**Coronavirus Disease-19 deaths among children and adolescents in an area of Northeast, Brazil: why so many?**

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**Abstract**

Objective: To describe COVID-19 deaths among children and adolescents in Sergipe, Brazil.

Methods: This was an ecological study of all COVID-19 reported cases and deaths occurring in children and adolescents < 19 years of age in Sergipe reported by the health surveillance and mortality information systems of Sergipe’s Health Secretary and hospital records.

Results: 37 deaths in children <19 years old were reported up to the 30th September, corresponding to 4.87 deaths for 100,000 population < 19 years old. Most deaths occurred among infants (n=15; 41%) and this age group had the highest case fatality rate (15.3 %). Most children had comorbidities such as chronic neurological diseases (n=7; 19%) and prematurity (n=4; 11%). Most children who died (n=18; 49%) were not admitted to the intensive care units (ICU).

Conclusion: COVID-19 mortality in children and adolescents in Sergipe was higher than in other Brazilian states and in high income countries. A high proportion of the deaths occurred among children with co-morbidities and a minority of children were admitted to ICU, reflecting the limited provision of these beds in the State. Newborns and infants are a high risk group that must have priority in health public policy.

**INTRODUCTION**

Coronavirus Disease-19 (COVID-19) disproportionally affects adults and older individuals have a high risk of severe disease and death . (1) Children and adolescents in turn account for a minority of cases and have more favorable disease outcomes, even among those who have comorbidities. (2–6)

Brazil, with 4.3 million COVID-19 cases and 135,000 deaths six months after the start of the pandemic, has reported 821 deaths in children and adolescents. (7) However, children’s deaths are not evenly distributed. Sao Paulo state for example, has reported 98 (0.16%) deaths in children and adolescents among the 62,000 COVID-19 cases reported(8), while Sergipe, the smallest State in the country, has reported 37 (0.61%) deaths in children and adolescents among its 6,038 COVID-19 cases in children and adolescents. (9) We describe here an analysis of the burden of COVID-19 deaths in children and adolescents in Sergipe, to identify possible reasons for the high proportion of deaths.

**METHODS**

This was an ecological study of all COVID-19 cases reported and confirmed deaths occurring in children and adolescents less than 19 years of age in Sergipe. All deaths had been confirmed by Reverse Transcription Polymerase Chain Reaction (RT-PCR) assays for Severe Acute Respiratory Syndrome-Corononarius-2 (SARS-CoV-2). COVID-19 cases reported by the state are diagnosed based on clinical presentation, radiology, serology or RT-PCR, severity of clinical presentation and place of consultation. Sergipe State has 2.2 million inhabitants, with 36.6% being less than 19 years old. (10) The state has 22 pediatric intensive care unit (ICU) beds, of which 20 (91%) belong to the Brazilian national health service (Sistema Único de Saúde, SUS) and 87 neonatal ICU beds, of which 64 belong to SUS. (11)

Data on COVID-19 cases and deaths were obtained from the Sergipe Health Surveillance (9) and Mortality Information systems. (12) The characteristics of the children (sex, age, place of death, co-morbidities, time from symptoms onset to hospitalization and death) were obtained from the hospital records. Population data stratified by age were obtained from the Brazilian Institute of Geography and Statistics. (10) The characteristics of the children were summarized using descriptive statistics and we calculated the number of deaths per 100,000 population and the case fatality rates (CFR) by age group. COVID-19 CFR was calculated by dividing the number of deaths by the number of COVID-19 cases. The study was approved by the Research Ethics Committee of the Federal University of Sergipe (approval number 36778320.0.0000.5546).

**RESULTS**

Sergipe reported 6,038 COVID-19 cases among children less than 19 years old up to the 30th September 2020, of which 37 died, resulting in a CFR of 0.61%. Sergipe has a population of 759,907 children under 19 years old, and thus the State had 4.87 deaths per 100,000 pediatric population. The highest proportion of deaths were reported in infants (N = 15), with 44.1 deaths per 100,000 infants less than one year, and a CFR of 15.3%, while older children had a lower number of deaths and CFR, as shown in table 1. The characteristics of all deaths in children and adolescents are shown in table 2. Among the 15 (41%) deaths in infants, five were newborns. Thirty-five (95%) of the 37 deaths had occurred in SUS hospitals. The mean time from symptom onset to hospitalization was 4.5 days (interquartile range (IQR) 0 – 4.75). Four children admitted to hospital without Covid-19 (polytrauma, cardiac disease, neoplasia and chronic neurologic disease), initiated symptoms after hospitalization . Nine (24%) children died within 24 hours of admission, with a median time to death of 6 days (IQR 1.5-13) after hospitalization. Twenty-five (68%) of the children had underlying co-morbidities, including chronic neurological diseases (n=7; 19 %) and prematurity (n=4; 11%) . Fourteen (38%) of the children who died were admitted to ICU.

**DISCUSSION**

We report an unusually high death rate and case fatality rate among children in Sergipe. Most of these children were infants and had a rapid progression to death after hospital admission. Most children had underlying co-morbidities and a low proportion of them were admitted to an ICU.

The proportion of COVID-19 deaths in children under 19 years in Sergipe is 37 times higher than the proportions reported from the USA and the UK (0.13 deaths per 100,000 children and adolescents for both) and six times higher than in other areas of Brazil (1.3 deaths per 100,000 children). (8,13,14)

Although the state has an adequate number of adult ICU beds and has deployed a further 88 adults’ ICU beds since the start of the pandemic, Sergipe has a 41% deficit in pediatric ICU beds (11,15), with only seven in its neonatal ICU and no additional pediatric ICU beds have been deployed during the epidemic. (9) Moreover, none of the pediatric ICU beds are ringfenced for COVID-19 and children often experience long waiting times before ICU admission. Another Brazilian study during the pandemic also described similar difficulties accessing ICU beds for pregnant women. (16) .

SSeven of the deaths occurred in neonates and infants with neonatal related problems. The high number of deaths among children with co-morbidities has been reported elsewhere, and especially neonates are at greater risk of severe illness and death than older children. (17,18) Neonates are more susceptible to infectious diseases and are more likely to present health complications such as prematurity, perinatal asphyxia and maternal infections which leds to high fatality rates.

One study has described the direct and indirect effects of the pandemic in the health services available for neonates in low and middle-income countries. (19) Sergipe has historically had high mortality rates among its neonates. Covid-19 related deaths in Sergipe may have highlighted these discrepancies in the Brazilian SUS, especially for services such as maternal and neonatal care that have had historically inadequate supply and service conditions. (20,21)

The role of comorbidities in severe COVID-19 has been reported less frequently in children than in adults. In Europe, COVID-19 deaths occur less frequently in children, even among those who are immunocompromised (22). Other studies have predominantly reported COVID-19 among previously healthy children, even among those with severe COVID-19. (4–6) In Sergipe, almost 70% of children’s deaths were associated with comorbidities, someof which require lengthy hospitalizations, which may have facilitated nosocomial transmission. Nine children died within 24 hours of hospital admission, reflecting delays on health seeking and severe presentation at the time of hospitalization.

This study has several limitations. The data analysed was not collected prospectively and was based on epidemiological surveillance and hospital records. Overall, there is a significant under-reporting of COVID-19 cases in Sergipe State and Brazil and therefore our information is likely to represent the most severe forms of the disease.

In conclusion, the COVID-19 deaths by population and case fatality ratio in children and adolescents in Sergipe is higher than in other Brazilian states and elsewhere, especially among infants. Despite most of the children having underlying health conditions, a low proportion of children were addimitted to ICU, reflecting the low paediatric ICU capacity in the State. Newborns and infants are a risk group that should have priority in public health policy and ICU services.

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Table 2: Characteristics of children and adolescents’ deaths by COVID-19, Sergipe.

Table 1: COVID-19 mortality rate and case fatality ratio for age group in Sergipe, May – Sep 2020

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Age group** | **Confirmed cases (N)\***  | **Deaths (N)\*** | **Population\*\*** | **Deaths for 100,000 age group population** | **Case fatality rate**  |
| < 1 y | 98 | 15 | 34,016 | 44.10 | 15.31 |
| 1 - 4 y | 935 | 4 | 136,606 | 2.93 | 0.43 |
| 5 - 14 y | 2,190 | 10 | 387,240 | 2.58 | 0.46 |
| 15 - 19 y | 2,815 | 8 | 202,045 | 3.96 | 0.29 |

\*Source: Secretary of State for Health, data recorded until 5th Sep, 2020;

\*\* Source: DATASUS – demographic indicators – Sergipe, data from 2012.

Table 2: Characteristics of children and adolescents’ deaths by COVID-19, Sergipe.

|  |  |
| --- | --- |
| **Characteristics** | **N = 37 (%)** |
| Male | 23 (62) |
| Female  | 14 (38) |
| **Age in years (%)** |  |
| < 1 | 15 (41) |
| 1 – 4 | 4 (11) |
| 5 – 14 | 10 (27) |
| 15 – 19 | 8 (22) |
| Days from symptom onset to hospitalization, mean (IQR) | 4.5 (0 – 4.8) |
| Days from hospital admission to death, median (IQR) | 6.0 (1.5 - 13) |
| **Comorbidities\* (%)** | 25 (68) |
| Chronic neurological disease | 7 (19) |
| Prematurity | 4 (11) |
| Chronic respiratory disease | 4 (11) |
| Neoplasia | 3 (8) |
| Chronic cardiac disease | 2 (5) |
| Genetic disease | 2 (5) |
| Diabetes | 2 (5) |
| Kidney disease | 2 (5) |
| Others \*\* | 3 (8) |
| Admitted to ICU (%) | 14 (38) |
| No registration | 5 (13) |
| **Attended SUS Hospital** | 35 (95) |

\*some cases with more than one Comorbidity \*\* Postoperative, Pregnancy.