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Original Article

Epidemiologic pattern of COVID-19 pandemic in East Africa

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Abstract

Introduction: *Coronavirus disease 2019 (COVID-19) is a global pandemic upending the health, political and economic landscape of the world. Knowledge about COVID-19 has evolved very fast and the epidemiologic pattern is far from comprehensive. Therefore, the primary aim of this study was to map the epidemiology of COVID-19 in Ethiopia in the past two years and to draw lessons for effective control measures.*

Methods: *A prospective synthesis on reports of new infections and mortality due to COVID-19 infection in Ethiopia from the first index case report in March 13, 2020 until June 20, 2022. Number of new cases, deaths and recoveries were extracted on daily bases from publicly available sources. Descriptive analysis was conducted, and trends were graphically depicted.*

Results: *Ethiopia is currently in the fifth wave of COVID-19 pandemic, sharing the global trend. So far, more than 5 million tests were carried out with 484,536 people (9.58%) with confirmed disease. The severity rate has declined with every wave with the most severe illness having occurred in the first wave and the least severe in the latest wave. Thus, the Case Fatality Rate (CFR) has declined from 4.7 in the first wave to 1.5 in the 4th wave. So far, 21% of the population has been fully vaccinated.*

Conclusion: *While the decline in mortality is encouraging, knowledge about the pandemic and vaccination trends remain poor. Continued efforts to understand the pandemic in Ethiopia and addressing barriers to vaccination are urgent priorities.*

Keywords*: COVID-19, epidemiologic pattern, global pandemic, public health control*

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Introduction

The novel coronavirus disease first emerged in Wuhan city, China, with a cluster of unknown pneumonia cases diagnosed in December 2019 [1]. In less than three months, the outbreak has reached multiple continents and was declared a pandemic on March 11, 2020 [2]. By June 20, 2022 the disease has affected 228 countries and territories of the world with more than 546 million infections and 6.3 million deaths [3]. The pandemic revealed how interconnected the world is and exposed how the health care system globally, not just systems in low-income settings, was unprepared to deal with major public health threats [4]. In this globalized and interconnected world, an outbreak of a highly contagious infectious disease in one country can spread quickly across the world. Improved early detection and preparedness play a crucial role in preventing an outbreak from having an extensive impact [5].

In addition to its catastrophic effect on the health care system, the coronavirus pandemic has created several disruptions of systems worldwide including education and economy [6]. Before the pandemic, the world was already facing an education crisis

and COVID-19 exacerbated pre-existing disparities between developed and developing countries. Closures of schools and other learn-ing spaces have impacted 94 percent of the world's student population, up to 99 percent in low and lower-middle income countries [8]. It has taken 1.6 billion learners out of school in more than 190 countries and all continents [7, 8].

According to the world economic forum report, students now risk losing $17 trillion in lifetime earnings in present value, or about 14% of today's global GDP, because of COVID-19 related school closures and economic shocks [9]. The pandemic has also caused short and long-term damage to economies and living standards for many people. It has put unprecedented pressure on governments to maintain essential services and keep their economies running. The virus threatens people's daily life on every level and the situation is worse in low- and middle-income countries particularly in Sub-Saharan Africa [10,11].

Knowledge about COVID-19 and its pathogenesis has evolved quickly. Relatively consistent findings were reported on the clinical manifestations [12-15], mode of transmission [3, 16], and its risk factors [13, 17, 18]. The overall burden of the disease, particularly the number of confirmed cases and deaths across the world, is changing constantly to the extent that predicting the future epidemiologic pattern has proven difficult. The varying case fatality rate in different countries also warrants explanation [3, 19].

Even though the discoveries of several vaccines and supportive treatments brought a significant reduction in the transmissibility and severity of the disease, countries have to monitor the epidemiologic pattern continuously and closely to put in place appropriate public health control measures, which can be adapted to changing disease patterns. This is particularly important in the current pandemic where the emergence of new variants continues to be a major public health concern.

This study aimed to determine the epidemiology of COVID-19 in Ethiopia and look into a change in the disease pattern driven by major events in the past two years. We also aimed to draw lessons from past and ongoing public health control measures and their effect on the disease pattern.

Methods

Study design and selected countries

A prospective synthesis approach was used to evaluate COVID-19 incidence in Ethiopia and mortality secondary to the infection in the past 26 months (March 13, 2020 to June 20, 2022). In addition, the number of new and total number of COVID-19 cases in Ethiopia were compared with neighboring East African countries namely: Eritrea, Sudan, Kenya, Somalia, and Djibouti. Subsequently, the proportions of incident cases from these five countries were compared.

Data abstraction and analysis procedures

Quantitative data on the number of new cases, deaths and recoveries were obtained from the data bases available at the Worldometer [3], our world in data [19], Johns Hopkins University [20], World Health Organization (WHO) [1], and Africa Center for Disease Preventions and Control (Africa CDC) [21, 22]. These databases were selected as they are the main sources of COVID-19 related global data and they provide reliable, original, and comprehensive data about the pandemic. Ethiopian Health Data [23], Ethiopian Public Health Institute (EPHI) [24], and the Ethiopian Ministry of Health websites [25] were reviewed as the main sources of data at the national level.

Publications in the British Medical. Journal, JAMA, the Lancet, Nature, and the New England Journal of Medicine were reviewed to identify typical interventions and explore the explanations for the outcomes. Articles published in local journals such as Ethiopian Medical Journal and Ethiopian Health Development were reviewed as important repositories of local knowledge. Scientific justifications were also sought by attending different webinars [26], international and national debriefings, and meetings as well as news media and expert opinions.

We tracked number of daily tests, new cases, and number of severely ill and dead on a daily basis between May 1, 2021 and June 20, 2022, the period when such details became available. Data from the reports were extracted into Microsoft Excel 2013 for analysis. Descriptive analysis was conducted to calculate frequencies, proportions, and positivity and severity rates. The case fatality rate was computed by dividing the total number of deaths due to COVID-19 by the total number of COVID-19 cases. The positivity rate was calculated by dividing the number of positive tests by the number of total COVID tests. Line graph, area graph, and bar graph were used to depict trends. The distribution of the cases was presented using a map of Ethiopia.

Throughout the process, the multidisciplinary research team of the knowledge synthesis unit (now Unit for Health Evidence and Policy) at the Center for Innovative Drug Development and Therapeutic Trials for Africa (CDT-Africa), Addis Ababa University, had virtual meetings at least three times per week in the first year of the pandemic and as frequently as needed in the year 2021. Findings of relevance, timeliness, methodological, and scientific plausibility of the extracted information were discussed in these meetings.

Result

By June 20, 2022, there were a total of 484,536 cases, 7524 deaths and 458,374 recoveries from COVID-19 in Ethiopia (Fig 1). This is the highest number of cases reported in East Africa followed by Kenya (329,605cases) and Sudan (62,521cases). Two third (66.89%) of the total COVID-19 cases were reported from Addis Ababa, 15.02% from Oromia and 5.37% from SNNPR regions (Fig 1).

Eritrea has a relatively low number of cases (9777 cases) in the region and only 103 deaths were reported as of June 2022. However, by considering the total population in these countries, Djibouti is the leading country with a total of 15,656 cases per one million population while Ethiopia was the third country with 4,110 cases per million people (Fig 2).

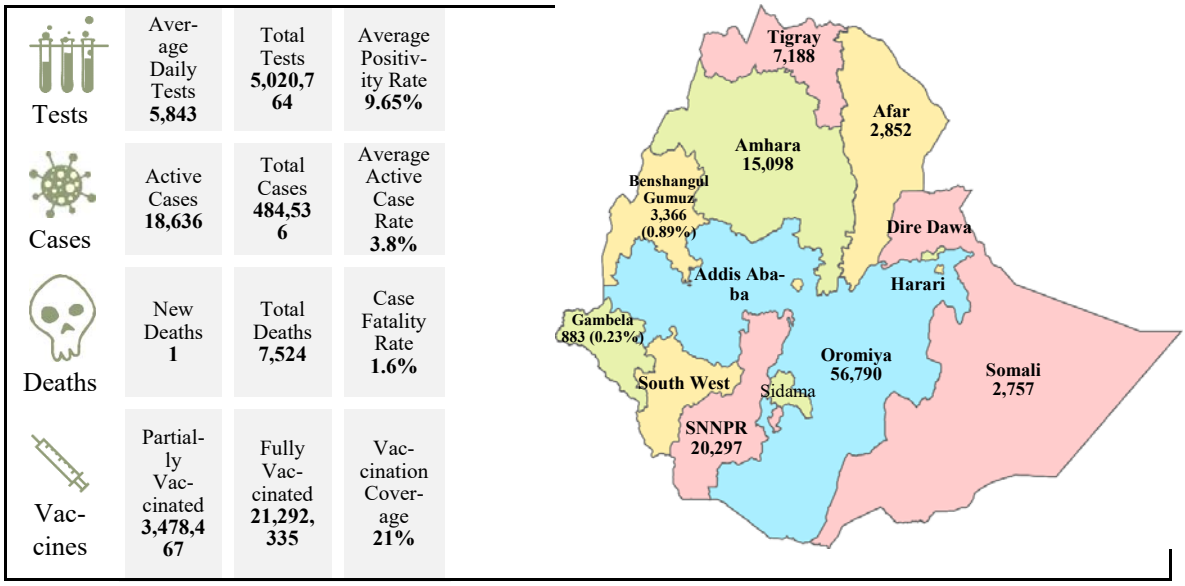

Figure 1: Profile of COVID-19 tests, cases, vaccine coverage and deaths in Ethiopia since the first report of COVID-19 to June 20, 2022, and case distribution by region (up to Jan 31, 2022).

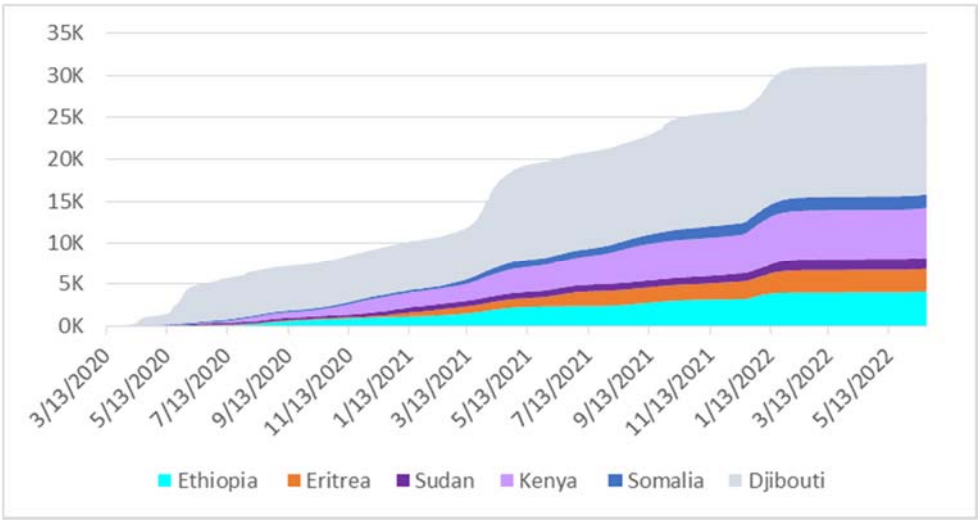

Figure 2: Total COVID-19 cases per million in Ethiopia comparing with neighboring countries from March 13, 2020 to June 2022

Ethiopia is currently on the fifth wave of COVID-19. In the first three months of the pandemic, the number of new cases was increasing slowly as almost all cases were identified among the people isolated in quarantine centers. Subsequently, the community transmission began to exceed the reports from quarantine centers with most of the cases identified through active surveillance and contact tracing. As a result, this number rose swiftly, especially starting from July 2020 until October 2020.

The second wave occurred between February 2021 and May 2021 while the third continued from August 2021 until Mid-November 2021.

The third and the biggest wave so far started in mid-December 2021 and the highest number of new cases (5,185 cases) was reported on December 28th, 2021. The fifth wave started in Mid-May 2022, and the number of new cases has continued to rise. Similarly, neighboring countries have experienced similar pattern of COVID-19 waves over the past 26 months except for Kenya, which is passing through a sixth wave (Fig 3).

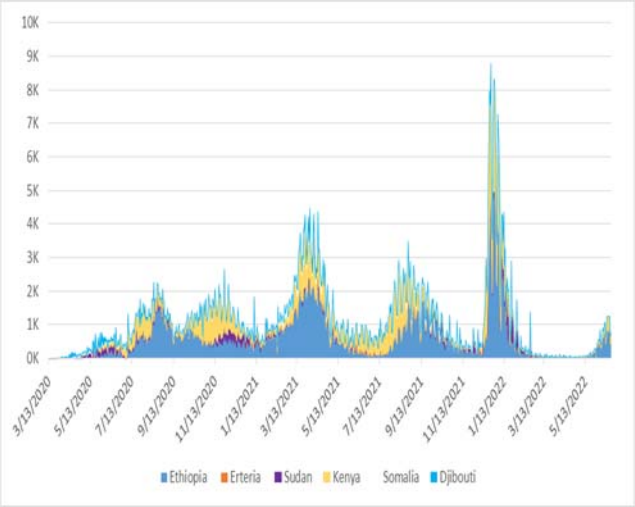

Figure 3: Number of new COVID- 19 cases and disease waves in Ethiopia compared with neighboring countries, June 2020 to June 2022

Next to Eritrea, a comparably lower number of deaths (63 deaths per million people) was reported in Ethiopia. Even though Djibouti is one of the countries in the region with a low absolute number of cases (15,690 cases), the relative number of deaths reported until the date of reporting was higher (188 deaths per million people) compared to other neighboring countries (Fig 4).

At the beginning of the pandemic, the Case Fatality Rate (CFR) in three of the countries was high ranging between 8.3 in Somalia to 4.7 in Ethiopia. The rate has gradually declined to below 2 (Supplementary file 1).

Ethiopia started in country Polymerase Chain Reaction (PCR) tests for SARS-CoV-2 in February 2020 in just one center until 2nd April when the testing centers increased to three. By the end of July 2020, the number of laboratories has increased to 46 and the overall testing capacity reached 11,000 tests per day. Initially, the testing was only for suspected cases and those with special indications.

The testing case definition then expanded to include all people under mandatory quarantine, those in the Intensive Care Unit (ICU), all those with respiratory symptoms, and essentially all deaths in hospitals. Currently, there are laboratories all over the country that perform both PCR and rapid tests. As of June 20, 2022, a total of 5,020,764 laboratory tests were carried out with a positivity rate of 9.58% (Fig 1). The severity rate was high relative to positivity rates in the second and third waves of the epidemic. However, the severity rate was declining over time despite the rising positivity rate during the fourth and fifth waves (Fig 5).

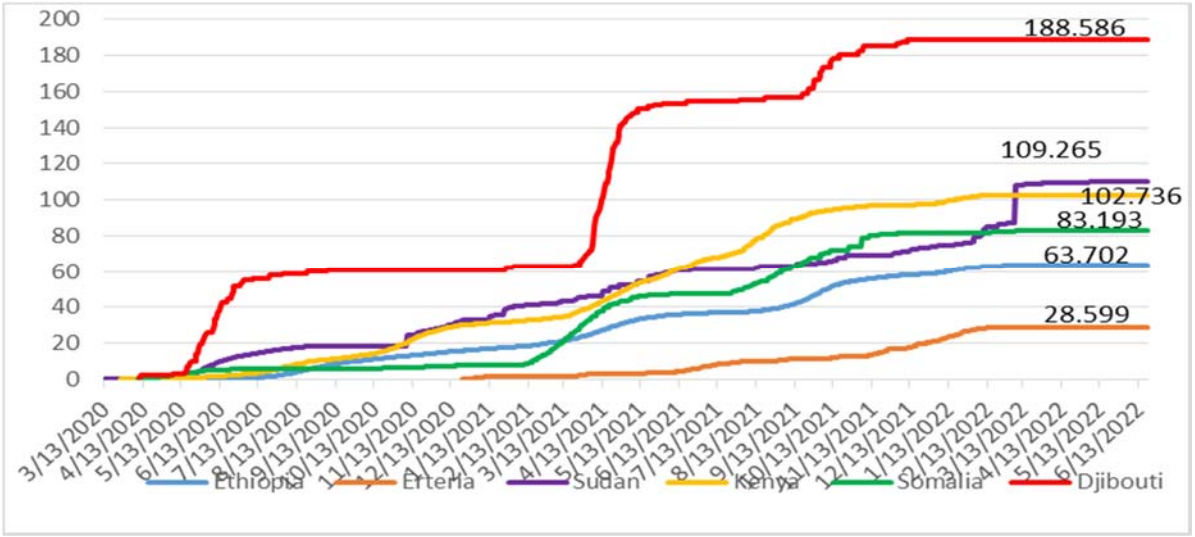

Figure 4: Total COVID-19 deaths per million from March 13, 2020 to June 2022

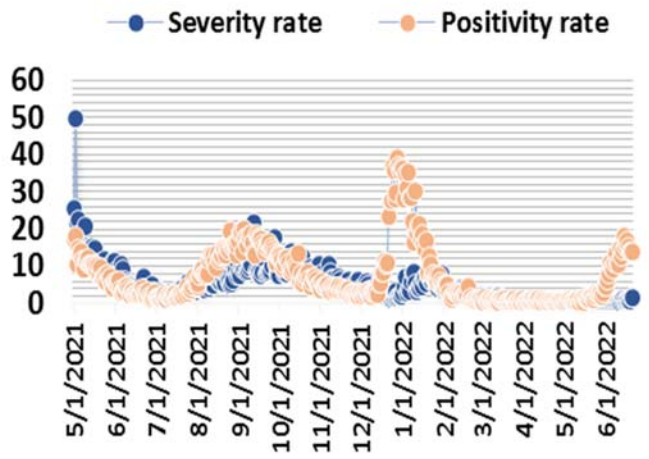

Figure 5: Ethiopia- COVID-19 Test Positivity and Severity Rates, May 2021 to June 2022

Ethiopia has administered at least 50,868,663 doses of COVID vaccines which accounted for 21 % of the country's population. Out of this, 21,292,335 (18 %) were fully vaccinated. A similar proportion of people (19%) were vaccinated in Djibouti with the vast majority fully vaccinated (15%). Kenya has the highest vaccination coverage (23%) in the region and more than two third were fully vaccinated (Fig 6).

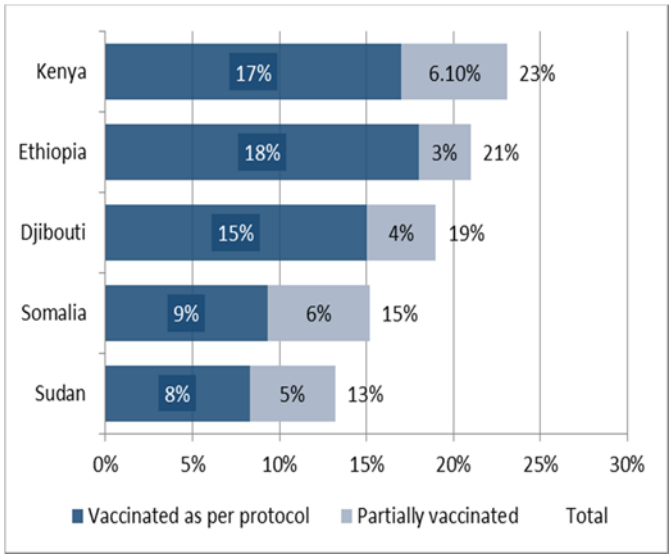

Figure 6: COVID-19 vaccination coverage in East African countries, June 2022

Discussion

In this study, we described the overall pattern of COVID -19 infection in Ethiopia over the past two years. Nearly half a million COVID-19 cases and more than 7500 deaths have been reported. Majority of the cases were reported from Addis Ababa possibly because, by the virtue of it being the capital city, is the primary epicenter of the disease. In addition, having more diagnostic centers than the remaining regional states in the country and mandatory COVID-19 tests for international travelers might have contributed to the high number of cases. Several reports have revealed that cities are more vulnerable to COVID-19 and the pandemic has brought some of the world's wealthiest global cities to their knees. New York, London, Nairobi, Lagos, and other Africa's largest cities were some of the witnesses of this [27, 28].

Although epidemiologic projections of the pandemic forecasted rapid transmission and subsequent catastrophic losses in Africa, the number of cases remained relatively low compared to other continents and the number of deaths was also minimal. This might be due to the delay in the onset of the pandemic that has given a rare opportunity for African countries to get prepared for and apply the recommended public health measures early on. The disparity in the number of cases and deaths in East African countries may be explained by the difference in total population, way of aggressively implementing public health control measures, mass testing, and vaccine coverage.

Several studies reported that non-pharmaceutical control measures were more effective in reducing the transmission of SARS-CoV-2 particularly during the first wave of the disease. Early implementation of such public health control measures helped to flatten the curve in different countries such as China, South Korea, Singapore, Germany [29-32] and averted an estimated 3 million deaths in 11 European countries [33]. Likewise, preparation to mitigate the spread of COVID-19 in Ethiopia was initiated as of the end of January 2020. Public health emergency operating centers were activated; screening at Bole international airport commenced, isolation and treatment centers were designated, and testing was initiated in early February with aggressive contact tracing and isolation. Schools and offices were also closed. Mandatory quarantine was announced for all incoming travelers, a five-month national state of emergency was declared, granted a pardon for 20,402 prisoners and parliamentary elections were officially postponed. International flights were also halted, testing capacity was expanded, and additional treatment centers were designated in different parts of the country [18, 26, 34, 35].

Despite these public health measures, the number of new cases was increasing, especially after the end of May 2020. The progressive decline in adherence to the control measures with the early reopening, increased movement of people for holidays, a national protest following the assassination

of the Ethiopian singer, and reopening of schools might have contributed to the first wave of the disease. Some countries such as the USA, Singapore, and South Africa have also witnessed the consequences of early reopening and loosening control measures [36 - 38]. Although subsequent waves follow surges in other parts of the world, major national events such as the election held in June 2021and the ongoing conflict in the north that began on November 3, 2021, may also have contributed to the second and third waves of COVID-19 in Ethiopia.

The low number of deaths in Ethiopia, and the continent more generally, is justified by the young population dominated demographics of the continent. Though the evidence is far from conclusive, the hot and humid tropical climate is also hypothesized to be unconducive for the virus and might reducing the risk of infection [39]. The possible explanation for the low severity rate, particularly after the second and third waves of the pandemic, can be due to immunity acquired through primary infection and the discovery of COVID-19 vaccine. Several studies proved that the vaccine has remarkably reduced severe or critical COVID-19-related hospitalizations and deaths [40 -42]. However, the significant decrement in the severity rate while the positivity rate was increasing during the fourth wave might be explained by the nature of the omicron variant. This variant is less severe than previous strains [43]. It is less able to penetrate deep lung tissue and 91% less fatal than other variants, with 51% less risk of hospitalization [44, 45].

Although a booster (third) dose of the COVID-19 vaccine is being administered widely all over the world [46, 47], the vaccine coverage in Ethiopia (21%) is still very low compared to the global average (66.4%) and that of developed countries: 86.0% in Canada, 82.3% Japan, 78.5% United Kingdom, 78.1% United States and 76.9% in Germany [19]. Irregular and limited vaccine supply and hesitancy might be the main reasons for the low coverage in the country (48,49). Therefore, more must be done to increase vaccine supply and uptake to speed up the control of the pandemic.

Some of the limitations of this study are in our review we prospectively extracted the data from some reliable databases. However, all the other sources were not explored. Our conclusions were mainly based on the data we gathered from these sources, and this may not consider the existing variations in those countries, particularly in relation to testing capacity and several other factors. Some countries have not reported some basic data, for example, vaccine coverage. It was not clear whether this was because vaccines were not offered or because these were simply not reported.

CONCLUSION

The pandemic is still evolving with recurrent waves and variants reported worldwide. The poor access to effective antiviral treatments, and low vaccine coverage in conjunction with the fragile health system in Africa calls for ongoing cautious monitoring. Despite the availability of vaccines, the current pattern of the disease also suggests that effective control measures should consistently be implemented to prevent subsequent waves of the pandemic. Urgent action and additional mitigation measures should be taken to improve vaccine uptake in Ethiopia.

Abbreviations

Africa CDC: Africa Center for Disease Preventions and Control; **CDT- Africa:** Centre for Innovative Drug Development and Therapeutic Trials for Africa; **CFR:** Case Fatality Rate; **COVID-19:** Coronavirus Disease of 2019; **EPHI:** Ethiopian Public Health Institute; **ICU:** Intensive Care Unit; **PCR**: Polymerase Chain Reaction; **SARS-CoV-2:** Severe Acute Respiratory Syndrome Coronavirus 2; **SNNPR:** Southern Nations, Nationalities, and Peoples' Region.

Declarations

Ethics approval and consent to participate

Not applicable for this study as the data were extracted from publicly available global and national data sources.

Consent for publication: Not applicable

Availability of data and material: The source datasets used and/or analysed during the current study are publicly available. The extracted data sets are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions
AF, AW, MK and RY conceived and designed the study. AW, BF, HN and ST extracted the data from the data sources. AW, RY, MS, RB and GM performed the data analysis and interpretation of the findings. AW and RY drafted the manuscript. AF and RY were actively involved in data interpretation and critically reviewed the manuscript. All authors read and approved the final manuscript.

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Supplementary Material
Supplementary file 1: Case fatality rate of COVID - 19 in Ethiopia compared with neighboring countries.

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Supplementary Material—https://bit.ly/3Wwtozh