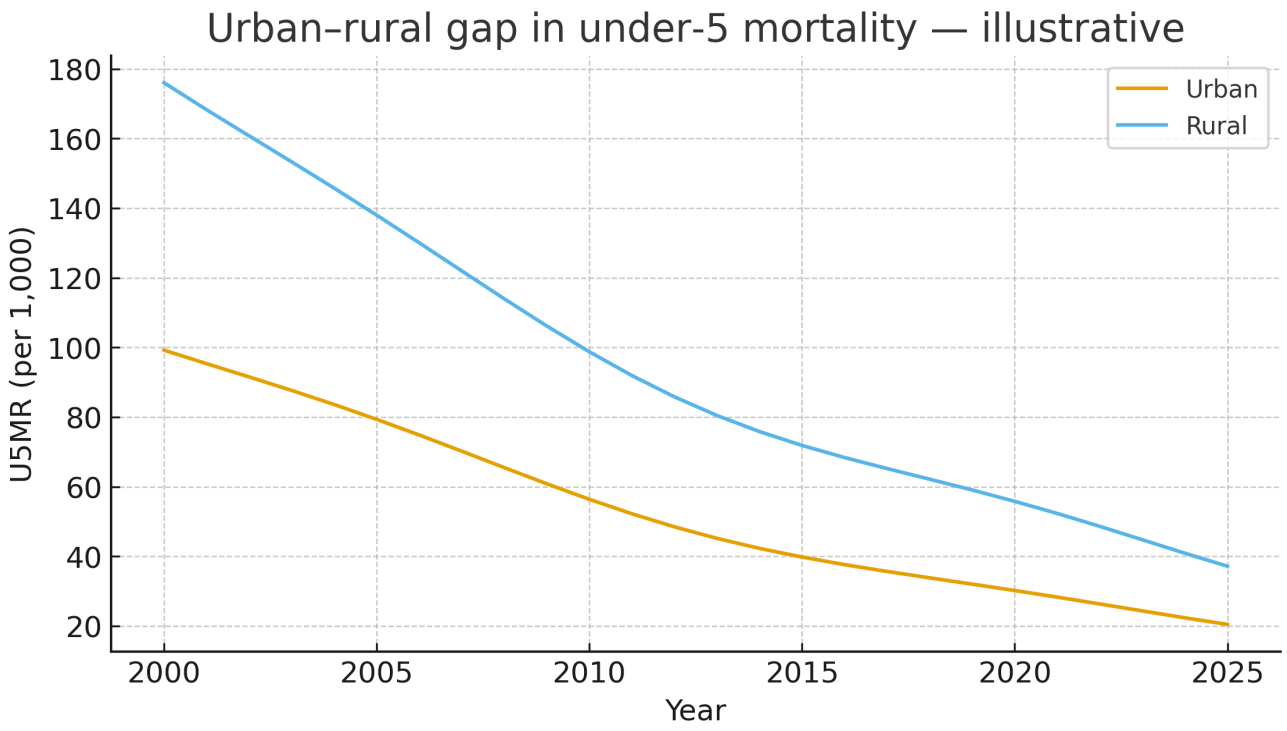


Figure . Survival to age in months (0–59), S(x)

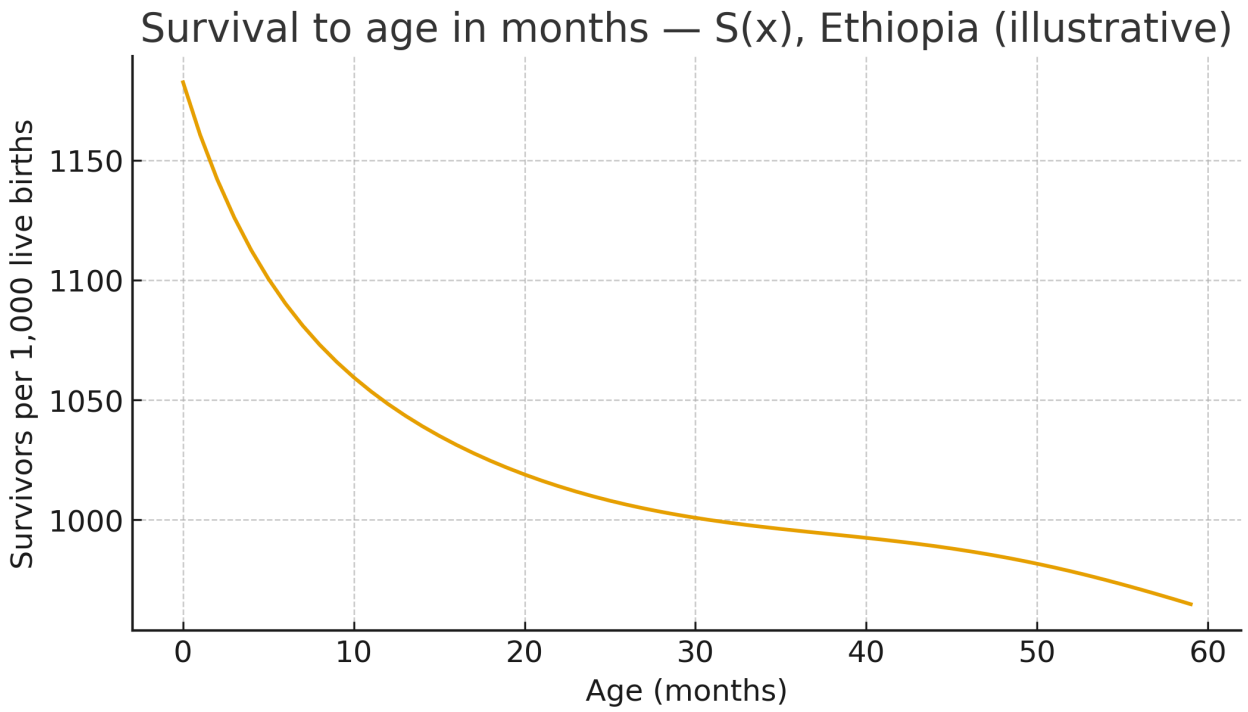


Table 6.3-A. Indicators and formulas

Indicator / Quantity	Definition / formula / note
Neonatal Mortality Rate (NNMR)	Deaths under 28 days per 1,000 live births in a period.
Infant Mortality Rate (IMR, 1q0)	Deaths under age 1 per 1,000 live births.
Under-5 Mortality (U5MR, 5q0)	Probability of dying before age 5 per 1,000 live births.
Post-neonatal mortality (1–11m)	IMR − NNMR.
Child mortality (1q4)	Probability of dying between ages 1 and 5; 1q4 = 5q0 − 1q0 (on probability scale).
Relationship (approx.)	If 1q0 and 1q4 are small: 5q0 ≈ 1 − (1 − 1q0)·(1 − 1q4).
Life table link	Convert 1q0 and 4q1 to l(x) at 0 and 1 to build child segments of the life table.

Table 6.3-B. Most recent national levels

Indicator	Value
NNMR	19.2
IMR (1q0)	26.2
U5MR (5q0)	35.1
Neonatal share of U5 deaths	55.9%

Table 6.3-C. Regional child mortality snapshot

Region	NNMR (per 1,000)	U5MR (per 1,000)
Addis Ababa	18	35
Afar	34	82
Amhara	24	54
Benishangul-Gumuz	26	58
Dire Dawa	22	45
Gambella	29	70

Harari	21	42
Oromia	26	60
Somali	36	88
SNNP	25	56
Sidama	24	55
Southwest	25	57
Tigray	23	52

Table 6.3-D. Urban–rural gap summary

Period	Urban U5MR (avg)	Rural U5MR (avg)	Absolute gap
2000–2005	89.4	157.0	67.6
2020–2025	25.3	46.6	21.3

Table 6.3-E. Data & methods notes

Topic	Guidance
Direct estimates (DHS/PMA)	Use full birth histories with period exposure assignment; present sampling uncertainty.
Smoothing / pooling	Pool adjacent years or apply Bayesian smoothing for annual series.
Shock handling	Avoid interpolating across crises; consider excess mortality adjustments.
Regional estimates	Borrow strength via small-area models; present uncertainty bands.
Consistency checks	Ensure IMR ≤ U5MR; NNMR ≤ IMR; and logical consistency across disaggregations.

References — Section 6.3

- United Nations Inter-agency Group for Child Mortality Estimation (IGME) — methods.

- DHS Guide to Statistics — child mortality estimation from full birth histories.

- WHO & UNICEF: Levels and Trends in Child Mortality reports.

- Ethiopia DHS/PMA survey reports (various years).

6.4) Adult Mortality (15–60): 45q15 & Adult Age Patterns

Purpose. Describe Ethiopia's adult mortality (15–60) using 45q15, sex-specific nMx profiles, survivorship from 15 to 60, and cause-of-death composition. Figures are templates to be replaced with official estimates (DHS sibling histories, CRVS/HMIS, WHO/GBD).

Figure . Adult mortality 45q15 with 95% CI

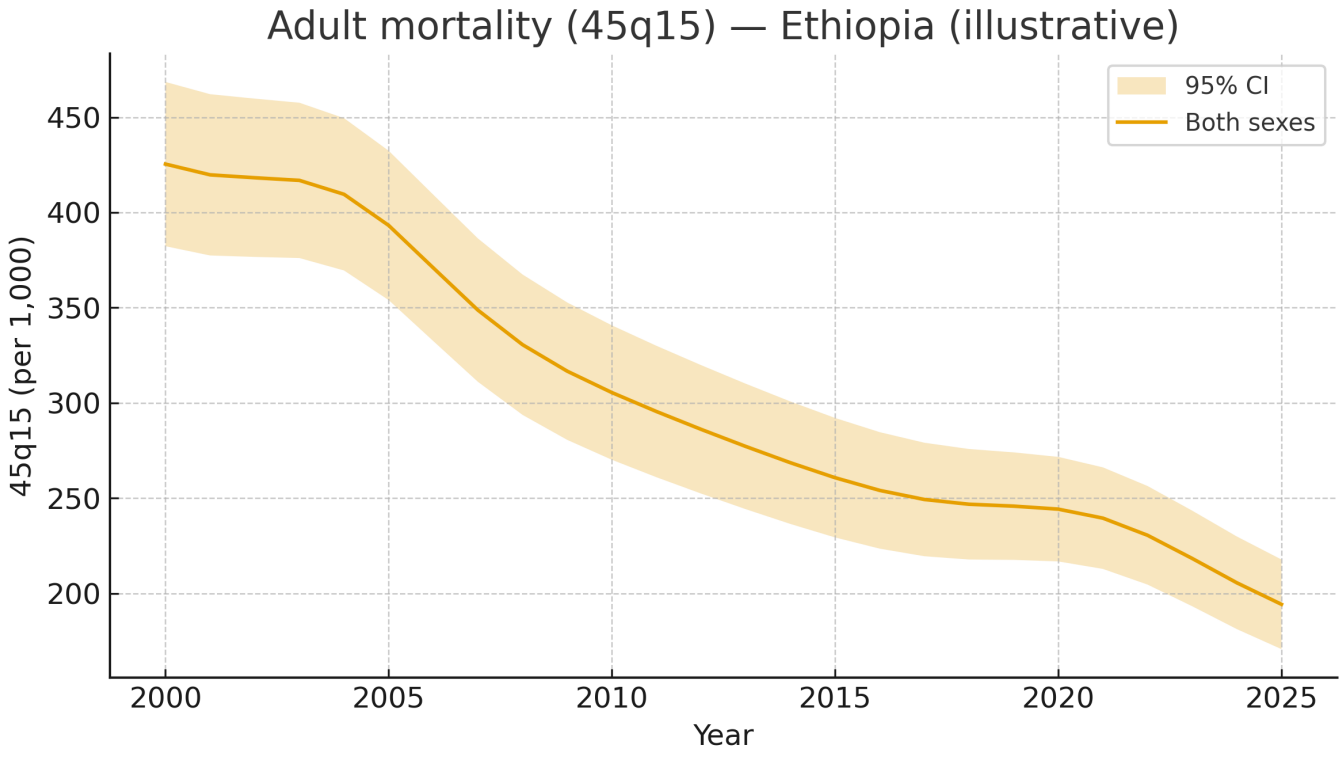


Figure . Sex-specific 45q15 trends

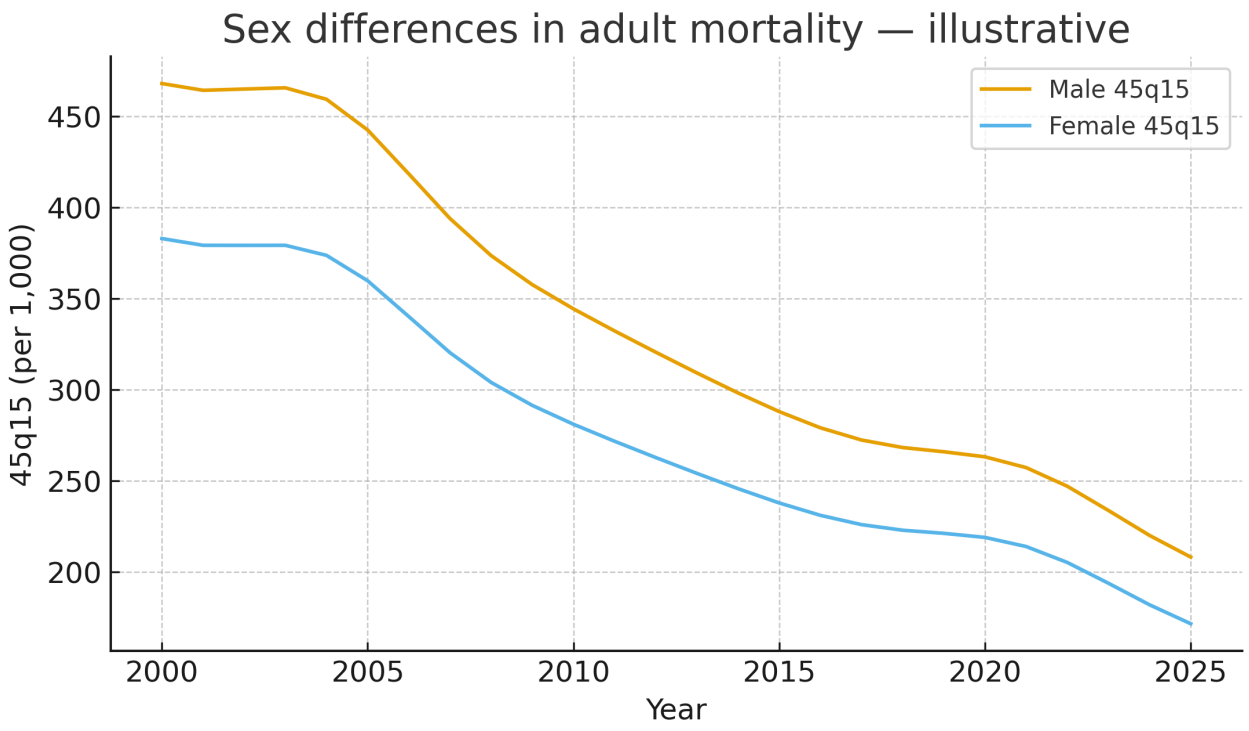


Figure . Regional snapshot: male vs female 45q15

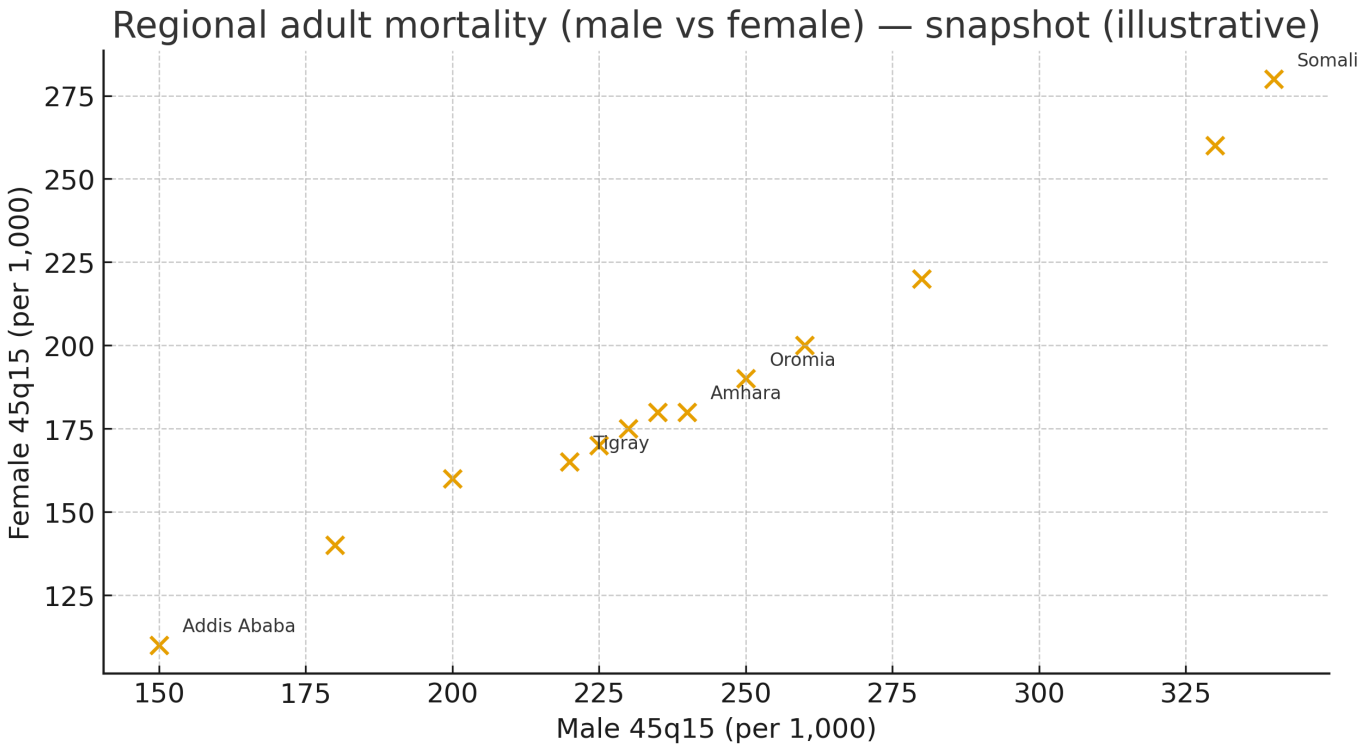


Figure . Gompertz plot: log(nMx) by age, males vs females

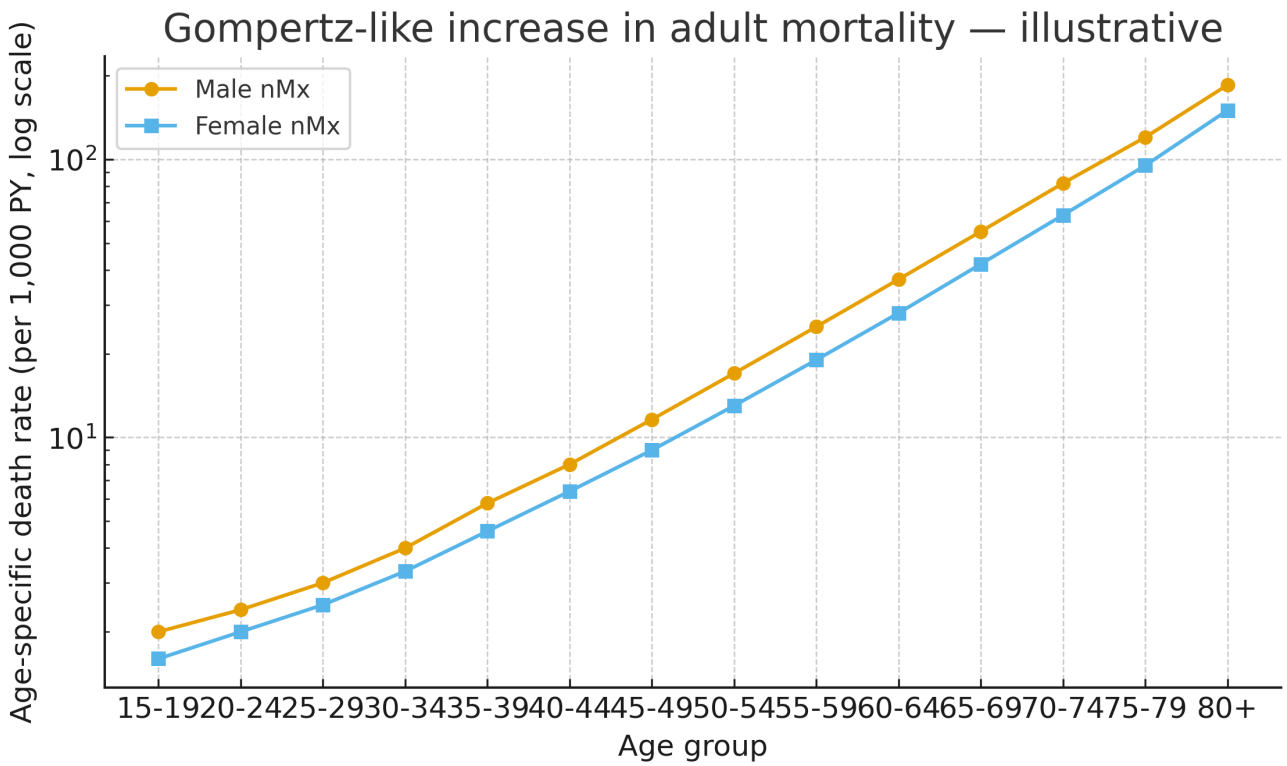


Figure . Adult survivorship (l15→l60)

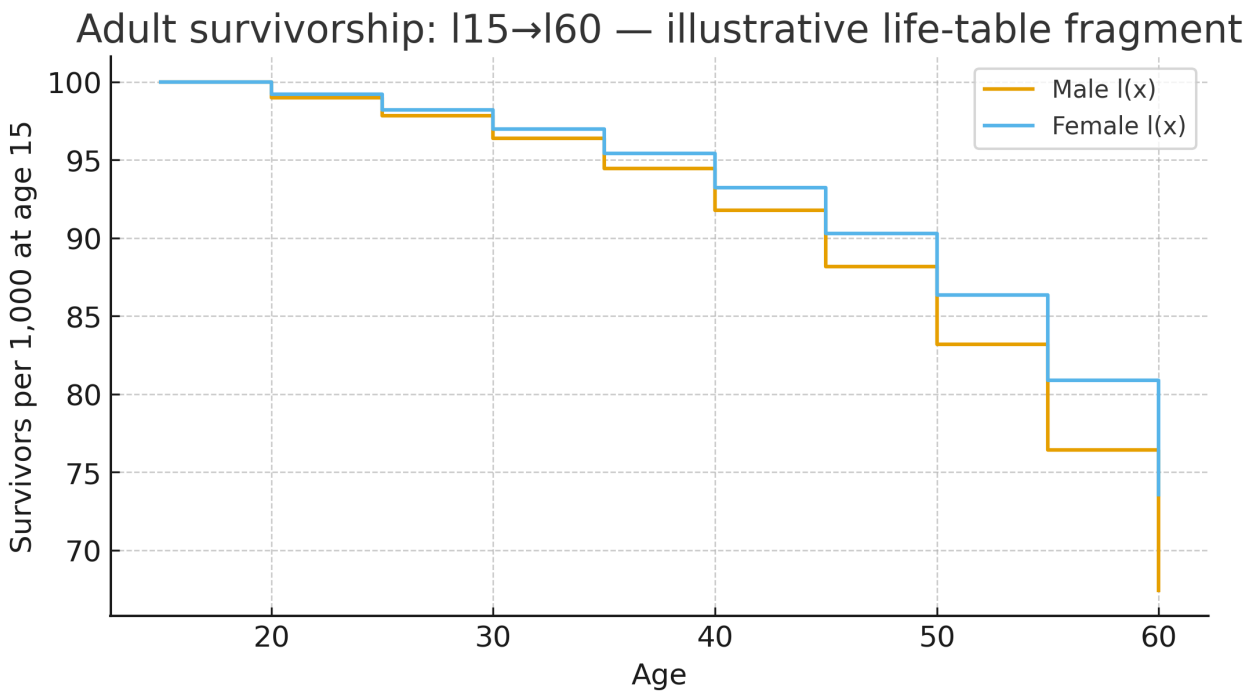


Figure . Adult cause-of-death composition over time

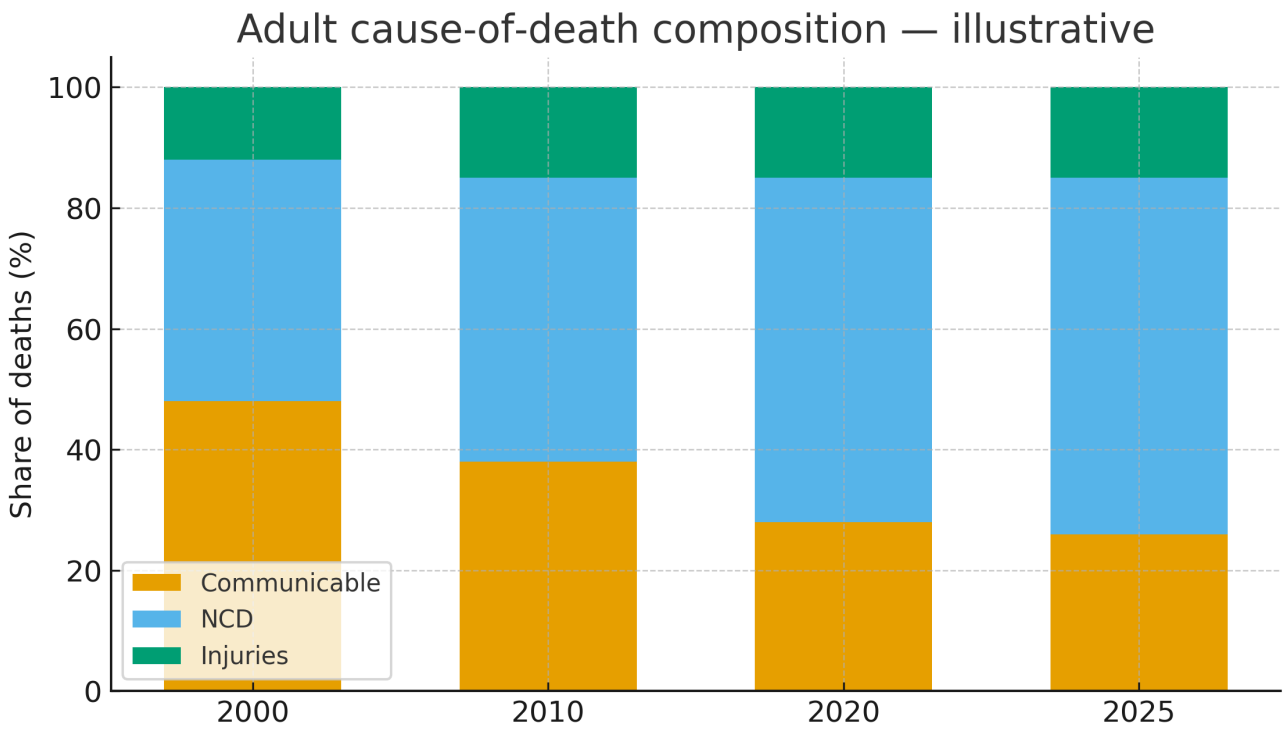


Figure . Rural-to-urban 45q15 ratio

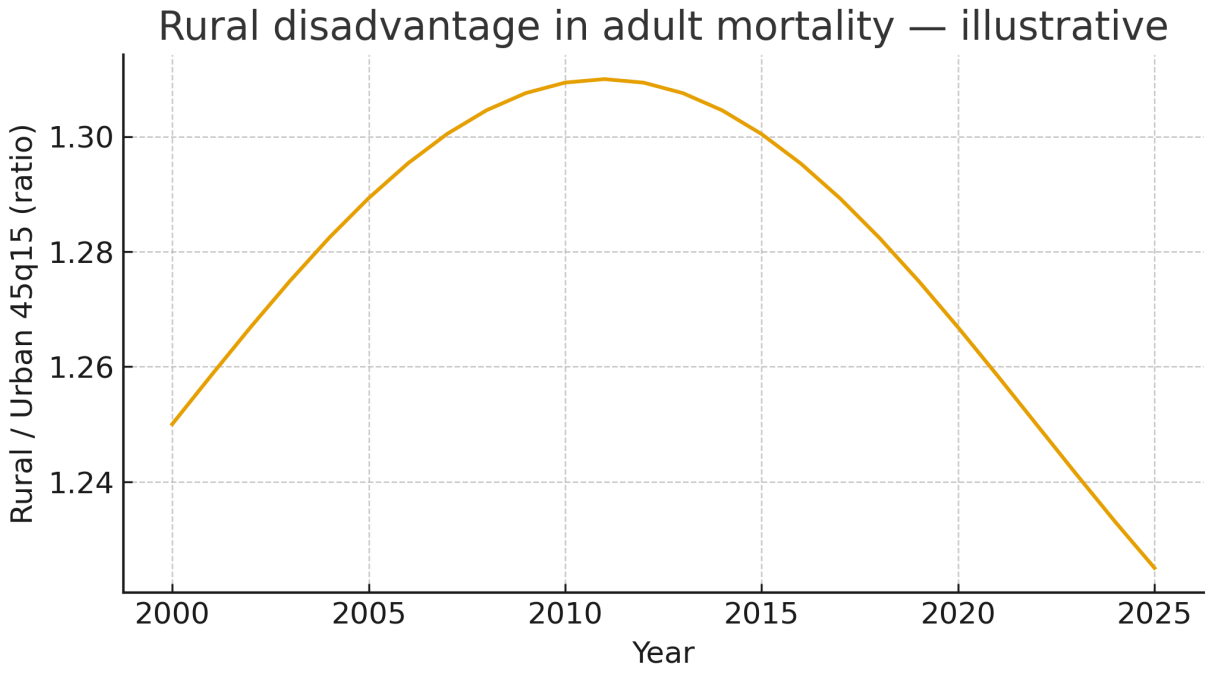


Table 6.4-A. Indicators & formulas

Indicator / Quantity	Definition / formula / note
Adult mortality (45q15)	Probability of dying between exact ages 15 and 60; often per 1,000.
Age-specific death rate (nMx)	Deaths in age interval / person-years in age interval.
From nMx to nqx (adult 5-year groups)	nqx = (n*nMx)/(1 + (n − nax)*nMx), with n=5 and nax≈2.5 (approx.).
Adult survivorship (l15→l60)	l60 = l15 × Π(1 − nqx); then 45q15 = 1 − l60/l15.
Cause-specific mortality fraction	Share of deaths due to cause category among all adult deaths.
Rural-urban ratio	45q15_rural / 45q15_urban (unitless).

Table 6.4-B. Latest national adult mortality levels

Metric	Value
45q15 (both sexes)	194.2
Male 45q15	208.1
Female 45q15	171.5
Rural/Urban ratio	1.22

Table 6.4-C. Regional adult mortality snapshot

Region	Male 45q15 (per 1,000)	Female 45q15 (per 1,000)
Addis Ababa	150	110
Afar	330	260
Amhara	240	180
Benishangul-Gumuz	260	200
Dire Dawa	200	160
Gambella	280	220
Harari	180	140

Oromia	250	190
Somali	340	280
SNNP	230	175
Sidama	225	170
Southwest	235	180
Tigray	220	165

Table 6.4-D. Life-table fragment (15–60) results

Sex	l15	l60	Derived 45q15
Male	100000	67419	325.8
Female	100000	73557	264.4

Table 6.4-E. Data & methods notes

Topic	Guidance
Data sources	DHS sibling histories; CRVS/HMIS deaths; HDSS/VA; WHO/GBD modelled series.
Bias & uncertainty	Survivor bias in sibling histories; under-registration; cod misclassification; conflict-related missingness.
Smoothing & modelling	Graduation of nMx; Gompertz-Makeham fits; Bayesian time-series with shock dummies.
Equity & disaggregation	Sex, residence, region; consider migration/IDP denominators in recent years.
Comparability	Align age groups; document cause lists and ICD revisions for COD trends.

References — Section 6.4

- Timaeus, I. M. (1991). Measurement of adult mortality in less developed countries: a comparative review.

- DHS Guide to Statistics: Sibling histories for adult mortality.

- WHO Global Health Estimates / GBD methodological notes for adult mortality and causes of death.

- Ethiopia MOH/CSA/EPHI documents on mortality data systems and verbal autopsy.

6.5) Older-Age Mortality & Longevity

Purpose. Characterize Ethiopia's mortality and longevity at older ages: e60, 20q60, survival to ages 60 and 80, older-age nMx profiles, cause-of-death composition, and ageing markers. Figures are templates to be replaced with official estimates (WHO/UN, CSA, HMIS/CRVS, HDSS/VA).

Figure . Life expectancy at age 60 (e60), both sexes and by sex

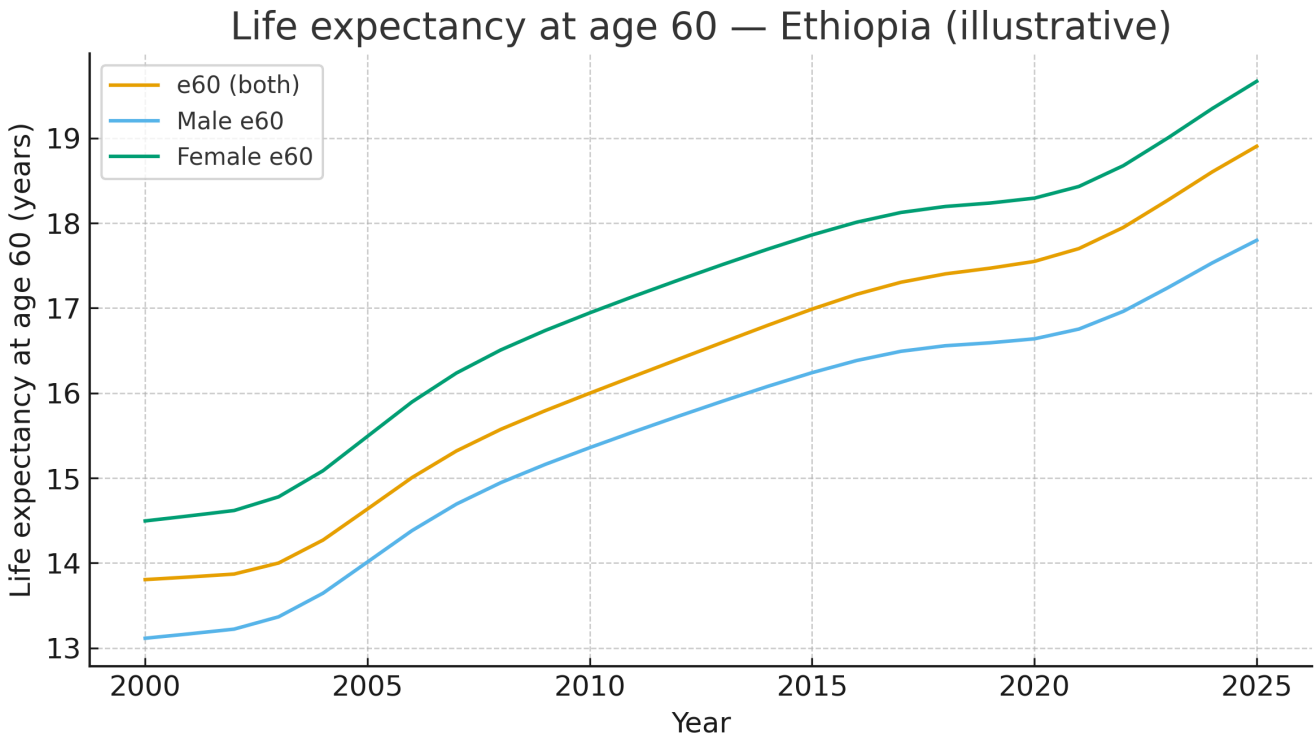


Figure . Probability of dying between ages 60 and 80 (20q60)

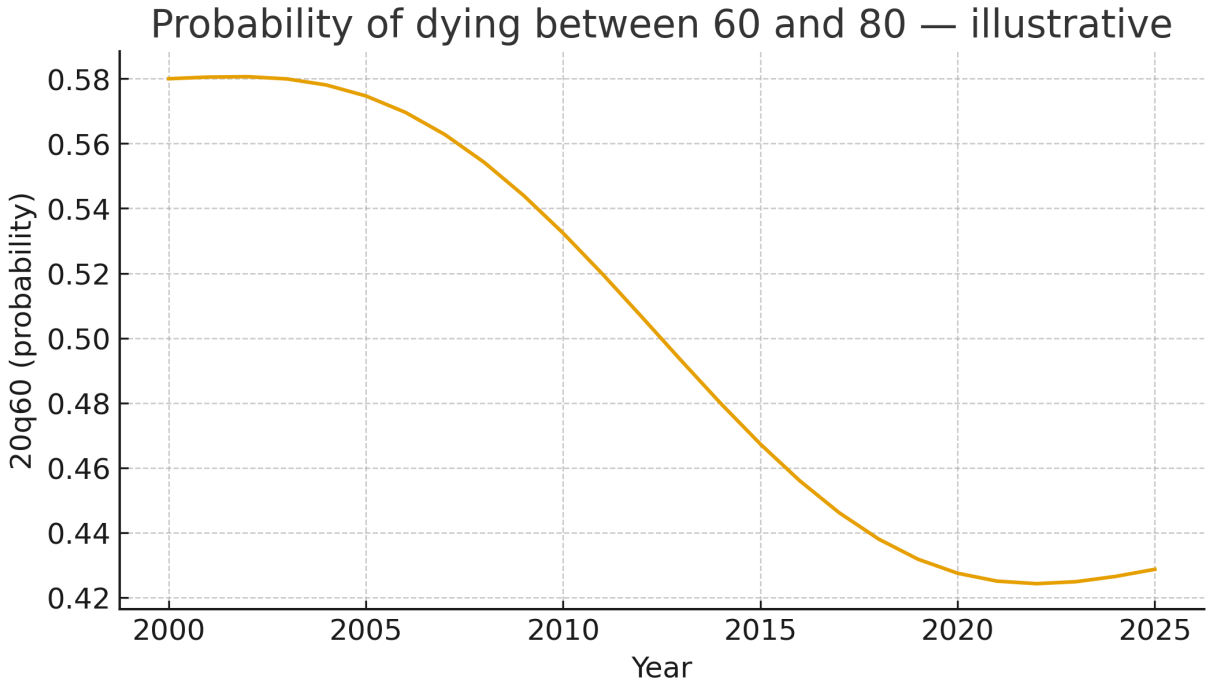


Figure 6.5-3. Share of birth cohort reaching ages 60 and 80

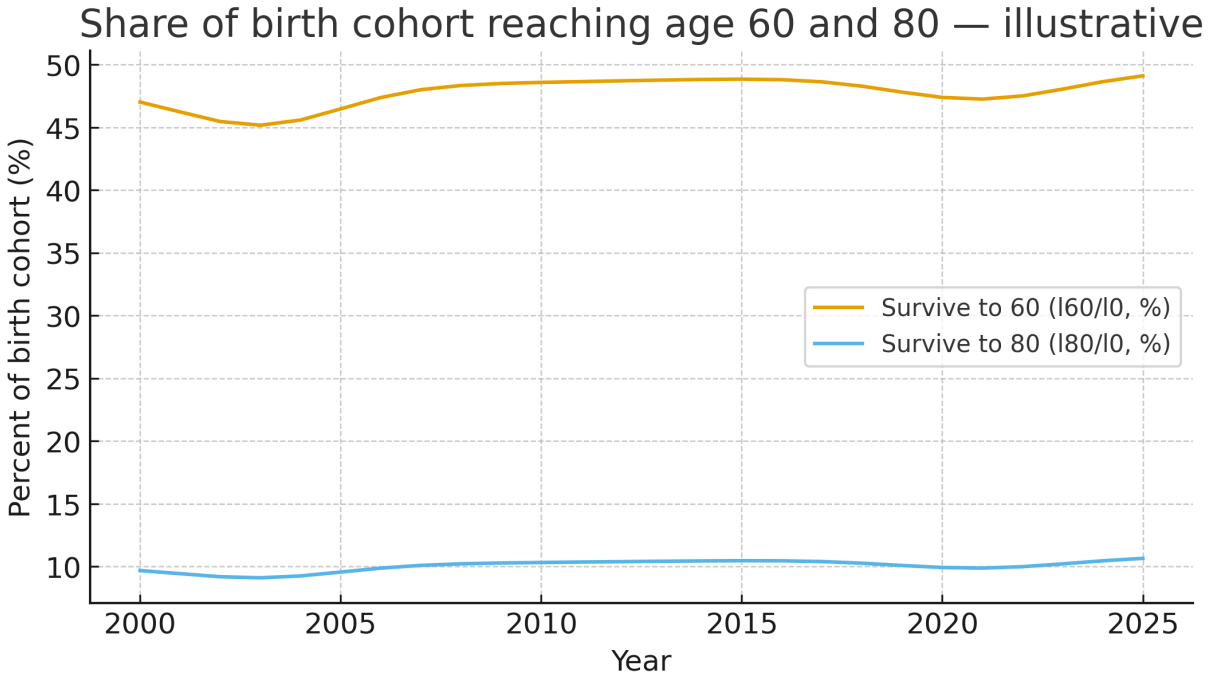


Figure . Older-age nMx profile (50+)

Figure . Cause-of-death composition at ages 60+

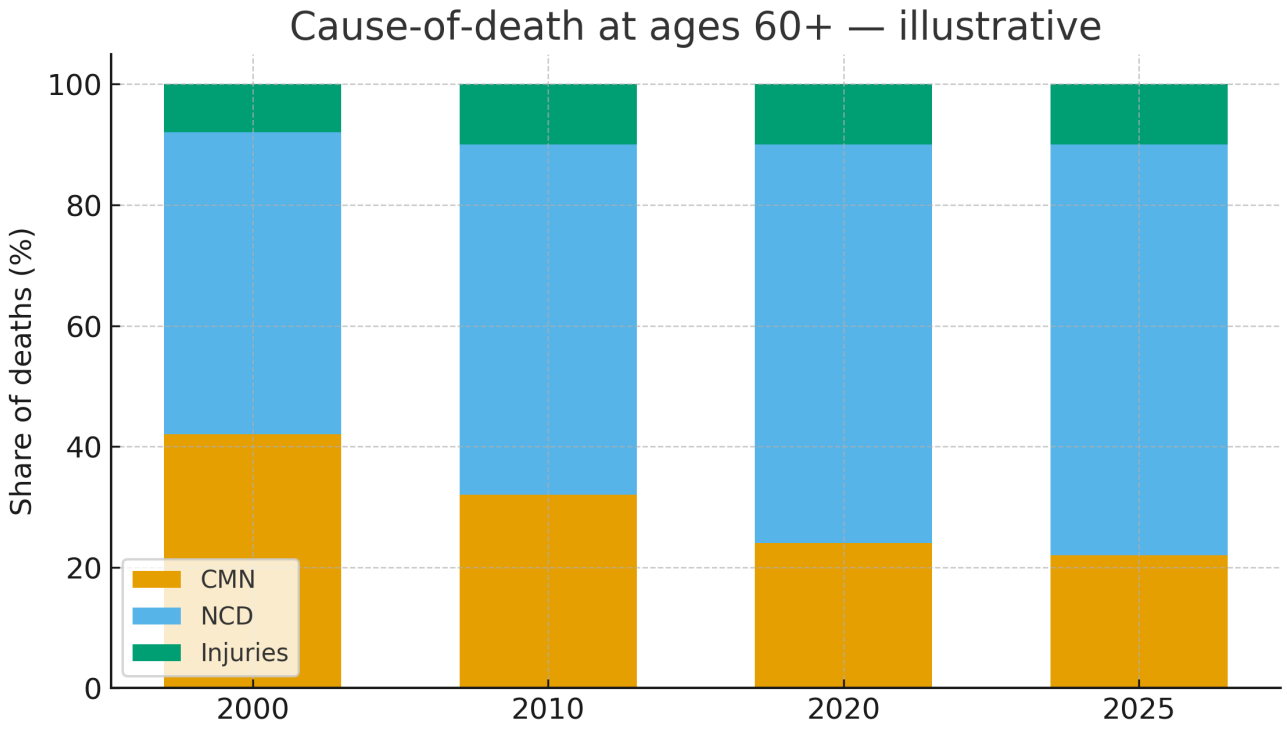


Figure . Population ageing markers (65+, 80+)

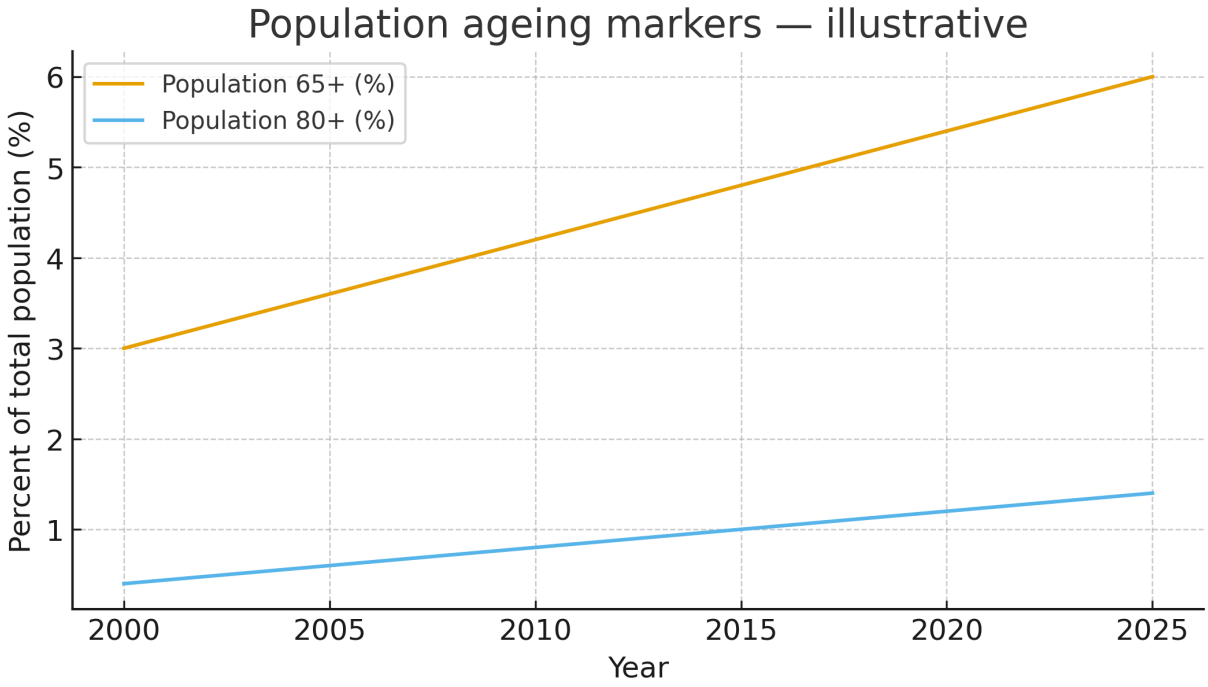


Table 6.5-A. Indicators & formulas

Indicator / Quantity	Definition / formula / note
Life expectancy at age 60 (e60)	e60 = T60 / l60 from a period life table.
20-year probability of dying (20q60)	Probability of dying between ages 60 and 80; from life table or approximated from nMx via nqx.
Survival to age 60, 80	l60/l0 and l80/l0: share of a birth cohort reaching ages 60 and 80.
Older-age nMx	Deaths / person-years in older-age intervals (usually 5-year groups).
Cause-specific mortality fraction (60+)	Share of deaths due to cause category among all deaths at ages 60+.
Healthy life expectancy (HLE60) (note)	Expected years lived at 60 in full health; requires YLD or disability weights (placeholder here).

Table 6.5-B. Life-table fragment 60+ (worked example)

Age	n	nqx	lx
60-64	5	0.202	100000
65-69	5	0.298	79775
70-74	5	0.431	56012
75-79	5	0.596	31850
80-84	5	0.788	12851
85-89	5	0.987	2726
90+	5	1.0	34
open+	open	1.0	0

Table 6.5-C. Latest national longevity markers

Metric	Value
e60 (both)	18.9
Male e60	17.8
Female e60	19.7
20q60	0.429
Survive to 60 (%)	49.1
Survive to 80 (%)	10.6
Pop 65+ (%)	6.0
Pop 80+ (%)	1.4

Table 6.5-D. Cause-of-death composition 60+ (shares %)

Year	CMN (%)	NCD (%)	Injuries (%)
2000	42	50	8
2010	32	58	10
2020	24	66	10
2025	22	68	10

Table 6.5-E. Data & methods notes

Topic	Guidance
Open interval handling	For 85+ or 90+, approximate Lω+ ≈ lω / Mω+; check sensitivity to assumed nax.
Graduation of nMx	Smooth older-age rates using Gompertz/Makeham or penalized splines to reduce noise.
Cause-of-death quality	Address ill-defined codes and VA misclassification; group causes to stable categories.
Small-area estimates	Borrow strength across districts; constrain to national totals for coherence.
Healthy ageing metrics	If data allow, add HLE60 using YLD estimates and Sullivan method.

References — Section 6.5

- Preston, Heuveline & Guillot (2000). Demography: Measuring and Modeling Population Processes.

- Kannisto, V. (1994). Development of oldest-old mortality.

- WHO Global Health Estimates & UN World Population Prospects — older-age mortality/longevity series.

- Sullivan method (healthy life expectancy) — standard notes.

6.6) Life Table Construction & Life Expectancy

Purpose. Provide a transparent, step-by-step abridged life-table construction for Ethiopia, from nMx and nax to nqx, l_x, L_x, T_x, and e_x, with scenario illustrations for child- and adult-mortality improvements. Figures and numbers are templates to be replaced with official estimates.

Figure . Life table survivorship l(x): baseline vs improvement scenarios

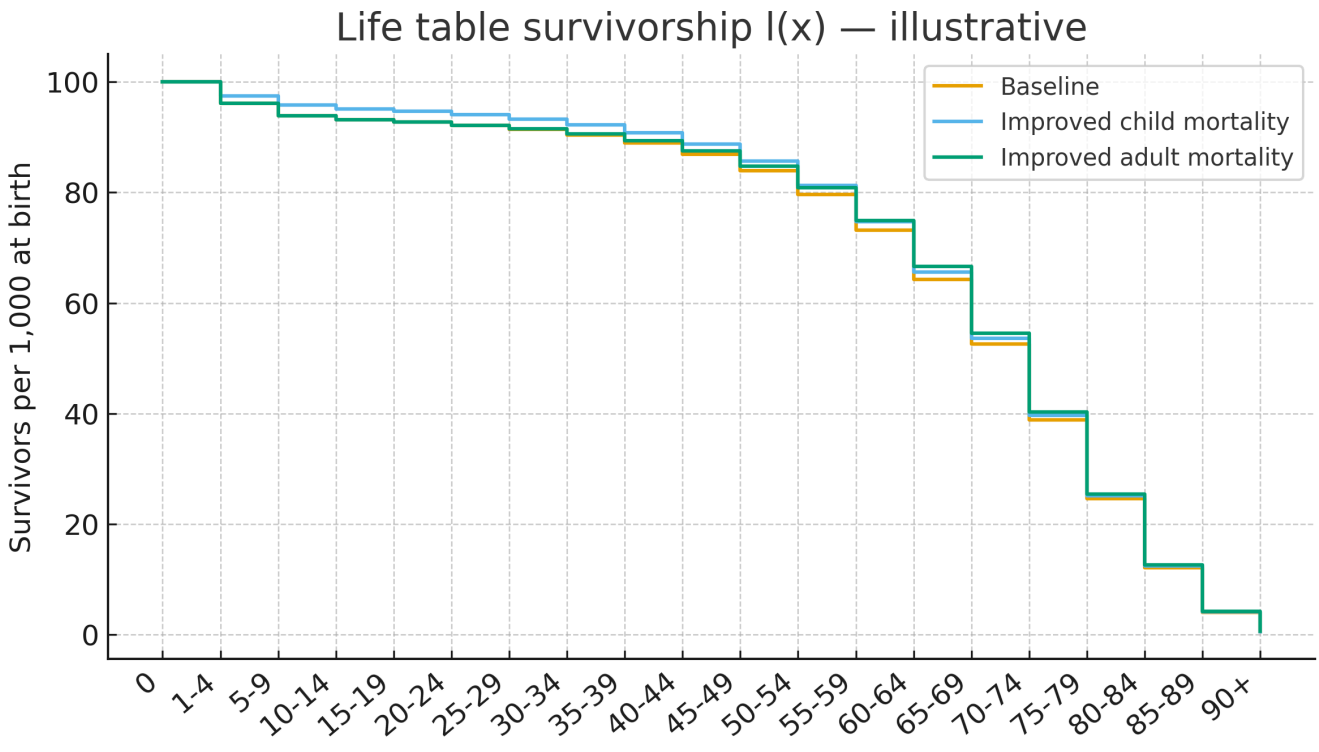


Figure . Life expectancy e(x) by age — baseline

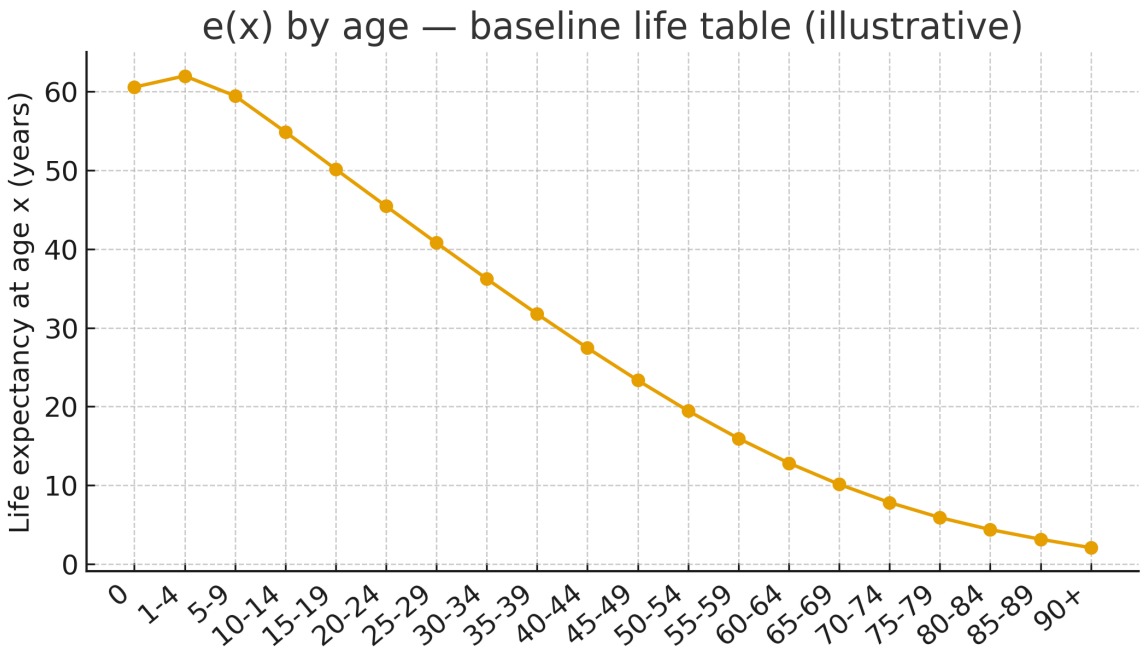


Figure . From nMx to nqx (selected ages)

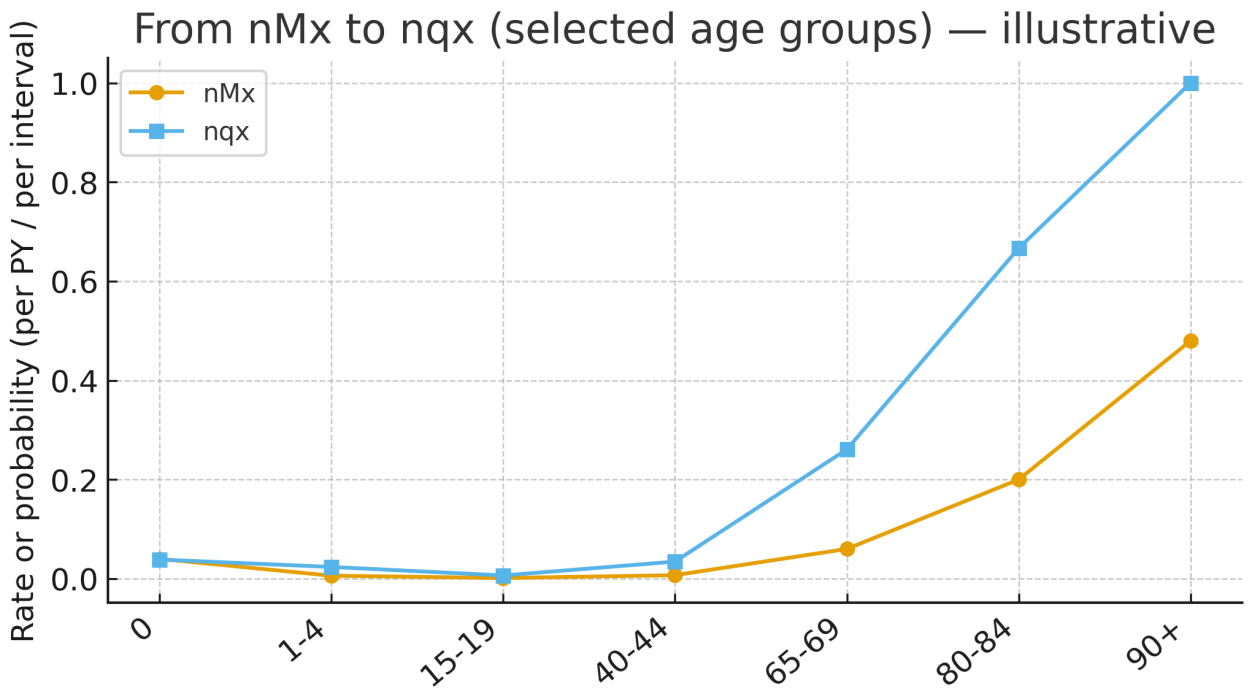


Table 6.6-A. Construction steps

Step	Action
1. Inputs	Choose age groups (x, n), death rates (nMx), and nax approximations.
2. Convert	Compute nqx = (n·nMx)/(1 + (n − nax)·nMx), with last open interval nqx=1.
3. Survivors	Initialize l0=100,000; compute lx+n = lx·(1 − nqx).
4. Deaths	ndx = lx·nqx.
5. Person-years	nLx = n·lx+n + nax·ndx; open interval Lω+ ≈ lω/Mω+.
6. Totals	Tx = Σ_{y≥x} nLy.
7. Expectancies	ex = Tx / lx; report e0 and other ex as needed.

Table 6.6-B. Abridged life table (baseline)

Age	n	nMx	nax	nqx	lx	ndx	nLx	Tx	ex
0	1	0.04	0.1	0.03861	100000	3861.0	96525.1	6055584.8	60.56
1-4	4	0.006	1.5	0.02365	96139	2273.0	378872.9	5959059.7	61.98
5-9	5	0.0015	2.5	0.00747	93866	701.0	467575.4	5580186.8	59.45
10-14	5	0.001	2.5	0.00499	93164	465.0	464660.3	5112611.5	54.88
15-19	5	0.0013	2.5	0.00648	92700	601.0	461997.2	4647951.1	50.14
20-24	5	0.0016	2.5	0.00797	92099	734.0	458661.1	4185953.9	45.45
25-29	5	0.0022	2.5	0.01094	91365	1000.0	454327.6	3727292.9	40.8
30-34	5	0.0032	2.5	0.01587	90366	1434.0	448242.9	3272965.3	36.22

35-39	5	0.0046	2.5	0.02274	88931	2022.0	439601.5	2824722.4	31.76
40-44	5	0.007	2.5	0.0344	86909	2990.0	427072.3	2385120.9	27.44
45-49	5	0.0105	2.5	0.05116	83920	4293.0	408865.8	1958048.6	23.33
50-54	5	0.017	2.5	0.08153	79627	6492.0	381902.3	1549182.8	19.46
55-59	5	0.026	2.5	0.12207	73134	8927.0	343353.4	1167280.5	15.96
60-64	5	0.04	2.5	0.18182	64207	11674.0	291850.4	823927.1	12.83
65-69	5	0.06	2.5	0.26087	52533	13704.0	228404.7	532076.7	10.13
70-74	5	0.09	2.5	0.36735	38829	14264.0	158484.9	303672.0	7.82
75-79	5	0.135	2.5	0.50467	24565	12397.0	91832.4	145187.1	5.91
80-84	5	0.2	2.5	0.66667	12168	8112.0	40559.3	53354.8	4.38
85-89	5	0.3	2.5	0.85714	4056	3477.0	11588.4	12795.5	3.15
90+	999	0.48	5.0	1.0	579	nan	1207.1	1207.1	2.08

Table 6.6-C. Scenario summary

Scenario	e0 (years)	U5 reduction applied	Adult reduction applied
Baseline	60.56	—	—
Improved child mortality	61.81	35% @ age 0, 30% @ 1–4	—
Improved adult mortality	61.18	—	10% @ 15–59

Table 6.6-D. Parameter choices

Parameter	Choice / note
Radix (l0)	100,000 (abridged)
nax rules	0: 0.1; 1–4: 1.5; 5+ : 2.5 except open interval (5.0).
Open interval (90+)	nqx=1; Lω+ ≈ lω / Mω+; check sensitivity.
Age bands	Abridged: 0, 1–4, 5-9, …, 85-89, 90+ (adapt as needed).
Units	nMx per person-year; nqx is a probability; nLx and Tx in person-years.

References — Section 6.6

- Preston, S., Heuveline, P., & Guillot, M. (2000). Demography: Measuring and Modeling Population Processes.

- UN (1983, 2017). Methods for Life Table Construction; Principles and Recommendations for a Vital Statistics System.

- WHO Global Health Estimates: life table methodology notes.

6.7) Causes of Death & the Epidemiological Transition

Purpose. Summarize Ethiopia's evolving cause-of-death profile and situate it within the epidemiological transition: from CMNN dominance to rising NCD shares, with persistent injuries and shocks. Replace the illustrative numbers here with official WHO/GBD/CSA/CRVS/HDSS-VA estimates during drafting.

Figure . Broad cause composition over time (CMNN, NCD, Injuries)

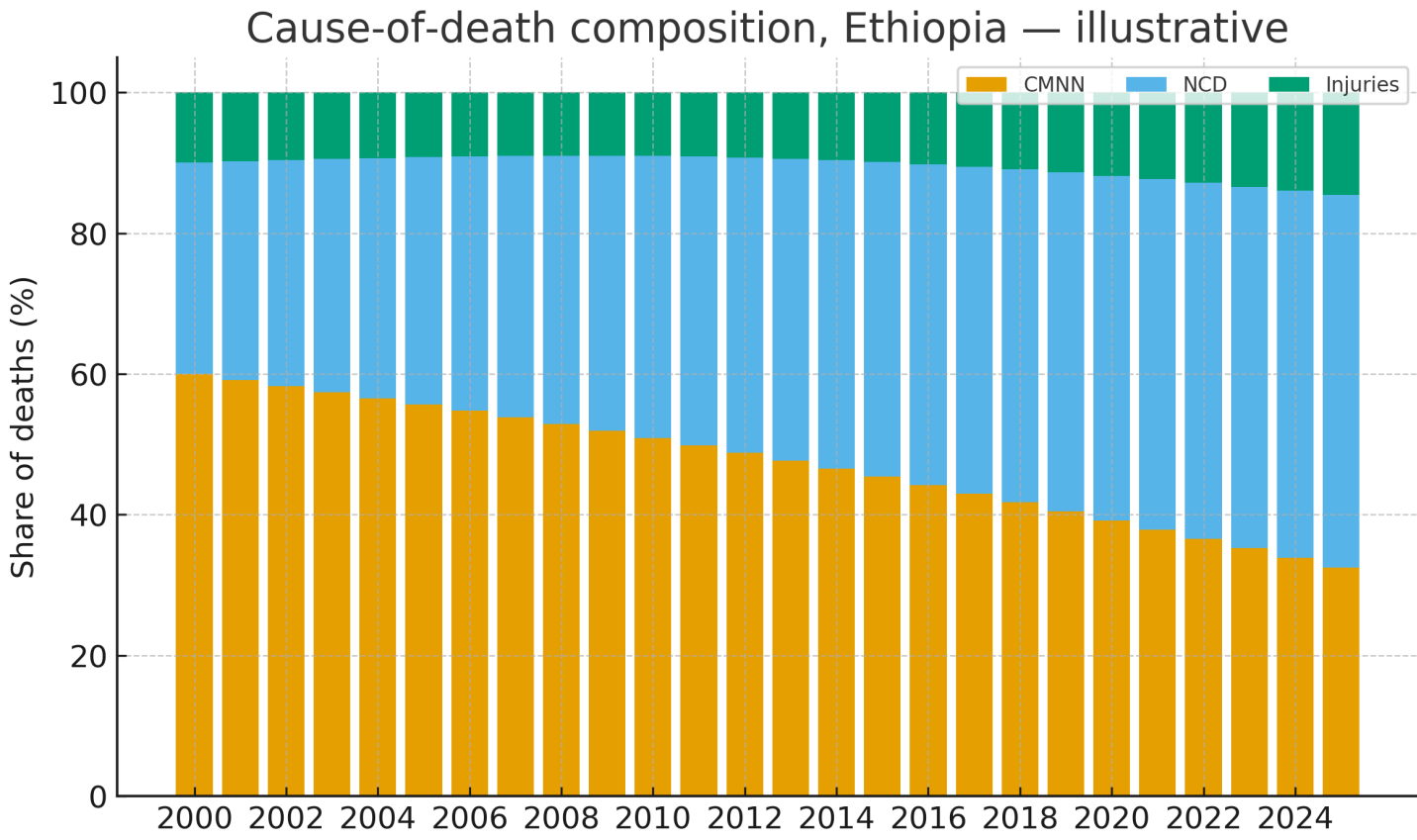


Figure . Cause shares by sex — snapshot (~2024)

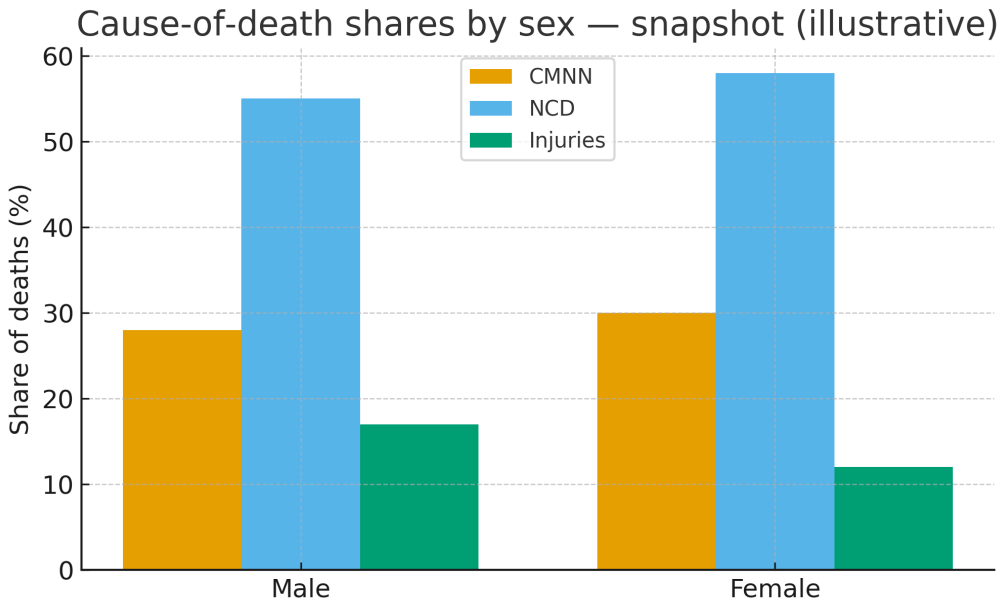


Figure . Top-10 causes: 2010 vs 2024 (age-standardized rates)

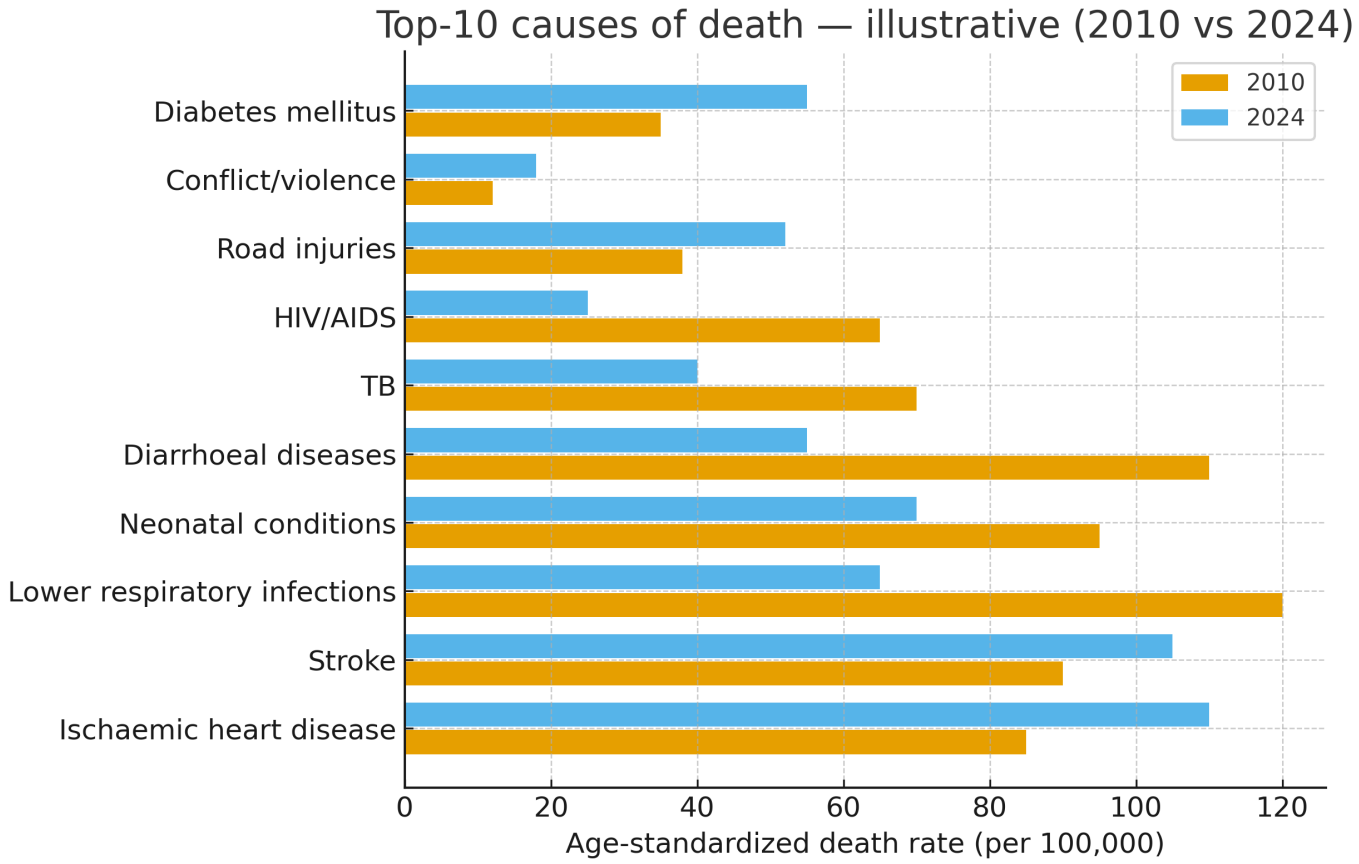


Table 6.7-A. Broad cause group definitions (ICD-aligned)

Group	Definition / examples
CMNN	Communicable, maternal, neonatal, and nutritional causes. Includes malaria, TB, HIV/AIDS, diarrhoeal diseases, LRI, maternal causes, neonatal disorders, malnutrition.
NCD	Non-communicable diseases. Includes cardiovascular diseases, cancers, chronic respiratory diseases, diabetes, chronic kidney disease, neurological disorders, etc.
Injuries	Road injuries, falls, drownings, self-harm, interpersonal violence, conflict and terrorism, other unintentional injuries.

Table 6.7-B. Ethiopia — top-10 causes (rates per 100,000 and change)

Cause	2010 rate (per 100k)	2024 rate (per 100k)	Change (pp)
Ischaemic heart disease	85	110	25
Stroke	90	105	15
Lower respiratory infections	120	65	-55
Neonatal conditions	95	70	-25
Diarrhoeal diseases	110	55	-55
TB	70	40	-30
HIV/AIDS	65	25	-40
Road injuries	38	52	14
Conflict/violence	12	18	6
Diabetes mellitus	35	55	20

Table 6.7-C. Data quality checks & adjustments

Check / issue	Action / note
Ill-defined fraction	Track share of R-codes / VA-indeterminate; aim to <10–15% for reliability; re-map using standard redistribution.
Shock periods	Flag conflicts/epidemics; adjust expected trend; evaluate excess morbidity/mortality.
COD list comparability	Harmonize ICD revisions (ICD-10→ICD-11) and VA cause lists; use broad groups when necessary.
Age/sex completeness	Check missing age/sex; model to adjust; align with life table totals (coherence).
Verbal autopsy calibration	Apply calibrated VA algorithms; compare with hospital COD mix to catch systematic shifts.

Table 6.7-D. Computation notes & formulas

Quantity	Computation / note
Cause-specific death rate	$M_c = D_c / P \times 100{,}000$
Cause fraction (share)	$F_c = D_c / D_{all}$
Age-standardized rate	$ASDR_c = \Sigma (M_{c,age} \times w_{std,age})$
Redistribution of ill-defined	$D_c^* = D_c + \alpha_c \times D_{garbage}$ (weights α_c from standard pattern)

References — Section 6.7

- WHO Global Health Estimates (GHE): cause-of-death methodology.

- Global Burden of Disease (GBD) study documentation and COD redistribution methods.

- ICD-10/ICD-11 manuals; Verbal Autopsy (VA) standards and tools.

- Ethiopia CRVS/HMIS documents and HDSS-VA site reports.

6.8) Inequalities Over Time (Urban–Rural, Sex)

Purpose. Track Ethiopia's mortality inequalities across residence and sex, summarize regional disparities, and distinguish composition (urbanization) from rate improvements. Replace templates with official estimates (DHS/PMA, HMIS/CRVS, WHO/UN/GBD).

Figure . Urban–rural U5MR over time

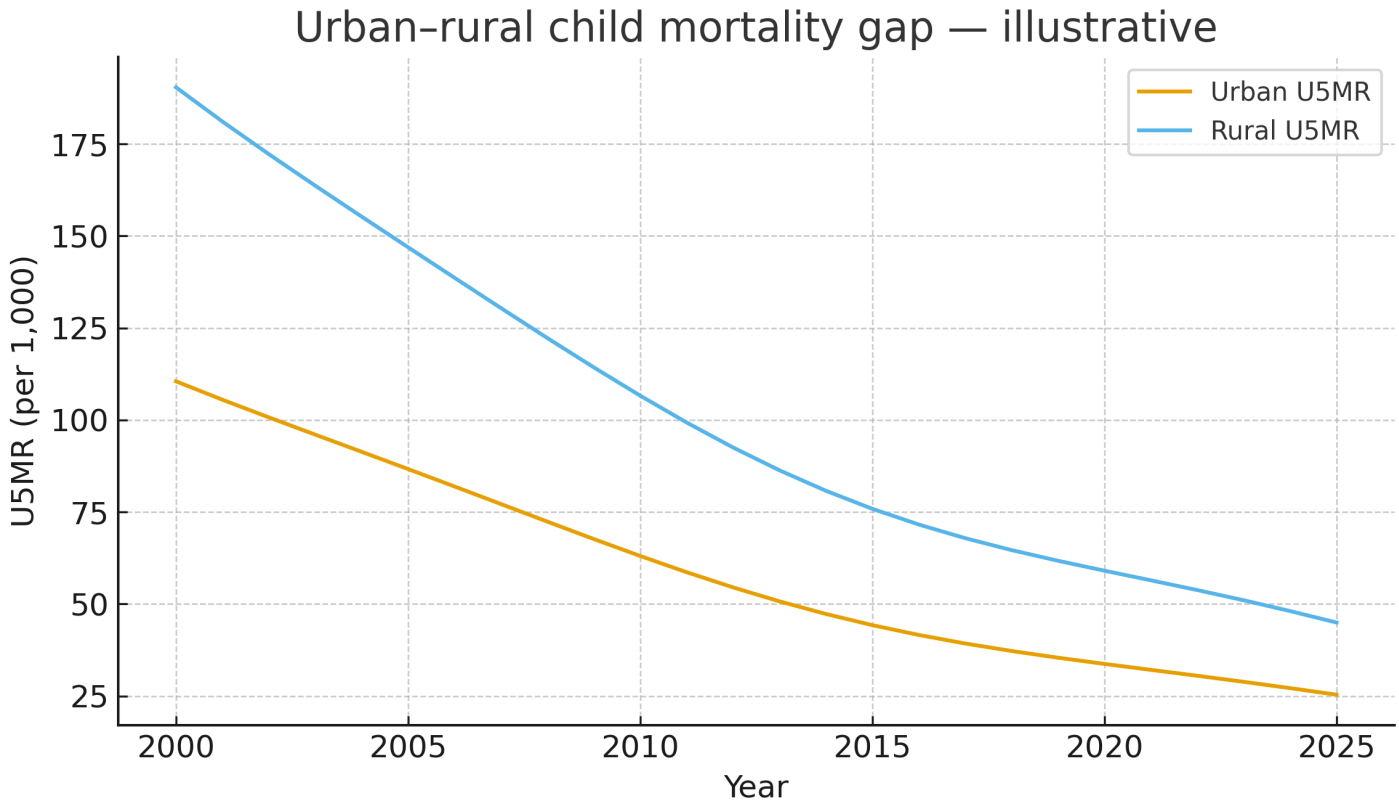


Figure . Adult 45q15 by sex

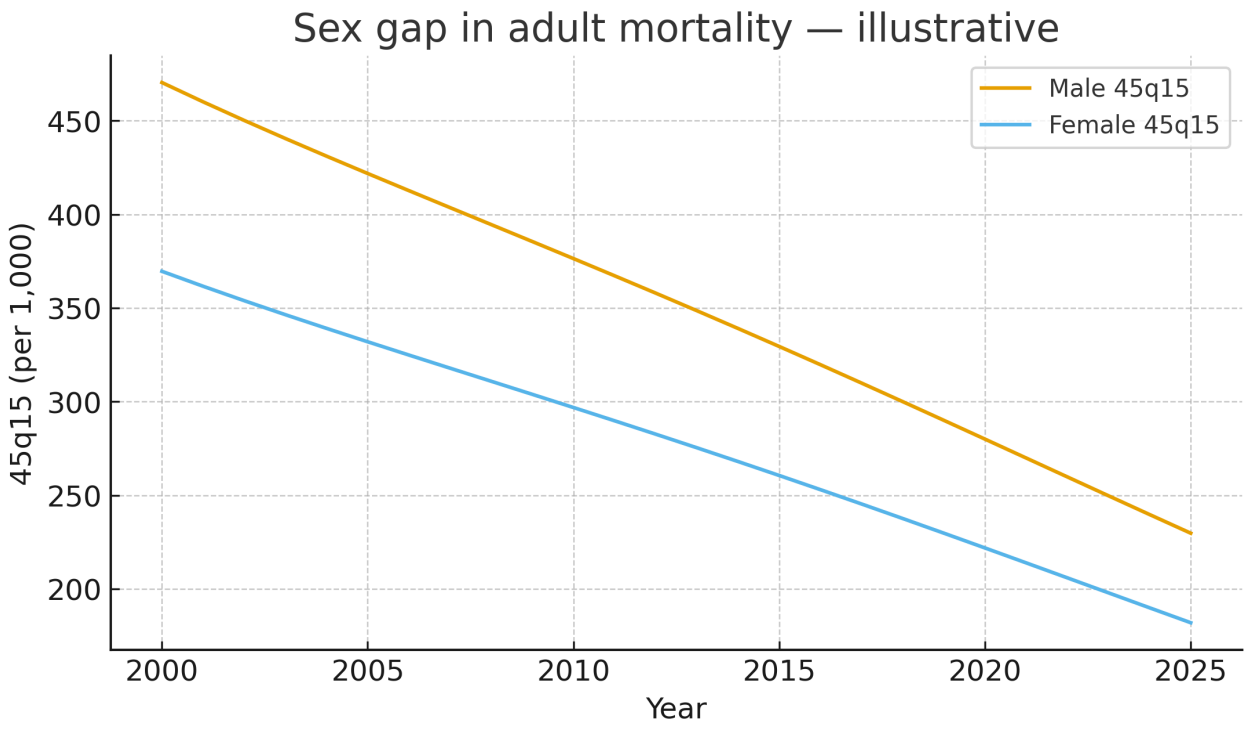


Figure . Regional inequality indices (snapshot)

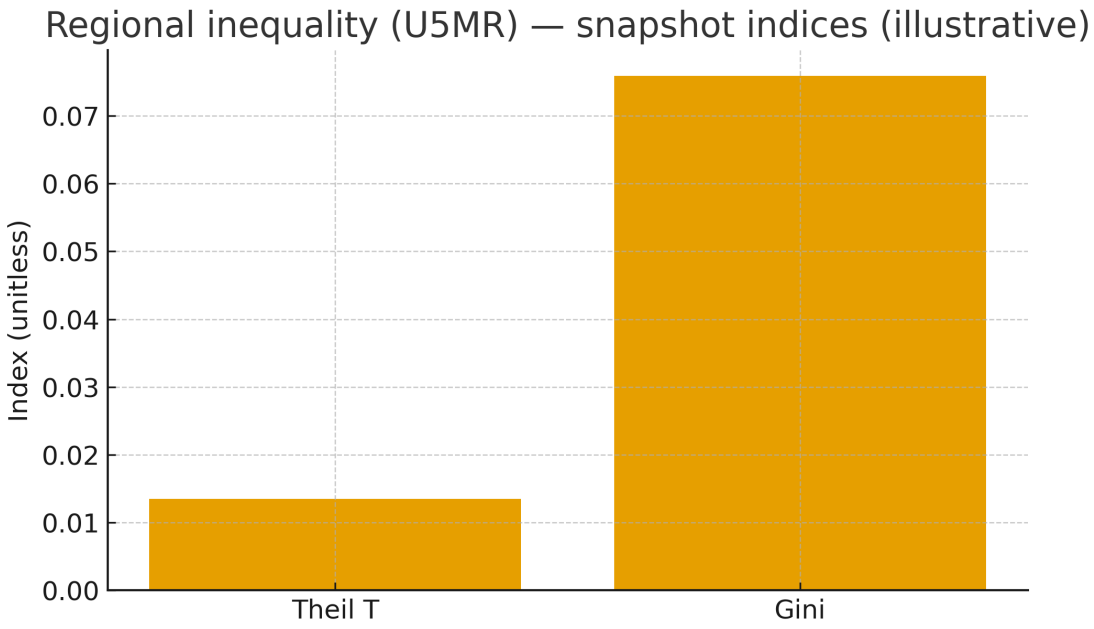


Figure . Composition vs rate effects (schematic)

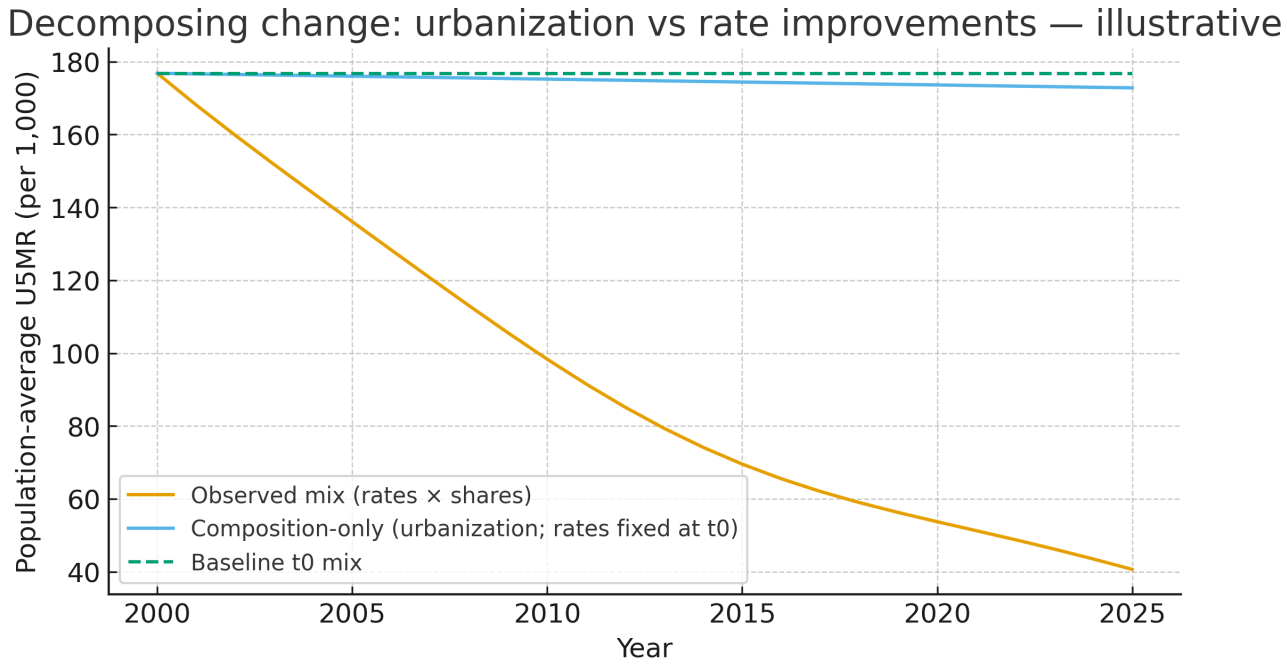


Figure . Equity ladder by wealth quintile

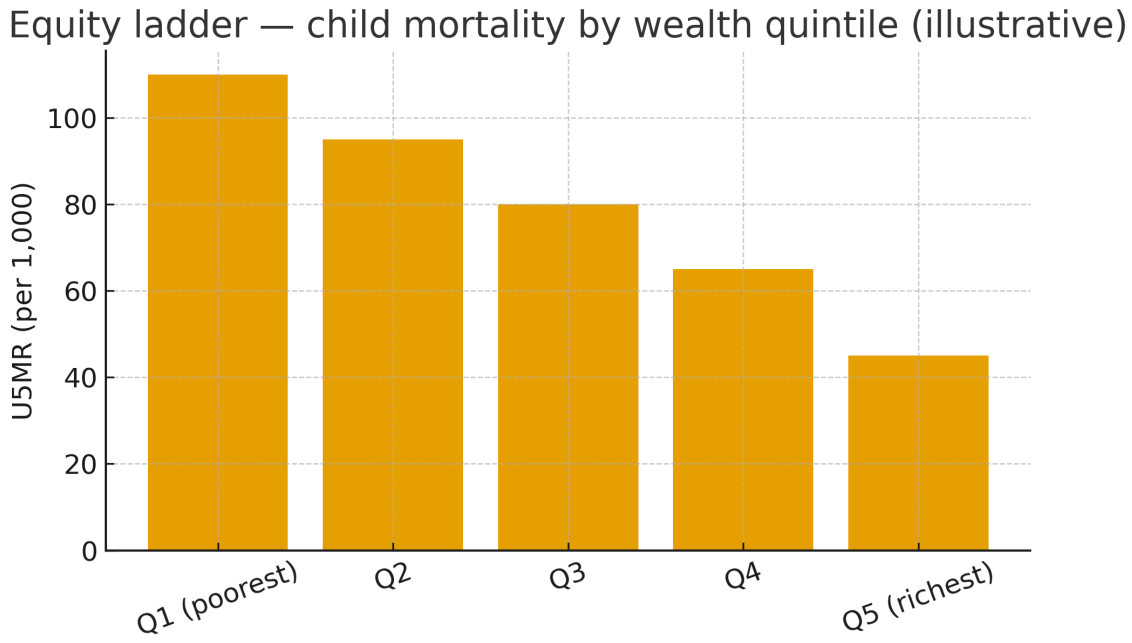


Figure . Sex gaps (U5 and adult)

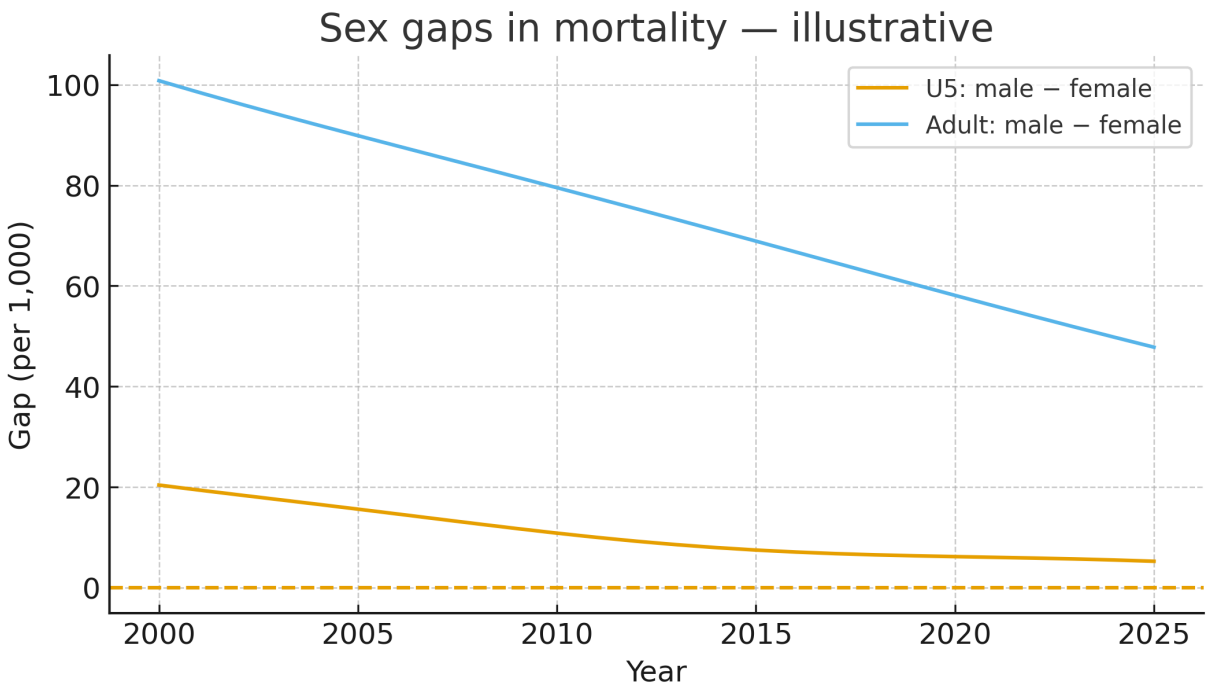


Table 6.8-A. Indicator definitions

Indicator / Concept	Definition / note
U5MR (urban/rural)	Under-5 deaths per 1,000 live births, by residence.
45q15 (male/female)	Probability of dying 15–60 per 1,000, by sex.
Inequality indices	Gini/Theil computed over regional indicators with population weights.
Urbanization share	Share of population living in urban areas; used in composition analysis.
Equity ladder	Ordering of indicator by wealth quintile (Q1 poorest → Q5 richest).

Table 6.8-B. Latest inequality levels

Metric	Value

U5MR — Urban	25.3
U5MR — Rural	45.0
U5MR gap (abs)	19.6
45q15 — Male	229.8
45q15 — Female	181.9
45q15 gap (abs)	47.8
Gini (U5MR, regional)	0.076
Theil T (U5MR, regional)	0.014

Table 6.8-C. Regional U5MR snapshot (with population weights)

Region	U5MR (per 1,000)	Population weight
Addis Ababa	35	0.044
Afar	82	0.018
Amhara	54	0.202
Benishangul-Gumuz	58	0.018
Dire Dawa	45	0.009
Gambella	70	0.009
Harari	42	0.009
Oromia	60	0.325
Somali	88	0.053
SNNP	56	0.167
Sidama	55	0.053
Southwest	57	0.026
Tigray	52	0.07

Table 6.8-D. Decomposition & inequality formulas

Quantity	Computation / note
Absolute gap	Δ = rate_groupA − rate_groupB
Relative gap	R = rate_groupA / rate_groupB
Kitagawa (two-group)	Δ = (w_A−w_B)·M_baseline + w_A·(M_A−M_B) (schematic; align to your baseline)
Population-average rate	$\bar{M}$ = Σ w_g · M_g; decompose d$\bar{M}$ into share and rate effects
Gini (discrete, weighted)	G = 1 − 2·∫ L(p) dp (approx. via Lorenz curve trapezoid)
Theil T	T = Σ w_i (y_i/μ) ln(y_i/μ)

Table 6.8-E. Equity ladder values

Wealth quintile	U5MR (per 1,000)
Q1 (poorest)	110
Q2	95
Q3	80
Q4	65
Q5 (richest)	45

References — Section 6.8

- Wagstaff, A., Paci, P., & van Doorslaer, E. (1991). On the measurement of inequalities in health.

- Rutstein & Rojas (2006). Guide to DHS Statistics — equity and disaggregation.

- UN/WHO reports on urbanization and mortality differentials; GBD inequality supplements (as available).

6.9) Mortality Shocks, Crises & Excess Mortality

Purpose. Quantify and characterize short-run mortality shocks in Ethiopia using excess-mortality methods. Distinguish direct vs indirect pathways and present uncertainty transparently. Replace templates with official CRVS/HMIS/HDSS/WHO/GBD estimates during drafting.

Figure . Observed vs expected deaths with 95% CIs

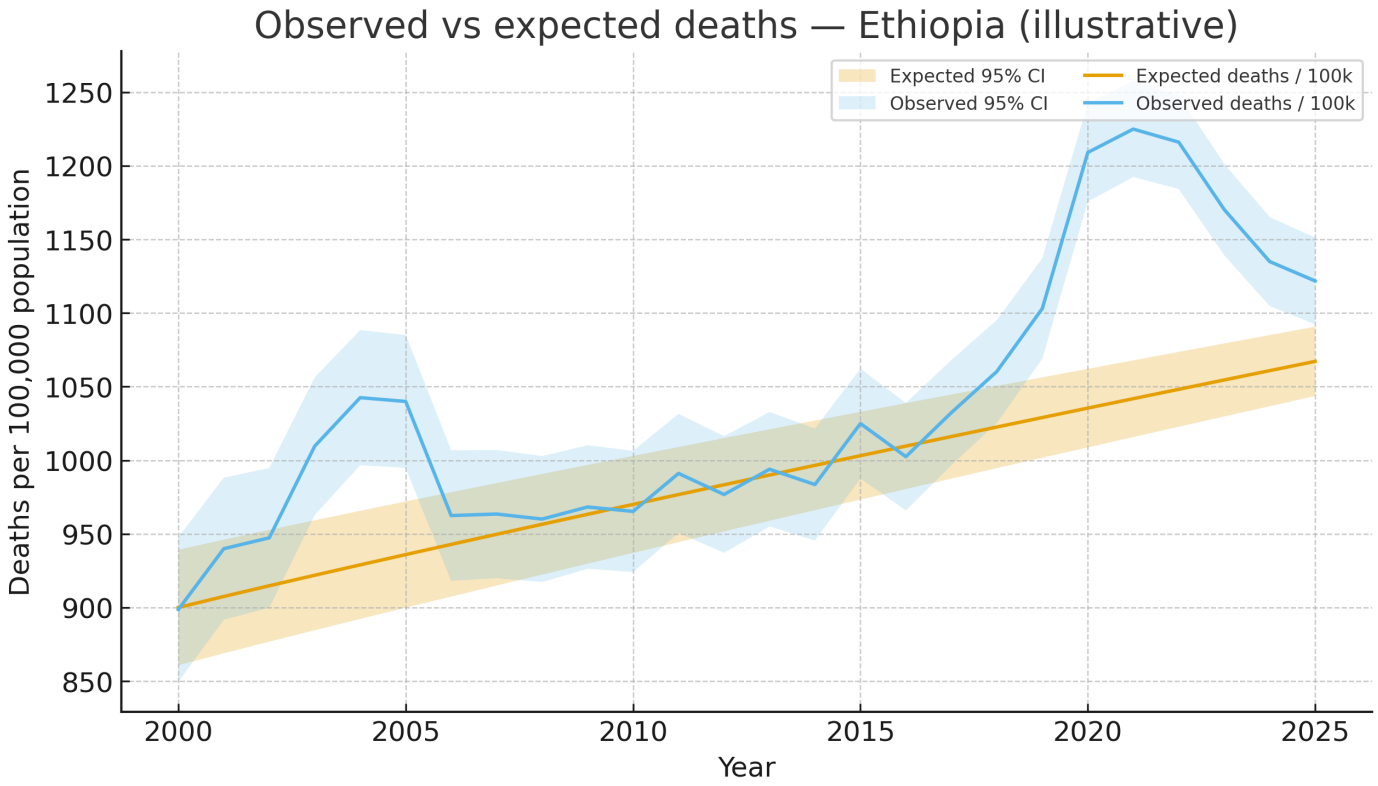


Figure . Excess mortality — level (per 100,000)

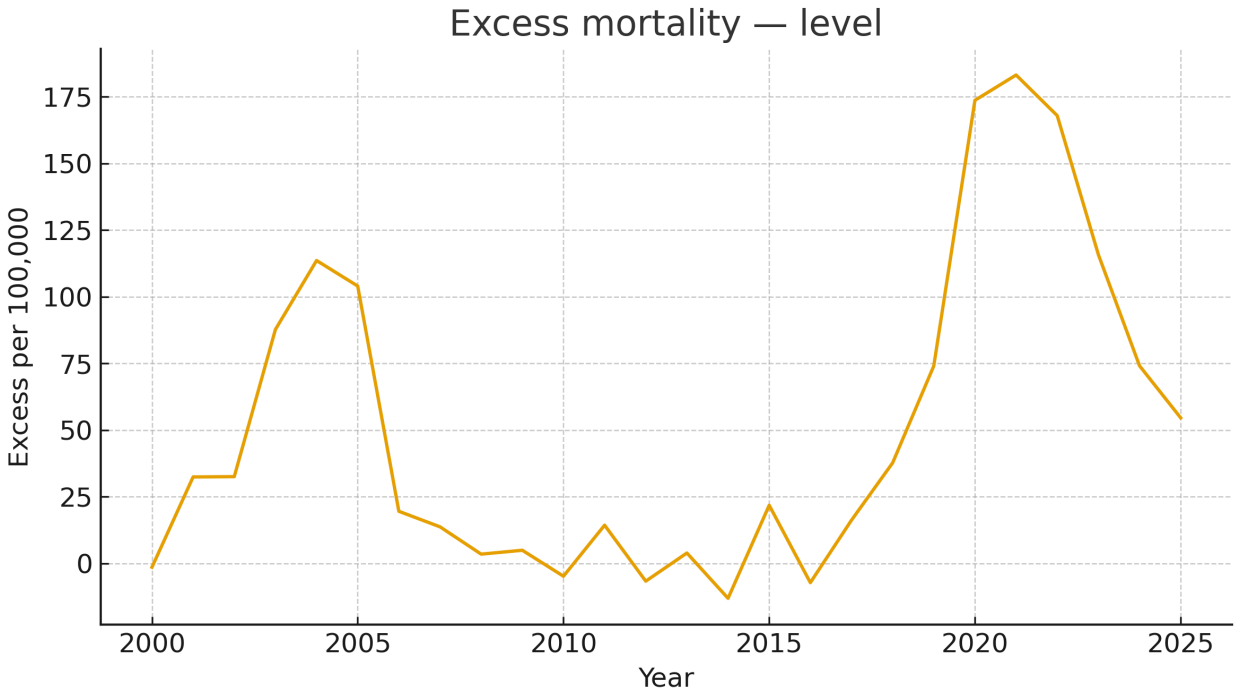


Figure . Excess mortality P-score (%)

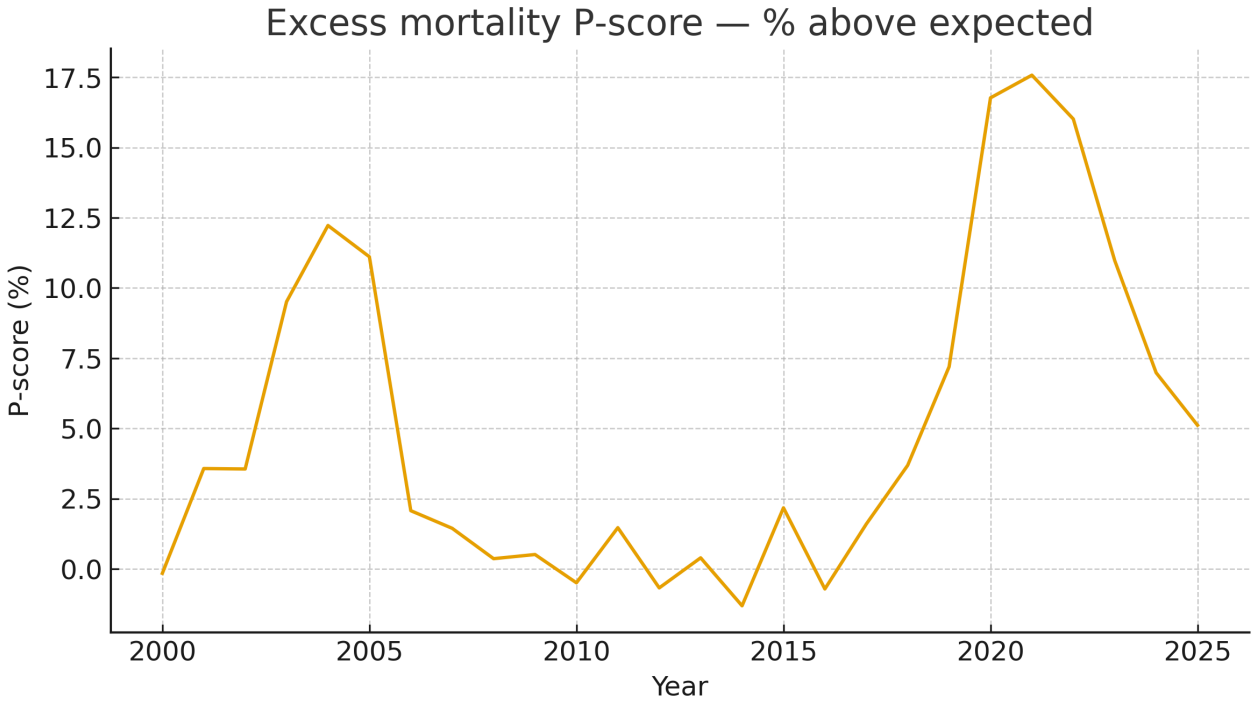


Figure . Counterfactual expected vs observed (schematic)

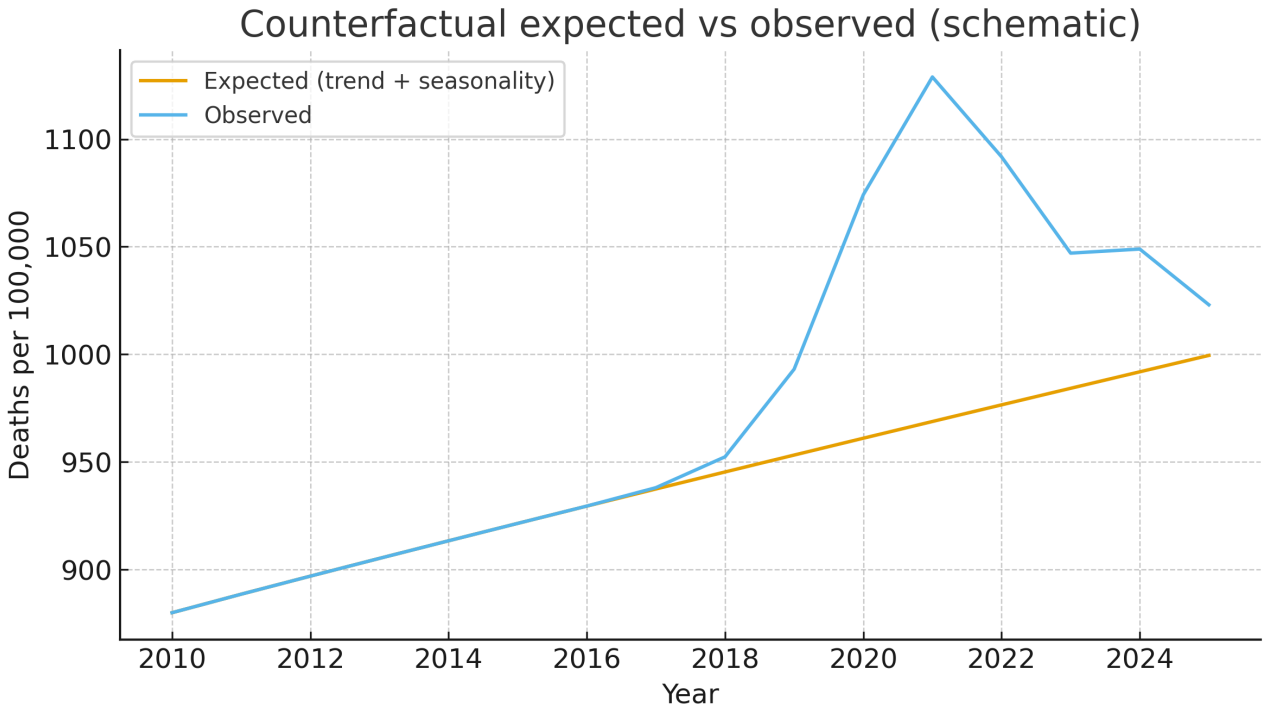


Figure . Age profile of excess (2021 vs 2022)

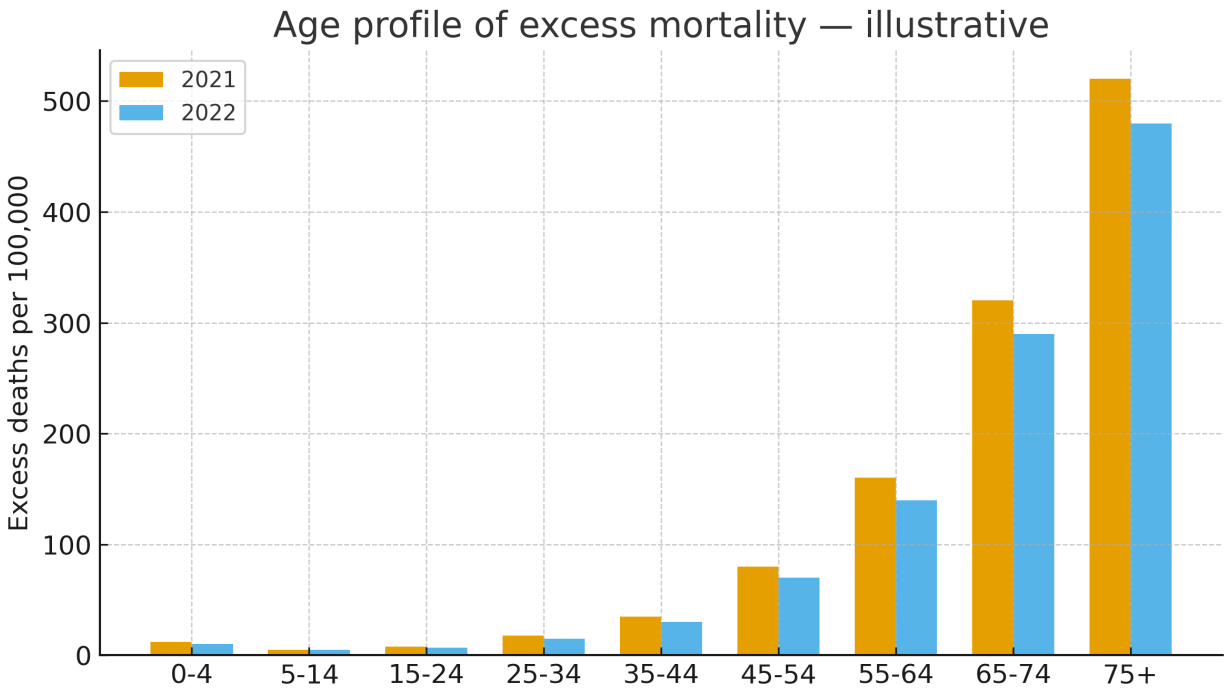


Figure . Attribution of excess mortality (schematic)

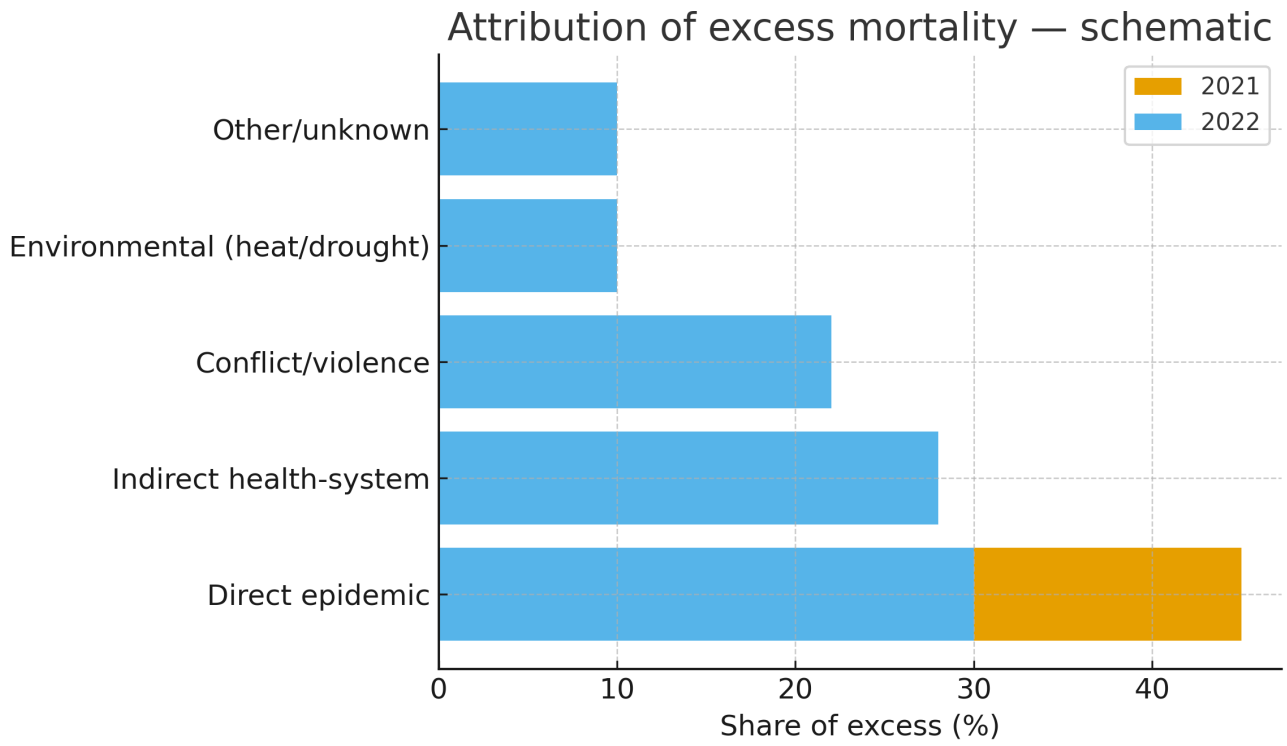


Table 6.9-A. Definitions & formulas

Quantity	Definition / computation
Expected deaths	Counterfactual deaths estimated from historical trends, seasonality, demographics (age-structure) and possibly covariates.
Observed deaths	Registered or otherwise measured deaths (CRVS, HMIS, HDSS, surveys, special surveillance).
Excess deaths	Observed − Expected (level per 100,000 or count).
P-score	(Observed − Expected) / Expected × 100%.
Uncertainty	Propagate variance from both expected and observed. Report 95% CIs for excess and P-score.

Table 6.9-B. Data sources & quality in Ethiopia

Source	Use / caveats
CRVS / Vital registration	Primary, continuous; under-registration likely — adjust for completeness.
HMIS / DHIS2	Facility-based deaths; limited for out-of-facility events; timeliness useful.
HDSS + Verbal Autopsy	High-quality cause coding in sites; not nationally representative.
Household surveys (DHS/PMA)	Limited for short-run shocks; recall bias; longer recall windows.
Burial/cemetery & community reports	Useful for triangulation in urban areas; coverage varies.
Modelled series (WHO/GBD)	Can provide cross-country comparators and priors; rely on assumptions.

Table 6.9-C. Worked example — 2020–2025 summary

Year	Expected (per 100k)	Observed (per 100k)	Excess (per 100k)	P-score (%)
2020	1035.4	1209.0	173.6	16.8
2021	1041.8	1224.9	183.1	17.6
2022	1048.2	1216.1	167.9	16.0
2023	1054.5	1170.3	115.8	11.0
2024	1060.9	1135.0	74.1	7.0
2025	1067.2	1121.8	54.6	5.1

Table 6.9-D. Uncertainty treatment

Topic	Guidance
Model for expected	Use pre-shock window (e.g., 2010–2019) with time trend + seasonality; validate via out-of-sample.
CIs for expected	Obtain SEs via regression fit or bootstrap; account for over-dispersion.

Observed variance	Include registration completeness uncertainty; sample error if using surveys.
Combination	Var(excess) = Var(obs) + Var(exp) assuming independence; otherwise add covariance term if needed.
Sensitivity	Test alternative baselines, shock windows, and lag structures.

Table 6.9-E. Communication & ethics

Principle	Note
Transparency	Report methods and assumptions; flag data gaps and areas with limited coverage.
Uncertainty	Publish intervals, not just point estimates. Avoid spurious precision.
Attribution cautions	Avoid over-attribution when COD data are weak; present multiple plausible pathways.
Equity	Disaggregate by region, sex, age, residence; consider IDPs and refugees.
Use in policy	Trigger surge response, resource allocation, and system strengthening.

References — Section 6.9

- Karlinsky & Kobak (2021). Tracking excess mortality across countries during the COVID-19 pandemic.

- WHO excess mortality framework and technical notes.

- GBD study: excess mortality attribution and decomposition approaches.

- Ethiopia CRVS/HMIS/HDSS documentation for shock periods (where available).

6.12) Chapter 6 Landing-Page Summary

What this chapter does. Puts Ethiopia's mortality on one page: headline trends, equity gaps, data sources, and a quick map to detailed sections (6.1–6.11). Replace the illustrative numbers with official CSA/MOH/WHO/UN/GBD series during drafting.

Key takeaways (snapshot — illustrative)

• Sustained long-term declines in U5MR and adult mortality, with recent shock-related interruptions.

• Life expectancy continues to improve but remains sensitive to child and adult mortality setbacks.

• Urban–rural and male–female gaps persist; rural under-5 mortality and male adult mortality remain higher.

• Cause-of-death mix is shifting from CMNN to NCDs, while injuries and shocks remain material.

• National progress masks substantial subnational heterogeneity — small-area methods are essential.

Figure . Mortality headline trends (U5MR, 45q15, e0)

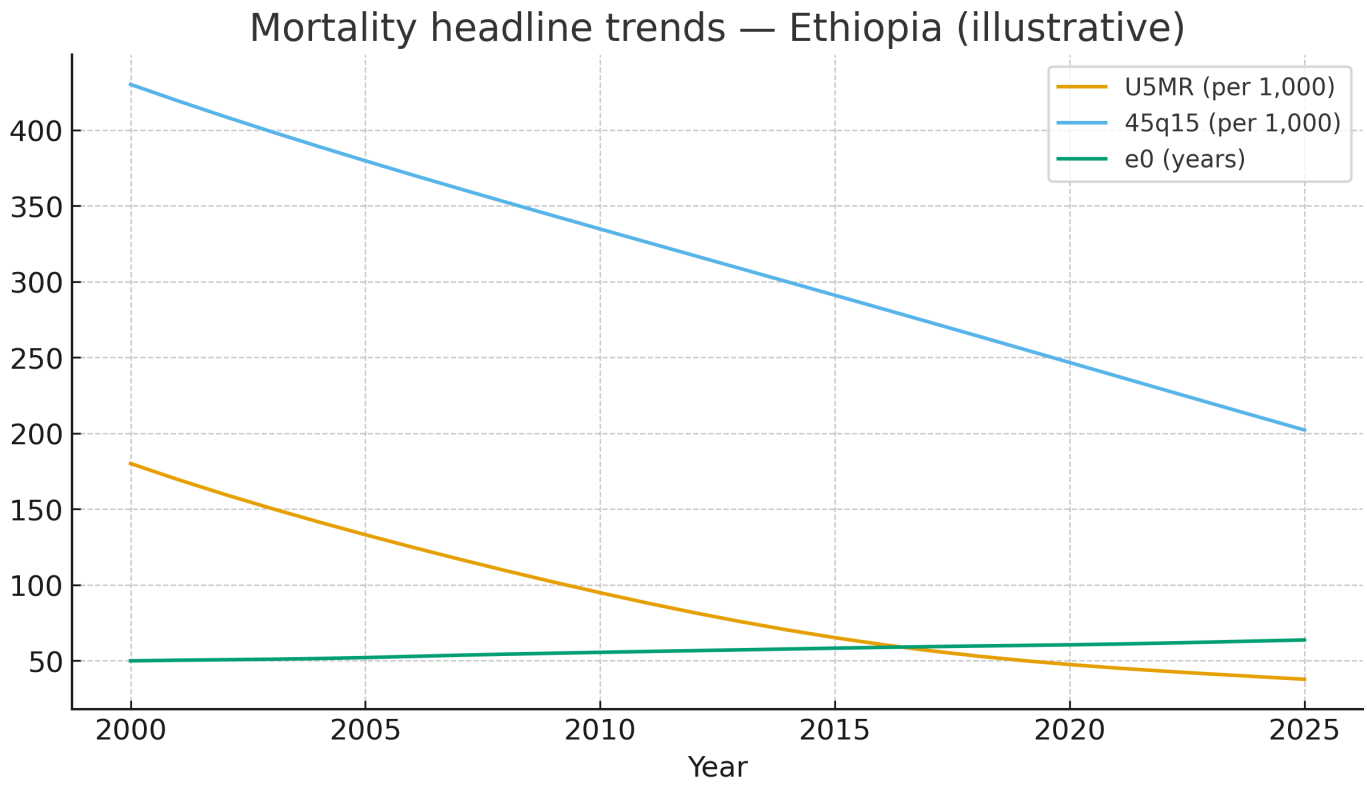
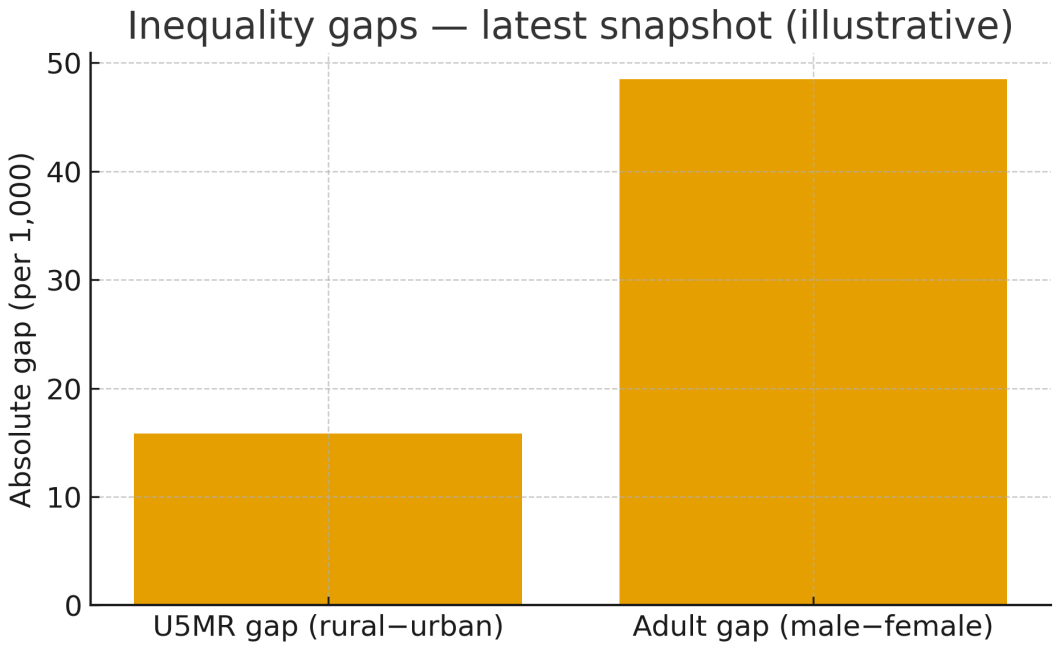


Figure . Inequality gaps — latest snapshot



At-a-glance indicators (latest)

Indicator	Latest value
Under-5 mortality (U5MR)	37.7
Adult mortality (45q15)	202.1
Life expectancy at birth (e0)	63.6
U5MR — Urban	26.4
U5MR — Rural	42.2
U5MR gap (rural−urban)	15.8
45q15 — Male	226.4
45q15 — Female	177.9
45q15 gap (male−female)	48.5

Quick navigation to subsections

Section	What you'll find
6.1	Concepts, indicators & data sources — definitions and Ethiopia's main inputs
6.2	Life expectancy & child mortality overview (headline trends)
6.3	Child mortality (NNMR/IMR/U5MR) — levels, trends, equity
6.4	Adult mortality (45q15) & adult age patterns
6.5	Older-age mortality & longevity (e60, 20q60, survival to 60/80)
6.6	Life table construction & scenario comparisons
6.7	Causes of death & epidemiological transition
6.8	Inequalities over time (urban–rural, sex, wealth)

6.9	Mortality shocks, crises & excess mortality (methods and findings)
6.10	Data quality, reconciliation & triangulation
6.11	Subnational estimates & small-area methods

Actionable priorities for Ethiopia

Priority action for Ethiopia	Why it matters
Strengthen CRVS completeness	Prioritize death registration in rural districts; expand cause-coding and VA where needed.
Exploit multiple sources	Routinely triangulate HMIS, DHS/PMA, HDSS/VA; publish reconciled national series.
Equity lens	Track urban–rural, sex, region, and wealth gaps; link to targeted interventions.
Shock readiness	Maintain near-real-time mortality monitoring for crises; publish excess mortality with uncertainty.
Subnational capacity	Adopt small-area models benchmarked to national targets; release district dashboards.

References — Landing page

- CSA Ethiopia; Ministry of Health CRVS/HMIS releases.

- WHO Global Health Estimates; UNICEF/UN IGME; UN World Population Prospects (life tables).

- DHS/PMA survey reports and microdata; HDSS/VA site publications.

- GBD cause-of-death and mortality synthesis documentation.