

Fig. 1 Reported cases of COVID-19, as of March 24, 2020. (Source: World Health Organization)

## COVID-19 in Africa: Dampening the storm?

Mbow M, Lell B, Jochems SP, et al.

*Science* 369 (6504), 624-626.

## COVID-19 in Africa: Dampening the storm?

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- Millions of COVID-19 deaths in Africa predicted by experts
- Four months later prevalence and mortality are still low!!!
- **WHY?**
  - Reliable reporting and death registration?
  - Lock- down stringency?
  - Demography?
  - Sociocultural aspects?
  - Environmental exposures?
  - Genetics?
  - Immune system?

Africa's major health and socioeconomic challenges should have allowed rapid transmission of COVID-19

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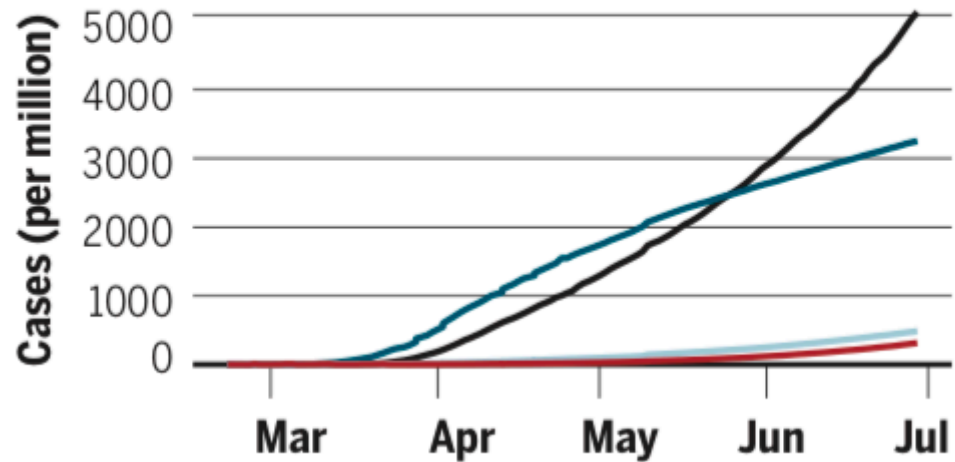
- **Weak health system**
  - Per capita health expenditure in most West African countries is <\$50
  - Per capita health expenditure in Europe and US >\$2500
- **Population densities are very high** in most African capital cities compared to the US:
  - Dakar (**12,617** persons/km<sup>2</sup>), Abidjan (**11,155** persons/km<sup>2</sup>), or Lagos (**13,909** persons/km<sup>2</sup>)
  - New York City has **7101** persons/ km<sup>2</sup>
- **Poverty**
- **Unhygienic conditions**

# COVID-19 in Africa: Dampening the storm?

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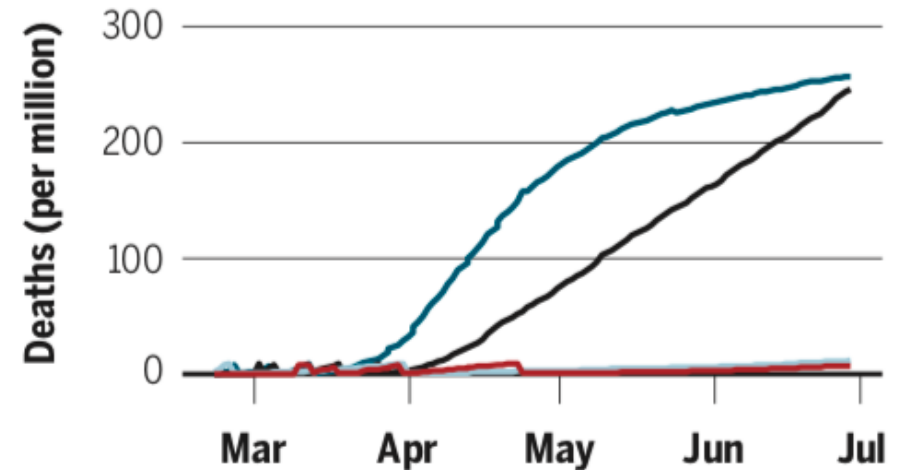
## COVID-19 cases

● Africa ● Asia ● America ● Europe



## COVID-19 deaths

● Africa ● Asia ● America ● Europe



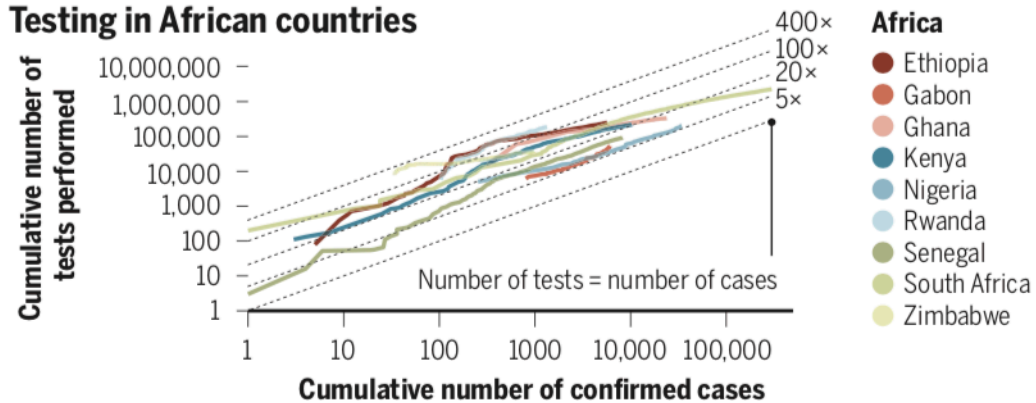
## COVID-19 deaths



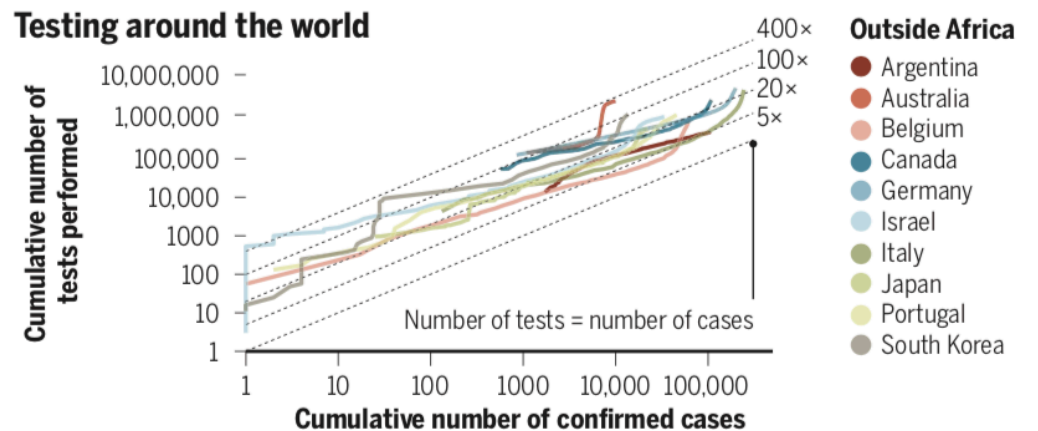
# Why have the predicted number of cases and deaths in Africa to COVID-19 has not yet been observed?

Are the low case numbers attributed to insufficient testing?

Testing in African countries



Testing around the world



- Many African countries implemented testing early on
- More tests/cases were carried out than in other countries at similar phases of the epidemic

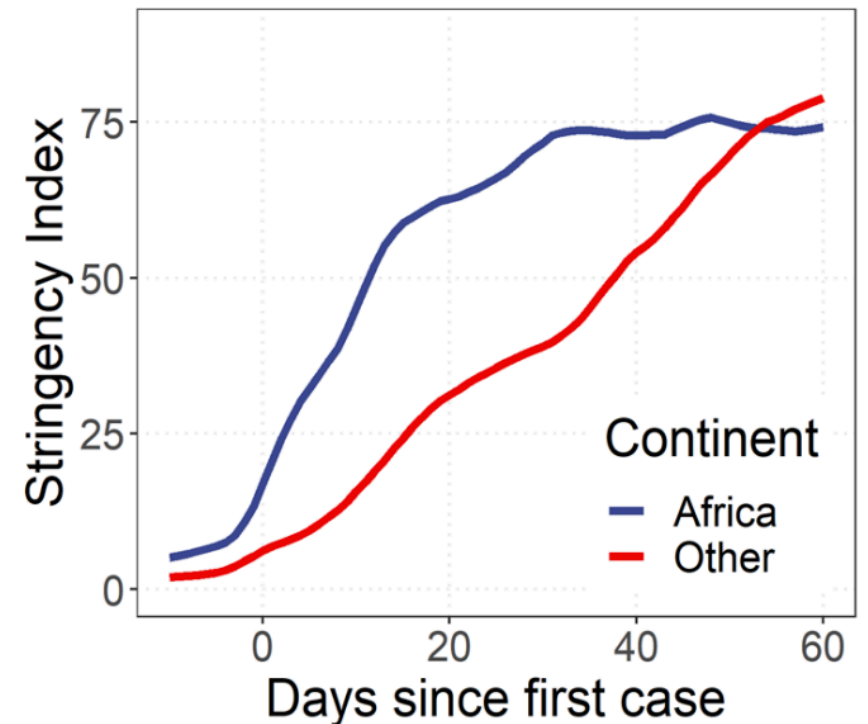
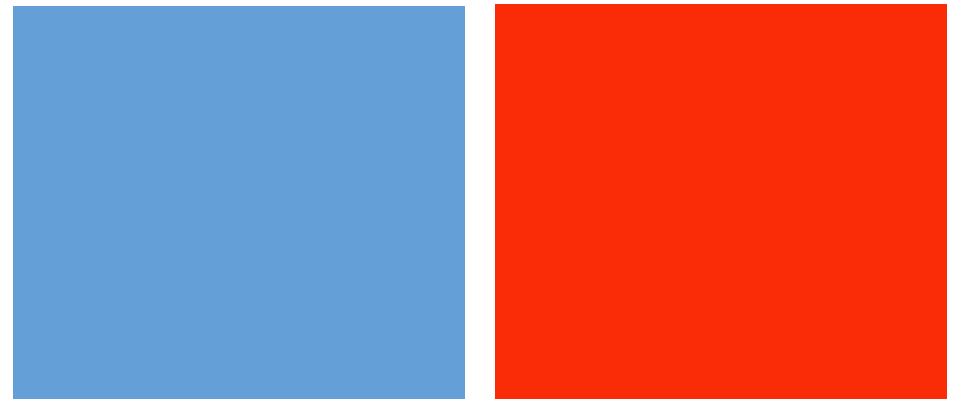
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- Travel restrictions, curfews, and school closures were **implemented early** often before an African country had detected a case
- These **early responses** might have resulted in fewer imported cases and reduced transmission
  - Allowing sufficient time to prepare for:
    - Diagnosis of cases
    - Quarantine/contact tracing/and social distancing strategies in an experienced continent (EBOLA)

# Stronger government stringency response in Africa

- Stringency response implemented days after the first case was reported. Comparison of indicators such as travel restrictions and school closures (stringency index), between 47 African countries for which data are available and the 47 non-African countries that currently have the most cases [Source of data: Oxford covid-19 government response tracker]



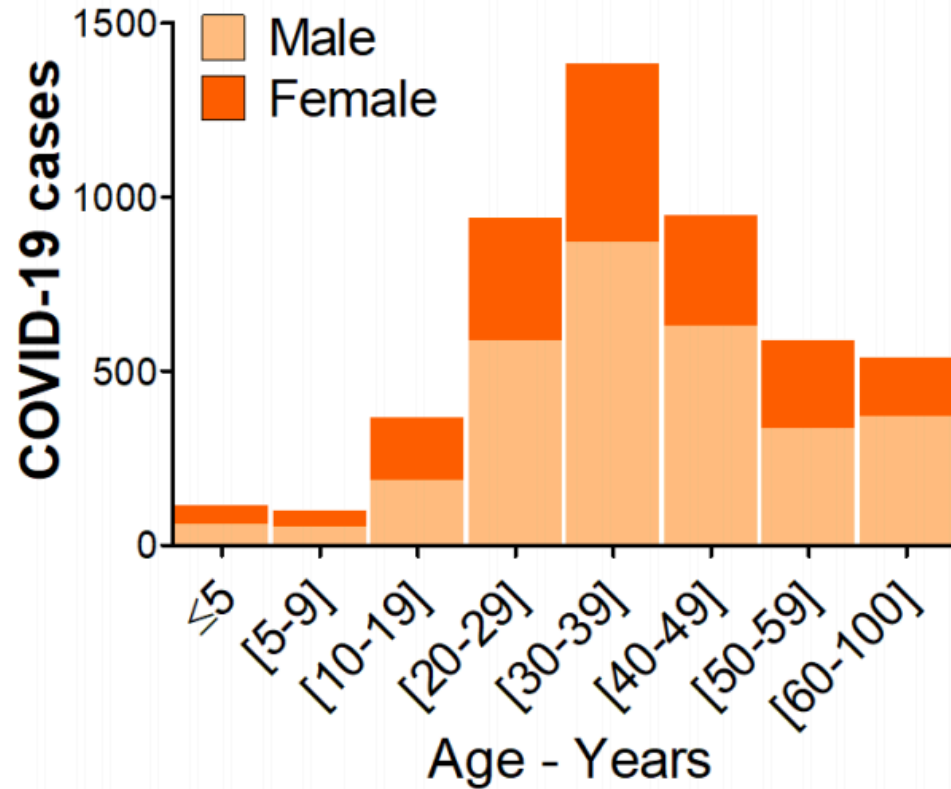
# Factors that May Influence Outcomes of COVID-19 in Africa

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- Age of the population?
- The genetics of the virus?
- The genetics of the people?
- Immunity?



# Age distribution of COVID-19 cases in Africa



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- Africa has a young population, with a median population age of 19.7 years for the continent versus 38.6 years for the US
- COVID-19 deaths would be expected to be only four times lower, rather than the observed 40 times lower
- No aggregated data on age-specific case or death rates are available for the continent

# Other reasons for low incidence of severe COVID-19 in Africa.

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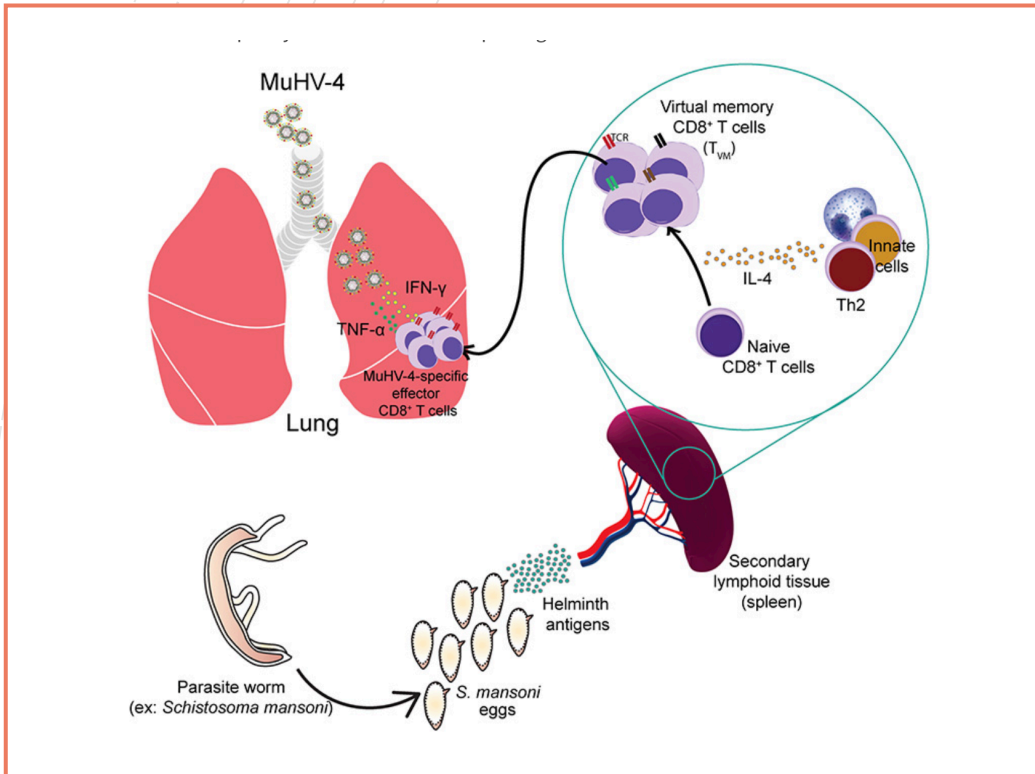
- **The genetics of the virus or of the people?**
  - The isolates found in Africa are like those of other continents.
  - If human genetics would have an impact African-Americans would also be protected, and they are not.
- **Immunity?**
  - Complementary mechanisms to prevent severe disease are being able to:
    - Suppress viral infection early
    - Temper excessive inflammation

# Other reasons for low incidence of severe COVID- 19 in Africa Immunity?

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- **Adaptive responses to clear viral infections**
  - Past or concurrent infections with other pathogens could generate immunological cross-reactivity in antibodies and T cells
- **Environmental exposures in Africa are different**
  - Environmental exposure to microorganisms and parasites (HIV, TB, Malaria, Parasites) educate the immune system to protect against specific and nonspecific invading pathogens by creating “**virtual memory T Cells (VMT)**”
  - VMT expand in response to helminth-induced IL-4, rather than through pathogen-specific antigens, leading to enhanced antiviral effector functions

# Helminth-induced IL-4 expands bystander memory CD8+ T cells for early control of viral infection



- Helminth antigens induce the development of type 2 inflammation leading to the production of interleukin 4 (IL-4) that induce the expansion of CD8+ "virtual memory" ( $T_{VM}$ ) T lymphocytes.
- $T_{VM}$  accumulate by conversion from naive T cells directly by IL-4 signaling and independently of antigenic stimulation while preserving T cell receptor diversity (TCR).
- These  $T_{VM}$  accumulate in the secondary lymphoid organs following helminth infection, and their ability to respond to viral antigens is more effective than that of naive lymphocytes, resulting in their faster migration to the lung to control viral infection.

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## “Hygiene hypothesis”

- Early and chronic exposure to pathogens leading to relentless immune cell activation in harsh environments induces a strong regulatory immune response to counteract excessive inflammation
- The ability to prevent excessive inflammation could be a critical parameter that is associated with COVID-19 outcome. Recent data suggest that inflammatory alveolar macrophages (AMs), from African individuals with high exposure to pathogens can be less proinflammatory

# Conclusion

- There are immunologic response not only in Africans versus Europeans but also among Africans with high and low exposure to microorganisms and parasites
- There are differences in opinion about whether the pattern of SARS-CoV-2 spread is different in Africa compared with that in the US and Europe.
- So far it appears that the virus is spreading differently and potentially with an attenuated outcome in Africa.
- There has been limited testing of asymptomatic cases or of antibody titers. Therefore, it is unknown whether early interventions were successful in preventing transmission or whether there are differences in susceptibility between populations of different regions.

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