ISSUES IN PUBLIC HEALTH

The impact of the SARS-CoV-2 epidemic on mortality in South Africa in 2020

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Background. The impacts on mortality of both the SARS-CoV-2 epidemic and the interventions to manage it differ between countries. The Rapid Mortality Surveillance System set up by the South African Medical Research Council based on data from the National Population Register (NPR) provides a means of tracking this impact on mortality in South Africa.
Objectives. To report on the change in key metrics of mortality (numbers of deaths, life expectancy at birth, life expectancy at age 60, and infant, under-5, older child and adolescent, young adult, and adult mortality) over the period 2015 - 2020. The key features of the impact are contrasted with those measured in other countries.
Methods. The numbers of registered deaths by age and sex recorded on the NPR were increased to account for both registered deaths that are not captured by the NPR and an estimate of deaths not reported. The estimated numbers of deaths together with estimates of the numbers in the population in the middle of each of the years were used to produce life tables and calculate various indicators.
Results. Between 2019 and 2020, the number of deaths increased by nearly 53 000 (65% female), and life expectancy at birth fell by 1 year for females and by only 2.5 months for males. Life expectancy at age 60 decreased by 1.6 years for females and 1.2 years for males. Infant mortality, under-5 mortality and mortality of children aged 5 - 14 decreased by 22%, 20% and 10%, respectively, while that for older children and adolescents decreased by 11% for males and 5% for females. Premature adult mortality, the probability of a 15-year-old dying before age 60, increased by 2% for males and 9% for females.
Conclusions. COVID-19 and the interventions to manage it had differential impacts on mortality by age and sex. The impact of the epidemic on life expectancy in 2020 differs from that in most other, mainly developed, countries, both in the limited decline and also in the greater impact on females. These empirical estimates of life expectancy and mortality rates are not reflected by estimates from agencies, either because agency estimates have yet to be updated for the impact of the epidemic or because they have not allowed for the impact correctly. Trends in weekly excess deaths suggest that the drop in life expectancy in 2021 will be greater than that in 2020.

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One of the ways in which the impact of the SARS-CoV-2 epidemic on mortality in different countries is compared is to assess the change in life expectancy at birth between 2019 and 2020 (on the assumption that mortality rates in 2019 are a reasonable estimate of the non-COVID-19 mortality rates for 2020). Although at this point there are no global estimates from bodies such as the Institute of Health Metrics and Evaluation and the United Nations Population Division, there are published estimates of the actual change in life expectancy between 2019 and 2020 for ~30 countries.[1,2]

While it is generally assumed that COVID-19 mortality rates increase exponentially with age[3] (although the rate of increase is not constant if there are significant comorbidities) and are greater for males than for females,[4,5] and hence that there will have been a significant drop in life expectancy between 2019 and 2020 as a result of the increase in mortality rates due to COVID-19, it is wrong to assume that the drop will always be substantial or that it will be greater for males than females when considering all causes of death combined.

Methods

The methods are described in more detail in the annual Rapid Mortality Surveillance (RMS) Report for 2020,[6] but essentially the numbers of registered deaths by age and sex recorded on the National Population Register (NPR) for each year from 2000 to 2020 are increased to account for both registered deaths that were not captured by the NPR and an estimate of deaths that were not reported at all. These numbers, together with estimates of the numbers in the population in the middle of each of these years, are used to produce mortality rates and hence life tables that allow for the estimation of the various indicators.

The impact of the SARS-CoV-2 epidemic is described by reporting on the change in numbers of deaths, life expectancy and selected measures of mortality rates by age group between 2019 and 2020 for males and females, combined and separately.

Results

There were nearly 53 000 more deaths in 2020 than in 2019, of which 65% were female. Although the greater proportion of deaths being female is generally due to the interaction of the increasing proportion of the population by age who are female and the exponentially higher mortality with increase in age, the difference is also due, more markedly, to the impact of interventions, particularly during strict lockdown, on non-COVID-19 mortality. As can be seen from

the impact on a number of indicators of the trends in mortality over recent years in Table 1, the epidemic led to a decline in life expectancy from 2019 to 2020 of only 0.6 years (1 year for females and 0.2 years for males).

The source of these somewhat surprising changes in life expectancy can be found in the other indicators. To some extent the change in adult mortality is as might have been expected, albeit somewhat more muted. For example, life expectancy at age 60 decreased from 2019 to 2020 for both males and females by 1.3 and 1.6 years, respectively, while adult mortality (as measured by the probability of a 15-year-old dying before reaching age 60, 45q15) increased for both sexes (although, again, less so for males than females, mainly owing to the greater impact for males of the decline in unnatural deaths).

While some of the effect of the reduction in non-COVID-19 mortality due to interventions is apparent in the low increase in adult mortality, particularly for males, between 2019 and 2020, it is more apparent when considering infant, childhood, adolescent and young adult mortality. Although proportionately the same for males and females, infant and under-5 mortality dropped by ~21% (22% and 20%, respectively) between 2019 and 2020, and by ~10% for older children, adolescents and young adults. These changes are mainly due to a drop in non-COVID-19 communicable diseases in the infants and young children and in unnatural deaths in older adolescents and young adults.

Discussion

During 2020, the RMS System was modified to track the weekly number of deaths and thereby provide critical insight into the impact of COVID-19 in near to real time.[7,8]

The two key features of the impact of the SARS-CoV-2 epidemic on life expectancy in South Africa (SA) in 2020 are the seemingly modest impact relative to countries with similar levels of infection (particularly given the high level of comorbidities in SA[9]) and the fact that the impact on life expectancy of females was greater than that on life expectancy of males. For example, only seven countries (all with lower prevalences of SARS-CoV-2) out of 29 considered by Aburto *et al.*[1] experienced a lower change in life expectancy between 2019 and 2020, and only three showed a lower drop in male than female life expectancy; all of these were smaller than that found in SA. And in the case of Brazil[2] the decline was 1.3 years, with the drop for males being higher than that for females (1.6 years v. 0.95 years).

The major reasons for this relatively unique outcome are the early, strict and to some extent long-lasting lockdown, and the fact that the mortality in 2019 overestimates the expected non-COVID-19 mortality in 2020 in SA. Since the trend in the total number of deaths over time has been downward, mainly as a result of treatment of people with HIV, the mortality in 2020 without COVID-19 can be expected to be lower than that in 2019. Deaths due to all causes combined in 2020 in excess of what might have been expected without the epidemic are therefore estimated to be nearly 74 000, of which 71% were female.[10]

The only other estimate of change in life expectancy between 2019 and 2020 for SA is that of Statistics South Africa,[11] which suggests a similar decline of 1.5 years and also a lesser impact for males than for females (1.4 years v. 1.6 years) for the calendar years. However, these estimates appear to reflect only the impact of their estimate of the total COVID-19 deaths (derived in an unclear way from the total number of excess deaths estimated by the South African Medical Research Council-University of Cape Town collaboration) for 2020, and ignore the impact of the epidemic and efforts to manage the epidemic on non-COVID-19 mortality.

However, the drop in life expectancy in 2021 can be expected to be somewhat greater than that in 2020 because of the devastating second and third waves of the COVID-19 pandemic associated with new variants of the virus, and the waning effectiveness of interventions to control the spread of the virus.

Table 1. Selected indicators of the trend in mortality and the impact of the SARS-CoV-2 epidemic on mortality, 2015 - 2020

	2015	2016	2017	2018	2019	2020
Life expectancy at birth (years) (e0)						
Persons	63.3	63.9	64.6	64.8	65.3	64.7
Males	60.1	60.9	61.6	61.8	62.4	62.2
Females	66.6	66.9	67.6	67.9	68.2	67.2
Life expectancy at age 60 (years) (e60)						
Persons	17.6	17.7	17.8	17.9	18.0	16.5
Males	15.5	15.6	15.7	15.9	16.1	14.8
Females	19.3	19.3	19.5	19.6	19.6	18.0
Adult mortality, % (45q15)						
Persons	34	33	32	31	29	31
Males	40	39	38	37	35	36
Females	28	27	26	25	24	26
U5MR, per 1 000 live births	39	36	33	35	36	28
IMR, per 1 000 live births	28	26	23	26	27	21
Older children and young adolescents mortality rate, per 1 000 (10q5)						
Persons	7.0	6.5	6.0	6.2	5.9	5.3
Males	7.8	7.4	7.0	7.0	6.7	6.1
Females	6.2	5.6	5.1	5.3	5.0	4.5
Older adolescents and youth mortality rate, per 1 000 (10q15)						
Persons	22.3	21.7	21.4	20.8	20.5	18.7
Males	26.3	25.8	26.0	25.2	25.5	22.7
Females	18.4	17.5	16.9	16.4	15.5	14.8

U5MR = under-5 mortality rate; IMR = infant mortality rate.

Conclusions

The somewhat surprising results suggest that care should be exercised when anticipating the impact of the SARS-CoV-2 epidemic in a particular country based on the experience in other countries and, given the delay in the release of official cause-of-death data (the most recently released data are for 2018[12]), highlight the critical role that rapid processing of local data could play. Mortality is determined not only by the extent of the epidemic and the level of comorbidities in a country, but also by efforts made to intervene and manage the epidemic. In the case of SA, the very severe lockdown early in the epidemic, with a higher level of popular support and enforcement than the continued lockdown, based on less convincing reasoning, resulted in a near shut-down of the economy, the closure of schools, a sharp decline in unnatural mortality[7,13] and a reduction in non-COVID-19 communicable mortality, particularly in infants and young children.

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