# 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 remained one of the least affected in the world, leading commentators to speculate about the so-called "Africa paradox." There are six primary credible explanations for the 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 are very certainly much more important than commentators have and continue to suggest. Other factors are most important at the beginning of the pandemic and their influence has waned over time. However, there is not a single African story of COVID-19. No explanation is, by itself, complete. The importance of each of these factors depends on *where* and *when* one is talking about.

**SUMMARY KEYWORDS**

Africa, coronavirus, testing, deaths, 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 for rampant COVID outbreaks posed by African countries' fragile health systems and vulnerable populations.[14,15] Yet by August and September, 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 cases globally (see Figure 1).[16,17] African countries have remained relatively unaffected even with the detection 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 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 without thorough review. In a context as heterogeneous as the African region, it is easy to cherry pick the most visible and most successful responses, leaving the policymakers and practitioners with a biased view of what may be important to consider 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 or health care infrastructure) but rarely consider multiple explanations in relation to one another. Moreover, it is likely that these 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 why there are fewer recorded cases and deaths from COVID-19 in the African region. 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 credible 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 genuinely limit cases and deaths. More recently, researchers have also considered (4) the potential protective effects of geospatial population distribution and contact patterns in more rural areas. Additionally, comentators 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 in 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 (Tavory and Timmermans, 2014), 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 the global health and scientific community's assessment of COVID-19 in Africa.

## Explanation 1. Undercounted Cases

Undercounting of COVID-19 cases is a problem in all countries of the world due to asymptomatic spread and limited testing capacity. Limited testing capacity was a particular issue in the earliest months of pandemic spread for most countries and remains a substantial concern across the African region. In African countries with available data, there are large discrepancies between reported COVID-19 cases and population prevalence of antibodies to SARS-CoV2[28–30] that strongly suggest undercounting of cases by several orders of magnitude.

Prior to the emergence of COVID-19, African countries scored poorly, on average, on capacity to respond to an outbreak or new infectious disease vis-à-vis testing, health services capacity, and surveillance.[7,9] By April 2020, recorded cases in all regions of the continent were already significantly lower than some estimates of likely spread.[11] For example, by June 30, 2020, Nigeria, which has a population of 200 million, had tested only 138,462 samples.[i]

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 2). These figures are comparable to Denmark, a top performer in testing, and the US in April 2020, just one month into the pandemic.[31]

Despite limited testing, there is now substantial serological evidence suggesting that the actual number of cases is much larger than reported across the African region (see Figure 3).[28,30,32] 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.[29] 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 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. Seroprevalence of SARS-CoV2 antibodies in the Eastern Cape was 68% at the same time that official case counts suggested only about 3% of the population had been exposed.[33]

Although there is substantial heterogeneity in seroprevalence measures and population, a meta-analysis of 151 unique seroprevalence studies conducted in the African region concluded that, by September 2021, seroprevalence of anti-SARS-CoV2 antibodies was 65.1% [95% CI: 56.3-73.0%].[30][ii] For the African region, the ratio of seroprevalence from infection to officially reported cumulative incidence of COVID-19 cases was 97:1, meaning that the number of true infections was, on average, 97 times larger than confirmed cases given available data through September 2021. This ratio is equivalent to 800 million infections compared to the 8.2 million confirmed cases that were officially reported.[30] The gap between recorded cases and seroprevalence was greatest in countries with limited health system access. South Africa had the smallest ratio of seroprevalence from infection to officially reported cumulative COVID-19 cases at 10 infections for every 1 reported case for data from November 2020. In

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[i] Samples are not necessarily from unique individuals.
[ii] Since vaccination was almost entirely absent prior to this period, seroprevalence reflects the development of antibodies from COVID-19 infection.

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, it is also notable that, especially during the first wave and into late 2020, seroprevalence was lower in African countries than in European and North American countries at the same time. For countries with repeated seroprevalence estimates (Malawi, Kenya, Ghana and South Africa), seroprevalence remains low through mid-to-late 2020.[30] The pooled seroprevalence estimate for the African region during quarter 3 of 2020 is 3.0% (n=6; 95% CI 1.0% to 9.2%). Similarly, in a randomized household serosurvey conducted in urban and rural Ethiopia from July 22 and September 2, 2020, seroprevalence was between 2% and 5% in urban areas around Ethiopia's largest city, Addis Ababa, and 0.2% in rural areas. 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.[34]

All evidence thus suggests that COVID cases were severely undercounted during the first two years of the pandemic, likely by several orders of magnitude in most countries. 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. However, later studies show sharp increases in seroprevalence among African countries with available data beginning in mid-to-late 2020 and continuing through 2021. As of September 2021, an estimated 65% of people in Africa had been infected with COVID-19.

**Explanation 2. Undercounted Deaths**

The WHO estimates that almost 40% of deaths in the world are unregistered every year.[35] In many low- and middle-income countries, vital registration data are incomplete. A recent global assessment conducted by the World Health Organization found that just 44% of births and 10% of deaths in the African region were registered.[35] Thus, even before the pandemic, mortality data for many African countries were limited or unreliable.[36] Moreover, countries have made very little progress in improving vital registration systems since early the early 2000s.

During the COVID-19 pandemic, experts also quickly documented the problem of undercounted COVID-related deaths due to misclassification or lack of cause of death, even in countries with strong vital registration systems, like the United States.[37] Some of this misclassification is 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 1 in five bodies was infected with COVID-19 during surveillance in June through September 2020.[38] Only 6 individuals who tested positive after death were tested while alive. During later 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.[39]

Additionally, deaths from COVID-19 were frequently misclassified as pneumonia or influenza[37] or unrecognized post-acute cardiovascular manifestations of COVID-19 (e.g., heart attack, heart failure, stroke, dysrhythmia, pulmonary embolism).[40,41] 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 number of deaths from all causes in 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: missingness on cause of death and misclassification of cause of death. The absolute value of estimated excess death may still be biased down by unregistered deaths, especially if a greater number of deaths go unregistered during emergencies, which researchers documented is the case generally during public health and humanitarian emergencies.[42] Importantly, 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 patients.

In African countries, several 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. Even in African countries with higher performing civil registration systems (e.g., South Africa), official estimates of COVID-19 deaths quickly diverged from excess deaths estimates.[43] Recent work estimating excess deaths globally during the COVID-19 pandemic finds that sub-Saharan African countries reported 150,000 COVID-19 deaths by Dec 31, 2021.[44] For the same period, estimated excess deaths were over two million (2,130,000). The average ratio of the estimated excess mortality rate to the reported COVID-19 mortality rate is g than 14:1 for the sub-Saharan African region and is 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 regions.

Second, there is also evidence in multiple contexts that responses to the pandemic, especially lockdowns, influenced baseline mortality patterns by changing people's actions and behaviors.[45,46] In South Africa, *fewer* people than expected died in March, April, and May 2020—despite confirmed COVID-19 deaths—because changes in mobility during the first lockdown period reduced deaths from other non-disease causes, like car accidents.[47] Ultimately, researchers can only estimate excess mortality due to COVID-19 in South Africa *after* the lockdown period, when the excess deaths again became positive on net. By July 28, 2020, nearly three months after the first lockdown restrictions had been eased, the government of South Africa reported 2,413 COVID 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 deaths, but researchers estimated more than two and a half times as many excess deaths from all causes (49,251). Again, although all excess deaths cannot be *directly* attributed to COVID-19, after lockdown restrictions were eased, official counts of COVID-19 deaths quickly and substantially diverged from observed changes in all-cause mortality, suggesting a much larger number of deaths due to COVID-19 in South Africa than recorded.

A third key likely contributing to low numbers of recorded deaths attributed to COVID-19 is limited access to hospitals. 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.[48,49] These metrics are worse in rural areas, where over 80% of the population live in countries like Malawi, Niger and Burundi.[50] 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%.[51] There is evidence from other epidemic outbreaks that individuals are more likely to avoid or be turned away from the hospital during epidemic surges.[52] 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 4 COVID-19 deaths in the community.[39]

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.[53] Across 38 hospitals in six different African countries, the estimated probability dying within 30-days of admission for COVID-19 is 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%.[54] This gap, researchers estimate, has resulted in 11 to 23 *additional* African deaths per 100 COVID-19 patients compared with the global average.[53] Researchers attribute these additional deaths to a lack of critical care resources, 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 the vast majority of hospital facilities in the Democratic Republic of Congo, Senegal, Malawi, and Tanzania may not have both oxygen and constant electricity available.[55] 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.[56] Similarly, while in-hospital isolation rooms were more present in Nigerian hospitals, nearly half had been constructed in response to COVID-19 and PPE remained widely unavailable as late as October 2020.[57] In other settings, many hospitals lacked laboratory services to diagnose COVID-19, ICU facilities, ventilators, and consistent clean water supply.[12,58] Many of these issues are longstanding and were noted during the 2014-2015 Ebola outbreak in Liberia, Sierra Leone and Guinea.[59]

All evidence suggests that COVID deaths have been and continue to be severely undercounted in Africa, with excess mortality estimates indicating that over two million Africans had died due to COVID-19 by 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.[39] Although the size of the gap between estimated deaths 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 the idea that a younger age structure may be protective for African countries during the COVID-19 pandemic.[13,22,26,60–62] 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+).[63] 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 (see Figure 4). For some countries, like Niger and Mali, the median age is even lower, at 15 and 16 years, respectively.[64] Relatedly, life expectancy is 10 to 15 years lower in African countries compared with other regions and survival to age 65 is lower.[65] As a result, the proportion of Africans at the highest risk of COVID mortality due to age alone is much smaller than in high-income countries. Only 3% of the population in the African region is over age 65 compared with 16% in the US and 23% in Italy.[66,67] Thus, a smaller proportion of the population on the African continent is in the older age group where risk of death and severe disease from COVID-19 increase dramatically. Applying age-specific case fatality rates (CFR) from China's first wave to the African population in May 2020, Mougeni and Lell estimated that the African region would experience 75% fewer COVID-19 deaths compared to North America and European populations.[68] Using pre-pandemic population data and reported COVID-19 mortality, which as we note in the preceding section have several flaws, Lawal and colleagues also show 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]

Importantly, however, 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.[69] This research includes data from 26 countries, including 10 low- and middle-income countries, but only one African country (South Africa) due to 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 6 African countries.[70] This analysis finds that age-standardized infection fatality rates (IFR) in low- and middle-income countries are higher than in high-income countries. At 20 years of age, the mean IFR 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 IFR for ages 18 to 65 years is over 5 times higher than high income countries. Another study demonstrates that age-adjusted mortality is higher at all ages in Lusaka, Zambia compared with the USA.[71] 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 aged 0 to 18 years old.[39] These findings present a substantial challenge to the notion that younger age structure is universally protective for countries in the African region. Researchers highlight lack of access to healthcare as a key driver of increased IFR at younger ages in low- and middle-income countries.[70]

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 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 African countries being less dense, less urban, less internationally connected, and warmer than countries in other regions.[13,62] These differences are likely to have limited the number of new introductions of the virus across the African region[72] and limited its spread out of urban centers, particularly during the first wave of the pandemic.

Research on factors associated with the growth in reported COVID-19 cases during the first wave of the pandemic in 182 countries found that population density and urbanization were positively associated with reported COVID-19 cases during the first weeks of the pandemic.[73] 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 might diminish 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 overall 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 2 months for antibodies to SARS-CoV19 via blood draw, Kleynhans and colleagues find overall 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.[74] Compared to individuals who seroconverted in the urban community, individuals who seroconverted in the rural community were 4.7 times more likely to have seroconverted during the second wave. In the same two cohort, 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.[75] After the third wave, this gap continued to narrow. Overall 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 of temperature and seasonality in COVID-19 transmission find more mixed results. Early work, including initial assessments from China[76,77] and models testing the effects of temperature on reported COVID-19 cases during the first wave,[73,78–80] 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.[81,82]

Anecdotal evidence suggests that when lockdowns first occurred in African countries, many people left major cities to return home to smaller cities and rural areas.  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. Migration became less protective, however, around Christmastime at the end of 2020, when Africans returned home from abroad, many of them bringing COVID with them.

**Explanation 5: Government Response**

Several commentators have credited African governments for their rapid responses and relative success in limiting the spread of COVID.[27,83–86] 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.[87] Initial reports highlighted the responses of Rwanda, Uganda, and South Africa. These countries utilized science-based risk communication and community-based disease surveillance in response to the pandemic.[88–91] 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.[92,93] In Senegal, where one of only two 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.[94] 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.[88] The governments of Senegal and South Africa also explicitly involved faith and traditional leaders in their response to the outbreak.[86,95]

However, even in Uganda, where response to COVID-19 was generally strong, President Museveni was unwilling to fully limit the movements of truck drivers throughout the country.[96] With 54 countries on the continent, many commentators have focused on earlier and more visible actors and actions. By highlighting the actions of a few, we neglect the countries that were less effective in their response or that intentionally downplayed the risk of COVID-19. Throughout 2020, for example, Tanzanian President John Magufuli dismissed the need for public health measures and advocated for prayer and use of herbal medicines to defeat COVID-19.[96] He disputed the accuracy of tests, claiming that laboratory staff had been "bribed by imperialists, or they have no expertise" and had them investigated.[89] 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 that Tanzania had eradicated "respiratory diseases." He died of suspected COVID-19 along with several other public figures and state officials in March 2021.[98]

In Burundi, too, President Nkurunziza actively limited information about COVID-19 and refused to carry out tests. 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.[99] 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.[100]

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.[101] There is ample evidence of substantial impacts to former heads of state and national ministers, as well as high-level figures, such as opposition leaders and prominent judges.[101]

Given the wide range of government responses across the continent and the fact that the deaths of African officials and heads of state have been associated with shifts in COVID-19 policies in some countries,[98,101] it is pertinent to assess government action in comparable ways over time and space. Figure 5 presents daily scores of the COVID-19 Stringency Index collected by the Oxford Coronavirus Government Response Tracker (OxCGRT) for African countries. The Stringency Index uses 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 to 100, where a higher score indicates a stricter response (i.e., 100=strictest response) and a low score indicates a less strict response (i.e., 0=no restrictions).

Using the Stringency Index, it is clear that nearly all African governments took some public health measures against COVID-19, especially during the first wave, beginning as early as January 2020 in countries like Botswana and Senegal with disease surveillance at airports. The Africa CDC also began active monitoring in January 2020. 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. The timing of these responses is later than Asian and European countries, which had significantly higher mean COVID-19 Stringency Index scores from January 1, 2020, through April 1, 2020 (see Figure 6 and Figure 7), but still consistent with the timings of the first detected cases and the timing of public health measures and case detection in European countries and the US. The first cases on the African continent were detected beginning in February 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.[102] 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.[103] By mid-to-late March, several African countries closed their borders to foreign nationals and implemented national or localized lockdowns.

The implementation of lockdowns and other mobility restrictions varies 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.[104,105] Ultimately, African countries adopted a variety of "lockdown” 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.[106] Multiple studies find that lockdown measures during the first 2 months of the pandemic in South Africa and the first 5 to 6 months in nine African countries did not effectively reduce community transmission of COVID-19.[106,107] Additionally, while countries like South Africa implemented a 2 month-long, countrywide mandatory home confinement and curfew, other countries like Sierra Leone only mandated that individuals stay at home for 3 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. Others, like Botswana, implemented a 3-day localized lockdown in the capital city of Gaborone in June 2020 following the detection of new cases after cases a 48-day national lockdown initiated at the end of March.

As shown in Figure 6, most African countries became less strict after the first wave. By September, nearly all countries had substantially eased or removed most restrictions. Compared to other regions, shown in Figure 8, African countries implemented fewer restrictions after September 2020 and throughout 2021 (more yellow and light green are visible). Fewer African countries exhibit the toggling off and on of restrictions that is apparent in many European countries (the appearance of multiple blue-purple bands followed by yellow or green) or the long-term high restriction (blue to purple) levels observed in several Asian and South American countries.

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 do noticeably differ from most Western 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. News media and human rights reports also highlight police violence against citizens and journalists in Nigeria, Kenya, Zambia, Uganda, and Namibia. In at least a few cases, officials have 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.

**Explanation 6. Community Response**

The behaviors of Africans in response to government restrictions, as well as independent of them, 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.[84] 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.[108] 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.[109] 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.[110] Work in Kenya, too, finds incredibly high self-reported mask use at 88% in Western Kenya.[111] However, incorporation of other data, including mobility data, compliance with public health measures, and direct observational data present a more mixed picture.

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.[112] In Botswana, research shows that residential mobility, indicative of time spent at or near home, had already increased by 10% before the country enacted its first lockdown at the beginning of April 2020.[113] During the first few days of the 48-day national lockdown, residential mobility skyrocketed to 40% higher than pre-pandemic levels. As the country's lockdown persisted into May, however, residential mobility slowly decreased as residents increasingly returned to activities outside of their residential area. Residential mobility then decreased dramatically 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), residential mobility increased again but remained below levels observed during the national lockdown and quickly deteriorated when the 14-day localized lockdown was lifted. By October 2020, residential mobility was about 5-8% higher than pre-pandemic levels, suggesting a small number of people were continuing to limit their activities but 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 degree.[112] In Cote d'Ivoire, for example, people began staying home more in late March and early April.[113] While mobility data do not allow for direct comparisons across countries, the slope of the decline in residential mobility in Cote d'Ivoire is shallower compared with countries where lockdowns toggled on and off. By July, time spent at home in Cote d'Ivoire returned to just above pre-COVID levels, while other kinds of mobility, like retail and transit, had returned to above pre-pandemic levels. Compared to other regions,[iii] the median Sub-Saharan African country[iv] had returned to at least baseline mobility or higher in retail and recreation, grocery and pharmacy, and transit as of October 2020.[113] Trends in residential mobility in Sub-Saharan African countries compared to countries in other regions are closely aligned and do not indicate greater (or lesser) retreat to residential spaces during February to October 2020. For African countries where we have mobility data, people stayed home during the first pandemic wave about as much as in other countries where we have mobility data and, since, have mostly returned to their activities outside of the house.

One reason that likely drove the return to pre-pandemic mobility in African countries is the economic cost of staying home. 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."[114] In general compliance with stay-at-home orders was challenging for many in sub-Saharan African countries. In particular, for the many who could not carry out their jobs virtually, complying with lockdown meant a (near) total loss of income. In South Africa, 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).[115] These income losses are associated with predictable impacts on food insecurity and other measures of wellbeing.[115,116] As elsewhere, access to work-from-home was associated with race in class in places like South Africa, where the majority of those able to work from home live in suburban areas (88%).[115]

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[iii] Data include 36 countries

[iv] Data include 8 sub-Saharan African countries with adequate data

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 employed South Africans were less likely to report staying home during lockdown.[117] 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.[116] 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.[117]

There are other signs, too, that individual responses to the pandemic are more varied than as portrayed by fell-good news media coverage. Although masks have not been politicized like they have in the US, all early assessments stress that surgical and other masks was already in short supply across the African continent.[7,9,56] Small, industry focused studies (e.g., on the impact of COVID-19 on construction site safety) also note a total lack of access to PPE, lack of compliance with public health measures, and necessary use of public transportation by workers, and inability to adhere to social distancing rules in the first months of the pandemic.[118] 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.[111] This gulf between self-reported usage and direct observations leads the researchers to conclude that “people are aware that mask use is socially desirable, but in practice they do not adopt this behavior.” Studies in other contexts, too, find discrepancies in survey versus interview reports of mask wearing in South Africa.[119]

African communities responded quickly, as mobility data show, and they did this with and without official orders from governments. However, substantial gaps remain for many in terms of being able to comply, especially for longer periods, without decreasing access to other basic needs like food and income.

## Discussion

This paper reviews current available evidence on six explanations that have been 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 very certainly much more important than commentators have and continue to suggest. 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 SE Asia region, if not higher, given antibody data. Subsequent waves have been severe and infections are increasingly being introduced into African countries from other African countries.[120] 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 million Africans 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 and burial and funeral surveillance in Ethiopia directly challenge the narratives that COVID-19 has left African countries unscathed.

Ultimately, the feel-good stories 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, which receives $4.5 USD in development assistance for health for every $1 USD received in Sudan. Stories commending the strict response of South Africa for keeping COVID-19 deaths low promotes lessons like fines, curfews, and arrests work rather than promoting honest, transparent governance. Mostly, the feel-good focus is dishonest. As elsewhere, there is wide variation in the impact and response to COVID-19 across the continent. Focusing on the governments or communities in a select few obscures the bad actors that downplayed the pandemic, and limited access to testing and vaccines.

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

We have evaluated the six primary explanations and find some support for each. Importantly, each alone is incomplete. None of them tell the whole story. Cases *are* underreported, but antibody evidence suggests they were still slower to accumulate during the initial global 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 outset, 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 encountered substantial barriers to maintaining these responses over time, and at least a few engaged in COVID-19 denialism to their detriment. African people also responded *en masse*. As elsewhere, they took care of their own, and there are myriad examples of this. But they also encountered massive structural barriers to their success and ability to continue these responses. And many did not or never could adopt recommended measures.

There is not a single African story of COVID-19. The importance of each of these factors depends on *where* and *when* one is talking about.

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

| 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, on average. Thus, fewer Africans will die from COVID-19 because there are fewer individuals in the older, higher risk age groups. | Protective |
| **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. | Protective early in pandemic |
| **5. Government Response** | Government preparedness due to previous experience with infectious disease, opportunity to learn from other countries' policy responses, and swift and strict responses have limited the number of cases. | Some protection |
| **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. | Some protection |

**Figure 1. COVID Cases and Deaths, by Region. Jan 2020 to Mar 2022**

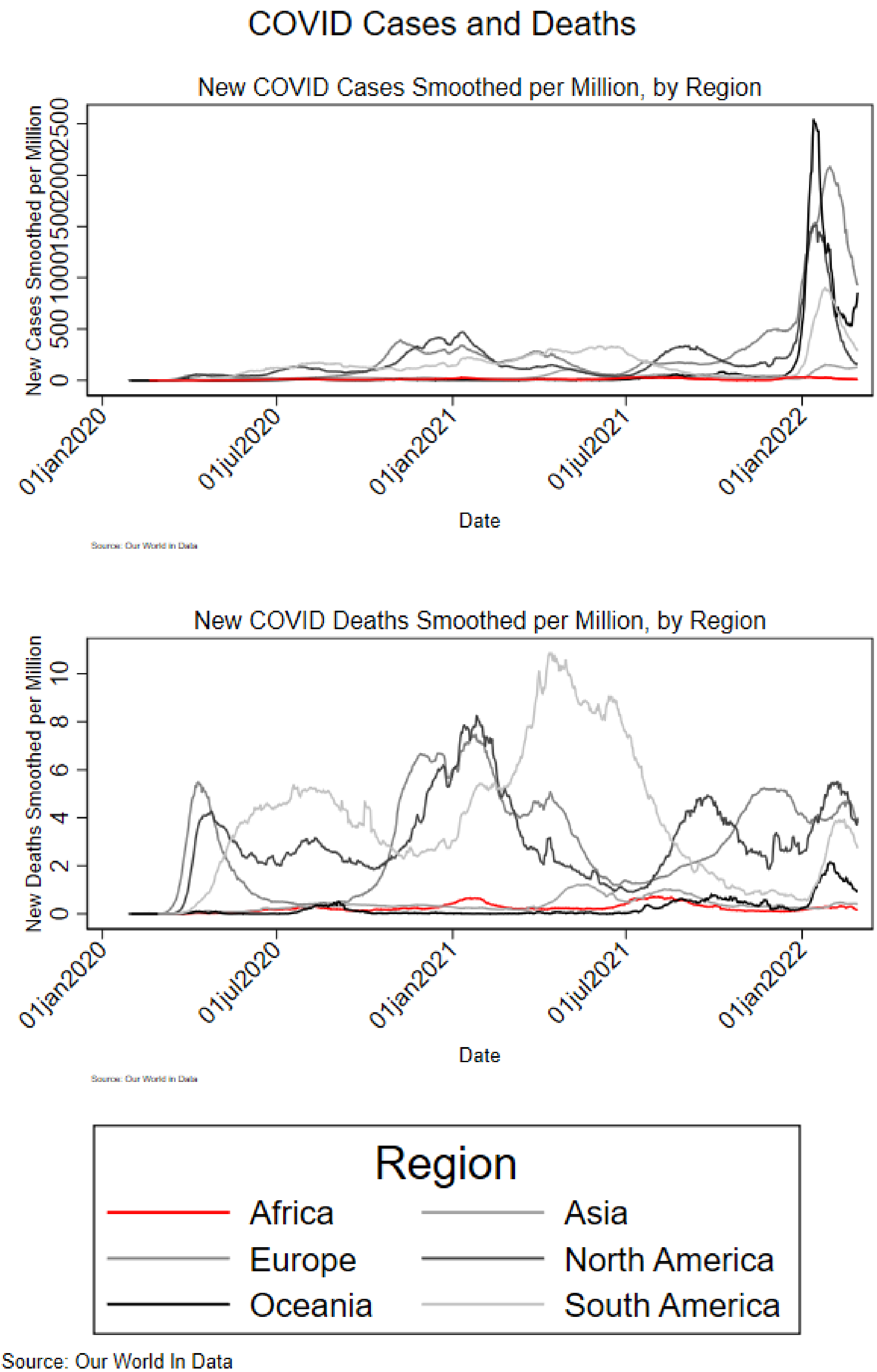


**Figure 2. New COVID Tests Smoothed per Thousand, by Region. Jan 2020 to Mar 2022**

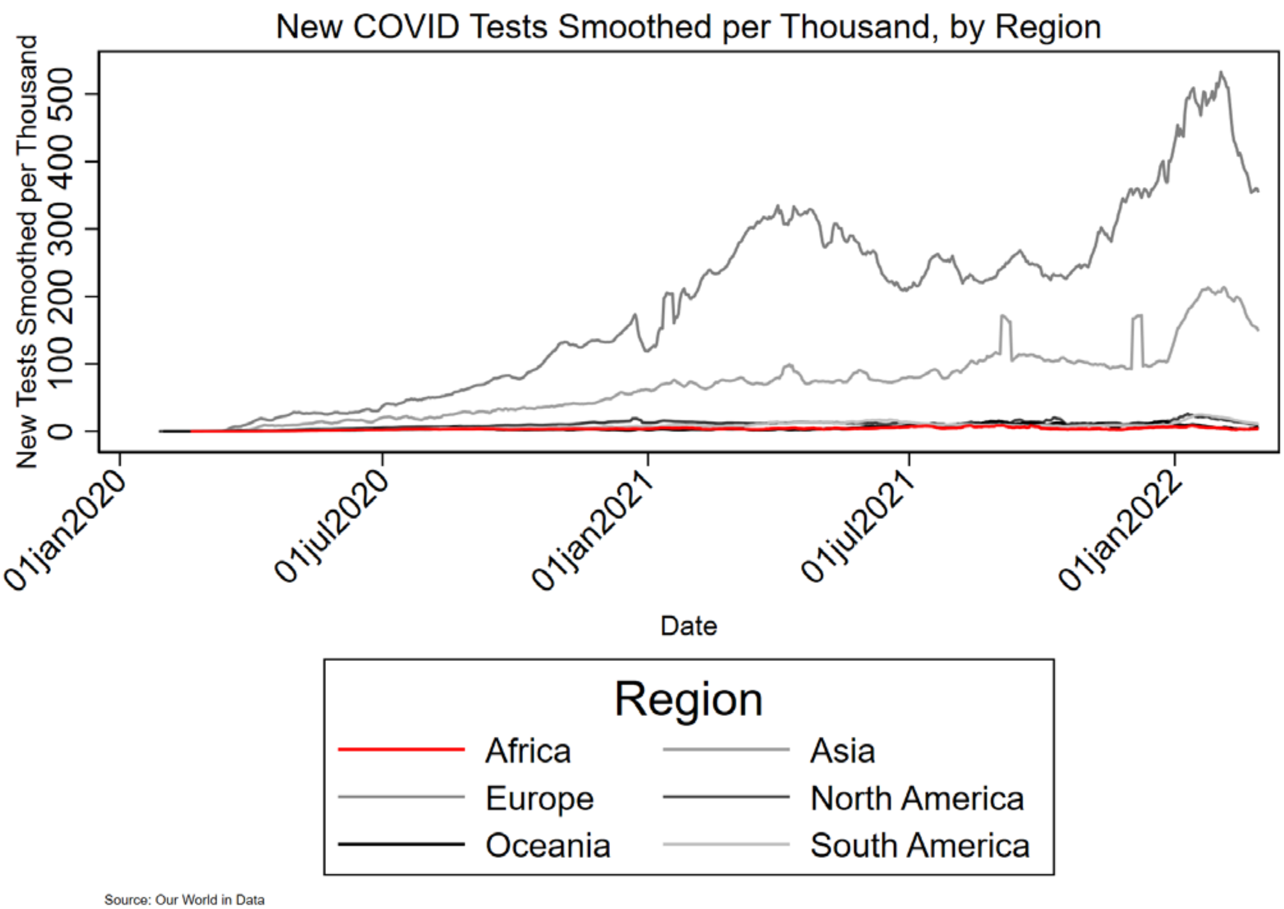
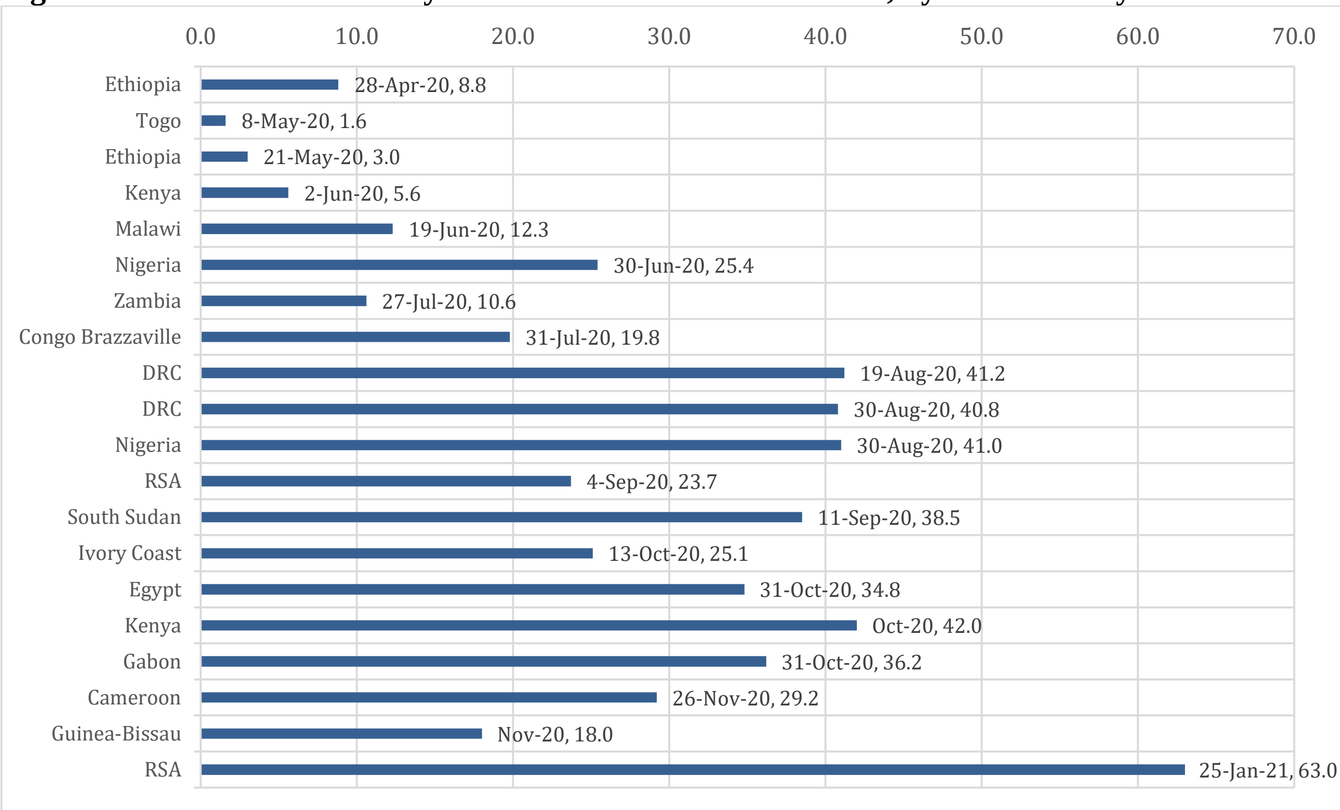


**Figure 3. SARS-CoV2 Antibody Prevalence in African Countries, by Date of Study**




Source: Chisale et al. 2021.

**Figure 4. Median Age of Total Population, by Region**

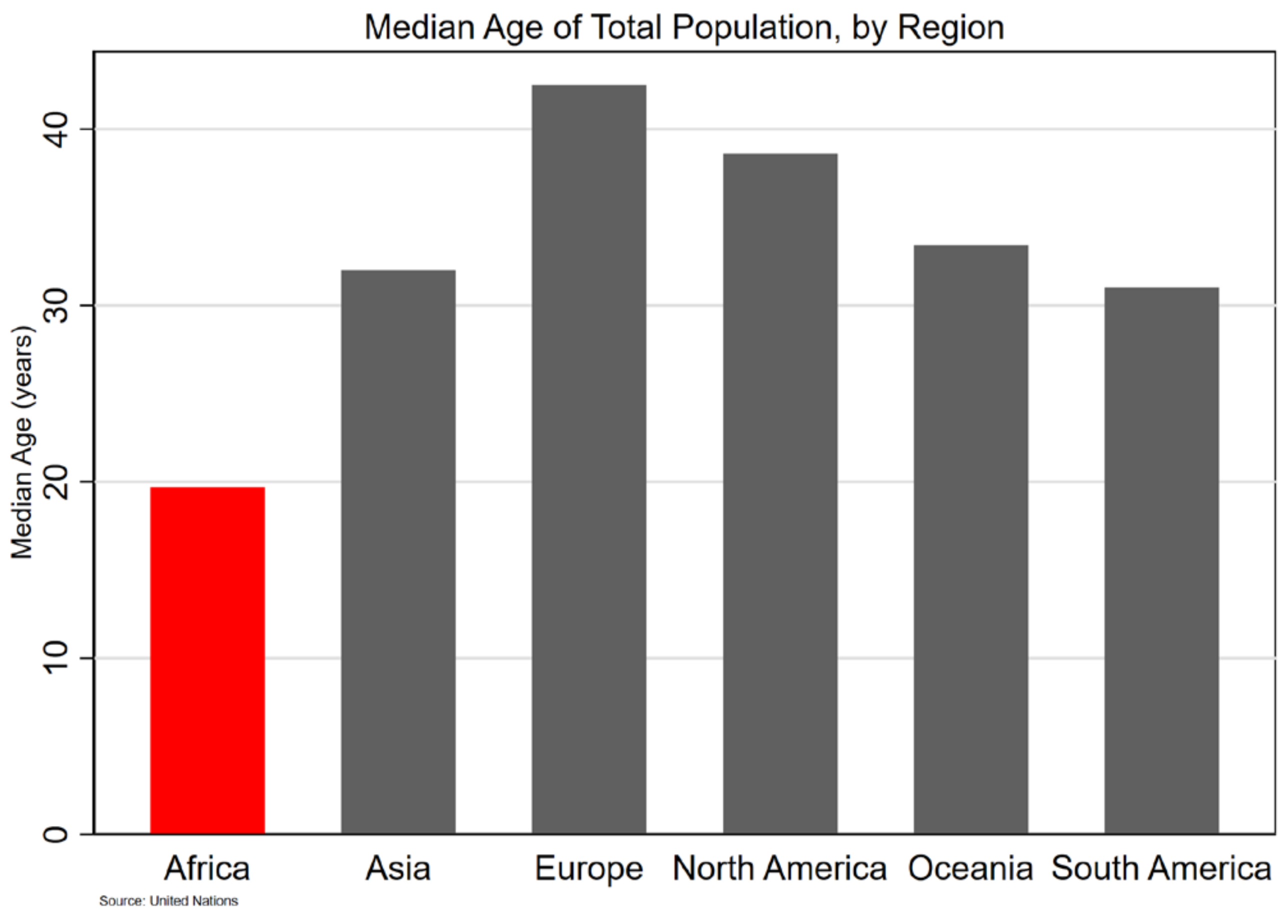
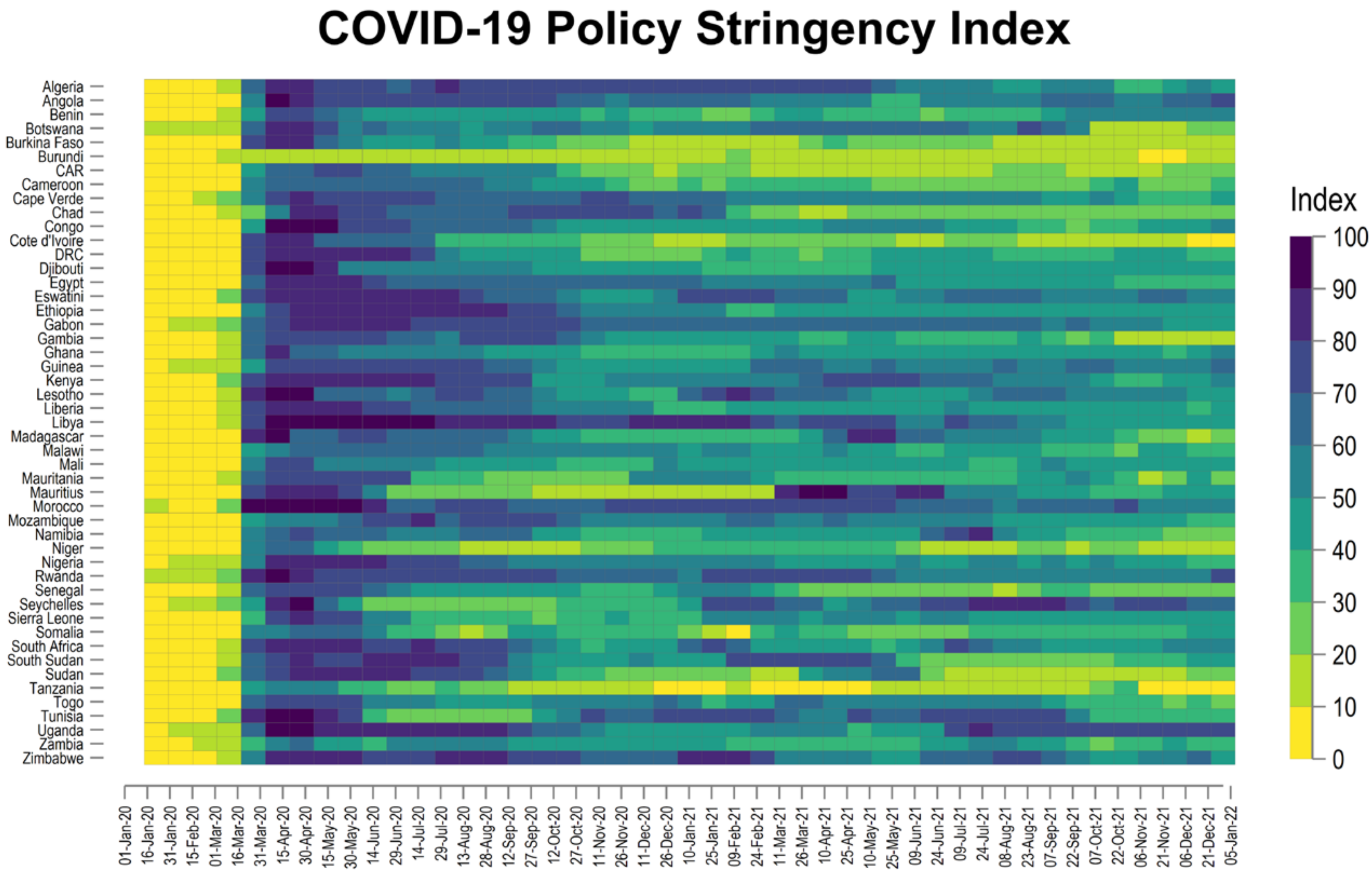
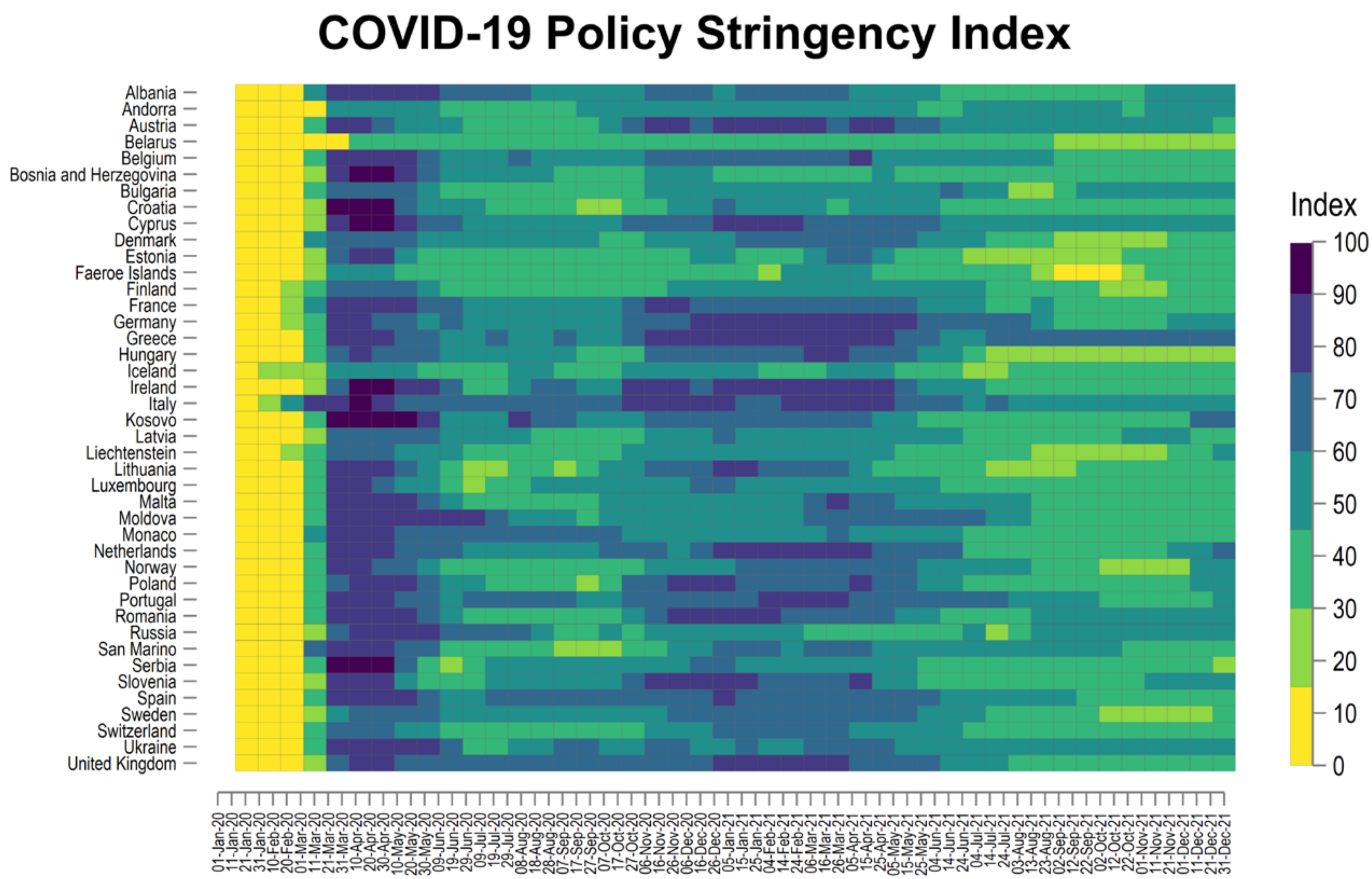


**Figure 5. COVID-19 Policy Stringency Index, African Region, Jan 2020 to Dec 2021**



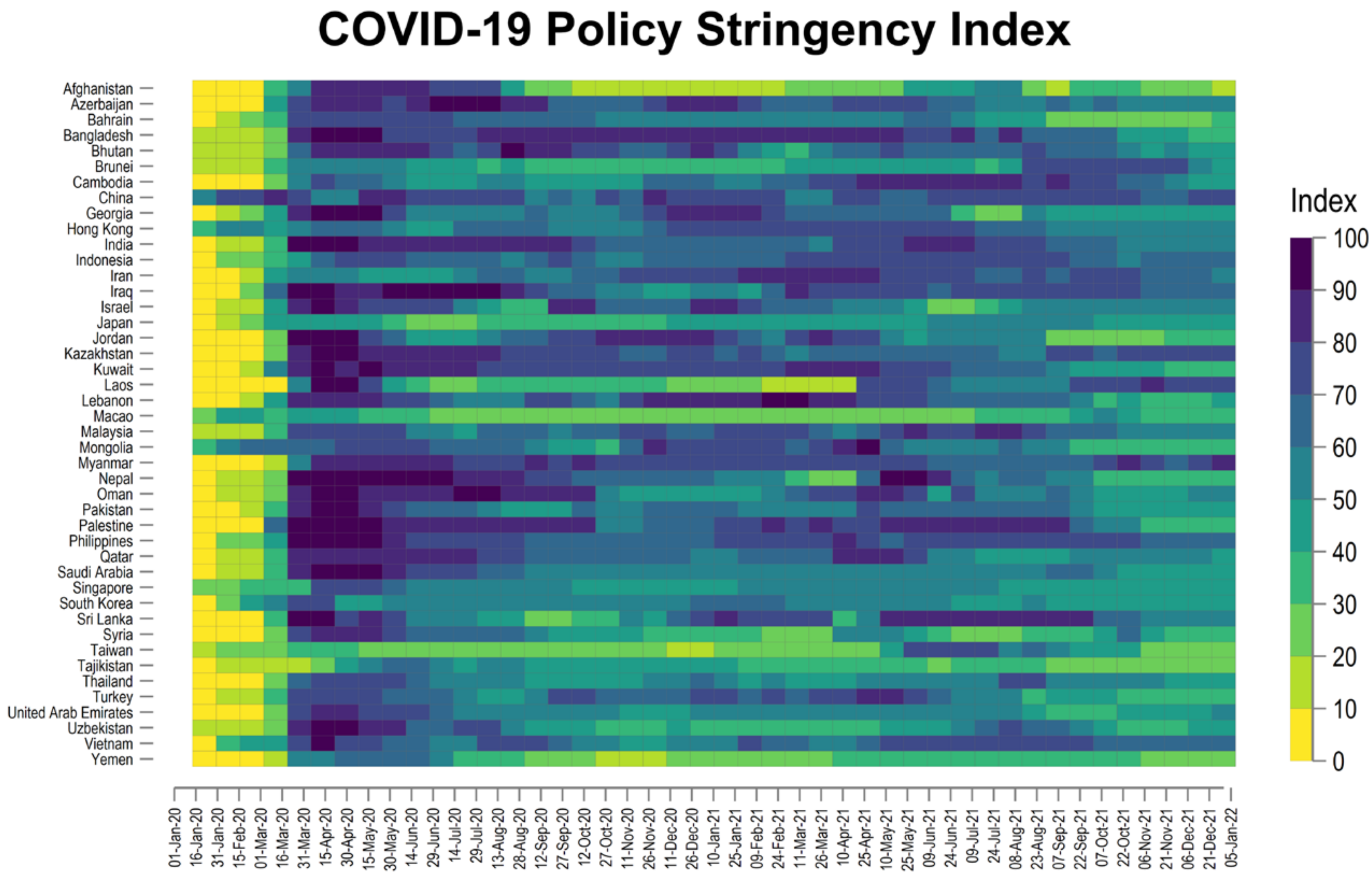

Data source: Oxford COVID-19 Government Response Tracker.

**Figure 6. COVID-19 Policy Stringency Index, European Region, Jan 2020 to Dec 2021**




Data source: Oxford COVID-19 Government Response Tracker.

**Figure 7. COVID-19 Policy Stringency Index, Asian Region, Jan 2020 to Dec 2021**




Data source: Oxford COVID-19 Government Response Tracker.

**Figure 8. COVID-19 Policy Stringency Index, by Region, Jan 2020 to Dec 2021**