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Early Impact of Social Distancing in Response to Coronavirus Disease 2019 on Hospitalizations for Acute Bronchiolitis in Infants in Brazil

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Background. Interventions to tackle the coronavirus disease 2019 (COVID-19) pandemic may affect the burden of other respiratory diseases. Considering the repercussions of these unique social experiences to infant health, this study aims to assess the early impact of social distancing due to the COVID-19 pandemic in hospital admissions for acute bronchiolitis.

Methods. Data from hospitalizations of acute bronchiolitis in infants <1 year of age were obtained from the Department of Informatics of the Brazilian Public Health database for the period between 2016 and 2020. These data were also analyzed by macroregions of Brazil (North, Northeast, Southeast, South, and Midwest). To evaluate the effect of social distancing strategy on the incidence of acute bronchiolitis, the absolute and relative reductions were calculated by analyzing the yearly subsets of 2016 vs 2020, 2017 vs 2020, 2018 vs 2020, and 2019 vs 2020.

Results. There was a significant reduction in all comparisons, ranging from −78% (incidence rate ratio [IRR], 0.22 [95% confidence interval {CI}, .20–.24]) in 2016 vs 2020 to −85% (IRR, 0.15 [95% CI, .13–.16]) in 2019 vs 2020, for the data from Brazil. For analyses by macroregions, the reduction varied from −58% (IRR, 0.41 [95% CI, .37–.45]) in the Midwest in 2016 vs 2020 to −93% (IRR, 0.07 [95% CI, .06–.08]) in the South in 2019 vs 2020.

Conclusions. There was a significant reduction in hospitalization for acute bronchiolitis in children <1 year old in Brazil, on the order of >70% for most analysis. Our data suggest an important impact of social distancing on reducing the transmission of viruses related to acute bronchiolitis. Such knowledge may guide strategies for prevention of viral spread.

Keywords. COVID-19; bronchiolitis; lockdown; infants; hospitalization.

According to the World Health Organization's coronavirus disease 2019 (COVID-19) strategy update, health authorities should adopt and adapt measures of distance and movement restrictions at the population level, in addition to other public health measures to reduce exposure and suppress viral transmission [1]. Such measures may impact the epidemiology of a variety of other diseases.

Acute bronchiolitis (AB) is among the main communicable diseases of childhood and is the most frequent cause of hospitalization in infants worldwide [2]. In Brazil, AB represented approximately 6% of total hospitalizations in infants aged <1 year during the 2008–2015 period [3].

Respiratory syncytial virus (RSV) is the main etiologic agent of AB and has high transmissibility, especially in the autumn and winter months [2]. Due to the seasonal epidemiology of bronchiolitis and regional differences, the peak incidence of hospitalizations is different throughout Brazil between the months of February and August [3]. The COVID-19 pandemic hit Brazil in February 2020, just before autumn–winter in the Southern Hemisphere (March–September), with the first case officially registered in São Paulo. Collective measures to contain the pandemic were implemented in the middle of March 2020, namely social distancing and restriction of commerce activities and nonessential services. Suspension of teaching activities at all educational levels throughout the country started by mid-March. Additionally, besides overall hygiene measures and mask protection strategies [4] (with variable degrees of adherence by the population), children have stayed out of schools and daycare centers, as all have been closed since then.

Considering the repercussions of these unique social experiences in infant health, this study aims to assess the early impact of social distancing due to the COVID-19 pandemic on

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bronchiolitis hospitalizations in infants <1 year old, in a large country such as Brazil.

METHODS

Data from hospitalizations of AB were obtained from the Department of Informatics of the Brazilian Public Health System (DATASUS) database (http://datasus.saude.gov.br/), which provides the diagnosis at hospital admission [5] for the period 2016–2020. To assess data, Informações de Saúde (Health Information), Epidemiológicas e Morbidade (Epidemiology and Morbidity), Morbidade Hospitalar (Hospital Morbidity), Lista de Morbidade (Morbidity List), and the *International Classification of Diseases, Tenth Revision* (*ICD-10*) (AB: code J21) were used for the age group <1 year. These data were also analyzed by macroregions of Brazil (North, Northeast, Southeast, South, and Midwest) and in the months of January, February, March, April, May, and June of each year, since this covers the typical season of high AB hospitalizations. To assess the reliability of the report, *ICD-10* code P96—other conditions originating in the perinatal period (eg, congenital renal failure, neonatal withdrawal symptoms, wide cranial sutures of newborn, termination of pregnancy)—was used as comparison, as social distancing measures are not expected to have a major impact on these conditions.

To calculate the incidence of hospitalizations in the public heath system, we used the following formula: total number of hospitalizations / population number by age (per year and place [Brazilian Institute of Geography and Statistics]) × 100 000 inhabitants) [6]. The Brazilian National Health Agency provides the percentage of the population that has health insurance per year, and the same percentage was excluded from the denominator, as this population uses other hospital structures and admissions data are not included in DATASUS. These percentages were 25.3% in 2016, 23.1% in 2017, 24.4% in 2018, 24.1% in 2019, and 21.2% in 2020 for the population of children <1 year old [7]. In addition to the closing date of schools, we used as a parameter of social distance the technological information system for tracking urban mobility by apps of Inloco. This index exists to assist authorities in targeting public security and communication and health resources, and shows the percentage of the population that is respecting the isolation recommendation [8]. To evaluate the effect of social distancing strategy on the incidence of AB, the absolute reduction (without social distancing – with social distancing) and relative reduction (without social distancing – with social distancing/without social distancing) was calculated by analyzing the subsets 2016 vs 2020, 2017 vs 2020, 2018 vs 2020, and 2019 vs 2020. For this analysis, the months of March–June were used because March 2020 was the period of implementation of the social distancing strategy in Brazil, including the law to determine the closing of schools and daycare centers for infants [9]. Data analysis has been truncated at the end of June for the purpose of this article, since there is a delay in data entry.

To calculate the difference in incidence rates between the without and with social distancing periods, incidence rate ratios (IRRs) were used to assess statistical significance, considering a 95% confidence interval (CI). This data analysis methodology is already well documented in the literature [10–12].

To ensure quality, 2 independent authors reviewed all data. This study does not contain personal or individual data, so it was considered exempt from evaluation by the Research Ethics Committee.

RESULTS

From January 2016 to June 2020, there were 595 482 hospitalizations for respiratory diseases (all hospitalizations registered for diseases related to the respiratory system) registered in DATASUS, in children <1 year of age in Brazil; AB represented 28.2% (167 870) of these cases. In the Brazilian public heath system, the monthly distribution of the incidence of hospitalizations in the months from January–March was similar, with a trend of increasing cases throughout the study period (2016–2020). The lowest incidence was observed in January 2016 with 489.4/100 000 and the highest in March 2019 with 2491.5/100 000 hospitalizations. In the period from April to May, the years 2016–2019 kept the increased trend in the incidence of hospitalizations. In June of 2017, 2018, and 2019, there was a slight reduction in incidence. In that same period, in the year 2020, there was an observable drop in incidence, with numbers ranging from 379.4/100 000 in April to 106.6/100 000 in June. In the period from January to June of the years 2016–2020, the incidence was 1689.8/100 000 (2016), 2207.1/100 000 (2017), 2171.1/100 000 (2018), 2599.7/100 000 (2019), and 574.2/100 000 (2020), respectively (Figure 1A).

When comparing the subsets of March–June 2016, March–June 2017, March–June 2018, and March–June 2019 with March–June 2020, there was an expressive reduction in all comparisons, with reductions ranging from −78% (IRR, 0.22 [95% CI, .20–.24]) in 2016 vs 2020 to −85% (IRR, 0.15 [95% CI, .13–.16]) in 2019 vs 2020 (Figure 1B and Table 1). Conversely, hospitalizations for other conditions originating in the perinatal period varied little in the same periods (Figure 1B). The data obtained by the Inloco application show that, in the period from March to June 2020, the average social distance in Brazil remained at 47.3%.

When comparing the subsets by macroregions of Brazil (2016 vs 2020, 2017 vs 2020, 2018 vs 2020, and 2019 vs 2020), there was also an expressive reduction in all comparisons. In the North region, there was a decrease in the incidence of hospitalizations that varied from −78% (IRR, 0.22 [95% CI, .19–.24]) in 2016 vs 2020 to −87% (IRR, 0.13 [95% CI, .11–.15]) in 2017 vs 2020. In the Northeast, the reduction ranged from −80% (IRR, 0.19 [95% CI, .17–.22]) in 2016 vs 2020 to −88% (IRR, 0.11 [95% CI, .10–.13]) in 2019 vs 2020. For the Southeastern region,

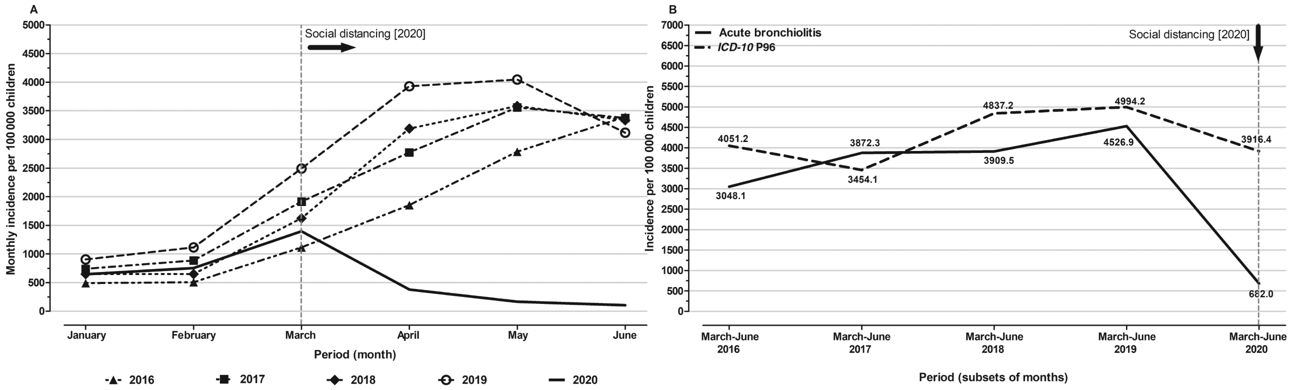

Figure 1. *A*, Monthly distribution of incidence of hospitalizations for acute bronchiolitis in children <1 year of age in Brazil (2016–2020). *B*, *International Classification of Diseases, Tenth Revision* (*ICD-10*), code P96 (other conditions originating in the perinatal period).

a reduction was observed that fluctuated from −75% (IRR, 0.24 [95% CI, .23–.26]) in 2016 vs 2020 to −81% (IRR, 0.18 [95% CI, .17–.19]) in 2019 vs 2020. The Southern region had the greatest impact, with a drop in incidence ranging from −90% (IRR, 0.10 [95% CI, .09–.11]) in 2016 vs 2020 to −93% (IRR, 0.07 [95% CI, .06–.08]) in 2019 vs 2020. In the Midwest region, the variation was from −58% (IRR, 0.41 [95% CI, .37–.45]) in 2016 vs 2020 to −86% (IRR, 0.14 [95% CI, .13–.15]) in 2019 vs 2020 in the incidence of hospitalizations.

The absolute number of hospitalizations, the incidence of hospitalizations per 100 000 inhabitants (<1 year old), and the comparisons between hospitalizations in the period between 2016 and 2020 are shown in Table 1.

DISCUSSION

To the best of our knowledge, this study is the first to assess the impact of social distancing interventions in reducing hospitalizations due to AB in Brazil, using a temporal trend analysis. Also noteworthy is the fact that interventions to control the COVID-19 pandemic in schools (extended to daycare centers) [13] were implemented by the Educational Ministry of Brazil on 17 March 2020, a few days before the beginning of autumn in the Southern Hemisphere, a period of historically significant increases in hospitalizations for bronchiolitis. In addition, probably no other country in the Southern Hemisphere has such robust national and regional epidemiological data, considering the population size, the viral seasonality, and the higher incidence than in developed countries [14].

Our results show an annual increase in the incidence of hospitalizations for AB in the past few years, similar to studies carried out in developing countries [2]. Since 2016, the peak of incidence begins in March and April, and goes on until July. In 2020, however, there was an abrupt decline in the monthly incidence of hospitalization due to AB that coincides with implementation of the social distancing measures. Our analysis of the DATASUS dataset detected a reduction of >70% in hospital admissions coded for AB in infants aged <1 year in all regions of the country, and the April–June incidence of AB admissions in 2020 was the lowest for the past 5 years.

Even when annual and geographical variations [15, 16] were considered, in 2020 there was an impressive decline in admissions. The absolute number of bronchiolitis admissions in Brazil in April range from 3391 (in 2016) to 7356 (in 2019) and in June from 6214 (in 2016) to 5836 (in 2019). In 2020 those absolute numbers fell to 733 in April and 206 in June [5]. In addition, <1000 registered bronchiolitis hospitalizations is a rare event in Brazil, even during the summer season in Brazil (December–January).

The impact of social distancing interventions has been reported in some studies (some still in the prepublication stages). Studies conducted in pediatric emergency department settings in Italy [17–19] have revealed a marked change in the pattern of care and hospitalizations, with a significant reduction, especially in respiratory infections, of up to >90% [18]. In France, a time-series analysis of >871 000 pediatric emergency visits found a significant decrease >70% in infectious diseases spread by air or the fecal-oral route (common cold, gastroenteritis, bronchiolitis, and acute otitis), associated with school closure and lockdown due to COVID-19 [20]. Therefore, our results could be considered in line with these studies, including the high percentage of reduction of cases.

Before the COVID-19 pandemic, studies that addressed changes in the pattern of social contact and school closures in diseases such as measles, influenza, and H1N1 emphasized the effect of such measures in slowing the transmission of diseases and mitigating the impact of the epidemic [21–23]. Our data suggest that the measures applied to the control of COVID-19 also have a critical impact on the spread of AB.

The impact of each preventive action is very difficult to assess. Social distancing was accompanied by many measures, such as the widespread use of masks [24], recommendations for handwashing, and the use of gel alcohol before and after contact

Table 1. Absolute Number and Incidence of Hospitalizations for Acute Bronchiolitis in Children <1 Year of Age in Brazil and Brazilian Macroregions, 2016–2020

Region	Absolute No. of Hospitalizations (No. of Hospitalizations per 100 000 Children)[a]					Relative Difference in Rate (Without Social Distancing vs With Social Distancing)			
	March–June 2016	March–June 2017	March–June 2018	March–June 2019	March–June 2020	Change 2016 vs 2020 IRR, % (95% CI)[b]	Change 2017 vs 2020 IRR, % (95% CI)[b]	Change 2018 vs 2020 IRR, % (95% CI)*	Change 2019 vs 2020 IRR, % (95% CI)[b]
All of Brazil	16 743 (3048.1)[a]	21 782 (3872.3)[a]	22 006 (3909.5)[a]	25 434 (4526.9)[a]	3953 (682.0)[a]	−78% 0.22 (.20–.24)[b]	−82% 0.17 (.16–.19)[b]	−83% 0.17 (.16–.18)[b]	−85% 0.15 (.13–.16)[b]
North	1035 (1439.5)[a]	1716 (2367.9)[a]	1648 (2223.9)[a]	1631 (2212.3)[a]	237 (318.3)[a]	−78% 0.22 (.19–.24)[b]	−87% 0.13 (.11–.15)[b]	−86% 0.14 (.12–.16)[b]	−86% 0.14 (.12–.16)[b]
Northeast	2790 (1553.0)[a]	3946 (2177.8)[a]	3505 (1922.0)[a]	4674 (2595.2)[a]	555 (304.3)[a]	−80% 0.19 (.17–.22)[b]	−86% 0.13 (.12–.15)[b]	−84% 0.15 (.14–.17)[b]	−88% 0.11 (.10–.13)[b]
Southeast	9112 (5166.4)[a]	11 059 (5945.7)[a]	12 145 (6616.0)[a]	12 641 (6842.8)[a]	2508 (1286.6)[a]	−75% 0.24 (.23–.26)[b]	−78% 0.21 (.20–.22)[b]	−81% 0.19 (.18–.20)[b]	−81% 0.18 (.17–.19)[b]
South	3096 (4305.4)[a]	3614 (4957.7)[a]	3180 (4404.4)[a]	4367 (5992.9)[a]	338 (445.1)[a]	−90% 0.10 (.09–.11)[b]	−91% 0.08 (.08–.09)[b]	−90% 0.10 (.09–.11)[b]	−93% 0.07 (.06–.08)[b]
Midwest	710 (1553.4)[a]	1447 (3082.4)[a]	1528 (3217.7)[a]	2121 (4496.0)[a]	315 (645.4)[a]	−58% 0.41 (.37–.45)[b]	−79% 0.20 (.19–.22)[b]	−80% 0.20 (.18–.21)[b]	−86% 0.14 (.13–.15)[b]

Abbreviations: CI, confidence interval; IRR, incidence rate ratio.

[a] Incidence number.

[b] $P < .05$.

with other people and inanimate objects, which are in line with guidelines to controlling the transmission of infection by RSV and other etiologic agents related to AB, at the population level [25].

Some other behavioral changes in a pandemic context may also influence our results, such as avoidance of seeking healthcare in a hospital or clinic. Nonetheless, these could be a reason for reduction only in mild AB episodes, and our study addresses only AB requiring hospitalization, sometimes with serious signs and symptoms [26]. As the dynamics of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) interaction with other respiratory viruses is not fully understood, other factors, such as decreased susceptibility to other viruses due to the colonization of the nasopharynx for SARS-CoV-2, could be an issue. However, as respiratory coinfection or codetection rates with SARS-CoV-2 up to 26.1% are reported, this rationale does not explain our findings completely [27].

Moreover, it could be questioned why social distancing had a higher impact in reducing transmission of RSV and other AB-related viruses than in SARS-CoV-2, considering that the basic reproduction number (R_0) of RSV, which is the most frequent cause of bronchiolitis, is around 3.0 [28, 29], and the estimated R_0 of SARS-CoV-2 is between 2.0 and 3.5 [30]. However, the actual R_0 of SARS-CoV-2 could be higher (in 1 study, 5.7 [95% CI, 3.8–8.9]) [31], which could explain the impact of social distancing in the incidence of AB compared to COVID-19, as respiratory viruses share similar routes of transmission.

Conducting a retrospective study has some limitations, especially in the context of a pandemic. The biggest limitation refers to the fact that we used a database that is filled in by third parties. To minimize this impact and ensure that the data are treated reliably, we captured data after 2 months of the month of hospitalization. According to our previous experiences [10–12], this period is sufficient for the base to present the final numbers or very approximate values, since the data are included based on hospitalization admission authorization forms in Brazil. In addition, we used *ICD-10* code P96 (other conditions originating in the perinatal period) as comparison.

CONCLUSIONS

In summary, the incidence of hospitalizations related to AB was markedly reduced after the implementation of social distancing measures. To our knowledge, such epidemiologic changes in AB-related hospitalizations during the Southern Hemisphere autumn–winter season in Brazil have not been previously reported.

Our data provide novel and significant evidence of the huge impact of social distancing measures in reducing of spread of AB-related viruses. We hope that our results can help in the planning of preventive strategies in the post–COVID-19 era. Data presented here will be useful in the planning of further studies and may help clarify how distancing measures or environmental protection of viral dissemination may affect the burden of AB.

Notes

Author contributions. F. F. participated in the conception and design of the study; acquisition, analysis, and interpretation of data; elaborating on the article; and reviewing the article critically. T. C. participated in the conception and design of the study; analysis and interpretation of data; elaborating on the article; and reviewing the article critically. L. A. P. participated in the study design; analysis and interpretation of data; writing of the article; and reviewing the article critically. R. O., T. N. V., M. C. S., R. T. S., M. S. L., and M. H. J. participated in the acquisition, analysis, and interpretation of data; article writing; and critical review. All authors approved the final version for publication.

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Potential conflicts of interest. The authors: No reported conflicts of interest. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest.

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