National COVID-19 Hospital Admissions and Mortality among Healthcare Workers in South Africa, 2020-2021

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Abstract

Background: Healthcare workers (HCWs) in close contact with SARS-CoV-2-infected patients have an increased risk of infection compared to non-HCWs, but little is known about the clinical course and risks for mortality amongst HCWs in South Africa. In this study, we compared characteristics of hospitalised HCWs with non-HCWs with COVID-19 and assessed factors associated with COVID-19 mortality among HCWs.

Methods: Data from 5 March 2020 to 30 April 2021 was obtained from DATCOV, the national surveillance programme monitoring COVID-19 admissions in private and public hospitals across South Africa. A logistic regression model was used to determine factors associated with COVID-19 HCW admissions and mortality.

Results: There were a total 169,678 confirmed COVID-19 admissions reported on DATCOV, of which 6,364 (3.8%) were HCWs. Compared to non-HCWs, HCWs were less likely to be male [aOR 0.3, 95%CI (0.3-0.4)], and more likely to be younger, white or other race, have pre-existing obesity and asthma, and be admitted in the private sector, in Eastern Cape, Gauteng, Kwa-Zulu Natal, Limpopo, Northern Cape and North West provinces. Pre-wave 1 [aOR 3.0; 95%CI 2.4-3.7)], wave 1 [aOR 2.1; 95%CI (1.8-2.5)] and post-wave 1 [aOR 1.3; 95%CI (1.0-1.7)] were associated with increase in HCW admissions compared to wave 2. There was an increased risk for in-hospital mortality among HCWs in the older age group (40-49 [aOR 3.8; 95%CI (1.6-8.80)]; 50-59 [aOR 4.7; 95%CI (2.0-10.9)] and 60-65 years [aOR 9.8; 95%CI (4.2-23.0)] compared to HCWs less than 40 years, with comorbidities such as hypertension, diabetes, chronic kidney diseases, malignancy and TB. Mortality was decreased for HCWs who were coloured [aOR 0.5; 95%CI (0.3-0.8)], admitted in the public sector [aOR 0.7; 95%CI (0.5-0.9)] in pre-wave 1 [aOR 0.6; 95%CI (0.3-0.9)] compared to wave one period.

Conclusion: In-hospital mortality in HCWs was associated with age, race, wave period, presence of comorbidites and sector. Policies should be put in place to remove older HCWs with comorbidities from direct patient care. Optimal management of comorbid conditions is advised and improvement of infection prevention and control measures in healthcare settings for those that come into direct contact with infected patients.

Background

On the 30 January 2020, the World Health Organization (WHO) declared the coronavirus disease 2019 (COVID-19) outbreak a Public Health Emergency of International Concern and a pandemic on the 11 March 2020 (1, 2). As at 30 April 2021, a total number of 153 million COVID-19 cases were reported globally, with 3.2 million deaths (3). In South Africa, the number of cumulative COVID-19 cases by 30 April 2021 was 1,581,210 and 54,350 deaths (4).

Health-care workers (HCWs), are the first to come into contact with infected patients and are at an increased risk of being exposed to infectious diseases compared to the general population. The WHO has estimated that up to 14% of COVID-19 cases globally are in HCWs (5). In South Africa, the estimated number of HCWs from both private and public sector is 1,25 million (6). Many factors can increase the risk of COVID-19 transmission among HCWs including lack of protective resources during treatment of patients such as adequate personnel protective equipment (PPE), masks and gloves, inappropriate training on specimen or patient-handling and infection control, and appropriate infection control strategies not being properly implemented in some healthcare facilities (7, 8). Nonetheless, even with clinical guidelines and protective measures in place for hospital staff to follow for the management of patients with respiratory diseases, aerosol-generating procedures (AGPs) increase the risk of HCWs acquiring infections. AGPs are carried out on admitted patients presenting severe acute respiratory diseases and include positive pressure ventilation, tracheal intubation, airway suction, tracheotomy and manual intubation, among others (9).

Several studies have shown poorer COVID-19 outcomes related to older age, male sex and a history of comorbidities such as hypertension, diabetes, malignancy, chronic cardiac diseases and asthma (10–12). South Africa has a high prevalence of diseases such as diabetes (12.8%), hypertention (41.6–54%), and obesity (68% of females, 31% of males) (13). In 2017, a national survey of HIV prevalence showed that about 14.6% of the South African population was living with HIV (14), additionally 11–12% of HCWs in South Africa are HIV infected (15). The prevalence of tubercolosis (TB) in South Africa was 3.6% (16), in addition high rates of TB infections have been recorded among South African HCWs, with an active TB disease incidence of 1.13–1.47% (15, 17). There is limited published information comparing hospitalised HCWs and non-HCWs due to COVID-19 infection in South Africa. This study aims to describe the characteristics of hospitalized HCWs and factors associated with in-hospital mortality among HCWs in South Africa.

Methods

Data Sources

The DATCOV national hospital surveillance system was established in March 2020 to monitor COVID-19 hospital admissions in South Africa (18). DATCOV contains data on all individuals, who had a positive test for SARS-CoV-2 using real-time reverse transcription-polymerase chain reaction (rRT-PCR) assay or a positive SARS-CoV-2 antigen test, with a confirmed duration of stay in hospital of one full day or longer, regardless of age or reason for admission. The case reporting tool contains variables on basic demographics such as age, sex, race, and potential risk factors such as comorbid disease(s). Data collection was either through direct entry onto the DATCOV online platform, or through import of electronic data from health information systems into the database (18). Data imports contained validation checks to identify data errors.

Study Population

This study included SARS-CoV-2 positive patients who were admitted to public and private health facilities around South Africa from 5 March 2020 to 30 April 2021. Patients were further classified as health care workers (HCWs) and non-health care workers (non-HCWs). HCW status was ascertained by a clinician report and included administrators and porters, doctors, nurses, allied health care workers, laboratory staff and paramedics. Unknown HCW occupations were labelled as “other”. The age for both HCW and non-HCWs was restricted to working age adults (20–65 years) to make the two groups comparable.

Data analysis

Descriptive analysis was used to summarise variables. Frequencies and percentages were used to summarize categorical variables. The outcome variable, hospital mortality was generated from the variable “discharge status” which included patients who were discharged alive or died. All patients who died of non-COVID causes were excluded from the analysis. We implemented multivariable logistic regression models to (a) compare the characteristics of hospitalised COVID-19 HCWs and non-HCWs, and (b) assess risk factors for in-hospital mortality among HCWs. Covariates included were age, which was categorized into five groups (20–29 years, 30–39 years, 40–49 years, 50–59 years and 60–65 years), sex, race, and individual comorbidities (hypertension, diabetes, chronic renal diseases, chronic pulmonary asthma, chronic cardiovascular diseases, current and past tuberculosis (TB), HIV status and obesity). The study period was divided into five wave periods: pre-wave 1 (weeks 10–23 (5 March – 6 June 2020)); wave 1 (weeks 24–35 (7 June – 29 August 2020)); post-wave 1 (weeks 36–47 (30 August – 21 November 2020)), wave 2 (week 48 of 2020 – week 5 of 2021 (22 November 2020–6 February 2021), and post-wave 2 (week 6 of 2021- week 17 of 2021 (7 February 2021-30 April 2021). Sector and province were adjusted for in the model to account for the differences in hospital admissions and in the quality of care received in the private and public sectors within provinces. The variable “weekly COVID-19 admissions” consisting of three categories was generated and used as a proxy to measure the burden of COVID-19 cases on hospital admission, where admissions < 3500 were described as “low admission”, 3500–7999 were “moderate admission” and > 8000 were “high admission”. For the final adjusted model, a maximum likelihood test was used to include variables at the 5% level. Variables that were statistically significant and those that are considered important based on the existing literature were included in the final model. The results were presented as unadjusted (OR) and adjusted odds ratios (AOR) and 95% confidence intervals. To investigate the effect of missing observation on the final model, a model with the variable containg more than 50% missing was fitted which was compared to the model without the variable. Data analysis was conducted using STATA 15 (Stata Corp® College Station, Texas, USA).

Results

Characteristics Of Covid-19 Patients Admissions

As of 30th April 2021, South Africa experienced two waves, the first wave peaked in week 28–29 of 2020 (July 11th –July 18th 2021) and the second wave peaked in week 1 of 2021 (December 26th 2020-

January 2nd 2021) (Fig. 1). The number of admissions in HCWs and non-HCWs in the first wave was 462 and 8,152, and in the second wave was 373 and 14,615 respectively.

A total of 169,678 admissions related to COVID-19 were reported across 625 hospitals (375 from the public sector and 250 from the private sector) in South Africa, with 6,364 (3.8%) patients reported as HCWs. Table 1 describes demographic and clinical characteristics of HCWs and non-HCWs. There were 30,191 (17.8%) deaths that were recorded, with a CFR of 9.5% for HCWs and 18.1% for non-HCWs. A multivariable analysis comparing characteristics of HCWs to non-HCWs shows that HCWs admitted with COVID-19 were less likely to be males [aOR 0.3, 95%CI (0.3–0.4)] and to have mortality as outcome [aOR 0.6; 95% CI (0.5–0.7)]. HCWs were more likely to be admitted in the private sector [aOR 1.3; 95%CI (1.1–1.5)], in the Eastern Cape [aOR 1.9;95%CI (1.5–2.4)], Gauteng [aOR 2.1; 95%CI (1.6–2.6)], Kwa-Zulu Natal [aOR 2.4; 95%CI (1.9–2.6)], Limpopo [aOR 1.7; 95%CI (1.2–2.6)] and North West [aOR 1.8; 95%CI (2.1–3.8)] provinces. HCW hospital admissions were more likely to occur in the age group 30–39 years [aOR 1.4; 95%CI (1.1–1.9)]; 40–49 years [aOR 1.6; 95%CI (1.2-2.0)] and 50–59 years [aOR 1.4; 95%CI (1.1–1.8)] compared to 20–29 years; and in pre-wave 1 [aOR 3.0; 95%CI (2.4–3.7)] and the first wave [aOR 2.1; 95%CI (1.8–2.5)] compared to the second wave. HCWs were more likey to have obesity [aOR 1.8; 95%CI (1.5–2.1)] and asthma [aOR 1.3; 95%CI (1.0-1.5)] as existing comorbidities, and less likely to have HIV [aOR 0.7; 95%CI (0.6–0.9)] and chronic kidney diseases [aOR 0.2; 95%CI (0.1–0.4)].

Table 1
Characteristics of COVID-19 admissions in HCW and non-HCW aged 20–65 years in South Africa; 5 March 2020-30 April 2021 (N = 169,678)

Characteristic	HCWs (N, %) N = 6,364	Non-HCWs (N, %) N = 163,314	OR	p value	aOR	p value
Sex						
Female	4,571 (71.9)	90,295 (55.4)	Ref (1.00)		Ref (1.00)	
Male	1,791 (28.2)	72,760 (44.6)	0.5 (0.4–0.5)	< 0.001	0.3 (0.3–0.4)	< 0.001
Age group (years)						
20–29	464 (7.3)	15,540 (9.5)	Ref (1.00)		Ref (1.00)	
30–39	1,341 (21.1)	31,129 (19.1)	1.4 (1.3–1.6)	< 0.001	1.4 (1.1–1.9)	0.005
40–49	1,769 (27.8)	38,715 (23.7)	1.5 (1.4–1.7)	< 0.001	1.6 (1.2-2.0)	< 0.001
50–59	2,103 (33.1)	49,927 (30.6)	1.4 (1.3–1.6)	< 0.001	1.4 (1.1–1.8)	0.005
60–65	687 (10.8)	28,003 (17.2)	0.8 (0.7–0.9)	< 0.001	0.8 (0.6-1.0)	0.139
Race(n/N, %)						
Black	3,865/6,273 (61.6)	89,298/162,518 (55.0)	Ref (1.00)		Ref (1.00)	
Coloured	387/6,273 (6.2)	7,562/162,518 (4.7)	1.2 (1.1–1.3)	0.002	1.0 (0.8–1.3)	0.799
Indian	457/6,273 (7.3)	6,043/162,518 (3.7)	1.7 (1.6–1.9)	< 0.001	0.9 (0.7–1.1)	0.296
White	648/6,273 (10.3)	7,054/162,518 (4.3)	0.4 (0.3–0.4	< 0.001	1.4 (1.0-1.7)	0.014
Other	916/6,273 (14.6)	52,561/162,518 (32.3)	2.1 (1.9–2.3)	< 0.001	0.4 (0.3–0.5)	< 0.001
Sector						
Private	4,030 (63.3)	78,998 (48.4)	1.8 (1.7–1.9)	< 0.001	1.3 (1.1–1.5)	< 0.001
Public	2,334 (36.7)	84,316 (51.6)	Ref (1.00)		Ref (1.00)	

Characteristic	HCWs (N, %) N = 6,364	Non-HCWs (N, %) N = 163,314	OR	p value	aOR	p value
Province						
Western Cape	721 (11.3)	32,140 (19.7)	Ref (1.00)		Ref (1.00)	
Eastern Cape	891 (14.0)	19,601 (12.0)	2.0 (1.8–2.2)	< 0.001	1.8 (1.5–2.4)	< 0.001
Free State	276 (4.3)	9,646 (5.9)	1.3 (1.1–1.5)	0.001	1.0 (0.7–1.4)	0.784
Gauteng	2,045 (32.1)	44,504 (27.3)	2.0 (1.9–2.2)	< 0.001	2.1 (1.6–2.6)	< 0.001
Kwa-Zulu natal	1,658 (26.1)	31,612 (19.4)	2.3 (2.1–2.6)	< 0.001	2.3 (1.9–2.9)	< 0.001
Limpopo	138 (2.2)	6,207 (3.8)	1.0 (0.8–1.1)	0.924	1.7 (1.2–2.6)	0.002
Mpumalanga	144 (2.3)	6,753 (4.1)	1.0 (0.8–1.1)	0.583	0.6 (0.4–1.2)	0.178
North West	424 (6.7)	9,683 (5.9)	2.0 (1.7–2.1)	< 0.001	2.8 (2.1–3.6)	< 0.001
Northern Cape	67 (1.1)	3,168 (1.9)	0.9 (0.7–1.2)	0.648	1.5 (1.0-2.6)	0.073
Wave						
Pre wave 1	418 (6.6)	7,068 (4.3)	2.0 (1.8–2.2)	< 0.001	3.0 (2.4–3.7)	< 0.001
Wave 1	3,095 (48.6)	52,707 (32.3)	2.0 (1.9–2.1)	< 0.001	2.1 (1.8–2.5)	< 0.001
Post-wave 1	500 (7.9)	17,530 (10.7)	1.0 (0.9–1.1)	0.725	1.3 (1.0-1.7)	0.040
Wave 2	2,036 (32.0)	70,124 (42.9)	Ref (1.00)		Ref (1.00)	
Post-wave 2	315 (4.9)	15,885 (9.7)	0.7 (0.6–0.8)	< 0.001	1.0 (0.7–1.4)	0.976
Chronic diseases (n/N, %)						
Obesity						
No	1,398 (81.1)	36,412 (88.2)	Ref (1.00)		Ref (1.00)	

Characteristic	HCWs (N, %) N = 6,364	Non-HCWs (N, %) N = 163,314	OR	p value	aOR	p value
Yes	325 (18.9)	4,857 (11.8)	1.7 (1.5–1.9)	< 0.001	1.8 (1.5–2.1)	< 0.001
Hypertension						
No	3,318/50,49 (65.7)	79,728/118,636 (67.2)	Ref (1.00)			
Yes	1,731/5,049 (34.3)	38,908/118,636 (32.8)	1.1 (1.0-1.1)	0.028		
Diabetes						
No	3,852/4,993 (77.2)	86,727/116,665 (74.3)	Ref (1.00)			
Yes	1,141/4,993 (22.9)	29,938/116,665 (25.7)	0.9 (0.8–0.9)	< 0.001		
Asthma						
No	4,543/4,880 (93.1)	104, 936/111,741 (93.9)	Ref (1.00)		Ref (1.00)	
Yes	337/4,880 (6.9)	6,805/111,741 (6.1)	1.1 (1.0-1.3)	0.020	1.3 (1.0-1.5)	0.014
HIV						
No	4,492/4,807 (93.5)	98,308/111,731 (88.0)	Ref (1.00)		Ref (1.00)	
Yes	315/4,807 (6.6)	13,423/111,731 (12.0)	0.5 (0.5–0.6)	< 0.001	0.7 (0.6–0.9)	< 0.001
TB (current/past)						
No	4,751/4,842 (98.1)	105,661/110,877 (95.3)	Ref (1.00)			
Yes	91/4,842 (1.9)	5,216/110,877 (4.7)	0.4 (0.3–0.5)	< 0.001		
Chronic kidney disease						
No	4,778/4,807 (99.4)	106,527/108,836 (97.9)	Ref (1.00)		Ref (1.00)	
Yes	29/4,807 (0.6)	2,309/108,836 (2.1)	0.3 (0.2–0.4)	< 0.001	0.2 (0.1–0.5)	< 0.001
Pregnancy (n/N, %)						

Characteristic	HCWs (N, %) N = 6,364	Non-HCWs (N, %) N = 163,314	OR	p value	aOR	p value
No	6,234/6,364 (98.0)	157,608/157,608 (96.1)	Ref (1.00)		Ref (1.00)	
Yes	130/6364 ((2.0)	5,706/16,314 (3.5)	0.6 (0.5–0.7)	< 0.001	0.3 (0.2–0.4)	< 0.001
Admission Outcomes						
Discharged alive	5,761 (90.3)	128,238 (81.3)	Ref (1.00)		Ref (1.00)	
Died	603 (9.7)	29,588 (18.7)	0.5 (0.4–0.5)	< 0.001	0.6 (0.5–0.7)	< 0.001

Comorbidities Reported For Covid-19 Deaths

Comorbidities reported among HCWs who died of COVID-19 are shown in Fig. 2, across age groups. Most COVID-19 related deaths were reported in the age groups, 50–59 years and 40–49 years, with malignancy, chronic cardiac diseases as commonly reported comorbidities in the age group 50–59 years and TB and obesity commonly reported comorbidities in the age group 40–49 years.

Factors Associated With Covid-19 Hospital Mortality Among Hcws

On multivariable analysis in Table 2, risk factors associated with in-hospital mortality among HCWs were older age, high weekly load of hospital admissions, province and history of comorbidities. The odds of HCW mortality increased with age, with HCWs in the age groups, 40–49 years [aOR 3.8; 95%CI (1.6–8.8)], 50–59 years [aOR 4.7; 95%CI (2.0-10.9)] and 60–65 years [aOR 9.8; 95%CI (4.2–22.9)] having increased odds of mortality compared to HCWs in the age group 20–29 years of age. The risk of mortality was increased among HCWs admitted in Limpopo [aOR 2.5; 95%CI (1.3–5.2)] and the Eastern Cape [aOR 1.9; 95%CI (1.3–2.9)] provinces compared to those in the Western Cape. Weekly hospital admissions of more that ≥ 8000 increased the risk of hospital mortality among HCWs compared to low admission numbers [aOR 1.5; 95%CI (1.1–2.3)]. HCWs with comorbidities such as hypertension [aOR 1.3, 95% CI (1.0-1.6)], diabetes [aOR 1.8, 95% CI (1.4–2.2)], chronic real diseases [aOR 3.7, 95% CI (1.6–10.0)], malignancy [aOR 3.7; 95%CI (1.1–7.2)] and TB [aOR 2.2; 95%CI (1.1–4.4)] were more likely to have died compared to those who did not have existing comorbidities.

Table 2
Factors associated with COVID-19 in-hospital mortality among hospitalized HCWs aged 20–65 years in South Africa, 5 March 2020-30 April 2021

Characteristics	Case Fatality Ratio n/N (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Sex					
Female	390/4462 (8.7)	1.00 (ref)			
Male	213/1,756(12.1)	1.4 (1.2–1.7)	< 0.001		
Age group (years)					
20–29	8/453 (1.8)	1.00 (ref)		1.00 (ref)	
30–39	47/1,318(3.6)	2.1 (1.0-4.4)	0.062	1.7 (0.7–4.1)	0.229
40–49	142/1,730 (8.2)	4.9 (2.4–10.2)	< 0.001	3.8 (1.6–8.8)	0.002
50–59	249/2,047 (12.2)	7.7 (3.8–15.6)	< 0.001	4.7 (2.0-10.9)	< 0.001
60–65	157/672 (23.4)	16.9 (8.2–34.7)	< 0.001	9.8 (4.2–23.0)	< 0.001
Race					
Black	391/3,758 (10.4)	1.00 (ref)		1.00 (ref)	
Coloured	28/75 (37.3)	0.7 (0.5-1.0)	0.074	0.5 (0.3–0.8)	0.008
Indian	59/454 (13.0)	1.3 (0.9–1.7)	0.092	1.2 (0.8–1.7)	0.329
White	68/635 (10.7)	1.0 (0.8–1.4)	0.817	0.8 (0.6-1.0)	0.081
Other	48/911 (5.3)	0.5 (0.4–0.7)	< 0.001	1.0 (0.6–1.5)	0.911
Wave					
Pre wave 1	19/412 (4.6)	0.5 (0.3–0.9)	0.015	0.6 (0.3–0.9)	0.041
Wave 1	274/3,044 (9.0)	1.00 (ref)		1.00 (ref)	
Post-wave 1	33/489 (6.7)	0.8 (0.67–1.2)	0.322	0.8 (0.4–1.3)	0.386
Wave 2	277/1,999 (13.9)	1.8 (1.5–2.2)	< 0.001	1.1 (0.9–1.5)	0.373
Post-wave 2	29/276 (10.5)	1.3 (0.9-2.0)	0.157	1.0 (0.6–1.8)	0.905

Characteristics	Case Fatality Ratio n/N (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Weekly national number					
Low < 3500	166/1,949 (8.5)	1.00 (ref)		1.00 (ref)	
Medium 3500–7999	270/2,998 (9.0)	1.2 (0.9–1.4)	0.142	1.1 (0.8–1.5)	0.385
High 8000–12499	167/1,110(15.0)	2.1 (1.6–2.6)	< 0.001	1.5 (1.1–2.3)	0.025
Sector					
Private	440/3,967 (11.1)	1.00 (ref)		1.00 (ref)	
Public	163/2,253 (7.2)	0.6 (0.5–0.8)	< 0.001	0.7 (0.5–0.9)	0.011
Province					
Western Cape	65/710 (9.2)	1.00 (ref)		1.00 (ref)	
Eastern Cape	134/872(15.4)	1.8 (1.3–2.5)	< 0.001	1.9 (1.3–2.9)	0.003
Free State	19/251 (7.6)	0.8 (0.5–1.4)	0.445	0.8 (0.4–1.6)	0.516
Gauteng	142/2,016 (7.0)	0.8 (0.6-1.0)	0.069	0.9 (0.6–1.5)	0.861
Kwa-Zulu natal	176/1,639 (10.7)	1.2 (0.9–1.6)	0.246	1.0 (0.6–1.6)	0.895
Limpopo	19/130 (14.6)	1.7 (0.9–2.9)	0.059	2.5 (1.3–5.2)	0.009
Mpumalanga	18/136 (13.2)	1.5 (0.9–2.6)	0.145	1.8 (0.8–3.7)	0.117
North West	25/404(6.2)	0.7 (0.4–1.1)	0.089	0.7 (0.3–1.2)	0.209
Northern Cape	5/62 (8.1)	0.9 (0.3–2.4)	0.774	1.3 (0.3–4.6)	0.658
Hypertension					
No	276/3,259 (8.5)	1.00 (ref)		1.00 (ref)	
Yes	283/1,686 (16.8)	2.2 (1.8–2.6)	< 0.001	1.3 (1.0-1.6)	0.027
Diabetes mellitus					
No	329/3,779 (8.7)	1.00 (ref)		1.00 (ref)	

Characteristics	Case Fatality Ratio n/N (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Yes	218/1,111 (19.6)	2.6 (2.1–3.1)	< 0.001	1.8 (1.4–2.2)	< 0.001
Chronic kidney disease					
No	516/4,690 (11.0)	1.00 (ref)		1.00 (ref)	
Yes	9/28 (32.1)	3.8 (1.7–8.5)	0.001	4.1 (1.6–10.0)	0.002
Malignancy					
No	518/4,674 (11.1)	1.00 (ref)		1.00 (ref)	
Yes	6/23 (26.1)	2.8 (1.1–6.9)	0.029	3.7 (1.1–7.2)	0.014
TB (current /past)					
No	514/4,665 (11.0)	1.00 (ref)		1.00 (ref)	
Yes	12/87 (13.8)	1.3 (0.7–2.3)	0.473	2.2 (1.1–4.4)	0.019

There was a lower risk of mortality among HCWs who were coloured [aOR 0.5; 95%CI (0.3–0.8)] when compared to black HCWs, admitted in the public sector [aOR 0.7; 95%CI (0.5–0.9)] and in pre-wave one [aOR 0.6; 95%CI (0.3–0.9)] compared to wave one period. There was no statistically significant difference in mortality in wave one and wave two [aOR 1.1; 95%CI (0.9–1.5)].

Discussion

As of 30 April 2021, a total of 6,364 COVID-19 admissions (2.7% of all hospital admissions) were reported amongst HCWs across South Africa. Compared to other countries, South Africa reached its first wave and second wave a few months later (19–21). The implementation of the four week hard lockdown period following identification of the first case in the country likely slowed transmission of COVID-19 infection in the general population (21). Early studies on COVID-19 reported that a large proportion of early cases were HCWs (21, 22). In this study, a high number of HCW admissions were seen in pre-wave one, wave one and post-wave one period compared to the second wave. The decrease in admissions in HCWs in the second wave may been due to proper safety protocols being put into place in facilities for managing the transmission of the virus, such as use of appropriate PPE and improved knowledge in handling admitted patients. In pre-wave one, the spread of the virus was new in the country, facilities and the frontline line workers were not prepared to handle rising COVID-19 cases. Work overload, lack of PPE, poor infection control, which resulted in outbreaks in hospitalsand limited training on handling the new infection, among other factors were reported risk factors of HCWs infections in the first wave (7). Improved competency of handling infected patients as well as better preparedness in facilities may have resulted in decrease of admissions in HCWs (18, 19). In addition, COVID-19 exposure in the first wave among HCWs may have increased antibody levels, thus subsequent improved immunity against the infection in the second wave (23, 24). It was expected that hospital admissions among non-HCWs would decrease in the second wave due to the introduction of several intervensions and therapeutic agents administered to admitted patients such as the use of high flow oxygen (HFNO)(25), remdesivir (26), dexamethasone (27), and thromboprophylaxis (28).

The majority of HCW and non-HCW admissions were females (71.9% for HCWs and 55.4% for non-HCWs) in the age group 50–59 years (33.1% and 30.6%). HCWs in this study were less likely to males, more likely to be in the age group 30–59 years in the private sector. In addition, we found that HCWs were less likely to have mortality as an outcome [aOR 0.6; 95%CI (0.5–0.7)]. A study comparing COVID-19 infections among HCWs and non-HCWs, reported that being a HCW was not associated with increased risk of mortality (22). Furthermore, the risk of mortality in HCWs was high in the older age group (≥ 60 years) (22).

We assessed COVID-19 hospital mortality among HCWs. After restricting the age to that of working population, the multivariable analysis showed that risk of mortality increased with age, with older age agoup (60–65 years) having higher risk of mortality compared to the young age group (20–29 years). In many countries, COVID-19 mortality were seen among the older age group, especially those aged ≥ 60 years (28, 29). Previous studies have shown that males were twice as likely to be at high risk of mortality than females across age groups (30–33), however our study did not find association of male sex with mortality.

Comorbidities have been identified as a significant factor for mortality in both older and young COVID-19 patients (34–36). A meta-analysis of 55 independent studies reporting clinical data of patients with COVID-19 reported that pre-exisiting hypertension, diabetes, respiratory diseases, malignancy and severe chronic kidney diseases were risk factors for severe COVID-19 infection and mortality (10). Our study showed that HCWs who had hypertension, diabetes, chronic renal diseases, malignancy and current and past TB history were more lileky to die compared to those without these comorbidities (10, 35, 37). Even though obesity has been shown to increase COVID-19 mortality as independent risk factor for comorbidities such as diabetes and hypertension (38, 39), this study did not find obesity to be a significant factor of HCW mortality. In addition, as previously reported by Jassat *et al.* (2002) that HIV and TB increased the risk of hospital mortality in the general population (40), we found that HIV infection in HCWs was not associated with COVID-19 mortality in HCWs. Antiretroviral (ART) drugs such as tenofovir (TDF) and lopinavir-ritonavir have been found to reduce the risk of severe COVID-19 in people living with HIV (35, 41). The lack of association in this study could be that HIV infected HCW may be receiving ART. A study conducted in the Western cape in South Africa on the risk of HIV on COVIID-19 death found an increased risk of COVID-19 mortality among people living with HIV, where those who reveived TDF as ART treatment had a lower risk of COVID- 19 mortality. A study by Boulle *et al.* (2020) conducted in the Western Cape in South Africa reported that patients with HIV and TB are at an increased risk of COVID-19 mortality (33). In a poor resourced county such as South Africa, TB infection prevention and control (IPC) measures are frequently poorly implemented. There have been reports that shows that HCWs who care care directly and indirectly for TB patients irregularly use appropriate respiratory protection, resulting in high prevalence of TB among HCWs (42). In this study, we found that current and past TB history was associated with HCW mortality.

This study shows that HCWs who were admitted for COVID-19 were more likely to white, nonetheless white and coloured HCWs were less likely to have mortality as an outcome. HCWs were more likely to be admitted to the private sector compared to the public sector and public sector had decreased odds of hospital mortality among HCWs compared to the private sector. This may be expected as most HCWs would access private health care sectors to seek medication attention. Differences in the povinces level may indicate differences in health systems and testing, health seeking behaviour and clinical practice (18).

Strengths And Limitations

The main strengths of this paper is that we used real time data from an ongoing hospital surveillance system that covers a large number of public and private health sectors across provinces in South Africa, thus maximizing generalizability of the data. Nonetheless, there are limitation in the use of this data to access mortality, such as the under-reporting of risk factors such comorbidities, race, obesity and specific job categories of HCWs, which may indicate which job cateogy of HCWs had increased mortality.

Conclusions

In summary, we found that the risk of in-hospital COVID-19 mortality among hospitalised healthcare workers was lower when compared to non-HCWs. HCW admission decreased in second wave due to improvement of resources in health facilities and improved preparedness for the disease within the country. In addition, acquired immunity from infections in the first wave could have lead to decline in HCW COVID-19 cases in the second wave. With the roll out of vaccine amongst HCW under way since February in South, we expect further decreases in COVID-19 cases and mortality among HCW despite the fact that the country is about to enter the third wave of the pandemic.

Abbreviations

SARS-COV-2 - Severe acute respiratory syndrome Coronavirus 2

HCWs - Healthcare workers

Non-HCWs - non-Healthcare workers

DATCOV - Daily Hospital COVID-19 Surveillance

Declarations

Ethics approval and consent to participate

I confirm that all relevant ethical guidelines have been followed, and any necessary Institutional research body (IRB) and ethics committee approvals for the study have been obtained. The Human Research Ethics Committee (Medical) of the University of the Witwatersrand, approved the study as part of a national surveillance program (**Ethics reference no: M160667**). All methods were carried out in accordance with the accepted national and international guidelines and standards. Also, informed consent was obtained from all the participants.

Consent for publication

NOT APPLICABLE

Availability of data and materials

The datasets generated and/or analysed during the current study are available in the repository at the National Institute of Communicable Diseases. The data may be made available on request. Data access requests may be directed to waasilaj@nicd.ac.za. Data requestors will need to sign a data access agreement. The request will have to be approved by the National Department of Health.

Competing interests

The authors declare that they have no competing interests.

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Authors contributions

NT performed the statistical analysis and interpretion of the data; NT, WJ, CC and NN were major contributors in writing the original draft,; WJ, CC, TK, FM, MM and NN critically reviewed and contributed scientific inputs equally to drafts of the manuscript. All authors read and approved the final manuscript.

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Figures

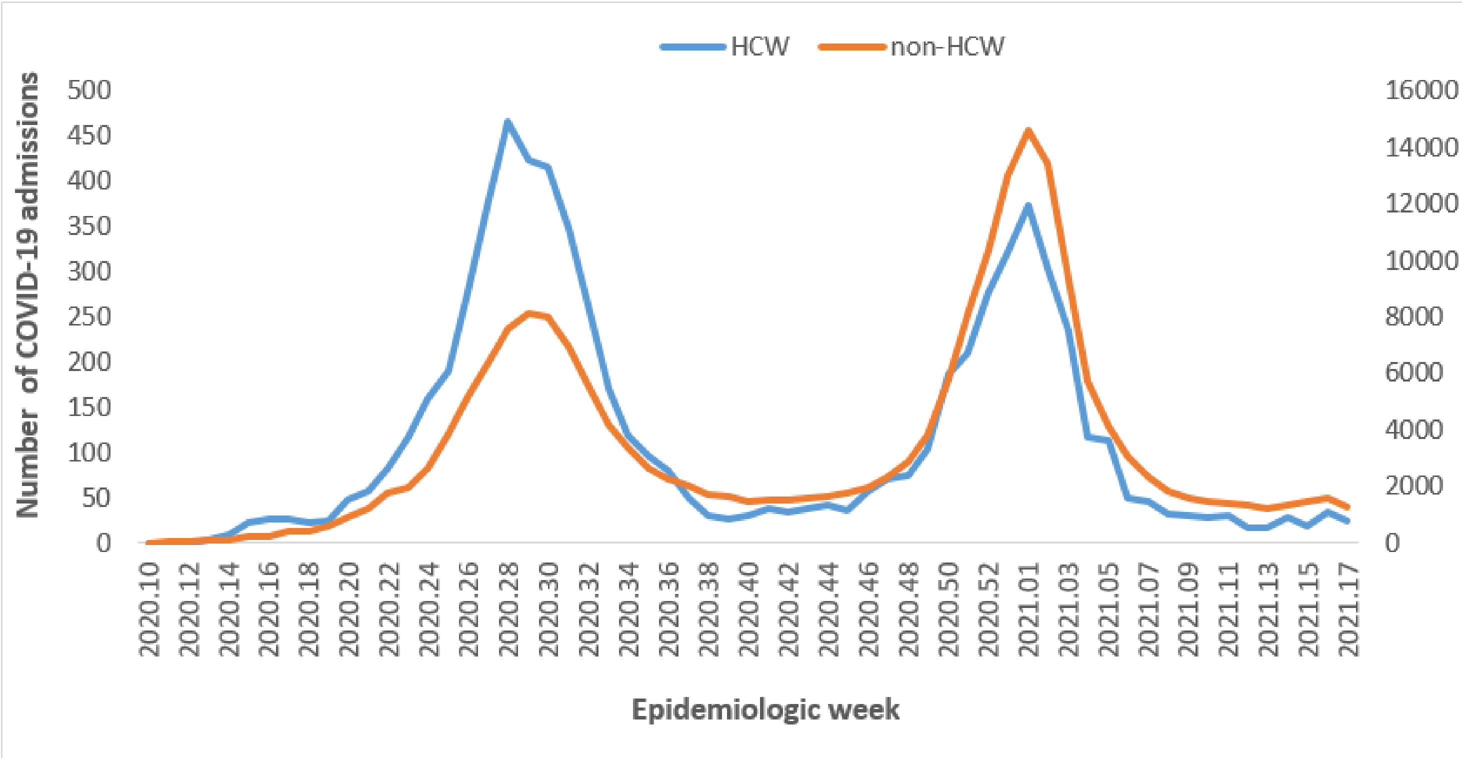

Figure 1

Number of COVID-19 admissions reported in health care workers and non-healthcare workers by epidemiological week, 5 March 2020-30 April 2021, n= 169,678.

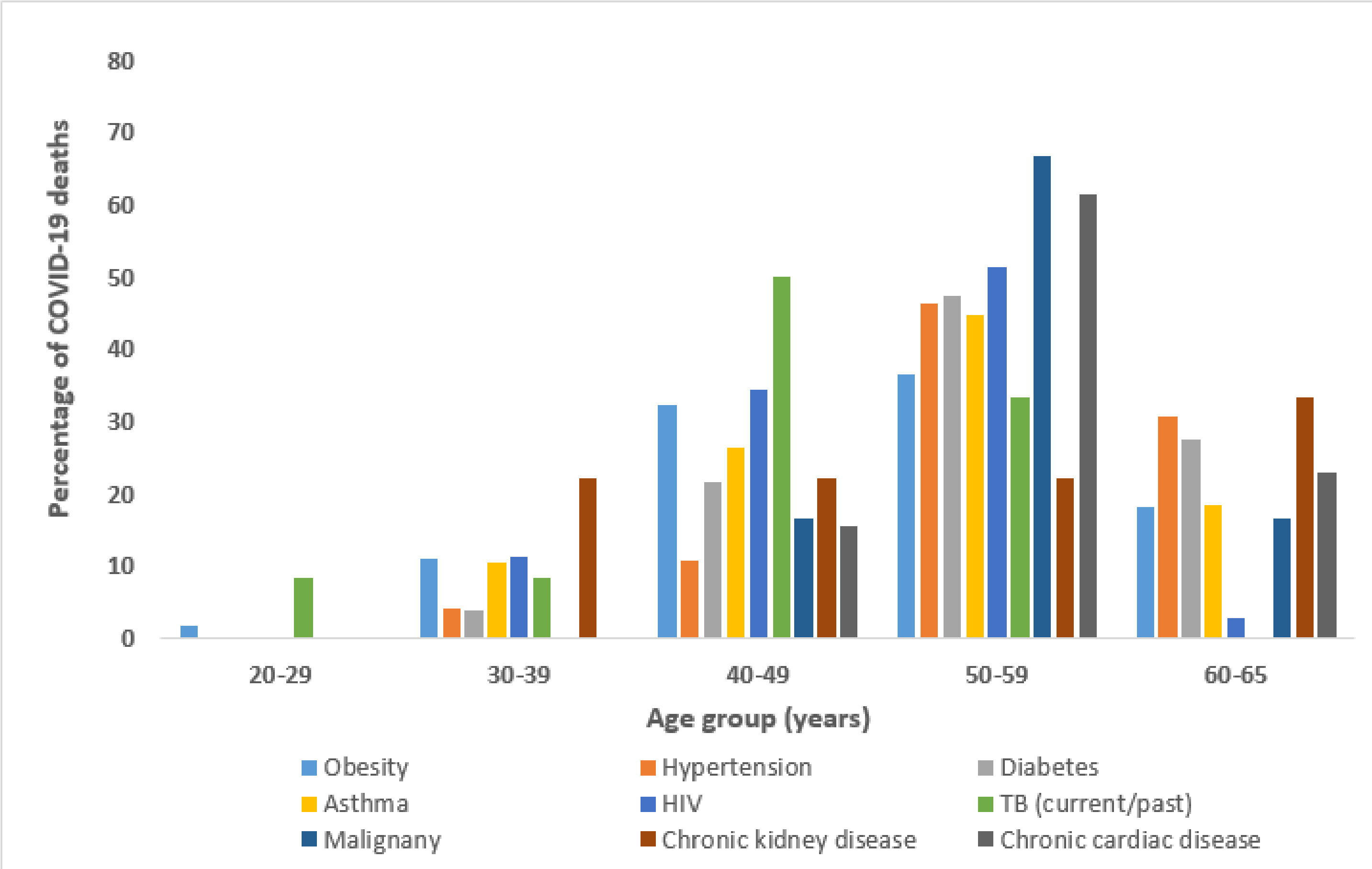

Figure 2

Percentage of reported comorbid diseases among HCWs who died from COVID-19, stratified by age-group between from 5 March 2020 through 30 April 2021, n=603.