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Why are COVID-19 effects less severe in Sub-Saharan Africa? Moving more and sitting less may be a primary reason

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The world is entering a new phase of the coronavirus disease 2019 (COVID-19) health crisis with the lifting of social and physical distancing as well as lockdown restrictions to control the pandemic. Scientific evidence obtained during the COVID-19 pandemic to this point have brought clear themes to the forefront. One important theme pertains to who is at a higher risk for poorer outcomes if infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Clearly, individuals with risk factors for chronic disease and one or more chronic disease diagnoses are at significantly higher risk for poor outcomes with SARS-CoV-2 infection.[1,2] Moreover, unhealthy lifestyle behaviors (i.e., physical inactivity, poor nutrition, smoking and excess body mass) are the leading cause for the high incidence and prevalence of chronic disease the world was facing well before the COVID-19 pandemic.[3] In fact, physical inactivity and chronic diseases were both characterized as pandemics prior to COVID-19.[1,4,5] In this context, decades of unhealthy lifestyle behaviors, both independently and through the association with chronic disease risk factors, *primed the pump* for poor COVID-19 outcomes.[1,6–8] Another emerging theme is the disproportionate burden of poor outcomes in underserved communities and underrepresented individuals.[9–11] A higher prevalence of unhealthy lifestyle characteristics and chronic disease certainly contributes to this disparity.[12–14] From an international perspective related to health inequalities, a common conclusion is that the burden of disease is usually highest in the lowest-income countries, especially countries in sub-Saharan Africa. This pattern is most starkly seen for a wide range of infectious diseases,[15] though rates of non-communicable diseases are already substantial and are rising in the region.[16,17] As such, since the early days of the pandemic, there has been grave concern for the disastrous impact the COVID-19 pandemic would have in sub-Saharan Africa.

A recent New York Times article highlighted a surprising exception to the pattern of health inequities disfavoring Africa – COVID-19 pandemic outcomes.[18] The reporter described both anecdotal and quantitative evidence for why the anticipated devastating toll of COVID-19 in Africa, due to poverty, crowding, limited medical care, and inadequate distributions and uptake of vaccinations, had not occurred. A compilation of "excess deaths" in virtually every country throughout the pandemic by The Economist, among others, seems to generally support the low mortality of COVID-19 in sub-Saharan African countries.[19,20]

If confirmed by further analysis of available data, this pattern raises obvious questions about what might account for low COVID-19 mortality in Africa. The generally younger age distribution throughout Africa has been offered as one explanation,[20] and it is a credible one. But there are other explanations that should be explored, and physical activity (PA) is a promising candidate. Africa is currently the most physically active region of the world.[21] There is a sizeable scientific literature documenting numerous biological effects of PA relevant to infectious diseases, including widespread improvements in immune functioning, lower infection rates, reduced inflammation during infections, less severe outcomes of infections, and enhanced effectiveness of vaccines, especially among immunocompromised groups such as older adults.[22,23] If these benefits are meaningful, we would expect to see benefits of cardiorespiratory fitness and PA during the COVID-19 pandemic, which has in fact been the case.[24–28] A recent systematic review by the United States (US) Centers for Disease Control (CDC) included 25 studies specific to COVID-19 outcomes from multiple continents using a variety of measures of PA and fitness, as well as multiple COVID-19 outcomes. They found the evidence was consistent and conclusive that adults who were physically active or fit prior to a COVID-19 diagnosis were less likely to be hospitalized and die, with notable, but weaker

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evidence related to ICU admission and being placed on a ventilator.[29] This analysis provided convincing evidence that low PA increases the risk for poor COVID-19 outcomes resulting in the CDC listing low PA as an established risk factor on their COVID-19 "people with certain medical conditions" webpage.[30] There is an additional recent large ($n = 65{,}361$) study from South Africa confirming the main results of the review using device-based measures of PA in a large sample, with apparently larger effect sizes than have been reported in prior studies of similar design.[31] Thus, the benefits of physical activity for COVID-19 also apply in Africa, though this appeared to be a mainly higher-income sample.

To explain lower COVID-19 death rates throughout sub-Saharan Africa, it would have to be shown, first, that PA is generally higher in Africa than in higher-income regions. There is substantial evidence this is the case. Self-report data from the World Health Organization's (WHO) STEPs surveillance program show rates of insufficient PA are well below the global average for women and men.[21] There are several studies among smaller samples in sub-Saharan Africa using device-based PA measures providing further evidence that African adults are substantially more physically active than samples in the US[32] and Europe.[33] Numerous health benefits directly relevant to infectious diseases are associated with being physically active, one of which is lower levels of systemic inflammation.[34,35] Poor outcomes with SARS-CoV-2 have been associated with a *cytokine storm*,[6] and elevated systemic inflammation prior to infection may foretell an increased risk for this storm and an untoward clinical course.[36] There is some evidence to indicate systemic inflammation levels are lower in the sub-Saharan African population.[37] Thus, higher PA contributing to lower systemic inflammation may be one mechanism for improved COVID-19 outcomes in this region of the world. Obesity has been strongly linked to poor COVID-19 outcomes.[38–40] While obesity is on the rise in sub-Saharan African population,[41,42] the overall prevalence still lags behind other countries such as the US.[43] Perhaps interactions between higher PA levels and a lower body mass in sub-Saharan Africa have also contributed to improved COVID-19 outcomes. Recent data suggest physical inactivity was a stronger predictor than obesity of COVID-19 deaths in 53 Sub-Saharan Africa countries.[44] However, it should be noted again that obesity is on the rise in this region, serving as an ominous sign for the future.

A related potential explanation for the lower COVID-19 death rates in Africa is that many Africans spend more time outdoors, especially those who live outside of cities and in the rural areas.[45–47] More outdoor living could be protective from infectious diseases through at least two mechanisms. First, a recent systematic review summarized evidence from 33 studies that being in nature has beneficial effects on the immune and inflammation systems.[48] Second, though the distribution of physical activity outdoors versus indoors has not been well-studied among adults,[49] at least some subgroups of adults prefer to be active outdoors.[50] Many common leisure activities are performed outdoors. The commonly reported outdoor activity types among adults and adolescents in Sub-Saharan Africa are walking, running, cycling, digging, swimming, dancing, and playing soccer.[47,51] However, it is unclear whether being active and being outdoors have synergistic benefits relevant to decreased risk of chronic disease as well as decreased illness severity in the event of a viral infection.

In addition to many Africans spending more time outdoors, it is probable the majority of individuals did not significantly reduce their PA levels during the pandemic. Not because they did not care about the public health directives on movement restrictions, but because PA (i.e., *moving more and sitting less*) is embedded in their activities of daily living and economic survival. For instance, active transportation is part of normal life in sub-Saharan Africa, with a majority relying heavily on public transport, and a relatively low proportion of individuals having access to or owning a private vehicle.[52] The population in sub-Saharan Africa, the majority of whom are from resource deprived low-income families, depend less on motorized, digitized, labor saving gadgets and equipment. Rather, this population relies on low technology activities (e.g., small informal business enterprises, farming) that involve extensive movement of light to moderate intensity to earn a living, including frequently interrupted sitting. Perhaps the benefits that come with energy expenditure and increased metabolism throughout the waking hours of a day in relation to COVID-19 infection rate and severity is worth exploring.

At the population level, there is evidence of a PA transition in sub-Saharan Africa that suggests disparity in physical activity by levels of urbanization and socioeconomic status,[47,53] with physical inactivity increasing with increasing urbanization and income.[54] Although data on disparities in COVID-19 infection rate and severity between Africa's urban and rural areas is scarce, anecdotal evidence suggests a sharp divide in urban-rural COVID-19 outcomes.[55,56] While fewer COVID-19 infections and less severity are often recorded in rural areas in Africa, the economic impact and social devastations, such as disruption in livelihoods and the agriculture and food system, are often more pronounced in rural than urban areas of Africa.[56,57] However, studies are needed to explore how each country's levels of urbanization, income and PA may interact to influence COVID-19 infection rate and severity in sub-Saharan Africa. Such studies could offer definitive answers to the hypothesis that PA in Africa may be, at least partly responsible for the lower incidence and prevalence of COVID-19 and its severe outcomes, when compared to those reported in the high-income Western countries.

In conclusion, the profound importance of being physical active to one's health is again being illustrated during the COVID-19 pandemic. While underserved communities and underrepresented individuals in many parts of the world are being disproportionately impacted by adverse COVID-19 outcomes, the sub-Saharan Africa region seems to be faring far better than would be expected. This is welcome news and the potential explanations for this favorable result should be examined. In this context, more studies identifying the benefits of PA and being outdoors prior to and during the COVID-19 pandemic are needed in sub-Saharan Africa. To inform evidence-based interventions in Africa, we suggest investigators should conduct PA and COVID-19 studies across the several phases of the behavioral epidemiological framework, including studies on establishing the link between physical activity and COVID-19, identifying social and structural factors that influence PA in the context of the COVID-19 pandemic, developing and evaluating interventions to increase PA during COVID-19, and translating research into practice and policy for current and future pandemics.[58] While the reasons for better outcomes are yet to be elucidated, higher levels of PA may be a primary protective contributor. If this proves to be the case, sub-Saharan Africa will serve as a shining example of how underserved communities can employ healthy living behaviors to prepare for and combat health crises, yet again illustrating *moving more and sitting less* is medicine that should be equitably administered around the world.

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