

# Trends in Burden of Diseases among Adolescents in Ethiopia, from 1990 to 2019: A Subnational Analysis in Global Burden of Diseases 2019 Study

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## Abstract

**Background:** Adolescence is a time of major physical, social, and emotional changes and can present significant health risks. Nearly 35% of the global disease burden is believed to be rooted in adolescence. However, the burden of diseases among adolescents is poorly studied in Ethiopia despite having a large adolescent population.

**Objective:** The objective of this research is to analyze the patterns of premature mortality, disability, and overall disease burden among adolescents in Ethiopia from 1990 to 2019, considering age, gender, and regional variation.

**Methods:** Using the 2019 Global Burden of Disease data and estimation techniques, disability-adjusted life years, years lived with disabilities, years of life lost, and maternal mortality rates were calculated. The causes of death ensemble model (CODEm) and Bayesian meta-regression disease modeling (DisMR 2) methods were used to calculate fatal and non-fatal health metrics values over time. All available data sources were used for this analysis, including e population census, demographic surveillance, household surveys, disease registry, health service use, disease notifications, and other data. The 95% uncertainty intervals were computed to check for the presence of statistical significance in the trend. Rates were estimated per 100,000 populations.

**Results:** From 1990 to 2019, there was a significant decreasing trend in mortality rate from 237 deaths (226–248) to 56 deaths (50–69), years of life lost from 18,093 years lost (17,264–19,008) to 4,264 years lost (3,788–5,276), and disability-adjusted life years from 24,615 years (22,598–27,127) to 9,803 years (8,153–11,815) among early adolescents, whereas mortality rate from 402 deaths (384–423) to 98 deaths (83–117), years of life lost from 28,769 years lost (27,439–30,266) to 7,015 years lost (5,949–8,372), and disability-adjusted life years from 36,494 years (33,987–39,428) in 1990 to 13,591 years (11,433–16,068) among late adolescents. Moreover, there were slight variations in the burden of diseases by sex and region. The leading causes of the total burden of diseases were mental disorders, HIV/AIDS and sexually transmitted infections, skin diseases, enteric infections, malaria and neglected tropical diseases, nutritional deficiencies, unintended injuries, tuberculosis and respiratory infections, and maternal and neonatal disorders. Additionally, those causes on the bottom list in 1990 shifted to the top in 2019.

**Conclusion:** According to the study, there has been a decline in the burden of diseases among adolescents from 1990 to 2019, although with slight variations across regions. Adolescents experienced a triple burden of diseases, including communicable, maternal, neonatal, and nutritional conditions, non-communicable diseases, and injuries. As a result, interventions aimed at addressing the health issues of adolescents should prioritize increased access to healthcare services, enhanced health education programs, better distribution of disease prevention resources across regions, and higher investment in public health infrastructure. [*Ethiop. J. Health Dev.* 2023;37 (SI-2)]

**Keywords:** adolescent health, burden of diseases, disability, HIV/AIDS, injuries, maternal disorders

## Background

Adolescence is a time of major physical, social, and emotional changes, and nearly 35% of the global disease burden has roots in this age group (10 to 19 years) (1). Since the 1990s, the disease burden has decreased in many countries due to the decrease in communicable, maternal, neonatal, and nutritional conditions and injuries. However, non-communicable diseases such as obesity, diabetes, and cardiovascular diseases are rising due to unhealthy lifestyles, poor diets, and a lack of physical activity. Mental health issues such as depression and anxiety are also prevalent among adolescents (2). The epidemiological transition has coincided with rapid demographic changes, especially in low-income countries where health systems are largely not keeping pace with the demographic change. These changes have made adolescents more vulnerable and face many health problems, contributing to decreased economic

productivity, increased health expenditure, and intergenerational transmission of poor health, poverty, and discrimination (3).

Africa has the highest rates of disability-adjusted life years (DALYs) among adolescents (1). Out of the 68 countries classified as multi-burden countries globally. Many are located in sub-Saharan Africa (4). Despite progress in global health, adolescents in sub-Saharan Africa continue to face significant health challenges. Conditions related to sexual and reproductive health, lower respiratory infections, human immunodeficiency virus (HIV) infection, diarrheal diseases, neglected tropical diseases, nutritional deficiencies, and injuries remain the leading causes of premature mortality, morbidity, and total disease burden in this population (5).

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In Ethiopia, despite having a large proportion of an adolescent population, little is known about diseases and conditions that have substantially contributed to the disease burden among adolescents across the regional states and chartered cities over time. A lack of such information is a major barrier to improving the health and wellbeing of this population group. Adolescents face various health problems, including mental health issues, infectious diseases, and chronic illnesses. Poor mental health, for instance, can result in lower educational attainment and fewer employment opportunities, whereas chronic conditions can raise healthcare costs and lower productivity. Therefore, this study aimed to describe the trends of premature mortality, disability, and total burden of diseases among adolescents by age, sex, regional states, and chartered cities in Ethiopia from 1990 to 2019.

## Methods

### *Study setting*

In Ethiopia, adolescents comprised 23.4% of the total population in 2019, making them a sizable demographic group (6). Ethiopia, with a federal system of government, comprises 11 regions (Tigray, Afar, Amhara, Benishangul-Gumuz, Gambella, Harari, Oromia, Somalia, Sidama, Southern Nations, Nationalities, and People's (SNNP), and Southwest Ethiopia People's region) and two chartered cities (Addis Ababa and Dire Dawa) in 2020. The Sidama and Southwest Ethiopia People's regions were under the SNNP region in this analysis. Adolescent healthcare services in Ethiopia face several challenges, including limited access to quality care and information. Despite the country's efforts to improve adolescent healthcare services, many still struggle to access the care they need. This is particularly true in rural areas, where healthcare facilities are often scarce, and transportation can be difficult.

Additionally, cultural and social norms may discourage adolescents from seeking healthcare services or discussing sensitive topics with healthcare providers. To address these challenges, Ethiopia has implemented several initiatives to improve adolescents' health outcomes. These include expanding access to sexual and reproductive health services, increasing awareness about the importance of adolescent health, and strengthening healthcare systems to meet the needs of young people better. While progress has been made in recent years, there is still much work to ensure that all adolescents in Ethiopia have access to the care they need to lead healthy and fulfilling lives (7).

### **Data sources and analyses**

The findings on adolescent mortality and disability presented in this paper were produced by the Ethiopian Subnational Burden of I Disease Initiative, a collaborative endeavor between the National Data Management and Analytics Center for Health at the Ethiopian Public Health Institute (EPHI) and the Institute for Health Metrics and Evaluation (IHME) at the University of Washington, as part of the GBD study 2019. Regional states and chartered cities

mapped the data sources before processing the data in the GBD analysis based on the GBD protocol.

The GBD estimates are updated for the entire time series based on including new data and modifications to the methods. The spatiotemporal Gaussian process of regression transfers strength between points and over time for each relevant metrics. Thus, the 2019 GBD results take precedence over those from earlier rounds. Data from the census, demographic surveillance, household surveys, disease registry, health service utilization, and disease notification were used to estimating GBD adolescents in Ethiopia. This study's exhaustive list of data sources is available at: <http://ghdx.healthdata.org/gbd-2019/data-input-sources>.

### **GBD methods and tools**

The detailed GBD methods and techniques are described elsewhere. In brief, GBD has quantified the burden of premature mortality and disability by age, sex, and region for more than 369 diseases and injury causes 87 risk factors, and over 3000 disease sequels. The analysis quantified the burden of diseases among adolescents using premature mortality measured in years of life lost (YLLs), disability measured in years lived with disability (YLDs), and the total burden of disease measured in DALYs from 1990 to 2019. Adolescents aged 10–14 were categorized as early adolescents, and those aged 15–19 were categorized as late adolescents. The corresponding 95% uncertainty intervals (95% UI) were computed for all metrics to check for statistical significance in the trend. Rates were estimated per 100,000 population. The causes of disease and injury are closely related to the diagnostic categories of the International Classification of Diseases (ICD-9 and ICD-10) (8). The percentage decline was calculated for each metric by subtracting the 2019 estimate from the 1990 estimate, dividing the sum by the 2019 estimate, and multiplying by 100.

### **Ethics statement**

The research conducted as a component of the GBD collaborator network and following the GBD protocol (IHME ID: 4239-GBD2019-042022) resulted in this study. In adherence to the guidelines issued by the University of Washington's institutional review board (<https://www.healthdata.org/gbd/2019>), informed consent waiver was evaluated and sanctioned for GBD studies.

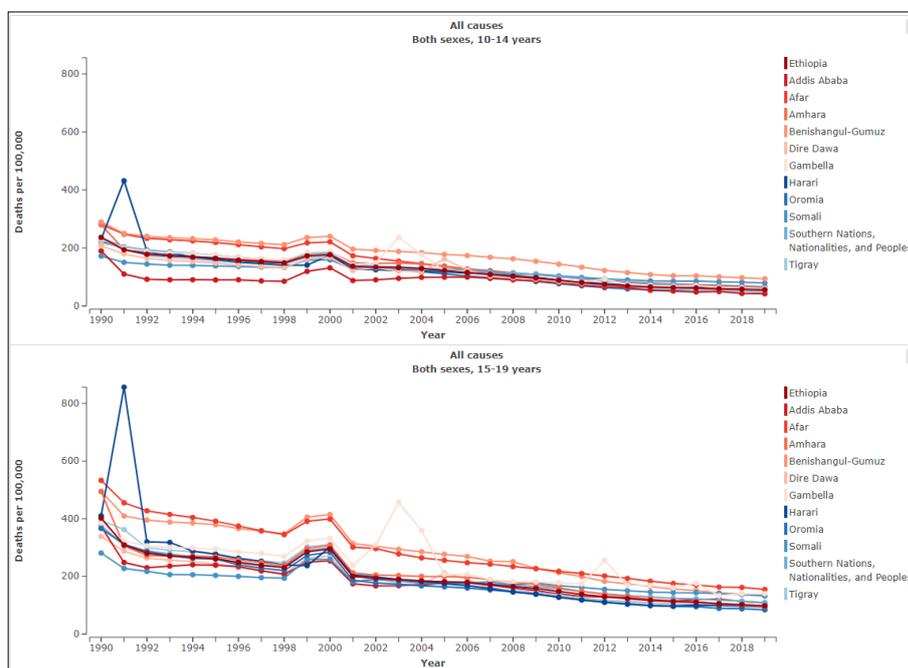
### **Results**

#### **Mortality**

The mortality rate trend among early adolescents declined from 237 deaths (226–248) in 1990 to 56 deaths (50–69) in 2019, making a percentage decline of 76.4%. The percentage decline was lower in Somalia [54.1%], Benshangul-Gumuz [67.5%], SNNP [73.2%], Gambella [74.3%], Harari [74.7%], and Dire Dawa [73.6%], whereas percentage decline was higher in Amhara [80.7%], Tigray [77.9%], Addis Ababa [77.9%], Oromia [77.6%], and Afar [76.9%]. In 2019, Addis Ababa had a lower than the national mortality rate [42 deaths (36–50)], whereas Benshangul-Gumuz

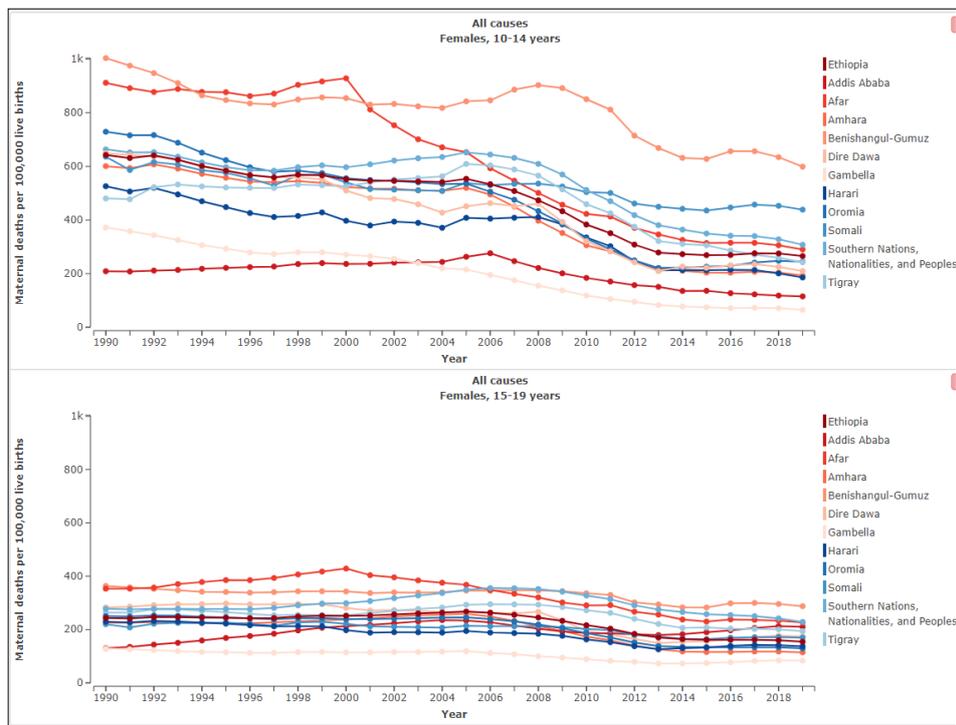
had a higher than the national mortality rate [94 deaths (81–109)]. Among late adolescents, the mortality rate trend declined from 402 deaths (384–423) in 1990 to 98 deaths (83–117) in 2019, making a percentage decline of 75.6%. The percentage decline was lower in Somalia [53%], Gambella [63.6%], Afar [70.9%], SNNP [71%], Addis Ababa [71%], Dire Dawa [72.3%], and Benshangul-Gumuz [72.9%], whereas the percentage decline was higher in Amhara [80.6%], Oromia [77%], Tigray [76.4%], and Harari [76.9%]. In 2019, the Afar region had a significantly higher

mortality rate than the national rate [155 deaths (120–193)] (**Figure 1**).



**Figure 1: Trends of deaths due to all causes per 100,000 adolescents in Ethiopia and regional states, 1990–2019.** During the transitional period in 1991, which armed group violence and led to peaks in Harari. In Gambella, fighting broke out in 2003 between mobs and armed groups. In addition, forceful evictions and villagization in Gambella in 2012 led to disputes between the government and landowners. Heavy flooding in 2005 left hundreds of people dead and hundreds more missing in Dire Dawa. The population in these three regions is also much lower than half a million, which raises the mortality rate even in small-scale incidents. In 1999 and 2000, there was a war between Ethiopia and Eritrea.

The trend of the maternal mortality rate among early adolescents declined from 642 deaths (328–1,186) in 1990 to 266 deaths (142–470) in 2019. Among late adolescents, the maternal mortality rate declined from 243 deaths (167–332) in 1990 to 154 deaths (103–221) in 2019. However, the decline was not statistically significant in all regions since the interval estimates crossed over (**Figure 2**).



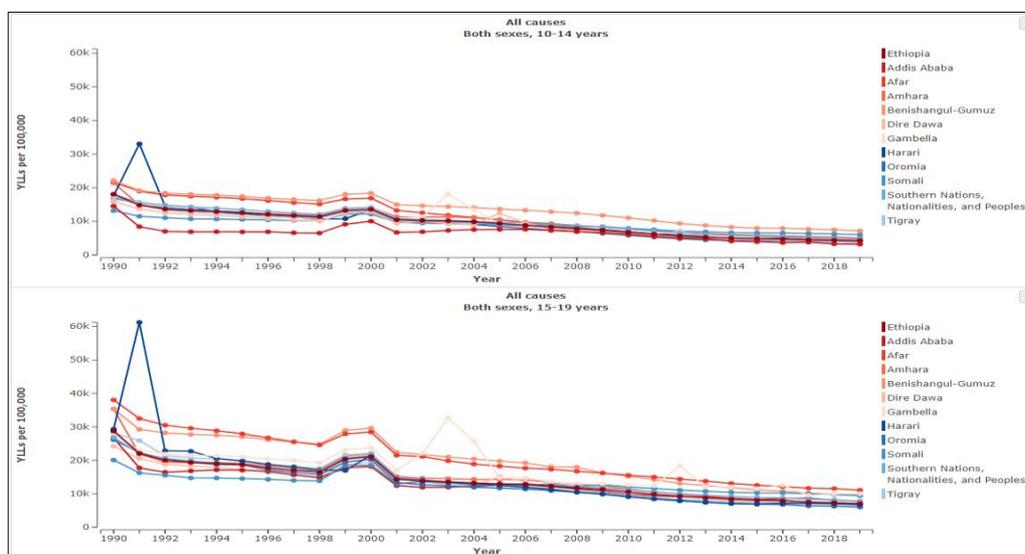
**Figure 2: Trends of maternal deaths per 100,000 live births among adolescents in Ethiopia and regional states, 1990–2019**

The major causes of death among early adolescents were enteric infections [9 deaths (6–14)], HIV/AIDS and sexually transmitted infections [7 deaths (5–9)], unintentional injuries [6 deaths (5–8)], other infectious diseases [6 deaths (4–7)], tuberculosis and respiratory infections [5 deaths (4–7)], and neglected tropical diseases and malaria [4 deaths (2–8)]. Likewise, the leading causes of death among late adolescents were HIV/AIDS and sexually transmitted infections [16 deaths (8–25)], enteric infections [10 deaths (7–16)], tuberculosis and respiratory infections [10 deaths (8–12)], self-harm and violence [9 deaths (7–12)], transport injuries [7 deaths (6–9)], and other infectious diseases [7 deaths (5–7)].

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

The trend of YLLs among early adolescents declined from 18,093 years lost (17,264–19,008) in 1990 to 4,264 years lost (3,788–5,276) in 2019, making a percentage decline of 76.4%. The percentage decline was lower in Somalia [53.9%], Benshangul-Gumuz [67.6%], Dire Dawa [73.4%], SNNP [73.4%], Harari [74.8%], and Gambella [75%], whereas the percentage decline was higher in Amhara [80.9%], Tigray [78%], Addis Ababa [77.9%], Oromia [77.8%], and Afar [76.8%]. There was a sharp increase in YLLs in Harari in 1991 [33,035 years lost (30,525–35,811)], Gambella in 2003 [18,107 years lost (15,720–20,283)], and Dire Dawa in 2005 [12,378 years lost (10,399–14,274)]. Among late adolescents, the trend of YLLs declined from 28,769 years lost (27,439–30,266) in 1990 to 7,015 years lost (5,949–8,372) in 2019, making a percentage decline of 75.6%. The percentage decline

was lower in Somalia [53%], Gambela [63.7%], SNNP [70.9%], Afar [70.9%], Dire Dawa [72.2%], Benshangul-Gumuz [73%], and Addis Ababa [72.9%], whereas the percentage decline was higher in Amhara [80.7%], Harari [77%], Tigray [77%], and Oromia [76.7%] (**Figure 3**).



**Figure 3: Trends of YLLs due to all causes per 100,000 adolescents in Ethiopia and regional states, 1990–2019.** In 1991, there was an armed group conflict in Harari. In 2003, there was a conflict between mobs and armed groups in Gambella. In addition, there was a clash between the government and landowners in Gambella in 2012 due to forceful displacement. In 1999 and 2000, there was a war between Ethiopia and Eritrea.

The leading causes of YLLs among early adolescents were enteric infection [670 years lost (437-10,29)], HIV/AIDS and sexually transmitted infections [504 years lost (389-668)], unintentional injuries [459 years lost (350-605)], other infectious diseases [421 years lost (327-558)], tuberculosis and respiratory infections [392 years lost (312-505)] and neglected tropical diseases and malaria [316 years lost (147-611)]. Similarly, the top causes of YLLs among late adolescents were HIV/AIDS and sexually-transmitted infections [1,114 years lost (551-1,812)], enteric infections [744 years lost (466-1,156)], tuberculosis and respiratory infections [718 years lost (575-878)], self-harm and violence [663 years lost (521-835)], transport injuries [530 years lost (411-677)],

unintentional injuries [506 years lost (396-639)], other infectious diseases [487 years lost (384-618)], and maternal and neonatal disorders [373 years lost (250-534)].

#### Years lived with disability (YLDs)

The YLDs among early adolescents were reduced from 6,522 years (4,610–8,888) in 1990 to 5,539 years (3,981–7,504) in 2019. Among late adolescents, the trend of YLDs declined from 7,726 years (5,511–10,336) in 1990 to 6,577 years (4,810–8,690) in 2019. However, the decline was not statistically significant in all regions since the interval estimates crossed over (Figure 4).

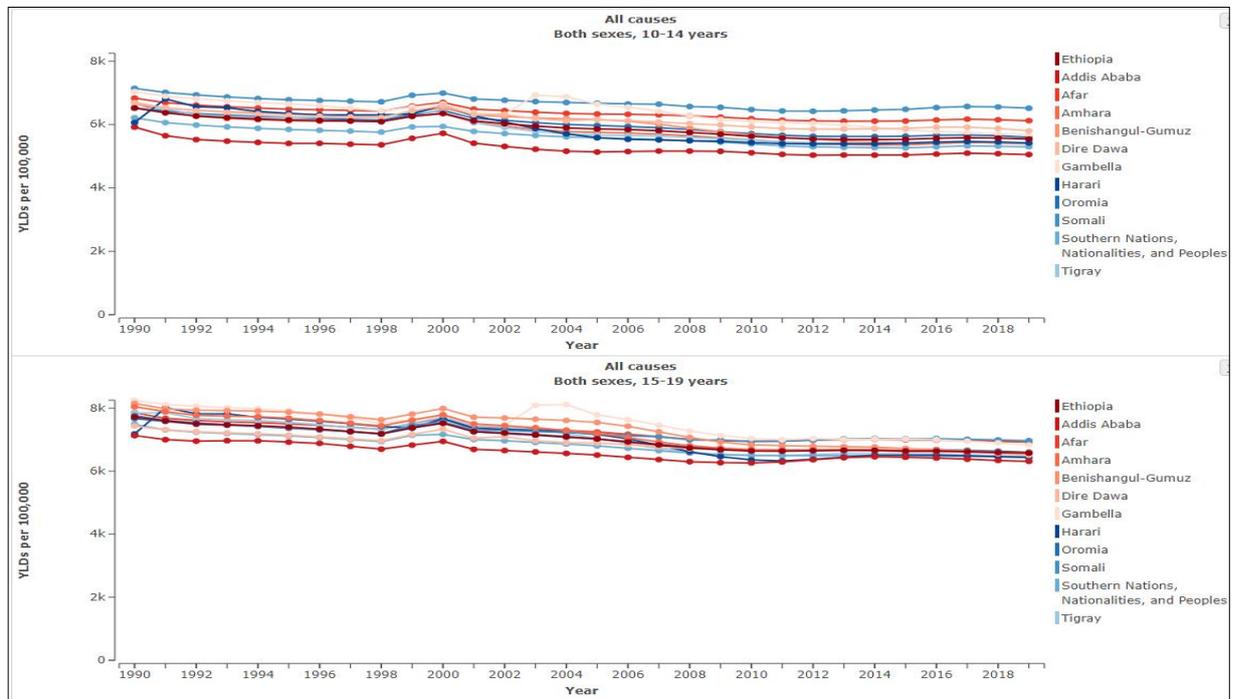
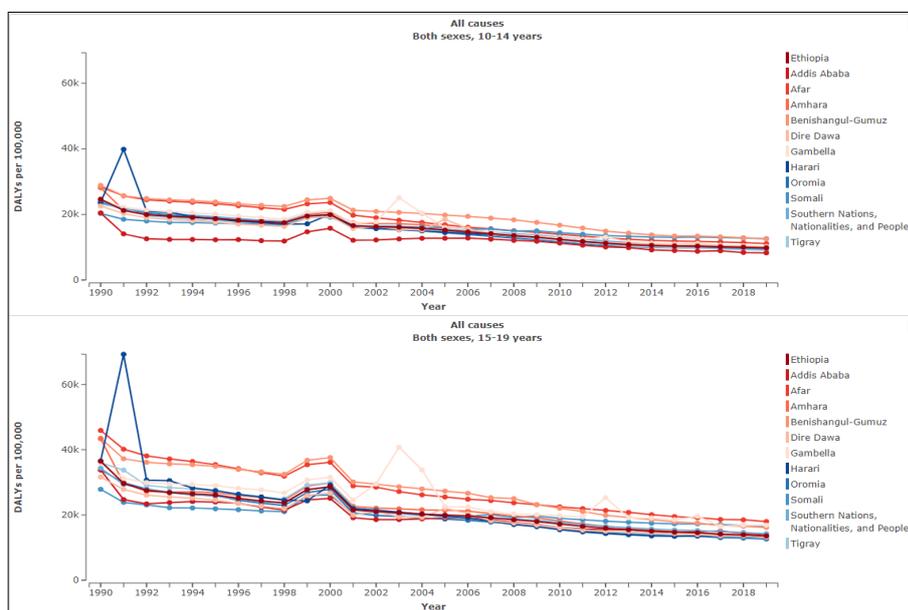


Figure 4: Trends of YLDs due to all causes per 100,000 adolescents in Ethiopia and regional states, 1990–2019. There was an armed conflict in Harari in 1991, Gambella in 2003 and 2004, and Ethiopia-Eritrea in 1999 and 2000.

#### Disability-adjusted life years (DALYs)

A sharp decline in DALYs among early adolescents between 1990 and 2019, from 24,615 years (22,598–27,127) to 9,803 years (8,153–11,815), making a percentage decline of 60.2%. The percentage decline was lower in Somali [38%], Dire Dawa [55.5%], Benshangul-Gumuz [56.5%], Harari [58.3%], SNNP [58.3%], Gambella [58.6%], and Addis Ababa [59.3%], whereas the percentage decline was higher in Amhara [66.2%], Tigray [60.9%], and Afar [60.8%]. On the other hand, the percentage decline in the Oromia region was consistent with the national average decline [60.2%] (Figure 5). From 1990 to 2019, there was a reduction in the trend of DALYs among male adolescents from 26,505 years (24,205–29,125) to 10,329 years (8,588–12,338), whereas the reduction was from 22,565 years (20,473–24,992) to 9,248 years (7,539–11,314) among female adolescents.

The trend of DALYs among late adolescents has decreased from 36,494 years (33,987–39,428) in 1990 to 13,591 years (11,433–16,068) in 2019, making a percentage decline of 62.8%. The percentage decline was lower in Somalia [41.1%], Gambella [53%], Dire Dawa [58.2%], Addis Ababa [58.5%], SNNP [58.5%], and Afar [60.8%], whereas the percentage decline was higher in Amhara [69.1%], Harari [63.9%], and Tigray [63.7%]. On the other hand, the percentage decline in Oromia and Benshangul-Gumuz regions was nearly consistent with the national average decline [62.7% and 62.9%, respectively] (Figure 5). From 1990 to 2019, there was a reduction in the trend of DALYs among male adolescents from 42,957 years (39,758–46,420) to 14,513 years (12,400–16,966), whereas the reduction was from 29,927 years (27,334–32,870) to 12,637 years (10,277–15,418) among female adolescents.



**Figure 5: Trends of DALYs due to all causes per 100,000 adolescents in Ethiopia and regional states, 1990-2019.** There was an armed conflict in Harari in 1991, Gambella in 2003 and 2012, Ethio-Eritrea in 1999 and 2000, and heavy flooding in Dire Dawa in 2005.

The leading causes of DALYs among early adolescents in 2019 were mental disorders [1,066 years (719-15,38)], skin diseases [878 years (541-1,396)], enteric infections [788 years (539-1,140)], malaria and neglected tropical diseases [767 years (504-1,124)], nutritional deficiencies [637 years (419-928)], unintended injuries [627 years (502-795)], and HIV/AIDS and sexually transmitted infections [542 years (417-715)]. Mental disorders were the leading causes of DALYs in Amhara [1,067 years (715-1,546)], Harari [1,051 years (702-1,497)], Oromia [1,065 years (715-1,528)], SNNP [1,071 years (718-1,543)], and Tigray [1,059 years (711-1,527)], and the second leading cause in Addis Ababa [1,043 years (693-1,520)], Afar [1,071 years (724-1,529)],

Benshangul-Gumuz [1,074 years (712-1,537)], Dire Dawa [1,046 years (703-1,521)], Gambella [1,063 years (715-1,523)]. Moreover, skin diseases were the second leading cause of DALYs in Amhara [945 years (586-1,485)] and Oromia [878 years (543-1,405)] regions, whereas enteric infections were the top leading cause in Benshangul-Gumuz [1,328 years (893-1,960)]. Nutritional deficiencies were the top leading causes of DALYs in Afar [1,157 years (704-1,804)] and Somalia [1,620 years (996-2,454)] regions, whereas HIV/AIDS and sexually transmitted infections were the top leading causes of DALYs in Addis Ababa [1,418 years (1,122-1,755)], Dire Dawa [1,332 years (920-1,885)], and Gambella [1,649 years (1,147-2,220)] regions (Table 1).

	Ethiopia	Addis Ababa	Afar	Amhara	Benshangul-Gumuz	Dire Dawa	Gambella	Harari	Oromia	Somali	SNNP	Tigray
Mental disorders	1	2	2	1	2	2	2	1	1	3	1	1
Skin diseases	2	3	4	2	6	4	4	3	2	7	3	3
Enteric infections	3	6	3	4	1	6	5	6	4	2	4	5
NTDs & malaria	4	13	9	3	5	5	3	4	3	6	5	2
Nutritional deficiencies	5	8	1	11	9	3	6	5	5	1	7	6
Unintentional inj	6	9	7	6	4	9	9	9	7	5	2	8
HIV/AIDS & STIs	7	1	6	5	8	1	1	2	10	10	14	4
Other non-communicable	8	7	10	7	10	7	7	7	6	9	8	7
Respiratory infections & TB	9	10	8	8	3	11	11	10	8	8	6	11
Other infectious	10	14	5	10	7	12	12	11	11	4	9	12
Neurological disorders	11	5	11	9	11	8	8	8	9	11	10	9
Maternal & neonatal	12	4	12	12	16	10	10	12	12	12	11	10
Neoplasms	13	11	13	13	12	13	14	13	13	14	12	13
Chronic respiratory	14	12	15	14	18	14	13	15	14	18	15	14
Transport injuries	15	19	14	15	13	15	16	14	15	13	13	16
Digestive diseases	16	17	17	17	14	16	18	17	17	15	17	18

**Table 1: The leading causes of DALYs per 100,000 early adolescents in Ethiopia and regional states, 2019**

The leading causes of DALYs among late adolescents in 2019 were mental disorders [1,563 years (1,065-2,158)], HIV/AIDS and sexually transmitted infections [1,161 years (603-1,858)], skin diseases [921 years (589-1,433)], tuberculosis and respiratory infections [919 years (756-1,116)], enteric infections [865 years (584-1,275)], and maternal and neonatal disorders [764 years (602-955)]. Mental disorders were the leading cause of DALYs in Benshangul-Gumuz [1,562 years (1,071-2,170)], Harari [1,558 years (1,079-2,160)],

Oromia [1,568 years (1,074-2,155)], Somalia [1,541 years (1,064-2,131)], SNNP [1,566 years (1,077-2,175)], and Tigray [1,557 years (1,077-2,165)] regions. Furthermore, HIV/AIDS and sexually transmitted infections were the top leading causes of DALYs in Addis Ababa [2,881 years (1,362-4,996)], Afar [2,357 years (1,003-4,234)], Amhara [1,744 years (888-2,857)], Dire Dawa [2,103 years (920-3,852)], and Gambella [3,613 years (1,417-6,659)] regions (**Table 2**).

	Ethiopia	Addis Ababa	Afar	Amhara	Benshangul-Gumuz	Dire Dawa	Gambella	Harari	Oromia	Somali	SNNP	Tigray
Mental disorders	1	2	3	2	1	2	2	1	1	1	1	1
HIV/AIDS & STIs	2	1	1	1	5	1	1	2	3	3	11	2
Skin diseases	3	3	9	3	6	3	5	3	2	9	5	3
Respiratory infections & TB	4	4	2	4	2	5	4	4	6	2	3	4
Enteric infections	5	11	4	5	3	8	6	7	4	4	4	6
Maternal & neonatal	6	6	6	11	4	9	13	9	5	5	7	5
Unintentional inj	7	10	8	9	7	10	7	11	10	7	2	11
Self-harm & violence	8	8	7	8	8	6	3	8	11	8	6	9
Neurological disorders	9	5	12	7	10	4	8	5	8	11	8	7
Other non-communicable	10	7	10	10	12	7	11	6	9	10	10	10
NTDs & malaria	11	21	15	6	13	12	10	12	7	13	12	8
Transport injuries	12	9	11	12	11	11	9	10	12	12	9	12
Other infectious	13	14	5	13	9	15	12	13	13	6	13	14
Cardiovascular diseases	14	12	13	14	14	13	14	14	14	15	14	13
Digestive diseases	15	15	16	15	15	16	15	15	16	16	15	15
Neoplasms	16	13	17	17	16	17	16	16	17	17	16	16

**Table 2: The leading causes of DALYs per 100,000 late adolescents in Ethiopia and regional states, 2019**

Among adolescents of both age groups, the causes of DALYs on the bottom list in 1990 shifted to the top in 2019 and vice versa (**Table 3**).

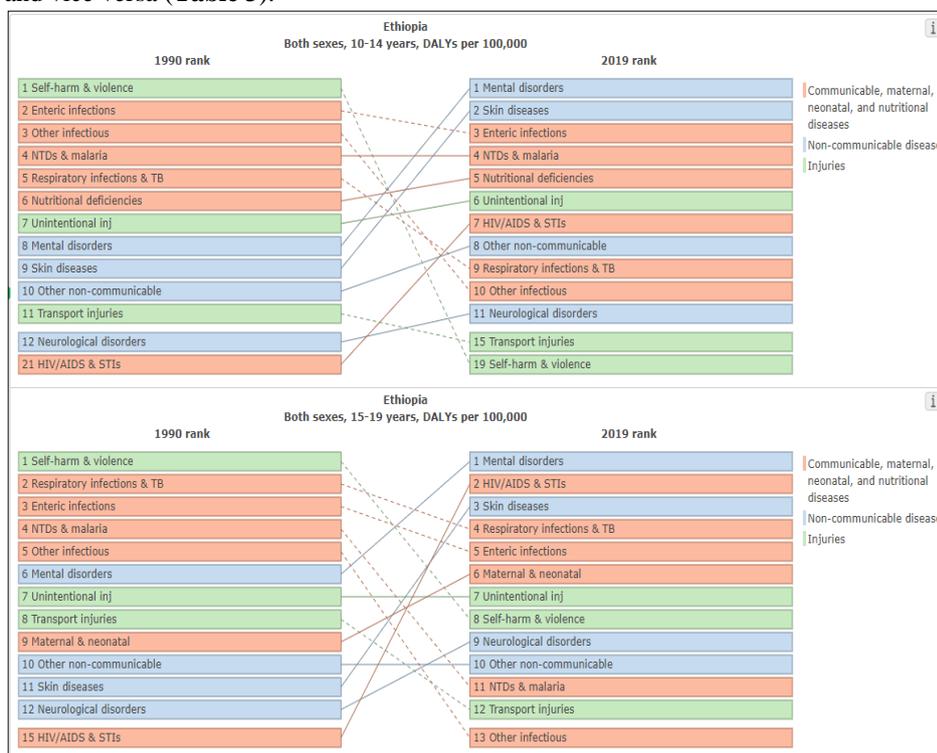


Table 3: The leading causes of DALYs per 100,000 adolescents in Ethiopia, 1990–2019

### Discussion

This study used the 2019 GBD data to describe the trends of premature mortality, disability, and total burden of diseases among adolescents by age, sex, regional states, and chartered cities in Ethiopia from 1990 to 2019. The study revealed a decreasing trend in the burden of diseases among adolescents from 1990 to 2019, except for the maternal mortality rate. Moreover, there were small variations in the trend of the burden of diseases at the sub-national level. The top contributing causes for the total burden of diseases were mental disorders, HIV/AIDS and sexually transmitted infections, skin diseases, enteric infections, malaria and neglected tropical diseases, nutritional deficiencies, unintended injuries, tuberculosis and respiratory infections, and maternal and neonatal disorders. In addition, those causes of DALYs on the bottom list in 1990 shifted to the top in 2019.

From 1990 to 2019, there was no significant decrement in the trend of the maternal mortality rate among adolescents in Ethiopia, and the rate remained high. The reasons for this trend are multifaceted and complex, but some contributing factors include limited access to quality healthcare services, inadequate maternal education and awareness, and socio-cultural norms that perpetuate harmful practices during pregnancy and childbirth (9). In order to address this issue, there needs to be a concerted effort from the government, healthcare providers, community leaders, and civil society organizations to improve maternal health outcomes. This can be achieved by increasing access to prenatal care services, providing comprehensive maternal health education programs, promoting evidence-based practices during childbirth, and addressing harmful cultural practices that put mothers at risk. Action must be taken now to reverse the trend of increasing maternal mortality rates in Ethiopia and ensure that all mothers have access to safe and quality healthcare services.

Nationally, there were decreasing trends in YLLs and DALYs among adolescents from 1990 to 2019. These health gains were realized due to a strong government commitment to improving the health and wellbeing of citizens. There have been increasing investments in health over the past three decades. To mention some, health service delivery at community levels was expanded through the health extension program, community-based health insurance packages, health facility construction, medical equipment and essential drugs, a community-based health information system, and skilled human resources. Furthermore, programmatic interventions like task shifting, free health services for the poor, and diagnostic and treatment cost exemptions for HIV/AIDS, tuberculosis, and maternity services could also have paramount impacts (10). However, the study has also revealed small variations in the burden of diseases among adolescents at the sub-national level during the study period. For example, the highest reductions were

observed in the Amhara region, whereas the lowest reductions were observed in Somalia. These findings suggest that targeted interventions may be necessary to address the disparities in disease burden among adolescents in different regions of Ethiopia. Such interventions could include increased access to healthcare services, improved health education programs, and greater investment in public health infrastructure. Additionally, it may be important to consider the unique cultural and socioeconomic factors that contribute to differences in disease burden across regions (11).

The leading causes of the total disease burden among adolescents were mental disorders, HIV/AIDS and sexually transmitted infections, skin diseases, enteric infections, malaria and neglected tropical diseases, nutritional deficiencies, unintended injuries, tuberculosis and respiratory infections, and maternal and neonatal disorders. These findings agree with previous epidemiological evidence of the triple burden of communicable diseases, non-communicable diseases, and injuries (9). This data emphasizes the pressing need for all-encompassing healthcare systems that cater to the various healthcare requirements of the adolescent population. Healthcare systems must prioritize non-communicable illnesses like mental disorders and maternal and neonatal disorders, in addition to preventing and treating communicable diseases like HIV/AIDS, tuberculosis, and malaria. For overall health, treating nutritional deficiencies is also essential. Moreover, healthcare systems must work to reduce unintentional injuries like those caused by falls, drowning, fire, heat, and hot substances by providing access to emergency care, educating the public, and improving infrastructure (12-14).

The study also found that the causes of DALYs at the bottom of the list in 1990 were now at the top in 2019, indicating the need to track the epidemiologic shift in diseases and health risks (1, 9, 11). This shift highlights the importance of ongoing research and analysis to identify emerging health threats and prioritize resources accordingly. Additionally, it underscores the need for continued investment in preventative measures, such as vaccination campaigns and public health education programs. By taking a proactive approach to disease prevention and management, we can reduce the overall burden of diseases, improve quality of life, and promote economic growth. To achieve this goal, we must work collaboratively across sectors to develop innovative solutions that address the complex interplay between social determinants of health, environmental factors, and individual behaviors. By leveraging data-driven insights and investing in evidence-based interventions, we can build a healthier future for all.

This systematic analysis used the 2019 GBD study data, a comprehensive and robust estimation of disease burden across nations around the globe. However, it

should be noted that data on adolescents are poor in quality and adequacy globally (5, 15, 16). Hence, in order to address the compromised quality of primary data, GDB employs modeling techniques. However, it is important to note that these models can potentially overestimate or underestimate the actual burden of diseases in adolescents..

### Conclusion

The study has revealed a decreasing trend in the burden of diseases among adolescents from 1990 to 2019, with slight inter-regional variations. Adolescents suffer a triple burden of communicable, maternal, neonatal, and nutritional conditions, non-communicable diseases, and injuries. Therefore, interventions to address adolescents' health issues should include increased access to healthcare services, improved health education programs, regional disease distributions, and greater investment in public health infrastructure.

**Conflict of interest:** We declare that we have no competing interests.

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**Data availability statement:** The datasets used for this study are available in the IHME data repository and can be accessed directly from <http://ghdx.647healthdata.org/gbd-results-tool>

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