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EPIDEMIOLOGY AND CLINICAL CHARACTERISTICS OF LABORATORY-CONFIRMED COVID-19 AMONG INDIVIDUALS AGED ≤19 YEARS, SOUTH AFRICA, 1 MARCH 2020 – 28 AUGUST 2021

HIGHLIGHTS

- As of 28 August 2021, individuals aged ≤19 years made up 14.2% of SARS-CoV-2 tests, 11.8% of laboratory-confirmed COVID-19 cases, 4.7% of all COVID-19-associated admissions and 0.7% of COVID-19 associated in-hospital deaths.
- There have been 2.2 million tests among individuals aged ≤19 years with a 15.8% percentage testing positive, 184 187 laboratory-confirmed COVID-19 cases aged ≤19 years, 17 184 reported COVID-19-associated admissions and 565 COVID-19-related deaths during the surveillance period.
- During the third wave, testing rate increased in all ages among individuals aged ≤19 years, with the 15-19 year age group peaking in weeks 26 and 33 of 2021. Between weeks 27 and 33 percentage testing positive among 10-14 years or 15-19 years surpassed that of individuals>19 years.
- In the third wave, the weekly incidence of laboratory-confirmed cases for individuals aged ≤19 years peaked in weeks 25 and 33 while schools were open, with rate of cases in the age group 15-19 years surpassing those in the adults in week 33.
- The cumulative incidence of laboratory-confirmed COVID-19 cases aged ≤19 years was 6392.2 per 100 000 population, 4.3 times lower than that in those aged >19 years (1482.1 per 100 000 population).
- The weekly incidence of COVID-19-associated admissions in individuals aged ≤19 years increased in all age groups in the third wave, with the <1-year age group having the highest incidence which peaked in week 27 of 2021.
- The incidence of admission among children aged ≤19 years was 11.9 times lower (787.3 per 1 million) than that in those aged >19 years (9367.3 per 1 million).
- Data on in-hospital outcome were available for 15 891 (92.4%) individuals aged ≤19 years. Among these, there were 565 in-hospital COVID deaths giving an in-hospital case fatality risk of 3.6% (565/15 891) compared to an in-hospital case fatality risk of 24.6% in individuals aged >19 years.
- Among all deaths in individuals aged ≤19 years, 201 (35.6%) were among adolescents aged 15-19 years and 108 (19.1%) were aged <1 year. Among 324 (57.3%) in-hospital deaths with available data on underlying conditions, 168 (51.9%) reported ≥1 underlying conditions.

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Background

The first case of COVID-19 in South Africa was reported on 5 March 2020. (2) On 28 August 2021, the country reported a cumulative total of 2 757 191 positive cases and 81 461 deaths. (2) COVID-19 disease in individuals aged \leq 19 years is more likely to be asymptomatic or mildly symptomatic and less likely to result in hospital admission compared to disease in adults. (3) However, there are concerns of possible limited testing in children leading to cases among children being missed. (4) There are also concerns regarding possible transmission within and outside schools and other congregate settings. Individuals aged \leq 19 years, constitute just over a third of the population of South Africa (21 825 534; 36.6%) and includes the entire compulsory school-going age – considered 7- 15 years (5).

In November 2020, South Africa experienced an increase in cases of COVID-19 in all the provinces in what became the second wave. (2) Associated with this second wave was the emergence of the SARS-CoV-2 lineage, initially named 501Y.V2 but now called Beta variant (2, 6). Subsequently, other variants have also been identified in smaller proportions including the Alpha variant which first was detected in the United Kingdom and the Delta variant which was identified in India in early 2021 (7). In May 2021 South Africa officially entered the third wave of the COVID-19 pandemic with the Delta variant dominating. South African public schools had been open for second term contact classes since 3 May 2021 but closed on 30 June 2021 following the implementation of adjusted alert level 4 regulations (8). From 9 to 18 July 2021, the country also experienced civil arrest in Gauteng and KwaZulu-Natal Provinces. The lockdown regulations were adjusted to alert level 3 on July 26, 2021, and public schools reopened for third term contact classes on the same day.

In this report, the epidemiological characteristics of individuals with SARS-CoV-2 tests performed, laboratory-confirmed COVID-19 cases aged ≤19 years notified through the laboratory-based national notification system and COVID-19-associated admissions aged ≤19 years at hospitals in South Africa are presented.

Methods

Data collection procedures

Data extraction for this report was done on 30 August 2021. Data on laboratory tests for SARS-CoV-2 were obtained from the Notifiable Medical Conditions Surveillance System (NMCSS). Laboratory testing was conducted in private and NHLS laboratories for people meeting the case definition for persons under investigation (PUI). This definition has been updated throughout the pandemic and is described further in the COVID-19 Testing Summary report. Data on laboratory results from public and private laboratories submitted to the NICD were extracted from the line list on the NMCSS. Limited demographic and epidemiological data collected at the time of specimen collection were available for analysis. Data on children and adults admitted to hospitals were collected on the DATCOV platform – an online hospital surveillance system. (9) Health care workers at hospitals admitting COVID-19 patients capture demographic and clinical information on admitted cases at admission, during admission and at discharge. The NMCSS and DATCOV databases are cleaned on an ongoing basis hence numbers of reported cases and deaths may increase or decrease as cases are verified and added or removed from the database. As of 28 August 2021, there were 664 hospitals submitting admissions data into DATCOV. This included 255 private hospitals and 409 public hospitals. (10)

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Definition of outcomes

A SARS-CoV-2 test was defined as a real-time reverse-transcription polymerase chain reaction (rRT-PCR) test which detects SARS-CoV-2 viral genetic material or an antigen test that detects specific SARS-CoV-2 antigens/proteins. A laboratory-confirmed case of COVID-19 was defined as any person who tested positive for SARS-CoV-2 on either i) rRT-PCR or ii) an antigen test conducted on a respiratory sample obtained from a nasopharyngeal and/or oropharyngeal swab. A COVID-19-associated admission was defined as any person who tested SARS-CoV-2 positive and was admitted to hospitals registered to submit data to DATCOV, regardless of the reason for admission. A COVID-19-associated death was defined as any person who died in a hospital as a result of COVID-19 and for whom outcome data was available.

Data analysis

Data from the national line list and DATCOV hospital surveillance database were exported into Statal4.2® for analysis. Descriptive statistics were used to describe the characteristics of cases aged ≤19 years. Incidence was determined as the number of cases in different age groups as a proportion of the population as provided by the Statistics South Africa (Stats SA) mid-year population estimates for 2020 and presented as cases per 100 000 persons by age, gender, province and week of diagnosis. Descriptive statistics were used to describe demographic and clinical characteristics among admissions aged ≤19 years at hospitals stratified by age groups: <1 year, 1- 4 years, 5- 9 years, 10- 14 years and 15- 19 years. Descriptive statistics were also used to compare characteristics of COVID-19 cases and associated admissions between the first wave and the second wave, first between patients aged ≤ 19 years vs >19years then among patients in different age groups aged ≤19 years. Univariate and multivariate logistic regression were used to determine factors independently associated with the ascending phase of the first, second and third waves. For the analysis of new tests, cases and admissions the ascending phase of the first, second and third waves were described as the periods in which weekly incidence risk was 30 and above cases per 100 000 population until the peak in the total population among all individuals. For wave 1, these were epidemiologic weeks 24-28 (7 June – 11 July 2020), for wave 2, these were epidemiologic weeks 47 of 2020-week 1 of 2021 (15 November 2020 - 9 January 2021) and for wave 3 these were epidemiologic weeks 19-week 26 of 2021 (16 May – 3 July 2021).

Results

SARS-CoV-2 testing rate and percentage test positive among individuals aged ≤19 years

At data extraction on 30 August 2021, data on tests conducted till 28 August 2021, were 16 094 072. Of these, 3 860 (0.02%) were missing age information. Among the remainder of tests with available age information (N= 16 090 212), 2 284 829 (14.2%) were among individuals aged ≤19 years. The majority of the tests among individuals aged ≤19 years were in five provinces; Gauteng (27.8%), KwaZulu-Natal (24.8%), Western Cape (12.2%), Eastern Cape (11.5%) and Free State (6.9%) provinces together accounting for 80.9% of all tests.

The cumulative testing rate among individuals aged <19 years by province ranged from 2614.9 per 100 000 population in Limpopo Province to 18155.5 per 100 000 population in Northern Cape with an overall rate of 10468.6 per 100 000 population. This overall testing rate among individuals aged <19 years was 3.5 times lower than that among individuals aged >19 years (10468.6 per 100 000 population vs 36525.3 per 100 000 population). Throughout the surveillance period, weekly testing rates were highest among individuals aged <1 year except for week 33 of 2021 where the rate was highest in the 15-19 year age group (Figure 1). Since week 29 of 2021, testing rates have been

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increasing in all age groups \leq 19 years. The overall percentage testing positive among individuals aged \leq 19 years was 15.8% (357870/2269425) compared to 18.5% (2533491/11198872) among individuals >19 years. Among individuals of all ages who received a SARS-CoV-2 test, there was an increase in the proportion of SARS-CoV-2 tests performed in the \leq 19 years age group compared to >19 years in both the second and third wave-to-peak period compared to the first wave-to-peak period, reflecting increased testing of children, particularly in the third wave (Table 2). When more detailed age groups among children are compared, the increase in testing in the second wave-to-peak (compared to the first wave) was noted among children aged 0-9 years and in the third wave was in children in all age groups (Table 3).



Figure 1. Rate of SARS-CoV-2 testing per 100 000 population by epidemiologic week and age group, South Africa, 1 March 2020 – 28 August 2021



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Table 2. Difference in proportions of new COVID-19 tests, cases, admissions and deaths among individuals aged ≤19 years vs >19 years between the ascending phase of the first, second and third waves of SARS-CoV-2 in South Africa

	Wave 1	Wave 2	Wave 3	Multi Wave (!	variable OR 2 vs Wave 1 95% Cl)	Multivariab vs Wave	ole OR Wave 3 a 1 (95% Cl)
Tests**							
>19 years	89.1%	87.1%	84.1%				
≤19 years	10.9%	12.9%	15.9%	1.15	(1.14-1.15)	1.52	(1.51-1.53)
Cases*							
>19 years	91.3%	91.1%	86.3%				
≤19 years	8.7%	9.0%	13.7%	1.00	(0.98 - 1.02)	1.73	(1.70-1.76)
Admissions**							
>19 years	96.4%	96.7%	95.3%				
≤19 years	3.6%	3.3%	4.7%	0.92	(0.85-0.99)	1.43	(1.32-1.55)
Deaths**#							
>19 years	99.4%	99.6%	99.5%				
≤19 years	0.6%	0.4%	0.5%	0.68	(0.45-1.02)	0.91	(0.59-1.43)

First wave-to-peak = epidemiologic week 24- 28; second wave-to-peak = epidemiologic week 47- week 1 2021; third wave-to-peak = epidemiologic week 19-week 26. All defined as periods with weekly incidence risk >30 cases per 100 000 population in the total population among all individuals. * Model adjusted for sex, province and testing at a public laboratory. ** Model adjusted for sex, province and admission at a public hospital. #In hospital deaths for individuals with outcome data

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 Table 3.
 Comparison of characteristics of SARS-CoV-2 testing among individuals of all ages between the ascending phase of the first, second and third waves of SARS-CoV-2 in South Africa, N=5 951 184

	Wave 1 (N = 1211610)	Wave 2 (N = 2165299)	Wave 3 (N = 2574275)	Multivariable OR Wave 2 vs Wave 1 (95% CI)		Multivariable OR Wave 3 vs Wave 1 (95% Cl)	
Age group (years), n (%)							
<1month	1960 (0.2)	4485 (0.2)	5049 (0.2)	1.19	(1.12-1.25)	1.23	(1.16-1.29)
1-11months	5051 (0.4)	14854 (0.7)	17586 (0.7)	1.50	(1.45-1.55)	1.71	(1.66-1.77)
1-4years	16267 (1.4)	39053 (1.8)	52075 (2.0)	1.30	(1.28-1.32)	1.62	(1.59-1.65)
5-9years	20101 (1.7)	46285 (2.2)	62955 (2.5)	1.27	(1.25-1.29)	1.54	(1.51-1.56)
10-14years	33225 (2.8)	58285 (2.7)	92930 (3.6)	0.96	(0.94-0.97)	1.36	(1.35-1.38)
15-19years	47864 (4.0)	89838 (4.2)	151132 (5.9)	1.05	1.05 (1.04-1.06)		(1.55-1.59)
>19 years	1079468 (89.7)	1886064 (88.2)	2165997 (85.0)	85.0) 1		1	
Sex, n (%)							
Female	680793 (56.2)	1138165 (52.6)	1350045 (52.4)	1		1	
Male	521143 (43.0)	994882 (45.9)	1199021 (46.6)	1.16	(1.15-1.16)	1.15	(1.15-1.16)
Unknown	9674 (0.8)	32252 (1.5)	25209 (1.0)	1.61	(1.58-1.65)	1.16	(1.13-1.19)
Province, n (%)							
Eastern Cape	176609 (14.6)	268329 (12.4)	150628 (5.9)	0.68	(0.67-0.68)	0.26	(0.26-0.26)
Free State	54656 (4.5)	90789 (4.2)	168535 (6.5)	0.74	(0.73-0.75)	0.95	(0.93-0.96)
Gauteng	488956 (40.4)	623061 (28.8)	1119784 (43.5)	0.61	(0.60-0.61)	0.78	(0.77-0.78)
KwaZulu-Natal	186852 (15.4)	499366 (23.1)	328710 (12.8)	1.22	(1.21-1.23)	0.53	(0.53-0.54)
Northern Cape	18748 (1.5)	35689 (1.6)	89980 (3.5)	0.85	(0.84-0.87)	1.41	(1.39-1.44)
Western Cape	170723 (14.1)	398149 (18.4)	361032 (14.0)	1.10	(1.09-1.11)	0.70	(0.70-0.71)
Other provinces	115066 (9.5)	249916 (11.5)	355606 (13.8)				
Public Sector, n (%)	455639 (37.6)	952391 (44.0)	1121144 (43.6)	1.22 (1.22-1.23)		1.37	(1.36-1.38)

First wave-to-peak = epidemiologic week 24- 28; second wave-to-peak = epidemiologic week 47- week 1 2021; third wave-to-peak = epidemiologic week 19-week 26. All defined as periods with weekly incidence risk >30 cases per 100 000 population in the total population among all individuals.

Incidence of COVID-19 cases among individuals aged ≤19 years

At data extraction, there were 2 764 929 laboratory-confirmed cases of COVID-19 with a date of specimen collection on or before 28 August 2021 captured on the national line list. Of these, 25 421 (0.9%) were missing age information. Of the 2 739 508 with known age, 323 467 (11.7%) were aged ≤19 years. The median age of the individuals aged ≤19 years was 14.0 years (interquartile range [IQR] 9.0 – 17.0 years) with 6 508 (2.0%) aged <1 year and 145 006 (45.1%) aged 15-19 years. There were 145 277 (44.9%) males with 6 745 (2.1%) missing information on gender. The majority of cases 262 720/323 467 (81.2%) were in five provinces – Gauteng Province (27.6%), KwaZulu-Natal (22.8%), Eastern Cape (12.4%), Western Cape (11.9%), and Free State (6.5%). The cumulative incidence of laboratory-confirmed COVID-19 among individuals aged ≤19 years was 4.3 times lower compared to individuals aged >19 years – 1482.1 per 100 000 population vs. 6392.2 per 100 000 population. The cumulative incidence among individuals aged ≤19 years ranged from 484.8 per 100 000 in Limpopo province to 3051.5 per 100 000 population in Northern Cape Province (Table 1). There has been a peak in incidence among individuals aged ≤19 years in all provinces except for Gauteng and Limpopo in week 33 of 2021 followed by a decline. Northern Cape recorded the highest incidence in this reporting week and the sharpest increase in week-to-week incidence (Figure 3).

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EC= Eastern Cape, FS= Free State, GP= Gauteng Province, KZN= KwaZulu Natal, LP= Limpopo Province, MP = Mpumalanga province, NW= North West Province, NC= Northern Cape, WC= Western Cape.

*Epidemiologic week was generated using the collection date or sample receipt date



*Term – School term as per Department of Basic Education

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An increase in weekly incidence was noted in the age group 15-19 years in week 25 of 2021, reducing slightly from week 26 to week 29 and then peaking again in week 33 of 2021 where it surpassed the total incidence in adults (Figure 4). These two peaks are associated with the third wave and may be related to schools opening. Weekly incidence has been increasing in all age groups increased from week 29 of 2021 peaking in week 33 and then declining. In this reporting week, the weekly incidence was highest among individuals aged 15-19 years at 134.7 cases per 100 000 (Figure 4).

Among individuals of all ages with laboratory-confirmed COVID-19, there was an increase in the proportion of cases in the <19 years age group in the third wave-to-peak period compared to the first wave-to-peak period, potentially reflecting greater testing associated with cluster outbreaks in schools, possible increased susceptibility to the Delta variant in children or reduced susceptibility among >19 year olds as these groups experienced higher rates of infection in the previous waves conferring immunity and hence pushing infections towards extremes of age (Table 2). Among all individuals, cases in the third wave-to-peak period were more likely to be individuals aged 1-19 years than individuals aged >19 years compared to the cases in the period first wave to peak. (Table 4).

 Table 4. Comparison of characteristics of new COVID-19 cases between the ascending phase of the first, second and third waves of SARS-CoV-2 in South Africa, N=1 251 600

Characteristic	Wave 1 (N = 258154)	Wave 2 (N = 512347)	Wave 3 (N = 230763)	Multivariable OR Wave 2 vs Wave 1 (95% Cl)		Multivariable OR Wave 3 vs Wave 1 (95% Cl)		
Age group (years), n (%)								
<1month	272 (0.1)	263 (0.1)	260 (0.1)	0.39	(0.33-0.47)	0.55	(0.46-0.66)	
1-11months	580 (0.2)	736 (0.1)	439 (0.1)	0.59	(0.53-0.67)	0.41	(0.35-0.46)	
1-4years	2226 (0.9)	4617 (0.9)	4618 (1.0)	0.98	(0.93-1.03)	1.20	(1.14-1.27)	
5-9years	3578 (1.4)	7197 (1.4)	9571 (2.0)	0.96	(0.92-1.00)	1.53	(1.47-1.60)	
10-14years	6099 (2.4)	11961 (2.3)	18946 (3.9)	0.94	(0.91-0.98)	1.83	(1.77-1.88)	
15-19years	9759 (3.8)	21050 (4.1)	31879 (6.6)	1.10	(1.07-1.13)	1.98	(1.93-2.03)	
>19years	235588 (91.3)	466487 (91.1)	415651 (86.3)					
Sex, n (%)								
Female	147694 (57.2)	290074 (56.6)	263577 (54.8)					
Male	108454 (42.0)	216363 (42.2)	214593 (44.6)	1.05	(1.04-1.06)	1.09	(1.08-1.10)	
Unknown	1980 (0.8)	5895 (1.2)	3226 (0.7)	1.13	(1.07-1.19)	0.90	(0.85-0.96)	
Province, n (%)								
Eastern Cape	50221 (19.5)	71782 (14.0)	13686 (2.8)	0.45	(0.44-0.46)	0.07	(0.07-0.07)	
Free State	6055 (2.3)	9683 (1.9)	24853 (5.2)	0.51	(0.49-0.53)	1.04	(1.01-1.08)	
Gauteng	105020 (40.7)	108036 (21.1)	283934 (59.0)	0.35	(0.35-0.36)	0.71	(0.70-0.73)	
KwaZulu-Natal	34428 (13.3)	139650 (27.3)	23566 (4.9)	23566 (4.9) 1.33 (1.30-1.35)		0.17	(0.17-0.18)	
Northern Cape	1621 (0.6)	5410 (1.1)	17783 (3.7)	1.02	(0.96-1.08)	2.64	(2.50-2.78)	
Western Cape	42149 (16.3)	122723 (24.0)	45572 (9.5)	0.95	(0.93-0.97)	0.28	(0.28-0.29)	
Other provinces	18634 (7.2)	55048 (10.7)	72002 (15.0)	1		1		
Tested at public laboratory n (%)	94751 (36.7)	237273 (46.3)	180066 (37.4)	1.39	(1.38-1.41)	1.19	(1.18-1.20)	

First wave-to-peak = epidemiologic week 24- 28; second wave-to-peak = epidemiologic week 47- week 1 2021; third wave-to-peak = epidemiologic week 19-week 26. All defined as periods with weekly incidence risk >30 cases per 100 000 population in the total population among all individuals.

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COVID-19-associated admissions in individuals aged ≤19 years

As of 28 August 2021, data on 371 238 COVID-19-associated admissions had been captured on DATCOV. Of these admissions, 2 000 (0.5%) were missing age information. Among the remainder of admissions with available age information (N= 369 238), 17 184 (4.6%) were among individuals aged \leq 19 years. The proportion of all COVID-19-associated admissions which were among individuals aged \leq 19 years varied across provinces from 8.1% in Eastern Cape to 11.6% in North West Province, possibly reflecting variation in clinical practice or the effect of clusters of cases (Table 1). The majority of the admissions among individuals aged \leq 19 years were in five provinces; Gauteng (29.3%), KwaZulu-Natal (18.1%), Western Cape (17.8%), North West (11.6%) and Eastern Cape (8.1%) provinces together accounting for 84.7% of all admissions (N=14 561) (Table 1).

The cumulative admission rate among individuals aged \leq 19 years by province ranged from 251.3 per 1 million population in Limpopo Province to 1381.3 per 1 million population in Western Cape with an overall rate of 509.9 per 1 million. This overall admission rate among individuals aged \leq 19 years was 13.2 times lower than that among individuals aged >19 years (787.3 per 1 million population vs 9367.3 per 1 million population). In most provinces, the weekly admission rate among those aged \leq 19 years peaked in week 27 and week 33 of 2021 and began to decrease after (Figure 5). In the reporting week, North West had the highest admission rate for individuals aged \leq 19 years at 62.2 per 1 million populations (Figure 5).

Weekly numbers of admissions, as well as the admission rates in the third wave, exceeded those in the first and second wave in all age groups which is different from adults where the third wave figures only exceeded those of the first wave and not the second wave. Throughout the surveillance period, weekly admission rates were highest among individuals aged <1 year (Figure 6). The rate of admission in infants aged <1 year increased markedly during the third wave, peaking in week 27 at 156.9 per 1 million then declining from week 29 of 2021. The reason for this is unclear but could reflect coincidental increased testing among young infants and neonates if admitted for other reasons, high transmission among women of childbearing age with transmission to infants or other factors. Data are not available on what proportion of these admissions are for medical indications as compared to precautionary reasons or incidental findings. The rate of admission has remained below 40 admissions per 1 million for all ages except the <1 year age group since week 2 of 2021 except for the 15-19 year age group which peaked in week 33 at 71.0 admissions per 1 million (Figure 6).



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Figure 5. Rate of COVID-19-associated admission per million population among individuals aged ≤19 years by epidemiologic week and province, South Africa, DATCOV, 1 March 2020 – 28 August 2021 (N=17 184)



Figure 6. Rate of COVID-19-associated admissions per 1 million population by epidemiologic week and age group, South Africa, DATCOV, 1 March 2020 – 28 August 2021 (N=369 238)

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Outcomes of COVID-19-associated admissions among individuals aged ≤19 years

Of the 17 184 COVID-19-associated admissions among individuals aged ≤19 years, 1 016 (5.9%) were admitted into ICU and 419 (2.4%) were ventilated at some point during admission. At analysis, 15 318 (89.2%) had been discharged, 835 (4.9%) were still admitted, 458 (2.7%) had been transferred to other facilities and 573 (3.3%) had died during admission including eight deaths confirmed as unrelated to COVID-19. Among individuals with outcome data available, the in-hospital case fatality risk (CFR) was 3.6% (565/15 891) in individuals ≤19 years and thus 6.8 times lower when compared with 24.6% (67 820/ 275 677) among individuals aged >19 years. The overall median length of hospital stay was 4 days (IQR 2- 8 days) and was 4 days (IQR 1- 9 days) for those who died. Of the 565 COVID-19 associated in-hospital deaths, 324 (57.3%) individuals had data on underlying conditions available. Of these 168 (51.9%) reported ≥1 underlying condition. HIV infection, diabetes mellitus, malignancy and heart disease were the most frequently reported among those who had underlying conditions and died in-hospital. Table 5 describes the 565 individuals who died in hospital. Children aged <1 year and those with one or more underlying conditions were overrepresented among those who died compared to those who did not die. Individuals aged <1 year made up 33.6% of deaths vs 19.4% of admissions (Table 5). Among individuals aged ≤19 years who were admitted and had data on underlying conditions available, more children who died had ≥1 underlying conditions compared with those who did not die (51.9% vs 17.3%). The proportion of hospitalised individuals aged ≤19 years admitted into ICU and the CFR in the third wave increased during months with increased admissions but was lower overall than the first and second wave (Figure 7).

The proportion of hospitalised individuals aged ≤19 years compared to >19 years with laboratory-confirmed COVID-19, was significantly higher in the third wave-to-peak period compared to the first wave-to-peak period (Table 2). Among all hospitalised individuals, admissions in the third wave-to-peak period compared to the first wave-to-peak period were more likely to be aged 1 month to 19 years compared with those aged >19 years (Table 6). The average length of hospital stay for individuals ≤19 years was also shorter in the third wave-to-peak period compared to the first wave-to-peak period compared to the first wave-to-peak period stay for individuals ≤19 years (SD 9.3 days)] vs 10.6 days (SD 17.8 days) (p-value <0.001].



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Table 5. Characteristics of COVID-19-associated hospitalised individuals aged ≤19 years who died in hospital, South Africa, DATCOV, 1 March 2020 - 28 August 2021 (N=565)

Characteristic	n (%)
Age (median, IQR*),	10.2 years (0.4–16.8 years)
Age group, n (%)	
<1 month	82 (14.5)
1 - 11 months	108 (19.1)
1 - 4 years	53 (9.4)
5-9 years	36 (6.4)
10- 14 years	85 (15.0)
15-19 years	201 (35.6)
Male, n (%)	280 (49.7)
Province, n (%)	
Eastern Cape	61 (10.8)
Free State	32 (5.7)
Gauteng	177 (31.3)
KwaZulu-Natal	106 (18.8)
Limpopo	34 (6.0)
Mpumalanga	46 (8.1)
North West	28 (5.0)
Northern Cape	12 (2.1)
Western Cape	69 (12.2)
Intensive care unit admission, n (%)	162 (28.7)
Data on underlying conditions available, n (%)	324 (57.3)
Had one or more underlying conditions**, n (%) Yes	168/324 (51.9)
Specific underlying conditions, n (%)	
Asthma/ Chronic Pulmonary Disease	17 (15.6)
Chronic Kidney Disease	8 (7.7)
Diabetes mellitus	24 (20.7)
HIV	50 (42.0)
Heart Disease	13 (12.0)
Hypertension	21 (17.8)
Malignancy	9 (8.8)
Obesity	8 (11.9)
Tuberculosis past	16 (16.8)
Tuberculosis current	19 (18.8)
Other (Acute appendicitis, Anaemia, Biliary atresia, Cerebral palsy, Epilepsy, Hypokalaemia, Hypocalcaemia, Prayer Willi Syndrome, pneumonia, Prematurity, Ileus, HIV-exposure, substance abuse)	53 (31.6)

*IQR= interquartile range; **the two individuals who died with respiratory conditions also had other underlying conditions.

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* CFR measured among 15891 with complete follow up. ICU-intensive care unit

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 Table 6.
 Comparison of characteristics of COVID-19 admissions of all ages between the ascending phase of the first, second and third waves of SARS-CoV-2 in South Africa, N= 147 540

	Wave 1 (N = 29230)	Wave 2 (N = 68500)	Wave 3 (N = 49810)	Multiv Wave 2 (9	ariable OR 2 vs Wave 1 5% Cl)	ble OR Multiva Wave 1 (95 CI)		Multivariable OR Wave 2 vs Wave 1 (95% CI)**		Multivariable OR Wave 3 vs Wave 1 (95% Cl)**	
Age group (years) n (%)											
<1month	65 (0.2)	127 (0.2)	102 (0.2)	0.81	(0.60-1.11)	0.73	(0.53-1.01)	0.83	(0.61-1.14)	0.77	(0.55-1.07)
1-11months	142 (0.5)	387 (0.6)	347 (0.7)	1.04	(0.85-1.27)	1.34	(1.09-1.65)	1.13	(0.92-1.38)	1.43	(1.15-1.77)
1-4years	138 (0.5)	462 (0.7)	442 (0.9)	1.29	(1.07-1.57)	1.76	(1.44-2.16)	1.44	(1.18-1.76)	1.91	(1.55-2.35)
5-9years	109 (0.4)	231 (0.3)	258 (0.5)	0.79	(0.63-1.00)	1.31	(1.03-1.66)	0.85	(0.67-1.07)	1.38	(1.09-1.76)
10-14years	172 (0.6)	285 (0.4)	368 (0.7)	0.62	(0.51-0.75)	1.12	(0.92-1.36)	0.70	(0.57-0.85)	1.23	(1.00-1.50)
15-19years	422 (1.4)	776 (1.1)	811 (1.6)	0.65	(0.57-0.73)		(1.09-1.42)	0.69	(0.61-0.78)	1.33	(1.16-1.52)
>19years	28181 (96.4)	66229 (96.7)	47482 (95.3)								
Sex, n (%)											
Female	16174 (55.4)	38206 (55.8)	26074 (52.4)								
Male	13045 (44.6)	30246 (44.2)	23710 (47.6)	1.00	(0.97-1.03)	1.08	(1.05-1.11)	0.98	(0.95-1.01)	1.06	(1.03-1.10)
Province, n (%)											
Eastern Cape	4596 (15.7)	11768 (17.2)	1462 (2.9)	0.81	(0.77-0.86)	0.08	(0.08-0.09)	0.78	(0.74-0.83)	0.08	(0.07-0.08)
Free State	874 (3.0)	1853 (2.7)	3861 (7.8)	0.69	(0.63-0.76)	1.13	(1.04-1.24)	0.67	(0.61-0.74)	1.15	(1.05-1.26)
Gauteng	10628 (36.4)	14240 (20.8)	25722 (51.6)	0.40	(0.38-0.42)	0.54	(0.51-0.57)	0.39	(0.37-0.41)	0.53	(0.50-0.56)
KwaZulu-Natal	3868 (13.2)	16099 (23.5)	2992 (6.0)	1.30	(1.23-1.38)	0.18	(0.17-0.19)	1.26	(1.18-1.34)	0.17	(0.16-0.18)
Northern Cape	184 (0.6)	730 (1.1)	1591 (3.2)	1.25	(1.05-1.48)	2.16	(1.84-2.53)	1.22	(1.03-1.45)	2.12	(1.80-2.49)
Western Cape	6938 (23.7)	16926 (24.7)	5540 (11.1)	0.79	(0.75-0.84)	0.21	(0.20-0.22)	0.80	(0.75-0.85)	0.21	(0.20-0.22)
Other provinces	2142 (7.3)	6884 (10.0)	8642 (17.3)								
Admitted in public sector n (%)	15041 (51.5)	36182 (52.8)	20676 (41.5)	1.06	(1.03-1.09)	0.75	(0.72-0.77)	1.05	(1.02-1.08)	0.70	(0.67-0.72)
One or more underlying con- ditions n (%)	14046 (48.1)	28679 (41.9)	17558 (35.2)	0.69	(0.67-0.71)	0.68	(0.66-0.70)	0.65	(0.64-0.67)	0.66	(0.64-0.68)
ICU admission n (%)	4392 (15.0)	8515 (12.4)	8705 (17.5)	0.89	(0.85-0.92)	1.16	(1.11-1.22)				
Died* n (%)	6214 (21.3)	19126 (27.9)	12713 (25.5)					1.49	(1.44-1.55)	1.52	(1.47-1.58)

First wave-to-peak = epidemiologic week 24- 28; second wave-to-peak = epidemiologic week 47- week 1 2021; third wave-to-peak = epidemiologic week 19-week 26. All defined as periods with weekly incidence risk >30 cases per 100 000 population in the total population among all individuals. *variables included only in the analysis of individuals with complete follow up (N= 87062). **Model including individuals with complete follow up (N= 87062).

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Discussion

This report presents data on the epidemiology and clinical features of individuals aged ≤19 years with laboratoryconfirmed COVID-19 using data from two surveillance systems established for monitoring the COVID-19 pandemic in South Africa. Since the last report, South Africa remained in the third wave and the data presented showed that, as of 28 August 2021, individuals aged ≤19 years made up 14.2% of SARS-CoV-2 tests, 11.8% of all laboratory-confirmed COVID-19 cases, 4.7% of COVID-19 associated admissions and 0.7% of COVID-19 associated deaths reported in South Africa, despite comprising almost 37% of the population.

Our data showed increasing trends in testing among individuals ≤19 years with successive SARS-CoV-2 waves (7). This could be due to increased testing as part of the effort to contain cluster outbreaks in schools, or to children's possible increased susceptibility to the Delta variant. The cumulative incidence of laboratory-confirmed COVID-19 cases in children and adolescents was 4.3 times lower than that of individuals aged >19 years during the same period while the incidence of admission was 11.9 times lower. Although reports from the United States have indicated a 10-fold increase in paediatric cases, admissions, and deaths since the emergence of the Delta variant, findings from this report show a 73% increase in cases and a 43% increase in admissions in children, but no increase in deaths or ICU admissions during the third wave (12). The overall in-hospital case fatality risk was 6.8 times lower among individuals aged ≤19 years with complete outcome data compared to individuals aged >19 years. The percentage of ICU admissions peaked in June while the case fatality risk peaked in July and both have been declining since. These increases could be attributed to hospital capacity constraints. However, the most common underlying cause among the children who died during the third wave to peak period was HIV infection. Even though absolute numbers of deaths remain substantially lower than those in adults, given the high prevalence of HIV among adolescents in South Africa, efforts should be considered to vaccinate adolescents with underlying conditions placing them at increased risk of severe SARS-CoV-2.

The ascending phase of the third wave has shown a rise in SARS-CoV-2 testing, cases and hospitalisations in individuals aged ≤19 years compared to the ascending phase of the first wave and this could reflect increased testing availability, shift of cases to extremes of age due to the gap in immunity between children and adults, less compliance with non-pharmaceutical interventions in this age group or increased infection of children with the third wave related to circulating variants. Cases and admissions peaked in all provinces at different times during the third wave with some provinces experiencing two peaks. Nationally the first and second peaks for the third wave for individuals aged ≤19 years were in weeks 25 and 33 for cases and weeks 27 and 33 for admissions. During this reporting week, the Northern Cape Province had the highest case incidence and North West Province had the highest admission rate. The different peaks in provinces and the increase in cases in children following the reopening of public schools in week 30 of 2021 could be due to a shift in predominance of the circulating variant from Beta to Delta variant resulting in a change in susceptibility, clusters in schools, or increased testing.

While there remains a need to maintain heightened vigilance and consistent implementation of nonpharmaceutical interventions within schools and discourage community and mass gatherings involving young people, vaccination in children- especially older children 15- 18 years - may need to be prioritised to close the immunity gap. Peaks in cases in the first and second wave did not appear to be related to the timing of the opening and closing of schools, suggesting that school opening and closures are not major drivers of SARS-CoV-2 waves. However, the peaks in the third wave were in week 25, one week before schools were closed and in week 33, three weeks after schools were opened.

This analysis was subject to several limitations. First, both surveillance systems included only SARS-CoV-2- confirmed or tested COVID-19 cases or admissions and therefore, asymptomatic cases would have been missed

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as well as individuals who were not tested. Testing approaches in South Africa have changed as the epidemic progressed, potentially biasing characteristics of detected cases. In particular, recent changes to increased use of antigen detection testing may bias numbers as individuals diagnosed with antigen tests are less likely to be reported and captured by surveillance systems as they may require manual reporting. Second, the national laboratory-based reporting system lacks complete information on symptoms or contact history to determine the source of infection. Third, information on underlying medical conditions is incomplete in the two surveillance systems and the section on underlying conditions has a generic list of specified underlying conditions which are not specific for children. Additional information on underlying conditions among admitted individuals aged ≤19 years is always being sought from reporting hospitals. Lastly, the indications or reasons for admission are mostly not provided. These would allow determination of whether the admission was due to COVID-19 disease, for isolation purposes or other diseases.

In conclusion, while the number of children and adolescents tested, diagnosed, and admitted increased in the third wave to peak period compared to the first and second waves to peak period, there was no increase in fatalities or ICU admissions compared to adults. There is a need to ensure high compliance with respect to nonpharmaceutical interventions within households and schools of individuals aged ≤19 years, especially those with underlying conditions.



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