Analysis of COVID-19 Prevalence in Africa Based on the Geographic Division and Income by the End of 2022: A Cross-Sectional Study

Ahmad Ali Alrasheedi, MD*

ABSTRACT

Objectives: Africa has become the focus of attention of the world, as it has been the least affected continent by the Coronavirus-19 Disease (COVID-19) pandemic. This study used COVID-19 data to examine the COVID-19 prevalence across Africa by the end of 2022 based on income and geographic division.

Methods: COVID-19 data, including the vaccination coverage rates, for each African country, were obtained from well-known publicly online websites. The analysis of variance (ANOVA) test and an Independent Samples t-Test was used to determine how much COVID-19 differs across the continent.

Results: By the end of 2022, Africa's share of global COVID-19 cases, deaths, and tests was 1.92%, 3.85%, and 1.62%, respectively. There was a significant difference in the means of median age, the vaccination coverage rate (the 2021 end), cases per million, deaths per million, and tests per population where low-income African countries had lower values than middle-income ones. Across Africa's five regions, Southern Africa was the most affected. In contrast, Central Africa was the least affected, with 2,337 cases per million and 35 deaths per million.

Conclusions: Although the impact of the COVID-19 pandemic on Africa was the least compared to other continents, the impact across Africa has been inconsistent. Low-income African countries were affected less than middle-income African countries. Moreover, COVID-19 statistics were uneven across the five parts of Africa. The inadequate testing capacity possibly plays an essential role in such inconsistency. Africa's experience with the COVID-19 pandemic must remain an open book to document mistakes made and lessons learned.

Keywords: Case-fatality, Median age, SARS-CoV-2, Testing, Vaccination coverage rate

INTRODUCTION

Approximately three years have passed since severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), causing the ongoing Coronavirus Disease 2019 (COVID-19) pandemic, emerged in Wuhan, China[1]. Because of the increased number of cases worldwide, the World Health Organization announced COVID-19 as a pandemic on 11 March 2020[1]. Since that time, the world has suffered from the pandemic unevenly. COVID-19 statistics have been inconsistent worldwide and dramatically changed[2]. Moreover, early expectations and predictions about the course of the pandemic globally were often not correct. In particular, experts anticipated that the COVID-19 pandemic in Africa could be challenging to control, and the consequences might be dire[3,4]. The doom predictions were based on what was known about how the disease is transmitted. Additionally, the socially deprived settings, unsanitary living conditions, weak health systems, and a sizeable immunocompromised population owing to the high prevalence of malnutrition, anemia, malaria, and HIV/AIDs, which are common throughout the continent, could exacerbate the spread and subsequent disease burden[4,5].

However, the catastrophic effects of COVID-19 have yet to occur in Africa, even though most African countries had recorded COVID-19 cases by April 18, 2020[6]. On the contrary, Africa was the least affected among the continents[2,4]. To illustrate, as of December 1, 2022, Africa's share of deaths was only 3.89% of the 6.6 million deaths reported globally, and Africa's recorded cases accounted for only 1.96% of the total of the 648 million cases, despite containing about 17.7% of the global population[2]. The reasons for the low disease burden of COVID-19 in Africa remain unclear. Several factors have been suggested, including age demographics, lack of long-term care facilities, limitations of SARS-CoV-2 testing, weather, and potential cross-protection from previous exposure to circulating coronaviruses[7,8].

When the pandemic was declared, most world countries began implementing precautionary measures to control and limit the spread of the emerging virus; these measures included isolation and quarantine, national lockdowns, curfews, and travel restrictions[6]. However, these measures have affected the national economies and thus pushed some countries into recession[9]. Specifically, because most of the African population depends on their own business and trade for their livelihood, these measures cannot continue for a long time[6]. Thus, some African countries, including South Africa and Ghana, have already lifted or eased these restrictions due to the significant impact on their economies[6]. Meanwhile, other countries partially implemented these measures or did not implement them from the outset because their governments seemed to promote a save-the-economy-at-all-costs approach[9]. This, in turn, was supposed to worsen the pandemic situation on the African continent.

Furthermore, despite the approval of COVID-19 vaccines in late 2020, the continent of Africa has the lowest vaccination coverage rate among the continents. By January 1, 2023, the vaccination coverage rate (the percentage of the population who completed the initial protocol: two doses) was 27.54%, while in Europe, the rate was 66.41%[10]. Moreover, the vaccination coverage rate in Arab countries located in Africa has been uneven[11], so the rate seems inconsistent across Africa.

* Associate Professor
Department of Family and Community Medicine
College of Medicine
Qassim University, Saudi Arabia.
E-mail: a.alrasheedi@qu.edu.sa

These multiple factors were supposed to increase the burden of the COVID-19 pandemic in Africa. Despite all this, the African continent has maintained its advantage over the continents since the beginning of the pandemic[7]. Therefore, Africa has attracted enormous interest from researchers all over the world because of predictions of catastrophic effects that have yet to materialize.

Africa is the world's second-largest and second-most-populous continent after Asia. So, for statistical convenience, the United Nations divided Africa into five regions: Northern Africa, Eastern Africa, Central Africa, Southern Africa, and Western Africa[12]. However, despite the large area and a wide range of natural resources, Africa is the least wealthy continent per capita[13]. Twenty-four African countries are classified as low-income countries, while all other African countries are among middle-income countries, except Seychelles and territories belonging to Britain and France, according to the World Bank[13]. On the other hand, Africa's population is the youngest among all the continents; the median age in 2021 was 18.6[14]. Therefore, the young median age was one of the hypotheses for the low burden of COVID-19 in Africa[7,8].

Our previous study, which examined the spread of COVID-19 in Africa by the end of September 2022, showed that COVID-19 statistics across the continent have been disproportionate; half of the deaths recorded occurred in two countries: Tunisia and South Africa[7]. However, to our knowledge, studies have yet to examine the COVID-19 statistics across Africa based on its geographic division. Understanding the epidemiology of COVID-19 across Africa and its various regions may help develop hypotheses as to why the burden of the pandemic has decreased in Africa, thus providing lessons for a more effective response to public health emergencies. Therefore, the purpose of this study was to use COVID-19 data, including the vaccination coverage rate, to examine the COVID-19 prevalence across Africa by the end of 2022 based on income and geographic division and determine how much it differs.

METHODS

Unless otherwise specified, data on COVID-19 were obtained from the "Worldometer" website[15]. The data on COVID-19 for all world countries/territories were copied and stored in Excel files at the end of 2022 (at 7:50 am Riyadh time on January 1st, 2023). The data used in this analysis consists of the cumulative incidence of COVID-19 (confirmed cases) per country, the cumulative number of deaths, the total number of tests performed, the total number of cases per million population, the total number of deaths per million population, the total number of tests per million population, and the total population. Data from cruise ships were excluded.

According to the objectives, the required data for each African country were obtained from the stored files. In addition, each African country's median age for 2021, which represents an average period for the three years 2020-2022, was extracted from the United Nations website[14]. The "Our World in Data" website was also searched to extract the vaccination coverage rate (people with a complete initial protocol: two doses) by the end of 2021 and 2022 for the countries included in the study. We considered the first of January 2022 and 2023 to extract the updated data[10]. The case-fatality rate (CFR) was calculated by dividing the number of deaths by the number of confirmed cases.

To better compare COVID-19 statistics across the continent, African countries were classified into five groups based on their geographic locations. The current study adopted the United Nations classification[12]. Additionally, African countries were analyzed based on income (low-income versus middle-income) according to the classification of the World Bank[13]. For simplicity, this study analyzed Seychelles and African territories among middle-income countries. The Gross Domestic Product (GDP) at Purchasing Power Parity per capita for each African country was also obtained from the World Bank website[13]. Results were presented as numbers, percentages, rates, and means with standard deviation (SD) as appropriate. To avoid using too many digits, the number of tests per population is calculated, instead of the number of tests per million, by dividing the number of tests by the population.

Statistical analysis was conducted using Statistical Package for Social Sciences (SPSS, version 26). The analysis of variance (ANOVA) test was used to compare variances across the means of the five regions of Africa based on the geographic division. If there are statistically significant differences between the groups as a whole, the Tukey post hoc test will be used to show which groups differed from each other. An Independent Samples t-Test was also used to compare the means between low-income and middle-income countries. The Spearman correlation coefficient was used to determine the relationship between different variables across Africa. A *p-value* of less than 0.05 was considered significant. Ethical approval from an Institutional Review Board was not required due to the secondary analysis of publicly available data.

RESULTS

By the end of 2022, 664,839,788 confirmed cases of COVID-19 and 6,696,944 deaths were recorded worldwide, of which Africa's share was 1.92% and 3.85%, respectively. Additionally, 6,883,298,260 COVID-19 tests were conducted globally, of which only 1.62% were conducted in Africa, even though 17.5% of the world's population lives in Africa, as shown in Table 1. Compared to middle-income African countries, low-income countries recorded low CFR, fewer cases per million, and fewer deaths per million. Also, they performed fewer tests per population, see Figure 1.

Table 1: COVID-19 statistics for Africa based on income by the end of 2022

	Low-income countries	Middle-income countries	All
No. of countries	24	34	58
No. of cases	1,991,291 (15.63%)	10,750,463 (84.37%)	12,741,754
No. of deaths	34,601 (13.39%)	223,743 (86.61%)	258,344
No. of tests	26,930,718 (24.52%)	82,893,876 (75.48%)	109,824,594
Population	603,615,288 (42.91%)	803,113,456 (57.09%)	1,406,728,744

The Independent Samples t-Test shows a significant difference in the means of median age, the vaccination coverage percentage at the end of 2021, cases per million, deaths per million, and tests per population between the low-income countries and the middle-income countries, where low-income African countries had lower values (see Table 2).

Across Africa's five regions, Southern Africa, whose population represents roughly 5% of the continent's total population, accounted for the largest share of cases, deaths, and tests, as shown in Table 3. In terms of deaths per million and cases per million, Southern Africa was the most affected region. In contrast, Central Africa was the least affected. The test-to-population rate ranged from 0.04 to 0.45, while the CFRs were between 1.28% and 2.40% (see Figure 2).

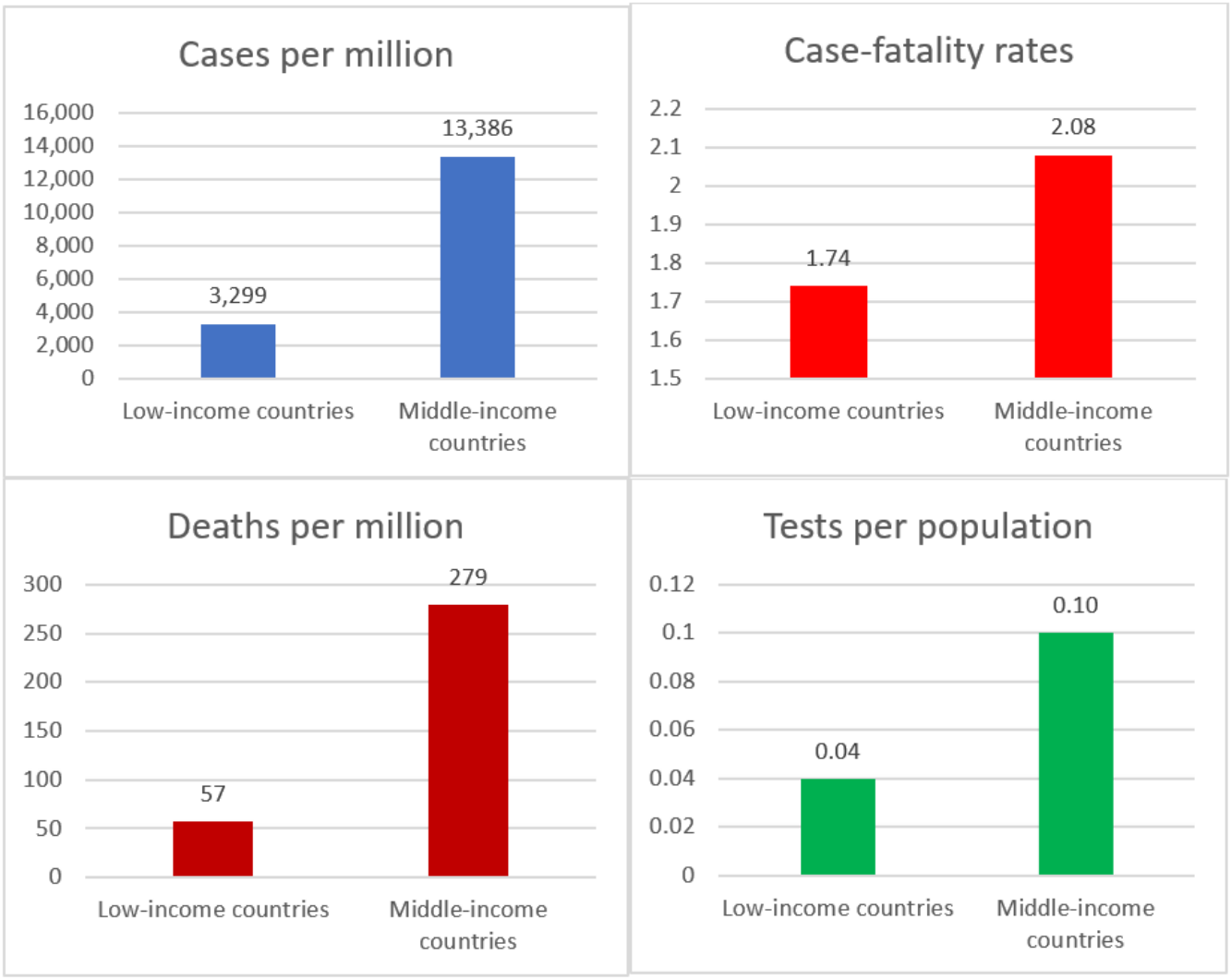

Figure 1: The rates of cases per million, case fatality (%), deaths per million, and tests per population across Africa based on income

Table 2: Comparison of variance of means between low-income countries and middle-income countries in Africa by the end of 2022

	Low-income countries (N=24)	Middle-income countries (N=34)	Sig. (2-tailed) *	All (N=58)
Mean median age ±SD#	17.03 ±1.49	23.54 ±7.43	.000*	20.8 ±6.58
Mean CFR# ±SD	2.12% ±1.65	1.77% ±1.72	.444	1.92% ±1.69
Mean C/M# ±SD	3,588 ±3,635	68,470 ±128,844	.006*	41,622 ±103,225
Mean D/M# ±SD	59 ±51	516 ±621	.000*	318 ±520
Mean tests/ pop. ±SD	0.06 ±0.09	0.28 ±0.37	.002*	0.21 ±0.31
Mean Vac. 2021# ±SD	6.23% ±8.70	22.05% ±21.41	.001*	15.48% ±18.78
Mean Vac. 2022# ±SD	26.83% ±18.37	34.61% ±19.97	.152	31.24% ±19.50

* The Independent Samples t-Test: A p-value of < .05 is considered significant.
# SD: Standard deviation, CFR: Case-fatality rate, C/M: The number of cases per million, D/M: The number of deaths per million, Vac.: The vaccination coverage rate (the percentage of people who complete the initial protocol) by the end of the year indicated.

Table 3: COVID-19 statistics for Africa based on geographic division by the end of 2022

	Northern Africa	Eastern Africa	Central Africa	Southern Africa	Western Africa
No. of countries	7	20	9	5	17
No. of cases	3,776,877 (29.64%)	2,913,648 (22.87%)	445,082 (3.49%)	4,655,868 (36.54%)	950,279 (7.64%)
No. of deaths	88,504 (34.26%)	39,491 (15.29%)	6,616 (2.56%)	111,572 (43.19%)	12,161 (4.71%)
No. of tests	24,810,848 (22.59%)	30,725,055 (27.98%)	6,735,365 (6.13%)	31,041,717 (28.26%)	16,511,609 (15.03%)
Population	254,985,178 (18.12%)	468,849,214 (33.33%)	190,463,620 (13.54%)	69,191,687 (4.92%)	423,239,045 (30.09%)

Table 4: Comparison of variance of means between the five parts of Africa by the end of 2022

	Northern Africa (N=7)	Eastern Africa (N=20)	Central Africa (N=9)	Southern Africa (N=5)	Western Africa (N=17)	Sig.*
Mean median age ±SD#	22.04 ±7.18	20.49 ±8.48	23.33 ±6.79	38.16 ±2.16	18.79 ±2.16	.064
Mean CFR# ±SD	4.32% ±3.41	1.56% ±1.14	1.41% ±0.59	1.95% ±0.66	1.60% ±1.00	.001*
Mean C/M# ±SD	30,456 ±38,653	66,108 ±157,753	8,487 ±9,643	68,787 ±42,297	26,965 ±73,982	.602
Mean D/M# ±SD	610 ±858	294 ±439	92 ±102	1,181 ±531	93 ±172	.000*
Mean test/pop. ±SD	0.19 ±0.19	0.24 ±0.43	0.14 ±0.22	0.55 ±0.29	0.10 ±0.17	.072
Mean Vac. 2021# ±SD	25.87% ±23.30	17.86% ±23.84	7.13% ±7.23	26.70% ±10.37	10.56% ±15.32	.156
Mean Vac. 2022# ±SD	33.47% ±20.24	37.18% ±23.34	19.60% ±12.99	38.16% ±12.55	28.46% ±18.00	.213

* Analysis of variance (ANOVA) test: A p-value of < .05 is considered significant.
# SD: Standard deviation, CFR: Case-fatality rate, C/M: The number of cases per million, D/M: The number of deaths per million, Vac.: The vaccination coverage rate (the percentage of people who complete the initial protocol) by the end of the year indicated.

Table 5: Multiple comparisons of variance of means between the five parts of Africa by geographical division using the Tukey post hoc test

Dependent Variable	(I) Geographic divisions	(J) Geographic divisions	Mean Difference (I-J)	Sig.*	95% Confidence Interval	
					Lower Bound	Upper Bound
Case-fatality rate#	Northern Africa	Eastern Africa	2.76*	.001	0.94	4.59
		Central Africa	2.91*	.002	0.82	5.01
		Southern Africa	2.37	.060	-0.064-	4.81
		Western Africa	2.71*	.001	0.85	4.58
	Eastern Africa	Central Africa	0.15	.999	-1.52-	1.82
		Southern Africa	-0.39-	.984	-2.47-	1.69
		Western Africa	-0.05-	1.000	-1.42-	1.32
	Central Africa	Southern Africa	-0.54-	.964	-2.86-	1.78
		Western Africa	-0.20-	.997	-1.92-	1.51
	Southern Africa	Western Africa	0.34	.991	-1.77-	2.46
Deaths per million	Northern Africa	Eastern Africa	317	.455	-216-	849
		Central Africa	518	.133	-93-	1129
		Southern Africa	-571-	.170	-1281-	139
		Western Africa	518	.070	-27-	1062
	Eastern Africa	Central Africa	201	.770	-286-	688
		Southern Africa	-888-*	.001	-1494-	-282-
		Western Africa	201	.619	-199-	601
	Central Africa	Southern Africa	-1089-*	.000	-1765-	-413-
		Western Africa	-0.203-	1.000	-500-	500
	Southern Africa	Western Africa	1089*	.000	472	1706

* The mean difference is significant at the 0.05 level.
# The mean difference of median age, cases per million, tests per population, and vaccination coverage rate were not included in the table because the ANOVA test (Table 4) did not show any significant difference.

Table 6: Correlation tests of study variables across Africa

		CFRs[#]	C/M[#]	D/M[#]	Tests/ pop.	Median age	Vac. 2021[#]	Vac. 2022[#]	GDP[#]
CFRs	Pearson Correlation	1	-.281-*	-.088-	-.253-	-.006-	-.170-	-.070-	-.103-
	Sig. (2-tailed)		.033	.515	.056	.963	.224	.617	.460
	N	58	58	57	58	58	53	53	54
C/M	Pearson Correlation	-.281-*	1	.597**	.559**	.627**	.685**	.480**	.699**
	Sig. (2-tailed)	.033		.000	.000	.000	.000	.000	.000
	N	58	58	57	58	58	53	53	54
D/M	Pearson Correlation	-.088-	.597**	1	.531**	.653**	.640**	.399**	.659**
	Sig. (2-tailed)	.515	.000		.000	.000	.000	.003	.000
	N	57	57	57	57	57	52	52	54
Tests per pop.	Pearson Correlation	-.253-	.559**	.531**	1	.334*	.338*	.215	.435**
	Sig. (2-tailed)	.056	.000	.000		.010	.013	.122	.001
	N	58	58	57	58	58	53	53	54
Median age	Pearson Correlation	-.006-	.627**	.653**	.334*	1	.803**	.527**	.807**
	Sig. (2-tailed)	.963	.000	.000	.010		.000	.000	.000
	N	58	58	57	58	58	53	53	54
Vac. 2021	Pearson Correlation	-.170-	.685**	.640**	.338*	.803**	1	.798**	.646**
	Sig. (2-tailed)	.224	.000	.000	.013	.000		.000	.000
	N	53	53	52	53	53	53	53	52
Vac. 2022	Pearson Correlation	-.070-	.480**	.399**	.215	.527**	.798**	1	.357**
	Sig. (2-tailed)	.617	.000	.003	.122	.000	.000		.009
	N	53	53	52	53	53	53	53	52
GDP	Pearson Correlation	-.103-	.699**	.659**	.435**	.807**	.646**	.357**	1
	Sig. (2-tailed)	.460	.000	.000	.001	.000	.000	.009	
	N	54	54	54	54	54	52	52	54

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
[#] CFR: Case-fatality rate, C/M: The number of cases per million, D/M: The number of deaths per million, Vac.: Vaccination coverage rate (the percentage of people who complete the initial protocol) by the end of the year indicated, GDM: Gross Domestic Product at Purchasing Power Parity per capita (current international $).

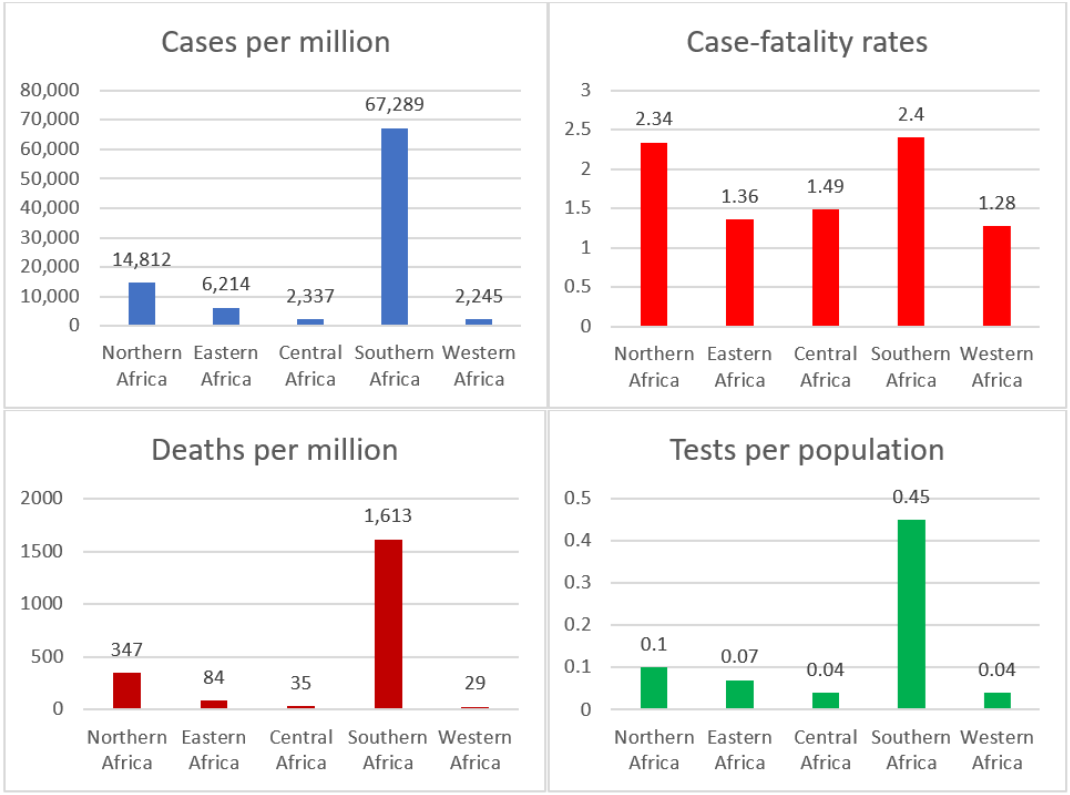

Figure 2: The rates of cases per million, case fatality (%), deaths per million, and tests per population for the five regions of Africa

Statistically, COVID-19 data were inconsistent across the five parts of Africa regarding the mean CFR and the mean deaths per million, as illustrated in Table 4. Northern Africa had the highest mean CFR. The mean deaths per million ranged from 92 in Central Africa to 1,181 in Southern Africa. The post hoc analysis revealed a significant difference in the variance of mean CFR between Northern Africa and Eastern Africa (p =.001), Central Africa (p =.002), and Western Africa (p =.001), as shown in Table 5. Also, there was a significant difference in the mean deaths per million between Southern Africa and Eastern Africa (p =.001), Central Africa (p =.000), and Western Africa (p =.000).

Table 6 shows a statistically significant correlation between most variables except CFRs. For example, the number of deaths per million was positively correlated with all other variables except the CFR. The number of cases per million and the number of deaths per million were also significantly proportional to tests performed per population.

DISCUSSION

Taking a quick look at COVID-19 data around the world and reviewing studies on the impact of the pandemic, one will find that Africa has been the least affected continent, despite the controversial doom predictions[3,5]. Several hypotheses have been suggested about the reasons for the low pandemic burden in Africa[4,5,8]. One hypothesis was the "poverty as a vaccine," in which evidence pointed out a significant negative relationship between COVID-19 and poverty in Africa[16]. However, such hypotheses are usually difficult to prove due to the interaction of many complex factors. What is remarkable, however, is that the number of COVID-19 cases and deaths are directly proportional to the number of tests conducted. This is what this study and many previous studies have shown[2,7,8,11]. Without the tests, cases of COVID-19 cannot be detected, and thus deaths cannot be attributed to SARS-CoV-2. In Africa, many citizens do not have access to the healthcare they need, as the continent's quality of health services is generally poor[17]. Therefore, in the context of COVID-19, most African countries could not conduct a reasonable number of tests; the testing rate per population in Africa was 0.08, while the rate in Europe was 3.74[2]. This would have exacerbated the situation since many more people would be infected with the virus and would continue to spread the disease and increase the burden. However, nothing of that kind happened. Globally, 103 countries/territories have performed tests more than their population; none were African except Reunion, an overseas territory of France.

Furthermore, the current study showed that the burden of the pandemic across Africa was lower in low-income countries. The median age in these countries was also significantly lower than in middle-income African countries. Poverty is generally associated with a higher fertility rate and, thus, a lower median age[18]. Additionally, the present study shows that the median age in African countries positively correlates with GDP. The vaccination coverage rate was highly correlated with GDP; rich countries generally had better vaccination coverage. The same was almost noted in a study conducted in the Arab world, where the high-income oil countries of the Gulf Cooperation Council were better regarding vaccination coverage (nine Arab countries are located in Africa). However, these findings cannot establish a causal relationship as the decrease includes almost all COVID-19 data (see Figure 1 and Tables 1 and 2), and the correlation test helps show an association. The median age in Europe is 41, while in Africa, it is 18.6. However, the median age in South America, the worst continent based on the number of deaths per million, is 30.3; it is higher than in Africa but much lower than in Europe[7]. Moreover, there is no justification for the association of median age with the number of cases and tests. A better explanation is that countries with a higher median age are often high-income countries and, therefore, would have a higher capacity for testing and hence more cases. However, the correlation analysis differs by continent. In two previous studies, the correlation analysis showed no association between median age and other variables across Europe[2,7].

Based on geographic division, Southern Africa was the hardest hit region; it has had the most cases, deaths, and tests, even though it represents only 5% of the continent's population. Also, it had the highest rates of cases, deaths, and tests among the five regions. Southern Africa contains five countries, all of which were among the fifteen most affected African countries based on the number of deaths per million; all these countries are classified as middle-income countries. On the other hand, Central Africa, followed by Western Africa, was the least affected region, although these two regions had the lowest vaccination rate. Nigeria is the most populous country in Africa, followed by Ethiopia and Egypt. However, these countries were affected less; they registered 15, 63, and 232 deaths per million, respectively. It seems that it is unfair to compare the burden of the COVID-19 pandemic between countries/regions based on the announced statistics because countries/regions differ significantly in terms of the definition of suspected cases, testing strategies, the criteria for when a result is considered positive, the capacity to perform testing, reporting methods, and other undetermined factors[7]. Moreover, politics may play a hidden role in influencing COVID-19 statistics worldwide[19]. Specifically in Africa, Tanzania ceased reporting COVID-19 cases and deaths in May 2020[4,15]. However, it has resumed reporting COVID-19 cases and deaths since the departure of the former president, who criticized COVID-19 tests and even refused COVID-19 vaccines[20].

Despite implementing the COVID-19 vaccine initiative, it was challenging to roll out the vaccine in Africa because of supply and access problems, short shelf life, and the cost of vaccination for health systems[21]. During the years 2021 and 2022, cases and deaths increased significantly in Europe and the Americas, despite ongoing vaccination programs[2]. Meanwhile, the continent of Africa has still been less affected by the pandemic. Therefore, it is believed that the application of universal vaccination became inappropriate for Africa[21]. It is interesting to note that measuring the effects of vaccines using population data is not straightforward; it can produce misleading results and inherent biases, which are difficult to spot, mainly if an important confounder such as natural immunity is overlooked[22,23]. Furthermore, there was a disparity in the vaccination coverage rate across African countries. By the end of 2022, the highest vaccination coverage rate in Africa has been achieved in Mauritius (83.74%), Seychelles (76.22%), and Liberia (70.36%). Of note, the vaccination coverage rate in Liberia by the end of 2021 was 14.24%. In contrast, Burundi, followed by Madagascar, had the lowest vaccination coverage rate; only 0.22% of Burundi's population was fully vaccinated. Southern Africa, followed by Northern Africa, had the highest vaccination coverage rate; however, the difference between the continent's five regions was not statistically significant. The vaccination coverage rate was positively correlated with other variables except for the CFRs. Vaccination coverage is often higher among wealthier nations[24]. On the other hand, the vaccination coverage rate positively correlated with the number of cases per million and the number of deaths per million. A previous study including 191 countries worldwide showed that vaccination was directly proportional to the number of cases detected and negatively to CFRs[25]. Countries with excellent vaccination coverage seem to have active COVID-19 testing programs and therefore have more cases and deaths[11].

When examining the impact of the COVID-19 pandemic (in terms of excess deaths) around the world, it is essential to look at it from a broad

angle (not just from the perspective of the virus) and to interpret the data with caution. For example, one study found that indirect effects of the pandemic –such as social isolation, economic insecurity, and barriers to healthcare access– accounted for 16% of excess deaths[26]. Scientific and medical bodies have often failed to provide adequate advice on the appropriate course of action on COVID-19 because proven steps were not known. At the same time, many governments worldwide took ineffective, late, or inappropriate COVID-19 control and containment strategies[27]. However, Africa had a lower disease impact than expected. In fact, the low impact of COVID-19 on the African continent was not a result of an excellent, coordinated, or thought-out response on behalf of governments or medical authorities in the African continent[28], but the low testing capacity and the younger median age were among the most critical factors[2,7,29]. The world's experience, especially in Africa, with the COVID-19 pandemic, must remain an open book to comprehensively document mistakes made and lessons learned and develop a global pandemic response protocol that will prepare governments, scientists, and healthcare professionals to take action in any future pandemics. Such lessons need to be reviewed from a broader view, as factors such as atmospheric stability and environmental pollution all have impacted COVID-19 morbidity and mortality[27,30].

Finally, this study provides an updated overview of COVID-19 statistics around Africa and how much they differ across Africa. However, this study has some limitations. The most important limit is that the quality of information obtained depends on the raw data quality. Not all countries were reporting COVID-19 statistics at the same frequency and quality.

CONCLUSIONS

Over the three years, Africa has been the least affected continent, despite the earlier doom predictions. However, COVID-19 statistics across the continent have been inconsistent; the burden of the pandemic across Africa was lower in low-income countries. Moreover, Southern Africa was the hardest-hit region; it has had the highest number of cases, deaths, and tests, even though it represents only about 5% of the continent's population.

Several hypotheses have been suggested about the low pandemic burden in Africa. However, these hypotheses are usually difficult to prove due to the interaction of many complex factors. What is remarkable, however, is that the number of COVID-19 cases and deaths are directly proportional to the number of tests conducted. Africa's experience with the COVID-19 pandemic must remain an open book to comprehensively document mistakes made and lessons learned. Such lessons need to be reviewed from a broader view.

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