

# Trends in Mortality and Years of Life Lost across regions in Ethiopia: A Systematic Subnational Analysis in Global Burden of Disease Study 1990-2019

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## Abstract

**Background:** Evidence on premature mortality from any cause is vital to understanding disparities in the availability and accessibility of health care and health resource allocation across regions and city administrations, yet this evidence is often lacking. This analysis investigates the levels and trends of mortality and age-standardized Years of Life Lost (YLL) rates and explores the cause-specific burden of disease variations across nine regions and two cities in Ethiopia from 1990 to 2019.

**Methods:** The Global Burden of Disease (GBD) 2019 utilized various data sources such as national census, demographic surveillance, household surveys, health service utilization, and other relevant data. The aim of GBD 2019 was to provide comprehensive information on the number of deaths, death rates, and years of life lost (YLLs). To determine the causes of death based on age, sex, year, and location, GBD 2019 applied a Cause of Death Ensemble Modelling (CODEm) approach, which involved using mixed-effects linear models and spatiotemporal Gaussian process regression (ST-GPR) models. This report specifically focuses on the trends and levels of deaths from all causes and age-standardized YLL rates for the top 25 causes of death in Ethiopia. The point estimates were accompanied by 95% uncertainty intervals (UI) to provide a measure of uncertainty.

**Results:** Overall, 559,997 (95% UI: 506,117-621,976) deaths occurred in Ethiopia in 2019 from all causes, with 317,818 (95% UI: 278,395-361,016) male deaths. In 2019 the age-standardized all-cause mortality rate was 993.5 per 100,000 population (95% UI: 915.0-1070.6). Males had a higher rate than females, 1,101.5 (963.4-1,246.0) per 100,000 population among males. A 38.2% decline in the number of deaths, a 58.4% decline in the age-standardized death rate, and a 68.3% decline in the age-standardized YLL rate were observed from 1990 to 2019 in Ethiopia. Age-standardized death rates due to communicable, maternal, neonatal, and nutritional diseases and disorders (CMNND), non-communicable diseases (NCDs), and injuries were 368.6 (95% UI: 329.7-413.5), 553.4 (95% UI: 501.9-604.9), and 71.6 (95% UI: 61.1-82.7) per 100,000 populations respectively in 2019. Neonatal disorders, diarrheal diseases, lower respiratory infections, tuberculosis, and stroke featured among the five leading specific causes of age-standardized YLL rates in all regions with different ranking orders. HIV/AIDS was the leading cause of age-standardized YLL rates in Addis Ababa and Gambella, causing respectively 4,381.9 (95% UI: 3,213.4-5,800.0) and 4,584.1 (95% UI: 2,776.2-7,087.1) YLL per 100,000 population in 2019. Tuberculosis was the leading cause of YLL in the Afar region, with YLL rates of 4,224.4 (95% UI: 3,303.1-5,286.2) per 100,000 populations in 2019.

**Conclusion:** There was a significant decline in age-standardized YLL rates between 1990 and 2019 across all regions, with some disparities. Neonatal disorders, diarrheal disease, lower respiratory infections, tuberculosis, HIV/AIDS, ischemic heart disease, and stroke were the leading causes of age-standardized YLL rates 2019 across the nation and regions. Federal, regional, and city administrative policymakers should focus on designing strategies, resources, and interventions on disease burden and avoiding leading causes of YLL. [*Ethiop. J. Health Dev.* 2023;37 (SI-2)]

**Keywords:** Cause of death, trends in mortality, Years of Life Lost, Ethiopia

## Introduction

Ethiopia has a population estimated at 107.6 million, the second-highest population in Africa (after Nigeria) (1). Ethiopia has progressively expanded access to a range of primary healthcare services and introduced a three-tier public healthcare delivery system and public-private partnerships to achieve universal access to primary healthcare for its people (2). With the vision to see healthy, productive, and prosperous citizens, as aligned with Sustainable Development Goals (SDGs), particularly target three, Ethiopia has been implementing various health sector strategies. The second Health Sector Transformation Plan (HSTP II) is currently at work (3). However, drought, famine, ongoing conflict, and war in Tigray, Amhara, Afar,

Oromia, and Benishangul-Gumuz could severely impact Ethiopia's health growth. In addition to deaths and injuries, the conflict harms people's health due to population displacement, violence, and the disintegration of social and medical services(4).

Avoiding premature death from any cause is a primary goal for the health care system, and morbidity and mortality reduction targets are central themes for the development agenda (5). Due to the lack of universal registration of vital events, most developing countries have limited and unreliable information on the number of deaths, how they occur, and when they happen. The burden of disease estimates (such as mortality and health loss measurements), is important to measure

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health disparity among nations and regions and portray the trends across the year, ultimately informing service providers, program leaders, and policymakers to devise tailored intervention and prevention mechanisms. Globally, policy decisions and quality care require national and regional comparable disease burden estimates and risks. Disparities in socioeconomic status, cultural differences, and unequal access to health care are attributed to the uneven distribution of disease among regions and the need for acceptable and affordable prevention and control strategies (6). In order to improve the survival and striving of the people, timely scientifically sound evidence on mortality levels and trends at the sub-national level is very important. Reliable information on the number of deaths and their causes at the level of administrative regions is fundamental to effective disease prevention and treatment strategies (7,8).

Monitoring the progress of national health development goals and poverty reduction strategies requires reliable evidence on how leading causes of death change over time. This is particularly true for Ethiopia, where decentralized health policy and decision-making are practiced among nine regions and two administrative cities. Health service coverage, accessibility, and quality of care vary among these regions (9). Regional autonomy and scarcity of resources for public health action make national and regional morbidity and mortality estimates essential for priority setting in public health and health services. Because of regional variation in ecology, demography, and economy, the effect of disease burden is estimated to vary across the region over time (6). Emerging regions, including Gambella, Benishangul-Gumuz, Afar, and Somali are historically under-served by health services.

Previous GBD studies have reported national-level burden of disease, injury, and risk factor estimates for Ethiopia (10). Therefore, this analysis aims to investigate the levels and trends of deaths from all causes, age-standardized death rates, Years of Life Lost (YLL) rates, and the burden of disease from 1990 to 2019 in Ethiopia and across nine regions and two administrative cities, to show progress and changes, and to explore variations across the regions from 1990 and 2019. The results will guide rational priority setting for health policy, disease prevention and control strategies, health service planning, and research at the national and regional levels.

## Methods

### *Overview of the methods and data sources*

Ethiopia has a federal system of government and, in 2020, comprises 11 regions (Afar, Amhara, Benishangul-Gumuz, Gambella, Harari, Oromia, Somali, Sidama, Southern Nations Nationalities and People (SNNP), Southwest Ethiopia and Tigray) and two administrative cities (Addis Ababa and Dire Dawa). In this analysis, the Sidama and South West Ethiopia regions were part of the Southern Nations Nationalities and Peoples' region. By the middle of 2019 in Ethiopia, 17,550 Health posts, 3,735 health centers, and 353 hospitals were available (3). In

addition, 159,545 health workforces found in Ethiopia in 2019 (11).

Data was extracted from the Global Burden of Disease (GBD) data. GBD study has produced comparable estimates on health loss, causes of death, illness, injury, and risk factors for nearly every country by age and sex (12-14). The cause-of-death analyses presented in this paper were produced by the Ethiopia Subnational Burden of Disease Initiative, a collaborative endeavor between the Ethiopian Public Health Institute (EPHI) and the Institute for Health Metrics and Evaluation (IHME) part of GBD 2019. The EPHI, in collaboration with IHME, gathered all accessible data sources by location for Ethiopia and all regions and cities. These sources included the national census, demographic surveillance, household surveys, health service utilization, disease registry, disease notifications, and other data. A comprehensive description of data sources, quality, and modelling for GBD 2019 has been reported elsewhere at: <https://ghdx.healthdata.org/gbd-2019/data-input-sources?components=9&locations=179> (15,16). All data sources were evaluated for quality and corrected for known bias in each data source [15, 16]. GBD 2019 regional results were reviewed by EPHI experts and GBD Ethiopia collaborators' expert network of more than 800 Ethiopian researchers and health workers.

The GBD 2019 provides the number of deaths, death rates, and years of life lost (YLLs) for national and regional estimates of Ethiopia. GBD 2019 used all available data sources and applied a cause of death ensemble modeling (CODEm) to assign causes of death by age, sex, year, and location Briefly (15,16). Briefly stated, CODEm evaluates a variety of models, including mixed-effects linear models and spatiotemporal Gaussian process regression (ST-GPR) models, and builds an ensemble model based on the results of the many models (17). Out-of-sample predictive validity testing was used to select the ensemble model to estimate mortality rates (17). The posterior distribution of each component model was sampled in this model to produce uncertainty intervals in proportion to the weight of each model in the ensemble (17).

GBD categorization of diseases and injuries was used to present and interpret the estimates. GBD uses a hierarchy of mutually exclusive and collectively exhaustive causes of fatal diseases and injuries into four levels (16). The first level's three broad groups are injuries, non-communicable diseases (NCDs) and communicable, maternal, neonatal and nutritional (CMNN) disorders. Level three was used to illustrate the cause-specific causes of death since it provides more disaggregated causes (16). Estimates were presented regarding the number of deaths from all causes, age-standardized death rates, and age-standardized YLL rates, with 95% uncertainty intervals (UI). Years of life lost for each leading cause were estimated using standard GBD 2019 methodology (18). According to this method, deaths that result from a specific cause are multiplied by the reference standard life expectancy at the age of the death, which is based

on the lowest recorded mortality rate for each 5-year age group in populations larger than 5 million (19). GBD 2019 created uncertainty intervals at crucial stages of all-cause and cause-specific mortality estimation to account for uncertainties resulting from adjusting sources, sample size, and other model settings.

From 1990 to 2019, percentage changes were recorded, with positive values to indicate rising trends and negative values to indicate falling trends. GBD 2019 estimated deaths from all causes, death rates, and years of life lost (YLLs) due to 369 diseases and injuries. All metrics were estimated separately for Ethiopia, 9 regions, and 2 administrative cities. The GBD cause-of-death database was used to compute cause-specific mortality rates. Years of life lost (YLLs) were estimated for each cause by location, age, and year by multiplying each cause-specific death by the normative standard life expectancy at each age. All rates presented are age-standardized per 100,000 populations. Diseases and injuries were organized into a leveled cause hierarchy from broadest (Level 1; communicable, maternal, neonatal, and nutritional diseases; non-communicable disease; and injuries) to most specific (Level 4) causes of death.

### Ethics Statement

This study was produced as part of the GBD Collaborator Network and following the GBD Protocol (IHME ID 4239-GBD2019-042022). For GBD studies, a waiver of informed consent was reviewed and approved by the Institutional Review Board of the University of Washington (<https://www.healthdata.org/gbd/2019>).

### Results

#### All-cause mortality

In 2019, 559,997 (95% UI: 506,117-621,976) deaths occurred in Ethiopia, and 317,818 (95% UI: 278,395-361,016) were among males. The highest number of deaths was from Oromia 198,153 (95% UI: 176,829-223,021), followed by Amhara 133,485 (95% UI: 118,983-149,286) and SNNP regions 113,738 (95% UI: 100,323-129,639). The differences between Oromia and other regions were statistically significant, but others were not. From 1990 to 2019, death was declined by 38.2% in both sexes. Substantial declines in all-cause mortality for both sexes and all age groups were observed in Amhara (49.4%), Dire Dawa (46.9%), Benishangul-Gumuz (44.6%) and Harari (43.4%) regions. In contrast, all-cause mortality increased in Somali region by 15.4% from 1990 to 2019 (Table 1). A steep decline in deaths in Oromia, Amhara, and SNNP began in 2000. However, this is not statistically significant. (Figure 1).

**Figure 1: Trends in deaths from all causes during 1990-2019, National and Sub-national states of Ethiopia**

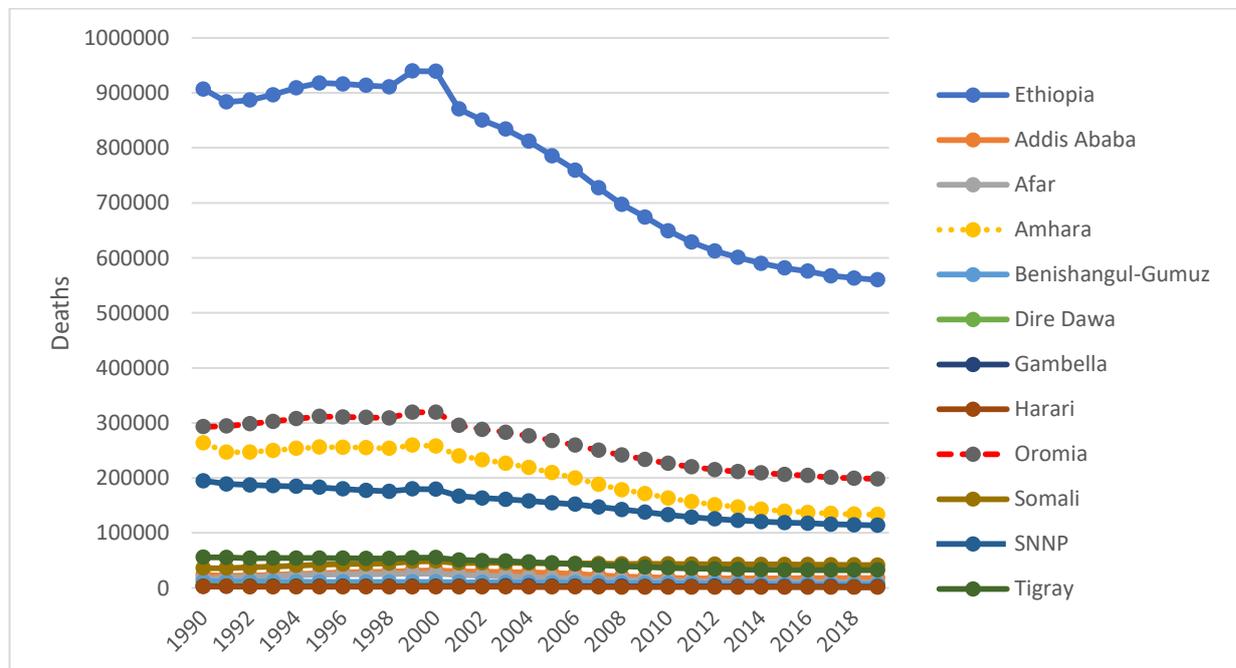


Table 1: Number of deaths from all causes between 1990 and 2019, National and Sub-national estimates in Ethiopia

National and Sub-nationals	1990			2019			%Change (2019-1990)
	Male	Female	Both sexes	Male	Female	Both sexes	
Oromia	164,558 (151785-178466)	128,565 (118790-138694)	293,123 (273750-312354)	110,068 (94381-127488)	88,085 (77960-101106)	198,153 (176829-223021)	-32.4
Amhara	149,800 (137895-162291)	114,012 (105340-123634)	263,812 (247750-281200)	78,215 (66458-91305)	55,270 (49151-63254)	133485 (118983-149286)	-49.4
SNNP	112,161 (103374-121918)	82,626 (76457-89406)	194,787 (182497-207636)	65,646 (55823-77493)	48,092 (41465-56236)	113,738 (100323-129639)	-41.6
Somali	17,257 (15822-18796)	18,819 (16917-20905)	36,076 (33287-38932)	24,680 (20725-29184)	16,938 (14282-20010)	41,618 (35940-47772)	15.4
Tigray	31,476 (28556-34656)	24,361 (21818-26968)	55,837 (51565-60326)	17,643 (14701-20823)	14,907 (12596-17534)	32,550 (28559-36653)	-41.7
Addis Ababa	12,883 (11526-14576)	10,883 (9524-12362)	23,766 (21669-26120)	9,274 (7323-11330)	8,711 (6968-10819)	17,986 (15556-20950)	-24.3
Afar	9,057 (8017-10199)	8,378 (7190-9708)	17,435 (15815-19078)	5,484 (4489-6619)	4,463 (3642-5441)	9,947 (8598-11478)	-42.9
Benishangul-Gumuz	6,034 (5459-6709)	5,956 (5290-6740)	11,990 (11057-13142)	3,408 (2815-4100)	3,234 (2687-3884)	6,642 (5722-7747)	-44.6
Dire Dawa	2,478 (2234-2739)	2,000 (1785-2237)	4,478 (4081-4883)	1,317 (1111-1587)	1,061 (906-1269)	2,378 (2072-2731)	-46.9
Gambella	1,738 (1593-1895)	1,365 (1235-1502)	3,103 (2875-3342)	1,356 (1112-1637)	8,36 (691-1015)	2,192 (1887-2548)	-29.4
Harari	1,290 (1147-1424)	1,019 (905-1154)	2,309 (2104-2514)	727 (594-877)	581 (483-699)	1,308 (1134-1504)	-43.4
Ethiopia	508,733 (476121-542829)	397,984 (374945-421733)	906,716 (859267-955007)	317,818 (278395-361016)	242,179 (217776-271476)	559,997 (506117-621976)	-38.2

In 2019, communicable, maternal, neonatal, and nutritional diseases and disorders (CMNND) contributed to 297,055 (95% UI: 257,369-347,338) deaths in Ethiopia. The highest number of deaths due to CMNND was observed in Oromia (109,733, 95% UI: 93,754-128,561), Amhara (66,571, 95% UI: 57,137-77,210), and SNNP (61,080, 95% UI: 51,970-73,103). In the same year, 219,284 (95% UI: 197,461-241,134) deaths occurred due to NCDs, and 43,658

(95% UI: 37,027-51,499) of these deaths were associated with injuries. Majority of NCD 74,689 (95% UI: 65,870-84,364) were contributed by Oromia, 57,283 (95% UI: 49,530-65,565) by Amhara, and 40,925 (95% UI: 35,787-46,605) by SNNP regions (Table 2). There is a statistical significant difference for Oromia and other regions but no statistical difference in the other regions.

Table 2: Deaths due to communicable, non-communicable and injuries, both Sexes Between 1990-2019 Sub-national and national in Ethiopia

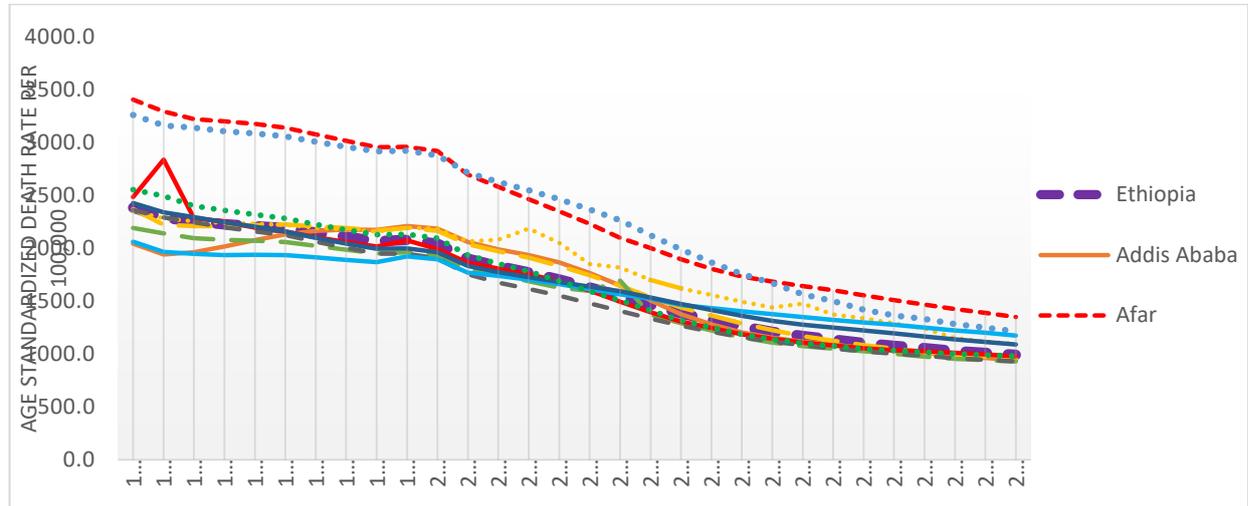
National and Sub-nationals	1990			2019		
	Communicable, maternal, neonatal, and nutritional diseases	Non-communicable diseases	Injuries	Communicable, maternal, neonatal, and nutritional diseases	Non-communicable diseases	Injuries
Addis Ababa	13,026 (11461-14859)	5,924 (5006-6887)	4816 (4605-5072)	6,836 (5785-8131)	9,893 (8521-11650)	1257 (986-1611)
Afar	12353 (10910-13866)	3516 (2603-4570)	1567 (1340-1780)	5,813 (4967-6786)	3322 (2794-3889)	812 (617-1044)
Amhara	171356 (156818-188072)	55221 (44258-65789)	37235 (35043-39843)	66,571 (57137-77210)	57,283 (49530-65565)	9,631 (7724-12216)
Benishangul-Gumuz	8681 (7708-9826)	2286 (1639-2921)	1023 (905-1160)	4014 (3337-4824)	2101 (1730-2510)	527 (422-657)
Dire Dawa	3165 (2785-3566)	880 (629-1122)	434 (383-487)	1211 (1006-1444)	997 (849-1170)	170 (132-222)
Gambella	2265 (2017-2511)	579 (423-743)	259 (222-296)	1240 (1020-1501)	770 (653-916)	183 (142-234)
Harari	1613 (1413-1823)	463 (322-598)	233 (204-269)	622 (527-746)	589 (500-681)	97 (74-126)
Oromia	212631 (193752-232995)	55,572 (44077-68304)	24920 (21743-27429)	109,733 (93754-128561)	74,689 (65870-84364)	13,731 (11469-16504)
Somali	26897 (24430-29562)	5,666 (4351-7069)	3512 (3112-4041)	26,335 (22478-30852)	12,156 (10124-14451)	3126 (2469-3974)
SNNP	137778 (124131-151469)	37802 (29082-47654)	19206 (16718-21664)	61,080 (51970-73103)	40,925 (35787-46605)	11,733 (9254-14329)
Tigray	37373 (33946-41276)	13512 (10495-16030)	4952 (4477-5514)	13,600 (11608-15690)	16559 (14267-19058)	2392 (1907-2972)
Ethiopia	627,138 (578013-681195)	181,421 (146929-215688)	98,157 (90841-105086)	297,055 (257369-347338)	219,284 (197461-241134)	43,658 (37027-51499)

**Age-standardized death rates**

2019, the age-standardized all-cause mortality rate was 993.5 per 100,000 population (95% UI: 915.0-1070.6). Males had a higher rate than females, which was 1,101.5 (963.4-1,246.0) among males and 882 (95% UI: 802-953) per 100,000 population among females. There is a statistically significant difference between

males and females. From 1990 to 2019, the cause age-standardized death rate for both sexes declined by 58.4% in Ethiopia. The highest declines in death rates were observed in Benishangul-Gumuz (62.8%) and Tigray (61.6%) regions. The lowest decline in age-standardized death rates was observed in Somali (43.1%) region (Table 3, Figure 2).

**Figure 2: Age-standardized Trends of death rates from all causes of death during 1990-2019, National and Sub-national states of Ethiopia**



**Table 3: Age-standardized death rates per 100,000 from all causes between 1990 and 2019, National and Sub-national estimates in Ethiopia**

National and Sub-nationals	1990			2019			Rate of change for both sexes
	Male	Female	Both Sexes	Male	Female	Both Sexes	
Afar	3264.6 (2864.3-3674.2)	3602.2 (3143.7-4075.8)	3410.9 (3108.6-3711.4)	1249.8 (1015.7-1517.3)	1567.5 (1326.8-1849.8)	1353.4 (1195.7-1526.2)	-60.3
Benishangul-Gumuz	3006.8 (2666.3-3359.3)	3592.5 (3139.0-4057.6)	3263.9 (2995.1-3575.2)	1119.9 (899.6-1381.1)	1345.6 (1106.8-1602.0)	1215.4 (1046.6-1394.0)	-62.8
Somali	1726.6 (1504.8-1971.6)	2360.5 (2038.1-2714.8)	2066.0 (1868.0-2276.8)	1202.9 (958.9-1461.3)	1127.5 (963.2-1340.0)	1175.5 (1007.8-1366.9)	-43.1
Gambella	3281.5 (2958.8-3638.6)	1750.6 (1510.0-2027.7)	2355.7 (2138.2-2613.6)	1436.4 (1204.8-1721.9)	779.4 (692.4-875.0)	1097.6 (985.2-1238.4)	-53.4
SNNP	2826.0 (2561.8-3092.4)	2013.7 (1801.2-2239.3)	2431.0 (2265.5-2615.8)	1245.9 (1031.5-1461.8)	935.9 (818.6-1065.2)	1091.6 (982.8-1211.4)	-55.1
Tigray	2832.8 (2526.8-3159.6)	2280.8 (1967.8-2581.5)	2558.7 (2333.0-2788.8)	1073.2 (888.9-1259.8)	896.0 (763.3-1051.7)	982.6 (869.5-1098.2)	-61.6
Harari	3708.3 (3327.0-4060.7)	2087.5 (1728.1-2475.2)	2487.2 (2189.4-2786.2)	1134.7 (917.3-1377.4)	851.9 (709.2-999.5)	981.4 (865.1-1101.0)	-60.5
Amhara	2608.9 (2374.8-2855.1)	2121.0 (1914.3-2353.9)	2373.6 (2214.9-2544.1)	1135.7 (943.7-1355.4)	783.3 (708.6-891.1)	955.4 (855.4-1065.9)	-59.7
Addis Ababa	2161.4 (1916.3-2455.4)	1940.7 (1653.1-2234.4)	2046.4 (1852.8-2254.9)	1059.1 (828.2-1256.1)	846.3 (711.5-1023.2)	943.2 (836.9-1055.4)	-53.9
Oromia	2679.0 (2429.1-2936.1)	2054.0 (1849.3-2273.9)	2363.9 (2192.7-2537.3)	984.9 (823.1-1159.5)	875.1 (769.6-965.8)	931.4 (842.9-1028.2)	-60.6
Dire Dawa	2675.0 (2377.7-3003.8)	1858.9 (1592.3-2162.9)	2195.8 (1968.1-2417.6)	1048.8 (879.2-1283.7)	822.8 (721.0-961.8)	930.8 (824.9-1054.7)	-57.6
Ethiopia	2645.8 (2473.6-2824.0)	2119.0 (1964.0-2271.1)	2386.9 (2271.3-2509.0)	1101.5 (963.4-1246.0)	881.7 (802.0-952.6)	993.5 (915.0-1070.6)	-58.4

At national level, age-standardized death rate due to CMNND was 368.6 (95% UI: 329.7-413.5) per 100,000 population, NCDs were 553.4 (95% UI: 501.9-604.9) per 100,000 population, and injuries were 71.6 (95% UI: 61.1-82.7) per 100,000 population in 2019. In the same year, the highest age-standardized death rates caused by CMNND were observed in Afar (569.2, 95% UI: 490.9-654.0 per 100,000 population) and Somali (510.4, 95% UI: 436.1-594.8 per 100,000 population). The highest age-standardized death rates caused by NCDs were observed in Addis Ababa

(616.4, 95% UI: 543.4-693.4), Afar (688.7, 95% UI: 601.5-783.9), and Benishangul-Gumuz (629.3, 95% UI: 528.9-742.2) per 100,000 population in 2019. The highest age-standardized death rates caused by injuries were observed in Afar (95.4, 95% UI: 76.4-119.0 per 100,000 population), Somali (84.1, 95% UI: 66.0-108.2 per 100,000 population) and Benishangul-Gumuz (83.9, 95% UI: 67.6-103.6 per 100,000 population) (Table 4). No statistically significant difference among regions.

Table 4: **Age-standardized death rates per 100,000 in both sexes from communicable, non-communicable and injuries, Between 1990-2019, Sub-national and national in Ethiopia**

National and Sub-nationals	1990			2019		
	Communicable, maternal, neonatal, and nutritional diseases	Non-communicable diseases	Injuries	Communicable, maternal, neonatal, and nutritional diseases	Non-communicable diseases	Injuries
Ethiopia	<b>1312.3</b> (1189.7-1442.2)	<b>833.4</b> (720.1-941.6)	<b>241.2</b> (221.1-260.5)	<b>368.6</b> (329.7-413.5)	<b>553.4</b> (501.9-604.9)	<b>71.6</b> (61.1-82.7)
Addis Ababa	<b>890.1</b> (771.5-1043.1)	<b>880.7</b> (757.3-1008.2)	<b>275.5</b> (259.1-296.4)	<b>274.0</b> (237.4-317.8)	<b>616.4</b> (543.4-693.4)	<b>52.8</b> (44.5-63.8)
Afar	<b>2104.9</b> (1785.0-2404.7)	<b>1044.9</b> (823.4-1314.7)	<b>261.1</b> (218.8-307.8)	<b>569.2</b> (490.9-654.0)	<b>688.7</b> (601.5-783.9)	<b>95.4</b> (76.4-119.0)
Amhara	<b>1240.1</b> (1115.4-1386.2)	<b>828.3</b> (705.4-935.0)	<b>305.2</b> (283.5-335.4)	<b>362.3</b> (316.4-418.8)	<b>529.0</b> (459.2-600.7)	<b>64.1</b> (51.7-81.0)
Benishangul-Gumuz	<b>2009.8</b> (1742.6-2284.0)	<b>996.3</b> (796.9-1212.1)	<b>257.7</b> (224.3-297.9)	<b>502.2</b> (425.9-587.9)	<b>629.3</b> (528.9-742.2)	<b>83.9</b> (67.6-103.6)
Dire Dawa	<b>1224.2</b> (1044.6-1426.5)	<b>783.0</b> (628.2-938.0)	<b>188.5</b> (165.8-212.5)	<b>338.6</b> (289.3-391.8)	<b>533.5</b> (461.3-611.5)	<b>58.7</b> (46.0-74.2)
Gambella	<b>1411.2</b> (1176.5-1645.7)	<b>750.1</b> (579.2-945.8)	<b>194.5</b> (166.6-224.4)	<b>415.8</b> (358.6-489.2)	<b>608.0</b> (540.8-692.1)	<b>73.8</b> (60.8-89.9)
Harari	<b>1371.0</b> (1119.3-1673.9)	<b>899.5</b> (648.3-1149.1)	<b>216.8</b> (188.0-254.0)	<b>338.8</b> (291.3-393.2)	<b>580.0</b> (500.0-656.5)	<b>62.6</b> (49.8-79.2)
Oromia	<b>1358.2</b> (1199.2-1525.4)	<b>806.2</b> (672.5-943.4)	<b>199.6</b> (173.3-221.7)	<b>347.1</b> (305.7-393.3)	<b>520.5</b> (459.0-582.2)	<b>63.8</b> (53.8-74.9)
Somali	<b>1229.0</b> (1017.5-1438.5)	<b>663.2</b> (508.9-829.5)	<b>173.9</b> (150.5-205.9)	<b>510.4</b> (436.1-594.8)	<b>581.1</b> (482.3-688.1)	<b>84.1</b> (66.0-108.2)
SNNP	<b>1363.4</b> (1190.1-1527.1)	<b>826.1</b> (688.6-984.6)	<b>241.4</b> (209.9-270.5)	<b>388.0</b> (343.2-444.1)	<b>603.0</b> (532.0-684.3)	<b>100.6</b> (81.0-119.0)
Tigray	<b>1343.6</b> (1198.3-1505.1)	<b>993.9</b> (851.0-1132.9)	<b>221.2</b> (195.8-248.8)	<b>318.6</b> (274.0-367.7)	<b>600.2</b> (521.5-682.7)	<b>63.8</b> (51.8-77.9)

In 2019, top five causes of age-standardized death rates for both sexes were stroke 90.2 (95% UI: 70.6-110.0), lower respiratory infections a rate of 86.4 (95% UI: 75.4-97.7), ischemic heart disease 84.2 (95% UI: 62.6-105.8), diarrheal diseases 76.4 (95% UI: 45.1-112.2), and tuberculosis 60.9 (95% UI: 50.4-71.5) per 100,000 populations (Table 7).

#### **Years of life lost (YLLs)**

In 2019, all-cause YLL was 30,188.2 (95% UI: 27,335.8-33,522.8) per 100,000 populations, and males

accounted for 33 656.5 (95% UI: 29329.6-38434.0) in Ethiopia. Ethiopia's age-standardized YLL rate was declined by 68.3% from 1990 to 2019. This is a statistically significant decline using 95% UI. YLL rates fell most dramatically between 2000 and 2015 across all regions. Age-standardized YLL rates were declined at the highest rates in Tigray (73%), Harari (71.4%), and Benishangul-Gumuz (70.1%). On the other hand, the lowest decline in the age-standardized YLL rate was observed in the Somali region, with a 50.3% change over this period (Table 5, Figure 3).

Table 5: **Age-standardized YLLs/100,000 from all causes between 1990 and 2019, National and Sub-national estimates in Ethiopia**

National and Sub-nationals	1990			2019			YLLs change, and both sexes
	Male	Female	Both Sexes	Male	Female	Both Sexes	
Afar	120900.5 (106576.4-136645.7)	136817.8 (116660.8-159215.6)	128,364.6 (115726.5-141122.0)	38024.6 (30891.2-46081.9)	45082.7 (36941.7-54439.3)	40,646.8 (35269.7-46519.6)	-68.3
Benishangul-Gumuz	124591.5 (111921.2-139015.9)	145837.7 (126556.2-167847.9)	134,483.8 (123094.5-148552.6)	38301.6 (31537.4-45911.4)	42714.8 (35285.3-51216.4)	40,246.9 (34763.9-46458.1)	-70.1
Somali	66194.0 (59471.0-73844.1)	84907.8 (74125.1-96892.3)	75,873.5 (68888.2-82932.9)	39101.0 (32276.8-46571.2)	35828.9 (29916.1-42775.2)	37,678.1 (32787.6-43171.1)	-50.3
SNNP	112469.3 (103022.8-122771.3)	83537.1 (76343.2-91191.5)	98,483.9 (92059.0-105551.5)	37724.9 (31927.2-44383.0)	27971.0 (24105.4-32513.6)	32,890.5 (29184.4-37155.5)	-66.6
Gambella	129431.5 (117305.1-142766.6)	76173.5 (67651.7-84849.8)	99,267.9 (90898.9-107721.6)	40161.1 (33217.4-48311.3)	23062.7 (19659.4-26958.5)	31,423.0 (27436.2-36073.9)	-68.3
Amhara	107967.3 (99195.0-116930.9)	87694.3 (80298.2-95964.5)	98,094.5 (91878.8-105125.2)	34944.1 (29673.8-40742.9)	24309.9 (21344.3-28052.0)	29,627.0 (26153.3-33252.0)	-69.8
Harari	134086.1 (119614.2-148428.5)	83990.5 (73016.3-96951.1)	101,652.6 (91766.2-111720.3)	33638.8 (27653.8-40521.8)	24647.6 (20438.9-29811.5)	29,023.2 (25052.8-33498.3)	-71.4
Oromia	104212.0 (95717.4-113748.2)	81835.0 (74737.0-89312.5)	93,122.5 (86874.9-99817.9)	30159.1 (25750.8-35341.4)	25729.5 (22546.6-29787.7)	27,993.6 (24822.9-31877.1)	-69.9
Dire Dawa	107149.0 (96411.2-119014.0)	79193.8 (69799.7-90197.7)	92,243.5 (83704.4-100931.3)	31504.1 (26574.2-37743.1)	24472.7 (20774.4-29063.4)	27,923.4 (24318.7-31972.6)	-69.7
Tigray	108655.1 (97579.2-120921.4)	86908.4 (77184.2-97218.7)	97,852.0 (89713.2-106067.0)	29250.6 (24341.4-34727.7)	23650.8 (19714.4-28204.5)	26,435.5 (22998.7-30181.6)	-73.0
Addis Ababa	78901.5 (70485.1-89366.0)	67035.9 (58094.2-76722.5)	72,811.2 (66274.8-79854.0)	27213.2 (21615.5-33156.6)	22406.3 (18156.6-27566.7)	24,588.0 (21376.6-28479.5)	-66.2
Ethiopia	104835.6 (98116.6-111879.5)	85016.8 (79749.7-90712.2)	95,166.8 (90183.1-100042.6)	33656.5 (29329.6-38434.0)	26577.4 (23737.7-29963.8)	30,188.2 (27335.8-33522.8)	-68.3

In Ethiopia, the CMNN diseases were the leading causes of age-standardized YLL rates in 2019, with 15,843.9 (95% UI: 13,772.5-18,472.3) followed by NCDs, 11,927.4 (95% UI: 10,686.8-13,179.3) per 100,000 population. CMNN diseases were the leading

causes of age-standardized YLL rates in Benishangul-Gumuz with 22,304.9 (95% UI: 18,846.5-26,500.6), Afar 21,728.6 (95% UI: 18,775.7-25,145.6), and Somali regions 21,631.8 (95% UI: 18,621.7-24,928.8) per 100,000 populations, the respectively (Table 6).

Table 6: **Age-standardized YLLs/100,000 from communicable, non-communicable and injuries, Both Sexes between 1990-2019 Sub-national and national in Ethiopia**

National and Sub-nationals	1990			2019		
	Communicable, maternal, neonatal, and nutritional diseases	Non-communicable diseases	Injuries	Communicable, maternal, neonatal, and nutritional diseases	Non-communicable diseases	Injuries
Ethiopia	61919.5 (57137.1-66891.5)	21861.4 (18219.8-25417.7)	11385.9 (10561.1-12165.4)	15843.9 (13772.5-18472.3)	11927.4 (10686.8-13179.3)	2416.9 (2042.8-2860.0)
Addis Ababa	38132.3 (33385.0-43640.9)	21141.7 (17979.9-24427.8)	13537.2 (12909.8-14318.5)	10229.8 (8668.1-12063.7)	12685.1 (10883.2-14942.9)	1673.0 (1321.3-2124.3)
Afar	86666.4 (75565.6-97814.8)	30129.2 (23035.8-38790.5)	11569.0 (9882.4-13261.8)	21728.6 (18775.7-25145.6)	15684.5 (13357.3-18132.4)	3233.8 (2488.6-4128.7)
Amhara	60965.4 (55707.1-66868.6)	21406.4 (17333.7-25176.9)	15722.7 (14816.5-16851.6)	16053.2 (13721.5-18875.3)	11380.0 (9811.7-13114.4)	2193.8 (1744.6-2826.7)
Benishangul-Gumuz	92855.9 (81863.9-105419.3)	29329.0 (21748.2-37020.2)	12299.0 (10878.2-13963.4)	22304.9 (18846.5-26500.6)	14810.2 (12342.6-17611.8)	3131.8 (2507.3-3895.7)
Dire Dawa	61309.4 (53913.1-68891.9)	21727.0 (16359.6-26999.9)	9207.1 (8123.5-10325.0)	15054.7 (12529.8-18046.2)	10981.3 (9324.1-12925.1)	1887.4 (1459.4-2456.3)
Gambella	68415.2 (60585.2-76107.2)	21359.3 (16098.4-26786.9)	9493.4 (8170.0-10809.6)	16515.5 (13787.5-19682.4)	12568.9 (10842.8-14766.7)	2338.6 (1849.7-2945.7)
Harari	65521.1 (56833.4-74631.3)	25704.3 (18607.1-32602.1)	10427.2 (9181.1-12134.2)	14821.2 (12430.2-18009.3)	12151.2 (10261.2-14173.6)	2050.8 (1569.1-2677.0)
Oromia	63269.0 (57336.0-69569.2)	20895.6 (16847.4-25088.9)	8957.9 (7846.7-9831.4)	14919.4 (12862.1-17405.8)	11014.7 (9594.4-12503.2)	2059.4 (1715.9-2480.0)
Somali	51328.4 (45632.5-57900.5)	16792.8 (13201.4-20478.4)	7752.3 (6857.0-8973.3)	21631.8 (18621.7-24928.8)	13076.3 (10901.9-15538.8)	2970.0 (2328.6-3767.6)
SNNP	64720.2 (58033.1-70969.0)	22980.3 (18531.0-28114.5)	10783.5 (9464.0-12036.1)	16179.9 (13933.5-19107.9)	13318.7 (11624.6-15199.6)	3391.9 (2704.5-4101.4)
Tigray	62961.6 (57199.7-69872.4)	25294.3 (19834.0-29963.1)	9596.0 (8649.9-10717.7)	12224.3 (10392.2-14226.3)	12201.9 (10347.2-14206.9)	2009.4 (1587.7-2530.2)

**Leading specific causes of premature mortality rates**

In 2019, the leading five causes of age-standardized YLLs for both sexes were neonatal disorders (including preterm birth, sepsis, and encephalopathy) 3,936.0 (95% UI: 3,102.0-5,062.4), diarrheal diseases 2,679.4 (95% UI: 1,823.9-3,760.2), lower respiratory infections 2,404.6 (95% UI: 2,059.4-2,833.3), tuberculosis 1,729.2 (95% UI: 1,421.6-2,049.9), and stroke 1,639.5 (95% UI: 1,277.3-1,998.8) per 100,000 people. In the same year, the leading specific causes of death by age-standardized YLL rates varied by region. HIV/AIDS was the leading cause of YLL for Addis Ababa 4,381.9 (95% UI: 3,213.4-5,800.0 YLL per 100,000 population) and Gambella 4,584.1 (95% UI: 2,776.2-7,087.1 YLL per 100,000 population). In contrast, tuberculosis was the leading cause in Afar, with a YLL rate of 4,224.4 (95% UI: 3,303.1-5,286.2) per 100,000 populations (Table 7). Neonatal disorders, diarrheal diseases, lower respiratory infections, tuberculosis, HIV/AIDS, malaria, stroke, and ischemic heart disease featured among the five leading specific causes of death in all regions, although ranking order varied across the regions (Table 7 and Figure 4 & 5).

**Figure 4. Age-standardized major cause-specific death rates by national and sub-national states of Ethiopia (L3), 2019 Both sexes, age-standardized, 2019, deaths per 100,000**

	Ethiopia	Addis Ababa	Afar	Amhara	ngul-Gumuz	Dire Dawa	Gambella	Harari	Oromia	Somali	SNNP	Tigray
Stroke	1	2	2	1	1	1	1	1	2	1	2	1
Lower respiratory infections	2	4	4	4	4	3	4	3	1	4	1	3
Ischemic heart disease	3	1	3	3	3	2	2	2	3	5	3	2
Diarrheal diseases	4	11	5	2	2	5	6	5	4	3	4	4
Tuberculosis	5	6	1	5	5	7	5	4	5	2	5	5
Cirrhosis and other chronic liver diseases	6	5	6	6	6	6	7	6	6	6	6	6
Neonatal disorders	7	15	9	7	7	8	10	7	7	7	7	10
Diabetes mellitus	8	7	8	9	8	9	8	9	8	9	8	7
HIV/AIDS	9	3	7	8	13	4	3	8	13	8	13	9
Hypertensive heart disease	10	8	10	10	9	10	9	10	9	11	9	8
Chronic obstructive pulmonary disease	11	12	12	11	11	14	12	13	11	12	10	11
Alzheimer's disease and other dementias	12	9	15	12	14	11	13	12	10	14	12	12
Chronic kidney disease	13	10	13	13	10	12	11	11	12	13	11	13
Road injuries	14	16	17	14	18	15	15	15	15	17	14	14
Meningitis	15	18	14	15	16	18	16	16	16	15	15	15
Protein-energy malnutrition	16	17	11	31	12	16	17	17	14	10	17	16
Self-harm	17	19	20	19	24	22	19	22	18	20	16	22
Breast cancer	18	13	22	23	23	17	22	18	17	34	21	17
Interpersonal violence	19	25	18	17	21	21	18	21	22	18	18	19
Falls	20	20	25	18	26	20	21	20	19	23	20	18
Malaria	21	73	41	21	17	13	14	14	20	24	19	31
Congenital birth defects	22	39	34	16	20	26	35	29	24	21	28	32
Asthma	23	31	19	20	22	30	20	26	25	19	23	21
Cervical cancer	24	23	21	26	19	27	34	23	21	27	25	20
Maternal disorders	25	45	16	33	15	35	47	33	23	16	27	23

Figure 5: **Age-standardized major cause specific YLLs by national and sub-national states of Ethiopia (L3), 2019.**

	Ethiopia	Addis Ababa	Afar	Amhara	Benishangul-Gumuz	Dire Dawa	Gambella	Harari	Oromia	Somali	SNNP	Tigray
Neonatal disorders	1	7	2	1	1	1	2	1	1	1	1	1
Diarrheal diseases	2	9	3	2	3	6	7	6	2	3	2	4
Lower respiratory infections	3	4	5	3	2	3	6	3	3	2	3	3
Tuberculosis	4	5	1	5	4	8	3	5	4	4	4	7
Stroke	5	3	6	6	5	4	4	4	5	5	5	2
HIV/AIDS	6	1	4	4	9	2	1	2	8	6	8	6
Ischemic heart disease	7	2	7	7	6	7	5	7	6	7	6	5
Cirrhosis and other chronic liver diseases	8	6	8	8	7	9	8	9	7	8	7	8
Congenital birth defects	9	20	18	9	12	11	18	11	9	12	11	11
Diabetes mellitus	10	8	11	11	14	10	10	10	10	13	10	9
Malaria	11	40	22	10	8	5	9	8	11	15	9	14
Meningitis	12	15	10	12	13	15	15	14	12	10	12	17
Hypertensive heart disease	13	10	13	13	15	12	11	12	14	17	15	10
Chronic kidney disease	14	11	14	16	17	13	12	13	13	18	13	13
Road injuries	15	13	15	15	16	14	13	15	16	16	14	15
Chronic obstructive pulmonary disease	16	14	19	14	19	18	17	16	17	20	16	12
Protein-energy malnutrition	17	25	12	25	11	17	20	20	15	9	20	22
Maternal disorders	18	28	9	21	10	23	34	23	18	11	18	16
Interpersonal violence	19	16	17	19	18	16	16	17	20	19	17	18
Whooping cough	20	47	16	17	20	26	21	18	19	14	21	32
Self-harm	21	19	20	23	23	24	19	22	22	21	19	20
Alzheimer's disease and other dementias	22	21	28	22	27	20	22	24	21	27	24	19
Leukemia	23	23	26	20	22	22	24	25	23	22	23	25
Breast cancer	24	12	24	29	24	21	26	21	25	34	25	21
Other malignant neoplasms	25	22	29	24	26	25	23	26	26	29	27	24

Table 7: Age-standardized top 20 causes of death in Rates and YLLs per 100,000 by national and sub-national, both sexes, 2019 (Level 3).

Rank	Death rate		YLL rate	
	<b>Ethiopia</b>			
1	Stroke	90.2(70.62-110.04)	Neonatal disorders	3936(3102.02-5062.36)
2	Lower respiratory infections	86.4(75.36-97.65)	Diarrheal diseases	2679.4(1823.93-3760.22)
3	Ischemic heart disease	84.2(62.56-105.75)	Lower respiratory infections	2404.6(2059.41-2833.31)
4	Diarrheal diseases	76.4(45.12-112.15)	Tuberculosis	1729.2(1421.57-2049.86)
5	Tuberculosis	60.9(50.44-71.5)	Stroke	1639.5(1277.27-1998.83)
6	Cirrhosis and other chronic liver diseases	52.2(44.17-62.07)	HIV/AIDS	1581.2(1311.51-1935.43)
7	Neonatal disorders	44.3(34.92-56.99)	Ischemic heart disease	1524.7(1133.11-1925.66)
8	Diabetes mellitus	36(31.01-41.43)	Cirrhosis and other chronic liver diseases	1331.6(1095.91-1625.94)
9	HIV/AIDS	33.6(28.68-39.58)	Congenital disabilities	735.8(447.45-1200.08)
10	Hypertensive heart disease	32(17.85-53.09)	Diabetes mellitus	706.2(606.76-813.68)
11	Chronic obstructive pulmonary disease	28.3(22.68-33.35)	Malaria	683(134.17-1805.31)
12	Alzheimer's disease and other dementias	27.8(6.68-75.12)	Meningitis	610.6(507.11-731.76)
13	Chronic kidney disease	26.2(22.48-30.08)	Hypertensive heart disease	537.3(299.59-899.12)
14	Road injuries	14.5(12.16-17.36)	Chronic kidney disease	522.7(454.91-600.02)
15	Meningitis	14.1(12-16.55)	Road injuries	510.7(422.65-615.89)
16	Protein-energy malnutrition	12.9(9.77-16.7)	Chronic obstructive pulmonary disease	484.1(385.65-573.47)
17	Self-harm	10.1(8.21-12.9)	Protein-energy malnutrition	446(336.29-605.03)
18	Breast cancer	9.7(7.96-11.64)	Maternal disorders	440(318.87-599.92)
19	Interpersonal violence	9.7(7.94-11.89)	Interpersonal violence	408.1(332.52-504.84)
20	Falls	9.6(8.09-11.29)	Whooping cough	399.5(41.75-1131.46)
	<b>Addis Ababa</b>			
1	Ischemic heart disease	116.5(93.99-139.84)	HIV/AIDS	4381.9(3213.4-5800.05)
2	Stroke	116.2(96.78-137.59)	Ischemic heart disease	2119.1(1686.63-2595.35)
3	HIV/AIDS	95.6(71.23-125.38)	Stroke	2076.7(1734.67-2511.62)
4	Lower respiratory infections	59.4(49.81-71.44)	Lower respiratory infections	1285.7(1065.07-1561.83)
5	Cirrhosis and other chronic liver diseases	47.2(38.14-58.42)	Tuberculosis	1257.7(987.65-1637.78)
6	Tuberculosis	45.2(37.71-55.2)	Cirrhosis and other chronic liver diseases	1227.6(953.12-1582.71)

7	Diabetes mellitus	39.8(33-47.63)	Neonatal disorders	1144.9(786.19-1613.71)
8	Hypertensive heart disease	34.4(16.91-54.07)	Diabetes mellitus	781.5(643.35-962.41)
9	Alzheimer's disease and other dementias	27.1(6.6-74.56)	Diarrheal diseases	706.9(346.09-1160)
10	Chronic kidney disease	27(22.3-32.27)	Hypertensive heart disease	578.7(280.46-923.66)
11	Diarrheal diseases	24.4(9.55-44.34)	Chronic kidney disease	531.1(436.12-648.14)
12	Chronic obstructive pulmonary disease	22.9(16.88-28.26)	Breast cancer	434.7(299.09-628.89)
13	Breast cancer	15.5(11.29-20.74)	Road injuries	431.3(325.37-556.51)
14	Neonatal disorders	12.9(8.85-18.16)	Chronic obstructive pulmonary disease	392.7(290.4-489.06)
15	Road injuries	12.9(9.89-16.03)	Meningitis	356.8(278.5-453.27)
16	Protein-energy malnutrition	11.2(9.2-13.43)	Interpersonal violence	315.9(226.89-434.94)
17	Meningitis	10.2(8.25-12.51)	Self-harm	299.8(217.5-412.76)
18	Self-harm	9.1(6.95-12.18)	Congenital disabilities	294.3(148.31-529.45)
19	Falls	8.2(6.8-10.08)	Alzheimer's disease and other dementias	280.9(67.7-776.23)
20	Cervical cancer	8(5.44-11.28)	Other malignant neoplasms	264.1(206.37-346.36)
<b>Afar</b>				
1	Tuberculosis	140.4(113.05-171.19)	Tuberculosis	4224.4(3303.11-5286.23)
2	Stroke	130(101.08-160.22)	Neonatal disorders	3334.2(2575.7-4376.74)
3	Ischemic heart disease	118.2(88.68-154.84)	Diarrheal diseases	3028.7(1858.68-4359.95)
4	Lower respiratory infections	103.7(86.62-122.62)	HIV/AIDS	2828.6(1852.03-4134.58)
5	Diarrheal diseases	101.1(55.82-151.57)	Lower respiratory infections	2824.7(2323.08-3414.07)
6	Cirrhosis and other chronic liver diseases	63.4(48.41-82.03)	Stroke	2643.3(2063.5-3255.2)
7	HIV/AIDS	60.7(40.56-86.47)	Ischemic heart disease	2391.8(1823.27-3112.12)
8	Diabetes mellitus	44.7(37.44-53.71)	Cirrhosis and other chronic liver diseases	1693.1(1249.58-2210.45)
9	Neonatal disorders	37.5(28.99-49.26)	Maternal disorders	1233.7(784.3-1875.55)
10	Hypertensive heart disease	37.4(20.89-59.95)	Meningitis	965.3(758.53-1204.6)
11	Protein-energy malnutrition	35.6(27.54-45.51)	Diabetes mellitus	949(782.94-1140.39)
12	Chronic obstructive pulmonary disease	32.1(21.92-45.83)	Protein-energy malnutrition	923.3(690.56-1193.61)
13	Chronic kidney disease	31.6(26.11-38.81)	Hypertensive heart disease	730.6(406.49-1138.62)
14	Meningitis	23.8(19.04-29.34)	Chronic kidney disease	686.5(561.31-835.23)
15	Alzheimer's disease and other dementias	23.6(5.43-65.31)	Road injuries	684.6(516.43-873.82)

16	Maternal disorders	23.5(14.98-35.44)	Whooping cough	605.7(26.91-2154.91)
17	Road injuries	19.4(15.31-24.19)	Interpersonal violence	599.3(409.86-876.16)
18	Interpersonal violence	14.2(10.04-20.08)	Congenital disabilities	583(363.12-963.96)
19	Asthma	13.8(8.91-20.93)	Chronic obstructive pulmonary disease	554.2(377-806.65)
20	Self-harm	13.4(10.53-17.6)	Self-harm	450.8(338.84-582.45)
<b>Amhara</b>				
1	Stroke	89.4(63.85-113.96)	Neonatal disorders	4263.9(3325.45-5535.56)
2	Diarrheal diseases	83.6(42.9-130.29)	Diarrheal diseases	2872.5(1619.57-4669.36)
3	Ischemic heart disease	82.6(57.25-108.94)	Lower respiratory infections	2016.5(1551.49-2541.83)
4	Lower respiratory infections	74.4(59.4-91.02)	HIV/AIDS	1922(1387.5-2530.78)
5	Tuberculosis	59.8(42.36-79.78)	Tuberculosis	1694(1206.7-2252.3)
6	Cirrhosis and other chronic liver diseases	50.3(37.16-73.63)	Stroke	1585.9(1113.95-2048.27)
7	Neonatal disorders	48(37.44-62.34)	Ischemic heart disease	1469(1013.35-1978.65)
8	HIV/AIDS	40.1(29.07-53.18)	Cirrhosis and other chronic liver diseases	1269.7(912.09-1954.72)
9	Diabetes mellitus	31.5(25.13-39.14)	Congenital disabilities	866(441.58-1475.29)
10	Hypertensive heart disease	31.5(16.76-54.86)	Malaria	643(81.19-1704.74)
11	Chronic obstructive pulmonary disease	28.5(22.17-38.11)	Diabetes mellitus	609.8(478.05-767.44)
12	Alzheimer's disease and other dementias	26.6(6.62-72.44)	Meningitis	536.1(404.85-691.23)
13	Chronic kidney disease	22.6(17.82-27.8)	Hypertensive heart disease	516.1(273.57-892.85)
14	Road injuries	12.9(10.13-16.31)	Chronic obstructive pulmonary disease	486.8(375.22-671.88)
15	Meningitis	12.9(9.83-16.55)	Road injuries	459.7(359.92-585.84)
16	Congenital disabilities	10(5.28-17.08)	Chronic kidney disease	446.6(351.84-556.86)
17	Interpersonal violence	9.6(6.93-12.96)	Whooping cough	441.1(18.96-1702.75)
18	Falls	9.4(7.26-12.24)	Interpersonal violence	402.1(290.01-550.62)
19	Self-harm	8.8(6.37-12.88)	Leukemia	291.6(158.14-412.55)
20	Asthma	8.6(5.26-17.23)	Maternal disorders	284(174.82-426.28)
<b>Benishangul-Gumuz</b>				
1	Stroke	114.1(87.35-144.52)	Neonatal disorders	4794.2(3682.23-6308.66)
2	Diarrheal diseases	106.6(58.68-168.74)	Lower respiratory infections	3571.2(2772.41-4510.79)
3	Ischemic heart disease	104(76.61-136.98)	Diarrheal diseases	3468(2075.83-5236.29)

4	Lower respiratory infections	101.8(84.02-121.72)	Tuberculosis	3122.5(2515.9-3818.3)
5	Tuberculosis	100.8(81.21-123.74)	Stroke	2265.6(1735.78-2873.04)
6	Cirrhosis and other chronic liver diseases	55.8(42.99-73.42)	Ischemic heart disease	2036.7(1495.64-2644.13)
7	Neonatal disorders	54(41.45-71.03)	Cirrhosis and other chronic liver diseases	1492.3(1132.75-1986.18)
8	Diabetes mellitus	39.1(32.12-47.98)	Malaria	1326.5(162.19-3879.9)
9	Hypertensive heart disease	36.4(19.54-59.42)	HIV/AIDS	1323.3(734.37-2257.41)
10	Chronic kidney disease	28(22.56-34.65)	Maternal disorders	1094.4(729.35-1510)
11	Chronic obstructive pulmonary disease	27.6(17.93-40.11)	Protein-energy malnutrition	1044.3(736.16-1426.44)
12	Protein-energy malnutrition	27.5(21.07-34.18)	Congenital disabilities	1023.6(524.59-1778.98)
13	HIV/AIDS	26.2(14.9-43.64)	Meningitis	975.3(750.02-1240.64)
14	Alzheimer's disease and other dementias	24.5(5.78-67.95)	Diabetes mellitus	822.1(655.85-1010.38)
15	Maternal disorders	20.2(13.38-28.37)	Hypertensive heart disease	683.2(369.07-1100.28)
16	Meningitis	20(15.89-24.49)	Road injuries	667.9(537.38-822.97)
17	Malaria	17.3(2.08-51.94)	Chronic kidney disease	620.6(500.31-770.69)
18	Road injuries	17.1(13.84-21.17)	Interpersonal violence	512.1(387.88-676.98)
19	Cervical cancer	12.6(8.02-17.54)	Chronic obstructive pulmonary disease	480.1(309.41-728.93)
20	Congenital disabilities	11.9(6.25-20.5)	Whooping cough	453.4(12.5-2061.47)
<b>Dire Dawa</b>				
1	Stroke	90.1(66.51-113.88)	Neonatal disorders	3598.5(2689.6-4760.63)
2	Ischemic heart disease	84.3(57.62-109.99)	HIV/AIDS	3369.6(2037.19-5146.92)
3	Lower respiratory infections	69.9(56.55-84)	Lower respiratory infections	1832.8(1407.35-2363.18)
4	HIV/AIDS	67.1(40.51-103.01)	Stroke	1572.8(1132.77-2021.77)
5	Diarrheal diseases	49.1(26.15-79.26)	Malaria	1569.6(176.86-3767.72)
6	Cirrhosis and other chronic liver diseases	47.3(35.8-63.72)	Diarrheal diseases	1527.3(863.89-2479.98)
7	Tuberculosis	47.1(36.58-58.63)	Ischemic heart disease	1460.6(979.94-1944.49)
8	Neonatal disorders	40.5(30.27-53.58)	Tuberculosis	1265.7(961.97-1615.11)
9	Diabetes mellitus	34.1(26.7-42.03)	Cirrhosis and other chronic liver diseases	1171.8(852.79-1648.64)
10	Hypertensive heart disease	31.8(16.06-56.11)	Diabetes mellitus	641.8(496.93-804.18)
11	Alzheimer's disease and other dementias	26.4(6.36-70.85)	Congenital birth defects	614.3(370.17-995.81)
12	Chronic kidney disease	25.8(21.13-30.78)	Hypertensive heart disease	513.2(260.79-902.74)

13	Malaria	21.5(2.26-54.94)	Chronic kidney disease	490.6(397.47-602.27)
14	Chronic obstructive pulmonary disease	20.1(14.43-26.6)	Road injuries	474.4(303.11-745.92)
15	Road injuries	14.1(9.05-22)	Meningitis	424(311.33-565.46)
16	Protein-energy malnutrition	12.6(8.93-18.56)	Interpersonal violence	353.5(247.69-490.2)
17	Breast cancer	10.8(8.02-14.88)	Protein-energy malnutrition	339.4(211.67-544.92)
18	Meningitis	10.3(8.16-12.92)	Chronic obstructive pulmonary disease	331.1(236.72-446.42)
19	Falls	8.6(6.79-10.78)	Alzheimer's disease and other dementias	272.5(64.28-769.26)
20	Interpersonal violence	8.4(6.12-11.46)	Breast cancer	258.7(187.3-375.48)

**Gambella**

1	Stroke	113.5(82.92-142.58)	HIV/AIDS	4584.1(2776.25-7087.13)
2	Ischemic heart disease	106(75.34-139.83)	Neonatal disorders	2802.7(2094.7-3707.8)
3	HIV/AIDS	92(56.85-139.75)	Tuberculosis	2108.5(1620.78-2668.38)
4	Lower respiratory infections	82.4(68.39-97.19)	Stroke	2089.7(1505.93-2660.73)
5	Tuberculosis	76.8(61.29-94.68)	Ischemic heart disease	1968.1(1389.57-2644.08)
6	Diarrheal diseases	66.2(31.72-106.05)	Lower respiratory infections	1937.5(1567.7-2344.65)
7	Cirrhosis and other chronic liver diseases	55.6(44.53-68.52)	Diarrheal diseases	1765.7(941.39-2671.89)
8	Diabetes mellitus	38.5(31.52-46.44)	Cirrhosis and other chronic liver diseases	1400.8(1101.59-1750.5)
9	Hypertensive heart disease	34.4(18.72-62.25)	Malaria	1145.9(255.32-2841.13)
10	Neonatal disorders	31.5(23.57-41.73)	Diabetes mellitus	758.6(610.59-934.72)
11	Chronic kidney disease	27.2(22.08-32.77)	Hypertensive heart disease	566.8(312.11-1012.36)
12	Chronic obstructive pulmonary disease	26.2(19.13-34)	Chronic kidney disease	531.6(422.7-654.89)
13	Alzheimer's disease and other dementias	25.2(6.01-68.84)	Road injuries	519.6(393.92-685.82)
14	Malaria	16.2(3.45-42.65)	Meningitis	481.7(370.82-603.58)
15	Road injuries	15.4(12.09-19.85)	Interpersonal violence	468.2(329.91-668.58)
16	Meningitis	13.1(10.51-16.1)	Chronic obstructive pulmonary disease	454.3(327.31-593.83)
17	Protein-energy malnutrition	12.9(8.84-17.04)	Congenital birth defects	444.2(286.9-696.67)
18	Interpersonal violence	11.2(8.23-15.69)	Self-harm	329.5(230.64-474.62)
19	Self-harm	10.4(7.56-14.69)	Protein-energy malnutrition	289.9(194.23-416.24)
20	Asthma	9.6(6.3-18.03)	Whooping cough	282.1(11.17-1086.73)

**Harari**

1	Stroke	102.7(78.39-126.79)	Neonatal disorders	3571.2(2669.98-4709.61)
2	Ischemic heart disease	92(67.71-116.29)	HIV/AIDS	2102.8(1264.16-3429.05)
3	Lower respiratory infections	77.1(63.09-92.52)	Lower respiratory infections	2060.5(1595.62-2623.15)
4	Tuberculosis	61(46.06-75.71)	Stroke	1844.5(1379.32-2326.34)
5	Diarrheal diseases	52.2(26.81-86.27)	Tuberculosis	1708.9(1268.87-2211.91)
6	Cirrhosis and other chronic liver diseases	50.4(39.35-64.7)	Diarrheal diseases	1696.8(949.97-2706.74)
7	Neonatal disorders	40.2(30.05-53.01)	Ischemic heart disease	1636.3(1184.83-2099.02)
8	HIV/AIDS	38.8(24.5-65.11)	Malaria	1389.5(208.1-3554.6)
9	Diabetes mellitus	37(29.18-45.21)	Cirrhosis and other chronic liver diseases	1282.2(959.15-1731.43)
10	Hypertensive heart disease	36.2(18.43-61.89)	Diabetes mellitus	722.8(567.26-908.61)
11	Chronic kidney disease	28.1(23.25-33.34)	Congenital birth defects	607.5(374.86-972.76)
12	Alzheimer's disease and other dementias	26.8(6.46-73.23)	Hypertensive heart disease	590.4(300.06-993.86)
13	Chronic obstructive pulmonary disease	23.2(16.54-29.01)	Chronic kidney disease	551(448.82-669.85)
14	Malaria	19.8(2.64-52.44)	Meningitis	527.4(389-694.81)
15	Road injuries	14.6(10.15-23.99)	Road injuries	507.5(342.8-840.62)
16	Meningitis	12.9(10.12-16.16)	Chronic obstructive pulmonary disease	397.1(274.17-504.33)
17	Protein-energy malnutrition	12.2(8.47-18.06)	Interpersonal violence	386.7(271.26-541.91)
18	Breast cancer	11.9(8.81-15.64)	Whooping cough	384.8(10.98-1622.83)
19	Falls	9.2(7.39-11.16)	Protein-energy malnutrition	323.3(201.45-527.07)
20	Interpersonal violence	9.2(6.57-12.5)	Breast cancer	287.8(204.78-406.31)
<b>Oromia</b>				
1	Lower respiratory infections	89.3(75.91-103.18)	Neonatal disorders	3962.8(3151.45-5047.45)
2	Stroke	77.5(57.53-98.33)	Diarrheal diseases	2636.7(1799.45-3752.16)
3	Ischemic heart disease	75(52.08-97.73)	Lower respiratory infections	2433.8(2042.25-2879.55)
4	Diarrheal diseases	71.4(43.92-110.98)	Tuberculosis	1424.6(1145.31-1764.27)
5	Tuberculosis	52.5(42.94-64.03)	Stroke	1382.5(1033.51-1753.97)
6	Cirrhosis and other chronic liver diseases	49.9(40.85-60.24)	Ischemic heart disease	1317.6(915.29-1719.34)
7	Neonatal disorders	44.6(35.47-56.81)	Cirrhosis and other chronic liver diseases	1250.9(1002-1549.27)
8	Diabetes mellitus	35.3(29.16-41.8)	HIV/AIDS	1154.7(791.12-1689.22)
9	Hypertensive heart disease	29.8(16.12-51.79)	Congenital birth defects	689.7(427.97-1142.24)

10	Alzheimer's disease and other dementias	28.9(6.93-77.37)	Diabetes mellitus	676.1(557.15-807.1)
11	Chronic obstructive pulmonary disease	27(20.6-32.21)	Malaria	654.7(117.28-1814.73)
12	Chronic kidney disease	26.4(21.43-31.3)	Meningitis	563.9(448.04-715.52)
13	HIV/AIDS	23.9(16.38-33.96)	Chronic kidney disease	511.2(426.59-603.31)
14	Protein-energy malnutrition	14.2(10.71-17.95)	Hypertensive heart disease	494.9(265.37-867.22)
15	Road injuries	13.9(11.31-17.1)	Protein-energy malnutrition	477.7(335.81-649.84)
16	Meningitis	13.1(10.81-15.78)	Road injuries	471.7(380.87-589.71)
17	Breast cancer	9.9(7.89-11.85)	Chronic obstructive pulmonary disease	451.6(338.94-543.17)
18	Self-harm	9.5(7.42-12.49)	Maternal disorders	435.8(286.62-644.6)
19	Falls	9.2(7.53-11.12)	Whooping cough	377.7(25.31-1198.75)
20	Malaria	9.1(1.6-25.26)	Interpersonal violence	340.5(263.93-445.33)
<b>Somali</b>				
1	Stroke	106.3(76.92-137.63)	Neonatal disorders	4346.2(3427.41-5558.73)
2	Tuberculosis	105.8(78.4-148.83)	Lower respiratory infections	3236.5(2537.45-4006.03)
3	Diarrheal diseases	99.7(55.99-155.16)	Diarrheal diseases	3189.1(2085.43-4620.42)
4	Lower respiratory infections	97.6(79.26-118.67)	Tuberculosis	3114.7(2316.65-4344.2)
5	Ischemic heart disease	93.9(67-126.02)	Stroke	2029.8(1472.25-2610.22)
6	Cirrhosis and other chronic liver diseases	55.5(41.23-75.1)	HIV/AIDS	2024.9(1418.98-2847.11)
7	Neonatal disorders	48.9(38.58-62.57)	Ischemic heart disease	1786.8(1267.81-2396.47)
8	HIV/AIDS	43(31.4-59.89)	Cirrhosis and other chronic liver diseases	1451.6(1072.82-2016.43)
9	Diabetes mellitus	36(28.49-44.91)	Protein-energy malnutrition	1133.4(724.21-1669.51)
10	Protein-energy malnutrition	33.3(23.07-46.02)	Meningitis	959.3(743.79-1226.97)
11	Hypertensive heart disease	31.7(16.68-56.83)	Maternal disorders	876.6(554.04-1265.93)
12	Chronic obstructive pulmonary disease	29.4(18.85-50.63)	Congenital birth defects	862.5(474.74-1444.55)
13	Chronic kidney disease	26.1(20.38-33.81)	Diabetes mellitus	730.3(576.84-909.92)
14	Alzheimer's disease and other dementias	24.1(5.66-65.44)	Whooping cough	643.6(27.19-2382.19)
15	Meningitis	20.7(16.1-26.3)	Malaria	634.2(78.43-1750.82)
16	Road injuries	16.4(12.71-20.75)	Road injuries	600.4(463.71-775.64)
17	Interpersonal violence	12.3(8.6-17.16)	Hypertensive heart disease	574(304.92-1032.18)
18	Asthma	11.5(7.18-18.97)	Chronic kidney disease	545.9(425.15-696.46)

19	Self-harm	10.8(8.07-14.8)	Interpersonal violence	524.7(369.67-725.35)
20	Congenital birth defects	10(5.71-16.79)	Chronic obstructive pulmonary disease	501.8(322.05-880.26)
<b>SNNP</b>				
1	Lower respiratory infections	99(83.81-116.65)	Neonatal disorders	3963.4(3074.49-5162.24)
2	Stroke	90.6(70.53-112.85)	Diarrheal diseases	2883.2(1933.89-4093.83)
3	Ischemic heart disease	86.9(65.02-111.24)	Lower respiratory infections	2698.2(2243.52-3250.28)
4	Diarrheal diseases	83.7(51.2-124.32)	Tuberculosis	1932.7(1568.38-2350.92)
5	Tuberculosis	67.4(55.73-81.7)	Stroke	1694.7(1329.04-2112.14)
6	Cirrhosis and other chronic liver diseases	62.1(50.89-74.44)	Ischemic heart disease	1615.9(1213.31-2075.9)
7	Neonatal disorders	44.6(34.6-58.11)	Cirrhosis and other chronic liver diseases	1612(1281.65-1974.9)
8	Diabetes mellitus	42.6(35.42-50.85)	HIV/AIDS	954.8(610.25-1395.8)
9	Hypertensive heart disease	34(20.02-53.15)	Malaria	861.6(194.07-2475.56)
10	Chronic obstructive pulmonary disease	31.2(24.15-37.86)	Diabetes mellitus	858.2(705.57-1039.85)
11	Chronic kidney disease	30.8(25.61-36.63)	Congenital birth defects	745.5(429.23-1259.86)
12	Alzheimer's disease and other dementias	28.8(6.99-77.05)	Meningitis	700(558.84-860.09)
13	HIV/AIDS	20.2(13.61-29.17)	Chronic kidney disease	634.2(531.74-754.82)
14	Road injuries	17.8(14.31-22.52)	Road injuries	633.4(499.45-830.87)
15	Meningitis	16.1(13.33-19.23)	Hypertensive heart disease	582.2(345.94-918.28)
16	Self-harm	13.9(11.11-17.56)	Chronic obstructive pulmonary disease	550.3(423.27-671.85)
17	Protein-energy malnutrition	13.9(10.2-18.57)	Interpersonal violence	500.6(380.86-643.56)
18	Interpersonal violence	11.9(9.09-15.09)	Maternal disorders	480.7(309.6-703.08)
19	Malaria	11.5(2.59-33.94)	Self-harm	453.4(350.74-576.53)
20	Falls	11.4(9.12-13.72)	Protein-energy malnutrition	436.1(304.55-641.83)
<b>Tigray</b>				
1	Stroke	117.9(91.08-147.91)	Neonatal disorders	2734.2(2110.52-3602.85)
2	Ischemic heart disease	96(67.34-123.71)	Stroke	2065(1571.61-2618.6)
3	Lower respiratory infections	84.6(69.26-100.15)	Lower respiratory infections	1977.2(1593.94-2395.05)
4	Diarrheal diseases	61.7(32.58-98.04)	Diarrheal diseases	1885.8(1160.09-2787.08)
5	Tuberculosis	50.2(39.61-62.96)	Ischemic heart disease	1691.5(1175.78-2229.61)
6	Cirrhosis and other chronic liver diseases	45.3(36.11-56.03)	HIV/AIDS	1592.4(895.8-2417.13)

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7	Diabetes mellitus	38(30.89-45.87)	Tuberculosis	1353.7(1052.73-1707.25)
8	Hypertensive heart disease	36.6(19.77-61.88)	Cirrhosis and other chronic liver diseases	1119.7(857.99-1431.6)
9	HIV/AIDS	33.8(19.21-50.31)	Diabetes mellitus	727.6(589.3-884.16)
10	Neonatal disorders	30.8(23.75-40.55)	Hypertensive heart disease	599.6(321.39-1034.76)
11	Chronic obstructive pulmonary disease	30.5(23.71-39.76)	Congenital birth defects	552.8(362.72-840.05)
12	Alzheimer's disease and other dementias	28.8(6.81-76.63)	Chronic obstructive pulmonary disease	518.6(396.85-679.95)
13	Chronic kidney disease	26.8(21.83-32.75)	Chronic kidney disease	515.3(417.04-637)
14	Road injuries	13(10.22-16.49)	Malaria	499(67.98-1567.23)
15	Meningitis	11.4(8.58-13.97)	Road injuries	434.7(333.41-567.46)
16	Protein-energy malnutrition	11.1(8.18-14.88)	Maternal disorders	430.5(269.75-645.46)
17	Breast cancer	10.4(7.63-13.6)	Meningitis	421.4(323.54-526.07)
18	Falls	10.2(8.07-12.67)	Interpersonal violence	402.9(296.58-535.61)
19	Interpersonal violence	9.7(7.36-12.84)	Alzheimer's disease and other dementias	300.2(70.56-784.48)
20	Cervical cancer	9(5.82-14.27)	Self-harm	264.2(185.33-386.58)

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## Discussion

Overall, in 2019, 559,997 (95% UI: 506,117-621,976) deaths, 993.5 per 100,000 populations (95% UI: 915.0-1070.6) of age-standardized all-cause mortality rate and 30,188.2 (95% UI: 27,335.8-33,522.8) per 100,000 population of all-cause YLL were occurred in Ethiopia. From 1990 to 2019 number of deaths, all-cause age-standardized death rates and age-standardized YLL rates declined by 38.2%, 58.4%, and 68.3% in both sexes, respectively. This decline indicates an increased overall life expectancy by 21.93 years (95% CI, 21.79–22.07) in Ethiopia from 1990 to 2019 (6). This implies that the Ethiopian government and partners' commitment to addressing universal health coverage through primary health care services yielded fruit (20,21). However, there was a disparity of death reduction in Ethiopia's regions and administrative cities except Somali. In the Somali region, the absolute number of deaths increased in 2019. This could be due to conflicts that were happened in 2018 and 2019.

Deaths due to CMNND have decreased in the last 30 years. However, death and premature mortality rates from CMNNDs are still high in Ethiopia compared to global figures. Moreover, the changes were not uniform across the regions – for example, age-standardized death rates due to CMNND in Somali and Benishangul-Gumuz regions were significantly higher than those in Amhara, Oromia, Tigray, and SNNP. Some regions like Gambella, Benishangul-Gumuz, Afar, and Somali have pastoralist and agro-pastoralist populations who have been severely under-served by health services. This may be due to their low Socio-demographic Index (SDI), poor health service accessibility, poor health workforce development and retention, and poor access to essential medicines because of their hard-to-reach natures (6). Regions vary in ecology, demography, and economy, leading to disease burden variations between regions, affecting health and mortality patterns over time (6).

In the last 30 years, age-standardized premature mortality rates have decreased significantly across all regions with unequal distribution. The decline was most significant between 2000-2015 across all regions and administrative cities. However, at the national level, stroke, lower respiratory infections, ischemic heart disease, diarrhoeal diseases, and tuberculosis remain the top five age-standardized specific causes of death in 2019. Neonatal disorders, diarrheal disease, lower respiratory infections, tuberculosis, and stroke were also the top five causes of age-standardized YLL rates in 2019. Despite being the leading causes of premature mortality, lower respiratory infections, tuberculosis, and diarrheal disease, premature mortality rates declined faster in Ethiopia than in the sub-Saharan Africa region or Eastern sub-Saharan Africa. The mortality decline between 2000 and 2015 might be due to the initiation of certain strategies and programs (22). These might include the introduction of the health extension program in 2003, the introduction of ART for HIV/AIDS, expansion of health care services and access, high workforce deployment, public and private partnerships, and strengthened primary health care

services to address major risk factors (23). The vast majority of deaths caused by communicable diseases like HIV and malaria could be avoided using existing interventions.

From 2000 and 2015, non-communicable diseases (NCDs), including stroke, ischemic heart disease, hypertensive heart diseases, cancer, and diabetes, were among the leading causes of age-standardized deaths in Ethiopia and the regions. Preventing premature mortality from NCDs requires a strong implementation strategy and considerable resources. The efforts to counter infectious diseases between 2000 and 2015 could be a good lesson for achieving the SDGs. Recognizing this, the Essential Health Service package released in 2019 has several NCD interventions (24) and may lead to considerable improvements.

The findings of this study highlight the epidemiological transition happening in Ethiopia and its regions: a disease burden transition from predominantly infectious diseases to non-communicable diseases (25). As a result of this transition, ischemic heart disease and stroke were found to be among the five leading causes of age-standardized death rates in 2019 in Ethiopia and across regions. This trend suggests that non-communicable diseases have existed as problems over decades but have become more visible following greater reductions in common infectious, maternal, and nutritional diseases (26). This could largely be explained by population growth and aging: these two factors increase deaths from non-communicable diseases as declines in age-standardized death rates are counterbalanced by population growth and aging (27). These findings support claims that Ethiopia's triple burden of NCDs and CMNND diseases exists (27,28). In addition, high premature mortality from CMNND diseases will likely lead to considerable economic and development challenges (29). This is comparable with another GBD study in Ethiopia (6).

## Implication of the findings for policies and practices

The findings of this study highlight the trends and levels of death rate and YLL in Ethiopia's regions and administrative cities. The findings will help evaluate Health Sector Transformation Plan I and NCD strategies at national and regional levels and create benchmarks for HSTP II (3). Therefore, these findings are also helpful for revising strategies and budget reallocations to incorporate more data on Ethiopia's health, demographic and epidemiological transitions. However, the observed variations of disease burden in the regions may also vary among districts of each region, which requires further exploration to support policy at lower administrative levels.

The general limitations of the GBD approach also apply to this paper. These limitations have been discussed widely in other published GBD articles; however, we summarize the relevant limitations by focusing on data sources for Ethiopia (27,30,31). Regardless of rigorous and standardized methodology in estimating causes of death and cause-specific mortality, data incorporated into GBD 2019 were scarce for several Ethiopian regions. The cause of

death data sources were mainly verbal autopsy and sibling history. In Ethiopia, verbal autopsy data sources lack national and regional representativeness, whereas sibling history data sources only address maternal health and related estimates. Because of the lack of completeness of these sources, there were considerable uncertainties (as indicated by the 95% UI for age-standardized death rates), which may affect policy debates, prioritization of causes, and health decisions. Limitations with verbal autopsy data sources also affected the uncertainty of the estimates. Variations in verbal autopsy data collection methods within and among data sources, including differences in recall period (between the time of death and interview), the type of questionnaire used, interviewers and physician reviewers, and completeness, may lead to low comparability of data (18,28,30). All verbal autopsy data sources represented regional locations, which greatly affects the uncertainty of national estimates during data processing and cause of death redistribution to provide national and regional estimates (32).

### Conclusion

This analysis has shown that premature mortality rates decreased significantly from 2000 to 2015 across all regions of Ethiopia. Age-standardized YLL rates have decreased significantly between 1990 and 2019 across all regions with some disparities. Neonatal disorders, diarrheal disease, lower respiratory infections, tuberculosis, HIV/AIDS, ischemic heart disease, and stroke remained the leading causes of age-standardized YLL rates 2019 across the nation and regions.

Ethiopia needs a strong commitment to implement existing strategies to strengthen and integrate health services and to design multi-sectoral responses targeting non-communicable diseases. The triple burden of communicable, maternal, neonatal, and nutritional deficiency disorders, as well as non-communicable diseases and injury, should be considered in all strategy levels.

### Competing interest:

The authors declare that they have no competing or potential conflicts of interest.

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### Acronyms:

CMNND	Communicable, Maternal, Neonatal, and Nutritional Diseases and Disorders
CODEm	Cause of Death Ensemble Modelling
EPHI	Ethiopian Public Health Institute
GBD	Global Burden of Disease
HEP	Health Extension Program
HSTP	Health Sector Transformation Plan
IHME	Institute for Health Metrics and Evaluation
NCDs	Non-communicable Disease
SDGs	Sustainable Development Goals
SDI	Socio-demographic Index
SNNP	Southern Nations Nationalities and People
ST-GPR	Spatiotemporal Gaussian Process Regression
UI	Uncertainty Intervals
YLL	Years of Life Lost

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