

# COVID deaths in South Africa: 99 days since South Africa's first death

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**Background.** Understanding the pattern of deaths from COVID-19 in South Africa (SA) is critical to identifying individuals at high risk of dying from the disease. The Minister of Health set up a daily reporting mechanism to obtain timeous details of COVID-19 deaths from the provinces to track mortality patterns.

**Objectives.** To provide an epidemiological analysis of the first COVID-19 deaths in SA.

**Methods.** Provincial deaths data from 28 March to 3 July 2020 were cleaned, information on comorbidities was standardised, and data were aggregated into a single data set. Analysis was performed by age, sex, province, date of death and comorbidities.

**Results.** SA reported 3 088 deaths from COVID-19, i.e. an age-standardised death rate of 64.5 (95% confidence interval (CI) 62.3 - 66.8) deaths per million population. Most deaths occurred in Western Cape (65.5%) followed by Eastern Cape (16.8%) and Gauteng (11.3%). The median age of death was 61 years (interquartile range 52 - 71). Males had a 1.5 times higher death rate compared with females. Individuals with two or more comorbidities accounted for 58.6% (95% CI 56.6 - 60.5) of deaths. Hypertension and diabetes were the most common comorbidities reported, and HIV and tuberculosis were more common in individuals aged <50 years.

**Conclusions.** Data collection for COVID-19 deaths in provinces must be standardised. Even though the data had limitations, these findings can be used by the SA government to manage the pandemic and identify individuals who are at high risk of dying from COVID-19.

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## The article in context

South Africa (SA) has a quadruple burden of disease, which includes a high burden of HIV and tuberculosis. The impact of COVID-19 was unclear with our disease burden. We searched PubMed on 5 August 2020 for articles published from December 2019 until that date, using the following search string: ((“coronavirus”[MeSH Terms] OR “coronavirus”[Title] OR “2019-nCoV”[Title] OR “2019nCoV”[Title] OR “COVID-19”[Title] OR “SARS-CoV-2”[Title]) AND (“Africa”[MeSH Terms]) AND “humans”[MeSH Terms] AND (“2019/12”[Date - Publication] : “3000”[Date - Publication])). Filters used: Books and Documents, Meta-Analysis, Review, Systematic Review. We excluded clinical trials and randomised controlled trials. No language restrictions were applied. Twelve studies were identified. An additional evidence-based brief on COVID-19 and non-communicable diseases was identified; however, none of the studies reported on COVID-19 age-specific and age-standardised death rates, sex mortality ratios and distribution of comorbidities among individuals who died from COVID-19 for SA.

Our study reports the pattern of COVID-19 deaths by age, sex, province and comorbidities for SA for the period 28 March 2020 to 3 July 2020. Even though our finding of males having higher death rates than females has been seen in other countries, the male/female ratio is not as high in SA as in some countries; the continued increase in the male-female mortality ratio in individuals aged  $\geq 70$  years was also not observed in other countries. At the current stage of the pandemic, the COVID-19 male/female mortality ratio had a similar pattern to the all-cause male/female mortality ratio for SA, with the exception of individuals aged  $\geq 70$  years, who experienced an even higher COVID-19 mortality differential than the usual all-cause. Most of our deaths occurred in individuals with comorbidities, and 58% had two or more comorbidities. Hypertension and diabetes were the most common comorbidities reported.

The pattern of COVID-19 deaths in SA may be different from patterns in other countries. However, this may change as the pandemic progresses. Our findings have health systems and public health implications, as they identify individuals at high risk of dying from COVID-19, and this information can be used to manage the pandemic. Even though we observed differential patterns of COVID-19 deaths by sex, age, comorbidities and province, individuals with hypertension and diabetes are at high risk of dying from COVID-19 in SA and should be managed carefully when they test positive for COVID-19. Furthermore, more stringent social distancing measures should be promoted to reduce transmission of COVID-19 among those who have hypertension and diabetes, particularly those who have challenges with controlling their levels of blood pressure and glucose.

Our study has identified areas in the data collection process that should be improved, and challenges with the reporting of cause of death information in SA. Addressing these shortcomings will benefit the health system beyond the pandemic.

South Africa (SA) is one of the first countries on the African continent to tackle COVID-19 head-on. Our country is different from the developed countries that have already faced the full force of the pandemic, due to its quadruple burden of disease of HIV/AIDS and tuberculosis (TB); other communicable diseases, perinatal conditions, maternal causes and nutritional deficiencies; non-communicable diseases; and injuries.<sup>[1,2]</sup> These factors have left much uncertainty about how the pandemic would progress in SA. COVID-19 reached SA about 6 weeks after the outbreak in Europe<sup>[3,4]</sup> and on 11 March 2020 the World Health Organization (WHO) characterised COVID-19 as a pandemic.<sup>[5]</sup> The SA government, guided by the WHO and the progress of the outbreak in other parts of the world, locked down the country to give provinces time to prepare for the onslaught of COVID-19. On 27 March 2020, we heard the sad news that SA had experienced its first death from COVID-19.<sup>[6]</sup> By the end of April there had been 103 deaths,<sup>[7]</sup> which increased to 683 deaths by the end of May<sup>[8]</sup> and to over 2 657 deaths by the end of June.<sup>[9]</sup> Due to the time lag for the national cause of death data based on death notifications to be processed, the Minister of Health has set up a daily reporting mechanism to obtain timeous details of COVID-19 deaths from the provinces to track the progression of the pandemic.

## Objectives

This article reports on COVID-19 deaths for SA and its nine provinces for the first 99 days since our first COVID-19 death.

## Methods

The COVID-19 death reports provided to the National Department of Health (NDoH) by each province between 28 March and 3 July 2020 were used in this analysis. The data were provided in an unstandardised format from each province in either PDF documents or Microsoft Excel workbooks. The variables and clinical information provided by each province varied. In data sets with identifiers, duplicate records were identified and removed. Twenty-four duplicates were identified and removed from the data, 23 from Gauteng and one from Western Cape. It was not possible to identify whether there were any duplicate cases in Eastern Cape, as no identifiers were provided. The clinical data provided were interrogated in order to identify comorbidities, which were then recorded in a standard format for each individual (Annexure A, <http://samj.org.za/public/sup/15249-1.pdf>). Comorbidities were reported as a mix of full disease names and abbreviated names, sometimes including conditions that were a consequence of COVID-19 itself rather than comorbidities that the individual had prior to becoming ill with COVID-19. Variables that were common across the provinces were collated into a single data set and included date of death, age, province and comorbidities. The data set was checked for missing data (Annexure B, <http://samj.org.za/public/sup/15249-2.pdf>). Age was categorised into 5-year age bands, 10-year age bands and broad age bands <50 years, 50 - 69 years and ≥70 years.

Statistical analysis was conducted using Microsoft Excel (Microsoft Corp., USA) and Stata 15 (StataCorp, USA).

Summary statistics involved expressing continuous data as medians and interquartile ranges (IQRs) for age distribution across sex, province and comorbidities. Discrete or categorical data such as comorbidities were summarised using frequencies and percentages with the associated 95% confidence intervals (CIs) by age group, sex, province and comorbidities. Associations between presence or absence of a specific comorbidity and age group, sex and province were quantified by  $\chi^2$  tests and  $p$ -values, using a cut-off value of 0.05 for a statistically significant association. Death rates and associated 95% CIs<sup>[10]</sup> were calculated using mid-year population estimates

from the Thembisa model<sup>[11]</sup> and standardised using the WHO world standard population.<sup>[12]</sup>

## Results

A total of 3 088 deaths were provided from the nine provinces for the period 28 March - 3 July 2020. Table 1 shows the characteristics of individuals who were reported to have died from COVID-19. The median (IQR) age was 61 (52 - 71) years. The age was similar for both sexes. Only 20.3% of the deaths were in individuals aged <50 years, and 29.4% of those who died were aged ≥70 years. There were six deaths reported in children aged <10 years, accounting for 0.2% of the total deaths.

**Table 1. Characteristics of reported COVID-19 deaths in South Africa, 3 July 2020**

Characteristics	n	%	(95% CI)	Age (years), median (IQR)*
Sex				
Male	1 602	52.0	(50.1 - 53.6)	61 (52 - 71)
Female	1 486	48.0	(46.4 - 49.9)	62 (52 - 72)
Total	3 088	100	-	61 (52 - 71)
Age categories (years), 10-year bands				
0 - 9	6	0.2	(0.1 - 0.4)	-
10 - 19	7	0.2	(0.1 - 0.5)	-
20 - 29	48	1.6	(1.2 - 2.1)	-
30 - 39	189	6.2	(5.4 - 7.1)	-
40 - 49	372	12.1	(11.0 - 13.3)	-
50 - 59	744	24.3	(22.8 - 25.8)	-
60 - 69	799	26.0	(24.5 - 27.6)	-
70 - 79	562	18.3	(17.0 - 19.7)	-
≥80	341	11.1	(10.0 - 12.3)	-
Total	3 068	100	-	
Age categories (years), broad age bands				
<50	622	20.3	(18.9 - 21.7)	-
50 - 69	1 543	50.3	(48.5 - 52.1)	-
≥70	903	29.4	(27.8 - 31.1)	-
Total	3 068	100	-	
Province				
Eastern Cape	519	16.8	(15.5 - 18.2)	60 (52 - 68)
Free State	19	0.6	(0.4 - 1.0)	68 (55 - 76)
Gauteng	348	11.3	(10.2 - 12.4)	63 (51 - 73)
KwaZulu-Natal	98	3.2	(2.6 - 3.9)	63 (52 - 73)
Limpopo	31	1.0	(0.7 - 1.4)	56 (42 - 66)
Mpumalanga	7	0.2	(0.1 - 0.5)	45 (39 - 52)
North West	36	1.2	(0.8 - 1.6)	58 (51 - 67)
Northern Cape	6	0.2	(0.1 - 0.4)	59.5 (55 - 71)
Western Cape	2 024	65.5	(63.8 - 67.2)	62 (52 - 72)
Total	3 088	100	-	61 (52 - 71)
Comorbidity				
None	102	4.2	(3.4 - 5.0)	56 (45 - 65)
≥1	2 355	95.8	(95.0 - 96.6)	62 (53 - 71)
Total	2 457	-		61 (52 - 71)
			(100)	

CI = confidence interval; IQR = interquartile range.

\*Median age and IQR not calculated for all groups.

Provinces with <100 deaths were combined due to small numbers and presented as 'other provinces'. Western Cape reported the highest number of deaths for SA (65.5%), followed by Eastern Cape (16.8%) and Gauteng (11.3%). The six other provinces collectively reported 6.4% of the deaths for SA (Fig. 1A).

Fig. 1B shows the increase in the number of deaths over time. March and April were combined due to small numbers, and June and July were combined as deaths for July only included deaths from 1 July to 3 July. There was an almost four-fold increase in deaths

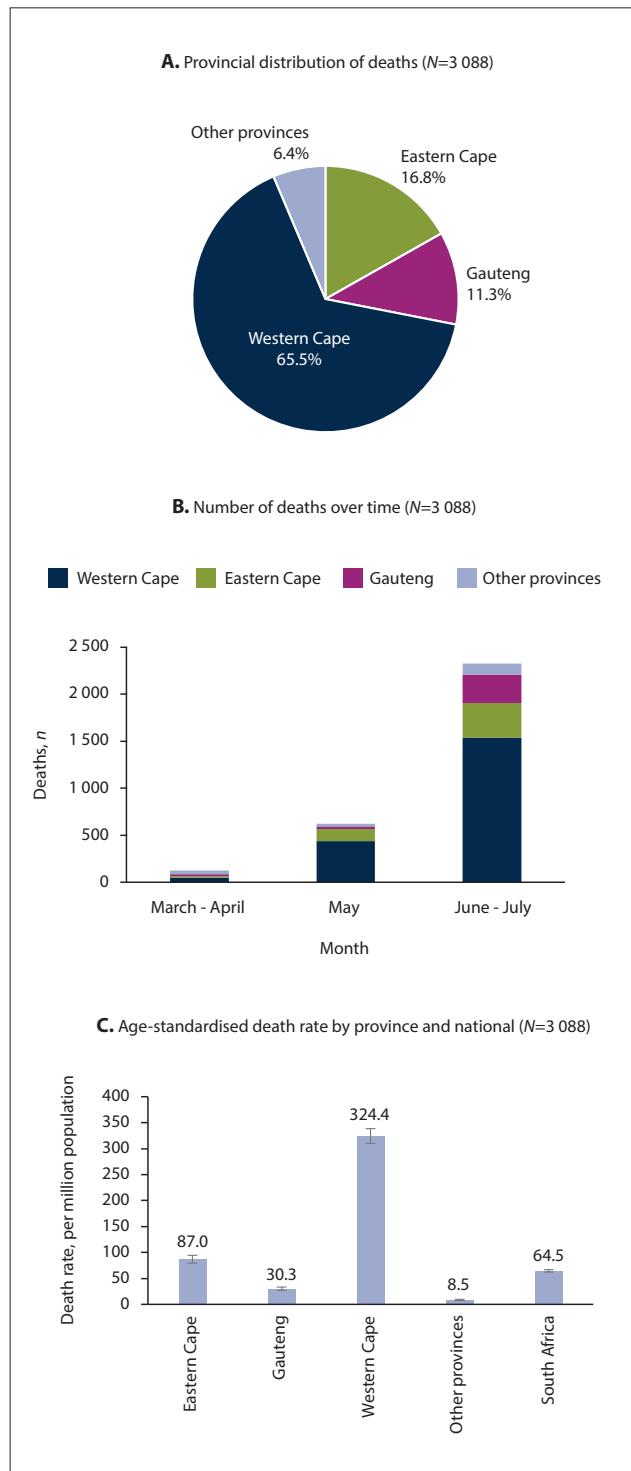


Fig. 1. Provincial distribution and death rates of COVID-19 deaths, as at 3 July 2020.

between May and June-July. Fig. 1C shows the age-standardised death rate; this measure removes the effect of the age structure of the population and allows for direct comparison of death rates across provinces. Western Cape had the highest age-standardised death rate, followed by Eastern Cape and Gauteng.

The crude death rate for Western Cape was 288.9 deaths per million population (95% CI 276.3 - 301.5), that for Eastern Cape was 77.1 deaths per million population (95% CI 70.4 - 83.7) and that for Gauteng was 23.8 deaths per million population (95% CI 21.3 - 26.2). SA had a crude death rate of 52.1 deaths per million population (95% CI 50.3 - 53.9) (data not reported).

Fig. 2A shows the age pattern of deaths for the provinces. Even though the age pattern appears similar across the provinces, there were some differences, i.e. the highest number of deaths in Western Cape was in 60 - 64-year-olds, in Eastern Cape it was in 55 - 59-year-olds, and in Gauteng the majority of deaths were in 70 - 74-year-olds. Fig. 2B shows age-specific death rates; this measure accounts for the age structure and population size for each province. Age-specific death rates increased dramatically with age for Western Cape from  $\geq 35$  years and for Gauteng from  $\geq 70$  years, with Eastern Cape showing a different pattern (Fig. 2B).

Fig. 3 shows the age distribution of deaths for males and females in SA. The highest percentage of deaths occurred in the 55 - 59- and 60 - 64-year age groups for both males and females (Fig. 3A). The percentage of deaths of individuals aged  $<30$  years was very low for both males and females, i.e. 2.0% (61 deaths). Age-specific death rates increased as age increased for both males and females (Fig. 3B). The death rate was higher in males compared with females in those aged

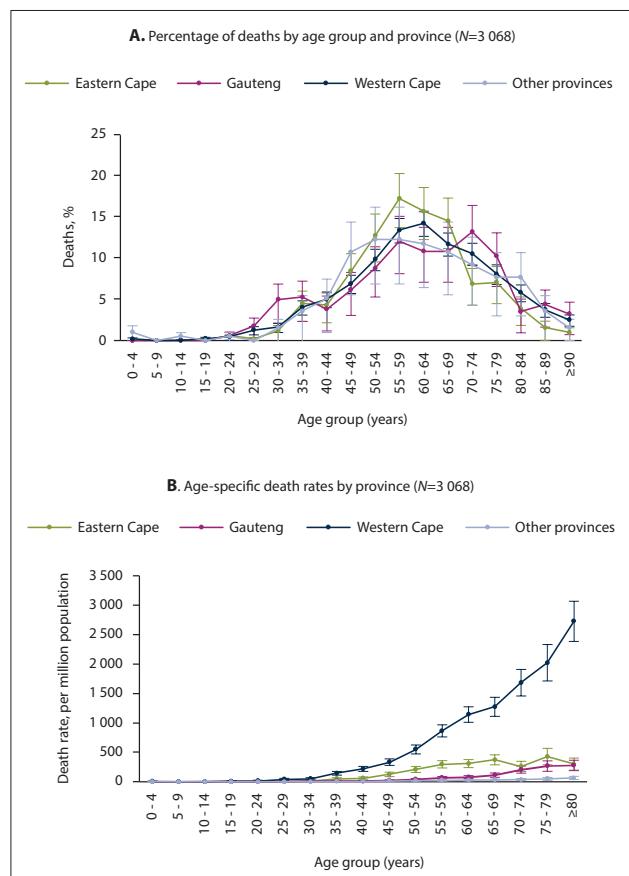


Fig. 2. Age distribution and death rates of COVID-19 deaths by province, as at 3 July 2020. For B, mid-year population estimates only available for age  $\geq 80$  years for the calculation of age-specific death rates.

≥40 years (Fig. 3C). As age increased, the COVID-19 mortality ratio increased. Comparison of the COVID-19 mortality ratio with the all-cause mortality ratio for the year 2012 from the Second National Burden of Disease Study<sup>[2]</sup> for SA revealed that the COVID-19 mortality ratio was higher in individuals aged ≥70 years (Fig. 3C).

Fig. 4 shows the sex distribution of deaths for province and national. The pattern of male and female deaths across all provinces followed the national pattern, with more male deaths occurring compared with females, except for Eastern Cape, which reported more female deaths (Fig. 4A). However, once the effect of the population structure was removed, the age-standardised death rates

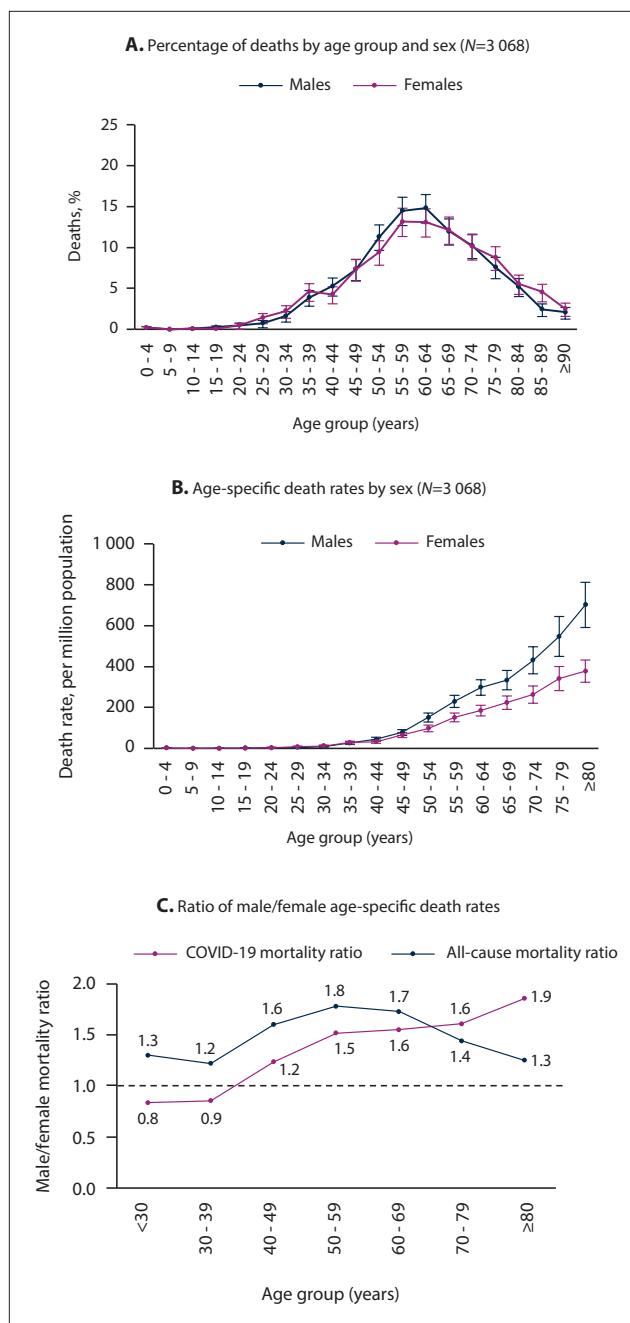


Fig. 3. Age distribution of COVID-19 deaths by sex, as at 3 July 2020. For B and C, mid-year population estimates only available for age ≥80 years for the calculation of age-specific death rates. All-cause age-specific death rates were calculated using deaths from the Second National Burden of Disease Study for South Africa for 2012<sup>[2]</sup> and Dorrington<sup>[13]</sup> mid-year population estimates.

showed that the male/female mortality ratio for Eastern Cape was similar to the national pattern (Fig. 4B and C). The age-standardised COVID-19 male/female mortality ratio was 1.5 compared with the all-cause mortality ratio of 1.4 (data not reported).

Table 2 shows the distribution of comorbidities. In a relatively high proportion of the deaths, information about comorbidities was missing or unknown (18.3% and 2.2%, respectively) (Annexure B, <http://samj.org.za/public/sup/15249-2.pdf>). At least one comorbidity was reported for 2 355 (95.8%) of individuals who died (Table 1). Hypertension and diabetes were by far the most common comorbidities among both males and females, occurring in more than half of the national deaths (60.5%; 95% CI 58.5 - 62.4 and 54.9%; 95% CI 52.9 - 56.9, respectively). Hypertension was significantly more common in females (66.2%; 95% CI 63.5 - 68.8) than males (55.0%; 95% CI 52.3 - 57.8), and diabetes was more common in males (56.4%; 95% CI 53.6 - 59.1) than females (53.3%; 95% CI 50.5 - 56.2). These were followed by HIV (13.9%; 95% CI 12.6 - 15.3), chronic respiratory conditions, i.e. asthma and chronic obstructive pulmonary

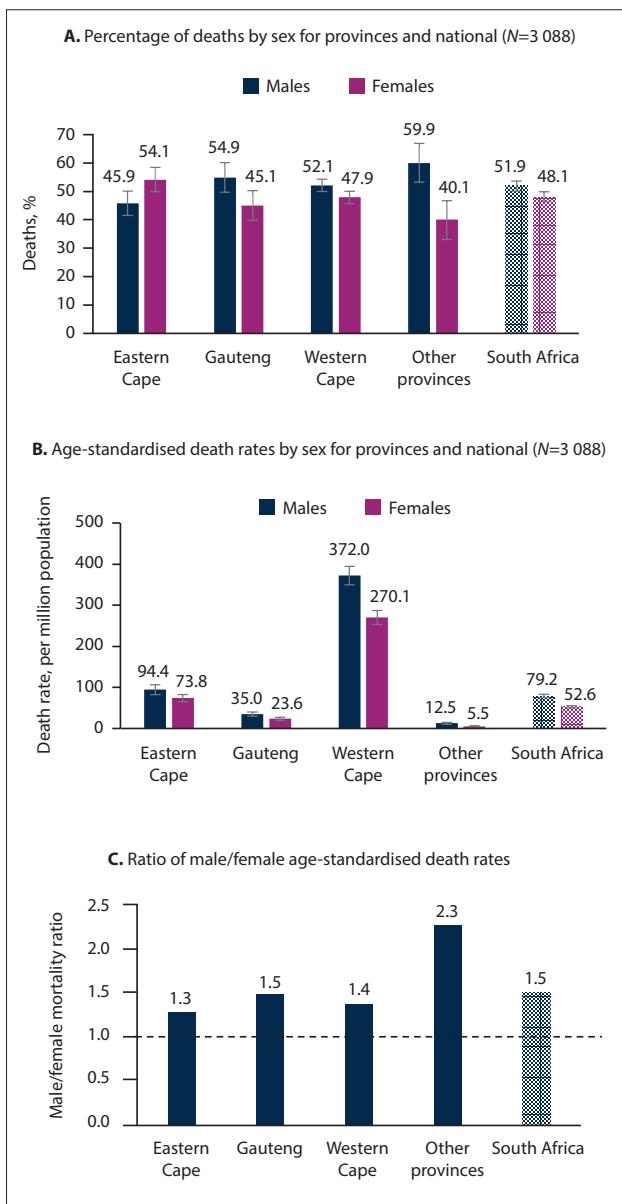


Fig. 4. Sex distribution of COVID-19 deaths by province and national, as at 3 July 2020.

Table 2. Median age by comorbidity and prevalence of comorbidities by sex, age and province for COVID-19 deaths, as at 3 July 2020

Comorbidities*	Total, % (N=2 457)	Age (years), median (IQR) (N=2 447)	Male (N=1 259)	Female (N=1 198)	Sex, %			Broad age groups (years), %			Province, %		
					<50 p-value	50 - 69 (N=476)	≥70 (N=704)	p-value	Western Cape (N=1 587)	Eastern Cape (N=406)	Gauteng (N=312)	Other provinces (N=152)	p-value
Hypertension	60.5	64 (56 - 73)	55.0	66.2	<0.001	34.2	64.3	71.2	<0.001	63.8	58.6	48.1	55.9 <0.001
Diabetes	54.9	61 (54 - 70)	56.4	53.3	0.128	41.2	62.4	50.4	<0.001	60.3	51.0	36.9	46.1 <0.001
HIV	13.9	51 (41 - 59)	12.8	15.0	0.109	33.2	12.7	3.1	<0.001	16.3	6.9	11.9	11.2 <0.001
Asthma/COPD	13.3	65 (52 - 71)	12.7	13.9	0.369	9.7	12.8	16.8	0.002	16.1	8.1	9.0	7.2 <0.001
Chronic kidney disease	13.3	66.5 (57 - 75)	12.3	14.3	0.152	6.6	12.6	19.2	<0.001	16.5	4.7	9.0	11.2 <0.001
Cardiovascular disease	6.3	68.5 (56 - 76)	6.2	6.3	0.879	4.4	5.0	9.9	<0.001	4.0	7.4	11.2	16.4 <0.001
Obesity	5.5	56.5 (46.5 - 63)	5.2	5.9	0.408	9.5	5.8	2.4	<0.001	5.9	3.4	5.1	8.6 0.092
Cancer	3.3	68.5 (55 - 78)	3.8	2.8	0.142	2.7	2.5	5.0	0.010	2.1	3.2	7.7	6.6 <0.001
TB current	3.3	51 (39 - 61.5)	4.0	2.5	0.041	7.8	2.6	1.4	<0.001	3.9	2.0	1.9	2.6 0.102
Autoimmune disease	0.1	59 (51 - 76)	0.1	0.2	0.535	0	0.2	0.1	0.695	0.2	0	0	0.649
Other disease†	9.1	67 (56 - 78)	8.7	9.5	0.459	7.6	6.8	14.3	<0.001	7.3	9.4	15.4	13.8 <0.001
No comorbidity	4.2	56 (45 - 65)	5.2	3.1	0.010	7.6	3.7	2.6	<0.001	0.7	10.8	11.5	7.2 <0.001

IQR = interquartile range; COPD = chronic obstructive pulmonary disease; TB = tuberculosis.

\*One individual can have more than one comorbidity.

†Other disease refers to external causes and medical conditions including mental illness (see Annexure A, <http://samj.org.za/public/sup/15249-1.pdf>).

disease (13.3%; 95% CI 12.0 - 14.7) and chronic kidney disease (13.3%; 95% CI 12.0 - 14.7). Cardiovascular diseases were reported for 6.3% (95% CI 5.4 - 7.3), obesity for 5.5% (95% CI 4.7 - 6.5) and cancers for 3.3% (95% CI 2.7 - 4.1) of the deaths. Other diseases combined were reported for 9.1% (95% CI 8.0 - 10.3) of the deaths, and eight females were pregnant (data not reported). Current TB was reported in 3.3% (95% CI 2.6 - 4.0) of the deaths and differed significantly by sex, with 4.0% (95% CI 3.0 - 5.2) in males and 2.5% (95% CI 1.8 - 3.6) in females.

There is a strong age pattern in the reported comorbidities. The ranking of the five most common comorbidities reported for all ages differed when disaggregated by broad age group. HIV and TB were much higher among individuals aged <50 years (33.2%; 95% CI 29.1 - 37.6 and 7.8%; 95% CI 5.7 - 10.6, respectively), and chronic kidney disease was much higher in individuals aged ≥70 years (19.2%; 95% CI 16.4 - 22.3). Diabetes ranked highest among <50-year-olds (41.2%; 95% CI 36.9 - 45.7), followed by hypertension (34.2%; 95% CI 30.1 - 38.7) and HIV (33.2%; 95% CI 29.1 - 37.6). Hypertension ranked highest in both 50 - 69-year-olds (64.3%; 95% CI 61.7 - 66.9) and ≥70-year-olds (71.2%; 95% CI 67.7 - 74.4), followed by diabetes (62.4%; 95% CI 59.7 - 65.1 in 50 - 69-year-olds and 50.4%; 95% CI 46.7 - 54.1 in ≥70-year-olds).

Hypertension was the most common co-morbidity reported in Western Cape (63.8%; 95% CI 61.4 - 66.2), Eastern Cape (58.6%; 95% CI 53.8 - 63.3) and Gauteng (48.1%; 95% CI 42.6 - 53.6), followed by diabetes (Table 2). The comorbidity proportions were statistically significantly different across provinces. Differences were observed in the top five comorbidities across provinces; for example, Gauteng and Eastern Cape reported cardiovascular disease in their top five comorbidities. TB was more common in Western Cape than in the other provinces (3.9%; 95% CI 3.1 - 5.0). Of the 167 deaths in which previous TB was reported, 159 were from Western Cape (data not reported). The findings on comorbidities must be interpreted with caution, as the proportions could be influenced by the low proportion of deaths with no comorbidities, which in turn could be related to the high proportion of unknowns in the data.

Fig. 5 shows the number of comorbidities per individual where comorbidity information was available. Most individuals had either one comorbidity (37.3%; 95% CI 35.4 - 39.2) or two comorbidities reported (36.3%; 95% CI 34.4 - 38.2). Only 4.2% (95% CI 3.4 - 5.0) had no comorbidities. More than half (58.6%; 95% CI 56.6 - 60.5) of the individuals who died had two or more comorbidities.

Fig. 6 shows the overall pattern of comorbidities, showing how often each condition was reported. This includes multiple comorbidities for individuals with more than one comorbidity. Hypertension and diabetes accounted for >50% of the comorbidities reported for most provinces except North West and Mpumalanga.

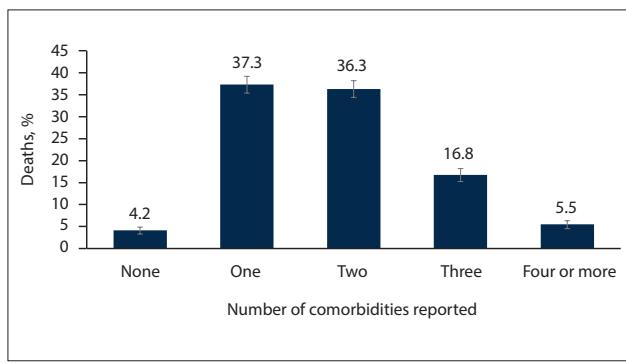


Fig. 5. Percentage of COVID-19 deaths by number of comorbidities reported, as at 3 July 2020 (N=2 457).

Table 3 reports on the top ten combinations of comorbidities in individuals. For those reported to have a comorbidity, the combination of diabetes and hypertension (19.9%; 95% CI 18.3 - 21.6) was most common, followed by hypertension only (13.4%; 95% CI 12.1 - 14.8) and diabetes only (12.7%; 95% CI 11.5 - 14.1).

## Discussion

Even though SA is still in the early stages of the COVID-19 pandemic, it is important to track how the pandemic is progressing and understand the pattern of deaths as they unfold. The SA government's swift actions to set up a daily reporting of deaths to the NDoH has provided some understanding of the nature of the pandemic in SA.

Our analysis found that the various provinces in SA are at different stages of the COVID-19 pandemic, with Western Cape being at a much later stage than its counterparts, contributing to 65% of total deaths with a death rate of 324.4 deaths per million population, a rate that is five times higher than the national death rate of 64.5 deaths per million population. The number of deaths peaked at 55 - 59 years in Eastern Cape, 60 - 64 years in Western Cape and 75 - 79 years in Gauteng. Most deaths occurred in individuals aged  $\geq 30$  years, starting slightly younger than in other countries, which could be due to SA having a younger population; SA's median age is 27.6 years, compared with Italy with 47.3 years and Spain with 44.9 years.<sup>[14]</sup> As

age increased, death rates increased. The age pattern observed for Eastern Cape is different where their number of deaths peaked at a younger age and no observable increase in death rates as age increases is difficult to explain and requires further investigation.

Our finding that males had higher death rates than females is similar to other countries.<sup>[15]</sup> However, the divergence of death rates between males and females as age increased was not observed in other countries. This could be indicative of the stage of the pandemic in SA. We found that the COVID-19 male/female mortality ratio of 1.5 for SA is similar to the all-cause male/female mortality ratio of 1.4 for our country for 2012.<sup>[2]</sup> The age pattern of SA's all-cause mortality ratio was similar to that observed in other countries where the male/female gap for death rates becomes smaller after 69 years of age. The male-female gap for COVID-19 death rates became bigger after 69 years of age. The COVID-19 male/female mortality ratio observed for the provinces was similar to the national ratio.

For individuals where information was available, at least one comorbidity was reported for 2 355/2 457 (95.8%) of the individuals who died. More than half (58.6%) of the deaths occurred in individuals with two or more comorbidities. Hypertension and diabetes were the most common comorbidities in individuals who were reported to have died from COVID-19; this finding is similar to what was found in Europe.<sup>[16]</sup> Hypertension and diabetes were the most common comorbidities in individuals across provinces, and across the broad age bands <50 years, 50 - 59 years, 60 - 69 years and  $\geq 70$  years, but the prevalence of these conditions increased significantly with age. Our findings that HIV and current TB were more common in <50-year-olds<sup>[17]</sup> and chronic kidney disease in  $\geq 70$ -year-olds have been reported previously.<sup>[17,18]</sup> The top five comorbidities did differ by province. At the current stage of the COVID-19 pandemic, very few deaths have been reported in children.

From a health services perspective, our analysis showed that most individuals who died of COVID-19 presented with both hypertension and diabetes, followed by hypertension only and then diabetes only. This information is critical to identifying individuals who are at high risk of dying from COVID-19 and may indicate the importance of screening for and managing these conditions among people infected with SARS-CoV-2.

While a large proportion of South Africans have HIV, TB or both diseases, our analysis shows that these conditions were not the most common comorbidities in individuals who died from COVID-19.

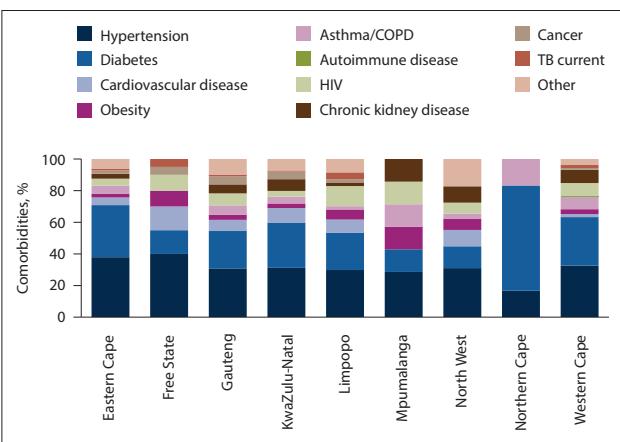


Fig. 6. Percentage of comorbidities by province for COVID-19 deaths, as at 3 July 2020.

Table 3. Combinations of comorbidities for COVID-19 deaths (N=2 355), as at 3 July 2020

Comorbidities*	n	%	(95% CI)
Diabetes and hypertension	469	19.9	(18.3 - 21.6)
Hypertension only	315	13.4	(12.1 - 14.8)
Diabetes only	300	12.7	(11.5 - 14.1)
HIV only	100	4.2	(3.5 - 5.1)
Diabetes and CKD and hypertension	100	4.2	(3.5 - 5.1)
Asthma/COPD and diabetes and hypertension	58	2.5	(1.9 - 3.2)
Asthma/COPD only	52	2.2	(1.7 - 2.9)
CKD and hypertension	49	2.1	(1.6 - 2.7)
Other disease <sup>†</sup>	44	1.9	(1.4 - 2.5)
Asthma/COPD and hypertension	44	1.9	(1.4 - 2.5)
Diabetes and HIV	38	1.6	(1.2 - 2.2)
Hypertension and other disease <sup>†</sup>	37	1.6	(1.1 - 2.2)
Diabetes and HIV and hypertension	35	1.5	(1.1 - 2.1)

CI = confidence interval; COPD = chronic obstructive pulmonary disease; CKD = chronic kidney disease.

\*One individual can have more than one comorbidity.

<sup>†</sup>Other disease refers to external causes and medical conditions including mental illness (see Annexure A, <http://samj.org.za/public/sup/15249-1.pdf>).

However, as the number of deaths increases in the country, this pattern could change.

An analysis of Western Cape COVID-19 deaths by Boulle *et al.*<sup>[19]</sup> showed similar findings to our analysis for the province. They investigated 625 public sector COVID-19 deaths that occurred before 1 June 2020. Their study highlighted that HIV and TB should not be forgotten in the COVID-19 pandemic, as there was a 3.3 times increased risk of dying from COVID-19 in individuals with TB and a 2 times increased risk of dying in individuals with HIV, when adjusted for age and sex.<sup>[19]</sup> That said, their study found that the risk of dying from COVID-19 was also higher in individuals with hypertension (2.2 times) and diabetes (ranging from 6.1 to 12.9 times higher depending on the level of glucose control), when adjusted for age and sex.<sup>[19]</sup>

### Study limitations

The study findings reflect the data that were provided and have limitations. Many provinces did not provide information on the dates of COVID-19 tests and the dates on which the results were received. It was therefore not possible to distinguish between a confirmed and probable COVID-19 death.<sup>[20]</sup> It was also unclear whether the data reported on comorbidities are complete, i.e. whether all the comorbidities have been reported, and whether missing data means no comorbidities in the individuals or this was just not reported. Furthermore, the impact of the inconsistent reporting of information across provinces and the completeness of reporting has not been investigated.

Bradshaw *et al.*<sup>[21]</sup> have shown, using deaths data from the Department of Home Affairs, that more deaths are being reported during the period of the pandemic compared with previous years, which could be attributed directly or indirectly to COVID-19. Their numbers are much higher than those reported in this study. This could be due to more individuals dying at home from COVID-19 and being missed in our analysis, or dying from other conditions at home because they are afraid to attend a health facility. The differences in the number of deaths require further investigation.

### Conclusions

Our study provides important epidemiological information on the pattern of the current state of COVID-19 mortality in SA that, even though it is not perfect, can be used by the SA government to identify high-risk individuals. Differential patterns of COVID-19 deaths by sex, age, comorbidities and provinces point to the need for targeted and localised interventions. That said, individuals with hypertension and diabetes should be given careful attention during the COVID-19 pandemic across SA.

Furthermore, data collection for COVID-19 needs to be standardised across provinces, and systems to verify the completeness and accuracy of the data should be put in place to ensure better reporting of information on COVID-19 deaths. The timeliness of the availability of cause of death information needs to be addressed. Firstly, SA's NDOH should have access to the cause of death information at the time of death registration in order to monitor epidemics more accurately. Secondly, efforts should be made to expedite the flow and processing of cause of death information between the SA's National Department of Home Affairs and the national statistics office, Statistics South

Africa. Doing this will have long-term benefits beyond the COVID-19 pandemic.

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