Africa's low COVID-19 mortality rate: A paradox?

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A R T I C L E   I N F O

A B S T R A C T

Background: COVID-19 continues to spread worldwide, with high numbers of fatalities reported first in China, followed by even higher numbers in Italy, Spain, the UK, the USA, and other advanced countries. Most African countries, even with their less advanced healthcare systems, continue to experience lower COVID-19 mortality rates. This was the case as the pandemic reached its first peak, plateaued, and declined. It is currently rising again in some countries, though not as rapidly as before.

This study aimed to determine the predictors of COVID-19 mortality rate. This may help explain why Africa's COVID-19 mortality rate is, ironically, lower than that of more advanced countries with better health systems. This will also assist various governments in balancing their COVID-19 restrictive and socioeconomic measures.

Methodology: This was an analytical review, which used pre-COVID-19 era population data and current COVID-19 mortality figures to determine predictors of COVID-19 mortality rates. Pearson's correlation was used to test the association between some population variables and COVID-19 mortality rates. Next, stepwise multiple regression analysis was used to determine significant predictors of COVID-19 mortality rates.

Results: Significant positive predictors of COVID-19 mortality rate included pre-COVID-19 era '65-yr+ mortality %' ($R^2 = 0.574$, $B = 2.86$, $p < 0.001$), population mean age ($R^2 = 0.570$, $B = 4.77$, $p = 0.001$), and life expectancy ($R^2 = 0.524$, $B = 1.67$, $p = 0.008$). Pre-COVID-19 era CVD death rate was a negative predictor of COVID-19 mortality rate ($R^2 = 0.524$, $B = -0.584$, $p = 0.012$).

Conclusion: Africa's lower COVID-19 mortality rate is due to the lower population mean age, lower life expectancy, lower pre-COVID-19 era '65yr+ mortality rate', and smaller pool of people surviving and living with cardiovascular diseases.

Introduction

Coronavirus disease 2019 (COVID-19) is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (World Health Organization, 2020a). The outbreak started in Wuhan, China, in December 2019 (Huang et al., 2020a; Huang et al., 2020b). It was declared a Public Health Emergency of International Concern by the World Health Organization (WHO) on January 30, 2020 and a pandemic on March 11, 2020 (World Health Organization, 2020b; World Health Organization, 2020c).

The primary mode of spread of SARS-CoV-2 is via close contact between persons, through small droplets generated by sneezing, coughing, and talking (World Health Organization, 2020c; World Health Organization, 2020d; Centers for Disease Control and Prevention, 2020a). The incubation period is around 5 days, with a range of 2–14 days. Common symptoms include fever, cough,

fatigue, shortness of breath, and anosmia, and can be complicated by pneumonia and acute respiratory distress syndrome (Centers for Disease Control and Prevention, 2020a; Hopkins and Kumar, 2020; Centers for Disease Control and Prevention, 2020b; Centers for Disease Control and Prevention, 2020c).

Recommended measures for preventing spread include hand hygiene, social distancing, wearing a face mask in public, and isolation of suspects. Other measures include travel restrictions, lockdowns, and facility closures (Centers for Disease Control and Prevention, 2020b; Centers for Disease Control and Prevention, 2020c; Velavan and Meyer, 2020).

During the early stages of the COVID-19 pandemic, when China, followed by Italy, Spain, and the USA, were severely hit by fatalities, it was widely speculated that Africa would be worst hit when the virus eventually reached the continent. The logic of this prediction lay in the fact that most of Africa is underdeveloped, constantly struggling with inadequate healthcare facilities and gloomy health indices. When the virus finally found its way to Africa, some fatalities followed, but the expected catastrophe never occurred,

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even when the pandemic reached its first peak, plateaued, and then declined. It is currently rising again in some countries, though not as rapidly as before.

This paradox formed the basis of this study, which aimed to look objectively at the possible factors affecting COVID-19 mortality rate, in an attempt to explain why Africa's COVID-19 mortality rate is, ironically, lower than that of more advanced countries with better healthcare systems. This will also enable heads of governments of advanced and underdeveloped countries to prioritize preventive measures that best suit their overall risk and pattern of COVID-19 fatalities, thereby ensuring a healthy balance between lockdown/restrictive measures and socioeconomic policies.

Methodology

This was an analytical review, which used population data and current COVID-19 mortality figures to attempt to answer why COVID-19 mortality in Africa is, ironically, lower than in more advanced countries.

In light of the considerable challenge of attempting to analyze data from all countries in the world, sample countries for analysis were selected to represent certain criteria in order to have ample representation of sociodemographic and mortality patterns (pre-COVID-19 and COVID-19) for the different world regions. These criteria included differences in population pyramids, median age, life expectancy, socioeconomic/technological advancement, pre-COVID-19 era mortality rates, and COVID-19 mortality rates. Additionally, the countries selected had reached their peaks of infection rates and/or case fatality rates (CFR), and were in the plateau or decline phase.

Current population data, for example population mean age, mean life expectancy, and pre-COVID-19 era mortality rates for the general population and for the > 65 years age group, were collated for selected countries. Additionally, data on diabetes prevalence and cardiovascular disease (CVD) mortality were obtained. Subsequently, the most up-to-date COVID-19 morbidity and mortality data were compiled and tabulated (Roser et al., 2020; United Nations, Department of Economic and Social Affairs, Population Division, 2019; Beltekian et al., 2020; World Population Review, 2020; Worldometer, 2020a; Worldometer, 2020b). IBM-SPSS version 23 (IBM Corp; Armonk, NY, USA) was used for statistical analysis. Pearson's correlation was used to test the association between some population variables and COVID-19 mortality rates.

Stepwise multiple regression analysis was used to determine significant predictors of COVID-19 mortality rates. COVID-19 mortality rate (deaths per million population) was used as a dependent variable in the regression analysis because it was more reliable than case fatality rate (CFR), since the latter depends heavily on COVID-19 testing capability, which is highly variable and resource-based.

Results

Pre-COVID-19 era population/mortality data and current COVID-19 mortality data from 23 countries were used for the analysis (Roser et al., 2020; United Nations, Department of Economic and Social Affairs, Population Division, 2019; Beltekian et al., 2020; World Population Review, 2020; Worldometer, 2020a; Worldometer, 2020b).

Countries with the highest mean age (years), and life expectancy (years) included Italy (47.9, 83.5), Spain (45.5, 83.6), the UK (40.8, 81.3), and the USA (38.3, 78.9). These countries also had 65-yr+ deaths comprising the highest percentage of total deaths in the pre-COVID-19 era (65-yr+ mortality %). Countries with the lowest mean age and life expectancy were Benin Republic

(18.8, 61.8), Burkina Faso (17.6, 61.6), Chad (16.7, 54.2), Cote d'Ivoire (18.7, 57.8), Cameroon (18.8, 59.3), Niger (15.1, 62.4), and Nigeria (18.1, 54.7). Accordingly, the 65-yr+ mortality % is lowest among these countries (Table 1) (Roser et al., 2020; United Nations, Department of Economic and Social Affairs, Population Division, 2019; Beltekian et al., 2020; World Population Review, 2020; Worldometer, 2020a; Worldometer, 2020b).

COVID-19 deaths per million population (mortality rate) was significantly directly correlated with population mean age ($r = 0.66$, $p < 0.001$), life expectancy ($r = 0.58$, $p = 0.003$), and pre-COVID-era 65yr+ mortality % ($r = 0.66$, $p < 0.001$), but inversely correlated with pre-COVID-19 era CVD death ($r = -0.59$, $p = 0.002$). COVID-19 CFR was also directly correlated with mean age, life expectancy, and pre-COVID-19 era 65yr+ mortality %, though with lower strength than COVID-19 mortality rate. CFR was also inversely correlated with pre-COVID-19 CVD deaths (Table 2).

Significant positive predictors of COVID-19 mortality rate included pre-COVID-19 era 65yr+ mortality % ($R^2 = 0.574$, $B = 2.86$, $p < 0.001$), population mean age ($R^2 = 0.570$, $B = 4.77$, $p = 0.001$), and life expectancy ($R^2 = 0.524$, $B = 1.67$, $p = 0.008$). Pre-COVID-19 era CVD death rate was a negative predictor of COVID-19 mortality rate ($R^2 = 0.524$, $B = -0.584$, $p = 0.012$) (Table 3).

Discussion

The aim of this study was to attempt to explain the seemingly low COVID-19 mortality rate in low-income, less-developed African countries. This would only be possible if we looked into possible determinants of COVID-19 mortality rate. Population data showed that the median ages and life expectancies of most African countries are lower than those in other parts of the world (Table 1). This has given rise to a population pyramid consisting of a predominantly young population in Africa, while the Western and other developed nations have a predominantly older population. This disparity may be explained by the high birth rates in less-developed African countries, and the more advanced healthcare systems in developed nations, allowing their citizens to live longer. Moreover, Africa, with its less advanced healthcare systems, continues to be troubled with communicable as well as non-communicable diseases, leading to a lower life expectancy.

In the same vein, mortality data showed that the '65-yr+ mortality %' is clearly higher in the West and in other developed nations than in Africa. This is obviously because a much higher proportion of the population in the West and other industrialized nations tend to live beyond 65 years of age compared with the African population (Table 1). This high '65-yr+ mortality %' in Italy, Spain, the UK, the USA, China, Japan, etc. may also be reflected in the COVID-19 mortality rate, since elderly persons are most susceptible to COVID-19 death (Table 1).

On further analysis, there was a significant positive correlation between COVID-19 mortality rate and population mean age, life expectancy, and pre-COVID-19 '65-yr+ mortality %'. This provides further evidence that a predominantly older population is more susceptible to COVID-19 deaths. Ironically, a significant negative correlation was noted between COVID-19 mortality and pre-COVID-19 era cardiovascular disease (CVD) deaths. This may be explained by the fact that advanced countries, such as the USA, Italy, Spain, Japan, and China, with their better healthcare facilities, were able to slow down CVD deaths prior to COVID-19 by maintaining a larger pool of persons surviving and living with moderate and even severe CVD. Those with CVD are highly susceptible to COVID-19 deaths. On the other hand, less advanced nations such as Nigeria, Chad, Benin Republic, Niger, and Ivory Coast, with their less advanced healthcare systems, will most likely have had their pool of persons with CVD trimmed by pre-COVID-19 era CVD deaths.

Table 1
Population and mortality data for selected countries.

Country	Population	Pre-COVID-19 population data						COVID-19 morbidity/mortality			
		Mean age (yrs)	LE (yrs)	Mortality rate/ 1000	65-yr+ mortality %	CVD deaths/10 0000	DM prevalence (%)	Total cases	Total deaths	Deaths/ million	CFR (%)
Italy	60 461 828	47.9	83.5	10.6	89	113	4.8	258 136	35 430	586.0	14.37
Spain	46 754 783	45.5	83.6	9.1	86	99	7.17	386 054	28 838	616.8	10.98
UK	67 886 004	40.8	81.3	9.4	85	122	4.28	324 601	41 423	610.2	15.42
US	331 000 000	38.3	78.9	8.8	74	151	10.79	5 668 105	176 362	532.8	3.87
China	1 440 000 000	38.7	76.9	7.3	72	262	9.7	89 654	4 711	3.27	5.44
India	1 380 000 000	28.2	69.7	7.3	49	282	10.4	3 044 940	56 706	41.09	2.55
Japan	126 000 000	48.2	84.6	10.7	90	79	5.7	61 747	1 176	9.30	4.20
Canada	37 742 157	41.4	82.4	7.8	82	106	7.37	124 629	9 071	240.3	8.08
Australia	25 499 881	37.9	83.4	6.6	83	108	5.07	24 602	485	19.02	1.04
Benin	12 123 198	18.8	61.8	8.7	23	236	0.99	2 115	39	3.22	1.91
Burkina Faso	20 903 278	17.6	61.6	7.9	21	269	2.42	1 320	55	2.63	5.11
Chad	16 425 859	16.7	54.2	12.0	14	281	6.1	982	76	4.63	8.47
Cote d'Ivoire	26 378 275	18.7	57.8	9.9	22	304	2.42	17 374	113	4.28	0.64
Cameroon	26 545 864	18.8	59.3	9.1	22	245	7.2	18 762	408	15.37	2.31
DRC	89 561 404	17	60.7	9.3	20	319	6.1	9 810	250	2.79	2.34
Ghana	31 072 945	21.1	64.1	7.2	30	298	5.0	43 505	261	8.4	0.53
Madagascar	27 691 019	19.6	67.0	5.9	31	406	3.9	14 277	178	6.43	0.87
Niger	24 206 636	15.1	62.4	8	20	238	2.42	1 172	69	2.85	6.26
Nigeria	206 000 000	18.1	54.7	12	19	181	2.42	51 905	997	4.84	2.21
Senegal	16 743 930	18.7	67.9	5.6	35	241	2.42	12 850	266	15.89	1.84
Uganda	45 741 000	16.4	63.4	6.4	19	213	2.5	1 848	19	0.415	0
Qatar	2 881 060	31.9	80.2	1.2	41	177	16.52	116 765	193	66.99	0.14
Saudi Arabia	34 813 867	31.9	75.1	3.5	52	260	17.72	306 370	3 619	103.9	0.97
World	7 790 000 000	30.9	72.6	8	57	233	8.51	23 243 621	805 740	103.4	4.28

LE = life expectancy, 65-yr+ mortality % = percentage of total deaths who were >65 yrs old in the pre-COVID-19 era, CVD = cardiovascular disease, DM = diabetes mellitus, CFR = case fatality rate.

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Table 2
Pearson's correlation of COVID-19 mortality rates and pre-COVID-19 era population and mortality data.

		Mean age	LE	Mortality rate	65-yr+ mortality %	CVD deaths	DM prevalence	Deaths per million	CFR
Mean age	R	1	0.939	0.023	0.978	−0.755	0.391	0.658	0.573
	p		0.000	0.914	0.000	0.000	0.059	0.000	0.003
LE	R	0.939	1	−0.267	0.944	−0.705	0.436	0.578	0.425
	p	0.000		0.207	0.000	0.000	0.033	0.003	0.039
Mortality rate	R	0.023	−0.267	1	0.024	−0.178	−0.547	0.260	0.499
	p	0.914	0.207		0.913	0.405	0.006	0.219	0.013
65yr+ mortality %	R	0.978	0.944	0.024	1	−0.741	0.303	0.659	0.571
	p	0.000	0.000	0.913		0.000	0.150	0.000	0.004
CVD deaths	R	−0.755	−0.705	−0.178	−0.741	1	−0.078	−0.592	−0.526
	p	0.000	0.000	0.405	0.000		0.719	0.002	0.008
DM prevalence	R	0.391	0.436	−0.547	0.303	−0.078	1	0.030	−0.093
	p	0.059	0.033	0.006	0.150	0.719		0.889	0.665
Deaths per million	R	0.658	0.578	0.260	0.659	−0.592	0.030	1	0.823
	p	0.000	0.003	0.219	0.000	0.002	0.889		0.000
CFR	R	0.573	0.425	0.499	0.571	−0.526	−0.093	0.823	1
	p	0.003	0.039	0.013	0.004	0.008	0.665	0.000	

R = correlation coefficient, p = level of significance, LE = life expectancy, 65-yr+ mortality % = percentage of total deaths who were >65 yrs old in the pre-COVID-19 era, CVD = cardiovascular diseases, DM = diabetes mellitus, CFR = case fatality rate.

Table 3
Linear regression showing predictors of COVID-19 mortality rate.

Independent variables	R^2	Unstandardized coefficients		Standardized coefficients	t	p	95.0% confidence interval for B	
		B	SE	Beta			Lower bound	Upper bound
65-yr+ mortality %	0.574	2.858	0.631	0.695	4.528	0.000	1.549	4.167
Mean age	0.570	4.765	1.204	0.645	3.959	0.001	2.269	7.261
Life expectancy	0.524	1.666	0.574	0.527	2.905	0.008	0.477	2.856
CVD deaths	0.524	−0.584	0.213	−0.605	−2.745	0.012	−1.027	−0.142
Mortality rate	0.429	1.507	0.929	0.216	0.790	0.439	0.285	2.729
DM prevalence	0.254	1.207	0.822	0.241	0.888	0.385	0.255	2.806

Dependent variable: COVID-19 mortality rate (deaths per million). 65-yr+ mortality % = percentage of total deaths who were >65 yrs old in the pre-COVID-19 era, R^2 = variation in dependent variable that can be explained by the independent variable, B = unstandardized coefficient, beta = regression coefficient, SE = standard error, p = level of significance, CVD = cardiovascular diseases, DM = diabetes mellitus.

Although diabetes mellitus (DM) has generally been identified as a risk factor for COVID-19 death, no significant correlation was found between COVID-19 mortality rate and DM prevalence. This may be explained by the effects of confounders, such as poor glycemic control, age of those with DM, duration of DM, prevalence of complications of DM, level of DM care, and pre-COVID-19 era mortality due to DM.

Similarly, COVID-19 case fatality rate (CFR) was positively correlated with population mean age, life expectancy, and pre-COVID-19 era '65yr+ mortality%', and negatively correlated with pre-COVID-19 era CVD mortality rate. However, COVID-19 mortality rate showed stronger correlations with these variables than COVID-19 CFR. This may be due to the fact that COVID-19 mortality rate, with the population as denominator, is a more reliable index of mortality than COVID-19 CFR, whose denominator is total confirmed cases of COVID-19, which is dependent on the testing capacity and resources of a facility or country.

Finally, multiple stepwise regression analysis identified pre-COVID-19 era '65-yr+ mortality %' as the strongest predictor of COVID-19 death. This further strengthens the evidence for vulnerability of the elderly to COVID-19 death. Other significant predictors identified were population mean age and life expectancy. Of course, these are factors that contribute to pre-COVID-19 era '65-yr+ mortality %', as well as increasing the proportion of elderly persons susceptible to COVID-19 death. Pre-COVID-19 era CVD death rate was identified as a negative or inverse predictor of COVID-19 mortality rate. This also strengthens the above argument — that advanced healthcare is associated with lower pre-COVID-19 era CVD mortality rate, leaving a larger pool of persons surviving and living with CVD who eventually become susceptible to COVID-19 death.

One limitation of this study was the non-inclusion of all the countries of the world in the analysis, but the effect of this confounding factor was minimized by the selection of countries from different categories, in terms of socioeconomic levels, COVID-19 mortality rates, and demographic characteristics. Differences in the testing capacities of different countries was another confounding factor; however, its effect was minimized by using the COVID-19 mortality rate as the dependent variable and not case fatality rate. This is because the denominator for COVID-19 mortality rate — the population — is more stable than the denominator for case fatality rate, i.e. total confirmed cases, which is dependent on the COVID-19 testing capacity of any given nation.

Conclusion

Africa's low COVID-19 mortality rate may be due to the paucity of factors identified as significant predictors of COVID-19 mortality rate. These factors include pre-COVID-19 era '65-yr+ mortality %', population mean age, and life expectancy. Pre-COVID-19 era CVD

mortality rate was identified as a negative predictor of COVID-19 mortality rate. The low COVID-19 mortality rate in Africa may also be responsible for the false belief by many in Africa that COVID-19 is unreal.

Recommendation

Countries with high pre-COVID-19 era '65-yr+ mortality %', high population mean age, high life expectancy, and large pool of persons surviving and living with CVD — especially Western countries and other advanced countries — are able to redirect their resources appropriately, and balance their restrictive/lockdown measures and socioeconomic policies towards keeping the elderly and persons with comorbidities like CVD safe from COVID-19 infection. Likewise, less advanced countries should balance their COVID-19 lockdown and socioeconomic policies in line with the preponderance of identified risk factors for COVID-19 mortality rate. In summary, there should be no 'one solution for all' when it comes to balancing COVID-19 restrictive and socioeconomic policies.

What is already known on this topic

- Coronavirus disease 2019 (COVID-19) is a pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV 2).
- It is life threatening and leads to death mostly in the elderly and those with comorbidities such as cardiovascular disease and diabetes mellitus.

What this study adds

- COVID-19 mortality rates are generally lower in Africa than in more advanced nations, whether at the peak or in the plateau or decline phases of infection rates and case fatality rates for the countries analyzed.
- The positive predictors of COVID-19 mortality rate include population mean age, life expectancy, and pre-COVID-19 era '65-yr+ mortality %'.
- Pre-COVID-19 era CVD mortality rate is a negative predictor of COVID-19 mortality rate.

Author's contribution

Y. Lawal was the sole author involved in the conceptualization, data collection, and writing of this article.

Ethical approval

Not applicable.

Funding

Competing interests

There were no conflicts of interest in the writing of this article.

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