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Letter to the Editor

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Predicting the transmission of SARS-CoV-2 in Africa: the case of Namibia

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African countries have a very different demographic structure than resource-rich countries: in many African countries, over 50% of the population live in rural communities. These communities are much smaller than urban communities, and are widely dispersed; therefore, in rural areas, there is 'intrinsic social distancing' due to low population density. There is considerable travel linking urban and rural areas.

Although many severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission models have been fairly accurate in their predictions for resource-rich countries, models have tended to be very inaccurate in their predictions for Africa.[1,2] We propose that one important reason for this inaccuracy is that the structure of the current models does not consider the spatial demography of African countries. We demonstrate the importance of spatial demography by using, as an example, spatial demographic and SARS-CoV-2 surveillance data[3] from Namibia, where ~50% of the population live in rural areas.[4]

Since March 2020, there have been four waves of coronavirus disease 2019 (COVID-19) in Namibia (Figure 1A), ~156 000 confirmed cases and ~4000 deaths.[5] We used the most recent Inter-census data[4] to calculate the urban–rural (UR) index for each of the 14 administrative regions of Namibia. The index specifies the proportion of the population that live in urban areas, and ranges from zero to one. A region has an index of one if all of its residents live in urban areas, and zero if they all live in rural areas. The UR index ranges widely from 0.05 for Omusati to 0.95 for Khomas; Khomas contains Namibia's capital Windhoek.

For all 14 regions, we compared the time of the first reported confirmed case of COVID-19 in a region with the UR index for that region. At the regional-level, the introduction of SARS-CoV-2 occurred over a period of 6 months: between March 2020 and August 2020. The more rural the region (i.e. the lower the UR index) the later the reported case: Spearman's correlation coefficient, $\rho = -0.64$; $P = 0.014$. This result, and the mapped surveillance data (Figure 1B), show that the COVID-19 epidemic in Namibia began in the most urbanized regions (which are in the central and southern regions of the country) and progressively spread to the most rural regions (which are in the north).

Notably, we found a very strong positive correlation between the UR index and SARS-CoV-2 transmission (we define transmission as the cumulative number of confirmed cases of COVID-19 per 100 000 individuals) over all four waves of the epidemic (Figure 1C; $\rho = 0.93$; $P < 0.001$) and for each separate wave: 1 ($\rho = 0.87$; $P < 0.001$), 2 ($\rho = 0.82$; $P < 0.001$), 3 ($\rho = 0.92$; $P < 0.001$) and 4 ($\rho = 0.78$; $P = 0.002$). Taken together, these results show that the more urban the region, the higher the transmission. Regional transmission varied 15-fold. It was the highest (10 645 confirmed cases per 100 000 individuals) in Karas, and the lowest (699 confirmed cases per 100 000 individuals) in Kavango West.

Our analysis has limitations. First, we cannot correct for possible bias in detection rates across regions: no regional data are available on the number of performed tests. Second, because we do not have data at a high enough spatial resolution, we cannot determine where the cases occurred within each administrative region or the connectivity (i.e. movement of infected individuals) between—and within—regions. Third, we do not have data (either genomic or contact tracing) to determine the number of subsequent introductions that occurred in each region.

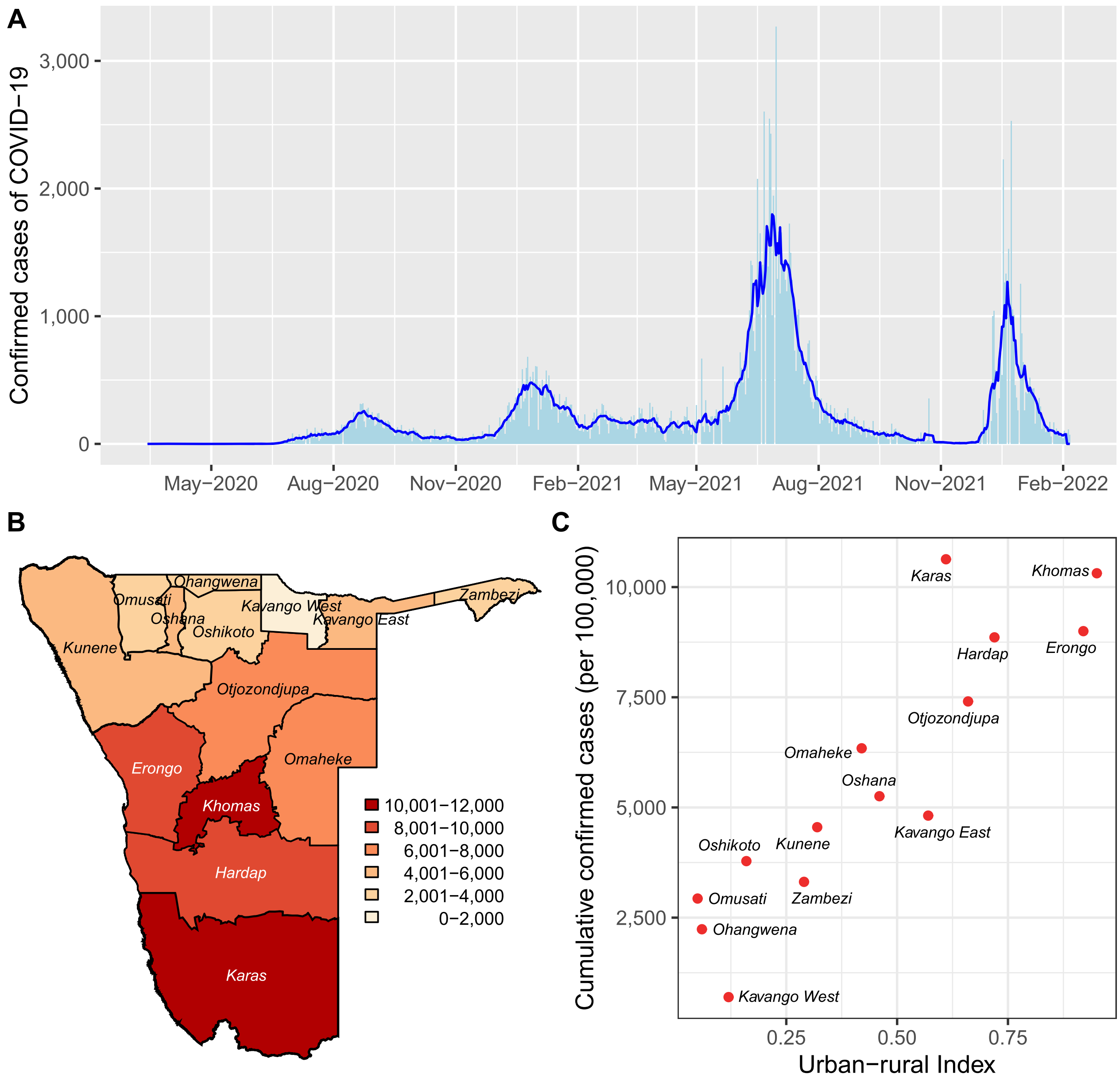

Figure 1. The COVID-19 epidemic in Namibia. (A) Reported confirmed cases of COVID-19 over time (light blue) with a 7-day moving average (dark blue). (B) Map of the cumulative confirmed number of cases of COVID-19 per 100 000 individuals in each of the 14 regions of Namibia. (C) The cumulative confirmed number of cases of COVID-19 per 100 000 individuals vs the UR index in each of the 14 regions of Namibia.

Confounding could occur if continuous introductions were associated with higher transmission. In addition, we cannot determine the impact of repeated introductions on the size and shape of regional outbreaks.

We have shown the importance of spatial demography for understanding geographic variation in the severity of the COVID-19 epidemic within Namibia; previous studies have shown the importance of spatial determinants for understanding differences in the severity of COVID-19 epidemics between African countries.[6–8] Consequently, we conclude that there is a need to include spatial demography, differential transmission in urban and rural areas and travel between—and within—regions (and countries), when constructing new SARS-CoV-2 transmission models for African countries. Such models may be more accurate, and hence more useful than the current transmission models, for predicting the future of COVID-19 epidemics in Africa.

Authors’ Contributions

J.T.O., E.V. and S.B. developed the concept. H.K.M. provided in-country expertise. S.B. drafted the manuscript. J.T.O. made the figure. J.T.O. and E.V. directly accessed and verified all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Conflict of Interest

The authors have declared no conflicts of interest.

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References

1. Pearson CA, Van Schalkwyk C, Foss AM *et al*. Projected early spread of COVID-19 in Africa through 1 June 2020. *Euro Surveill* 2020; **25**:2000543.
2. Wamai RG, Hirsch JL, Van Damme W *et al*. What could explain the lower COVID-19 burden in Africa despite considerable circulation of the SARS-CoV-2 virus? *Int J Environ Res Public Health* 2021; **18**:8638.
3. World Health Organization. *Namibia COVID-19 Situation Reports 1-688*. https://www.afro.who.int/publications/namibia-covid-19-situation-reports-420 (7 February 2022, date last accessed).
4. Namibia Statistics Agency. *Namibia Inter-censal Demographic Survey 2016 Report*. https://cms.my.na/assets/documents/NIDS_2016.pdf (18 October 2021, date last accessed).
5. Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. *Lancet Infect Dis* 2020; **20**: 533–4.
6. Rader B, Scarpino SV, Nande A *et al*. Crowding and the shape of COVID-19 epidemics. *Nat Med* 2020; **26**:1829–34.
7. Rice BL, Annapragada A, Baker RE *et al*. Variation in SARS-CoV-2 outbreaks across sub-Saharan Africa. *Nat Med* 2021; **27**:447–53.
8. Zhang F, Karamagi H, Nsenga N *et al*. Predictors of COVID-19 epidemics in countries of the World Health Organization African region. *Nat Med* 2021; **27**: 2041–47.