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SARS CoV 2 Infection Fatality Rate Estimates for South Africa

Laurette Mhlanga
South African DST-NRF Centre of Excellence in Epidemiological Modelling and Analysis, Stellenbosch University https://orcid.org/0000-0002-7805-4231

Marion Vermeulen
South African National Blood Service https://orcid.org/0000-0003-4383-4526

Eduard Grebe
Vitalant Research Institute https://orcid.org/0000-0001-7046-7245

Alex Welte (alexwelte@gmail.com)
South African DST-NRF Centre of Excellence in Epidemiological Modelling and Analysis, Stellenbosch University https://orcid.org/0000-0001-7139-7509

Short Report

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SARS CoV 2 Infection Fatality Rate Estimates for South Africa

*Laurette Mhlanga[1], Marion Vermeulen[2,3], Eduard Grebe[1,4,5], Alex Welte[1] **

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This is a brief report. The intention is simply to communicate findings and thereby trigger discussion and further work – not to provide a substantial contextual, comparative, or interpretive narrative.

It is of course important to ascertain the risk of death that comes with SARS-CoV-2 infection (the 'Infection Fatality Rate/Ratio' or IFR) but it is difficult to observe directly, as the majority of infections go undiagnosed. Using a positive clinical diagnosis as the defining element of a 'case', leads to the related 'Case fatality Rate', or CFR. While CFR is relatively simple to assess, within a study or a stable clinical record keeping or case reporting system, it is less clear what it means, and its meaning will inevitably vary from place to place, due to structural inequities; and from time to time, as testing systems adapt to the evolving epidemic.

There has been some speculation that African and some other developing nations have been affected less severely than developed countries, in particular seeing fewer than expected deaths from Covid-19. It has also been suggested that the paucity of data, and the very different age structures of the populations in different parts of the world, might largely explain the apparent differences seen in crude CFRs, which mask distributions of (primarily) age and other key risk factors for severe disease from SARS-CoV-2 infection.

The Blood Services in South Africa (SANBS and WCBS) have recently published national SARS-CoV-2 seroprevalence estimates based on a substantial, approximately nationally representative, sample of blood donors [1]. This analysis indicates no dependence of seroprevalence on sex or age (in the sampled age range of 16 to 80), but alas, as is typical for many health and welfare indicators in South Africa, race and province are strong predictors of seroprevalence.

The Medical Research Council has been producing weekly excess deaths estimates for some time. These are not disaggregated by either race or age. As it is well known that age is a very strong, indeed probably the strongest, predictor of severity of Covid-19, it is largely meaningless to discuss CFR or IFR without paying attention to age.

Given that the just-published donor-based South African seroprevalence estimates, reflecting prior SARS-CoV-2 infection. vary sharply by race, and substantially by province, and that we know fatality depends strongly on age, it would be optimal to have excess deaths reported by race, precise age, and province. We understand that the vital registration system in South Africa does not report deaths by race, and that the MRC only occasionally publishes disaggregation by age. Indeed, we are

* 1) DSI-NRF Centre of Excellence in Epidemiological Modelling and Analysis (SACEMA), Stellenbosch University; 2) South African National Blood Service; 3) University of the Free State; 4) Vitalant Research Institute 5) University of California San Francisco

aware of a single South African report on excess deaths by age [2] and even then only in decade age bands, and not simultaneously by province.

It would be a simple matter to estimate age specific IFR, nationally averaged, if the excess deaths estimates and the prevalence estimates applied to the same point in time. As it is, the published age disaggregated excess deaths estimates are as of the end of 2020, and our prevalence estimates are representative of the period of January to May 2021 – which we will interpret, for the present purposes, as an estimate applicable to late March. Incidence was not very high from January to May, as this was between the second and third wave – but the delay seen with deaths means that deaths more than doubled between December and March.

For the sake of this preliminary estimate, we rescale the December 2020 age specific excess deaths by a factor of 2.12, to obtain a cumulative, national, excess deaths estimate which has the correct total for March 2021. For provincial, age aggregated estimates, we use the provincial cumulative deaths reported by the MRC in March 2021 – not rescaled provincial estimates from December 2020.

We are choosing to interpret the reported estimated excess natural deaths as Covid-19 deaths. As far as we can tell, this could as credibly be argued to be an under- or over-estimate. Some have highlighted collateral deaths of various kinds, and others have noted the reduction in other infection related deaths during lockdown periods.

In order to have a well-defined age aggregated IFR, we allocated neither cases nor deaths to the age group <10 years, and we allocated the observed (non-age dependent) prevalence from the blood donor study to all ages from 10 up. These estimates, then, are a population averaged IFRs for persons aged 10 and over.

Table 1 indicates our nationally aggregated, age disaggregated, infection fatality rates, which used the population estimates from [3]. These IFR estimates for are broadly comparable with previous estimates of which we are aware, such as from a locale-based study from South Africa [4] and a meta-analysis of estimates from the Global North [5]. For visual representation, we interpret the numbers from Table 1 as mid-decade estimates, and fit an exponential curve (See Figure 1). It seems reasonable to say that the relationship between age and IFR is heuristically characterisable as a doubling of fatality for every ten years of age.

Table 2 shows the provincial age aggregated IFR estimates. The actual estimate, based on the available data, is the column ‘estimated IFR’. To better understand differences in IFR between provinces, we calculated a so called ‘expected IFR’ by province, which is what we would observe if provinces all share the national age dependent IFRs, in each case averaged over the province-specific age distribution. This way, we can compare the actual estimate with the ‘expected’ estimate, and thus not unnecessarily interpret a provincial IFR to be ‘relatively high’ simply because that province has a relatively older population.

What is not clear is to what extent these various indicators reflect 1) differences in the relationship between blood donors and the provincial population which bias the provincial seroprevalence estimates in different ways, 2) differences in actual age-specific fatality between provinces, and 3) differences in the quality of death data and excess deaths estimates.

In fact, we are also not sure whether deaths may end up being allocated to provinces differently than the provincial allocation of the deceased persons during life, given significant mobility of people of working age.

Our analysis is not optimal, mainly because the mortality data which one would ideally use, and which forms the basis of the routine MRC reports, is not publicly available. When this limitation is addressed, it is hard to imagine that the fatality rate estimates will change substantially. Since estimates of IFR are clearly important as part of the overall epidemiological assessment, scenario projections, and health system evaluation, we are disseminating these estimates at the present time in the hope that they will stimulate discussion and epidemiological thinking.

Acknowledgements

Even though the present analysis relies only on publicly available data ([1], [2] and [3]), we would not be doing this analysis now if not for our collaborators in the blood services (***Russell Cable, Charl Coleman, Tanya Glatt, Nadia Pietersen, Ronel Swanevelder, Wendy Sykes, Karin van den Berg***) whose efforts led to the crucial new results (prevalence estimates [1]) that make this analysis possible.

Conflicts of Interest

The Authors affirm they have no conflicts of interest with regard to this publication.

References

1. M Vermeulen, L Mhlanga, W Sykes, C Coleman, N Pieterson, R Cable, R Swanevelder, TN Glatt, E Grebe, A Welte, K van den Berg; **Prevalence of anti-SARS-CoV-2 antibodies among blood donors in South Africa during the period January-May 2021.** Preprint DOI: 10.21203/rs.3.rs-690372/v1

2. D Bradshaw, RE Dorrington, R Laubscher, TA Moultrie, P Groenewald; **Tracking mortality in near to real time provides essential information about the impact of the COVID-19 pandemic in South Africa in 2020**; South African Medical Journal; May 2021; doi.org/10.7196/SAMJ.2021.v111i8.15809

3. Machemedze T, Kerr A, Dorrington R. **WIDER Working Paper 2020/67-South African population projection and household survey sample weight recalibration**. 2020; https://doi.org/10.35188/UNU-WIDER/2020/824-5

4. J Kleynhans, S Tempia, N Wolter, A von Gottberg, et al, for the PHIRST-C Group; **Longitudinal SARS-CoV-2 seroprevalence in a rural and urban community 2 household cohort in South Africa, during the first and second waves July 3 2020-March 2021**; medRxiv preprint https://doi.org/10.1101/2021.05.26.21257849

5. A Levin, WP Hanage, N Owusu-Boaitey, KB Cochran, SP Walsh, G Meyerow; **Assessing the age specificity of infection fatality rates for COVID-19: systematic review, meta-analysis, and public policy implications**; European Journal of Epidemiology (2020) 35:1123–1138 https://doi.org/10.1007/s10654-020-00698-1

Table 1: Age specific estimates of SARS-CoV-2 Infection Fatality Rates in South Africa, as of March 2021

Age Range	Population Size	Excess Natural Deaths	Scaled Excess Natural Deaths	SARS-CoV-2 Infections	IFR (%)
1-9	11,217,099	0	0	0	N/A
10-19	10,280,989	332	705	4,873,189	0.014
20-29	9,954,072	1,194	2,535	4,718,230	0.054
30-39	10,333,318	4,213	8,944	4,897,993	0.183
40-49	7,211,051	6,509	13,819	3,418,038	0.404
50-59	5,020,135	13,881	29,470	2,379,544	1.238
60-69	3,327,195	19,724	41,875	1,577,090	2.655
70-79	1,602,572	14,102	29,939	759,619	3.941
80-	725,977	11,010	23,375	344,113	6.793
Total	**59,672,408**	**70,965**	**150663**	**22,967,816**	**0.656**

Figure 1: Fitted SARS-CoV-2 Infection Fatality Rate as an exponential function of age, in South Africa, as of March 2021

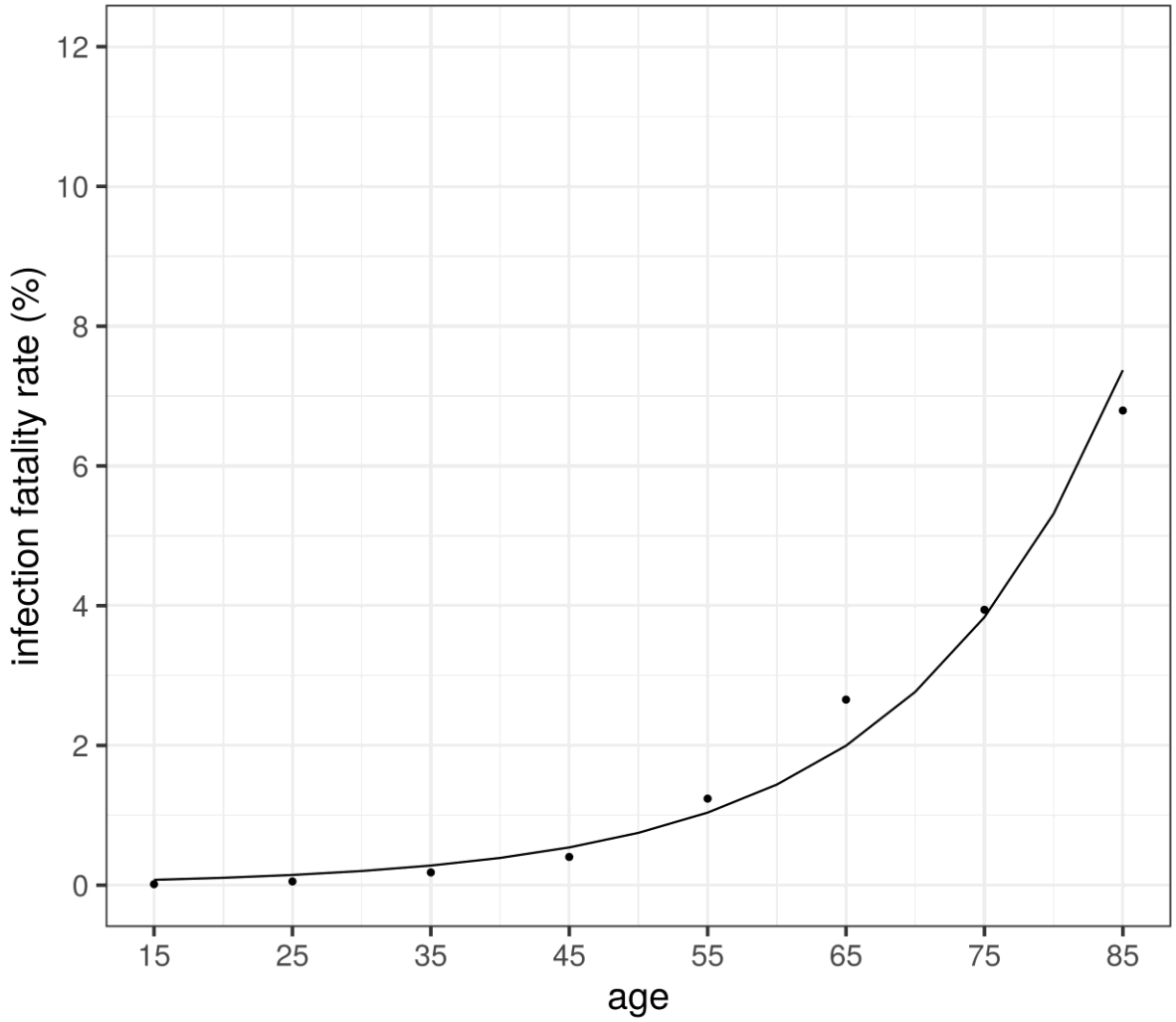

Table 2: South African Provincial, age aggregated, SARS-CoV-2 Infection Fatality Rates. The 'expected IFR' column indicates what the provincial IFR would be if the national age specific IFR estimates apply to each province, and are adapted to the province only by age-averaging the IFR using the provincial age distribution.

Province	Population Size	Excess Natural Deaths	SARS-CoV-2 Infections	Estimated IFR (%)	Expected IFR (%)
Eastern Cape	5,430,323	33,900	3,392,727	0.999	0.771
Free State	2,353,101	6,884	1,077,680	0.639	0.654
Gauteng	12,907,289	24,411	5,661,984	0.431	0.615
Limpopo	4,610,507	13,731	2,132,791	0.644	0.736
Mpumalanga	3,874,435	10,617	1,846,066	0.575	0.617
Northern Cape	919,620	3,067	29,253	1.048	0.697
North West	3,255,572	5,212	1,580,355	0.330	0.641
Western Cape	5,882,400	16,179	2,200,998	0.735	0.720
KwaZulu Natal	9,222,061	36,661	4,802,063	0.763	0.583