# EPIDEMIOLOGY AND CLINICAL CHARACTERISTICS OF LABORATORY-CONFIRMED COVID-19 AMONG CHILDREN AND ADOLESCENTS AGED ≤18 YEARS, SOUTH AFRICA, 1 MARCH – 19 SEPTEMBER 2020

NICD COVID-19 and DATCOV teams

## Summary


- As of 19 September, children and adolescents ≤18 years made up 8.0% of laboratory-confirmed COVID-19 cases and 3.2% of all COVID-19-associated admissions at sentinel hospitals.
- The cumulative incidence of laboratory-confirmed COVID-19 cases aged ≤18 years was 256 per 100 000 population, six times lower than that in adults (1544 per 100 000). The cumulative incidence was lowest in Limpopo province and highest in Free State province, was higher in females compared to males and increased with age among individuals aged ≥1 year.
- The weekly incidence of laboratory-confirmed COVID-19 cases aged ≤18 years and cases admitted to sentinel hospitals peaked during weeks 26-30 for all provinces except Northern Cape and has been declining since then. This mirrored trends among adults >18 years.
- There were 2229 reported COVID-19-associated admissions among individuals aged ≤18 years; of these, 1605 (72.0%) had data on underlying conditions and of these 240 (14.9%) had ≥1 underlying conditions. Asthma and other chronic pulmonary conditions and HIV were the commonest underlying conditions.
- The median length of hospital stay among COVID-19-associated admissions aged ≤18 years was 3 days (interquartile range 2-7 days) with 151 (6.8%) individuals admitted into intensive care units at some point during admission and 64 (2.9%) having been ventilated.
- Data on in-hospital outcome were available for 2017 (90.5%) individuals aged ≤18 years. Among these, there were 60 in-hospital deaths giving a case fatality rate of 3.0% (60/2017). Among all deaths, 16 (26.7%) were aged under one year. Among 43 (71.7%) in-hospital deaths who had available data on underlying conditions, 16 (37.2%) reported ≥1 underlying condition. Additional data are being sought on individuals not reporting an underlying illness and those without available data.

## Background

In December 2019, a cluster of pneumonia cases of unknown aetiology was reported in Wuhan, Hubei Province China.[1] The cause of the outbreak has since been confirmed as severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) and the disease named coronavirus disease 2019 (COVID-19). Infections had been reported in 213 countries and territories with 30.9 million individuals infected and 960 000 deaths reported to World Health Organization as of 19 September 2020. [1] The first case of COVID-19 in South Africa was reported on 5 March 2020 in KwaZulu- Natal Province.[2] On the 19 September 2020, the country reported 661 211 cases and 15 953 deaths. [2]

Published studies suggest that the clinical presentation of COVID-19 in children differs from that of adults. Disease in children is more likely to be asymptomatic or mildly symptomatic and less likely to result in hospital admission compared to that in adults.[3] However, there are concerns of possible limited testing in children and cases among children being missed.[4] There are concerns regarding increased transmission within and outside schools and other congregate settings. Individuals aged ≤18 years, constitute just over a third of the population of South Africa (20 633 557; 35.1%) and includes the entire compulsory school-going age – considered 7- 15 years [5].

In this report, the epidemiological characteristics of laboratory-confirmed COVID-19 cases aged ≤18 years notified through the laboratory based national notification system and COVID-19-associated admissions aged ≤18 years at sentinel hospitals in South Africa are presented.

## Methods

**Data collection procedures.**
Laboratory results from public and private laboratories were submitted to the National Institute for Communicable Diseases (NICD). Limited demographic and epidemiological data were collected at the time of specimen collection. Data extraction for the report was done on 22 September 2020. Data on children and adults admitted to sentinel hospitals were collected on the DATCOV platform – an online data collection system. [6] Health care workers at the sentinel hospitals capture demographic and clinical information on admitted COVID-19 cases at admission, during admission and at discharge. As of the 19 September 2020, there were 513 hospitals submitting admissions data into DATCOV. This included 100% of the private hospitals in the country and 75% of public hospitals – with 100% coverage in the Western Cape.

**Definition of outcomes**
A laboratory-confirmed case of COVID-19 was defined as any person who tested positive for SARS-CoV-2 on real-time reverse-transcription polymerase chain reaction (rRT-PCR) 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 a sentinel hospital regardless of the reason for admission.

**Data analysis**
Data from the national line list was exported into Stata14.2® for analysis of the national dataset. Descriptive statistics were used to describe the characteristics of cases aged ≤18 years. Incidence was

determined as the number of cases in different age groups as a proportion of the population size as provided by the Statistics South Africa (Stats SA) mid-year population estimates for 2019 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 ≤18 year at sentinel hospitals stratified by age groups: <7 days, 7- 28 days, 29 days – <1 year, 1- 4 years, 5- 9 years , 10- 14 years and 15- 18 years. Individuals for whom age data was missing were excluded from the analysis.

## Results

### Incidence of COVID-19 among children and adolescents aged ≤18 years

As of 19 September, 662,343 laboratory-confirmed cases of COVID-19 had been reported to the NICD. Of these 52,715 (8.0%) were aged ≤18 years. The median age of the children was 13.2 years (interquartile range [IQR] 8.2 – 16.8 years) with 2261 (4.3%) aged <1 year, 20,145 (38.2%) aged ≥15 years and 23 251 (44.1%) male. The majority of cases 45,183/52,715 (85.7%) were in five provinces – Eastern Cape (16.6%), Free State (8.7%), Gauteng Province (27.9%), KwaZulu Natal (22.0%) and Western Cape (10.6%). The cumulative incidence of laboratory-confirmed COVID-19 among individuals aged ≤18 years was 255.5 per 100 000 population as compared to 1544 per 100 000 population in individuals aged >18 years. The cumulative incidence ranged from 59.4 per 100 000 in Limpopo province to 442.6 per 100 000 population in Free State province (Table 1). The national weekly incidence among individuals aged ≤18 years increased from <1 per 100 000 in week 9, peaking at 30 per 100 000 during weeks 27-29. Most provinces experienced peaks in incidence during the weeks 27-30 and thereafter showed declining weekly incidence – with the exception of Free State and Northern Cape (Figure 1).

**Table 1.** Cumulative incidence of laboratory-confirmed of COVID-19 among children and adolescents aged ≤18 years, 1 March-19 September 2020 (N=52,715)

| Province | Total cases (n, %) | Population (≤18 years) | Incidence risk per 100 000 |
|---|---|---|---|
| Eastern Cape | 8724 (16.6) | 2 714 308 | 321.4 |
| Free State | 4576 (8.7) | 1 031 291 | 442.6 |
| Gauteng | 14689 (27.9) | 4 434 404 | 331.2 |
| KwaZulu Natal | 11592 (22.0) | 4 350 890 | 266.4 |
| Limpopo | 2013 (2.7) | 2 417 100 | 59.4 |
| Mpumalanga | 2270 (4.7) | 1 692 768 | 133.7 |
| North West | 2013 (3.8) | 1 451 987 | 138.6 |
| Northern Cape | 1810 (3.4) | 450 096 | 401.7 |
| Western Cape | 5602 (10.6) | 2 090 713 | 267.9 |
| **All provinces** | **52 715 (100)** | **20 633 557** | **255.9** |

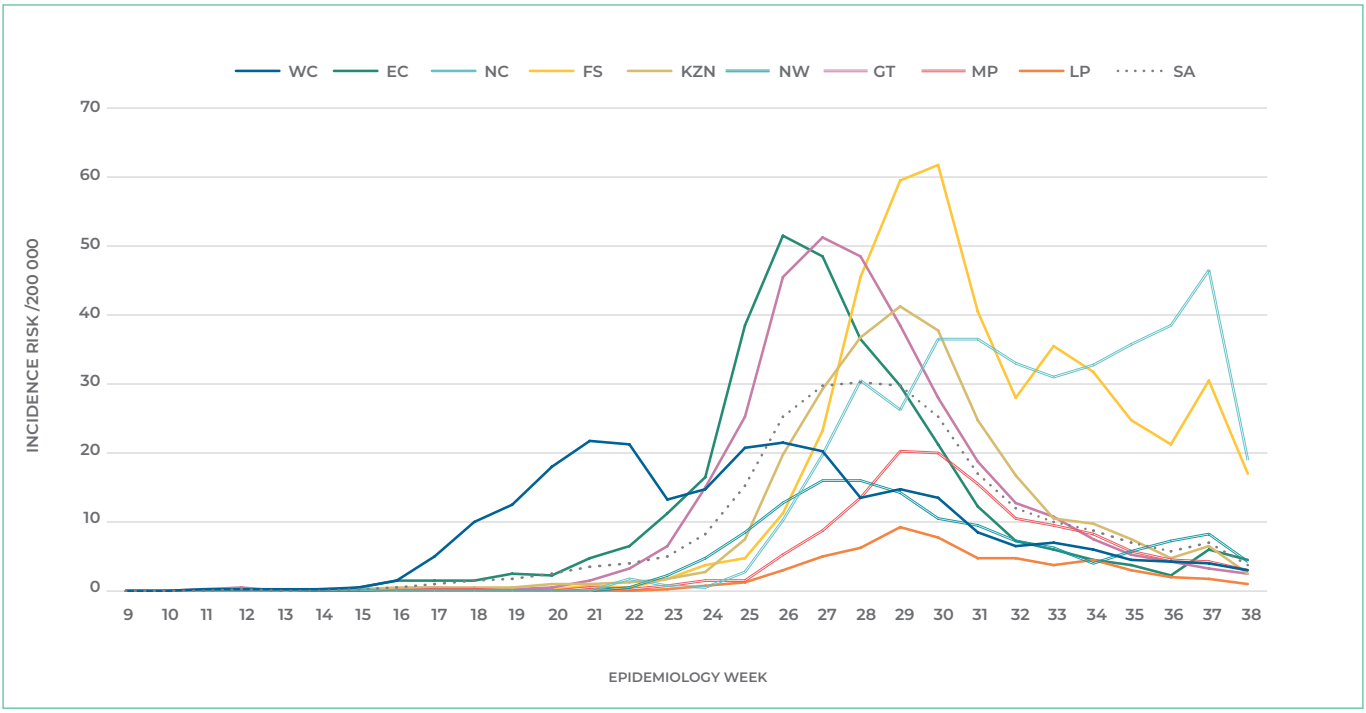


**Figure 1.** Weekly incidence of laboratory-confirmed of COVID-19 among children ≤18 years by epidemiologic week, South Africa 1 March- 19 September (N=52, 715).

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.

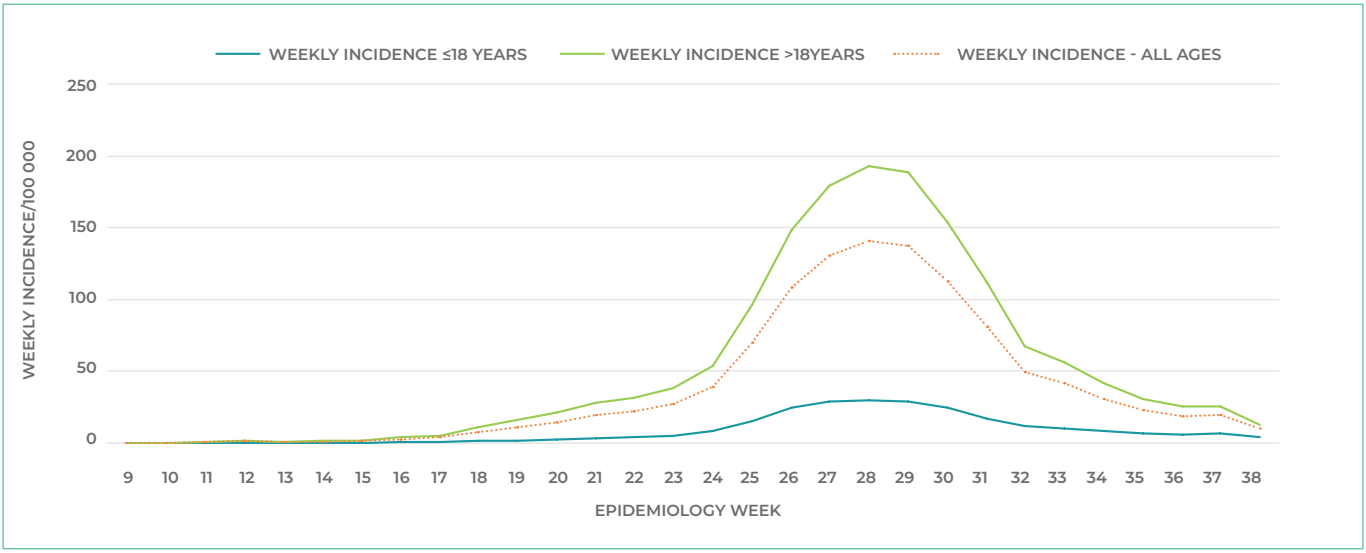


**Figure 2.** Weekly incidence of laboratory-confirmed COVID-19 comparing children ≤18 years to adults, South Africa, 1 March – 19 September 2020 (N=662 342).

The weekly incidence curve for children ≤18 years was similar in shape to that of adults >18 years although the peak incidence was much lower- Figure 2. Generally the cumulative incidence increased with age from 119 per 100 000 among children aged 1-4 years to 539 per 100 000 among adolescents aged 15-18 years (data not shown). The cumulative incidence was higher among females compared to male (278.8 per 100 000 vs 222.9 per 100 000) (Figure 3).

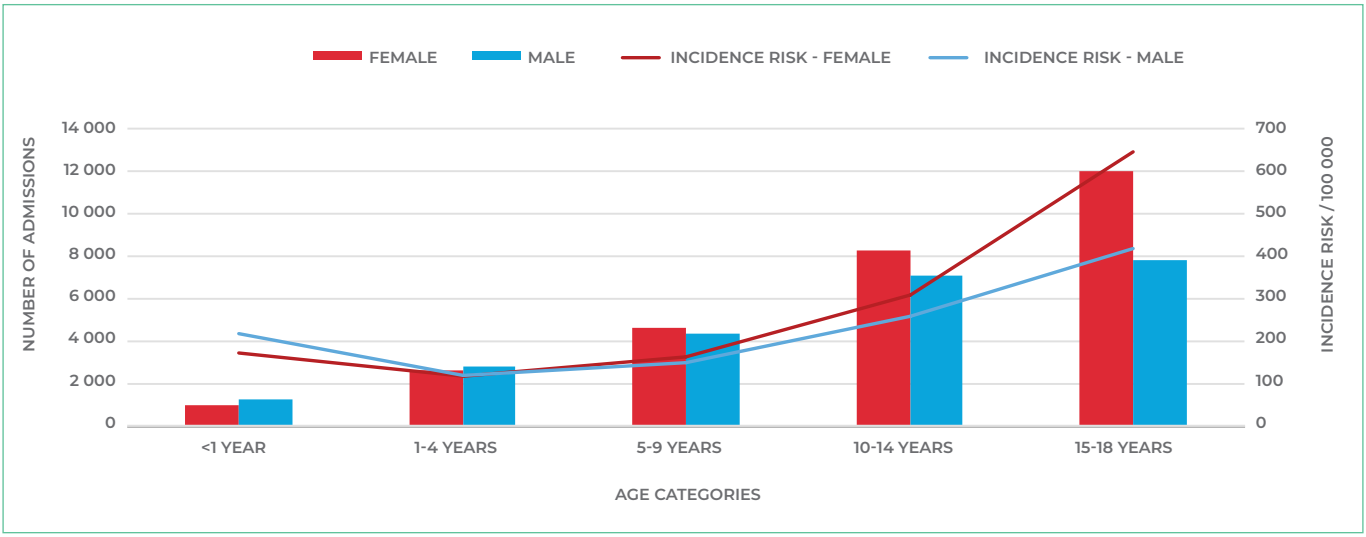


**Figure 3.** Cumulative incidence of laboratory-confirmed of COVID-19 among children and adolescents by age and birth sex, South Africa, 1 March- 19 September (N=52, 715).

**COVID-19-associated admissions in children and adolescents aged ≤ 18 years**

As of 19 September 2020, data on 70,622 COVID-19-associated admissions had been captured on DATCOV. Of these admissions, 2 229 (3.2%) were among individuals aged ≤18 years. The proportions of COVID-19-associated admissions in individuals aged ≤18 years varied across provinces from 2.5% in Gauteng to 4.8% in Limpopo. The first admission among a COVID-19 positive child was during week 9 (Figure 4). The majority of the admissions were in five provinces; Western Cape (29.7 %), Gauteng (20.2%), KwaZulu Natal (18.1%), Eastern Cape (12.7%) and Free State (7.0%) provinces together accounting for 87.8% of all admissions. Overall, the number of admissions peaked during week 29 (Figure 3). Admissions were highest in children aged 0-4 years followed by those aged 15-18 years. Admissions in the age group 15- 18 years peaked earlier (week 26) compared to the other age groups which peaked in week 29 for children aged 5-9 years and 10- 14 years and in week 30 among children <5 years (Figure 5).

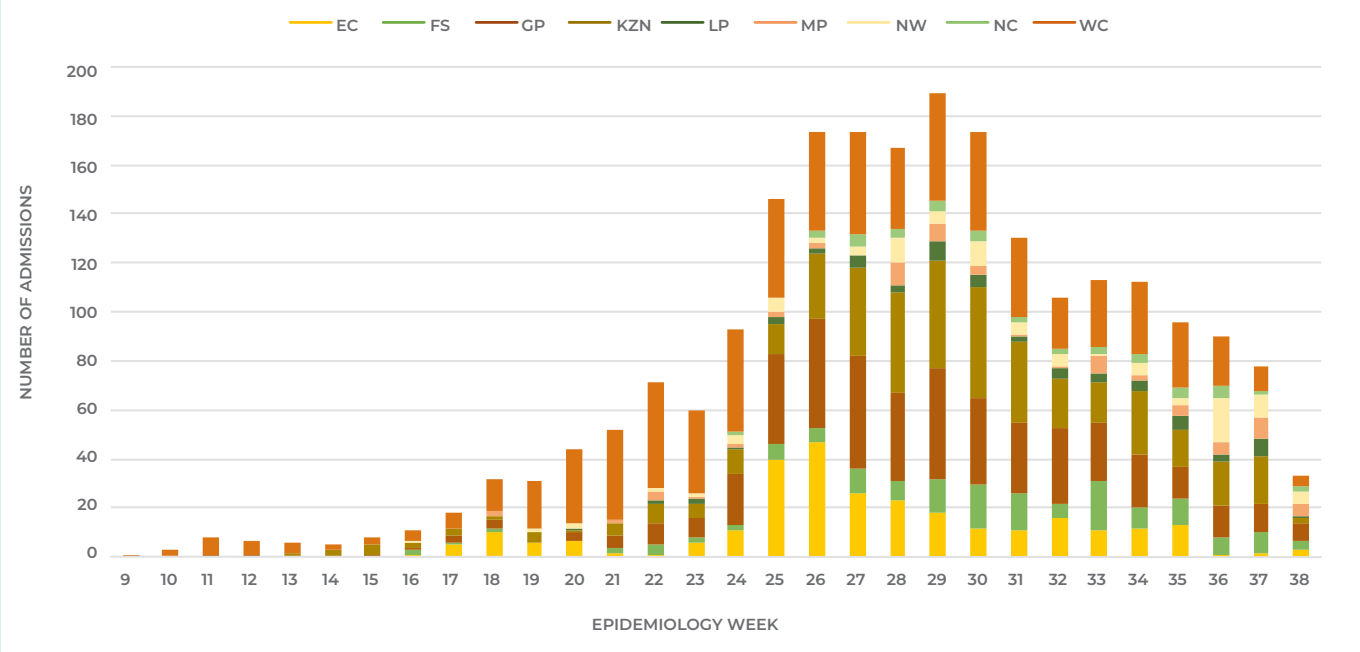


**Figure 4.** Number of COVID-19-associated admissions aged ≤18 years by epidemiologic week and province, South Africa, DATCOV, 1 March – 19 September 2020 (N=2229).

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.

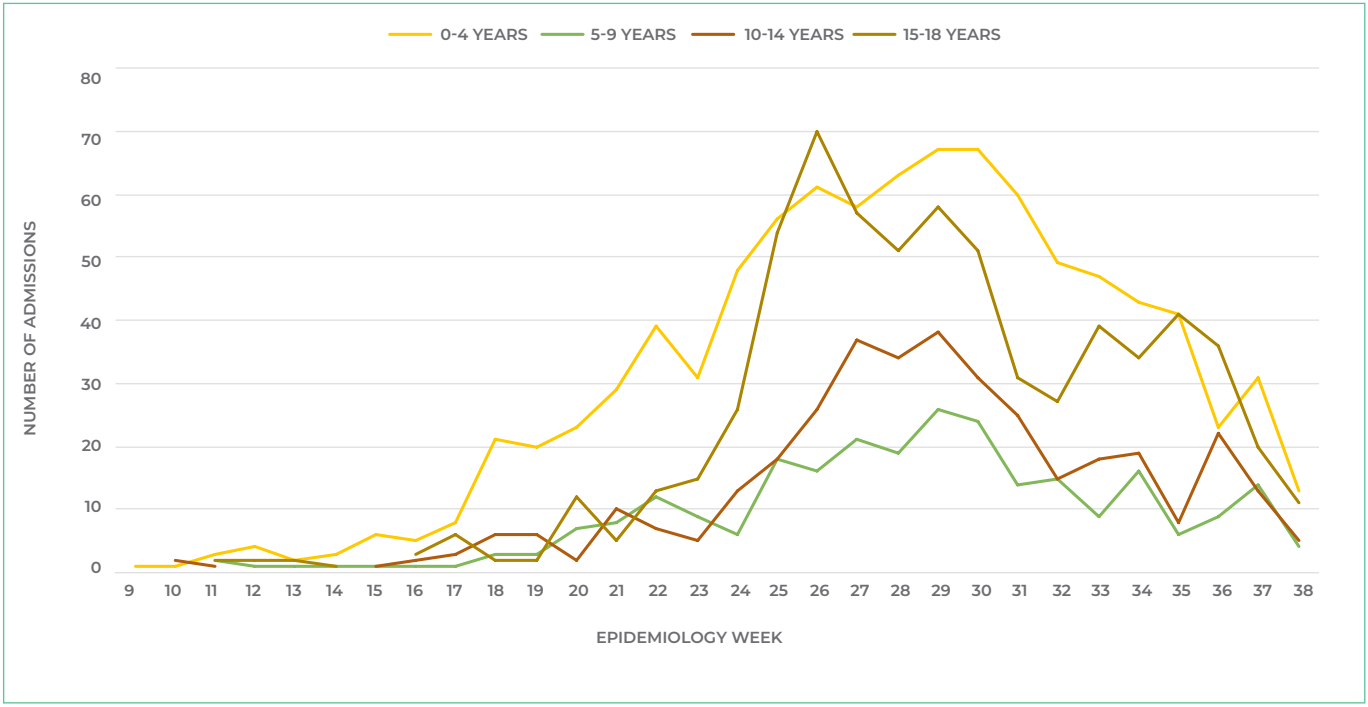


**Figure 5.** Number of COVID-19-associated admissions among individuals aged ≤18 years at sentinel hospitals by epidemiologic week and age group, South Africa, DATCOV, 1 March - 19 September 2020 (N=2229).

Of the 2229 admitted individuals included in the analysis, the median age was 8.5 years (IQR 1.4 -16.1 years) with 473 (21.0%) aged <1 year, 671 (30.1%) aged ≥15 years and 1086 (48.7%) were male. Figure 5 shows the distribution of the admissions by age and sex. About 45% of the children were admitted at hospitals in the public sector (1,012, 45.4%). Table 3 shows the demographic and clinical characteristics of COVID-19-associated admissions among children and adolescents aged ≤18 years at sentinel hospitals overall and stratified by age group. Overall 1605 (72.0%) had data on underlying conditions available. Of these 240 (15.0%) had one or more underlying conditions. Among the 240 who had one or more underlying conditions reported, 38 (15.8%) had ≥2 underlying conditions. Asthma or chronic pulmonary diseases were the most frequently reported underlying conditions followed by HIV and diabetes (Figure 6).

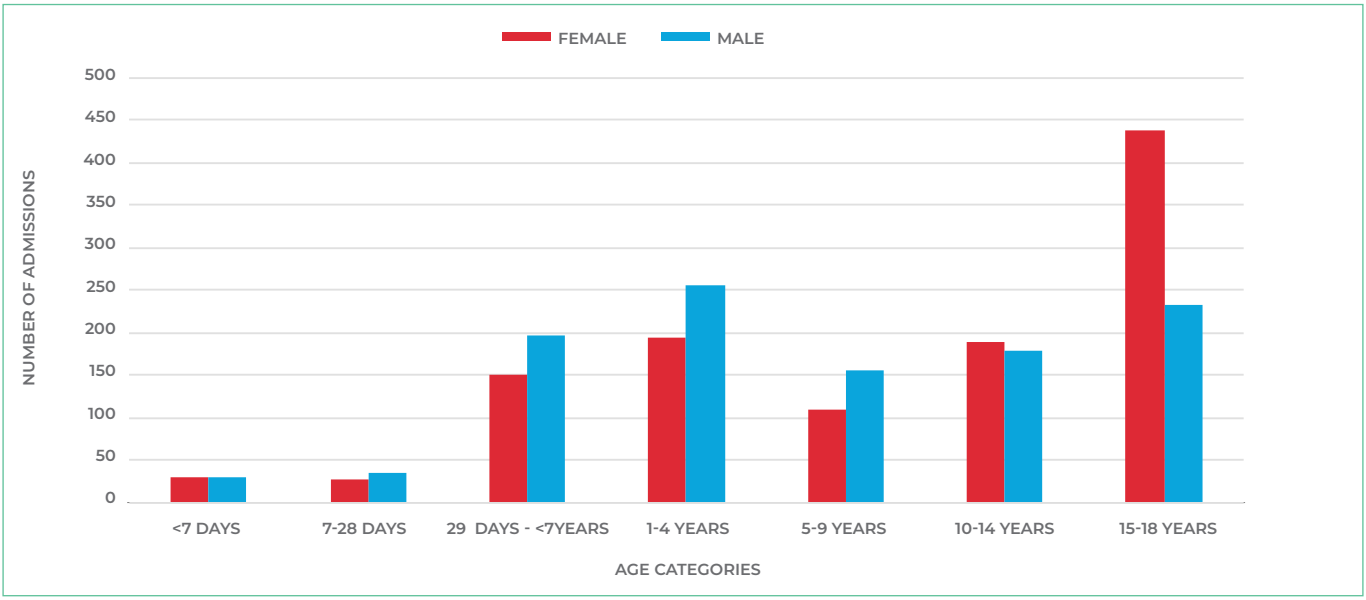


**Figure 6.** Number of COVID-19-associated admissions aged ≤18 years by age group and sex, South Africa, DATCOV, 1 March – 19 September 2020 (N=2229).

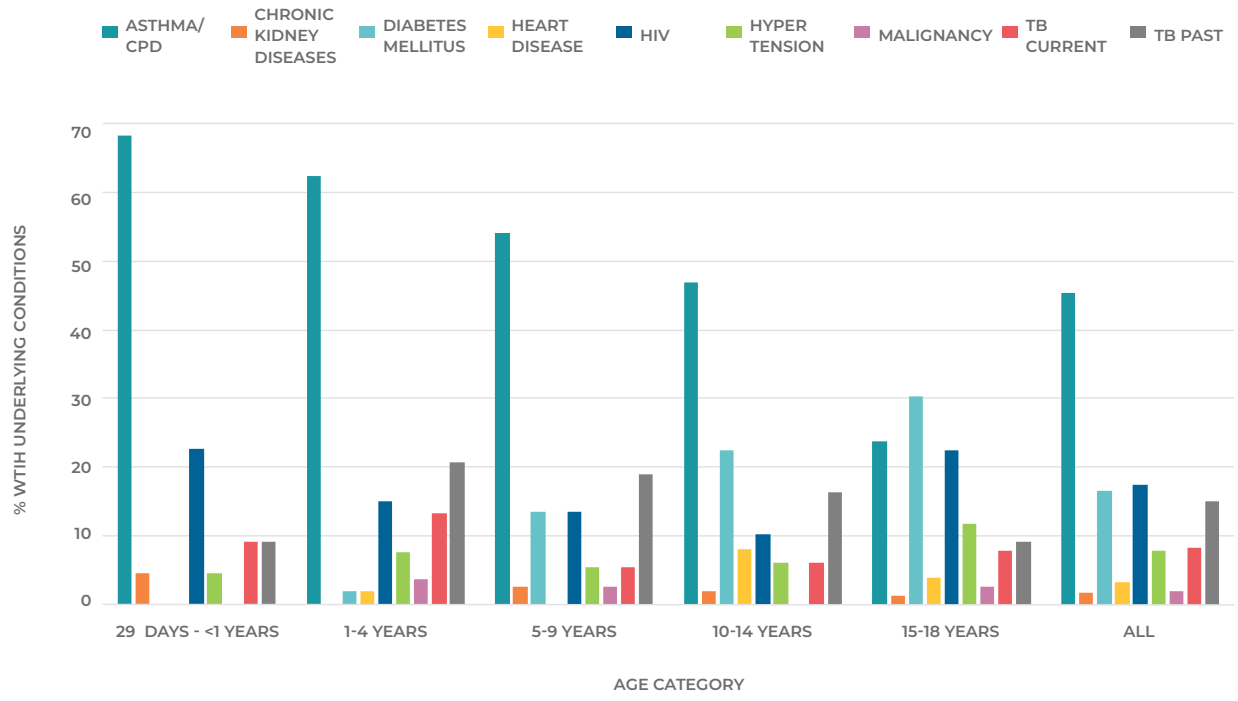


**Figure 7.** Distribution of underlying conditions among COVID-19-associated admissions aged ≤18years with ≥1 underlying conditions, South Africa, DATCOV, 1 March – 19 September 2020 (N=237)*

* excludes three children aged 7- 28 day with HIV and TB. CPD= chronic pulmonary disease, DM= diabetes mellitus, HTN= hypertension, TB =tuberculosis;

## Outcomes of COVID-19-associated admissions among children aged ≤18 years

Of the 2229 COVID-19-associated admissions among children ≤18 years, 151 (6.8%) were admitted into ICU and 64 (2.9%) were ventilated at some point during admission. At analysis, 1995 (87.7%) had been discharged, 193 (8.7%) were still admitted, 19 (0.9%) had been transferred to other facilities and 62 (2.8%) had died during admission. Two of the deaths were considered unrelated to COVID-19. Among individuals with outcome data available, the case fatality ratio was 3.0% (60/2017). The overall median length of hospital stay was 3 days (IQR 2- 7 days) and was 9 days (IQR 2- 19 days) for those who died. Of the 60 COVID-19 associated in-hospital deaths, 43 (71.7%) individuals had data on underlying conditions available. Of these 16 (37.2%) reported ≥1 underlying condition. Diabetes mellitus and heart disease were the most frequently reported among those who had underlying conditions and died in-hospital. Table 3 includes descriptions of these outcomes by age categories.

**Table 2.** Characteristics of COVID-19-associated admissions aged ≤18years, South Africa, DATCOV, 1 March- 19 September 2020 (N=2229)

| Variable | <7days (n=62) | 7- 28 days (n=63) | 29days- <1yr (n=348) | 1- 4 years (n=450) | 5- 9 years (n=267) | 10- 14 years (n=368) | 15- 18 years (n=671) | Overall (n=2229) |
|---|---|---|---|---|---|---|---|---|
| Age (median, IQR) | 0 days (0- 2 days) | 14.0 days (10- 20days) | 4.5 mons (2.2- 7.9mons) | 2.2 yrs. (1.5- 3.3yrs) | 7.6 yrs. (6.4- 8.8yrs) | 12.9 yrs. (11.4- 14.0yrs) | 17.5 yrs. (16.5- 18.2yrs) | 8.5 yrs. (1.4-16.1 yrs.) |
| Male (n, %) | 31 (50.0) | 35 (55.6) | 198 (56.9) | 255 (56.7) | 156 (58.4) | 178 (48.4) | 233 (34.8) | 1086 (48.7) |
| **Province** | | | | | | | | |
| Eastern Cape | 6 (9.7) | 5 (7.9) | 17 (4.9) | 32 (7.1) | 24 (9.0) | 44 (12.6) | 156 (23.3) | 284 (8.2) |
| Free State | 0 | 2 (3.2) | 12 (3.5) | 32 (7.1) | 15 (5.6) | 31 (8.4) | 64 (9.5) | 156 (7.0) |
| Gauteng | 15 (24.2) | 11 (17.5) | 71 (20.4) | 95 (21.1) | 63 (23.6) | 82 (22.3) | 113 (16.8) | 450 (20.2) |
| KwaZulu Natal | 13 (21.0) | 10 (15.9) | 60 (17.2) | 70 (15.6) | 50 (18.7) | 85 (23.1) | 116 (17.3) | 404 (18.1) |
| Limpopo | 4 (6.5) | 2 (3.2) | 8 (2.3) | 5 (1.1) | 12 (4.5) | 11 (3.0) | 20 (3.0) | 62 (2.7) |
| Mpumalanga | 4 (6.5) | 2 (3.2) | 7 (2.0) | 16 (3.6) | 6 (2.3) | 8 (2.2) | 24 (3.6) | 67 (3.0) |
| North West | 3 (4.8) | 1 (1.6) | 5 (1.4) | 15 (3.0) | 8 (3.0) | 15 (4.1) | 52 (7.8) | 99 (4.4) |
| Northern Cape | 1 (1.6) | 0 | 4 (1.2) | 10 (2.2) | 8 (3.0) | 14 (3.8) | 8 (1.2) | 45 (2.0) |
| Western Cape | 16 (25.8) | 30 (47.6) | 164 (47.1) | 175 (38.8) | 81 (30.3) | 78 (21.2) | 118 (17.6) | 662 (29.7) |
| Admitted at a public hospital, (n, %) | 19 (30.7) | 43 (68.3) | 179 (51.4) | 172 (38.2) | 108 (40.5) | 164 (44.6) | 327 (48.7) | 1012 (45.4) |
| **Data on underlying conditions available, (n, %)** | 37 (59.7) | 28 (44.4) | 192 (55.2) | 307 (68.2) | 200 (74.9) | 281 (76.4) | 560 (83.5) | 1605 (72.0) |
| Has ≥1 underlying conditions, (n/N, %)* | 0/37 (0) | 3/28 (10.7) | 22/192 (11.5) | 53/307 (17.3) | 37/200 (18.5) | 49/281 (17.4) | 76/560 (13.6) | 240/1605 (15.0) |
| Length of stay (median, IQR)** | 11 (4-38) | 5 (3-11) | 4 (2-7) | 3 (1-5) | 2 (1-6) | 3 (1-8) | 4 (2-8) | 3 (2-7) |
| ICU admission | 18 (29.0) | 11 (17.5) | 28 (8.1) | 23 (5.1) | 18 (6.7) | 26 (7.1) | 27 (4.0) | 151 (6.8) |
| Ventilation | 14 (22.6) | 4 (6.4) | 8 (2.3) | 5 (1.1) | 10 (3.8) | 14 (3.8) | 9 (1.3) | 64 (2.9) |
| Died*** | 1 (1.6) | 6 (9.5) | 9 (5.6) | 4 (0.9) | 5 (1.9) | 13 (3.5) | 22 (3.3) | 60 (2.7) |
| Discharged alive | 52 (83.9) | 50 (79.4) | 311 (89.4) | 409 (90.9) | 237 (88.8) | 314 (85.3) | 582 (86.7) | 1995 (87.7) |
| Transferred to another hospital | 0 (0.0) | 1 (1.6) | 3 (0.9) | 3 (0.7) | 0 (0.0) | 7 (1.9) | 5 (0.8) | 19 (0.9) |
| Still admitted | 7 (11.3) | 6 (9.5) | 25 (7.2) | 34 (7.6) | 25 (9.4) | 34 (9.2) | 62 (9.2) | 193 (8.7) |

Mons= months; Yrs. = years; IQR= interquartile range; ICU = intensive care unit; *Individual can have more than one comorbidity and denominator is those with available data on underlying conditions;** among those who died, transferred or discharged *** excludes 2 deaths which were deemed unrelated to COVID-19

**Table 3.** Characteristics of COVID-19-associated admissions ≤ 18years who died in hospital, South Africa, DATCOV, 1 March – 19 September 2020 (N=60).

| Characteristic | n (%) |
|---|---|
| Age (median, IQR) | 12.7 years (7.1 months – 16.5 years) |
| Age < 1 year | 16 (26.7) |
| Age ≥15 | 22 (36.7) |
| Male | 38 (63.3) |
| **Province** | |
| Eastern Cape | 12 (20.0) |
| Free State | 6 (10.0) |
| Gauteng | 13 (21.7) |
| KwaZulu-Natal | 12 (20.0) |
| Limpopo | 1 (1.7) |
| Mpumalanga | 2 (3.3) |
| North West | 0 (0.0) |
| Northern Cape | 0 (0.0) |
| Western Cape | 14 (23.3) |
| ICU admission | 26 (43.3) |
| Data on underlying conditions available | 43 (71.7) |
| Underlying conditions Yes | 16/43 (37.2) |
| **Underlying conditions** | |
| Asthma/ CPD | 0/16 (0) |
| DM | 4/16 (25.0) |
| HIV | 2/16 (12.5) |
| Heart Disease | 3/16 (18.8) |
| Hypertension | 1/16 (6.3) |
| Malignancy | 2/16 (12.5) |
| Chronic Kidney Disease | 2/16 (12.5) |
| TB past | 2/16 (12.5) |
| TB current | 1/16 (6.3) |
| Other (Biliary atresia, hypokalaemia, morbid obesity, nephrotic syndrome, pneumonia, ileus, HIV-exposed) | 7/16 (43.8) |

IQR=interquartile range, DM= diabetes mellitus, TB= tuberculosis, CPD= chronic pulmonary disease, HIV= human immunodeficiency syndrome

## Discussion

This report presents data, on the epidemiology and clinical features of laboratory-confirmed COVID-19 among individuals aged ≤18 years using data from two surveillance systems established for monitoring the COVID-19 pandemic in South Africa. The data presented showed that children made up 8.0 % of all laboratory-confirmed COVID-19 cases reported in South Africa and around 3.2 % of COVID-19 associated admissions, despite comprising just over a third of the population. The cumulative incidence among children was six times lower compared to that of adults during the same period. The data showed higher cumulative incidence and proportion admitted among older females aged 15- 18 years (645/100 000 population) compared to other age groups in children (115- 417/100 000). This higher incidence among females observed from age 10- 14 years is apparent until the age 60 , (7) and maybe due to some unknown biological factor, differential exposures to COVID-19 through care work or other frontline roles or from better health seeking behaviour and subsequent testing in women.

The data also showed continued declining trends in new laboratory confirmed COVID-19 cases and COVID-19 associated admissions among children and adolescents in most provinces in recent weeks, reflecting national trends and trends among older individuals. However, weekly incidence risk in the Free State and Northern Cape remained higher than the rest of the provinces indicating on-going community transmission, similar to trends in all age groups (7). The median age of children admitted to hospital was lower than that among all diagnosed cases aged ≤18 years (8.5 years vs 13.2 years), suggesting that severe disease may be more common among younger children or that clinicians are more likely to admit younger children as a precaution. Some of the COVID-19 associated admissions younger than one year were new-borns and may have been admitted for birth-related complications rather than the COVID-19-related illness.

The overall case fatality rate was 3.0% among those with available data on in-hospital outcome, which is somewhat higher than has been reported in smaller hospital cohorts elsewhere – on average 0.2% in studies from Europe and China. (8-12) Infants aged <1 years were over-represented among deaths in our dataset. Although infants made up 21% of admissions, they made up 27% of deaths. This is consistent with what has been described in China, United States and Europe. (13-16) In China – 11% of infants <1 year had severe or critical illness compared 4.8% among the rest of the children.(13) In the United States infants made up 15% of all childhood cases and 40% of hospitalizations in a cohort reported during February to April. (14) In a report on deaths among children and adolescents aged <21 years in the United States, infants made up 10% of these deaths. (15) In a multicentre study of COVID-19 hospitalizations among children in Europe during April 2020, infants <1 year were five times more likely to be admitted into intensive care units, although overall mortality was low at 0.7%. (16) Respiratory underlying conditions – asthma and chronic pulmonary disease – were the most common but were not associated with any deaths. Diabetes and cardiac disease were the most comorbidities among children who died and had data on underlying conditions available. Almost 60% of children who died and had data on underlying medical conditions available did not have any reported underlying medical conditions. Additional data are being sought on individuals not reporting an underlying illness and those without available data.

## Limitations

This analysis was subject to several limitations:

- Both surveillance systems included only SARS-CoV-2-confirmed or tested COVID-19 cases or admissions and therefore, asymptomatic cases would have been missed 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.

- The national laboratory based reporting system lacks complete information on symptoms or contact history to determine source of infection.

- The DATCOV system is a sentinel hospital based system. It therefore does not include all admissions at all hospitals in South Africa. As a result, hospitalization rates by province, epidemiology week, age or gender cannot be determined.

- Information on underlying medical conditions is incomplete in the two surveillance systems.

- The indications or reasons for admission are not provided. These would allow determination of whether admission was due to COVID-19 disease, isolation purposes or other diseases

## REFERENCES

1. World Health Organizatio. Coronavirus Disease (COVID-19) Situation report. Geneva, Switzerland: Available from https://covid19.who.int/. Accessed 21 September 2020.
2. Republic of South Africa. National Department of Health. COVID-19 Corona Virus South African Resource Portal 2020.
3. Mofenson L.M IP, Anthony D., Requejo J., You D, Luo C, Peterson S,. The Evolving Epidemiologic and Clinical Picture of SARS-CoV-2 and COVID-19 Disease in Children and Young People. UNICEF Office of Research 2020 July 2020.
4. Idele P; David A DKA, You D. Does COVID-19 Affect the Health of Children and Young People More Than We Thought? The case for disaggregated data to inform action. Innocenti, Florence: UNICEF Office of Research, 2020.
5. Department of Basic Education. Information for parents and guardians. Available from https://www.education.gov.za/Informationfor/ParentsandGuardians/SchoolAdmissions.aspx . Accessed 30 September 2020.
6. Jassat W, Cohen C, Kufa T, Goldstein S, Masha M , Cowper B, Slade D, Greyling C, Soorju S, Kai R, Walaza S, Blumberg L. DATCOV:A sentinel surveillance programme for hospitalised individuals with COVID-19 in South Africa, 2020. Johannesburg, South Africa: National Institute for Communicable Diseases, 2020 10 June 2020.
7. National Institute for Communicable Diseases. COVID-19 Weekly epidemiology brief. Available from https://www.nicd.ac.za/wp-content/uploads/2020/09/COVID-19-Weekly-Epidemiology-Brief-week-38.pdf.
8. Mantovani A, Rinaldi E, Zusi C, Beatrice G, Saccomani MD, Dalbeni A. Coronavirus disease 2019 (COVID-19) in children and/or adolescents: a meta-analysis. Pediatric research. 2020 Jun 17.
9. Hoang A, Chorath K, Moreira A, Evans M, Burmeister-Morton F, Burmeister F, et al. COVID-19 in 7780 pediatric patients: A systematic review. EClinicalMedicine. 2020 2020/07/01/;24:100433.
10. de Souza TH, Nadal JA, Nogueira RJN, Pereira RM, Brandão MB. Clinical manifestations of children with COVID-19: A systematic review. Pediatric Pulmonology. 2020;55(8):1892-9.
11. Zhang L, Peres TG, Silva MVF, Camargos P. What we know so far about Coronavirus Disease 2019 in children: A meta-analysis of 551 laboratory-confirmed cases. Pediatric Pulmonology. 2020;55(8):2115-27.
12. Mustafa NM, L AS. Characterisation of COVID-19 Pandemic in Paediatric Age Group: A Systematic Review and Meta-Analysis. Journal of clinical virology : the official publication of the Pan American Society for Clinical Virology. 2020 Jul;128:104395.
13. Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang Z, et al. Epidemiology of COVID-19 among children in China. Pediatrics. 2020;145(6).
14. Kim L WM, O'Halloran A, Kambhampati A, Chai S.J, Reingold A, Armistead I, Kawasaki B, Meek J, Yousey-Hindes K, Anderson E.J, Openo K.P, Weigel A, Ryan P, Monroe M.L, Fox K., Kim S, Lynfield R, Bye E, Davis S.S, Smelser C, Barney G, Spina N.L, Bennett N.M, Felsen C.B, Billing L.M, Shiltz J, Sutton M, West N, Talbot H.K, Schaffner W, Risk I, Price A, Brammer L, Fry A.M, Hall A.J, Langley G.E, Garg S for COVID-NET Surveillance Team. Hospitalization Rates and Characteristics of Children Aged <18 Years Hospitalized with Laboratory-Confirmed COVID-19 — COVID-NET, 14 States, March 1–July 25, 2020. MMWR Morb Mortal Wkly Rep. 2020 7 August 2020;ePub.
15. Bixler D, Miller AD, Mattison CP, Taylor B, Komatsu K, Peterson Pompa X, et al. SARS-CoV-2-Associated Deaths Among Persons Aged <21 Years - United States, February 12-July 31, 2020. MMWR Morb Mortal Wkly Rep. 2020 Sep 18;69(37):1324-9.
16. Götzinger F, Santiago-García B, Noguera-Julián A, Lanaspa M, Lancella L, Calò Carducci FI, et al. COVID-19 in children and adolescents in Europe: a multinational, multicentre cohort study. The Lancet Child & Adolescent Health.

# MONTHLY COVID-19 IN CHILDREN SURVEILLANCE REPORT

NATIONAL INSTITUTE FOR COMMUNICABLE DISEASES
Division of the National Health Laboratory Service

SOUTH AFRICA | 09 OCTOBER 2020