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Epidemiology | Review

Africa's COVID-19 third wave: A coupled behavior-disease system in a mutual feedback loop

Jia Bainga Kangbai[1, 2, 3*], Mahmoud Sheku[4], Braima Koroma[5, 6], Joseph Mustapha Macathy[5, 6], Daniel Kaitibi[7], Foday Sahr[8, 9, 10], Angella Magdalene George[11], Fatmata Gegbe[11], Daphne Cummings-Wray[11], Lawrence Sao Babawo[11]

[1]Center for International Health, University of Munich (LMU), Germany
[2]School of Tropical Medicine and Public Health, Tulane University, USA
[3]Department of Environmental Health Sciences, Njala University, Sierra Leone
[4]Institute for Global Health, University of Siena, Italy
[5]Sierra Leone Urban Research Center, Sierra Leone
[6]Department of Geography, Njala University
[7]Njala University, Sierra Leone
[8]The National COVID Emergency Response Centre (NACOVERC), Sierra Leone
[9]University of Sierra Leone
[10]The 34 Military Hospital, Wilberforce, Sierra Leone
[11]Department of Nursing, Njala University, Sierra Leone

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Address for correspondence:
Jia Bainga Kangbai, Center for International Health, University of Munich (LMU), Germany. Email- Jia.Kangbai@lrz.uni-muenchen.de

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Abstract

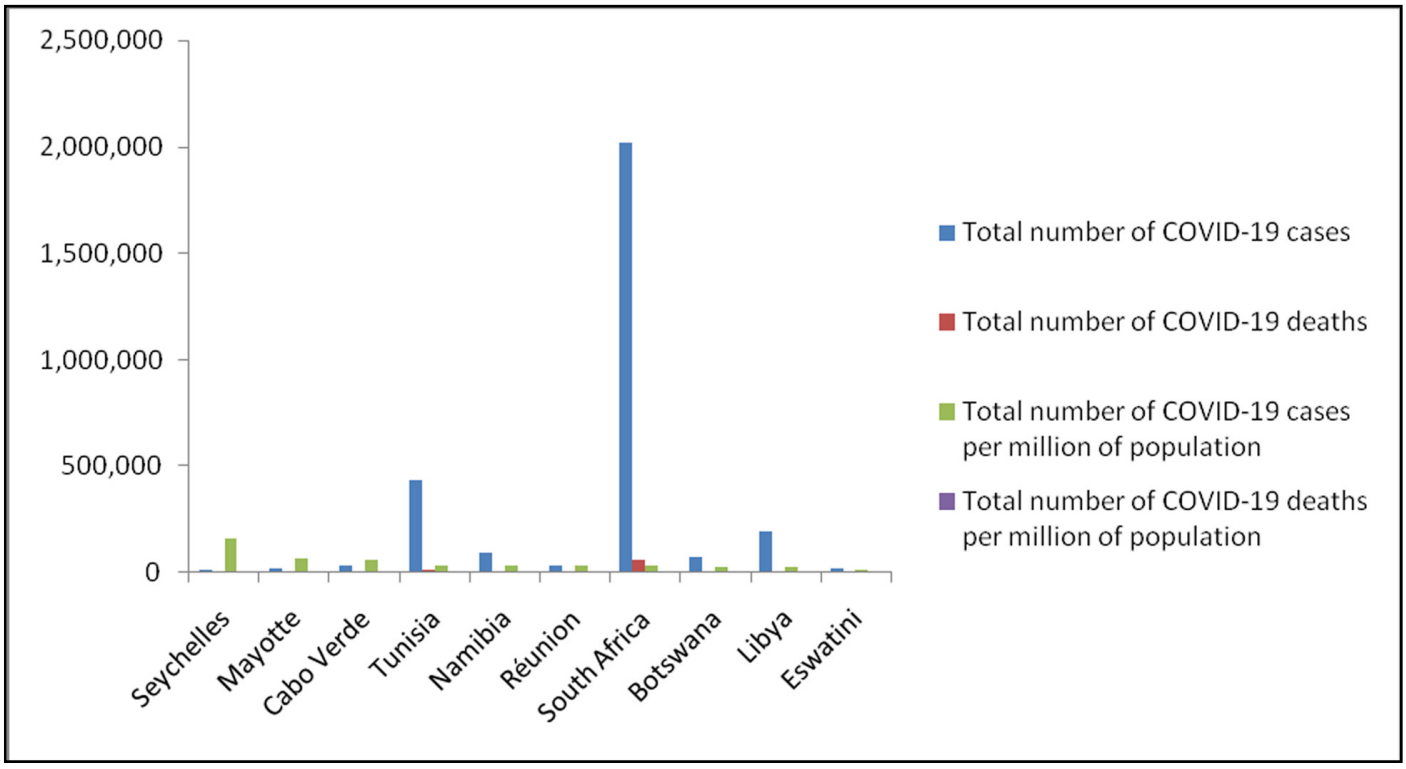
A year after COVID-19 was declared a pandemic much of the Africa continent started experiencing spikes in the number of COVID-19 cases and related deaths in what was referred to as the third wave of the pandemic. These spikes came right behind the heels of a second wave of the pandemic that barely went unnoticed in Africa. As of July 2021, Morocco, South Africa, Tunisia, Egypt, Nigeria, Libya, Kenya, Algeria, Zambia and Ethiopia accounted for approximately 86% of the reported increase in COVID-19; these countries were aptly described as being at the forefront of the continent's third wave of the COVID-19 pandemic. Unlike those countries in Asia and Latin America that experienced what may generally being described as autochthonous COVID-19 third wave, Africa's third wave COVID-19 cases are widely believed to have been triggered by imported cases. Africa like the rest of the world relaxed its COVID-19 restrictions almost at the same time; hence the continent's spikes of COVID-19 cases and related deaths during the third wave of the pandemic have raised some questions.

Main text

In late April 2021 some countries in Africa started experiencing spikes in the number of COVID-19 cases and related deaths in what was now referred to as the continent's third wave of the pandemic. These spikes came right behind the heels of a second wave [1] of the pandemic that barely went unnoticed in Africa. There were contentions whether Africa actually experienced a second wave of the COVID-19 pandemic [2]. The COVID-19 third wave came after many jurisdictions around the world relaxed their COVID-19 pandemic restrictions. In mid-June 2021, the World Health Organisation Regional Director Matshidiso Moeti reported that Africa's COVID-19 incidence and death rates rose by

over 30% and 15% respectively [3] with Seychelles (25.1%, n = 160244/638232), Mayotte (10.9% n = 69460/638232), Cape Verde (9.1% n = 58122/638232), Tunisia (5.7 n = 36238/638232), Namibia (5.6% n = 35901/638232), Reunion (5.3% n = 33917/638232), South Africa (5.3% n = 33633/638232), Botswana (4.7% n = 29781/638232), Libya (4.4% n = 27901/638232) and Eswatini (2.6% n = 16281/638232) accounting for approximately 78.6% (n = 501477/638232) [4] of the total number of confirmed COVID-19 cases per million of the population in early July 2021 (Figure 1).

Figure 1: Total number of COVID-19 cases and deaths per million of population for the twelve most affected countries in Africa as of the first week of July 2021



South Africa has the highest COVID-19 cases and deaths but Seychelles recorded the highest COVID-19 cases per million of the population as of the first week in July 2021.

This third wave of the COVID-19 pandemic in Africa was worrying because it came right behind the heels of the reopening of international borders and crossing points by many countries which allowed the movement of people into and within nations. Few studies [5, 6] have earlier connected the second wave of the pandemic to the lifting of the restriction on traveling, physical distancing and other social activities by many jurisdictions around the world. Mathematical models backed by empirical analysis have also shown that physical distancing can mitigate COVID-19 transmission and control [7-9], and that such mitigating measures can actually reduce the reproduction number of COVID-19 to below one [10-12].

We discovered that those African countries that were actively described to be experiencing the third wave of COVID-19 were those with high volume of international flight traffic [13]. However, we believe that the lifting of the restriction on international traveling, physical distancing and other social activities are part of the response to the accumulating socio-economic impact of COVID-19 pandemic on the populace. Thus, it appears that the COVID-19 pandemic is operating as a coupled behavior-disease system in which the disease and social dynamics are intertwined with each other in a mutual feedback loop. We are however of the opinion that blaming Africa's current third wave of COVID-19 only on the relaxation of pandemic precaution including the easing of international flight will require a second opinion. For instance, it takes at least two weeks for a person who has been exposed to COVID-19 to become sick enough to be tested and have their case epidemiologically linked or counted in an epidemiological database; and that it takes even more time for more people to become ill after being exposed to the primary case.

Also, Africa's high youthful population which was initially thought of be a protective factor against increasing COVID-19 infection and mortality rates since young people are generally believed to have asymptomatic COVID-19 infection may even now prove not to be so. Young people may serve as super-spreaders of the infection to the

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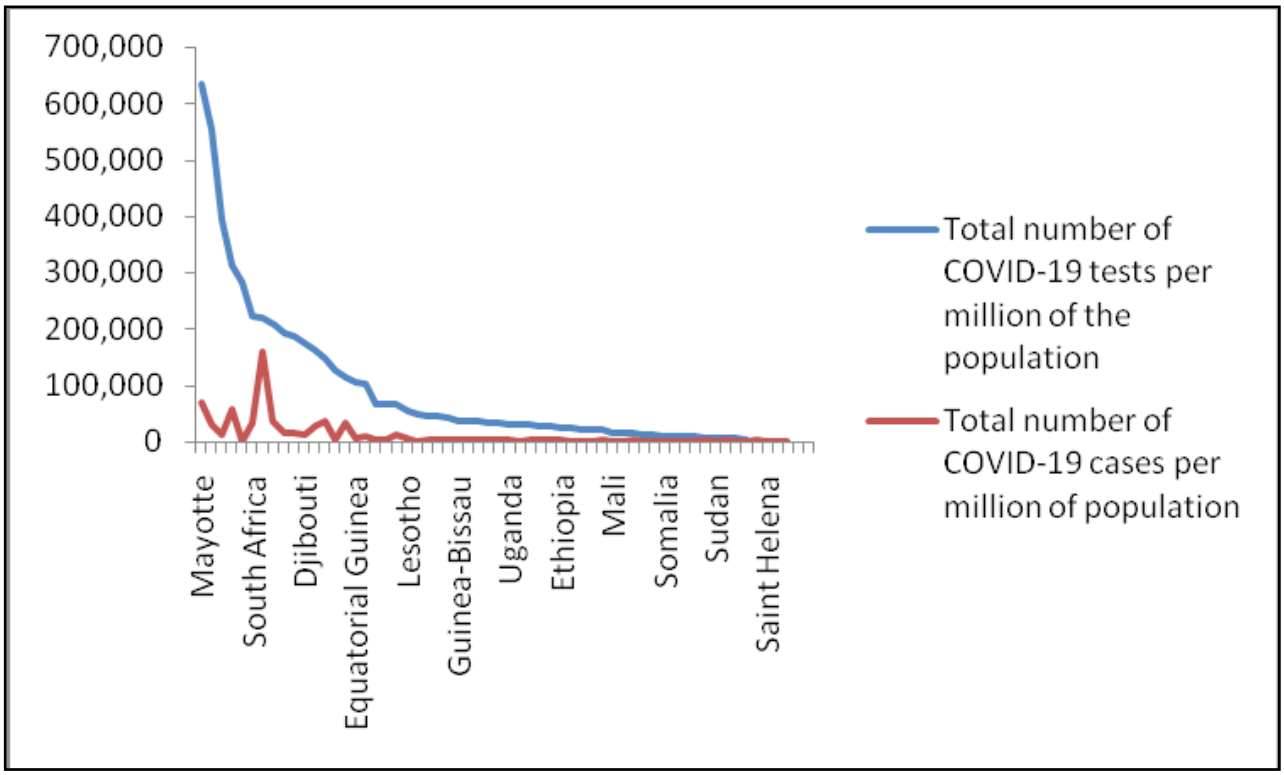
older generation since large proportion of COVID-19 transmission occurs during the asymptomatic period while 40% [14] of COVID-19 infected people are asymptomatic. Africa's high youthful population may have exacerbated Africa's COVID-19 third wave considering the fact that many of the COVID-19 cases in the youth patients were largely asymptomatic and either largely unnoticed or undetected; a situation that will spread the virus to Africa's vulnerable and aging population. We are of the opinion that unlike the low COVID-19 infection and mortality rates that were reported in the first and second waves in Africa, the continent's third wave infection and mortality rates were worsen off because of the region's limited resources including either non-existing or partially functioning lab as well as the overreliance on syndromic COVID-19 diagnosis surveillance which invariably implies that large number of COVID-19 transmission would have occurred occur prior to the laboratory detection of cases.

Africa unlike other continents recorded fewer COVID-19 cases and deaths during the first and second phases of the pandemic which led many schools of thoughts to postulate that the continent was being spared by the pandemic. From the epidemiological data available during the third wave of COVID-19 in Africa it is clear that the spikes in the incidence and mortality rates were not due to increase in diagnostic COVID-19 testing (Figure 2).

Figure 2. A graph showing the trend of COVID-19 tests and number of COVID-19 cases per million of the population for the twelve most affected countries in Africa during the first week of July 2021



In the few months after the second wave of COVID-19, Africa has upped its number of COVID-19 testing with Mayotte recording the highest number of COVID-19 tests per million of its population as of July 2021 [3]. We observed a strong association between increase in the total number of confirmed COVID-19 cases per million of a country's population and the number of COVID-19 tests conducted per million of a country's population (OR = 1.5, p-value = < 0.0005). In early period of the pandemic, Africa was known for its lack of or limited COVID-19 testing; but this pattern changed with the foreign donation (especially from China) of COVID-19 diagnostic kits to the continent in mid-2021. Africa has also shifted its population that's now being tested. Previously, much of Africa's COVID-19 tests were done on only sick persons suspected of having COVID-19 as opposed to now when testing is done more within the community where they are likely going to capture more infected people, including asymptomatic COVID-19 cases.

Unlike Europe and USA where the upsurge of COVID-19 cases that constituted the third wave of pandemic are autochthonous or community transmitted and were triggered by the emergence of COVID-19 Delta and Delta Plus strains, most of Africa's COVID-19 cases that are viewed to constitute the third wave of the pandemic are either imported cases or triggered by imported COVID-19 cases. In Sierra Leone for instance, inbound international passengers constitute majority of the country's daily COVID-19 cases.

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This importation of COVID-19 cases through international traveling also adds fuel to the argument for the need to understand the behavior-disease system of the pandemic. For the COVID-19 pandemic to be halted with or without mass vaccination, its behavior-disease system should be fully understood in the first place. Unlike the first and second waves of the pandemic in which few cases were reported in Africa, the effect of the third wave in Africa is so pronounced thereby indicating variations in the distribution of COVID-19 incidences and mortality rates. From our knowledge of the 1918 flu, several factors are responsible for spikes in disease incidence following the first wave of an outbreak. Like 1918 flu pandemic and other disease outbreaks, human behavior remains the most important factor responsible for the third phase of such outbreaks [15-17].

There are differences in the ways in which people respond to pandemics. Like Asia with some of the most disorganized human settlement systems, human behavior and residency is playing an important role of the impact of the COVID-19 third wave in Africa. One in three Africans is living below the global poverty level [18]. Thus, for Africans to follow COVID-19 precautions such as physical distancing, hand hygiene and the wearing of face mask may appear as a difficult chore. The closure of cities, towns, communities, and other public places in order to limit the number of people interacting with each other is difficult within the Africa context also. Africa is a continent with high population mixing since most of its people practice communal living as a means of sustaining their livelihood. Because of such living system, Africans tend to display high state of communal behavior which is expected to invariably lead to the greater spread and increase in the incidences and mortality rates of COVID-19 within the continent compared to other continents.

The effect of the third wave of COVID-19 pandemic will be more pronounced on people of with low-incomes, the homeless and people with limited access to healthcare since they cannot take time off of work when sick thereby causing others to become infected and making the cycle continue. Africa thus was perfect candidate for the full effect of the third wave of the COVID-19 pandemic. An early management of the third wave COVID-19 pandemic will be a welcoming move considering the economic and healthcare inequities among Africans.

All the various COVID-19 waves are exacerbated by different human behaviors, inertia governmental actions and rules, travel, daily activities, as well as the emergence of viral variants. The relationship between COVID-19 mitigating actions and its incidence and hence mortality is clear; places where few people wear face masks, largely gather indoors to eat, drink, celebrate, socialize, or observe religious practices, are expected to observe more COVID-19 cases. Also, multigenerational households and places where people live or work closely together; which are typical of the Africa setting are also expected to see more spread of COVID-19 cases. Thus, from an African perspective it appears that human behavior alone may triggered the worst-case scenario for the continent's third wave of COVID-19.

Competing interests

All authors declared they have no competing interest.

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Authors' contribution

JBK, BK, DW, AMG, DK, LSB, FG, FS and MS conceived and designed this study as well as organized the conduct of this research. JK, BK, DW, AMG, DK, LSB, FG, FS and MS drafted the manuscript. JK, BK, DW, AMG, DK, LSB, FG, and FS critically reviewed and revised the manuscript.

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