THE MISSING MILLIONS: COVID-19 CASES AND DEATHS IN THE AFRICAN REGION

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Abstract

Early in 2020, experts warned of the toll that COVID-19 could have on low- and middle-income African countries and projected widespread transmission and death. However, by the close of 2021, two years into the global pandemic, the African region appeared to remain one of the least affected in the world, leading commentators to speculate about a so-called "Africa paradox." Six primary explanations exist for the apparent lack of COVID-19 cases and deaths across the African region: (1) undercounted cases, (2) undercounted deaths, (3) younger population age structure, (4) geographic factors, (5) the responses of African governments, and (6) the responses of African people and communities. This review consolidates and evaluates current research and data in relation to each of these explanations and covers the period of 2020 and 2021. We find that undercounted cases and undercounted deaths contribute more to the apparent lack of COVID-19 in the Africa region than commentators suggest. Evidence also suggests that the rate of undercounted COVID-19 cases and deaths has increased as the pandemic has progressed. The importance of other factors is greatest at the beginning of the pandemic and wanes over time. However, no explanation is complete by itself. The importance of each explanation varies over pandemic time and place. Our findings in relation to the COVID-19 pandemic in Africa reinforce the need for a more equitable global distribution of healthcare resources and expanded disease surveillance across the continent.

SUMMARY KEYWORDS

Africa, coronavirus, COVID-19, testing, COVID-19 mortality, surveillance, response

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Introduction

Early in 2020, experts warned of the toll that COVID-19 could have on low- and middle-income African countries (1–3). Global health professionals and policymakers were particularly concerned about an "African COVID-19 apocalypse" (4). In a press conference on April 2, 2020, John Nkengasong, director of the Africa Centers for Disease Control and Prevention, stated that COVID-19 "is an existential threat for our continent" (5). In a World Health Organization (WHO) press release on April 7, 2020, Ahmed Al-Mandhari, director of the WHO region that includes north Africa, stated that the continent should "plan for the worst" (6). Experts projected widespread transmission throughout the region for a number of reasons, including African countries' moderate-to-high risk of importation from China, high health system vulnerability, dense urban settlements, high prevalence of HIV, significant movement between urban and rural areas, and low capacity to detect, contain, and respond to the COVID-19 pandemic (7–13). As a result of these concerns, many African countries imposed strict quarantine measures before ever experiencing significant numbers of cases.

Even as cases remained low across African countries through May and June 2020, commentators continued to draw attention to the risk COVID-19 posed to African countries' fragile health systems and vulnerable populations (14, 15). Yet by August and September of 2020, as Europe and North American countries entered their second or third wave, the worst-case scenarios for African countries still had not materialized. At the close of 2021, the African region remained one of the least affected regions according to the WHO and other independent groups monitoring COVID-19 cases and deaths globally (see Figures 1 and 2) (16, 17). African countries have remained relatively unaffected even with the identification of multiple highly transmissible variants in South Africa (B.1.351/Beta detected in October 2020 (18) and B.1.1.529/Omicron detected in late November 2021(19)).

The absence of COVID-19 cases and deaths across the African region has inspired several commentaries on what has come to be called the "African paradox" (9, 20–27). These commentaries present a range of theories and explanations but only rarely summarize existing scholarship on the role of different competing factors. Frequently, authors have highlighted unique or visible responses while neglecting or downplaying other explanations. In a context as heterogeneous as the African region, it is easy to cherry pick the most visible and most successful responses, leaving policymakers and practitioners with a biased view of how to respond to COVID-19 moving forward, or how to act in future pandemics.

Meanwhile, researchers have examined the role of one or two key determinants of African COVID-19 morbidity and mortality (e.g., population density and health care infrastructure) but rarely consider multiple explanations in relation to one another. It is likely that multiple factors intersect with one another and have heterogeneous effects over the course of the pandemic.

This review consolidates and evaluates current research and data in relation to the primary credible explanations for fewer recorded cases and deaths from COVID-19 in the African region as compared to other world regions. Below, we introduce each explanation and examine existing data and research to evaluate it. Our analysis covers the period from the beginning of the pandemic in early 2020 through the end of 2021.

Six Explanations

There are six primary explanations for the lack of cases and deaths across the African region (see Table 1). Commentators frequently note that limited testing availability and poor vital registration data across the region may lead to undercounting of (1) cases and (2) deaths, while (3) the younger age structure of most African populations may limit the size of the population at risk of severe COVID-19 disease. More recently, researchers have also considered (4) the potential protective effects of geospatial population distribution and contact patterns in more rural areas. Additionally, commentators widely lauded (5) African governments and (6) African communities for their swift responses to COVID, suggesting their actions helped keep infections low.

Data and Methods

We draw on a range of sources to capture relevant scholarly research on COVID-19in countries across the African region during the first two years of the pandemic from January 1, 2020, through December 31, 2021. These sources include published academic research, published opinion pieces and letters to the editor in academic journals, pre-prints of academic research, long-form news media stories, white papers, and tracking materials and reports from government agencies. We obtained these sources through comprehensive searches of online English-language public health, global health, international development, and social science journals; PubMed; medRxiv and other preprint servers; and news media on allAfrica.com, a news aggregator for the region.

We also use COVID-19 case, testing, mortality, and government stringency data from Our World in Data to summarize trends across the region over time. Our World in Data aggregates information from multiple government and other research sources. They report official COVID-19 case, testing, and death data as they appear on government websites or official reports. For African countries that do not report official estimates, Our World in Data collates data from the Africa Centers for Disease Control and Prevention, which maintains a dashboard reporting the number of tests performed for every country in the continent. The government policy response data come from the Oxford Coronavirus Government Response Tracker (OxCGRT), which collects publicly available information on 17 indicators of government response, such as school closures, curfews, economic stimulus efforts, and testing regimes.

This review is guided by the principles of an abductive analytic approach (28), wherein we first review and revisit the literature on COVID-19 in African contexts and then read it within a critical frame to (a) identify gaps between expectations, narratives, and observed outcomes, (b) uncover blind spots, and (c) articulate a new set of counternarratives, issues, and concerns based on the existing empirical work. For each explanation, we provide an assessment of the quality of the evidence, and the likely impact of that explanation on COVID-19 in Africa.

Explanation 1. Undercounted Cases

Undercounting of COVID-19 cases has been a problem in all countries of the world due to asymptomatic spread, limited testing capacity, and changes in availability of at-home testing in early 2022. Limited testing capacity was a particular issue in the earliest months of pandemic spread for most countries and remained a substantial concern across the African region through 2021. Prior to the COVID-19 pandemic, African countries generally scored poorly on capacity to respond to an outbreak or new infectious disease vis-à-vis testing, health services capacity, and surveillance (7, 9). Although national, regional, and WHO efforts to scale up testing on the continent have been substantial and increased the number of operational labs from two to 47 in a matter of months, most African countries still tested fewer than 10 people per thousand population through December 2021 (see Figure 3). These figures are comparable to the US and Denmark, a top performer in testing, in April 2020, just one month into the pandemic (29).

Despite limited testing, there is now substantial serological evidence confirming that the actual number of cases is much larger than reported across the African region (see Figure 4) (30–32). Research across multiple surveillance sites reveals that seroprevalence of antibodies to SARS-CoV2 grew rapidly in late 2020 and early 2021 in countries like Ghana, Kenya, Malawi, Mozambique, and South Africa (30). For samples collected between April 30 and June 16, 2020, the population prevalence of SARS-CoV2 antibodies in Kenya was 5.2%, which is comparable to Spain in mid-May of that same year (33). This prevalence level suggests that about one in every 20 Kenyans in the 15 to 64 age range—or 1.6 million people—had been infected by COVID-19 by June 16, 2020. On the same day, the Kenyan government reported just 2,093 cumulative cases, suggesting Kenya was officially detecting only about one in every 750 cases. In South Africa, multiple surveillance studies have documented antibody prevalence that far outstrips the official count of cumulative cases, and rates of increase in prevalence that exceed growth in reported case rates across multiple states. In January 2021, at the same time that official case counts suggested only about 2.8% of the population of the Eastern Cape had been exposed, 63% had antibodies to SARS-CoV2 (34).

Although there is substantial heterogeneity in measures and sampling methods, a meta-analysis of 151 unique seroprevalence studies conducted in the African region concluded that, by September 2021, 65% of Africans likely had antibodies to SARS-Cov2 [95% CI: 56.3-73.0%] (30). Since vaccination was rare on the African continent prior this period (<7%) (35) seroprevalence here most likely reflects antibodies from COVID-19 infection. The ratio of seroprevalence to officially reported cumulative incidence of COVID-19 cases in the African region was 97:1, meaning that the number of infections was 97 times larger than confirmed cases. This ratio is equivalent to 800 million infections compared to the 8.2 million confirmed cases that were officially reported by the end of September 2021 (30). The gap between recorded cases and seroprevalence was greatest in countries with limited health system access, suggesting reduced testing capacity explains the gap. South Africa had the smallest ratio of seroprevalence from infection to officially reported cumulative COVID-19 cases at 10 infections for every one reported case for data from November 2020. In Nigeria, the country with the largest gap, the ratio of seroprevalence from infection to officially reported cumulative COVID-19 cases was 958:1 (July 2021).

Although gaps between seroprevalence and reported cases are substantial, seroprevalence was lower in African countries than in European and North American countries at the same time, especially during the first wave and into late 2020. For countries with repeated seroprevalence estimates (Malawi, Kenya, Ghana and South Africa), seroprevalence remained low through mid-to-late 2020 (30). The pooled seroprevalence estimate for the African region during the third quarter of 2020 was just 3.0% (n=6; 95% CI 1.0% to 9.2%). Similarly, in a randomized household serosurvey conducted in urban and rural Ethiopia during August 2020, seroprevalence was between 2% and 5% in urban areas around Ethiopia's largest city, Addis Ababa, and 0.2% in rural areas (36). By comparison, seroprevalence was already as high as 14% in New York state and 22% in New York City by the end of March 2020 (37). However, later studies show sharp increases in seroprevalence among African countries with available data beginning in mid-to-late 2020 and continuing through 2021. In one meta-analysis study of seroprevalence, an estimated 65% of people in Africa had been infected with COVID-19 as of September 2021 (30). A second global meta-analysis study estimated that 87% of people in the African region had been infected by the end of December 2021, with the ratio of seroprevalence to official cases increasing from 82:1 in quarter 3 of 2020 to about 177:1 in quarter 3 of 2021.

All evidence thus suggests that COVID-19 cases were severely undercounted during the first two years of the pandemic, likely by several orders of magnitude in most countries and potentially at an increasing rate as infections increased. There is some evidence from seroprevalence studies suggesting that the first epidemic wave may have generated fewer infections in African countries compared to other countries.

Explanation 2. Undercounted Deaths

During the COVID-19 pandemic, experts quickly documented the problem of undercounted COVID-related deaths due to misclassification or lack of cause of death data, even in countries with strong vital registration systems, like the United States (38). Some of this misclassification was due to the ripple effects of limited access to testing while alive. A prospective study of COVID-19 infection in deceased people at University Teaching Hospital in Lusaka, Zambia showed that about one in five bodies was infected with COVID-19 during surveillance in June through September 2020 (39). Only six individuals who tested positive after death were also tested while alive. During later epidemic waves, researchers detected COVID-19 in almost 90% of all deaths at the same morgue. Only 10% of positive cases were identified while the individual was still alive (40).

Additionally, deaths from COVID-19 were frequently misclassified as pneumonia or influenza (38) or as due to cardiovascular causes that were actually post-acute manifestations of COVID-19 (e.g., heart attack, heart failure, stroke, dysrhythmia, pulmonary embolism) (41,42). To avoid biases introduced by misclassified deaths, demographers instead calculate a measure of excess mortality by comparing the number of deaths from all causes during the COVID-19 pandemic to the expected number of deaths from all causes based on data from earlier years. Using this method, researchers estimate the number of deaths that occurred during COVID-19 compared to what would normally be expected. Importantly, this method addresses two problems: missing cause of death and misclassification of cause of death. Not all excess mortality can be attributed directly to COVID-19. Excess mortality also captures people who died of other causes but might have survived had the pandemic not happened, such as people who needed acute care but could not access an intensive care unit because it was overcrowded by COVID-19 patients. Estimates of excess deaths may also be negative due to decreases in other causes of death resulting from pandemic-related social, behavioral, and economic changes.

Recent work by the massive international team, the COVID-19 Excess Mortality Collaborators, finds that sub-Saharan African countries reported 150,000 COVID-19 deaths by Dec 31, 2021 (43). For the same period, they estimate that over 2.1 million (2,130,000; 95% CI=1,730,000-2,820,000) Africans died due to COVID-19. Estimated COVID-19 deaths in sub-Saharan Africa account for about 12% of the global burden of estimated excess COVID-19 mortality. Africans living in the sub-Saharan region make up 14.9% of the global population (44). The average ratio of the estimated excess mortality to reported COVID-19 mortality is more than 14:1 for the sub-Saharan African region and greater than 30:1 in several countries, including Ethiopia, Kenya, Mozambique, and Democratic Republic of the Congo. The ratio of estimated excess deaths to recorded COVID-19 deaths is higher in the African region than in any other region.

In African countries, several additional factors complicate estimating changes in all-cause mortality due to COVID-19. First, African countries are more likely to have incomplete and inaccurate information on mortality and cause of death. The WHO estimates that almost 40% of deaths in the world are unregistered every year (45). In many low-and middle-income countries, vital registration data are incomplete. A recent global assessment conducted by the WHO found that just 44% of births and 10% of deaths in the African region were registered (45). Thus, even before the pandemic, mortality data for many African countries were limited or unreliable (46). Because of this lack of data, South Africa and the smaller countries of Cape Verde, Reunion, Mauritius are the only sub-Saharan African countries that regularly contributes all-cause mortality data in excess mortality models (47). Most estimates of mortality and life expectancy in sub-Saharan African countries are made without reference to empirical data on adults (47, 48). This makes mortality estimates for the region more reliant on external and researcher-defined parameters that may bias estimates up or down. Demonstrating this, models that use different data or define estimation parameters differently (e.g., duration of immune protection from prior COVID-19 infection) predict fewer excess deaths from COVID-19 than were actually observed by newer surveillance systems in South Africa (49, 50).

Relatedly, while estimates of excess death consider underreporting of deaths due to variation in completeness of vital registration, the rate of undercounting is assumed to be constant (e.g., fixed as measured pre-pandemic) (43). Models predicting excess deaths do not adjust for whether and how public health and humanitarian emergencies may exacerbate undercounted deaths through disruption of civil and vital registration efforts (51). By the close of 2021, African countries affected by conflicts reported the fewest number of COVID-19 cases, which may reflect lower or uneven state capacity to document mortality in the population (52). If the rate of undercounting deaths increases with public health and humanitarian emergencies as is suggested by the literature, the best estimates of excess death from COVID-19 that we currently have, which treat undercounting of deaths as a fixed country-level parameter, will underestimate excess COVID-19 mortality.

A second challenge for estimating excess mortality in African countries is changes to baseline patterns of disease, injury, and death resulting from social, behavioral, and economic changes associated with the pandemic. Changes in magnitude and distribution of other causes of death complicate calculations of excess mortality due to COVID-19. There is evidence in multiple contexts that responses to the pandemic, especially lockdowns, influenced baseline mortality patterns by changing people's actions and behaviors (53, 54). In South Africa, *fewer* people than expected died in March, April, and May 2020 despite concurrent confirmed COVID-19 deaths because of changes in mobility during the first lockdown period that reduced deaths from other non-disease causes, like car accidents (55, 56) Ultimately, researchers can only reliably estimate excess mortality due to COVID-19 in South Africa *after* the lockdown period, when underlying patterns in other causes of death are more similar to pre-pandemic. As we discuss below, African countries implemented a wide range of lockdown restrictions that were both national and localized and varied in their duration and stringency (57). This variation presents several challenges to estimating excess deaths where we also do not have reliable data on other causes of deaths.

While exact estimates of excess deaths across the region vary, multiple sources confirm that official estimates of COVID-19 deaths are very low compared to estimates of COVID-19 excess mortality (56). By July 28, 2020, nearly three months after the first lockdown restrictions had been eased, the government of South Africa reported 2,413 COVID-19 deaths. At the same time, researchers estimated there to have been 28,329 excess deaths. By November 3, 2020, the South African government reported 19,539 COVID-19 deaths, but researchers estimated more than two and a half times as many excess deaths from all causes (49,251), suggesting a much larger number of deaths due to COVID-19 in South Africa than recorded.

The wide gap between estimated and recorded COVID-19 deaths in the African continent is due in part to poor access to hospitals and critical care resources. In general, access to hospitals in many countries on the African continent is limited, with fewer than one hospital per 100,000 people across several countries (58, 59). These metrics are worse in rural areas, where over 80% of the population live in countries like Malawi, Niger and Burundi (60). The costs of hospital visits are also beyond what many can afford. In 2019, out of pocket expenditure as a share of current health expenditure for Ghana was 36.2% (61). There is evidence from other epidemic outbreaks that individuals are more likely to avoid or be turned away from the hospital during epidemic surges (62). If people do not go to the hospital, even when critically ill with COVID-19, they are less likely to be diagnosed with COVID-19, and should they die, are less likely to be recorded as a COVID-19 death. In Lusaka, Zambia, a majority (79%) of deaths among individuals whose remains tested positive for COVID-19 through June 2021 occurred in the community rather than a medical facility; that is, for every COVID-19 death at a medical facility, there were four COVID-19 deaths in the community (40).

Notably, those infected with COVID-19 in the African region who do make it to a hospital are more likely to die than in other countries (63). Across 38 hospitals in six different African countries, the estimated probability dying within 30-days of admission for COVID-19 was about 50%. This rate is much higher than the global mortality rate due to COVID-19 following critical care admission. In Milan, Italy, for example, the 30-day probability of mortality following hospitalization during the first wave of the pandemic was 19.7% (64). This gap, researchers estimate, has resulted in 11 to 23 *additional* African deaths per 100 COVID-19 patients compared with the global average (63). Researchers attribute these additional deaths to a lack of critical care resources, like oxygen, ventilation machines, and constant electricity, after controlling for differences in patient characteristics and facility staffing.

The lack of critical care resources is substantial in many African countries. Assessments using data prior to the pandemic suggest that most hospital facilities in the Democratic Republic of Congo, Senegal, Malawi, and Tanzania may not have both oxygen and constant electricity available (65). At the beginning of the COVID-19 pandemic in Malawi, assessments from 13 of the country's 26 public hospitals found that oxygen was not adequately available in 62% of outpatient or emergency departments, that mask and eye protection for healthcare workers was not generally available in any setting, and that isolation rooms were not available in about half of sampled hospitals (66). A seroprevalence study among healthcare workers in Malawi confirms widespread exposure to COVID-19 in 2020 (67). Similarly, while in-hospital isolation rooms were more present in Nigerian hospitals, nearly half had been constructed in response to COVID-19 and personal protective equipment remained widely unavailable as late as October 2020 (68). In other settings, many hospitals lacked laboratory services to diagnose COVID-19, intensive care facilities, ventilators, and consistent clean water supply (12, 69). Many of these issues are longstanding and were noted during the 2014-2015 Ebola outbreak in Liberia, Sierra Leone and Guinea (70).

All evidence suggests that COVID-19 deaths have been and continue to be severely undercounted in Africa, with excess mortality estimates indicating that over two million Africans have died due to COVID-19 as of the end of 2021. Localized data suggest that during Beta and Delta wave peaks, 90% of deceased individuals were infected with COVID-19 when they died (40). Although the size of the gap between estimated and reported deaths varies, there is greater alignment between reported and estimated deaths in African countries with higher performing civil registration systems. Some evidence suggests that Africans who were hospitalized with COVID-19 were more likely to die than in other countries due to a lack of critical care resources throughout the African region.

Explanation 3: Population Age Structure

Several scientific papers and commentaries suggest that a younger age structure may have protected African populations during the COVID-19 pandemic (13, 22, 26, 71–74). Older age is a risk factor for severe disease and death due to COVID-19. Based on data from high-income countries, rates of hospitalization and mortality increase substantially from age 30 onwards and are highest in the oldest age group (85+) (75). Compared to other regions, Africans are much younger. The median age in the African region is just under 20 years old, more than a decade younger than in any other region and more than two decades younger than the median age in Europe. For some countries, like Niger and Mali, the median age is even lower, at 15 and 16 years, respectively (44). Relatedly, life expectancy is 10 to 15 years lower in African countries compared with other regions and survival to age 65 is lower (76). As a result, only 3% of the population in the African region is over age 65 compared with 16% in the US and 23% in Italy (77, 78). Thus, a smaller proportion of the population on the African continent is in the oldest age groups where risk of death and severe disease from COVID-19 increase dramatically. Applying age-specific case fatality rates from China's first wave to the African population, researchers estimated in May 2020 that the African region would experience 75% fewer COVID-19 deaths compared to North America and European populations due to age structure alone (79). Using pre-pandemic population data and reported COVID-19 mortality, which as we note in the preceding section have several flaws, others find that younger mean age and a lower percentage of total deaths among adults over age 65 are protective for several African countries relative to the US, Canada, Japan, and European countries (22).

Age structure may not be entirely protective, however, as recent work suggests that the age-mortality curve for COVID-19 may be flatter (i.e., there is higher COVID-19 mortality at younger ages) in low- and middle-income countries as compared to high-income countries (80). This research includes data from 26 countries, including 10 low- and middle-income countries, but only one African country (South Africa) due to the COVID-19 data availability issues described above. This finding is replicated by a systematic review of 62 studies of 25 low- and middle-income countries, including six African countries (81). This analysis finds that age-standardized infection fatality rates in low- and middle-income countries are higher than in high-income countries, in large part due to a lack of access to healthcare (81). At 20 years of age, the mean infection fatality rate in low- and middle-income countries is 2.7 times higher than that in high-income countries. In one study from Nairobi, Kenya, the population infection fatality rate for ages 18 to 65 years was over five times higher than in high income countries. Another study demonstrates that age-adjusted mortality is higher at all ages in Lusaka, Zambia compared with the USA (82). This is consistent with the study of COVID-19 infection among decedents also in Lusaka, a majority (78%) of whom were under age 60 and 15% of whom were under age 18 (40). These findings present a substantial challenge to the notion that younger age structure is universally protective for countries in the African region.

The evidence is mixed regarding the protective effects of younger age structure. One the one hand, younger age structure is at least part of the explanation for lower COVID-19 mortality rates in the African region. There is growing evidence, however, that age-adjusted COVID-19 mortality curves may be flatter in low- and middle-income countries, suggesting that age structure alone is an incomplete explanation for lower observed COVID-19 incidence and mortality in African countries.

Explanation 4: Geographic Factors

Dense communities, urban congestion, international connectedness, and colder weather favor the transmission of respiratory viruses like SARS-CoV2. Several papers have highlighted the potential protective effects from African countries being less dense, less urban, less internationally connected, and warmer than countries in other regions (13, 73). These differences are likely to have limited the number of new introductions of the virus across the African region (83) and limited its spread out of urban centers, particularly during the first wave of the pandemic.

Research on 182 countries found that population density and urbanization were positively associated with reported COVID-19 cases during the first weeks of the pandemic (84). The authors also found that pandemic duration had a larger association with official COVID-19 case numbers for sub-Saharan African countries compared with countries in other regions, suggesting that the protection provided to African countries by geographic factors diminished over time.

Supporting this assertion, a meta-analysis of 151 unique seroprevalence studies conducted in African countries and published from January 2020 to December 2021, found lower seroprevalence of anti-SARS-CoV2 antibodies in rural (PR 0.58 [0.45-0.74]) and low population density areas (PR 1.86 [1.18-2.95]) (30). Despite these general trends, however, this study also identified high heterogeneity in seroprevalence of antibodies to SARS-CoV2, suggesting that geographic location and population density were not universally protective against COVID-19.

A longitudinal study of seroprevalence of SARS-Cov2 antibodies among an urban cohort and a rural cohort in South Africa provides additional evidence that lower population density may be less protective over multiple pandemic waves. Testing all household members every two months for antibodies to SARS-CoV19 via blood draw, researchers found higher overall seroprevalence in the urban cohort after both the first and second waves, but observe higher attack rates in the rural cohort and a narrowing of the gap in seroprevalence (1% vs 15% to 26% vs 41%) during the second wave (85). Compared to the urban community, rural community members were 4.7 times more likely to have seroconverted during the second wave. In the same two cohorts, the gap in seroprevalence by site was still over 15 percentage points going into the third Delta wave, at 26% (95% Credible Interval [CrI]: 22-29%) in rural communities and 41% (95% CrI: 37-45%) in urban communities.(86) After the third wave, this gap continued to narrow. Seroprevalence increased to 60% (95% CrI: 56-64%) in the rural community and to 70% (95% CrI: 66-74%) in the urban community. Incidence during the third wave was highly similar across sites, at 39% in the rural and 40% in the urban community.

Studies find mixed results of temperature and seasonality on COVID-19 transmission. Early work, including initial assessments from China (87, 88) and models testing the effects of temperature on reported COVID-19 cases during the first wave (84, 89–91), found that temperature was negatively associated with COVID-19 incidence; that is, countries with lower temperatures initially had higher COVID-19 case counts. Except for North African countries bordering the Mediterranean, African countries experience warmer and drier weather relative to other regions. However, more recent work has shown that the relation between temperature or climate and COVID-19 transmission is more complex and varies over time and space in response to a number of other human and nonhuman factors (92, 93).

News media from Senegal, the Democratic Republic of Congo, and South Africa, as well as informal conversations with researchers living and working in Ghana, Togo, Nigeria, Democratic Republic of Congo, Malawi, and South Africa suggest that when lockdowns first occurred in African countries, many people left major cities to return home to smaller cities and rural areas (94, 95). This behavior may ultimately have been protective as it would have reduced congestion in major cities and did not put those living elsewhere at risk given that major cities had not yet been infected. Indeed, multiple studies find that lockdown measures during the first two months of the pandemic in South Africa and the first five to six months in nine African countries did not effectively reduce community transmission of COVID-19 (57, 96). However, migration became less protective around Christmastime at the end of 2020, when Africans returned home from abroad, many of them bringing COVID-19 with them.

Overall, the ability of geographic factors to account for apparently lower COVID-19 transmission in the African region is highly contextually and temporally specific, suggesting that urbanicity, population density, and temperature likely play a minor role in explaining the overall gap between observed COVID-19 rates in Africa as compared to elsewhere in the world.

Explanation 5: Government Response

Several commentators have credited African governments for their rapid responses and relative success in limiting the spread of COVID (27, 97–100). These arguments suggest that African countries' experiences with other infectious disease outbreaks and rapid, strict, and coordinated responses helped contain the initial spread of COVID-19 and limit the number of COVID-19 cases and deaths (101). Initial reports highlighted the responses of governments in Senegal, Rwanda, Uganda, and South Africa. These governments utilized science-based risk communication and community-based disease surveillance in response to the pandemic (102–105). They repurposed structures, personnel, and public health measures from the 2014-2016 West Africa Ebola outbreak to quickly respond to COVID-19 by disseminating public health information, converting existing infrastructure and personnel to focus on contact tracing, and setting up quarantine zones and curfews to contain spread of COVID-19 (106, 107). In Senegal, where one of only two African labs that could test for COVID-19 at the outset of the pandemic is located, the public health response included a massive effort to train lab personnel and scale-up 24/7 testing capacity in and beyond the capital city of Dakar (108). The government of Rwanda also employed innovative strategies which included remote case identification, use of a toll-free hotline, a national WhatsApp number, drones for information dissemination, and robots for patient monitoring in hospitals (102). The governments of Senegal and South Africa also explicitly involved faith and traditional leaders in their response to the outbreak (100, 109).

However, these narratives miss substantial variation within countries over time and across countries. A study of nine African countries on COVID-19 related public health measures concluded that, while there were commonalities in the implementation of measures like lockdowns across countries, “a more notable finding was the variation in the design, timing, and implementation of lockdown measures” (57). Even in Uganda, where responses to COVID-19 were generally strict–schools remained closed for 2 years—political and economic considerations limited restrictions in other areas as evidenced by President Museveni’s unwillingness to fully limit the movements of truck drivers, an identified risk group for transmission, throughout the country (110).

Further, with 54 countries on the continent, many commentators have focused on earlier and more visible actors and actions, neglecting the countries that were less effective in their response or that intentionally downplayed the risk of COVID-19. Throughout 2020, Tanzanian President John Magufuli dismissed the need for public health measures and advocated for prayer and use of herbal medicines to defeat COVID-19 (110). He disputed the accuracy of tests, claiming that laboratory staff had been “bribed by imperialists” or had “no expertise” and had them investigated (111). In May 2020, his administration stopped reporting COVID-19 cases to the WHO. In February 2021 he said that Tanzania would not administer or acquire COVID-19 vaccines, which he believed to be manipulated to harm Tanzanians, and announced that Tanzania had eradicated “respiratory diseases.” He died of suspected COVID-19 along with several other public figures and state officials in March 2021 (112).

In Burundi, too, President Nkurunziza actively limited information about COVID-19 and refused to carry out COVID-19 testing. In May 2020, Nkurunziza’s administration ejected the WHO’s country director and staff who supported a public health response more in line with WHO recommendations (113). After multiple hospitalizations of Nkurunziza and his wife, who was confirmed to have had COVID-19, the president died on June 8, 2020 of suspected COVID-19 (114).

Across the continent, 17 in-office African ministers and heads of state died of COVID-19 between February 2020 and February 2021, making up more than 70% of COVID-19 deaths among in-office national politicians around the world (115). COVID-19 also substantially impacted former African heads of state and national ministers, as well as high-level figures, such as opposition leaders and prominent judges (115). The result is an African political landscape explicitly and markedly changed by the pandemic. In some African countries, the deaths of officials and heads of state led to shifts in COVID-19 policies that were more transparent and science based (112, 115).

Given the wide range of government responses across the continent, it is pertinent to assess government action in systematic and comparable ways over time and space. To make systematic comparisons, we use the COVID-19 Stringency Index from the Oxford Coronavirus Government Response Tracker (OxCGRT), available via Our World in Data. The Stringency Index includes nine metrics, including school closures, workplace closures, cancellation of public events, restrictions on public gatherings, closures of public transportation, stay-at-home requirements, public information campaigns, restrictions on internal movements, and international travel controls. The index on any given day is calculated as the mean score of the nine metrics and takes a value from 0 (no restrictions) to 100 (strictest response).

Using the Stringency Index, nearly all African governments took some public health measures against COVID-19 during the first wave and beginning as early as January 2020 in countries like Botswana and Senegal with disease surveillance at airports. In nearly all cases, African countries began to increase public health measures to limit spread of COVID-19 by the second and third weeks of March 2020. Figure 5 presents mean daily scores of the COVID-19 Stringency Index from January 1, 2020, to April 1, 2020, for 187 countries grouped by continent. The responses from African governments came later than those of Asian and European governments, which had significantly higher mean COVID-19 Stringency Index scores from January 1, 2020, through April 1, 2020. This difference is offset by adjusting for the date of the first detected case. The first cases on the African continent were detected beginning in February 2020 in the most internationally connected locations. On February 14, 2020, Egypt became the first country in Africa to report a coronavirus case. Nigeria followed shortly after on February 27, 2020 (116). By the end of the first week of March, nine African countries (Algeria, Cameroon, Egypt, Morocco, Nigeria, Senegal, South Africa, Togo and Tunisia) were reporting over 40 cases (117). By mid-to-late March, several African countries closed their borders to foreign nationals and implemented national or localized lockdowns.

The subsequent implementation of lockdowns and other mobility restrictions varied widely across the continent. Studies from Wuhan, China, that were available by March 2020 showed some effectiveness of geographic containment (e.g., internal mobility restrictions, closure of public spaces, and restrictions on social gatherings) in reducing COVID-19 transmission (118, 119). Ultimately, African countries adopted a variety of measures to reduce the transmission of COVID-19, ranging from recommendations for specific locales regarding hygiene, mask use, and physical distancing to strict national curfews and home confinement for the general population (57). Additionally, while countries like South Africa implemented a two-month-long, countrywide mandatory home confinement and curfew, other countries like Sierra Leone only mandated that individuals stay at home for three days at a time on two occasions (April 5 to 7, 2020, and May 3 to 5, 2020), interspersed with a two-week recommended restriction on inter-district travel. In Botswana, the government implemented a three-day lockdown in the capital city of Gaborone in June 2020 following the detection of new cases after a 48-day national lockdown initiated at the end of March.

Figure 6 uses a heat plot to depict changes in government stringency among a subset of countries over time. A full depiction of all countries is provided in Appendix A. Figure 6 contains several notable elements. First, most African countries became less strict after the first pandemic wave. By September, nearly all countries had substantially eased or removed most restrictions. Compared to countries in other regions (below solid line), African countries implemented fewer restrictions after September 2020 and throughout 2021 (i.e., more yellow and light green are visible). Very few African countries exhibit the toggling off and on of restrictions apparent in many European countries (repeating patterns of blue-purple bands followed by yellow-green bands) or the long-term, high restriction (consistently blue or purple) levels observed in several Asian and South American countries.

Second, heterogeneity of government responses among African countries is also highly visible. While the sustained strict responses of countries like Uganda and Botswana are apparent in the solid blue-to-purple bands, so too are the limited and nonresponse trajectories of Burundi, Tanzania, and Niger.

Although African countries appear to have implemented similar public health measures in terms of strictness in response to the first wave when compared with countries in other regions, African countries differ from most European and North American countries in their enforcement of public health and lockdown measures during the first wave. In some countries, the enforcement of public health measures by police and security forces may have increased initial compliance with lockdowns, mask wearing, and gathering restrictions. Police and security forces enforced lockdowns with fines or arrests in several places. In Zimbabwe, police arrested more than 105,000 people for violating COVID-19 regulations between March and mid-July (120). News media and human rights reports also highlight police violence against citizens and journalists in Nigeria, Kenya, Zambia, Uganda, Namibia, and South Africa (121–127). In at least a few cases, officials used COVID-19 as a cover to consolidate power and to hoard financial and other social resources and to enact violence against already marginalized groups (121, 128–130).

In sum, African governments' responses to COVID-19 probably do not explain much of the observed differences in COVID-19 rates given that these responses paralleled those observed in other countries during the first wave of the pandemic, and then lessened over time, suggesting they protected Africans no more, and perhaps even less, than in other regions.

Explanation 6. Community Response

The behaviors of Africans in response to government restrictions, as well as independent of them, may have also influenced the contours of the pandemic. Multiple commentators have commended the quick adoption of public health measures, like hand-washing, mask wearing, and social distancing, among Senegalese and Rwandans (98). These narratives highlight the open and direct channels of communication with communities, the involvement of community members in encouraging compliance with public health measures, and the generation of new organizations by "young innovators" to serve the most vulnerable from the ground up (131). One news story from March 2020 featured Kenyan Fashion Designer David Avido who had sewn over 1,700 masks for people living in slums near his neighborhood (132). In South Africa, self-reported data from household surveys conducted in three provinces suggest a high uptake of preventative measures to control COVID, with over 95% of respondents reporting face mask use by August 2020 (133). Work in Kenya, too, found incredibly high self-reported mask use at 88% in Western Kenya (134). However, other data, including on mobility, compliance with public health measures, and on actual mask wearing present a more mixed picture. High centralization of COVID-19 responses within the national government, with little openness for collaboration with community organizations, may also have contributed to decades-long trend in decreasing space for African civil society organizations (130).

Mobility data are based on the location and movement of mobile phones and show substantial mandated and voluntary reductions in travel in response to the first pandemic wave of COVID-19, especially in areas of denser population (135). In Botswana, time spent at or near home had already increased by 10% before the government enacted the first lockdown in April 2020 (136). During the first few days of the 48-day national lockdown, time spent at or near home increased to 40% higher than pre-pandemic levels. As the country's lockdown persisted into May, however, residents increasingly returned to activities outside of their residential area, and then dramatically so when the first lockdown was lifted. After the Botswana government implemented a second, shorter lockdown limited to the capital of Gaborone (home to 10.9% of the population), time spent at or near home increased again but remained below levels observed during the national lockdown. This effect quickly deteriorated when the 14-day localized lockdown was lifted. By October 2020, time spent at or near home was about just 5-8% higher than pre-pandemic levels, suggesting only a small number of people were continuing to limit their activities. Most had returned to normal activities outside of their residential area.

Mobility also changed in countries that did not enact national lockdowns, although to a lesser extent (135). In Côte d'Ivoire, for example, people began staying home more in late March and early April 2020 (136). While mobility data do not allow for direct comparisons across countries, the slope of the decline in time spent at or near home in Côte d'Ivoire is shallower compared with countries like Botswana where lockdowns toggled on and off. By July, time spent at home in Côte d'Ivoire returned to just above pre-pandemic levels, while other kinds of mobility, like retail and transit, had returned above pre-pandemic levels. As of October 2020, the median sub-Saharan African country had returned to at least baseline mobility or higher in retail and recreation, grocery and pharmacy, and transit (136). Trends in time spent at or near home in sub-Saharan African countries compared to countries in other regions are closely aligned and indicate comparable retreat to residential spaces during February to October 2020. For African countries with mobility data, people stayed home during the first pandemic wave about as much as in other countries with mobility data and since then, have mostly returned to their activities outside of the house.

The substantial economic costs of staying home likely drove the return to pre-pandemic mobility in African countries. A global report published in 2021 by the International Monetary Fund estimated that "close to 95 million more people are estimated to have fallen below the threshold of extreme poverty in 2020 compared with pre-pandemic projections" (137). In general, compliance with stay-at-home orders was challenging for many in sub-Saharan African countries. For the vast majority who could not carry out income generating activities virtually, complying with lockdown meant a (near) total loss of income. The percentage of South Africans who reported no income increased from 5.2% before the first lockdown in April to 15.4% by the sixth week of national lockdown (early May 2020) (138). These income losses were associated with predictable impacts on food insecurity and other measures of wellbeing (138, 139). As elsewhere, access to work-from-home was associated with race and class in places like South Africa, where the majority (88%) of those able to work from home live in suburban areas (138). In contrast, just 5.4% of township residents reported being able to work from home. Survey results from April 2020 also suggest that younger people, less educated, and unemployed South Africans were less likely to report staying home during lockdown (140).

In the largest African cities, where at least 60% of people live in slums or townships, social distance requirements also conflicted with the realities of living in close quarters, multigenerational households, reliance on public transportation, and limited access to water and sanitation (139). While most South Africans reported feeling confident that they and their family were adhering to lockdown and isolation orders, far fewer were confident that their neighbors or broader community were adhering to the lockdown and isolation order (140).

There are other signs, too, that individual responses to the pandemic were more varied than as portrayed by news media coverage. Although masks have not been politicized in Africa like in the US, all early assessments stressed that surgical and other masks were already in short supply across the African continent (7, 9, 66). Small, industry focused studies (e.g., on the impact of COVID-19 on construction site safety) also note a total lack of access to personal protective equipment, lack of compliance with public health measures, necessary use of public transportation by workers, and inability to adhere to social distancing rules in the first months of the pandemic (141). More broadly, observational studies of individual mask use in public spaces (e.g., villages, markets, public transportation) call into question the near universal self-reported mask use reported by survey studies. While 88% of survey respondents in a study conducted in Western Kenya reported consistent mask use in public, 90% of people observed in almost 10,000 direct observations were not wearing a mask—a gulf researchers attribute to social desirability bias in survey responses (134). Studies in South Africa also find discrepancies between survey and interview reports of mask wearing (142).

African communities responded quickly to COVID-19, as mobility data show, and did so with and without official orders from governments. However, many Africans struggled to comply, especially for longer periods, amidst strong pressures to fulfil other basic needs like food and income. For these reasons, African community responses to COVID-19 were probably no more protective than those observed in other countries, and likely declined in influence on COVID-19 cases and deaths over time.

Discussion

This paper reviews available evidence on six primary explanations proposed for the lower-than-expected cases and deaths due to COVID-19 on the African continent. Our aim in doing so has been to provide a much-needed evaluation that moves beyond limited assessments of single factors or specific countries that performed either very well or very poorly in their responses to COVID-19. We find that undercounted cases and undercounted deaths are much more important than commentators have suggested. The WHO has downplayed concerns around the underreporting of cases. Many commentators also briefly note the possible effects of a younger age structure but go on to highlight things people or governments have more control over, like mask wearing or lockdowns. This selective attention, which may make a better story, is ultimately a mistake. Cases in the African region are likely to be at least comparable to Southeast Asia region, if not higher, given antibody seroprevalence. Subsequent waves have been severe and infections are increasingly being introduced into African countries from other African countries (143). As in other low- and middle-income countries with younger populations, deaths may have a lower ceiling in African countries; however, estimates suggest that over 2.1 million Africans—12% of all people who died from COVID-19 globally—have died due to COVID-19. We should also be gravely concerned and mobilized by recent work that shows higher mortality from COVID-19 at *every age group* in low- and middle-income countries compared with high income countries. The morgue study in Lusaka, Zambia, burial and funeral surveillance in Ethiopia, and new surveillance systems set up to monitor COVID-19 mortality in South Africa all directly challenge the narratives that COVID-19 has left African countries unscathed.

Ultimately, feel-good stories about specific countries take the focus away from inequality in deaths and the significant economic impacts of public health measures. They give credit to governments and leaders where the outcome was likely to be favorable anyway, like Uganda's, which receives US$4.5 in development assistance for health for every US$1 received in Sudan. Stories commending the strict response of South Africa for keeping COVID-19 deaths low promote conclusions that fines, curfews, arrests, and violence protect against infectious disease rather than the importance of honest, transparent governance and science-based communication. Mostly, the feel-good focus is dishonest. As elsewhere, there is wide variation in the impact and response to COVID-19 across countries, governments, and locales. Focusing on a select few countries obscures the bad actors that downplayed the pandemic and limited access to testing and vaccines. It also obscures the things that relatively successful governments did poorly.

Notably, there are explanations which are still being evaluated scientifically that we do not fully cover here. Some work has argued that immunity resulting from prior exposures to other coronaviruses in sub-Saharan Africa may have been protective due to cross-reactivity with SARS-CoV2 (144, 145). Work in other populations has also found that infection with another human coronavirus provides short-term protection against SARS-CoV2, but more distant infections in the last 5 years are not associated with reduced risk (146). Consistent with this finding, a large body of work now shows that immunity to human coronaviruses and SARS-CoV2 specifically is partial and short-lived (147). SARS-CoV2 may also cause long-lasting immune dysfunction that could increase risks for secondary infections and reinfection with SARS-CoV2 (148). Additionally, subsequent variants of SARS-CoV2 have developed substantial immune escape, limiting the protection conferred by earlier exposures to human coronaviruses, including SARS-CoV2 (149). Given these findings, existing protection due to prior exposures to another human coronavirus are most likely to have mattered most for exposures that occurred very early in the pandemic and for exposures to the original Wuhan strain of SARS-CoV2. This explanation is possibly consistent with our assessment that infections, while substantially undercounted, were still lower than expected during quarters 2 and 3 of 2020 given seroprevalence data presented above.

Other work has proposed that exposure to malaria, a parasite endemic to much of the African region, may decrease inflammatory immune response to other pathogens, including COVID-19. This explanation suggests that by decreasing the body's inflammatory response to SARS-CoV2, exposure to malaria may reduce severe disease caused by COVID-19 (150). Newer work in a longitudinal cohort finds no effect of malaria infection on COVID-19 incidence or symptom severity (151). Other mechanisms of protection have been proposed and are under examination (152). With mixed evidence and few studies, we defer to future research to evaluate this explanation.

Conclusion

We may never know the full toll of COVID-19 on the African region. We have consolidated here the available data, including official data on testing and deaths, as well as national and localized reports, studies, and narratives. While many datapoints are tell a more coherent story than they once did, some elements continue to change, sometimes quickly and dramatically, as when new variants of COVID-19 emerge.

We have evaluated the six primary explanations and find some support for each. Importantly, however, each alone is incomplete; no single explanation tells the whole story. Cases *are* underreported, but antibody evidence suggests they still accumulated more slowly than in other regions during the first global pandemic wave. Deaths *are* far higher than recorded, but they are also lower than we might expect based on global population. The younger age structure is protective, but it is not as protective as is widely thought. Lower population density and other geographic factors limited spread, especially at the beginning of the pandemic, but these same factors make subsequent waves more deadly due to lack of access to critical care resources in rural settings. Most African governments did react swiftly, but most did not do so faster than elsewhere. Several governments also encountered substantial barriers to maintaining these responses over time and at least a few engaged in COVID-19 denialism. African people also responded quickly and dramatically. As myriad examples show, they took care of their own. But they also encountered massive structural barriers to initiating and maintaining these responses, some great enough to prevent sustained adoption of recommended measures. These same structural barriers drive elements behind many of the explanations for differences in COVID-19 rates among African countries, including limited health systems and weak vital registration systems. Ultimately, there is not a single African story of COVID-19. The importance of each of these explanations varies across pandemic time and place and reinforces the need for a more equitable global distribution of healthcare resources and expanded disease surveillance across the continent.

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Table 1. Six Explanations for Lower-than-Expected COVID-19 Cases and Deaths in the African Region

Explanation	Description	Assessment
1: Undercounted Cases	• The true count of cases far exceeds the reported count given limited testing.	Strong support
2*:* Undercounted Deaths	• The true count of deaths far exceeds the reported count given weak vital registration systems and a high frequency of deaths outside hospitals. Thus, deaths caused by COVID-19 are not counted, or are erroneously attributed to other causes.	Strong support
3*:* Population Age Structure	• Africa's young population age structure limits the number of cases and deaths. Young people are less likely to have comorbid conditions and develop severe disease in high income countries. Thus, fewer Africans will die from COVID-19 because there are fewer individuals in the older, higher risk age groups.	Moderate support
4. Geographic Factors	• Africa's lower connectedness to heavily affected countries decreased the number of new introductions of the virus, and in turn, lower prevalence in urban areas helped reduce transmission to rural areas.	Weak support (early in pandemic)
5. Government Response	• Government preparedness due to previous experience with infectious disease and swift, strict responses limited the number of cases.	Weak support (early in pandemic)
6. Community Response	• African communities responded quickly, with or without their governments, by adopting preventative strategies, educating community members on hand washing and other prevention strategies, avoiding crowds, and wearing masks, thus limiting the number of cases.	Weak support (early in pandemic)

Figure 1. Daily COVID-19 Cases (Smoothed), by Region. January 2020 to July 2022. Our World in Data.

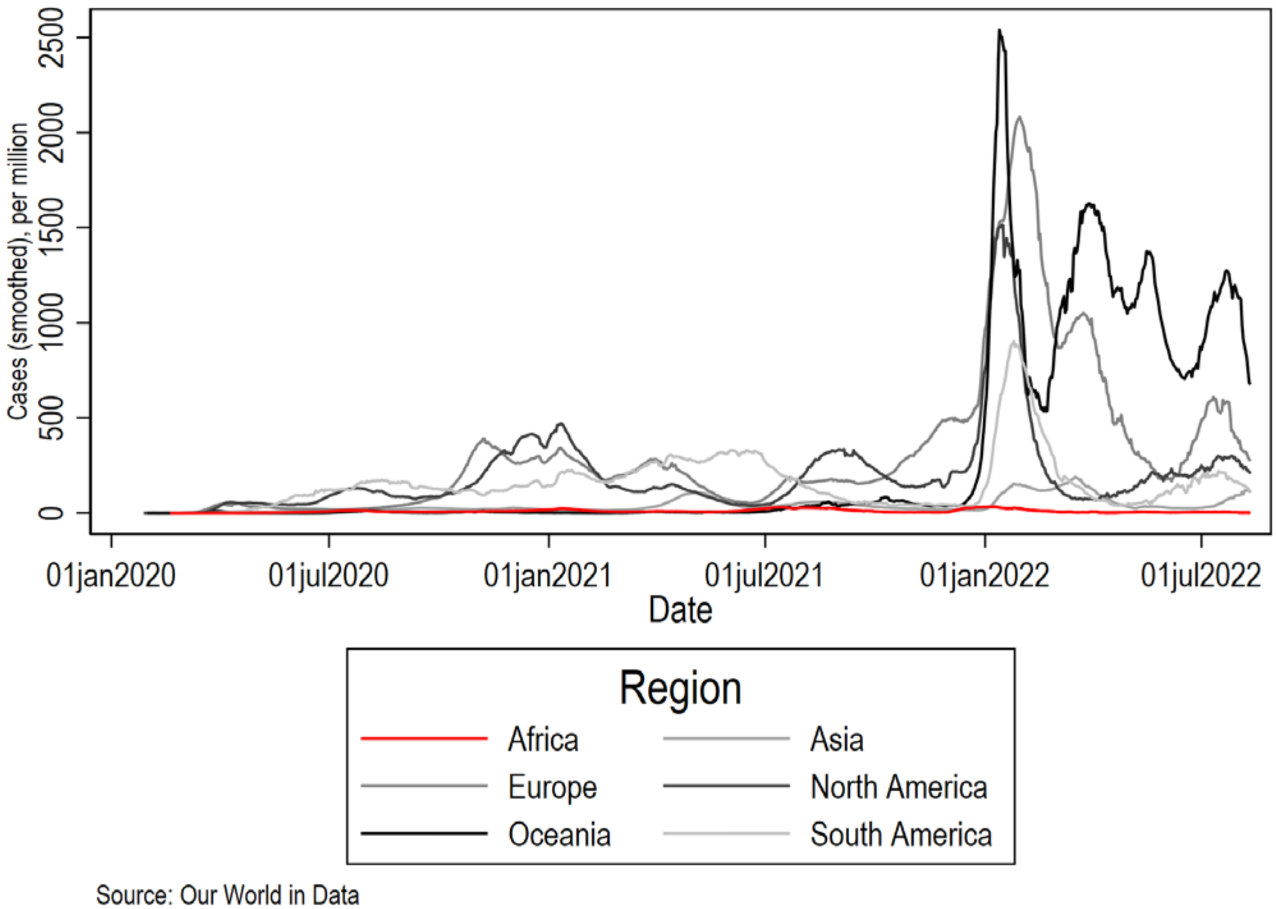


Figure 2. Daily COVID-19 Deaths (Smoothed), by Region. January 2020 to July 2022. Our World in Data.

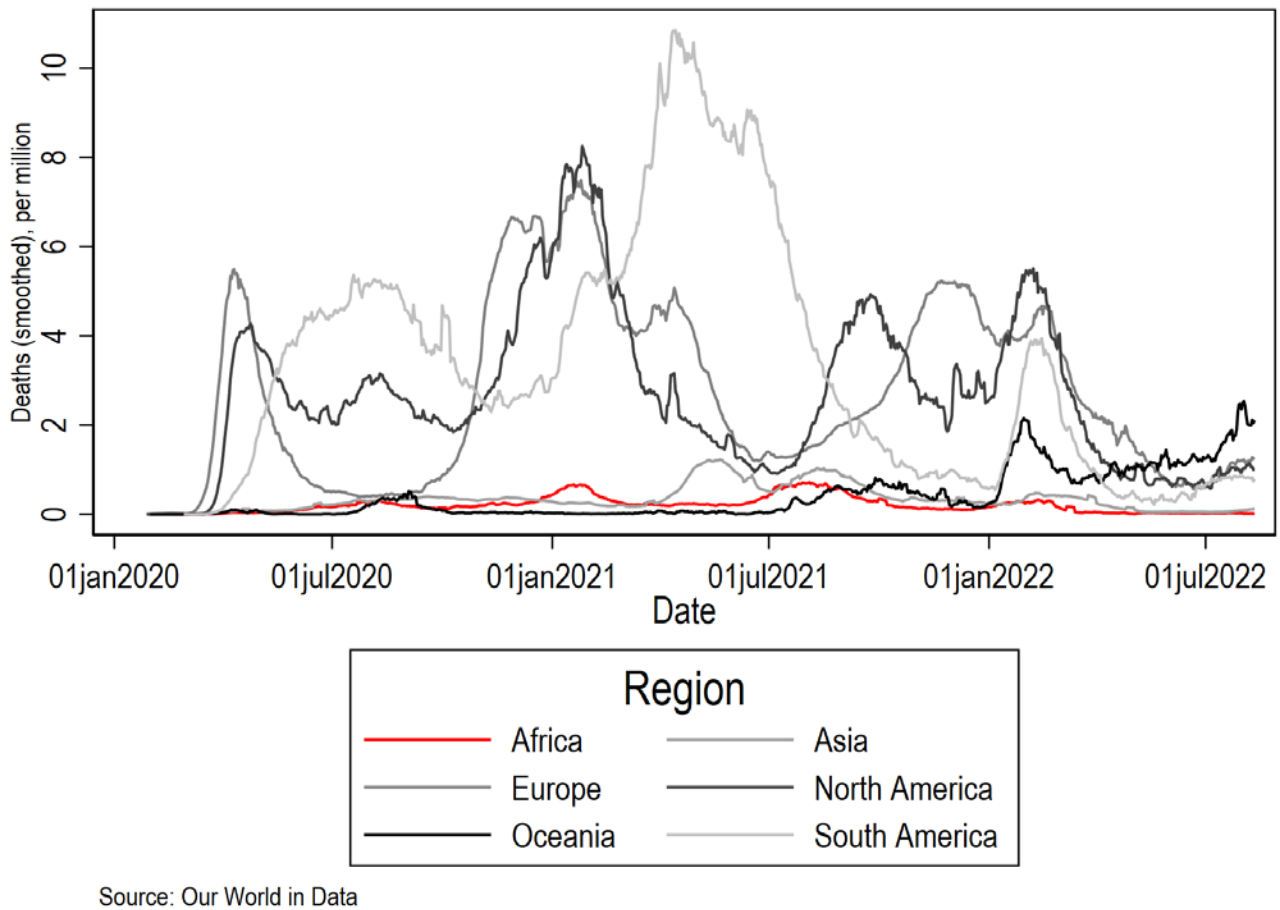
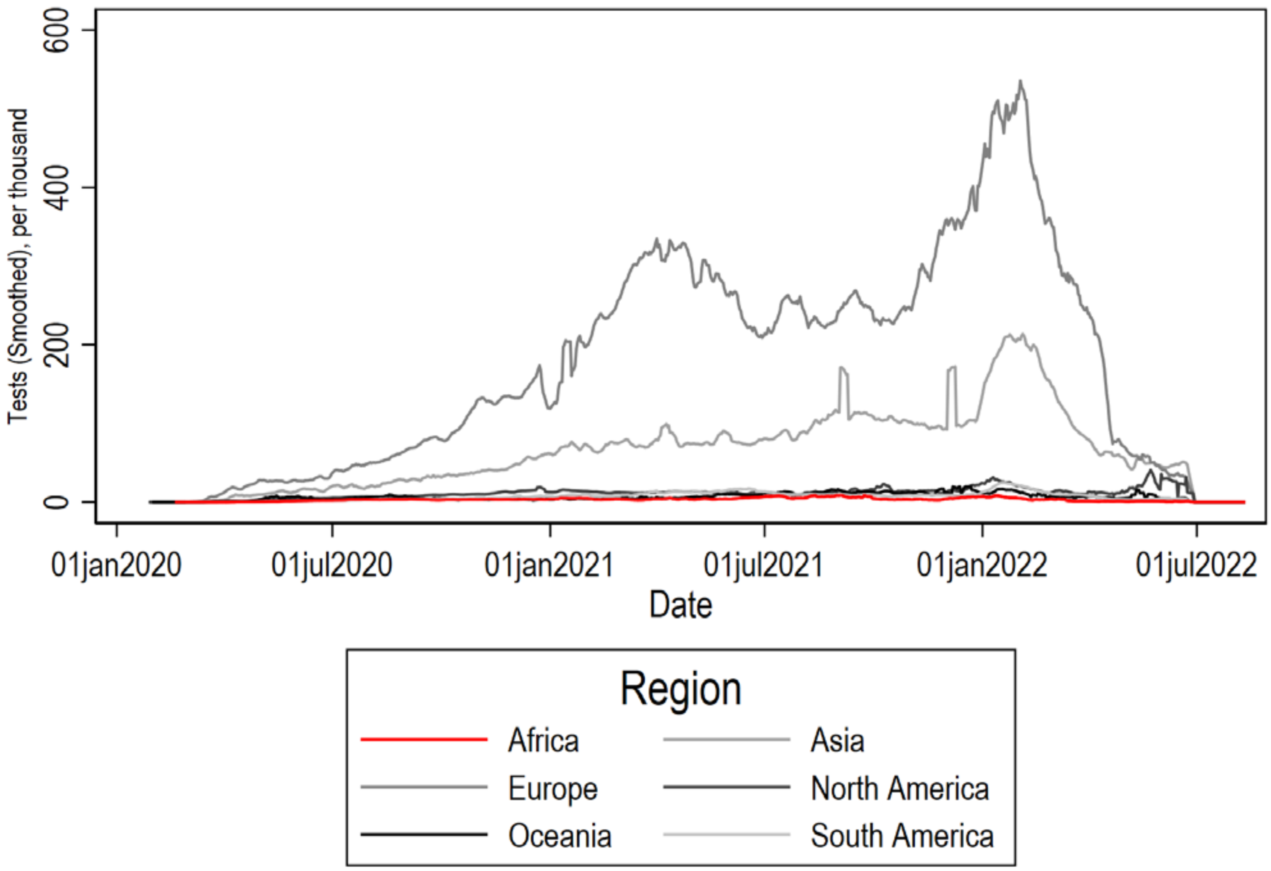
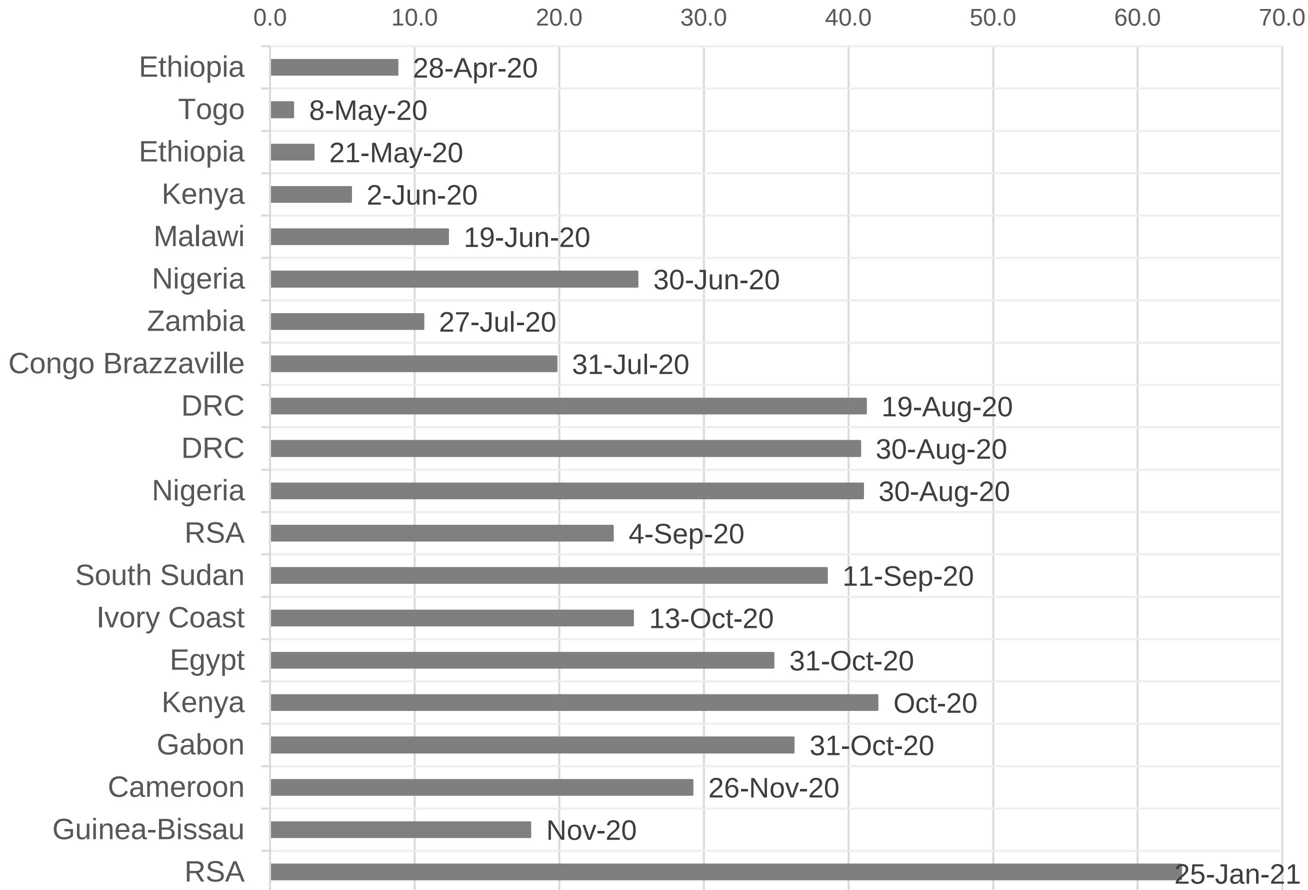


Figure 3. Daily COVID-19 Tests (Smoothed), by Region. January 2020 to July 2022. Our World in Data.



Source: Our World in Data

Figure 4. Population Prevalence of Antibodies to SARS-CoV2 in African Countries, by Date of Study



Note: DRC=Democratic Republic of Congo. RSA=Republic of South Africa.
Source: This is a presentation of data documented by Chisale et al. 2021.

Figure 5. Mean Stringency Index Score by Continent, January to April 2020. Our World in Data.

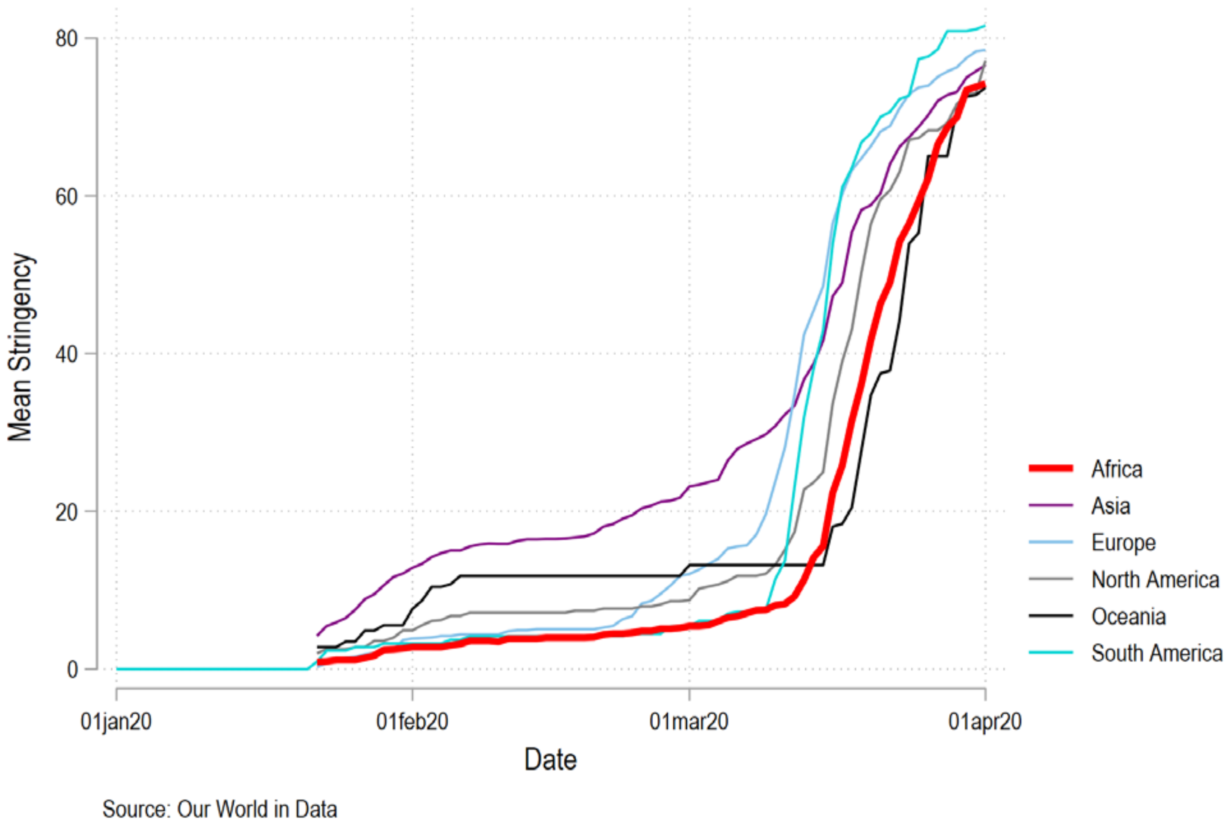


Figure 6. Heat Plot of Stringency for Select Countries, January 2020 to December 2021. Our World in Data.