Investigating the Possible Reasons for the Low Reported Morbidity and Mortality of COVID-19 in African Countries

An Integrative Review

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Background: COVID-19 has impacted the world differentially with the highest mortality and morbidity rate burden in Europe and the USA and the lowest mortality and morbidity burden in Africa. This study aims to investigate the possible reasons why Africa recorded the lowest COVID-19 mortality and morbidity.

Methods: The following search terms were used PubMed database: ["mortalit*" (tw) OR "morbidit*" (tw) AND "COVID-19" (tw) AND "Africa" (tw)]. Studies that discuss a factor for the low COVID-19 burden in Africa have a defined methodology, discuss its research question and mention its limitations are selected for review. Data from the final articles were extracted using a data collection tool.

Results: Twenty-one studies were used in this integrative review. Results were grouped into 10 themes, which are younger African population, lower health capacity, weather, vaccines and drugs, effective pandemic response, lower population density and mobility, African socioeconomic status, lower prevalence of comorbidities, genetic difference and previous infection exposure. The low COVID-19 mortality and morbidity in Africa is largely a result of a combined effect of the younger African population and underreporting of COVID-19 cases.

Conclusions: There is a need to strengthen the health capacities of African countries. Moreover, African countries that have other health problem priorities may use a tailored approach to vaccinating the elderly. More definitive studies are needed to know the role of BCG vaccination, weather, genetic makeup and prior infection exposure in the differential impact of the COVID-19 pandemic.

Key Words: COVID-19, mortality, morbidity, Africa

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Coronavirus Disease 2019 (COVID-19) is an ongoing pandemic that has greatly threatened the world. As of May 25, 2022, COVID-19 infected about 524 million people and killed about 6.3 million people.[1] Up to this point, Africa has experienced about 2% of total COVID-19 confirmed cases and about 3% of the total COVID-19 deaths while its population makes up 16.7% of the world population.[2] COVID-19 has impacted the world differentially with a greater burden in the Unites States of America and Europe and a relatively lower apparent impact in Africa. This integrative review aims to investigate possible reasons why Africa recorded the lowest COVID-19 mortality and morbidity.

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METHODS AND MATERIALS

This was a literature-based systematic review that used the search strategy: ["mortalit*" (tw) OR "morbidit*" (tw)] AND "COVID-19" [tw] AND "Africa" [tw] into a PubMed database. Articles that were written in English language and mention any factor that may explain the low reported mortality or morbidity of COVID-19 in Africa were first selected on abstract screening and are further selected on full-text review if they have adequately described methodology, listed limitations of the study and discussed results in light of research questions (Fig. 1). Data from each article were collected using a customized data collection tool. Factors that were identified to potentially explain the low COVID-19 burden in these articles were first listed and then put under different themes used for discussion. Each theme is discussed critically depending on each factor's information taken from the selected articles.

RESULTS

After entering the search strategy into PubMed, 498 articles were identified from the PUBMED database after excluding 5 duplicates. From this list, 62 articles were selected after review based on their abstracts. A total of 41 articles were excluded upon full-text assessment of these 62 articles leaving 21 articles for the integrative review. The articles reviewed included observational, systematic reviews, and interventional studies.

Factors that were proposed by every article to explain the low COVID-19 burden in Africa were grouped into common themes or categories. The 10 themes that were selected for discussion and analysis include the younger age of the African population, lower health capacity, weather, usage patterns of vaccines and drugs, effective pandemic response, lower population density and mobility, African socioeconomic status, lower prevalence of comorbidities, genetic differences and previous infection exposure.

DISCUSSIONS

Younger African Populations

Studies[3,4] have shown that age is a major risk factor for COVID-19 hospitalization and mortality. According to the US Center for Disease Control and Prevention,[5] the rate of hospitalization and death due to COVID-19 increases dramatically with the age of patients. Africa has the world's youngest population with 67.6% of its population under 29 and only 3.4% of its population >65 years old (Table 1).[6,7]

In an analytical review, Lawal[8] found an increase in COVID-19 death rate along with an increase in median age and life expectancy. Moreover, most of the countries severely affected by COVID have a higher proportion of elderly population.[9] Elderly individuals are also more likely to harbor comorbidities, which are also a risk factor.[10] So, Africa had a relative advantage in the COVID-19 pandemic because it has a younger population.

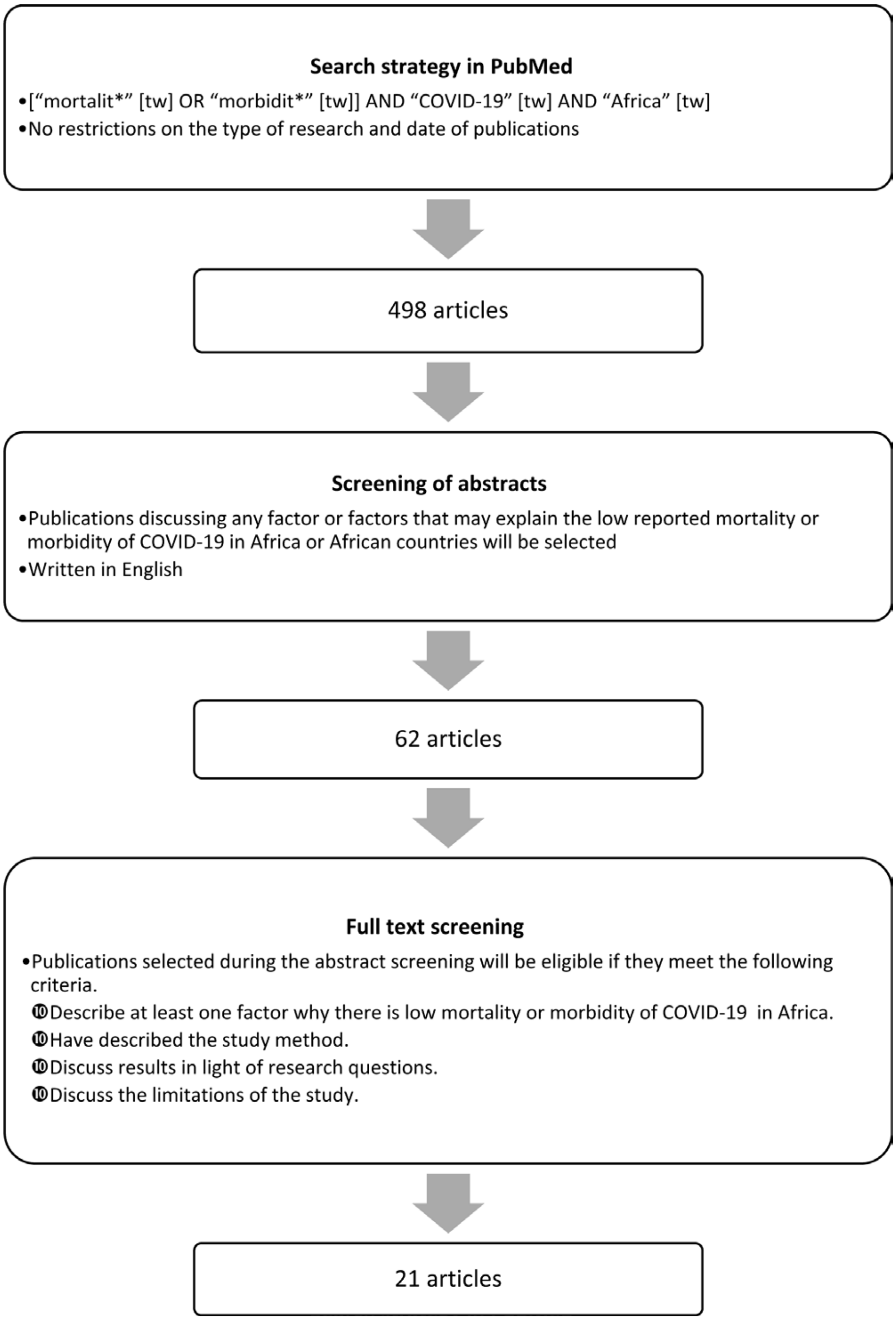

FIGURE 1. The flowchart of study identification and study selection process.

A comparison of countries with the highest and lowest COVID-19 mortality rates along with their median population age shows that most of the countries with the lowest COVID-19 deaths per 100,000 had lower median ages and most countries that have recorded the highest deaths rate have relatively higher median ages (Table 2).[11,12] However, countries have differences in their testing capacity, which may bias this comparison. Moreover, there is a concern that African children may have a different risk for COVID-19 deaths and hospitalizations.[13]

Lower Health Capacity

Before the COVID-19 pandemic, the African health system had major challenges in human resources, budgetary allocation to health and leadership and management.[14] The COVID-19 pandemic happened in the context of African health systems with limited capacity to deal with the stress of COVID-19. This has led to arguments that Africa's low COVID-19 morbidity and mortality are due to the limited testing capacity of African countries.

TABLE 1. World Continents and Their Population Age Characteristics

	Continent	Africa	Europe	Asia	South America	North America	Oceania
	Population	1,308,064,176	747,182,815	4,603,371,266	427,199,424	366,600,944	42,128,047
	Median age	18	42	31	31	35	33
Age ranges and their respective percentage	0–14	40.6%	16.1%	23.6%	22.9%	18.3%	23.6%
	15–29	27%	16.6%	23.5%	24.4%	20.3%	21.7%
	30–39	12.6%	14.1%	15.4%	15.6%	13.5%	14%
	40–49	8.6%	13.9%	13.4%	13.1%	12.4%	12.3%
	50–64	7.5%	20.6%	15.5%	14.7%	19.3%	15.7%
	65–74	2.4%	10.1%	4.7%	5.7%	9.6%	7.2%
	75–84	0.9%	6.2%	2.4%	2.6%	4.8 v	3.8%
	Above 85	0.1%	2.3%	0.7%	0.9%	2.0%	1.5%

TABLE 2. Countries With the Lowest and Highest COVID-19 Deaths per 100,000 People and Median Population Age

10 Highest Death Rate Countries	Median Population Age	Deaths per 100,000 Population	10 Lowest Death Rate Countries	Median Population Age	Deaths per 100,000 Population
Peru	31	656.34	Nigeria	18	1.53
Bulgaria	45	542.48	Tanzania	18	1.41
Hungary	43	491.26	Benin	19	1.34
Bosnia and Herzegovina	43	491.22	Tajikistan	22	1.31
North Macedonia	39	457.24	Niger	15	1.29
Montenegro	38	442.63	South Sudan	19	1.23
Georgia	38	423.65	Chad	17	1.17
Croatia	44	410.72	China	38	1.07
Czechia	43	382.85	Burundi	17	0.32
Slovakia	41	376.12	Korea, North	35	0.02

In an attempt to estimate actual COVID-19 infection in Africans, seroprevalence studies[15–17] done in Sierra Leone, South Africa, Ghana, Madagascar and Burkina Faso have shown that African countries have been detecting only a fraction of Severe Acute Respiratory Syndrome-Coronavirus-2 (SARS-CoV-2) infections. In addition to this, a comparison of the ratio of seroprevalence rate to cumulative incidence across different parts of the world show more people are left uninvestigated in the African region.[18] In support of this, Bouba et al[19] found a positive association between COVID-19 tests done per million population and COVID-19 detection rate. Furthermore, the testing strategy employed may determine the chances that the COVID-19 tests are done on COVID-19-positive individuals.[20] It is estimated that Africa is detecting only about 13% of COVID-19 cases.[21] However, the strongest evidence for underreporting cases in Africa comes from a prospective postmortem surveillance study of 264 deceased people in Zambia.[13] According to this study, COVID-19 was the cause of death in 15% of the study population, and about 80% of those who tested positive were not investigated for COVID-19 before they died. Another alarming finding of this study was that child deaths account for 10% of deaths that tested positive for SARS-CoV-2. This study highlights the high rate of underreporting and underinvestigation of patients in Africa. Moreover, COVID-19 was not looked for even in settings where investigating for SARS-CoV-2 was feasible.

Weather

Africa is the most tropical continent with hot and humid weather in most parts.[22] It has been proposed that SARS-CoV-2 may not survive well in these African climates.[23] The impact of weather conditions like humidity and temperature on COVID-19 infection dynamics has not been consistent in many studies.[24–30]The contradicting results of studies on the effect of temperature and humidity on COVID-19 incidence make it difficult to assess the impact of these weather conditions.

Vaccines and Drugs

Bacillus Calmette-Guerin (BCG) vaccination and ivermectin treatment for parasitic infections have been proposed as possible explanations for the low COVID-19 burden in Africa. BCG is known to have nonspecific benefits against other infections,[31] and it may have protected Africa from COVID-19 in the same way. In an analysis of COVID-19 cases, Sharma et al[32] noted that the incidence and mortality of COVID-19 were lower in countries where BCG is commonly given. However, in this study countries were not matched based on other contributing variables such as median age. Moreover, a randomized clinical trial of revaccination of BCG among health workers in South Africa showed no protective benefits of BCG against COVID-19.[33] Other BCG clinical trial results are pending and may help us understand the effect of BCG in the COVID-19 pandemic.[34]

Ivermectin is an antiparasitic drug commonly given as a prophylaxis for parasitic infections. In an ecological study, Guerrero et al[35] found lower mortality and infection rate of COVID-19 among African countries that use ivermectin as prophylaxis for parasitic infections. However, there was no control of confounding factors between these countries and it is not confirmed if the countries have given ivermectin in the immediate weeks before the pandemic. Although ivermectin has shown in vitro activity against SARS-CoV-2, the calculated effective human dose is much higher than the dose commonly given for parasitic infections.[36,37] The World Health Organization and the Food and Drug Administration have only recommended the use of ivermectin only in clinical trials because there is no evidence of efficacy.[38,39] This negates the role of ivermectin in reducing the COVID-19 burden in African countries

Effective Pandemic Response

According to Kaba et al,[9] African countries have shown a commitment to the public health measures that are advised to reduce COVID-19 transmission. Moreover, Gholizadeh et al[40] suggested experience and impact of previous infectious epidemics, such as the Ebola virus epidemic, may have benefited African countries to make their public health response to COVID-19 more effective. Additionally, most African countries experienced their first COVID-19 cases in March 2020, which gave them a longer window period to prepare for COVID-19 before they had their first case.[41] Therefore, Africa was likely to have fewer COVID-19 cases and deaths as compared with Europe and the USA in the first few months of the pandemic because of the later viral introduction in Africa and proactive health measures. However, it does not explain why Africa still records low COVID-19 deaths despite relatively relaxed public health measures, and the lowest COVID-19 vaccine coverage.[42] Moreover, seroprevalence studies revealed higher exposure of Africans to SARS-CoV-2.[15–17] So, the impact of public health measures in the differential impact of COVID-19 could be possible only in the first few months of the pandemic.

Lower Population Density and Mobility

Higher population mobility and density increase the contact rate of an infected person to an uninfected person, thereby increasing the transmissibility of some infections. In the early stages of the pandemic, studies found a positive correlation between COVID-19 cases and death and the number of international flights in African countries.[10,43] However, African countries like Egypt and South Africa having busy airports did relatively more COVID-19 tests and have relatively higher median populations age, which may result in high COVID-19 cases in these countries.

Different studies[44–47] have shown that population density increases cumulative COVID-19 cases, while some illustrate a density paradox where highly populated cities and countries have recorded a smaller number of cases and that population density effect may be modified by other coexisting factors.[48] Africa is the second most densely populated continent following Asia,[49] and studies showed high SARS-CoV-2 exposure in Africans.[5–17] So, it is less likely that population density has contributed to the low COVID-19 burden in Africa as compared with the rest of the world. Table 3[11,50] provide a list of the 10 most and least dense countries with population numbers >1 million along with COVID-19 deaths per 100,000 population. This table shows that higher population density does not necessarily lead to higher COVID-19 deaths among countries. This does not rule out the impact of density but elucidates that there are factors that outweigh population density as the main predictor of the COVID-19 pandemic.

African Socioeconomic Status

Early in the pandemic, the BBC released a story that linked African poverty with low COVID-19 deaths in Africa.[51] According to this report, African poverty has led to a reduced COVID-19 burden in Africa. This is followed by studies that tried to explore the relationship between COVID-19 and poverty. Osayomi et al[52] did a geographical analysis of COVID-19 among African countries and found a negative relationship between poverty and COVID-19. However, the study did not conclude that there was a protective role of poverty because the coefficient of the determinant was very low.

Another observation showed a negative relationship between the human development index (HDI), health access and quality index, and the COVID-19 burden.[10] Its implications are counter-intuitive to say that poverty and low access to health facilities may have resulted in a low COVID-19 burden in Africa. A population who has access to better health care to fight off the pandemic could not be at a disadvantage relative to those who do have not access. One possible reason is that low health access and poverty are associated with countries' low capacity to detect all COVID-19 cases and deaths. Second, a country scores high HDI when the life expectancy of its people is high.[53] So, high HDI may be associated with high COVID-19 mortality because countries with high HDI may have more elderly populations who are susceptible to COVID-19 hospitalization and mortality.

Low Prevalence of Comorbidities

Multiple risk factors affect the prognosis of COVID-19, whose presence increases the risk of hospitalization and death due to COVID-19.[54] These risk factors do not have homogenous distribution in the world. Kaba et al[9] commented that low obesity levels in Africa may have contributed to the low COVID-19 mortality burden in Africa. This argument would have a greater weight if Africa did not have a higher prevalence of another risk factor that could outbalance the effect of obesity. Poor prognostic risk factors that are highly prevalent in Africa include HIV/AIDS,[55] tuberculosis[56] and sickle cell disease (SCD).[57] African countries with high HIV/AIDS burden are highly affected by COVID-19 regardless of their median population age.[11,58] The death rate of SCD has increased by 12% in the USA, and this increment is attributed to COVID-19.[59] The same increase may be happening in Africa as it has a high SCD burden. Moreover, the context of the health system should be considered in addition to comorbidities prevalence. Some diseases, which are less prevalent in Africa, may still have a higher effect on COVID-19 in Africa because of inadequate access to healthcare. In conclusion, the current overall disease burden in Africa is less likely to have contributed to the low burden of COVID-19 in Africa.

Genetic Differences

The genetic background of a population is a key factor that modulates the susceptibility of people to certain infections. Some individuals are found more susceptible to COVID-19 hospitalization and death because of their genetic makeup.[60,61] Although the role of the genetic makeup in susceptibility to diseases is inarguable, the role of the genetic background of Africans in the low COVID-19 impact in Africa is not well founded.

Epidemiological studies in a society where people of African ancestry coexist with other races have shown people with African ancestry have been at a greater risk for COVID-19 hospitalization and mortality as compared with other people in these countries.[62] The poor socioeconomic situation of these people is forwarded as an explanation for this disparity. But people in some African countries live in a worse socio-economic situation, which could have resulted in worse COVID-19 outcomes from this extrapolation. It is imperative to evaluate the role of the genetic makeup of Africans in both directions of association with COVID-19 susceptibility. However, all Africans could not be seen as single-family who share the same ancestry and their genetic makeup may differ from one another and from African Americans.[63] To better understand the role of genetic background, epidemiologic studies accompanied by genomic studies are needed.

Previous Infection Exposure

Africa is a host to many infectious diseases that have been affecting its population continuously. It has been argued that previous infection exposures of Africans may have rendered their immunity an ability to wall off the severity of COVID-19.

TABLE 3. Most Dense and Least Dense Countries and Death Rates of COVID-19

Most Dense Countries	Population Density/km	Median Age	Deaths per 100,000 Population
Singapore	8424	42	27.83
Bahrain	2300	32	89.33
Bangladesh	1278	28	17.84
State of Palestine	867.6	21	NA
Taiwan	673.7	42	48.82
Lebanon	661.7	30	156.53
Mauritius	627.3	37	80.7
Rwanda	538.2	20	11.33
Republic of Korea	527.7	44	55.87
Netherlands	509.3	43	136.8
Least Dense Countries	**Population Density/km^2**	**Median Age**	**Deaths per 100,000 Population**
Gabon	8.844	23	13.75
Central Africa republic	7.898	18	2.34
Kazakhstan	7.036	31	101.47
Mauritania	4.633	20	101.47
Botswana	4.230	24	118.60
Canada	4.186	29	119.33
Libya	3.955	24	93.68
Australia	3.357	38	60. 37
Namibia	3.143	22	21.85
Mongolia	2.143	28	65.00

Tso et al[64] compared the cross-reactivity of pre-COVID-19 samples from Sub-Saharan Africa (SSA) (Zambia and Tanzania) and the USA against the nucleocapsid and spike proteins of SARS-CoV-2 and found that serum samples from SSA countries were more cross-reactive both to the proteins of SARS-CoV-2 and the other common human coronaviruses (HCoV-NL63 and HCoV-229E). This suggests that populations in SSA were previously exposed to HCoVs, which provided some cross-reactivity against SARS-CoV-2 and this may have limited the number and severity of COVID-19 infections in SSA. However, cross-reactivity does not mean protection, and more studies are needed to validate their functionality. In the same argument, the low incidence of COVID-19 in malaria-endemic regions has led to suggestions that malaria infections may have a protective role.[65] However, most malaria-endemic regions have a younger population and low testing capacity, which may have confounded the associations. More controlled studies are needed to validate these associations.

The review has limitations that should be considered. The first limitation of this study emanates from the time sensitivity of COVID-19 data. The same studies may yield different outcomes depending on the time these studies were done because of the dynamicity of COVID-19 data. Second, it was difficult to rule out the effect of confounding factors in many of the articles. Third, the study could only provide factors that resulted in a low COVID-19 burden in Africa but could not objectively identify the size of the effect of each factor. Lastly, most of the studies were restricted to certain regions and generalization of their data to the whole of Africa may lead to a biased conclusion.

CONCLUSIONS

The COVID-19 pandemic has been very dynamic where multiple factors have contributed to variability in disease impact in different places across time. This makes it difficult to answer the question of why Africa has the lowest apparent COVID-19 burden. But, if COVID-19 mortality in Africa was the same as that observed in Europe and the Unites States of America as of 30 November 2022, it could have killed roughly about 4 million Africans—about 20 times higher than what has been reported.[66] One could argue that this amount of mortality would not have gone unnoticed. Factors that seem to have a greater impact on the low COVID-19 burden in Africa include underreporting of COVID-19 and the lower median age of the African population. Lower health capacity also has an effect on the low observed COVID-19 impact by creating an apparent low COVID-19 rate due to a low testing rate. Overall, global COVID-19 deaths are much higher than the official reports, and the health capacity of countries has contributed to this discrepancy.[67] Our understanding of the role of genetic factors, prior BCG vaccination and weather conditions need further study, but their impact on the low COVID-19 burden in Africa is not evident at this time.

African countries need to strengthen their health capacity, assess the burden of COVID and other diseases, so that health priorities can be appropriately assigned.

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