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Short Communication

# Socio-economic inequalities and COVID-19 incidence and mortality in Brazilian children: a nationwide register-based study

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## ARTICLE INFO

## ABSTRACT

*Objectives:* This study aimed to estimate the incidence and mortality rates of coronavirus disease 2019 (COVID-19) in Brazilian children and to analyze its relationship with socio-economic inequalities in a state-level analysis.

*Study design:* This is a nationwide register-based study.

*Methods:* To estimate the incidence and mortality rates of COVID-19 in Brazilian children aged 0–19 years, we extracted data of confirmed cases and deaths from the de-identified microdata catalog and official bulletins of the 27 Brazilian states' health department websites until September 3, 2020. Social and economic inequalities were evaluated using the Social Vulnerability Index and Gini coefficient, respectively. The relationship between COVID-19 rates in Brazilian children and socio-economic vulnerability at the state level was analyzed using Spearman's rank correlation.

*Results:* Of the 3,998,055 individuals with COVID-19 included in our database, 335,279 (8.4%) were children aged 0–19 years. Eight hundred deaths in children were registered, which accounts for about 0.7% of the deaths related to COVID-19 in the country. There were important differences in the incidence and mortality rates among Brazilian regions, and a correlation between mortality rates and social ($\rho = 0.519$; *P*-value = 0.007; effect magnitude: moderate) and economic ($\rho = 0.615$; *P*-value < 0.001; effect magnitude: strong) inequalities was found in a state-level analysis.

*Conclusions:* This population-based study showed important regional differences in COVID-19 estimates for children in Brazil and a relationship between mortality rates and socio-economic inequalities. The knowledge of sociogeographic differences in the estimates of COVID-19 is crucial to planning societal strategies and local decision-making to mitigate the effects of disease in the pediatric population.

## Introduction

Coronavirus disease 2019 (COVID-19) is affecting a diverse group of individuals with varying severity during the ongoing global pandemic.[1] Accumulating evidence has shown that the proportion of COVID-19–confirmed cases among children is relatively small and deaths are uncommon,[2,3] but the impact of disease in pediatric populations is likely to vary considerably between and within countries.

In a recent study, discussion was on the urgent need to understand comprehensive pediatric data from South America to implement proper preventive and treatment protocol in the region.[4] As part of South America, Brazil has seen a devastating spread of COVID-19 across the country. As of September 2020, Brazil had registered more than 4.1 million cases and 126,000 deaths from COVID-19 in the general population. Moreover, it is of utmost importance to understand whether geographic and socio-

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P.R. Martins-Filho, L.J. Quintans-Júnior, A.A. de Souza Araújo et al.

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**Table 1**
Incidence, mortality, and case fatality rates of COVID-19 among children aged 0—19 years in Brazil as per macroregions.

| Region | No. of states | Socio-economic indicators (range between states) | | No. of cases | No. of deaths | Estimates per 100,000 | | CFR (%) |
|---|---|---|---|---|---|---|---|---|
| | | SVI | Gini Index | | | Incidence | Mortality | |
| Northeast | 9 | 0.306 (0.272—0.349) | 0.559 (0.530—0.580) | 108,540 | 312 | 620.5 | 1.8 | 0.29 |
| North | 7 | 0.283 (0.191—0.327) | 0.537 (0.472—0.576) | 67,219 | 182 | 1015.0 | 2.8 | 0.27 |
| Central-West | 4 | 0.241 (0.194—0.258) | 0.507 (0.456—0.553) | 34,304 | 38 | 711.0 | 0.8 | 0.11 |
| Southeast | 4 | 0.235 (0.207—0.284) | 0.527 (0.488—0.551) | 85,674 | 238 | 369.1 | 1.0 | 0.28 |
| South | 3 | 0.186 (0.134—0.209) | 0.467 (0.422—0.483) | 39,542 | 30 | 505.2 | 0.4 | 0.08 |
| Brazil | 27 | 0.243 | 0.543 | 335,279 | 800 | 559.0 | 1.3 | 0.24 |

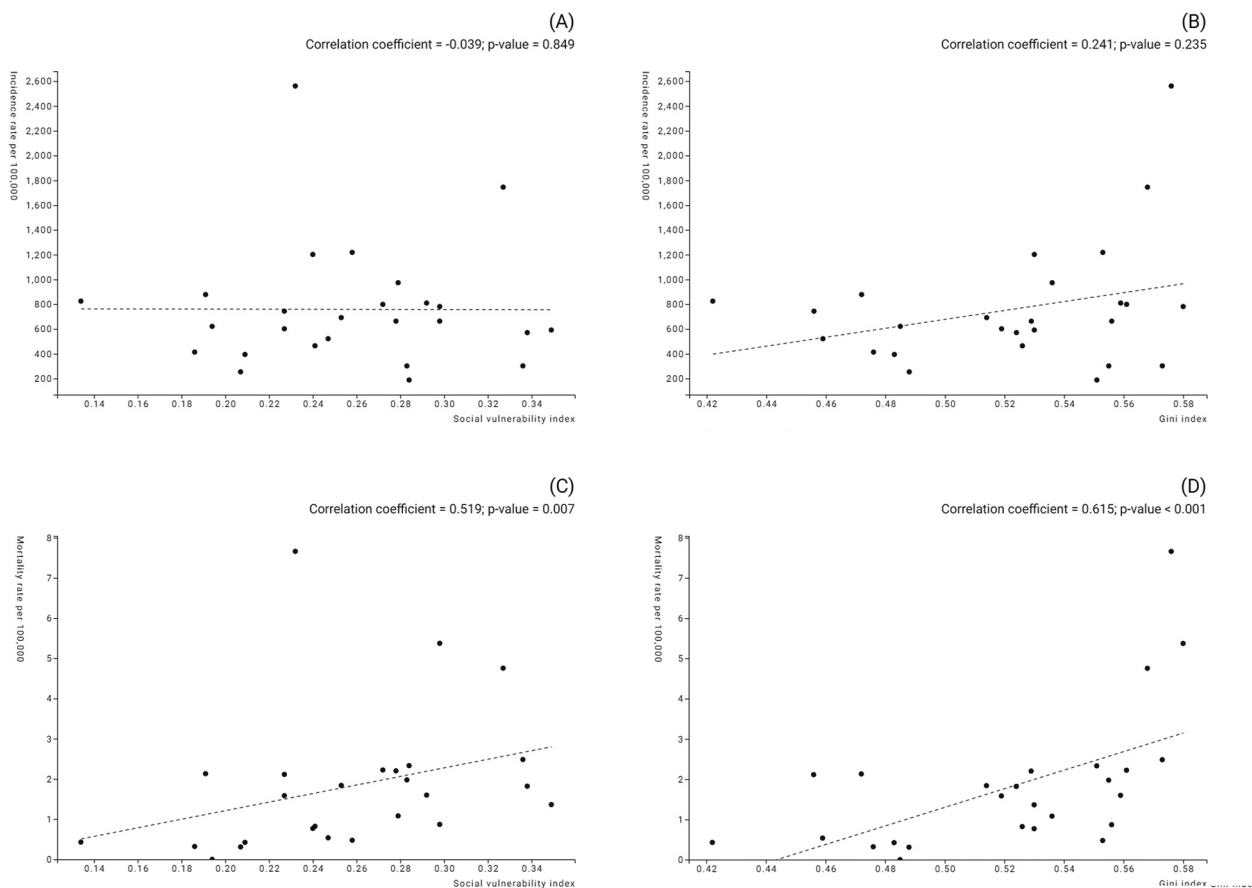COVID-19, coronavirus disease 2019; SVI, Social Vulnerability Index; CFR, case fatality rate.



**Fig. 1.** Relationship between incidence and mortality rates of COVID-19 in children and socio-economic indicators of Brazilian states. (A) Correlation between incidence rate and Social Vulnerability index; (B) Correlation between incidence rate and Gini index; (C) Correlation between mortality rate and Social Vulnerability index; and (D) Correlation between mortality rate and Gini index.

economic inequalities also help to explain the impact of COVID-19 in the pediatric population in Brazil.

This nationwide register-based study had two complementary objectives: (1) to estimate the incidence and mortality rates of COVID-19 in Brazilian children and (2) to analyze its relationship with socio-economic inequalities in a state-level analysis.

## Methods

To estimate the incidence and mortality rates of COVID-19 in Brazilian children aged 0—19 years, we extracted data of confirmed cases and deaths from the de-identified microdata catalog and official bulletins of the 27 Brazilian states' health department websites until September 3, 2020. Incidence and mortality rates were calculated based on the population estimate provided by the Brazilian Institute of Geography and Statistics (https://www.ibge.gov.br). We also calculate the case fatality rate dividing the number of confirmed deaths from COVID-19 by the number of registered cases in the pediatric population.

Social inequality was evaluated using the Social Vulnerability Index (SVI) obtained from the Institute of Applied Economic Research (IPEA; http://ivs.ipea.gov.br). This index is composed of 16 social indicators comprising domains of urban infrastructure, human capital, and income and work in Brazil. We used the Gini coefficient, which is a measure of the distribution of income across a population, to examine the dispersion of economic inequality among Brazilian states (https://www.ibge.gov.br). The SVI and Gini

index range from 0 to 1, and higher values indicate higher social and economic inequality, respectively.

We analyzed the relationship between COVID-19 rates in Brazilian children and socio-economic vulnerability at the state level using Spearman's rank correlation (ρ), categorizing correlations as very weak (0–0.19), weak (0.2–0.39), moderate (0.4–0.59), strong (0.6–0.79), or very strong (0.8–1.0). *P*-values <0.05 were considered statistically significant. All data were analyzed using R software (version 3.1.3).

## Results

Of the 3,998,055 individuals with COVID-19 included in our database, 335,279 (8.4%) were children aged 0–19 years. The incidence rate of COVID-19 in Brazilian children was 559 cases per 100,000 inhabitants, with higher estimates in the North (1015 cases per 100,000 inhabitants) and Central-West (711 cases per 100,000 inhabitants) regions. Eight hundred deaths in children were registered, which accounts for about 0.7% of the deaths related to COVID-19 in the country. The higher mortality rates were found in the North (~3 deaths per 100,000 inhabitants) and Northeast (~2 deaths per 100,000 inhabitants) (Table 1). Although we found no clear evidence of a relationship between the incidence of COVID-19 in children and socio-economic inequality in a state-level analysis, a correlation was found between mortality rates and social (ρ = 0.519; *P*-value = 0.007; effect magnitude: moderate) and economic (ρ = 0.615; *P*-value < 0.001; effect magnitude: strong) inequalities (Fig. 1).

## Discussion

State-level reports are the best publicly available data in Brazil to explore regional differences in COVID-19 estimates and the impact of inequalities on unfavorable health outcomes related to the disease. Although we found a low mortality rate of approximately one death from COVID-19 per 100,000 in the pediatric population in the country, this population-based study showed a moderate to strong relationship between mortality and socio-economic inequalities. Nevertheless, these results could be underestimating the true COVID-19 rates among children in Brazil because the official database used for analysis only accounts for confirmed cases, and it is well known that many cases go undiagnosed.

Adverse outcomes due to COVID-19 are not only the result of individual clinical characteristics. Studies have suggested that the socio-economic and environmental conditions may also be related to worse outcomes of COVID-19.[5,6] A recent country-level analysis on COVID-19–related health outcomes showed that low levels of national preparedness, scale of testing, and socio-economic factors are associated with the increased national case load and mortality.[6] It is important to recognize health inequalities among vulnerable populations to improve access to health care, the surveillance system, protocols for diagnosis and management, and effective social protection response during disease outbreaks.

The COVID-19 pandemic has led to dramatic changes in people's lives especially in low- and middle-income countries. Despite reduction in health, income, and schooling inequalities in the last decade in Brazil, socio-economic disparities are still a major problem in the country and have a pivotal role in the widening health and economic gap, both within and between communities. There are millions of Brazilian people living in highly dense communities, with precarious housing conditions and poor sanitation, which increase the risk of severe acute respiratory syndrome coronavirus 2 spread and mortality.[7] For children, the COVID-19 pandemic has also been associated with profound educational, social, and

psychological changes, food insecurity, and increased risk of serious adverse outcomes that can result in death in more deprived regions.[8,9] COVID-19 mortality in children in high-income countries is extremely rare,[10] but the disease has emerged as a novel cause of death among children in poor communities as observed in the North and Northeast regions of Brazil. The knowledge of socio-geographic differences in the estimates of COVID-19 is crucial to planning societal strategies and local decision-making to mitigate the effects of disease in the pediatric population.

Although exploratory analysis using publicly available data has limitations associated with the lack of accuracy, this population-based study found important regional differences in COVID-19 estimates for children in Brazil and a relationship between mortality rates and socio-economic inequalities.

## Author statements

### Ethical approval

Not required.

### Competing interests

None declared.

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